

Colonial Past

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2025-03-19

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- Who is the best and worst colonial master?
- What is the situation with the *not-colonized* counterparts?
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 - Plot 2: Interaction Effects of Colonial Overlord × Year on GDP per Capita
 - Hints:
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Overall design

When comparing the effect of a certain event, e.g. colonialism, we need to inspect and statistically assess not only what happened with the affected countries, but also the non-affected countries. Inspection relates not only to the calculation and diachronic statistical overview of GDP, but consideration of other potentially impactful factors, such as colonial power, start century, and duration of colonization. It is important to articulate expectations behind these factors, such as with duration of colonial rule: one might hypothesize that colonizers with long experience would have experienced mismanagement and learned to manage their colonies reasonably well. Newcomers will be catching up and erring on the side of overreaction and brutality. First, it is good to generate visuals, describe the trends, answer the starting questions and develop new ones; inspect potential causalities and comment on outliers. Second, test trends emerging in the visuals for significance. Eyes and charts are seductive not not always 'right'. How do you test what differences actually matter? Here, many tests can be administered, but we shall start with linear regression.

Load libraries and create the data

```
library(tidyverse)
```

```
## — Attaching core tidyverse packages ————— tidyverse 2.0.0 —
## ✓ dplyr      1.1.4      ✓ readr      2.1.5
## ✓ forcats    1.0.0      ✓ stringr    1.5.1
## ✓ ggplot2    3.5.1      ✓ tibble     3.2.1
## ✓ lubridate  1.9.4      ✓ tidyr      1.3.1
## ✓ purrr      1.0.4
## — 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
```

```
library(gapminder)
```

```
## Warning: pakke 'gapminder' blev bygget under R version 4.4.3
```

```
library(sf)
```

```
## Warning: pakke 'sf' blev bygget under R version 4.4.3
```

```
## Linking to GEOS 3.13.0, GDAL 3.10.1, PROJ 9.5.1; sf_use_s2() is TRUE
```

```
# Create a dataframe for colonized countries
```

```
colonized_data <- data.frame(
  Country = c('India', 'Australia', 'Hong Kong, China', 'Canada', 'South Africa', 'Algeria', 'Vietnam', 'Morocco', 'Brazil', 'Mozambique', 'Indonesia', 'Suriname', 'Congo, Dem. Rep.', 'Rwanda', 'Namibia', 'Somalia', 'Libya', 'Eritrea', 'Philippines', 'Puerto Rico', 'Kazakhstan', 'Georgia', 'Moldova', 'Afghanistan', 'Tanzania', 'Czech Republic', 'Slovakia', 'Romania', 'Serbia', 'Bulgaria'),
  Colonial_Overlord = c('United Kingdom', 'United Kingdom', 'United Kingdom', 'United Kingdom', 'United Kingdom', 'France', 'France', 'France', 'Portugal', 'Portugal', 'Netherlands', 'Netherlands', 'Belgium', 'Belgium', 'Germany', 'Italy', 'Italy', 'Italy', 'United States', 'United States', 'Russia', 'Russia', 'Russia', 'United Kingdom', 'Germany', 'Austria', 'Austria', 'Austria', 'Turkey', 'Turkey'),
  Years_of_Colonization = c(190, 132, 156, 108, 120, 132, 67, 44, 322, 477, 350, 235, 80, 40, 35, 36, 31, 62, 48, 126, 250, 108, 103, 80, 44, 300, 500, 300, 350, 350)
)

# Save the dataframe as CSV
dir.create("data")
```

```
## Warning in dir.create("data"): 'data' findes allerede
```

```
write.csv(colonized_data, "data/colonized_countries.csv", row.names = FALSE)
read.csv("data/colonized_countries.csv")
```

##	Country	Colonial_Overlord	Years_of_Colonization
## 1	India	United Kingdom	190
## 2	Australia	United Kingdom	132
## 3	Hong Kong, China	United Kingdom	156
## 4	Canada	United Kingdom	108
## 5	South Africa	United Kingdom	120
## 6	Algeria	France	132
## 7	Vietnam	France	67
## 8	Morocco	France	44
## 9	Brazil	Portugal	322
## 10	Mozambique	Portugal	477
## 11	Indonesia	Netherlands	350
## 12	Suriname	Netherlands	235
## 13	Congo, Dem. Rep.	Belgium	80
## 14	Rwanda	Belgium	40
## 15	Namibia	Germany	35
## 16	Somalia	Italy	36
## 17	Libya	Italy	31
## 18	Eritrea	Italy	62
## 19	Philippines	United States	48
## 20	Puerto Rico	United States	126
## 21	Kazakhstan	Russia	250
## 22	Georgia	Russia	108
## 23	Moldova	Russia	103
## 24	Afghanistan	United Kingdom	80
## 25	Tanzania	Germany	44
## 26	Czech Republic	Austria	300
## 27	Slovakia	Austria	500
## 28	Romania	Austria	300
## 29	Serbia	Turkey	350
## 30	Bulgaria	Turkey	350

Check other sources for Western and Asian imperialism for Africa and Asia and the Americas. Some examples are:

<https://www.reddit.com/media?url=https%3A%2F%2Fpreview.redd.it%2Fflw1qqtmxl841.png%3Fauto%3Dwebp%26s%3D45a5eee700205f4d24f36c1f116a84a60233dae6>

(<https://www.reddit.com/media?url=https%3A%2F%2Fpreview.redd.it%2Fflw1qqtmxl841.png%3Fauto%3Dwebp%26s%3D45a5eee700205f4d24f36c1f116a84a60233dae6>)

https://accordingtophillips.weebly.com/uploads/8/1/8/3/81833274/imperialism-in-asia-1900_orig.jpg

(https://accordingtophillips.weebly.com/uploads/8/1/8/3/81833274/imperialism-in-asia-1900_orig.jpg)

<https://s3.amazonaws.com/s3.timetoast.com/public/uploads/photos/3841662/imper.gif?1474580603>

(<https://s3.amazonaws.com/s3.timetoast.com/public/uploads/photos/3841662/imper.gif?1474580603>)

```
# Create a dataframe for non-colonized countries
not_colonized_data <- data.frame(
  Country = c('Japan', 'Korea, Rep.', 'Thailand', 'Turkey', 'Saudi Arabia', 'Iran', 'Iceland',
    'Sweden', 'Norway', 'Switzerland', 'Afghanistan', 'Bhutan', 'Nepal', 'Liberia',
    'Mongolia', 'Korea, Dem. Rep.', 'Ethiopia', 'Tonga', 'Tibet', 'Haiti',
    'Luxembourg', 'Lesotho', 'Malta', 'Swaziland', 'Chile', 'China'),
  Reasonably_Proprosperous = c('YES', 'YES', 'YES', 'YES', 'YES', 'YES', 'YES',
    'YES', 'YES', 'YES', 'NO', 'NO', 'NO', 'NO',
    'NO', 'NO', 'NO', 'NO', 'NO', 'NO',
    'YES', 'NO', 'YES', 'NO', 'YES', 'NO')
)

# Save the dataframe as CSV
write.csv(not_colonized_data, "data/not_colonized_countries.csv", row.names = FALSE)
read.csv("data/not_colonized_countries.csv")
```

```
##           Country Reasonably_Proprosperous
## 1           Japan                YES
## 2      Korea, Rep.                YES
## 3         Thailand                YES
## 4           Turkey                YES
## 5      Saudi Arabia                YES
## 6             Iran                YES
## 7          Iceland                YES
## 8            Sweden                YES
## 9           Norway                YES
## 10        Switzerland                YES
## 11      Afghanistan                NO
## 12           Bhutan                NO
## 13            Nepal                NO
## 14          Liberia                NO
## 15         Mongolia                NO
## 16 Korea, Dem. Rep.                NO
## 17          Ethiopia                NO
## 18            Tonga                NO
## 19            Tibet                NO
## 20           Haiti                NO
## 21        Luxembourg                YES
## 22          Lesotho                NO
## 23            Malta                YES
## 24        Swaziland                NO
## 25            Chile                YES
## 26            China                NO
```

In order to check economic development, we need to connect the selected country lists with the econmic indicators from the gapminder data. We join them using `left_join` function on the Country column. For the join to work, the spelling of a country in both lists needs to be identical. Check if you are spelling your countries identically to gapminder. Beware that the standard gapminder dataset is `filtered` and does not contain all the countries of the world, for example Denmark! If your country is missing, load and use the `unfiltered` gapminder.

```
# filtered gapminder
unique(gapminder$country)
```

```
## [1] Afghanistan      Albania      Algeria
## [4] Angola            Argentina   Australia
## [7] Austria           Bahrain     Bangladesh
## [10] Belgium           Benin       Bolivia
## [13] Bosnia and Herzegovina Botswana    Brazil
## [16] Bulgaria          Burkina Faso Burundi
## [19] Cambodia          Cameroon    Canada
## [22] Central African Republic Chad         Chile
## [25] China             Colombia    Comoros
## [28] Congo, Dem. Rep.  Congo, Rep. Costa Rica
## [31] Cote d'Ivoire     Croatia     Cuba
## [34] Czech Republic   Denmark     Djibouti
## [37] Dominican Republic Ecuador       Egypt
## [40] El Salvador       Equatorial Guinea Eritrea
## [43] Ethiopia          Finland     France
## [46] Gabon             Gambia      Germany
## [49] Ghana            Greece       Guatemala
## [52] Guinea           Guinea-Bissau Haiti
## [55] Honduras          Hong Kong, China Hungary
## [58] Iceland           India        Indonesia
## [61] Iran              Iraq          Ireland
## [64] Israel            Italy         Jamaica
## [67] Japan             Jordan        Kenya
## [70] Korea, Dem. Rep.  Korea, Rep. Kuwait
## [73] Lebanon           Lesotho      Liberia
## [76] Libya             Madagascar   Malawi
## [79] Malaysia          Mali          Mauritania
## [82] Mauritius         Mexico        Mongolia
## [85] Montenegro        Morocco      Mozambique
## [88] Myanmar           Namibia      Nepal
## [91] Netherlands       New Zealand  Nicaragua
## [94] Niger             Nigeria      Norway
## [97] Oman              Pakistan     Panama
## [100] Paraguay          Peru         Philippines
## [103] Poland            Portugal     Puerto Rico
## [106] Reunion           Romania      Rwanda
## [109] Sao Tome and Principe Saudi Arabia Senegal
## [112] Serbia            Sierra Leone Singapore
## [115] Slovak Republic   Slovenia     Somalia
## [118] South Africa      Spain        Sri Lanka
## [121] Sudan             Swaziland    Sweden
## [124] Switzerland       Syria         Taiwan
## [127] Tanzania          Thailand     Togo
## [130] Trinidad and Tobago Tunisia       Turkey
## [133] Uganda            United Kingdom United States
## [136] Uruguay           Venezuela    Vietnam
## [139] West Bank and Gaza Yemen, Rep.   Zambia
## [142] Zimbabwe
## 142 Levels: Afghanistan Albania Algeria Angola Argentina Australia ... Zimbabwe
```

```
# unfiltered gapminder
data("gapminder_unfiltered")
unique(gapminder_unfiltered$country)
```

## [1] Afghanistan	Albania	Algeria
## [4] Angola	Argentina	Armenia
## [7] Aruba	Australia	Austria
## [10] Azerbaijan	Bahamas	Bahrain
## [13] Bangladesh	Barbados	Belarus
## [16] Belgium	Belize	Benin
## [19] Bhutan	Bolivia	Bosnia and Herzegovina
## [22] Botswana	Brazil	Brunei
## [25] Bulgaria	Burkina Faso	Burundi
## [28] Cambodia	Cameroon	Canada
## [31] Cape Verde	Central African Republic	Chad
## [34] Chile	China	Colombia
## [37] Comoros	Congo, Dem. Rep.	Congo, Rep.
## [40] Costa Rica	Cote d'Ivoire	Croatia
## [43] Cuba	Cyprus	Czech Republic
## [46] Denmark	Djibouti	Dominican Republic
## [49] Ecuador	Egypt	El Salvador
## [52] Equatorial Guinea	Eritrea	Estonia
## [55] Ethiopia	Fiji	Finland
## [58] France	French Guiana	French Polynesia
## [61] Gabon	Gambia	Georgia
## [64] Germany	Ghana	Greece
## [67] Grenada	Guadeloupe	Guatemala
## [70] Guinea	Guinea-Bissau	Guyana
## [73] Haiti	Honduras	Hong Kong, China
## [76] Hungary	Iceland	India
## [79] Indonesia	Iran	Iraq
## [82] Ireland	Israel	Italy
## [85] Jamaica	Japan	Jordan
## [88] Kazakhstan	Kenya	Korea, Dem. Rep.
## [91] Korea, Rep.	Kuwait	Latvia
## [94] Lebanon	Lesotho	Liberia
## [97] Libya	Lithuania	Luxembourg
## [100] Macao, China	Madagascar	Malawi
## [103] Malaysia	Maldives	Mali
## [106] Malta	Martinique	Mauritania
## [109] Mauritius	Mexico	Micronesia, Fed. Sts.
## [112] Moldova	Mongolia	Montenegro
## [115] Morocco	Mozambique	Myanmar
## [118] Namibia	Nepal	Netherlands
## [121] Netherlands Antilles	New Caledonia	New Zealand
## [124] Nicaragua	Niger	Nigeria
## [127] Norway	Oman	Pakistan
## [130] Panama	Papua New Guinea	Paraguay
## [133] Peru	Philippines	Poland
## [136] Portugal	Puerto Rico	Qatar
## [139] Reunion	Romania	Russia
## [142] Rwanda	Samoa	Sao Tome and Principe
## [145] Saudi Arabia	Senegal	Serbia
## [148] Sierra Leone	Singapore	Slovak Republic
## [151] Slovenia	Solomon Islands	Somalia
## [154] South Africa	Spain	Sri Lanka
## [157] Sudan	Suriname	Swaziland
## [160] Sweden	Switzerland	Syria
## [163] Taiwan	Tajikistan	Tanzania
## [166] Thailand	Timor-Leste	Togo
## [169] Tonga	Trinidad and Tobago	Tunisia
## [172] Turkey	Turkmenistan	Uganda
## [175] Ukraine	United Arab Emirates	United Kingdom
## [178] United States	Uruguay	Uzbekistan
## [181] Vanuatu	Venezuela	Vietnam
## [184] West Bank and Gaza	Yemen, Rep.	Zambia
## [187] Zimbabwe		

