Computer Assignment 2: France (Group 12)

Javier Torralba Flores (ANR u146430, SNR 2042878)
Maximilian Grotz (ANR u271366, SNR 2056313)
Abdirahman Nuur (ANR u824009 , SNR 2057152)
Mathieu Van de Vel (ANR u130770, SNR 2050053)

01/05/2021

Q1: Data Preparation

We will be using the GDP and investment data in euro, as this was the best data we found and transforming it using the exchange rate would lead to high fluctuations. The sources for all the data are given in the references at the end of this document.

All working files can be found on GitHub (link here).

On the next two pages you may find the tables with our quarterly and annual data. After those, the code to import, clean and prepare the data for analysis will be visible.

Table 1: Quarterly Data for France

Date	Current Account Balance (as % of GDP)	Interest Rate (in %)	Exchange Rate €/USD	GDP (millions of €)	Investment (millions of €)	Investment rate (as % of GDP)
1999-Q1	4.3844	3.9442	0.8925	344117	70478	20.4808
1999-Q2	4.8480	4.2036	0.9463	347464	72075	20.7432
1999-Q3	2.2296	5.0046	0.9530	351727	73845	20.9950
1999-Q4	2.2150	5.2828	0.9645	356592	74774	20.9691
2000-Q1	1.5850	5.5710	1.0143	362660	76970	21.2237
2000-Q2	1.9327	5.3864	1.0713	367789	78600	21.3709
2000-Q3	0.3161	5.3928	1.1059	372166	80714	21.6876
2000-Q4	0.5900	5.2277	1.1518	376980	82060	21.7677
2001-Q1	1.7772	4.9031	1.0846	380845	82467	21.6537
2001-Q2	1.2125	5.1190	1.1447	383539	82632	21.5446
2001-Q3	1.3897	5.0156	1.1226	386507	83310	21.5546
2001-Q4	1.9134	4.7202	1.1171	388555	82894	21.3339
2002-Q1	1.4909	5.0546	1.1402	392514	82625	21.0502
2002-Q2	1.1986	5.2034	1.0887	395640	82682	20.8983
2002-Q3	0.8124	4.6969	1.0161	399012	83542	20.9372
2002-Q4	1.0951	4.4900	0.9997	401288	84117	20.9618
2003-Q1	0.9023	4.1114	0.9317	403234	84730	21.0126
2003-Q2	0.3858	3.9360	0.8806	404603	85027	21.0149
2003-Q3	0.7657	4.1337	0.8878	409627	86474	21.1104
2003-Q4	1.2776	4.3424	0.8389	414298	87009	21.0015
2004-Q1	1.1807	4.1059	0.8001	419847	88890	21.1720
2004-Q2	0.4774	4.3066	0.8301	423647	90435	21.3468
2004-Q3	0.3557	4.1589	0.8179	426215	91196	21.3967
2004-Q4	0.1348	3.8253	0.7698	431768	92734	21.4777
2005-Q1	0.2788	3.6419	0.7626	435001	93764	21.5549
2005-Q2	-0.1391	3.3738	0.7942	438435	95310	21.7387
2005-Q3	0.3456	3.2335	0.8200	441972	96752	21.8910
2005-Q4	-0.0657	3.3886	0.8410	448518	98537	21.9695
2006-Q1	0.1408	3.5125	0.8311	453785	100428	22.1312
2006-Q2	-0.3137	3.9870	0.7951	460637	103263	22.4174
2006-Q3	0.5671	3.8974	0.7849	463892	104645	22.5581
2006-Q4	0.6060	3.7861	0.7753	471205	107074	22.7234
2007-Q1	0.6308	4.0541	0.7628	477008	109163	22.8849
2007-Q2	-0.1653	4.3879	0.7416	483601	111688	23.0951
2007-Q3	-0.3438	4.4428	0.7274	488760	113982	23.3206
