



Analysis of CO2 Emission and Energy Consumption around the world

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Country China and USA

0.1 Read data

```
options(scipen = 200)
Analysis_Data <- read_csv(here::here("Data/Assignment_data.csv"))
```

0.2 Data preprocessing

```
# filtering data from 1970 to 2017 for China and the United States
data <- Analysis_Data %>%
  filter(Entity %in% c("China","United States")) %>%
  filter(Year>=1970 & Year<=2017)
dim(data)
```

```
## [1] 96 7
```

0.3 Overall descriptive statistical analysis

```
data <- data %>%
  rename(Average.annual.hours.worked=
    "Average annual hours worked by persons engaged (avh) (PWT 9.1 (2019))",
    GDP.per.capita="Output-side real GDP per capita (gdppc_o) (PWT 9.1 (2019))",
    Population="Population (historical estimates)",
    Country=Entity)
overall <- data %>%
  group_by(Country) %>%
  summarise_at(c("Average.annual.hours.worked","GDP.per.capita","Population"),
    list(Minimum = ~min(.,na.rm=TRUE),
        Median = ~median(.,na.rm=TRUE),
        Mean = ~mean(.,na.rm=TRUE),
        Maximum = ~max(.,na.rm=TRUE))) %>%
  pivot_longer(!Country, names_sep ="_")
```

Table 1: Descriptive statistical analysis of China and the United States

Country	Variable	Minimum	Median	Mean	Maximum
China	Hours.worked	1969.39	1985.48	2049.81	2192.35
China	GDP.per.capita	1394.16	3127.29	4574.76	13042.65
China	Population	827601385.00	1224418542.50	1179497606.85	1421021794.00
United States	Hours.worked	1729.96	1795.14	1799.27	1891.41
United States	GDP.per.capita	23285.58	37978.02	39046.42	54794.76
United States	Population	209513340.00	260886667.00	264561185.08	325084758.00

```
names_to = c("Variable", ".value"))%>%
  mutate(Variable=ifelse(Variable=="Average.annual.hours.worked",
                        "Hours.worked",Variable))

knitr::kable(overall, digits = 2,
             caption = "Descriptive statistical analysis of China and the United States")
```

0.4 Trends in average annual hours worked and GDP per capita

```
ggplot(data,mapping = aes(x = Year,y=GDP.per.capita,
                           color=Country,group=Country)) +
  geom_line() +
  labs(y ="GDP per capita",
       caption = "Source: World Bank data base")+
  theme_bw()
```

```
ggplot(data,mapping = aes(x = Year,y=Average.annual.hours.worked,
                           color=Country,group=Country)) +
  geom_line() +
  labs(y ="Average annual hours worked",
       caption = "Source: World Bank data base")+
  theme_bw()
```