187 Levels: Afghanistan Albania Algeria Angola Argentina Armenia ... Zimbabwe

```
# compare the values to your (un-)colonized datasets
sort(unique(colonized_data$Country))
```

```
## [1] "Afghanistan" "Algeria" "Australia" "Brazil"
## [5] "Bulgaria" "Canada" "Congo, Dem. Rep." "Czech Republic"
## [9] "Eritrea" "Georgia" "Hong Kong, China" "India"
## [13] "Indonesia" "Kazakhstan" "Libya" "Moldova"
## [17] "Morocco" "Mozambique" "Namibia" "Philippines"
## [21] "Puerto Rico" "Romania" "Rwanda" "Serbia"
## [25] "Slovakia" "Somalia" "South Africa" "Suriname"
## [29] "Tanzania" "Vietnam"
```

```
sort(unique(not_colonized_data$Country))
```

```
## [1] "Afghanistan" "Bhutan" "Chile" "China"
## [5] "Ethiopia" "Haiti" "Iceland" "Iran"
## [9] "Japan" "Korea, Dem. Rep." "Korea, Rep." "Lesotho"
## [13] "Liberia" "Luxembourg" "Malta" "Mongolia"
## [17] "Nepal" "Norway" "Saudi Arabia" "Swaziland"
## [21] "Sweden" "Switzerland" "Thailand" "Tibet"
## [25] "Tonga" "Turkey"
```

```
# join gapminder data with your country lists
colonized_data <- colonized_data %>%
  left_join(gapminder_unfiltered, by = c("Country" = "country"))
not_colonized_data <- not_colonized_data %>%
  left_join(gapminder_unfiltered, by = c("Country" = "country"))
```

Explore the data with descriptive statistics

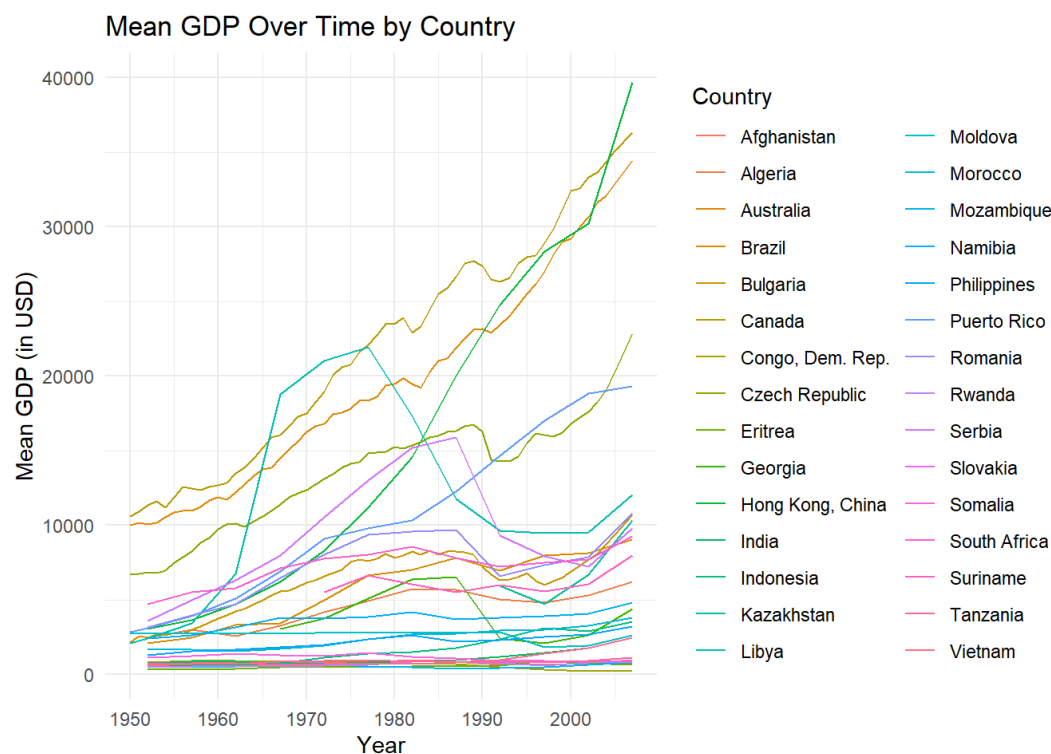
Start with basic descriptive statistics for both groups to get an overview of central tendencies and variability.

- Mean: Compare the average GDP per capita for colonized vs. non-colonized countries.
- Median: Useful to mitigate the influence of outliers.
- Variance: Compare the spread of GDP per capita values between the two groups.
- Range: The range can give you an idea of the economic diversity in each group.

This provides a first glance at whether there's a significant difference between the economic outcomes of the two groups.

```
ggplot(colonized_data, aes(x = year, y = gdpPercap, group = Country, color = Country))+
  geom_line()+
  labs(title = "Mean GDP Over Time by Country",
       x = "Year",
       y = "Mean GDP (in USD)") +
  theme_minimal() + # Minimal theme for a clean look
  theme(legend.position = "right")
```

```
## Warning: Removed 1 row containing missing values or values outside the scale range
## (`geom_line()`).
```



Measure the effect of colonial power

Does it make sense to calculate GDP for all countries grouped by colonial power? Ja, det giver mening at beregne BNP for alle lande grupperet efter kolonimagt, da det kan give indsigt i de økonomiske eftervirkninger af kolonialismen. Ved at gruppere landene efter deres tidligere koloniale herskere kan man analysere, om der er økonomiske mønstre, der stadig eksisterer på grund af tidligere koloniale relationer. For eksempel kan man undersøge, om tidligere britiske kolonier har haft en anden økonomisk udvikling end tidligere franske eller portugisiske kolonier. Men det er vigtigt at være opmærksom på, at mange faktorer påvirker BNP, såsom geografiske forhold, politiske beslutninger, ressourcer og internationale handelsrelationer. Kolonialhistorien er kun én faktor blandt mange, men den kan stadig være relevant i en økonomisk analyse.

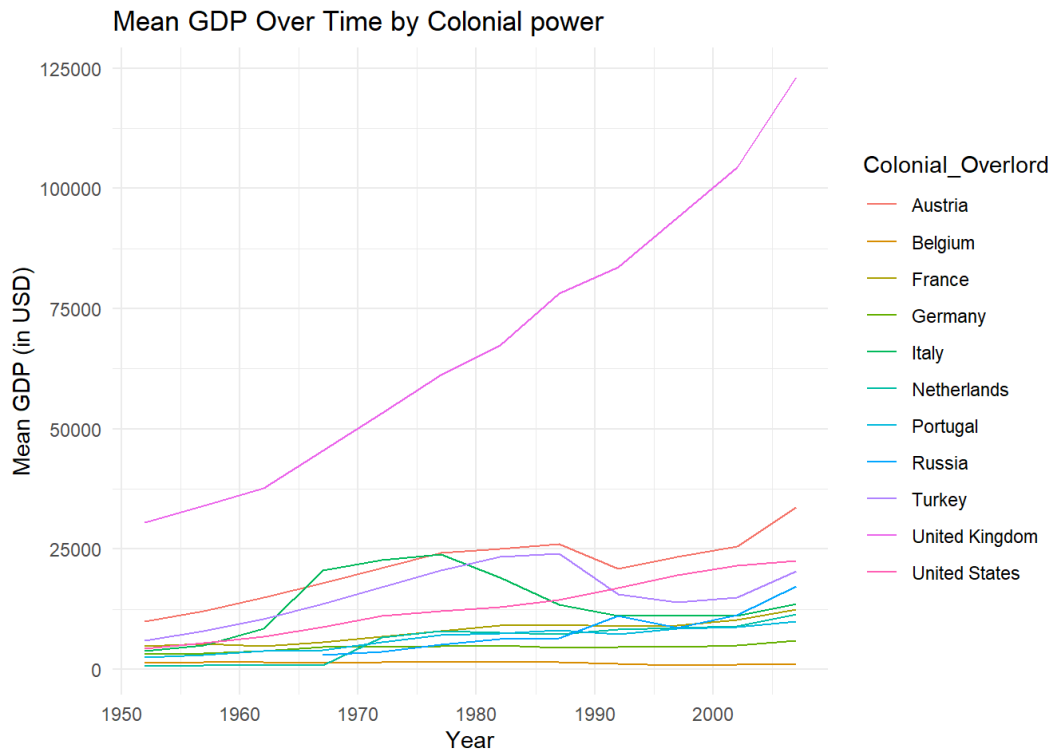
```
colonized_data %>%
  select(Country, Colonial_Overlord) %>%
  distinct(Country, Colonial_Overlord)
```

```
##          Country Colonial_Overlord
## 1         India      United Kingdom
## 2      Australia      United Kingdom
## 3 Hong Kong, China      United Kingdom
## 4         Canada      United Kingdom
## 5      South Africa      United Kingdom
## 6         Algeria          France
## 7         Vietnam          France
## 8         Morocco          France
## 9         Brazil      Portugal
## 10      Mozambique      Portugal
## 11      Indonesia      Netherlands
## 12      Suriname      Netherlands
## 13 Congo, Dem. Rep.      Belgium
## 14         Rwanda      Belgium
## 15         Namibia      Germany
## 16         Somalia      Italy
## 17         Libya      Italy
## 18         Eritrea      Italy
## 19      Philippines      United States
## 20      Puerto Rico      United States
## 21      Kazakhstan      Russia
## 22         Georgia      Russia
## 23         Moldova      Russia
## 24      Afghanistan      United Kingdom
## 25         Tanzania      Germany
## 26 Czech Republic      Austria
## 27         Slovakia      Austria
## 28         Romania      Austria
## 29         Serbia      Turkey
## 30         Bulgaria      Turkey
```

```
colonized_summary <- colonized_data %>%
  filter(year %in% unique(gapminder$year)) %>%
  group_by(Colonial_Overlord, year) %>%
  summarize(gdpPerGroup = sum(gdpPercap))
```

```
## `summarise()` has grouped output by 'Colonial_Overlord'. You can override using
## the `.groups` argument.
```

```
ggplot(colonized_summary, aes(x = year, y = gdpPerGroup, group = Colonial_Overlord, color = Colonial_Overlord))+
  geom_line()+
  labs(title = "Mean GDP Over Time by Colonial power",
       x = "Year",
       y = "Mean GDP (in USD)" ) +
  theme_minimal() + # Minimal theme for a clean look
  theme(legend.position = "right")
```