2007-Q4	-0.5084	4.3280	0.6905	493210	115657	23.4498
2008-Q1	-0.6819	4.0829	0.6664	499044	118276	23.7005
2008-Q2	-1.0177	4.4698	0.6400	499558	119017	23.8245
2008-Q3	-0.7171	4.4847	0.6653	498729	118548	23.7700
2008-Q4	-0.3666	3.8999	0.7575	493593	113934	23.0826
2009-Q1	-0.9334	3.6424	0.7672	484599	108793	22.4501
2009-Q2	-1.0537	3.7878	0.7343	482344	106466	22.0726
2009-Q3	-0.1551	3.6357	0.6991	482260	105505	21.8772
2009-Q4	-0.0606	3.5294	0.6774	487648	106705	21.8816
2010-Q1	-1.0327	3.4837	0.7235	491370	107600	21.8980
2010-Q2	-1.1858	3.1835	0.7849	495993	109348	22.0463
2010-Q3	-0.4468	2.7816	0.7729	501089	110992	22.1502
2010-Q4	0.1287	3.0192	0.7360	505200	112330	22.2348
2011-Q1	-1.6412	3.5519	0.7300	511232	113312	22.1645
2011-Q2	-1.8491	3.5366	0.6945	512641	114766	22.3872
2011-Q3	-0.6333	3.0094	0.7081	515339	115532	22.4186
2011-Q4	0.6644	3.1863	0.7421	518136	117550	22.6871
2012-Q1	-0.9644	3.0499	0.7621	520378	117693	22.6168
2012-Q2	-1.6003	2.7716	0.7791	521185	117224	22.4918
2012-Q3	-0.9006	2.2106	0.7995	523736	117272	22.3914
2012-Q4	-0.3964	2.1119	0.7706	523834	117130	22.3601
2013-Q1	-0.2135	2.1603	0.7578	525342	116349	22.1473
2013-Q2	-0.5737	1.9621	0.7654	529783	116589	22.0069
2013-Q3	-1.1343	2.3650	0.7546	530170	116656	22.0035
2013-Q4	-0.1168	2.3300	0.7342	532841	117668	22.0831
2014-Q1	-0.7892	2.2629	0.7297	535238	117833	22.0151
2014-Q2	-2.0642	1.8587	0.7291	535848	117277	21.8862
2014-Q3	-0.7180	1.4387	0.7547	538574	117483	21.8137
2014-Q4	-0.2588	1.1055	0.8002	541699	116961	21.5915
2015-Q1	0.1386	0.5934	0.8892	546839	117750	21.5328
2015-Q2	-0.0859	0.8398	0.9035	547600	116790	21.3276
2015-Q3	-0.4265	1.0411	0.8994	551067	118151	21.4404
2015-Q4	-1.0907	0.8932	0.9129	552787	119934	21.6962
2016-Q1	-0.6819	0.6481	0.9062	557860	121077	21.7038
2016-Q2	-0.3702	0.4712	0.8853	555959	120940	21.7534
2016-Q3	-0.6182	0.1695	0.8958	557486	121575	21.8077
2016-Q4	-0.2777	0.5827	0.9277	561128	123171	21.9506
2017-Q1	-1.6937	0.9718	0.9380	567132	126956	22.3856
2017-Q2	-0.7552	0.7845	0.9084	572562	128451	22.4344
2017-Q3	-0.0253	0.7485	0.8507	576959	130098	22.5489
2017-Q4	-0.6077	0.7346	0.8491	581934	131790	22.6469
2018-Q1	-1.3809	0.8920	0.8137	585024	132470	22.6435
2018-Q2	-0.4898	0.7711	0.8388	587880	134223	22.8317
2018-Q3	0.2059	0.7119	0.8599	592206	136528	23.0541
2018-Q4	-0.5818	0.7614	0.8761	597300	138123	23.1246
2019-Q1	-1.6098	0.5441	0.8808	602638	140292	23.2796
2019-Q2	1.3553	0.2518	0.8899	605984	143004	23.5986
2019-Q3	-1.1091	-0.2279	0.8992	608584	144970	23.8209
2019-Q4	-1.3020	-0.0472	0.9030	609740	145772	23.9072
2020-Q1	-2.6078	-0.0809	0.9073	580233	131148	22.6026
2020-Q2	-0.8781	-0.0054	0.9078	515406	111945	21.7198
2020-Q3	-2.9307	-0.1754	0.8548	593490	138276	23.2988
2020-Q4	NA	-0.3193	0.8385	588053	140339	23.8650