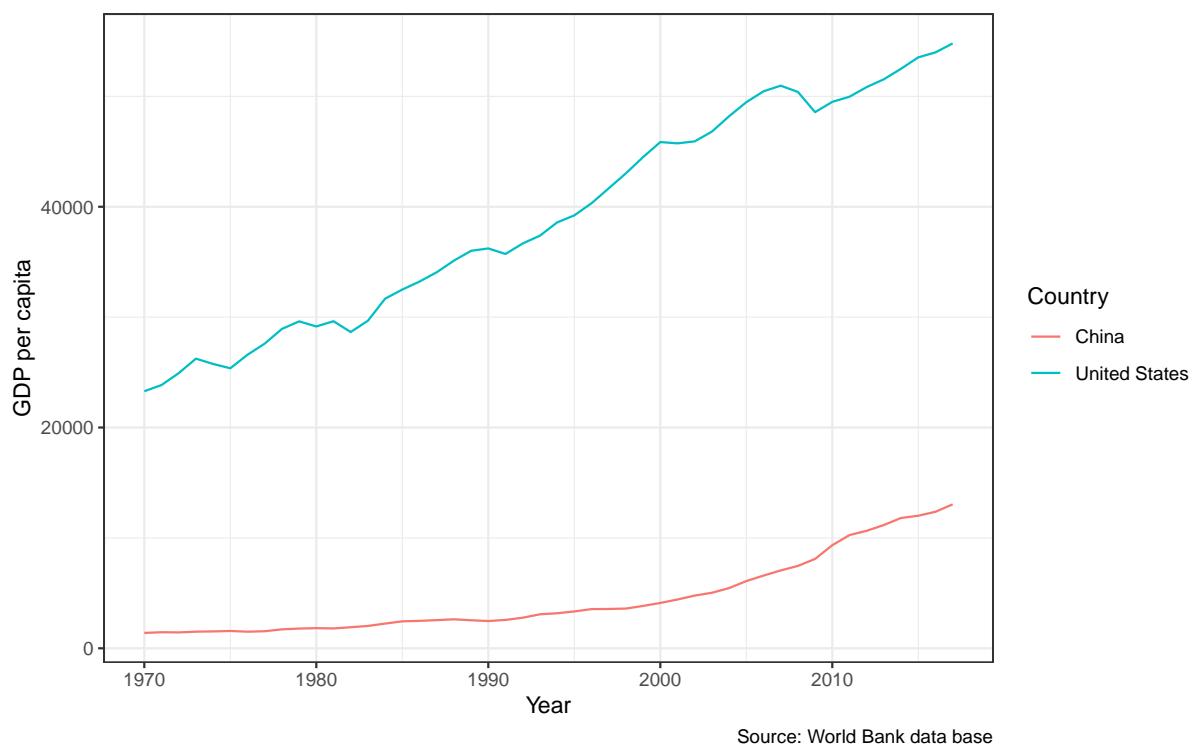


Figure 1: Trends in GDP per capita

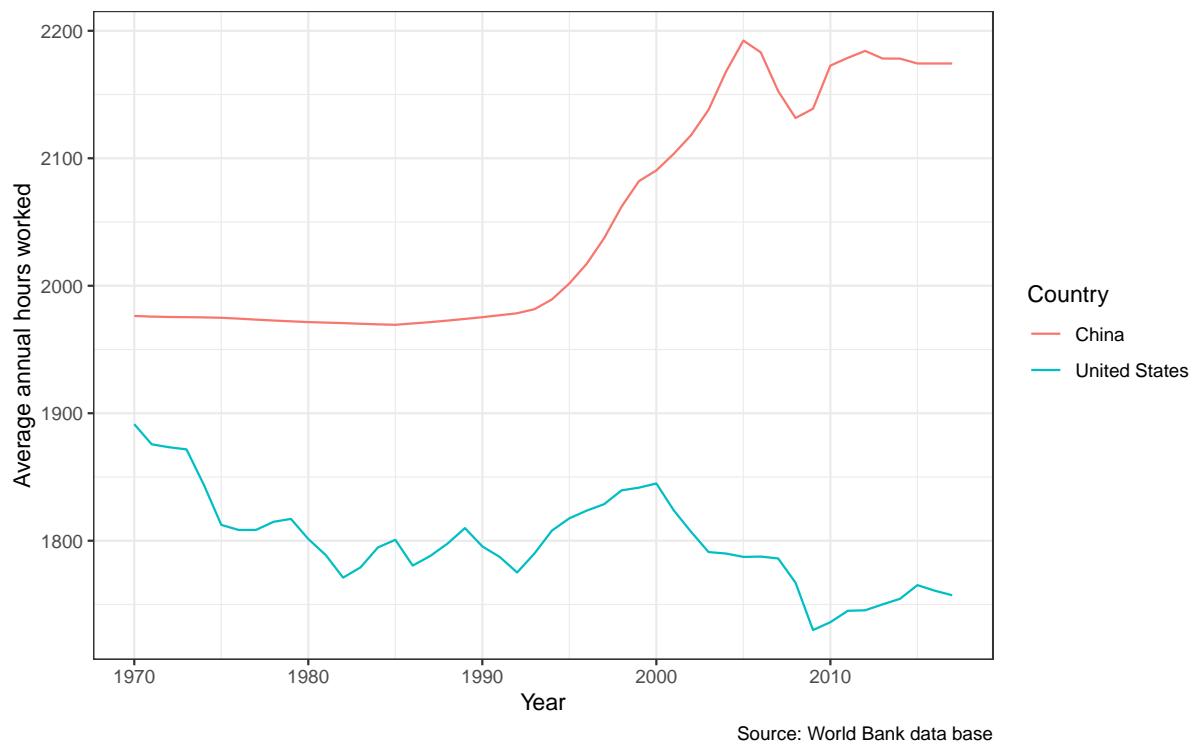


Figure 2: Trends in average annual hours worked

0.5 The relationship between average annual hours worked and GDP

```
data %>%
  filter(Country=="China")%>%
  ggplot(mapping = aes(x = Average.annual.hours.worked,