#What's going on with the steps in 1982, 1987, in some of the groups? Springene i 1982 og 1987 i nogle af grupperne kan skyldes flere faktorer: Økonomiske kriser eller reformer – Visse tidligere kolonier kan have oplevet pludselige økonomiske ændringer, fx gældskriser eller økonomiske reformer, der påvirkede BNP drastisk. Ændringer i dataindsamling eller metode – Hvis der er skift i, hvordan BNP blev beregnet eller rapporteret i disse år, kan det skabe kunstige spring i grafen. Politiske omvæltninger – Nogle lande kan have gennemgået større politiske ændringer, såsom revolutioner, kup eller overgang til markedsøkonomi, hvilket kan have påvirket deres økonomi. Valutakursændringer – Hvis en gruppe lande har haft store devalueringer eller valutakursændringer i forhold til USD, kan det have påvirket deres BNP-målinger. Specifikke begivenheder i tidligere kolonier – For eksempel oplevede flere latinamerikanske og afrikanske lande økonomiske kriser i 1980'erne, som kan have skabt udsving i BNP. For at afgøre den præcise årsag, ville det kræve en nærmere undersøgelse af de specifikke lande i hver kolonimagt-gruppe.

```
colonized_data %>%
  filter(Colonial_Overlord == "United Kingdom") %>%
  filter(year == 1982 | year == 1983 | year == 1987 | year == 1988) %>%
  arrange(year)
```

```
##      Country Colonial_Overlord Years_of_Colonization continent year
## 1      India      United Kingdom           190      Asia 1982
## 2    Australia      United Kingdom           132    Oceania 1982
## 3 Hong Kong, China      United Kingdom           156      Asia 1982
## 4      Canada      United Kingdom           108  Americas 1982
## 5    South Africa      United Kingdom           120    Africa 1982
## 6    Afghanistan      United Kingdom            80      Asia 1982
## 7      Australia      United Kingdom           132    Oceania 1983
## 8      Canada      United Kingdom           108  Americas 1983
## 9      India      United Kingdom           190      Asia 1987
## 10     Australia      United Kingdom           132    Oceania 1987
## 11 Hong Kong, China      United Kingdom           156      Asia 1987
## 12      Canada      United Kingdom           108  Americas 1987
## 13    South Africa      United Kingdom           120    Africa 1987
## 14    Afghanistan      United Kingdom            80      Asia 1987
## 15      Australia      United Kingdom           132    Oceania 1988
## 16      Canada      United Kingdom           108  Americas 1988
##      lifeExp      pop      gdpPercap
## 1  56.596 708000000 855.7235
## 2  74.740 15184200 19477.0093
## 3  75.450 5264500 14560.5305
## 4  75.760 25201900 22898.7921
## 5  58.161 31140029 8568.2662
## 6  39.854 12881816 978.0114
## 7  75.550 15393500 19214.5612
## 8  76.130 25456300 23329.8046
## 9  58.553 788000000 976.5127
## 10 76.320 16257249 21888.8890
## 11 76.200 5584510 20038.4727
## 12 76.860 26549700 26626.5150
## 13 60.834 35933379 7825.8234
## 14 40.822 13867957 852.3959
## 15 76.360 16520206 22508.1908
## 16 76.940 26894800 27562.4145
```

years xxx3 and xxx8 seems the problematic ones in the UK case, but others are in the other countries. Use gapminder reduced data years, those seem to exist everywhere?

```
colonized_data %>%
  filter(Colonial_Overlord == "United Kingdom") %>%
  arrange(year)
```

##	Country	Colonial_Overlord	Years_of_Colonization	continent	year
## 1	Australia	United Kingdom	132	Oceania	1950
## 2	Canada	United Kingdom	108	Americas	1950
## 3	Australia	United Kingdom	132	Oceania	1951
## 4	Canada	United Kingdom	108	Americas	1951
## 5	India	United Kingdom	190	Asia	1952
## 6	Australia	United Kingdom	132	Oceania	1952
## 7	Hong Kong, China	United Kingdom	156	Asia	1952
## 8	Canada	United Kingdom	108	Americas	1952
## 9	South Africa	United Kingdom	120	Africa	1952
## 10	Afghanistan	United Kingdom	80	Asia	1952
## 11	Australia	United Kingdom	132	Oceania	1953
## 12	Canada	United Kingdom	108	Americas	1953
## 13	Australia	United Kingdom	132	Oceania	1954
## 14	Canada	United Kingdom	108	Americas	1954
## 15	Australia	United Kingdom	132	Oceania	1955
## 16	Canada	United Kingdom	108	Americas	1955
## 17	Australia	United Kingdom	132	Oceania	1956
## 18	Canada	United Kingdom	108	Americas	1956
## 19	India	United Kingdom	190	Asia	1957
## 20	Australia	United Kingdom	132	Oceania	1957
## 21	Hong Kong, China	United Kingdom	156	Asia	1957
## 22	Canada	United Kingdom	108	Americas	1957
## 23	South Africa	United Kingdom	120	Africa	1957
## 24	Afghanistan	United Kingdom	80	Asia	1957
## 25	Australia	United Kingdom	132	Oceania	1958
## 26	Canada	United Kingdom	108	Americas	1958
## 27	Australia	United Kingdom	132	Oceania	1959
## 28	Canada	United Kingdom	108	Americas	1959
## 29	Australia	United Kingdom	132	Oceania	1960
## 30	Canada	United Kingdom	108	Americas	1960
## 31	Australia	United Kingdom	132	Oceania	1961
## 32	Canada	United Kingdom	108	Americas	1961
## 33	India	United Kingdom	190	Asia	1962
## 34	Australia	United Kingdom	132	Oceania	1962
## 35	Hong Kong, China	United Kingdom	156	Asia	1962
## 36	Canada	United Kingdom	108	Americas	1962
## 37	South Africa	United Kingdom	120	Africa	1962
## 38	Afghanistan	United Kingdom	80	Asia	1962
## 39	Australia	United Kingdom	132	Oceania	1963
## 40	Canada	United Kingdom	108	Americas	1963
## 41	Australia	United Kingdom	132	Oceania	1964
## 42	Canada	United Kingdom	108	Americas	1964
## 43	Australia	United Kingdom	132	Oceania	1965
## 44	Canada	United Kingdom	108	Americas	1965
## 45	Australia	United Kingdom	132	Oceania	1966
## 46	Canada	United Kingdom	108	Americas	1966
## 47	India	United Kingdom	190	Asia	1967
## 48	Australia	United Kingdom	132	Oceania	1967
## 49	Hong Kong, China	United Kingdom	156	Asia	1967
## 50	Canada	United Kingdom	108	Americas	1967
## 51	South Africa	United Kingdom	120	Africa	1967
## 52	Afghanistan	United Kingdom	80	Asia	1967
## 53	Australia	United Kingdom	132	Oceania	1968
## 54	Canada	United Kingdom	108	Americas	1968
## 55	Australia	United Kingdom	132	Oceania	1969
## 56	Canada	United Kingdom	108	Americas	1969
## 57	Australia	United Kingdom	132	Oceania	1970
## 58	Canada	United Kingdom	108	Americas	1970
## 59	Australia	United Kingdom	132	Oceania	1971
## 60	Canada	United Kingdom	108	Americas	1971
## 61	India	United Kingdom	190	Asia	1972
## 62	Australia	United Kingdom	132	Oceania	1972
## 63	Hong Kong, China	United Kingdom	156	Asia	1972
## 64	Canada	United Kingdom	108	Americas	1972
## 65	South Africa	United Kingdom	120	Africa	1972
## 66	Afghanistan	United Kingdom	80	Asia	1972
## 67	Australia	United Kingdom	132	Oceania	1973
## 68	Canada	United Kingdom	108	Americas	1973
## 69	Australia	United Kingdom	132	Oceania	1974

## 70	Canada	United Kingdom	108	Americas 1974
## 71	Australia	United Kingdom	132	Oceania 1975
## 72	Canada	United Kingdom	108	Americas 1975
## 73	Australia	United Kingdom	132	Oceania 1976
## 74	Canada	United Kingdom	108	Americas 1976
## 75	India	United Kingdom	190	Asia 1977
## 76	Australia	United Kingdom	132	Oceania 1977
## 77	Hong Kong, China	United Kingdom	156	Asia 1977
## 78	Canada	United Kingdom	108	Americas 1977
## 79	South Africa	United Kingdom	120	Africa 1977
## 80	Afghanistan	United Kingdom	80	Asia 1977
## 81	Australia	United Kingdom	132	Oceania 1978
## 82	Canada	United Kingdom	108	Americas 1978
## 83	Australia	United Kingdom	132	Oceania 1979
## 84	Canada	United Kingdom	108	Americas 1979
## 85	Australia	United Kingdom	132	Oceania 1980
## 86	Canada	United Kingdom	108	Americas 1980
## 87	Australia	United Kingdom	132	Oceania 1981
## 88	Canada	United Kingdom	108	Americas 1981
## 89	India	United Kingdom	190	Asia 1982
## 90	Australia	United Kingdom	132	Oceania 1982
## 91	Hong Kong, China	United Kingdom	156	Asia 1982
## 92	Canada	United Kingdom	108	Americas 1982
## 93	South Africa	United Kingdom	120	Africa 1982
## 94	Afghanistan	United Kingdom	80	Asia 1982
## 95	Australia	United Kingdom	132	Oceania 1983
## 96	Canada	United Kingdom	108	Americas 1983
## 97	Australia	United Kingdom	132	Oceania 1984
## 98	Canada	United Kingdom	108	Americas 1984
## 99	Australia	United Kingdom	132	Oceania 1985
## 100	Canada	United Kingdom	108	Americas 1985
## 101	Australia	United Kingdom	132	Oceania 1986
## 102	Canada	United Kingdom	108	Americas 1986
## 103	India	United Kingdom	190	Asia 1987
## 104	Australia	United Kingdom	132	Oceania 1987
## 105	Hong Kong, China	United Kingdom	156	Asia 1987
## 106	Canada	United Kingdom	108	Americas 1987
## 107	South Africa	United Kingdom	120	Africa 1987
## 108	Afghanistan	United Kingdom	80	Asia 1987
## 109	Australia	United Kingdom	132	Oceania 1988
## 110	Canada	United Kingdom	108	Americas 1988
## 111	Australia	United Kingdom	132	Oceania 1989
## 112	Canada	United Kingdom	108	Americas 1989
## 113	Australia	United Kingdom	132	Oceania 1990
## 114	Canada	United Kingdom	108	Americas 1990
## 115	Australia	United Kingdom	132	Oceania 1991
## 116	Canada	United Kingdom	108	Americas 1991
## 117	India	United Kingdom	190	Asia 1992
## 118	Australia	United Kingdom	132	Oceania 1992
## 119	Hong Kong, China	United Kingdom	156	Asia 1992
## 120	Canada	United Kingdom	108	Americas 1992
## 121	South Africa	United Kingdom	120	Africa 1992
## 122	Afghanistan	United Kingdom	80	Asia 1992
## 123	Australia	United Kingdom	132	Oceania 1993
## 124	Canada	United Kingdom	108	Americas 1993
## 125	Australia	United Kingdom	132	Oceania 1994
## 126	Canada	United Kingdom	108	Americas 1994
## 127	Australia	United Kingdom	132	Oceania 1995
## 128	Canada	United Kingdom	108	Americas 1995
## 129	Australia	United Kingdom	132	Oceania 1996
## 130	Canada	United Kingdom	108	Americas 1996
## 131	India	United Kingdom	190	Asia 1997
## 132	Australia	United Kingdom	132	Oceania 1997
## 133	Hong Kong, China	United Kingdom	156	Asia 1997
## 134	Canada	United Kingdom	108	Americas 1997
## 135	South Africa	United Kingdom	120	Africa 1997
## 136	Afghanistan	United Kingdom	80	Asia 1997
## 137	Australia	United Kingdom	132	Oceania 1998
## 138	Canada	United Kingdom	108	Americas 1998
## 139	Australia	United Kingdom	132	Oceania 1999

## 140	Canada	United Kingdom	108	Americas 1999
## 141	Australia	United Kingdom	132	Oceania 2000
## 142	Canada	United Kingdom	108	Americas 2000
## 143	Australia	United Kingdom	132	Oceania 2001
## 144	Canada	United Kingdom	108	Americas 2001
## 145	India	United Kingdom	190	Asia 2002
## 146	Australia	United Kingdom	132	Oceania 2002
## 147	Hong Kong, China	United Kingdom	156	Asia 2002
## 148	Canada	United Kingdom	108	Americas 2002
## 149	South Africa	United Kingdom	120	Africa 2002
## 150	Afghanistan	United Kingdom	80	Asia 2002
## 151	Australia	United Kingdom	132	Oceania 2003
## 152	Canada	United Kingdom	108	Americas 2003
## 153	Australia	United Kingdom	132	Oceania 2004
## 154	Canada	United Kingdom	108	Americas 2004
## 155	Canada	United Kingdom	108	Americas 2005
## 156	India	United Kingdom	190	Asia 2007
## 157	Australia	United Kingdom	132	Oceania 2007
## 158	Hong Kong, China	United Kingdom	156	Asia 2007
## 159	Canada	United Kingdom	108	Americas 2007
## 160	South Africa	United Kingdom	120	Africa 2007
## 161	Afghanistan	United Kingdom	80	Asia 2007
##	lifeExp	pop	gdpPercap	
## 1	69.020	8267337	10031.1214	
## 2	68.280	14011422	10581.2655	
## 3	68.720	8510600	10160.7367	
## 4	68.550	14330675	10932.4668	
## 5	37.373	372000000	546.5657	
## 6	69.120	8691212	10039.5956	
## 7	60.960	2125900	3054.4212	
## 8	68.750	14785584	11367.1611	
## 9	45.009	14264935	4725.2955	
## 10	28.801	8425333	779.4453	
## 11	69.700	8857924	10157.9130	
## 12	69.130	15183375	11586.6146	
## 13	69.850	9064017	10544.0874	
## 14	69.990	15636245	11173.2595	
## 15	70.170	9277087	10864.6177	
## 16	70.050	16050356	11901.5095	
## 17	70.050	9500606	10974.1284	
## 18	70.040	16445087	12555.5495	
## 19	40.249	409000000	590.0620	
## 20	70.330	9712569	10949.6496	
## 21	64.750	2736300	3629.0765	
## 22	69.960	17010154	12489.9501	
## 23	47.985	16151549	5487.1042	
## 24	30.332	9240934	820.8530	
## 25	70.880	9915267	11240.9589	
## 26	70.620	17462004	12384.4102	
## 27	70.450	10131729	11678.0707	
## 28	70.660	17872034	12590.8003	
## 29	70.890	10361273	11897.9637	
## 30	71.040	18266765	12701.4831	
## 31	71.160	10598814	11711.5000	
## 32	71.270	18634977	12817.9222	
## 33	43.605	454000000	658.3472	
## 34	70.930	10794968	12217.2269	
## 35	67.650	3305200	4692.6483	
## 36	71.300	18985849	13462.4855	
## 37	49.951	18356657	5768.7297	
## 38	31.997	10267083	853.1007	
## 39	70.990	11001483	12722.2170	
## 40	71.310	19342841	13882.5627	
## 41	70.650	11218304	13329.8973	
## 42	71.690	19711053	14510.8993	
## 43	70.980	11439384	13739.9269	
## 44	71.790	20071104	15198.1101	
## 45	70.820	11655083	13860.9581	
## 46	71.920	20448496	15884.8362	
## 47	47.193	506000000	700.7706	