Table 2: Annual Data for France

Year	General Government Debt (as % of GDP)	Gross National Savings (as % of GDP)
1999	74.0152	24.4935
2000	72.4292	23.8347
2001	71.4731	23.9391
2002	75.1616	22.7448
2003	79.0776	22.2346
2004	80.5495	22.5492
2005	82.1422	22.4634
2006	77.2693	23.3063
2007	75.9418	23.7466
2008	82.5035	23.4340
2009	97.5731	20.9645
2010	100.9953	21.0843
2011	103.8066	22.1130
2012	111.9382	21.4558
2013	112.4676	21.3892
2014	120.1551	21.4860
2015	120.8252	22.2540
2016	123.6707	22.0046
2017	122.9442	22.7529
2018	121.3599	23.0591
2019	123.9643	23.3952

```r
# Here we import all relevant packages and set options

library(dplyr)
library(tidyverse)
library(lubridate) # This package is used for working with dates
library(knitr) # This package is for nice tables
library(kableExtra) # Package for even nicer tables.

options(scipen = 999) # Disable scientific notation
```

```r
# Importing the Current Account Balance as a % of GDP of France
# SOURCE: FRED https://fred.stlouisfed.org/series/FRAB6BLTT02STSAQ

CABalance_FR <- read_csv("sourcecode/FRED_bop_france_quarterly.csv",
    col_types = cols(DATE = col_date(format = "%d/%m/%Y"),
        FRAB6BLTT02STSAQ = col_number())) %>%
  mutate(FRAB6BLTT02STSAQ = FRAB6BLTT02STSAQ /100) %>%
  rename(date = DATE, CAasPercGDP_quart_FR = FRAB6BLTT02STSAQ)


# Importing the General Government Debt as a % of GDP.
# THIS IS NOT IN PERCENT! GOVERNMENT DEBT OF 100%  -> 1
# SOURCE: OECD https://data.oecd.org/gga/general-government-debt.htm

GovDebt_FR <- read_csv("sourcecode/OECD_gov_debt_annual.csv",
    col_types = cols(LOCATION = col_character(),
        INDICATOR = col_skip(), SUBJECT = col_skip(),
        MEASURE = col_skip(), FREQUENCY = col_skip(),
        TIME = col_date(format = "%Y"), Value = col_number(),
        `Flag Codes` = col_skip())) %>%
  rename(date = TIME) %>%
  filter(LOCATION == "FRA") %>%
  mutate(LOCATION = NULL, GovDebt_ann_FR = Value / 100, Value = NULL)


# This function transform dates
# from a quarterly format of "2000-Q1" to 2000-01-01
QuarterToDate <- function(QuarterlyDate){

  NumberofQuarter <- substr(QuarterlyDate, 7, 7)

  Month <- 3 * as.numeric(NumberofQuarter) - 2
  Month <- ifelse(Month == 10, Month, paste(0, Month))

  Year <- substr(QuarterlyDate, 1, 4)

  Date_String <- paste(Year, "-", Month, "-01") %>%
    str_replace_all(" ", "")

  Date <- as.Date(Date_String)

  Date
}
```

```
# Importing Interest Rate on Government Bonds (10 year),
# also called "Long term interest rate", in %/annum
# SOURCE: OECD https://data.oecd.org/interest/long-term-interest-rates.htm

IntRate_FR <- read_csv("sourcecode/OECD_interest_rates_france_quarterly.csv",
    col_types = cols(INDICATOR = col_skip(),
        SUBJECT = col_skip(), MEASURE = col_skip(),
        FREQUENCY = col_skip(), Value = col_number(),
        `Flag Codes` = col_skip())) %>%
  mutate(date = QuarterToDate(TIME),
         IntRate_quart_FR = Value / 100,
         Value = NULL, TIME = NULL, LOCATION = NULL)


# Exchange rate against the US dollar
# SOURCE: FRED https://fred.stlouisfed.org/series/DEXUSEU

XR_EurUSD <- read_csv("sourcecode/FRED_exchage_rate_quarterly.csv",
    col_types = cols(DATE = col_date(format = "%d/%m/%Y"),
        DEXUSEU = col_number())) %>%