                        y=GDP.per.capita))+ 
  geom_point() +
  stat_smooth(method=lm) +
  labs(x ="Average annual hours worked",
       y ="GDP per capita",
       caption = "Source: World Bank data base")+
  theme_bw()
```

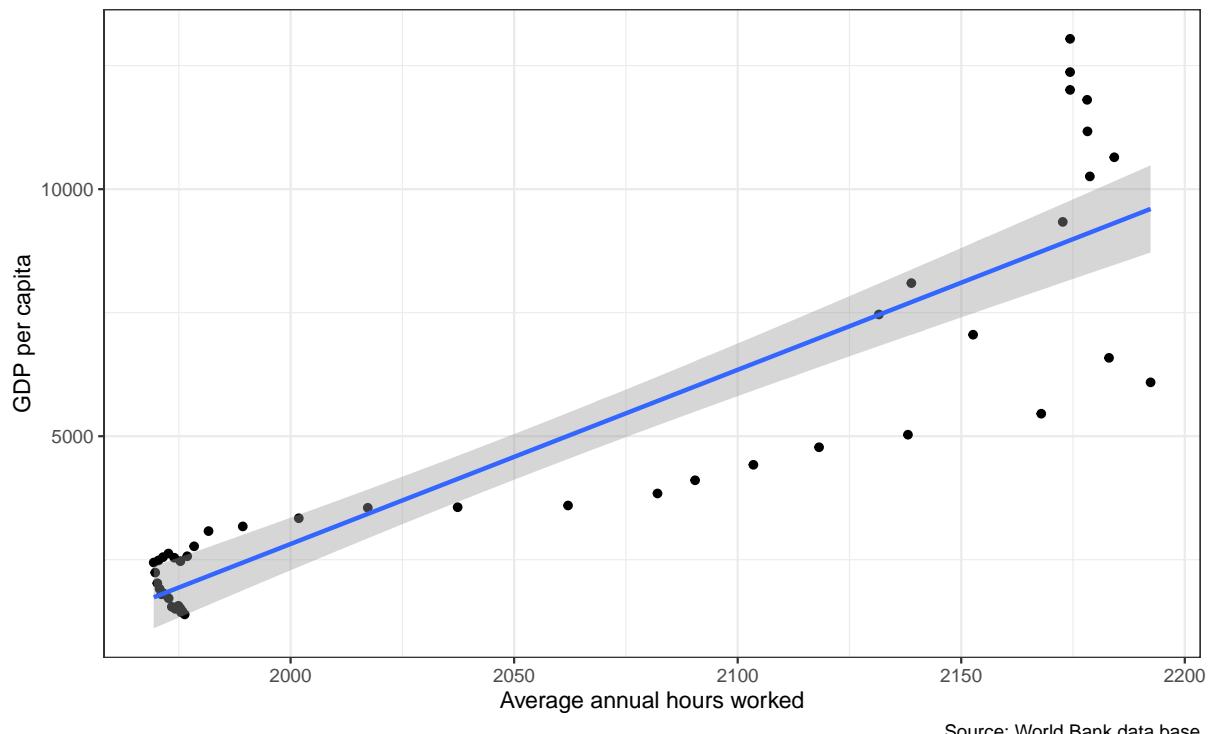
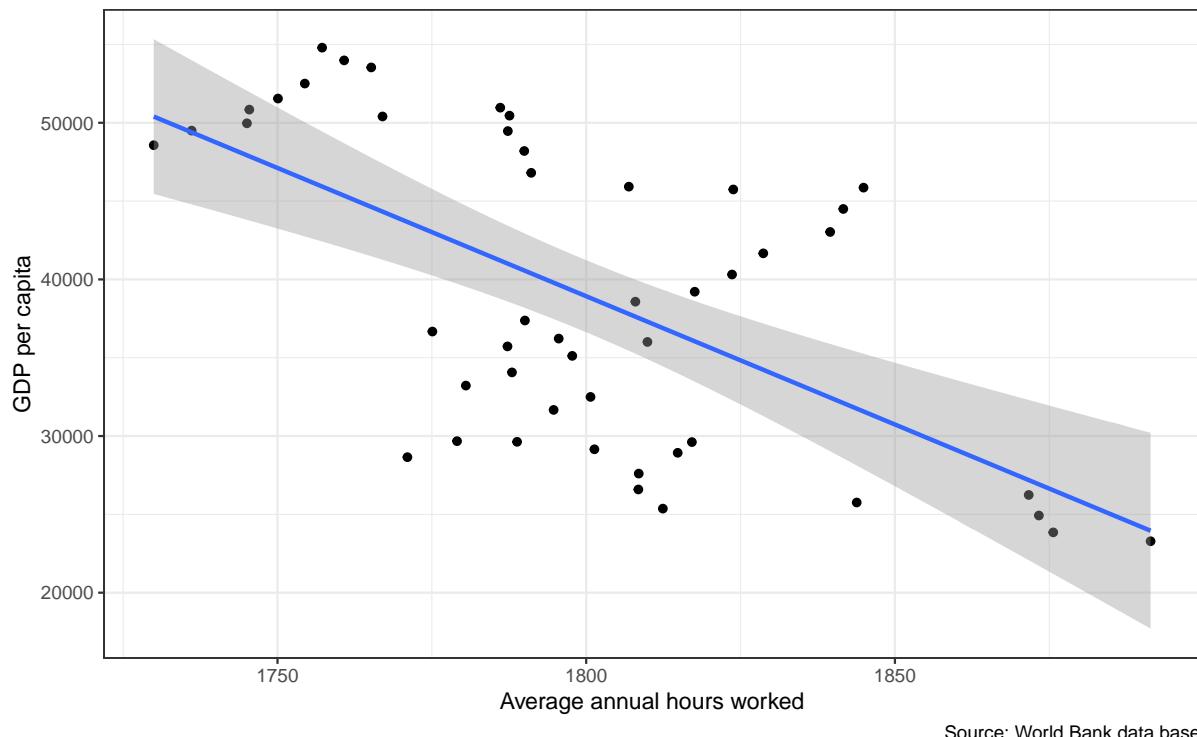