## 48	71.100	11872264	14526.1246
## 49	70.000	3722800	6197.9628
## 50	72.130	20819767	16076.5880
## 51	51.927	20997321	7114.4780
## 52	34.020	11537966	836.1971
## 53	70.730	12101660	15088.5584
## 54	72.290	21143100	16658.2133
## 55	71.140	12379384	15647.1094
## 56	72.450	21448073	17286.9933
## 57	70.810	12660160	16273.1421
## 58	72.650	21749986	17487.4571
## 59	71.410	12937200	16633.1259
## 60	72.980	22026400	18229.6427
## 61	50.651	567000000	724.0325
## 62	71.930	13177000	16788.6295
## 63	72.000	4115700	8315.9281
## 64	72.880	22284500	18970.5709
## 65	53.696	23935810	7765.9626
## 66	36.088	13079460	739.9811
## 67	72.140	13380400	17429.7180
## 68	73.110	22559500	20081.3072
## 69	71.890	13599100	17574.5817
## 70	73.190	22874700	20613.5916
## 71	72.840	13771400	17824.5704
## 72	73.490	23209200	20775.5051
## 73	72.880	13915500	18351.0679
## 74	73.920	23517500	21626.0855
## 75	54.208	634000000	813.3373
## 76	73.490	14074100	18334.1975
## 77	73.600	4583700	11186.1413
## 78	74.210	23796400	22090.8831
## 79	55.527	27129932	8028.6514
## 80	38.438	14880372	786.1134
## 81	73.880	14248600	18635.0381
## 82	74.540	24036300	22754.8274
## 83	74.440	14421900	19380.6356
## 84	74.900	24276900	23465.8267
## 85	74.600	14615900	19505.5545
## 86	75.140	24593300	23473.8969
## 87	74.970	14923260	19841.8795
## 88	75.550	24900000	23904.5256
## 89	56.596	708000000	855.7235
## 90	74.740	15184200	19477.0093
## 91	75.450	5264500	14560.5305
## 92	75.760	25201900	22898.7921
## 93	58.161	31140029	8568.2662
## 94	39.854	12881816	978.0114
## 95	75.550	15393500	19214.5612
## 96	76.130	25456300	23329.8046
## 97	76.020	15579400	20295.2529
## 98	76.430	25701800	24431.8489
## 99	75.460	15788300	21040.4946
## 100	76.410	25941600	25514.7852
## 101	76.130	16018350	21168.8105
## 102	76.560	26203800	25921.1670
## 103	58.553	788000000	976.5127
## 104	76.320	16257249	21888.8890
## 105	76.200	5584510	20038.4727
## 106	76.860	26549700	26626.5150
## 107	60.834	35933379	7825.8234
## 108	40.822	13867957	852.3959
## 109	76.360	16520206	22508.1908
## 110	76.940	26894800	27562.4145
## 111	76.460	16780235	23133.9764
## 112	77.200	27379300	27729.8960
## 113	77.060	17022133	23151.8903
## 114	77.510	27790600	27387.2739
## 115	77.550	17257526	22893.8567
## 116	77.690	28117600	26491.5956
## 117	60.223	872000000	1164.4068

```
## 118 77.560 17481977 23424.7668
## 119 77.601 5829696 24757.6030
## 120 77.950 28523502 26342.8843
## 121 61.888 39964159 7225.0693
## 122 41.674 16317921 649.3414
## 123 78.100 17688687 24053.1010
## 124 77.830 28920644 26590.3994
## 125 78.100 17892557 24780.1724
## 126 78.020 29262472 27543.9081
## 127 78.490 18116171 25518.7154
## 128 78.140 29619002 27969.6729
## 129 78.560 18348078 26151.1325
## 130 78.400 29983162 28074.8365
## 131 61.765 959000000 1458.8174
## 132 78.830 18565243 26997.9366
## 133 80.000 6495918 28377.6322
## 134 78.610 30305843 28954.9259
## 135 60.236 42835005 7479.1882
## 136 41.763 22227415 635.3414
## 137 79.330 18768789 28169.1534
## 138 78.830 30628924 29837.4581
## 139 79.580 18968247 28983.2672
## 140 79.060 30957019 31154.8565
## 141 79.990 19164620 29241.5145
## 142 79.420 31278097 32448.6076
## 143 80.350 19357594 30043.2428
## 144 79.650 31592805 32570.5665
## 145 62.879 1034172547 1746.7695
## 146 80.370 19546792 30687.7547
## 147 81.495 6762476 30209.0152
## 148 79.770 31902268 33328.9651
## 149 53.365 44433622 7710.9464
## 150 42.129 25268405 726.7341
## 151 80.780 19731984 31634.2424
## 152 79.950 32207113 33635.2544
## 153 81.150 19913144 32098.5062
## 154 80.250 32507874 34346.9655
## 155 80.360 32805041 35078.0000
## 156 64.698 1110396331 2452.2104
## 157 81.235 20434176 34435.3674
## 158 82.208 6980412 39724.9787
## 159 80.653 33390141 36319.2350
## 160 49.339 43997828 9269.6578
## 161 43.828 31889923 974.5803
```

```
colonized_data %>%
  filter(Colonial_Overlord == "United Kingdom", year %% 10 == 3 | year %% 10 == 8) %>%
  summary()
```

```
## Country Colonial_Overlord Years_of_Colonization continent
## Length:22 Length:22 Min. :108 Africa : 0
## Class :character Class :character 1st Qu.:108 Americas:11
## Mode :character Mode :character Median :120 Asia : 0
## Mean :120 Europe : 0
## 3rd Qu.:132 FSU : 0
## Max. :132 Oceania :11
## year lifeExp pop gdpPercap
## Min. :1953 Min. :69.13 Min. : 8857924 Min. :10158
## 1st Qu.:1964 1st Qu.:71.07 1st Qu.:14482294 1st Qu.:14184
## Median :1978 Median :74.21 Median :18228738 Median :19648
## Mean :1978 Mean :74.51 Mean :19156518 Mean :20416
## 3rd Qu.:1992 3rd Qu.:77.61 3rd Qu.:23667100 3rd Qu.:25956
## Max. :2003 Max. :80.78 Max. :32207113 Max. :33635
```

Who is the best and worst colonial master?

For at afgøre hvilken kolonimagt, som var den værste eller den bedste, afhænger det af, hvilke parametre man vælger at måle det ud fra. Kigger man på BNP-udviklingen i de tidligere kolonier, som grafen viser, kan vi analysere, hvilke tidligere koloniale herskere der efterlod deres tidligere kolonier med en stærkere økonomi.

Bedste kolonimagt (økonomisk set) • USA: Kurven for tidligere amerikanske kolonier (fx Filippinerne og Puerto Rico) ser ud til at være langt højere end mange andre grupper. Det kan skyldes investeringer i infrastruktur, uddannelse og en økonomisk model, der var relativt robust. • Storbritannien: Flere tidligere britiske kolonier, som Hongkong, Singapore, Canada og Australien, har haft en stærk økonomisk vækst. Det kan delvist tilskrives briternes tidlige fokus på handel, jernbaner og retsstatsprincipper.

Værste kolonimagt (økonomisk set) • Belgien: Belgisk kolonialisme (især i Congo) er berygtet for ekstrem udbytning uden at efterlade institutioner eller økonomiske strukturer, der kunne understøtte vækst efter uafhængighed. • Portugal: Portugals tidligere kolonier (fx Angola og Mozambique) har haft vedvarende økonomiske problemer, muligvis fordi Portugal investerede mindre i infrastruktur og institutioner sammenlignet med andre kolonimagter. • Frankrig: Mens nogle franske kolonier har haft en anstændig økonomisk vækst, har mange afrikanske lande, der var franske kolonier, oplevet lav vækst og høj afhængighed af bistand.

Men BNP kun én måde at vurdere kolonial arv på. Politisk stabilitet, uddannelsesniveau, sociale forhold og graden af uafhængighed fra den tidligere kolonimagt er også vigtige faktorer, for et mere overordnet og præcist billede.

We summarize colonies by their masters and then log their summed gdp to see the difference in development in the last 50 years.

```
# Load required Libraries
```

```
library(ggplot2)
```

```
library(ggrepel)
```

```
## Warning: pakke 'ggrepel' blev bygget under R version 4.4.3
```

```
# Assuming your data frame is 'colonized_data'
```

```
colonized_summary <- colonized_data %>%
  filter(year %in% unique(gapminder$year)) %>%
  #filter(!grepl("3$/8$", year)) %>%
  group_by(Colonial_Overlord, year) %>%
  summarize(gdpPerGroup = sum(gdpPercap))
```

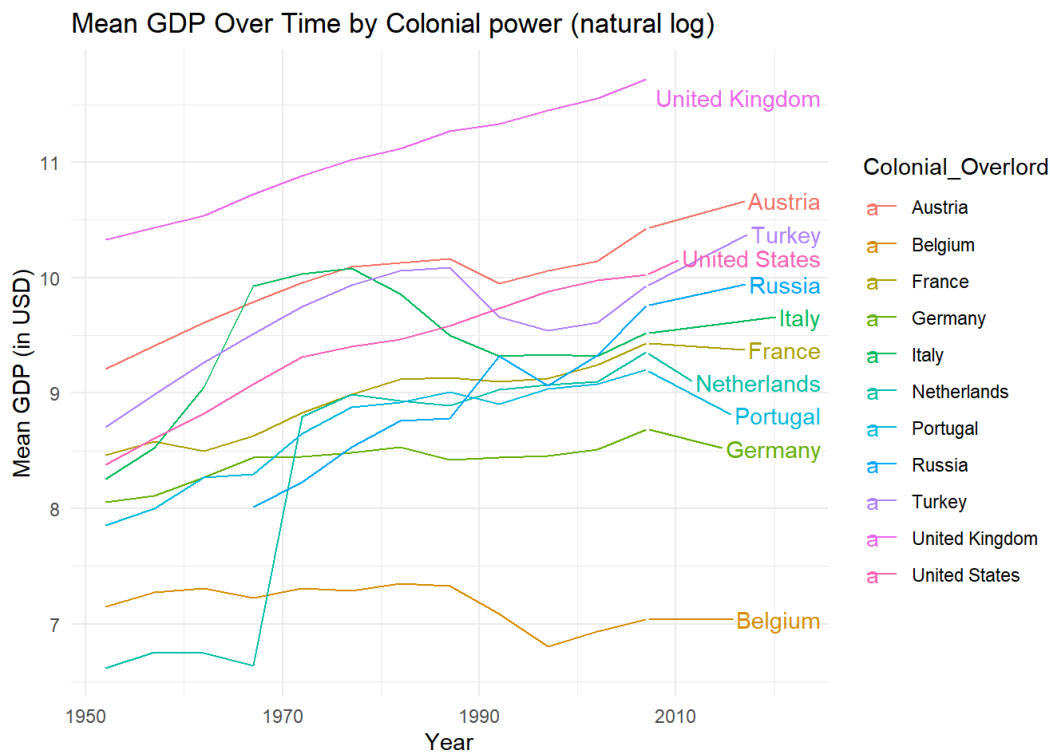
```
## `summarise()` has grouped output by 'Colonial_Overlord'. You can override using
## the `.groups` argument.
```

```
# Find the last year for each country to Label
```

```
last_year_data <- colonized_summary %>%
  group_by(Colonial_Overlord) %>%
  filter(year == max(year)) # Get the data for the last year per country
```

```
# Create the plot
```

```
ggplot(colonized_summary, aes(x = year, y = log(gdpPerGroup), group = Colonial_Overlord, color = Colonial_Overlord))+
  geom_line()+
  geom_text_repel(data = last_year_data, # Use the last year data for labeling
    aes(label = Colonial_Overlord), # Label each country at the last data point
    nudge_x = 15, # Nudges labels slightly to the right for clarity
    direction = "y", # Keep labels vertical
    hjust = 0) + # Align the labels horizontally to the left
  labs(title = "Mean GDP Over Time by Colonial power (natural log)",
    x = "Year",
    y = "Mean GDP (in USD)") +
  theme_minimal() #+ # Minimal theme for a clean look
```