  rename(date = DATE, XR_quart_EurUSD = DEXUSEU) %>%
  mutate(XR_quart_EurUSD = 1/XR_quart_EurUSD)


# Total GDP, in millions of euro
# SOURCE: FRED https://fred.stlouisfed.org/series/CPMNACSCAB1GQFR

GDP_FR <- read_csv("sourcecode/FRED_euros_france_gdp_quarterly.csv",
    col_types = cols(DATE = col_date(format = "%d/%m/%Y"),
        CPMNACSCAB1GQFR = col_number())) %>%
  mutate(date = DATE, GDP_quart_Millionseur_FR = CPMNACSCAB1GQFR,
         CPMNACSCAB1GQFR = NULL, DATE = NULL)


# Investment (usually Gross Fixed Capital Formation), in millions of euro
# SOURCE: FRED https://fred.stlouisfed.org/series/FRAGFCFQDSMEI#0

Invest_FR <- read_csv("sourcecode/FRED_euros_investments_quarterly.csv",
    col_types = cols(DATE = col_date(format = "%d/%m/%Y"),
        FRAGFCFQDSMEI = col_number())) %>%
  mutate(Invest_quart_Millionseur_FR = FRAGFCFQDSMEI / 1000000,
         FRAGFCFQDSMEI = NULL) %>%
  rename(date = DATE)


# Gross national savings as a % of GDP (savings rate).
# Again, this is in decimals, and not percent!
# SOURCE: World Bank https://data.worldbank.org/indicator/NY.GNS.ICTR.ZS

SavingsR_FR <- read_csv("sourcecode/WorldBank_GrossSavings_annual.csv",
    col_types = cols(`Country Code` = col_skip(),
        `Indicator Name` = col_character(),
        `Indicator Code` = col_skip()), skip = 3) %>%
```

```
  filter(`Country Name` == "France") %>%
  pivot_longer(cols = -c(`Country Name`, `Indicator Name`),
               names_to = "date",
               values_to = "Savings_PercentageGDP") %>%
  mutate(`Country Name` = NULL,
         `Indicator Name` = NULL,
         date = as.Date(paste(date, "-01-01", sep = "")),
         SavR_ann_FR = Savings_PercentageGDP / 100,
         Savings_PercentageGDP = NULL) %>%
  filter(date >= "1999-01-01", "2019-01-01" >= date)


# Merging them all together

DF_FR <- CABalance_FR %>%
  full_join(IntRate_FR, by = "date") %>%
  full_join(XR_EurUSD, by = "date") %>%
  full_join(GDP_FR, by = "date") %>%
  full_join(Invest_FR, by = "date") %>%
  full_join(GovDebt_FR, by = "date") %>%
  full_join(SavingsR_FR, by = "date") %>%
  filter(date != "1998-10-01") %>%
  mutate(InvestmentR_Fr = Invest_quart_Millionseur_FR/GDP_quart_Millionseur_FR)


# Creating and printing a table with all the quarterly data

DF_quart_FR <- DF_FR %>%
  select(!c(GovDebt_ann_FR, SavR_ann_FR)) %>%
  mutate(date = paste(as.character(year(date)), "-Q",
                      as.character(quarter(date)), sep = ""),
         InvestmentR_Fr = InvestmentR_Fr * 100,
         CAasPercGDP_quart_FR = CAasPercGDP_quart_FR * 100,
         IntRate_quart_FR = IntRate_quart_FR * 100) %>%
  rename(`Current Account Balance (as % of GDP)` = CAasPercGDP_quart_FR,
          `Interest Rate (in %)` = IntRate_quart_FR,
          `Exchange Rate €/USD` = XR_quart_EurUSD,
          `GDP (millions of €)` = GDP_quart_Millionseur_FR,
          `Investment (millions of €)` = Invest_quart_Millionseur_FR,
          `Investment rate (as % of GDP)` = InvestmentR_Fr,
         `Date` = date
          )

table_quart_FR <- DF_quart_FR %>%
  kbl(caption = "Quarterly Data for France", booktabs = T,
      linesep = "", digits = 4) %>%
  kable_styling(latex_options = c("striped", "scale_down"))
```