Figure 3: Relationship between average annual hours worked and GDP (China)

```
data %>%
  filter(Country=="United States")%>%
  ggplot(mapping = aes(x = Average.annual.hours.worked,
                        y=GDP.per.capita))+
```

```

geom_point() +
stat_smooth(method=lm) +
labs(x = "Average annual hours worked",
y = "GDP per capita",
caption = "Source: World Bank data base") +
theme_bw()
    
```



Source: World Bank data base

Figure 4: Relationship between average annual hours worked and GDP (United States)

0.6 Conclusion

In this section, I analyzed data from China and the United States. First, I filtered out the data for these two countries from 1970 to 2017. Then I performed an overall descriptive statistical analysis of the primary variables (Average.annual.hours.worked, GDPper.capita and Population).

As shown in Table11, the mean or median population in China is significantly larger than in the United States. But in GDP per capita, China is significantly less than the United States. And the average annual hours worked is slightly higher in China than in the United States.

The trends of GDP in China and USA in Figure1 shows that GDP per capita in both China and the U.S. is rising year by year, but the upward trend is more obvious in the United States. And for the

average annual hours worked shown in Figure2, I found a clear upward trend of average annual hours worked in China, while the United States has fluctuated but declined slightly overall.

Finally, I compared the relationship between average annual hours worked and GDP per capita in China and the United States. In China, the two variables showed a negative correlation in Figure3, while in the United States of Figure4, average annual hours worked decreases as GDP per capita rises.

0.7 Reference

[1] Wickham H, Averick M, Bryan J, et al. Welcome to the Tidyverse[J]. Journal of open source software, 2019, 4(43): 1686.

[2] Wickham H, Chang W, Wickham M H. Package ‘ggplot2’[J]. Create elegant data visualisations using the grammar of graphics. Version, 2016, 2(1): 1-189.