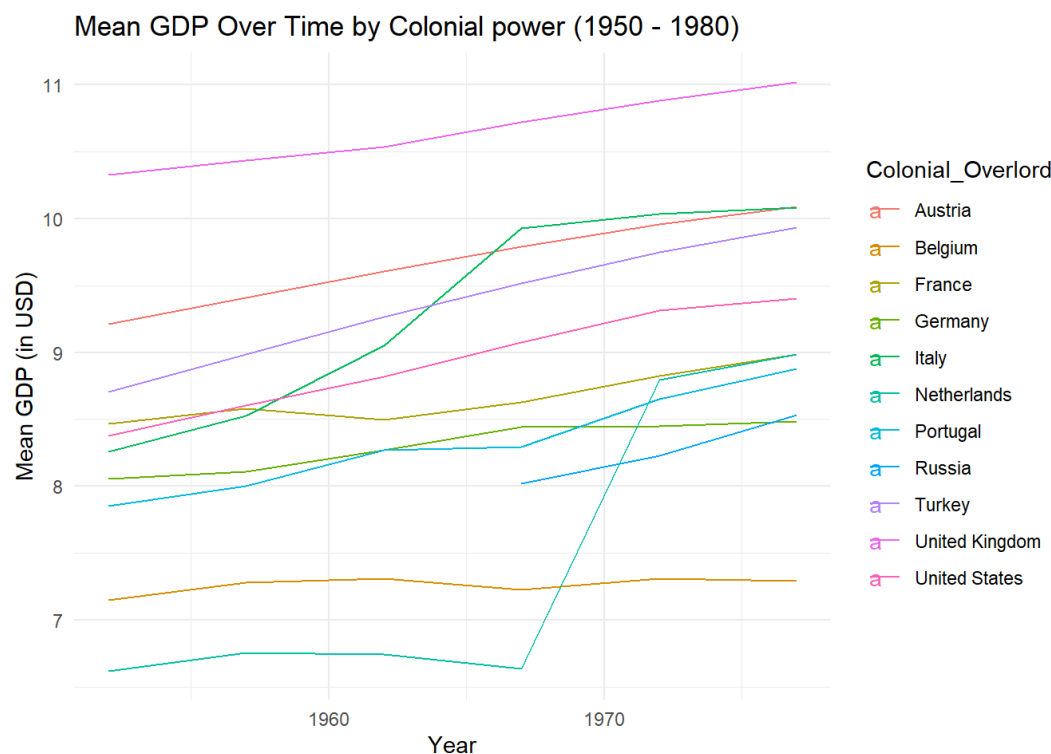
```
#theme(legend.position = "none")
```

```
# Hide the Legend since we have direct labels
```

Most colonial regimes ended after WW2, so let's look at the effect in 30 years

```
# Find the last year for each country to label
last_year_data <- colonized_summary %>%
  group_by(Colonial_Overlord) %>%
  filter(year == 1980) # Get the data for the last year per country

ggplot(colonized_summary %>% filter(year < 1980), aes(x = year, y = log(gdpPerGroup), group = Colonial_Overlord, color = Colonial_Overlord)) +
  geom_line() +
  geom_text_repel(data = last_year_data, # Use the last year data for labeling
    aes(label = Colonial_Overlord), # Label each country at the last data point
    nudge_x = 15, # Nudges labels slightly to the right for clarity
    direction = "y", # Keep labels vertical
    hjust = 0) + # Align the labels horizontally to the left
  labs(title = "Mean GDP Over Time by Colonial power (1950 - 1980)",
    x = "Year",
    y = "Mean GDP (in USD)") +
  theme_minimal()
```



What is the situation with the *not-colonized* counterparts?

Hvis man kigger på grafen nedenfor kan man se BNP-udviklingen over tid for lande, der ikke har været koloniseret i lang tid eller overhovedet.

Kigger man kun på grafen kan man se: Høj økonomisk vækst for nogle lande: Lande som Japan, Schweiz, Norge, Luxembourg og Sverige har oplevet markant økonomisk vækst og har i dag et meget højt BNP pr. indbygger. Dette kan skyldes stabile institutioner, tidlig industrialisering og stærke økonomiske politikker. Moderat vækst i flere asiatiske lande: Lande som Sydkorea, Thailand og Kina har haft en stærk stigning i BNP siden 1950'erne, især efter økonomiske reformer og industrialisering. Lav økonomisk vækst for visse lande: Lande som Afghanistan, Haiti, Liberia, Nepal og Lesotho har haft en meget lav vækst og forbliver blandt verdens fattigste. Dette kan skyldes interne konflikter, geografiske begrænsninger, manglende ressourcer eller svage institutioner.

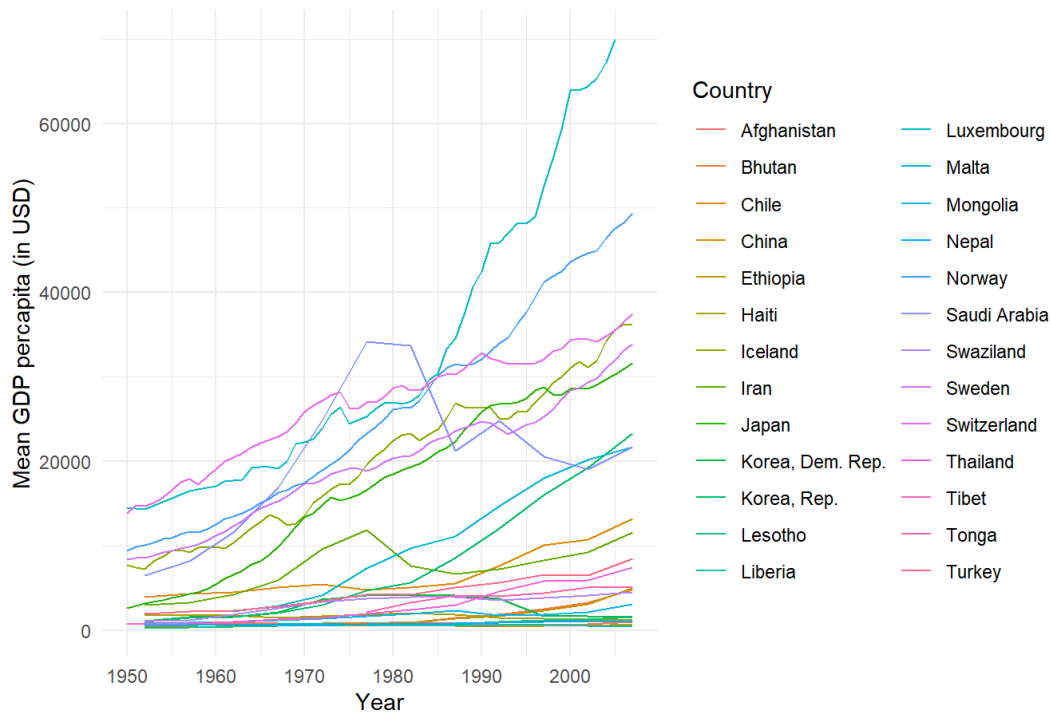
Sammenligner man dem derimod med de tidligere kolonier kan man se: Højt BNP blandt ikke-koloniserede vestlige lande: Schweiz, Norge og Sverige har en væsentlig højere vækst end de fleste tidligere kolonier. Asiatiske og mellemøstlige lande klarer sig godt: Japan, Sydkorea og Saudi-Arabien har haft en bedre udvikling end mange tidligere kolonier. Afrikanske og nogle latinamerikanske lande sakker bagud: Flere afrikanske lande uden en lang kolonihistorie (fx Liberia, Etiopien, Afghanistan) klarer sig ikke markant bedre end koloniserede lande.

Ikke-koloniserede lande viser altså en mere polariseret udvikling: Nogle lande som eksempelvis Schweiz, Japan, Sydkorea, har klaret sig exceptionelt godt, mens andre lande som eksempelvis Afghanistan, Liberia, Haiti, har haft en svag økonomisk udvikling. Dette tyder på, at andre faktorer som geografi, politik og økonomiske reformer spiller en større rolle end blot kolonial status alene.

```
# Let's check their results
ggplot(not_colonized_data, aes(x = year, y = gdpPercap, group = Country, color = Country))+
  geom_line()+
  # geom_text_repel(data = last_year_data,          # Use the last year data for labeling
  #               aes(label = Colonial_Overlord),    # Label each country at the last data point
  #               nudge_x = 15,                     # Nudges labels slightly to the right for clarity
  #               direction = "y",                  # Keep labels vertical
  #               hjust = 0) +                       # Align the labels horizontally to the left
  labs(title = "Not colonized for long (or at all): Mean GDP Over Time",
       x = "Year",
       y = "Mean GDP percapita (in USD)") +
  theme_minimal()
```

```
## Warning: Removed 1 row containing missing values or values outside the scale range
## (`geom_line()`).
```

Not colonized for long (or at all): Mean GDP Over Time



It is hard to see which country is which, so let's add some labels. Expand the graph at the end, so as to see the lines and labels clearly.

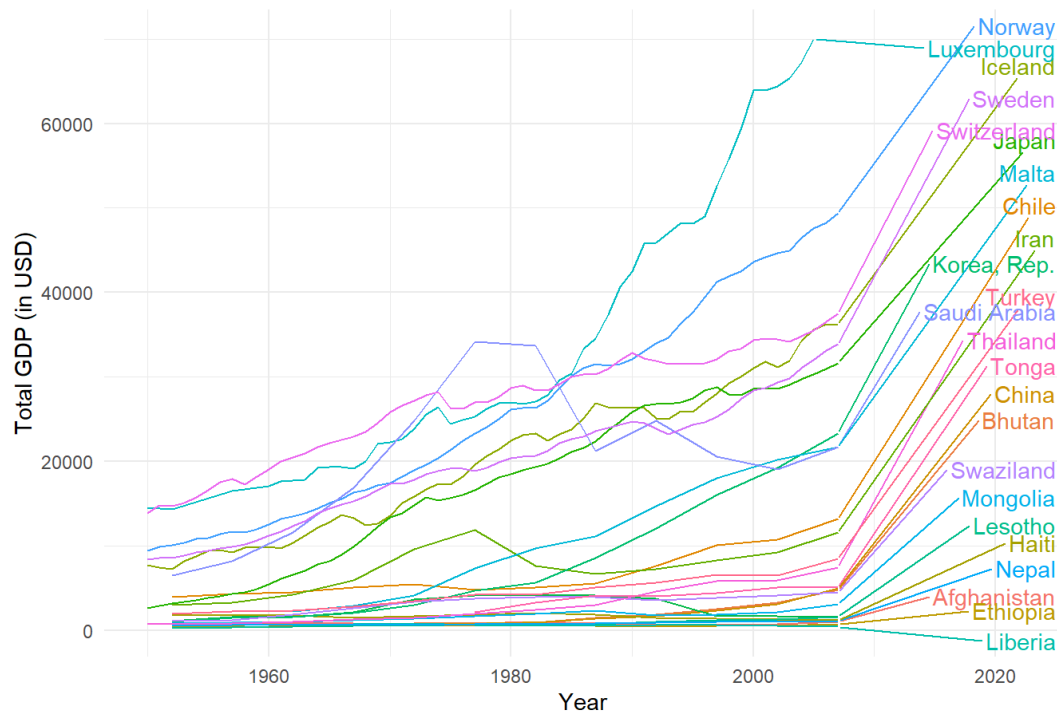
```
nc_last_year_data <- not_colonized_data %>%
  group_by(Country) %>%
  filter(year == max(year)) # Get the data for the last year per country

# Expand this chart once it plots as it is rather detailed
not_colonized_data %>%
  ggplot(aes(x = year, y = gdpPercap, group = Country, color = Country))+
  geom_line()+
  geom_text_repel(data = nc_last_year_data, # Use the last year data for labeling
                  aes(label = Country), # Label each country at the last data point
                  nudge_x = 15, # Nudges labels slightly to the right for clarity
                  direction = "y", # Keep labels vertical
                  hjust = 0) + # Align the labels horizontally to the left
  labs(title = "Not colonized for long (or at all): Mean GDP Over Time",
        x = "Year",
        y = "Total GDP (in USD)") +
  theme_minimal() +
  theme(legend.position = "none")
```

```
## Warning: Removed 1 row containing missing values or values outside the scale range
## (`geom_line()`).
```

```
## Warning: ggrepel: 1 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

Not colonized for long (or at all): Mean GDP Over Time



Does “not being a colony” guarantee affluence?

Nej, “ikke at være en koloni” garanterer ikke velstand, hvilket kan forklares ud fra grafen: Store forskelle mellem landene: Lande som Luxembourg, Norge, Schweiz, Island og Sverige har oplevet ekstrem økonomisk vækst og har i dag et meget højt BNP. Moderat vækst i nogle asiatiske og mellemøstlige lande: Japan, Sydkorea, Saudi-Arabien, Tyrkiet og Thailand har set markant vækst, men på forskellige tidspunkter og af forskellige årsager. Meget lav vækst i nogle lande: Liberia, Haiti og Afghanistan forbliver blandt verdens fattigste lande trods deres historiske uafhængighed.

Det kan i det større perspektiv også forklares ud fra nogle andre faktorer: Andre faktorer spiller en større rolle: Økonomisk succes afhænger af politisk stabilitet, institutioner, ressourcer, geografisk placering og økonomiske reformer – ikke kun kolonial status. Nogle tidligere kolonier klarer sig bedre: Flere tidligere britiske kolonier (fx Australien, Canada, Hongkong) har højere BNP end nogle af de ikke-koloniserede lande i denne graf. Kolonialisme var skadelig, men ikke den eneste faktor: Mange tidligere kolonier kæmper økonomisk pga. deres arv, men at undgå kolonisering var heller ingen garanti for succes.

Ikke at være en koloni giver altså ingen automatisk fordel. Mens nogle ikke-koloniserede lande er ekstremt rige, er andre blandt verdens fattigste. Økonomisk udvikling afhænger af mange faktorer, ikke kun historisk uafhængighed.

Explore the bottom members of the not-colonized company. Create percentiles of wealth and group not-colonized countries by them. Who is at the bottom. How deep is the bottom compared to the worst-off colonies?