For the resulting table, see page 2

```r
# Creating and printing a table with all the annual data

DF_ann_FR <- DF_FR %>%
  select(c(date, GovDebt_ann_FR, SavR_ann_FR)) %>%
  mutate(date = format(as.Date(date), "%Y"),
         GovDebt_ann_FR = GovDebt_ann_FR * 100,
         SavR_ann_FR = SavR_ann_FR * 100) %>%
  na.omit() %>%
  rename(`General Government Debt (as % of GDP)` = GovDebt_ann_FR,
         `Gross National Savings (as % of GDP)` = SavR_ann_FR,
         `Year` = date)

table_ann_FR <- DF_ann_FR %>%
  kbl(caption = "Annual Data for France", booktabs = T,
      linesep = "", digits = 4) %>%
  kable_styling(latex_options = c("striped", "hold_position"))
```

For the resulting table, see page 3.

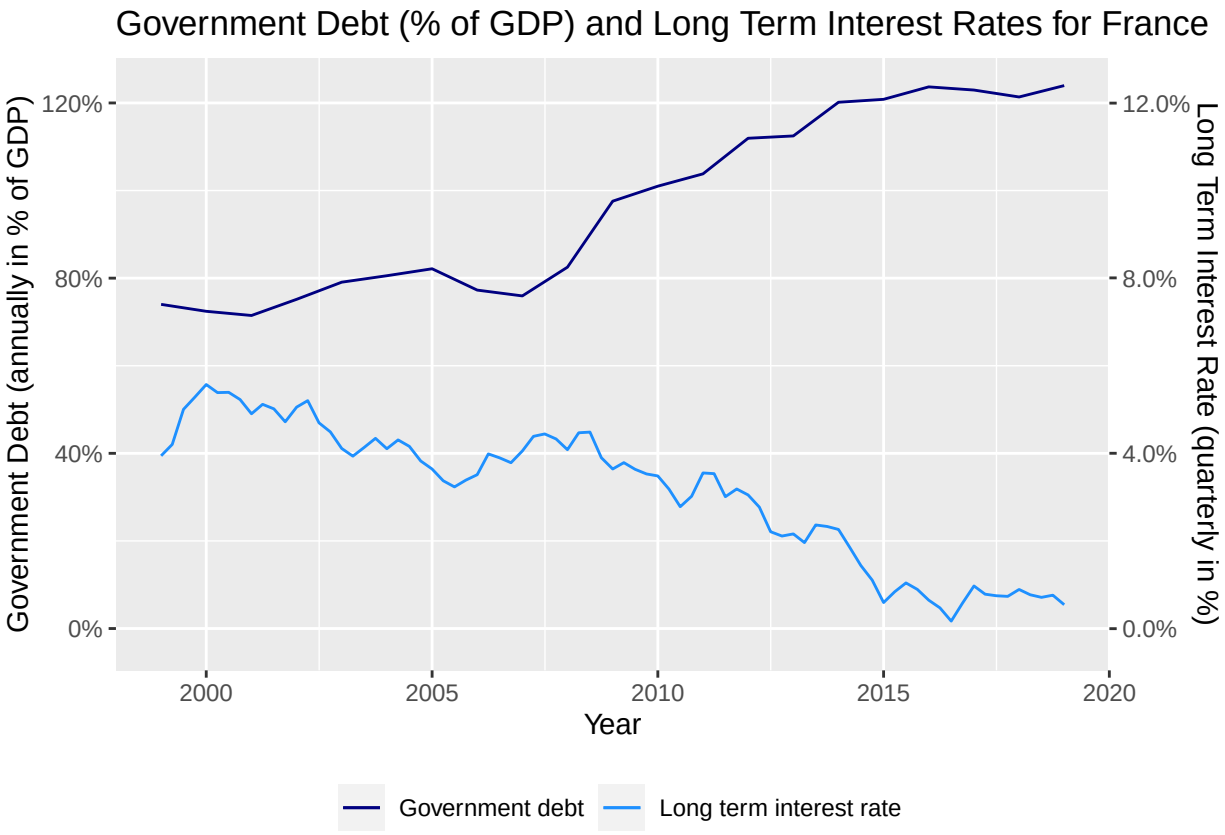
Q2: Government debt, interest rate, current account and the exchange rate

1. Government debt and interest rate

```
#Creating plot for Gov Debt & Interest Rate v Time
#Omitting NA first
DF_FR_NA <- DF_FR %>%
  na.omit


colors1 <- c("Government debt" = "navyblue",
             "Long term interest rate" = "dodgerblue1")


ggplot() +
  geom_line(DF_FR_NA,
            mapping = aes(x = date,
                          y = GovDebt_ann_FR,
                          color = "Government debt")) +
  geom_line(DF_FR,
            mapping = aes(x = date, y = IntRate_quart_FR*10,
                          color = "Long term interest rate")) +
  scale_y_continuous(labels = scales::percent,
                     name = "Government Debt (annually in % of GDP)",
                     sec.axis = sec_axis(~ . /10,
                                         name = paste("Long Term Interest",
                                                      "Rate (quarterly in %)"),
                                         labels = scales::percent)) +
  labs(x = "Year",
       title = "Government Debt (% of GDP) and Long Term Interest Rates for France",
       color = "") +
  scale_color_manual(values = colors1) +
  theme(legend.position="bottom") +
  scale_x_date(limits = c(as.Date("1999-01-01"), as.Date("2019-01-01")))
```