```
not_colonized_data <- not_colonized_data %>%
  mutate(totalGdp = pop * gdpPercap)

# Consider whether we should be summarizing total or per capita GDP
not_colonized_ntiles <- not_colonized_data %>%
  filter(year %in% unique(gapminder$year)) %>%
  group_by(year) %>%
  mutate(quantileGdp = ntile(gdpPercap, 5))

not_colonized_summary <- not_colonized_ntiles %>%
  group_by(year, quantileGdp) %>%
  summarize(gdpPerGroup = sum(gdpPercap),
            meangdpPerGroup = mean(gdpPercap))
```

```
## `summarise()` has grouped output by 'year'. You can override using the
## `.groups` argument.
```

```
not_colonized_ntiles
```

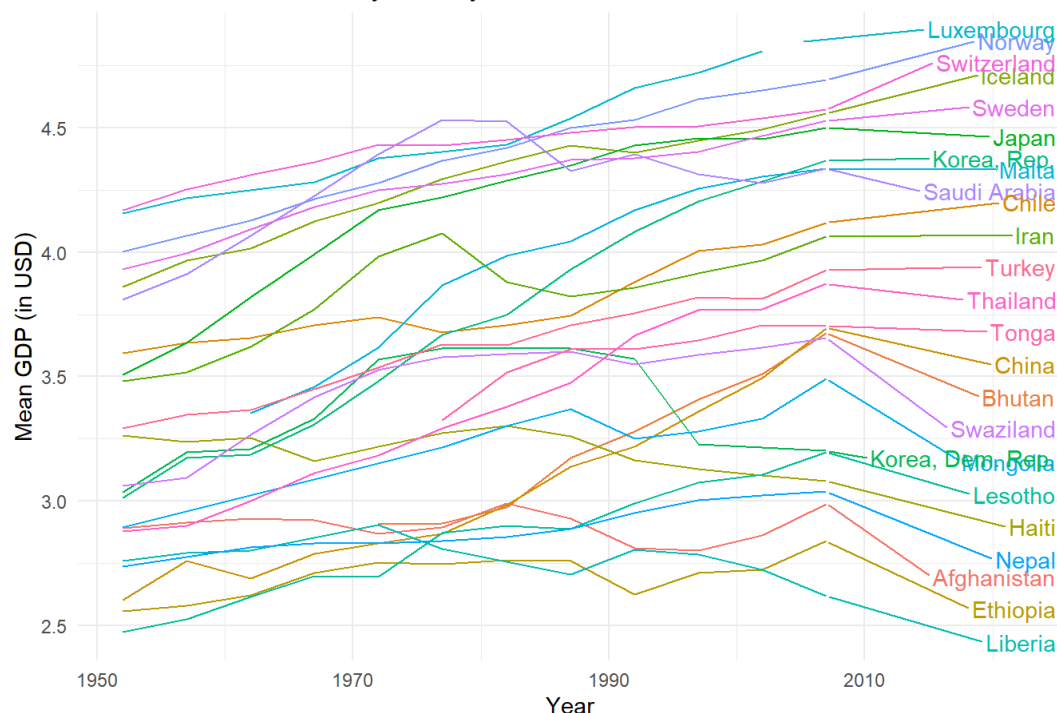
```
## # A tibble: 288 × 9
## # Groups:   year [12]
##   Country Reasonably_Prosporous continent year lifeExp      pop gdpPerCap
##   <chr>    <chr>                <fct>   <int>   <dbl>    <int>    <dbl>
## 1 Japan   YES                      Asia    1952    63.0  86459025    3217.
## 2 Japan   YES                      Asia    1957    65.5  91563009    4318.
## 3 Japan   YES                      Asia    1962    68.7  95831757    6577.
## 4 Japan   YES                      Asia    1967    71.4  100825279   9848.
## 5 Japan   YES                      Asia    1972    73.4  107188273  14779.
## 6 Japan   YES                      Asia    1977    75.4  113872473  16610.
## 7 Japan   YES                      Asia    1982    77.1  118454974  19384.
## 8 Japan   YES                      Asia    1987    78.7  122091325  22376.
## 9 Japan   YES                      Asia    1992    79.4  124329269  26825.
## 10 Japan  YES                      Asia    1997    80.7  125956499  28817.
## # i 278 more rows
## # i 2 more variables: totalGdp <dbl>, quantileGdp <int>
```

```
# Find the last year for each country to label
ntile_last_year_data <- not_colonized_ntiles %>%
  group_by(quantileGdp) %>%
  filter(year == max(year)) %>%
  summarize(gdpPerGroup = sum(gdpPerCap)) # Get the data for the last year per country
```

Let's log the y-axis so we spread the data and can better see the differences in orders of magnitude.

```
# Logarithmic y axis!
ggplot(not_colonized_ntiles, aes(x = year, y = log10(gdpPerCap), group = Country, color = Country)) +
  geom_line() +
  geom_text_repel(data = nc_last_year_data, # Use the last year data for labeling
    aes(label = Country), # Label each country at the last data point
    nudge_x = 15, # Nudges labels slightly to the right for clarity
    direction = "y", # Keep labels vertical
    hjust = 0) + # Align the labels horizontally to the left
  labs(title = "Mean GDP Over Time by country",
    x = "Year",
    y = "Mean GDP (in USD)") +
  theme_minimal() +
  theme(legend.position = "none")
```

Mean GDP Over Time by country



We can also group countries

by GDP into quantiles (exactly 5 groupings from the poorest to the richest) and plot these. It is not super meaningful chart, but exploring who is in which group at the start and the end does point to countries' varied economic (and political) fortunes.

```
not_colonized_ntiles
```

```
## # A tibble: 288 × 9
## # Groups:   year [12]
##   Country Reasonably_Prosporous continent  year lifeExp      pop gdpPerCap
##   <chr>    <chr>                <fct>   <int>  <dbl>    <int>    <dbl>
## 1 Japan  YES                      Asia    1952   63.0  86459025   3217.
## 2 Japan  YES                      Asia    1957   65.5  91563009   4318.
## 3 Japan  YES                      Asia    1962   68.7  95831757   6577.
## 4 Japan  YES                      Asia    1967   71.4 100825279   9848.
## 5 Japan  YES                      Asia    1972   73.4 107188273  14779.
## 6 Japan  YES                      Asia    1977   75.4 113872473  16610.
## 7 Japan  YES                      Asia    1982   77.1 118454974  19384.
## 8 Japan  YES                      Asia    1987   78.7 122091325  22376.
## 9 Japan  YES                      Asia    1992   79.4 124329269  26825.
## 10 Japan YES                      Asia    1997   80.7 125956499  28817.
## # i 278 more rows
## # i 2 more variables: totalGdp <dbl>, quantileGdp <int>
```

```
# How are the best and worst countries moving economically over the last 60 years?
not_colonized_summary <- not_colonized_ntiles %>%
  arrange(desc(year)) %>%
  group_by(year, quantileGdp) %>%
  summarize(gdpPerGroup = sum(gdpPerCap),
            meangdpPerGroup = mean(gdpPerCap)) %>%
  mutate(quantileGdp = as.factor(quantileGdp))
```

```
## `summarise()` has grouped output by 'year'. You can override using the
## `.groups` argument.
```

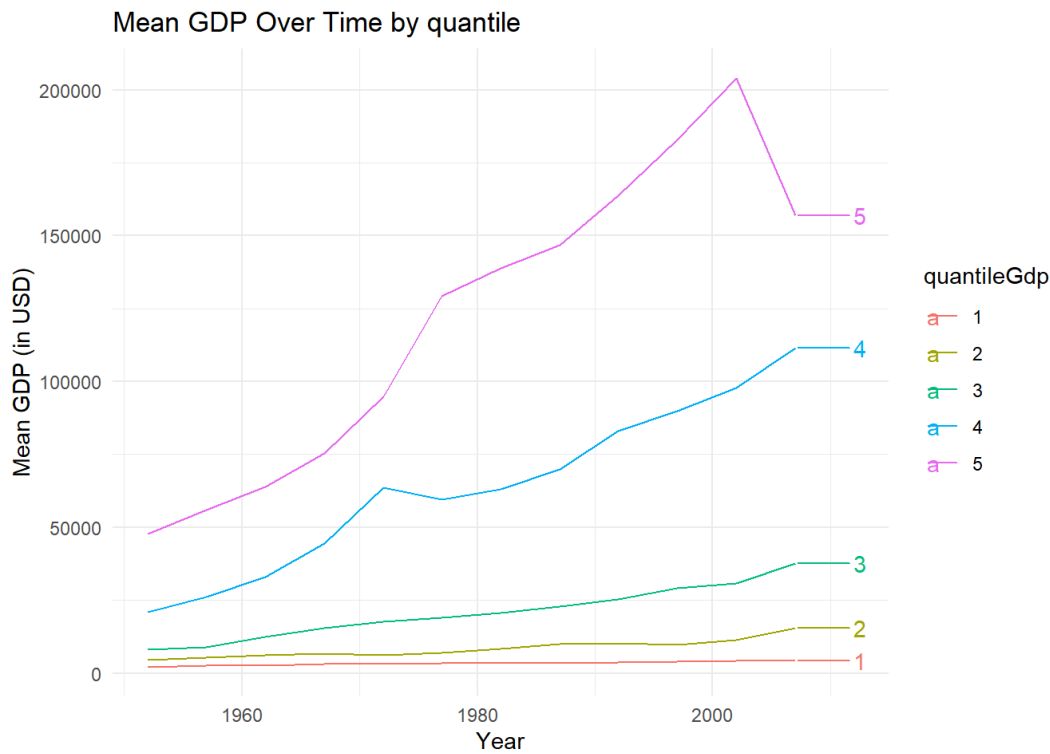
```
not_colonized_summary
```

```
## # A tibble: 60 × 4
## # Groups:   year [12]
##   year quantileGdp gdpPerGroup meangdpPerGroup
##   <int> <fct>        <dbl>         <dbl>
## 1 1952 1          2183.         437.
## 2 1952 2          4443.         889.
## 3 1952 3          7993.        1998.
## 4 1952 4         20884.        5221.
## 5 1952 5         47684.       11921.
## 6 1957 1          2510.         502.
## 7 1957 2          5259.        1052.
## 8 1957 3          8807.        2202.
## 9 1957 4         26035.        6509.
## 10 1957 5         56021.       14005.
## # i 50 more rows
```

```
# Extract data for the last year to use in geom_text_repel
ntile_last_year_data <- not_colonized_summary %>%
  group_by(quantileGdp) %>%
  filter(year == max(year)) # Extract the last year for each quantile
ntile_last_year_data
```

```
## # A tibble: 5 × 4
## # Groups:   quantileGdp [5]
##   year quantileGdp gdpPerGroup meangdpPerGroup
##   <int> <fct>        <dbl>         <dbl>
## 1 2007 1          4373.         875.
## 2 2007 2         15516.        3103.
## 3 2007 3         37545.        7509.
## 4 2007 4        111542.       22308.
## 5 2007 5        156904.       39226.
```

```
ggplot(not_colonized_summary, aes(x = year, y = gdpPerGroup, group = quantileGdp, color = quantileGdp))+
  geom_line()+
  geom_text_repel(data = ntile_last_year_data,      # Use the last year data for labeling
                  aes(x = year, y = gdpPerGroup, label = quantileGdp),      # Label each country at the last data poi
nt
                  nudge_x = 5,                  # Nudges labels slightly to the right for clarity
                  direction = "y",              # Keep labels vertical
                  hjust = 0) +                  # Align the labels horizontally to the left
  labs(title = "Mean GDP Over Time by quantile",
       x = "Year",
       y = "Mean GDP (in USD)") +
  theme_minimal()
```



Who is in groups 1 and 5 at the start and the end?

```
not_colonized_ntiles %>%
  filter(year == 1957 & quantileGdp == 5) %>%
  select(Country, gdpPercap)
```

Adding missing grouping variables: `year`

```
## # A tibble: 4 × 3
## # Groups:   year [1]
##   year Country      gdpPercap
##   <int> <chr>      <dbl>
## 1 1957 Sweden        9912.
## 2 1957 Norway       11654.
## 3 1957 Switzerland  17909.
## 4 1957 Luxembourg   16546.
```

```
not_colonized_ntiles %>%
  filter(year > 2002 & quantileGdp == 5) %>%
  select(Country, gdpPercap)
```

Adding missing grouping variables: `year`

```
## # A tibble: 4 × 3
## # Groups:   year [1]
##   year Country      gdpPercap
##   <int> <chr>         <dbl>
## 1  2007 Iceland      36181.
## 2  2007 Sweden      33860.
## 3  2007 Norway      49357.
## 4  2007 Switzerland 37506.
```

```
# Where is China in all this and how does its progress compare to e.g. Saudi Arabia?
```

```
not_colonized_ntiles %>%
  filter(Country == "China") %>%
  select(year, gdpPercap, quantileGdp)
```

```
## # A tibble: 12 × 3
## # Groups:   year [12]
##   year gdpPercap quantileGdp
##   <int>     <dbl>     <int>
## 1  1952      400.         1
## 2  1957      576.         1
## 3  1962      488.         1
## 4  1967      613.         1
## 5  1972      677.         1
## 6  1977      741.         1
## 7  1982      962.         2
## 8  1987     1379.         2
## 9  1992     1656.         2
## 10 1997     2289.         2
## 11 2002     3119.         2
## 12 2007     4959.         3
```

```
not_colonized_ntiles %>%
  filter(Country == "Saudi Arabia") %>%
  select(year, gdpPercap, quantileGdp)
```

```
## # A tibble: 12 × 3
## # Groups:   year [12]
##   year gdpPercap quantileGdp
##   <int>     <dbl>     <int>
## 1  1952     6460.         4
## 2  1957     8158.         4
## 3  1962    11626.         4
## 4  1967    16903.         5
## 5  1972    24837.         5
## 6  1977    34168.         5
## 7  1982    33693.         5
## 8  1987    21198.         4
## 9  1992    24842.         4
## 10 1997    20587.         4
## 11 2002    19015.         4
## 12 2007    21655.         4
```

```
# Can you think of other 'climbers'?
```

Significance testing 1: Does the colonial overlord matter?

Ja, den koloniale overlord ser ud til at have en signifikant effekt på BNP per capita.

Kigger man på regressionen nedenfor kan man se følgende: P-værdierne for alle koloniale overlords er ekstremt lave ($p < 0.001$). Hvilket betyder, at forskellene i BNP per capita mellem tidligere kolonier af forskellige kolonimagter ikke skyldes tilfældigheder. F-statistikken er høj (39.7) med en ekstremt lav p-værdi ($< 2.2e-16$). Hvilket indikerer, at modellen som helhed er stærkt signifikant. Multiple R-squared = 0.4441. Cirka 44% af variationen i BNP per capita kan forklares ved kolonimagten, hvilket er en betydelig andel.

Den koloniale overlord har altså en målbar og signifikant indflydelse på BNP per capita i tidligere kolonier. Forskellige kolonimagter har efterladt deres tidligere kolonier i markant forskellige økonomiske situationer.

```
# Run a basic linear regression model
model <- lm(gdpPercap ~ Colonial_Overlord, data = colonized_data)
```

```
# Summary of the regression results
summary(model)
```

```
##
## Call:
## lm(formula = gdpPercap ~ Colonial_Overlord, data = colonized_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -15693.1  -3269.8  -196.6   2633.2  23485.3
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      12505.2      773.0   16.177  < 2e-16 ***
## Colonial_OverlordBelgium      -11843.2      1529.8   -7.742  5.54e-14 ***
## Colonial_OverlordFrance       -9874.7      1326.4   -7.445  4.32e-13 ***
## Colonial_OverlordGermany      -10242.8      1529.8   -6.695  5.83e-11 ***
## Colonial_OverlordItaly        -8007.2      1314.5   -6.091  2.25e-09 ***
## Colonial_OverlordNetherlands   -8994.5      1639.8   -5.485  6.59e-08 ***
## Colonial_OverlordPortugal      -9319.4      1529.8   -6.092  2.24e-09 ***
## Colonial_OverlordRussia        -8293.9      1709.2   -4.853  1.63e-06 ***
## Colonial_OverlordTurkey        -5777.4      1097.1   -5.266  2.08e-07 ***
## Colonial_OverlordUnited Kingdom  3734.4       925.9    4.033  6.37e-05 ***
## Colonial_OverlordUnited States  -6134.1      1506.9   -4.071  5.45e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6467 on 497 degrees of freedom
## (1 observation deleted due to missingness)
## Multiple R-squared:  0.4441, Adjusted R-squared:  0.4329
## F-statistic: 39.7 on 10 and 497 DF, p-value: < 2.2e-16
```

How to interpret the summary?

- Coefficients on Colonial_Overlord: These will show how GDP differs depending on which colonial power ruled a country. If some powers had more detrimental impacts, their coefficients will be more negative (assuming GDP is used as the dependent variable).
- Coefficient on Colonial_Duration: This will tell you how an additional year of colonization impacts GDP per capita, on average, across all colonial powers.
- R-squared: This will tell you how much of the variation in GDP per capita is explained by the model.

Significance testing 2: Does the duration of colonialism matter?

Ja, varigheden af kolonisering (Years_of_Colonization) ser ud til at have en signifikant effekt på BNP per capita (gdpPercap).

Koefficienten for Years_of_Colonization er 103.46, hvilket betyder, at for hver ekstra års kolonisering øges BNP per capita med cirka 103.46 enheder. p-værdien er 0.00152, hvilket er meget lavere end den typiske signifikansgrænse på 0.05. Dette tyder på, at effekten er statistisk signifikant.

Det betyder altså, at varigheden af kolonisering har en betydelig effekt på BNP per capita i dette datasæt.

```
model_interaction <- lm(gdpPercap ~ Years_of_Colonization * factor(Colonial_Overlord), data = colonized_data)
summary(model_interaction)
```

```
##
## Call:
## lm(formula = gdpPercap ~ Years_of_Colonization * factor(Colonial_Overlord),
##     data = colonized_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -18659.8  -2746.7    16.5   2045.6  25608.0
##
## Coefficients: (2 not defined because of singularities)
##                                     Estimate
## (Intercept)                       -18532.64
## Years_of_Colonization                103.46
## factor(Colonial_Overlord)Belgium     19235.64
## factor(Colonial_Overlord)France      18812.39
## factor(Colonial_Overlord)Germany     33199.39
## factor(Colonial_Overlord)Italy       33551.52
## factor(Colonial_Overlord)Netherlands 33736.53
## factor(Colonial_Overlord)Portugal    35345.35
## factor(Colonial_Overlord)Russia      19367.26
## factor(Colonial_Overlord)Turkey     -10950.34
## factor(Colonial_Overlord)United Kingdom 43278.44
## factor(Colonial_Overlord)United States 15741.35
## Years_of_Colonization:factor(Colonial_Overlord)Belgium -104.14
## Years_of_Colonization:factor(Colonial_Overlord)France -74.44
## Years_of_Colonization:factor(Colonial_Overlord)Germany -417.49
## Years_of_Colonization:factor(Colonial_Overlord)Italy -349.99
## Years_of_Colonization:factor(Colonial_Overlord)Netherlands -141.92
## Years_of_Colonization:factor(Colonial_Overlord)Portugal -137.57
## Years_of_Colonization:factor(Colonial_Overlord)Russia -79.02
## Years_of_Colonization:factor(Colonial_Overlord)Turkey NA
## Years_of_Colonization:factor(Colonial_Overlord)United Kingdom -171.59
## Years_of_Colonization:factor(Colonial_Overlord)United States NA
##                                     Std. Error
## (Intercept)                       9658.21
## Years_of_Colonization                32.10
## factor(Colonial_Overlord)Belgium    10467.95
## factor(Colonial_Overlord)France      9975.00
## factor(Colonial_Overlord)Germany    14848.47
## factor(Colonial_Overlord)Italy      10238.74
## factor(Colonial_Overlord)Netherlands 12336.03
## factor(Colonial_Overlord)Portugal   11756.50
## factor(Colonial_Overlord)Russia     10346.40
## factor(Colonial_Overlord)Turkey     1923.85
## factor(Colonial_Overlord)United Kingdom 9963.56
## factor(Colonial_Overlord)United States 6941.35
## Years_of_Colonization:factor(Colonial_Overlord)Belgium 71.45
## Years_of_Colonization:factor(Colonial_Overlord)France 42.57
## Years_of_Colonization:factor(Colonial_Overlord)Germany 285.50
## Years_of_Colonization:factor(Colonial_Overlord)Italy 82.41
## Years_of_Colonization:factor(Colonial_Overlord)Netherlands 40.58
## Years_of_Colonization:factor(Colonial_Overlord)Portugal 36.08
## Years_of_Colonization:factor(Colonial_Overlord)Russia 40.47
## Years_of_Colonization:factor(Colonial_Overlord)Turkey NA
## Years_of_Colonization:factor(Colonial_Overlord)United Kingdom 37.40
## Years_of_Colonization:factor(Colonial_Overlord)United States NA
##                                     t value Pr(>|t|)
## (Intercept)                       -1.919 0.055587
## Years_of_Colonization                3.223 0.001352
## factor(Colonial_Overlord)Belgium    1.838 0.066733
## factor(Colonial_Overlord)France      1.886 0.059895
## factor(Colonial_Overlord)Germany     2.236 0.025811
## factor(Colonial_Overlord)Italy       3.277 0.001124
## factor(Colonial_Overlord)Netherlands 2.735 0.006469
## factor(Colonial_Overlord)Portugal    3.006 0.002779
## factor(Colonial_Overlord)Russia      1.872 0.061821
## factor(Colonial_Overlord)Turkey     -5.692 2.17e-08
## factor(Colonial_Overlord)United Kingdom 4.344 1.71e-05
## factor(Colonial_Overlord)United States 2.268 0.023780
## Years_of_Colonization:factor(Colonial_Overlord)Belgium -1.458 0.145580
```

```
## Years_of_Colonization:factor(Colonial_Overlord)France      -1.748  0.081026
## Years_of_Colonization:factor(Colonial_Overlord)Germany    -1.462  0.144293
## Years_of_Colonization:factor(Colonial_Overlord)Italy       -4.247  2.60e-05
## Years_of_Colonization:factor(Colonial_Overlord)Netherlands -3.498  0.000512
## Years_of_Colonization:factor(Colonial_Overlord)Portugal    -3.813  0.000155
## Years_of_Colonization:factor(Colonial_Overlord)Russia      -1.953  0.051426
## Years_of_Colonization:factor(Colonial_Overlord)Turkey      NA      NA
## Years_of_Colonization:factor(Colonial_Overlord)United Kingdom -4.588  5.71e-06
## Years_of_Colonization:factor(Colonial_Overlord)United States NA      NA
##
## (Intercept) .
## Years_of_Colonization **
## factor(Colonial_Overlord)Belgium .
## factor(Colonial_Overlord)France .
## factor(Colonial_Overlord)Germany *
## factor(Colonial_Overlord)Italy **
## factor(Colonial_Overlord)Netherlands **
## factor(Colonial_Overlord)Portugal **
## factor(Colonial_Overlord)Russia .
## factor(Colonial_Overlord)Turkey ***
## factor(Colonial_Overlord)United Kingdom ***
## factor(Colonial_Overlord)United States *
## Years_of_Colonization:factor(Colonial_Overlord)Belgium
## Years_of_Colonization:factor(Colonial_Overlord)France .
## Years_of_Colonization:factor(Colonial_Overlord)Germany
## Years_of_Colonization:factor(Colonial_Overlord)Italy ***
## Years_of_Colonization:factor(Colonial_Overlord)Netherlands ***
## Years_of_Colonization:factor(Colonial_Overlord)Portugal ***
## Years_of_Colonization:factor(Colonial_Overlord)Russia .
## Years_of_Colonization:factor(Colonial_Overlord)Turkey
## Years_of_Colonization:factor(Colonial_Overlord)United Kingdom ***
## Years_of_Colonization:factor(Colonial_Overlord)United States
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6254 on 488 degrees of freedom
## (1 observation deleted due to missingness)
## Multiple R-squared:  0.4896, Adjusted R-squared:  0.4697
## F-statistic: 24.63 on 19 and 488 DF, p-value: < 2.2e-16
```

How do you interpret this model summary?

- Colonial Duration: This coefficient shows the general effect of an additional year of colonization across all colonial powers, assuming no interaction.
- Colonial Overlord: This coefficient shows the effect of the specific colonial power, assuming no interaction with the duration.
- Interaction Term: The interaction term measures how the effect of each additional year of colonization differs depending on the colonial overlord.

Significance codes tell you if the different could have arisen by chance or not? 0 = no chance, 1 = all chance R-squared amount tells you how much of the data is explained by this model. 1 = 100%. If below 1, other factors are in play. In our case, consider existing regimes (dictator ship, socialist episode, starting development level etc.)

Visualize the model results