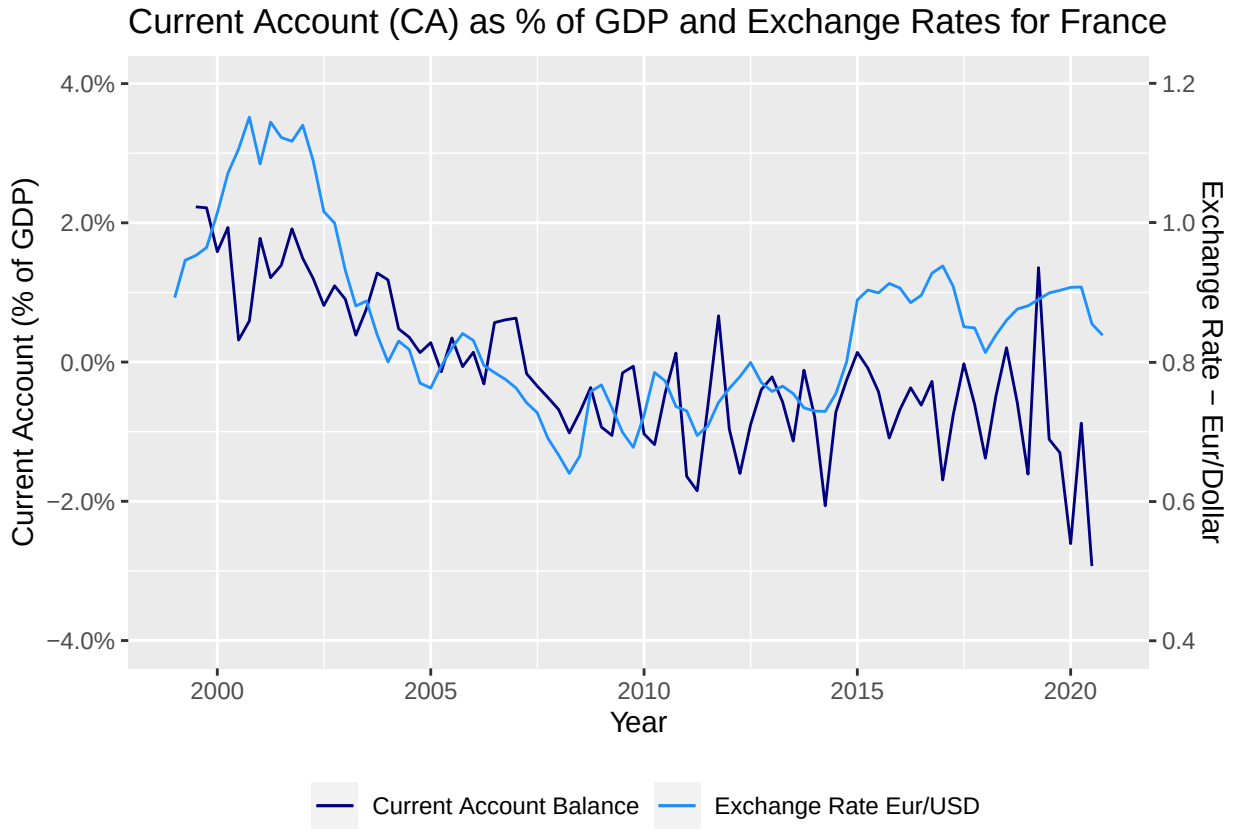


Government debt has been rising steadily, while long term interest rates have decreased. Hence, they move against each other. This might be because, during recessions, low interest rates and expansionary fiscal policy (causing government debt) are used as economic stimuli. Low interest rates also decrease the borrowing costs for governments.

2. Current account and the exchange rate

```
# Plotting Current Account and Exchange Rates with different y-axes
colors2 <- c("Current Account Balance" = "navyblue",
             "Exchange Rate Eur/USD" = "dodgerblue1")


ggplot() +
  geom_line(DF_FR,
            mapping = aes(x = date,
                          y = CAasPercGDP_quart_FR,
                          color = "Current Account Balance")) +
  geom_line(DF_FR,
            mapping = aes(x = date,
                          y = (XR_quart_EurUSD - 0.8) / 10,
                          color = "Exchange Rate Eur/USD")) +
  scale_y_continuous(labels = scales::percent,
                     limits = c(-.04, 0.04),
                     sec.axis = sec_axis(~ . *10 +.8,
                                         name = "Exchange Rate - Eur/Dollar")) +
  labs(x = "Year",
       y = "Current Account (% of GDP)",
       title = paste("Current Account (CA) as % of GDP",
                     "and Exchange Rates for France"),
       color = "") +
  scale_color_manual(values = colors2) +
  theme(legend.position="bottom")
```



The current account and the exchange rate have both decreased, seemingly moving together (deviations might occur because of e.g. changes in exchange rate expectations). Assuming relative price levels to be stable, if the euro appreciates, imports will get more expensive, while exports become less competitive abroad, worsening the current account.

3. Relevant events and policy responses

The euro appreciated steadily during the 2000s as it established itself as an international currency (Maggiori, Brent, & Schreger, 2019). This might, combined with France's competitive weaknesses (International Monetary Fund. European Dept., 2013), have driven the deterioration of its current account. During the Great Recession government debt increased. Interest rates have declined due to a fall in both inflation expectations and the real interest rate (Claeys & Efstathiou, 2017). The latter and the sudden depreciation of the euro in 2015 were partially caused by the ECB's quantitative easing program (Dedola, Georgiadis, Gräb, & Mehl, 2020).

4. Currency union and its effects

As France is a euro area country, it only has limited influence on its exchange rate and its monetary policy. To increase its real exchange rate it would need to decrease its price levels. France can reduce its current account deficit through contractionary fiscal policy, potentially disrupting its internal balance.

Q3: Investment rate and the Feldstein-Horioka puzzle

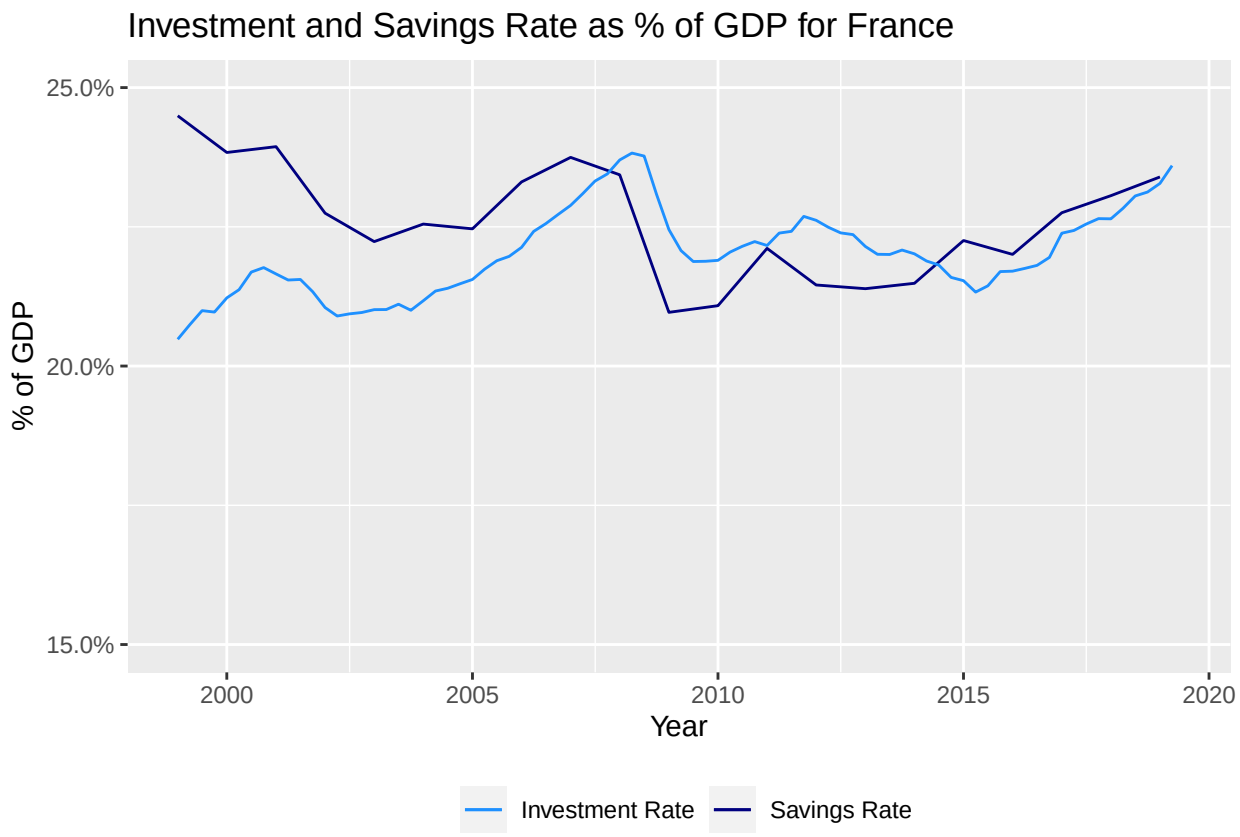
1. Investment rate

See table "Quarterly data for France" in question 1 on page 2.