```
# Extract model coefficients
coefficients <- as.data.frame(coef(summary(model_interaction)))

# Create a column for variable names
coefficients$Variable <- rownames(coefficients)

# Split into main effects (Colonial_Overlord) and interaction terms (Colonial_Overlord x Year)
main_effects <- coefficients %>%
  filter(grepl("Colonial_Overlord", Variable) & !grepl(":", Variable)) %>% # Only colonial overlord effects
  mutate(Country = sub(".*factor\\(Colonial_Overlord\\)", "", Variable)) # Extract the country name

interaction_effects <- coefficients %>%
  filter(grepl("Colonial_Overlord", Variable) & grepl(":", Variable)) %>% # Only interaction terms

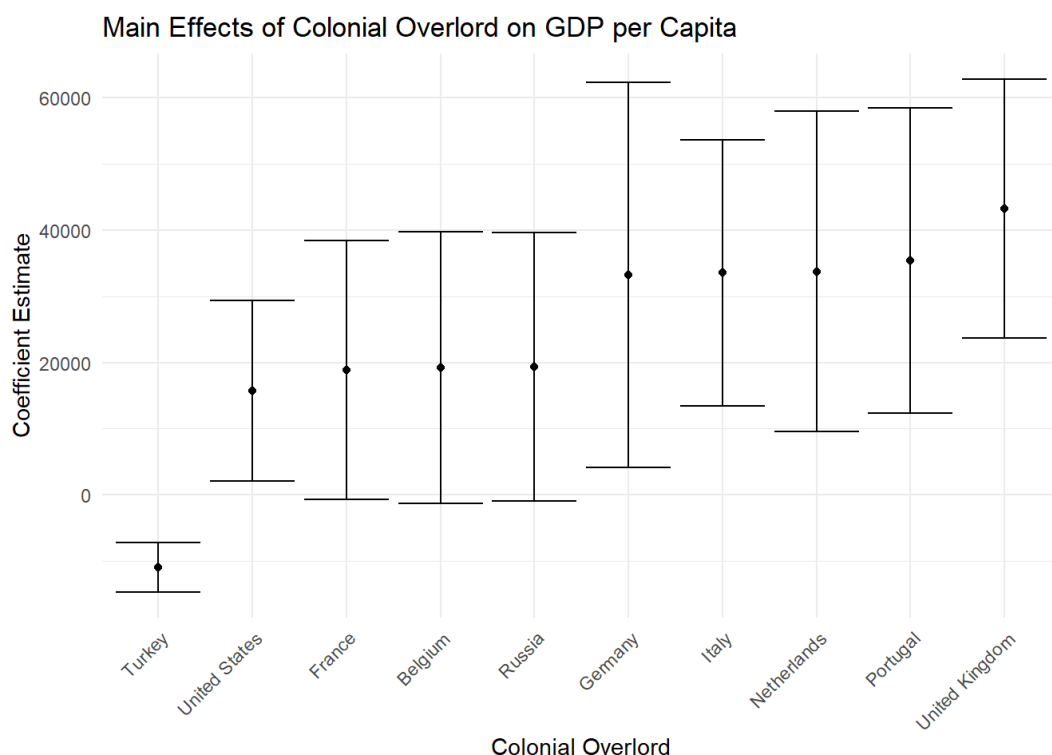
interaction_effects_clean <- interaction_effects %>%
  mutate(Country = sub(".*factor\\(Colonial_Overlord\\)", "", Variable)) # Extract the country name

options(scipen = 999)
```

Plot 1: Main Effects of Colonial Overlord

```
# Plot 1: Main Effects of Colonial Overlord
plot1 <- ggplot(main_effects, aes(x = reorder(Country, Estimate), y = Estimate)) +
  geom_point() +
  geom_errorbar(aes(ymin = Estimate - 1.96 * `Std. Error`, ymax = Estimate + 1.96 * `Std. Error`)) +
  labs(title = "Main Effects of Colonial Overlord on GDP per Capita",
       x = "Colonial Overlord",
       y = "Coefficient Estimate") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) # Rotate x-axis labels
```

plot1

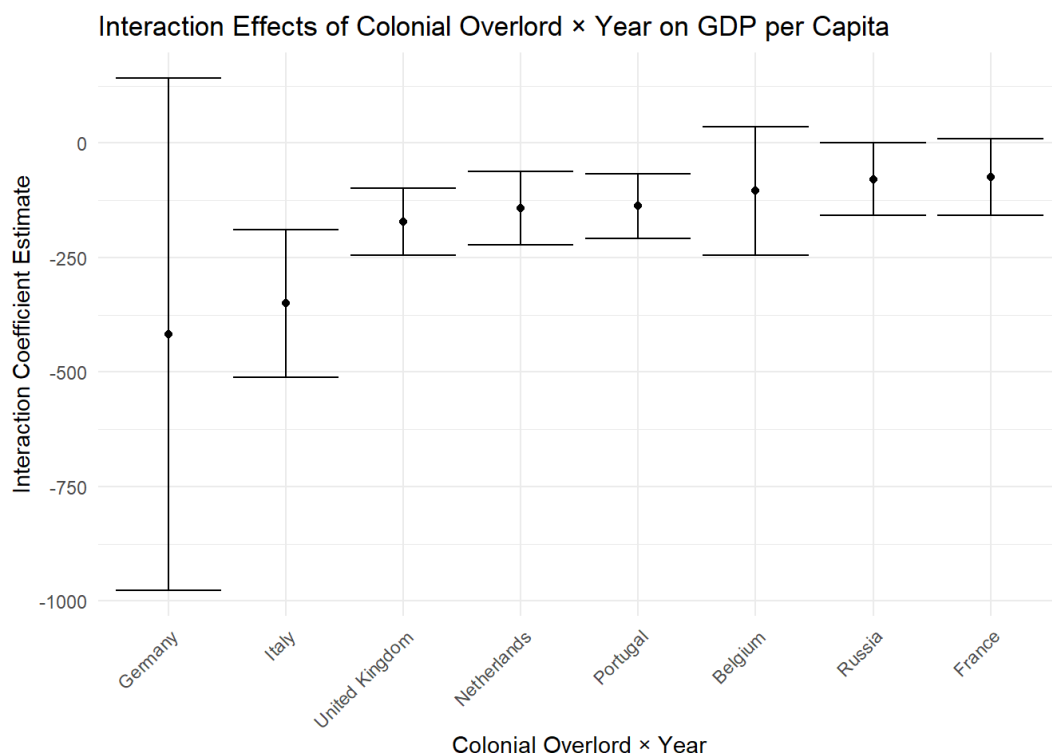


Plot 2: Interaction Effects of Colonial Overlord × Year on GDP

per Capita

```
# Plot 2: Interaction Effects of Colonial Overlord × Year on GDP per Capita
plot2 <- ggplot(interaction_effects_clean, aes(x = reorder(Country, Estimate), y = Estimate)) +
  geom_point() +
  geom_errorbar(aes(ymin = Estimate - 1.96 * `Std. Error`, ymax = Estimate + 1.96 * `Std. Error`)) +
  labs(title = "Interaction Effects of Colonial Overlord × Year on GDP per Capita",
       x = "Colonial Overlord × Year",
       y = "Interaction Coefficient Estimate") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```

plot2



Hints:

If you wish to combine two or more plots

.. you need to first write them into objects and then combine using the `patchwork` library. Choose more meaningful names than `plot1` and `plot2`, please ;).

```
install.packages("patchwork")
library(patchwork) # you will need to install it first

plot1 + plot2
```

How is rate of change affected?

Ændringsraten (rate of change) beregnes i den givne R-funktion `pctchange` som den procentvise ændring fra en observation til den næste. Formlen nedenfor betyder, at ændringsraten afhænger af forskellen mellem den nuværende værdi (x) og den foregående værdi ($\text{lag}(x)$), relativt til den foregående værdi. Hvordan ændringsraten påvirkes i konteksten af kolonialisme og BNP per capita afhænger af de observerede tendenser i dataene.

Eksempelvis kan man ud fra nogle af graferne se: - Forskellige koloniale overherrer har forskellige hovedvirkninger på BNP per capita (venstre graf). Nogle lande som Tyskland og Italien har høje koefficienter, mens Tyrkiet og USA har lave. - Interaktionskoefficienterne mellem kolonialmagt og år (højre graf) viser, at kolonialhistorien kan påvirke væksthastigheden forskelligt. Hvor negative værdier for Storbritannien, Italien og Tyskland tyder på, at længere kolonisering er forbundet med lavere vækstrater. Og positive eller neutrale værdier for Rusland og Frankrig antyder, at deres tidligere kolonier ikke nødvendigvis har oplevet samme negative effekt.

Det vil altså sige, at afhængigt af kolonialmagts indflydelse kan ændringsraten for BNP per capita variere – nogle tidligere kolonier kan have haft en nedadgående vækstrate, mens andre har opretholdt eller forbedret deres vækstrate over tid.

```
#Let's define a function for percent change
```

```
pctchange <-function(x) {
  pct <- 100*((x - lag(x))/(lag(x)))
  return (pct)
}
```

Possible expansions:

1. Investigate closely two opposite cases (e.g. Liberia, Ethiopia) and delve into their colonial background. An empire for 300 years or 3 years under an aggressive inexperienced wanna-be-colonist?
2. Recode the table on how long it is *since colonialism*. How much effect is there?
3. Change the focus from Colonialism to political establishment. Add data on 'Duration_socialism', or 'Duration_dictatorship' for the last 100 years and check their effect. (Check the Varieties of Democracy project if you need more input <https://v-dem.net/> (<https://v-dem.net/>))

Evaluation

After this initial bout of visualisations and tests, it is time to summarize your findings and reflect on them as well as the whole process of analysis.

1. Consider the pipeline from the beginning: by what criteria did you selected your (un-) colonized countries and colonizers? What biases / intent shaped your interpretations and thereby your results? What considerations or rules did you implement when encoding the 'victims' and 'perpetrators'? Are other interpretations possible and do they significantly change the results?
2. Next, what sense do you make of the linear regressions? What significant outcomes do you see and how do you understand their visual outputs? Explain the meaning of the lm results, underscore the lessons learnt.
3. Describe the visualisations to the reader: what should the reader notice and how should she understand the various log and other y axis values, the trendlines, groupings, and their colors etc.? Remember that data don't speak for themselves. What do we see?
4. Document the code so that each chunk has a rationale and an explanation. Beautify and explain concisely.

#5. Finally, reflect on what lessons do you think this sort of analysis offers to the historian? Analysen af kolonial arv gennem økonomiske data, som vist i regressionen og graferne, tilbyder historikere flere vigtige indsigter:

Økonomisk arv og ulige udvikling: - Forskelle i BNP per capita mellem tidligere kolonier viser, hvordan kolonialhistorie kan have haft langvarige økonomiske konsekvenser. - Visse koloniale overherrer ser ud til at være forbundet med højere eller lavere økonomiske resultater, hvilket kan afspejle forskelle i kolonial administration, investeringer og økonomisk udnyttelse.

Koloniseringens varighed og dens effekt: - Den signifikante effekt af Years_of_Colonization antyder, at længere kolonisering ikke nødvendigvis er positivt for økonomisk udvikling. - Nogle tidligere kolonier kan være fanget i afhængighedsforhold eller institutionelle svagheder, som hæmmer vækst.

Institutionelle eftervirkninger: - Kolonimagternes forskellige strategier (f.eks. udvindingskolonier vs. bosætterkolonier) kan forklare variationer i de økonomiske resultater. - Institutioner, love og økonomiske strukturer indført under kolonitiden kan have formet den moderne økonomi i tidligere kolonier.

Historisk ansvar og økonomisk politik: - Disse analyser kan give grundlag for diskussioner om erstatning, gældseftergivelse eller udviklingsbistand, især hvis visse koloniale systemer har haft vedvarende negative effekter. - De kan også vejlede politikere og økonomer i at udvikle strategier for at overvinde de negative virkninger af kolonialismen.

Man kan derfor sige, at for historikere giver denne form for analyse en kvantitativ dimension til studiet af kolonialisme. I stedet for kun at se på tekster og arkiver kan økonomiske modeller hjælpe med at måle og forstå kolonialismens varige effekter – og dermed give en mere nuanceret forståelse af global udvikling og ulighed.