2. Investment rate: Graph

```
#Assinging colors to titles
colors3 <- c("Savings Rate" = "navyblue", "Investment Rate" = "dodgerblue1")

#Plotting graph
ggplot() +
  geom_line(DF_FR_NA,
            mapping = aes(x = date,
                          y = SavR_ann_FR,
                          color = "Savings Rate")) +
  geom_line(DF_FR,
            mapping = aes(x = date,
                          y = InvestmentR_Fr,
                          color = "Investment Rate")) +
  labs(x = "Year",
       y = "% of GDP",
       title = "Investment and Savings Rate as % of GDP for France",
       color = "") +
  scale_y_continuous(labels = scales::percent,
                     breaks = seq(0, 0.25, by = 0.05),
                     limits = c(0.15, 0.25)) +
  scale_color_manual(values = colors3) +
  theme(legend.position="bottom") +
  scale_x_date(limits = c(as.Date("1999-01-01"), as.Date("2019-06-01")))
```



3. Feldstein-Horioka puzzle

France's investments and savings rates correlate quite strongly. According to Feldstein and Horioka this does not indicate a smoothly working international capital market. The graph illustrates an increasing correlation, more specifically, we observe a stronger correlation after the 2008 financial crisis, perhaps due to a home bias on equity holdings.

References

Board of Governors of the Federal Reserve System (US). 2021. *U.S. / Euro Foreign Exchange Rate [DEXUSEU]*. Retrieved from FRED, Federal Reserve Bank of St. Louis: https://fred.stlouisfed.org/series/DEXUSEU

Claeys, G., & Efstathiou, K. (2017). Is the recent increase in long-term interest rates a threat to euro-area recovery? *Bruegel Policy Contribution* (2017/14). Retrieved from http://hdl.handle.net/10419/173110

Dedola, L., Georgiadis, G., Gräb, J., & Mehl, A. (2020, October 20). Does a big bazooka matter? Quantitative easing policies and exchange rates. *Research Bulletin*, 76. Retrieved from https://www.ecb.europa.eu/pub/economic-research/resbull/2020/html/ecb.rb201020~85fb68a983.en.html

Eurostat. (2021). *Gross Domestic Product for France [CPMNACSCAB1GQFR]*. Retrieved from FRED, Federal Reserve Bank of St. Louis: https://fred.stlouisfed.org/series/CPMNACSCAB1GQFR

International Monetary Fund. European Dept. (2013, August 5). France: Selected Issues paper. *IMF Staff Country Reports*, Volume 2013 (Issue 252), 4-14. doi:https://doi.org/10.5089/9781484389133.002

Maggiori, M., Brent, N., & Schreger, J. (2019, May). The Rise of the Dollar and Fall of the Euro as International Currencies. *AEA Papers and Proceedings*, 109, 521-526. doi:10.1257/pandp.20191007

Organization for Economic Co-operation and Development. (2021). *Balance of payments BPM6: Current account Balance: Total: Total Balance as % of GDP for France [FRAB6BLTT02STSAQ]*. Retrieved from FRED, Federal Reserve Bank of St. Louis: https://fred.stlouisfed.org/series/FRAB6BLTT02STSAQ

Organization for Economic Co-operation and Development. (2021). *General government debt*. Retrieved from OECD Data: https://data.oecd.org/gga/general-government-debt.htm

Organization for Economic Co-operation and Development. (2021). *Gross Fixed Capital Formation in France [FRAGFCFQDSMEI]*. Retrieved from FRED, Federal Reserve Bank of St. Louis: https://fred.stlouisfed.org/series/FRAGFCFQDSMEI

Organization for Economic Co-operation and Development. (2021). *Long-term interest rates (indicator)*. Retrieved from OECD Data: https://data.oecd.org/interest/long-term-interest-rates.htm

World Bank. (2021). *Gross savings (% of GDP)*. Retrieved from World Bank Open Data: https://data.worldbank.org/indicator/NY.GNS.ICTR.ZS