Applied Macroeconomics

Problem Set 5

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Problem 1

In the main lecture, you discussed the empirical estimation of the output-inflation tradeoff by Ball. Since the paper was published over 30 years ago, it is interesting to see if the results have changed and if they did how.

To obtain the "trade-off" parameter, estimate the following equation using OLS:

$$y_{i,t} = c + \gamma_{i,t} + \tau i \Delta x_{i,t} + \lambda_i y_{t-1}$$

where $y_{i,t}$ is log real GDP,$\gamma_{i,t}$ is a time trend, $Deltax_{i,t}$ is the change in log nominal GDP and $y_{i,t-1}$ is lagged log real GDP. i is the country indicator and t is the time indicator.

Getting the data, renaming the columns, removing the missing values, creating a balanced sample. Creating the logNominalGDP and logRealGDP columns. Finding the mean and std ofthe variables, preparing the data for the tasks.

```
df <- wb_data(c("NY.GDP.MKTP.CD","NY.GDP.MKTP.KD", "FP.CPI.TOTL.ZG")
              , start_date = 1960, end_date = 2018, freq="Y")
df <- df[c('country','date','FP.CPI.TOTL.ZG','NY.GDP.MKTP.CD','NY.GDP.MKTP.KD')]
names(df) <- c('country','year','inflation','nominalGDP','realGDP')
df <- na.omit(df)

countries = names(head(sort(table(df$country), decreasing = TRUE), 41))
df = subset(df, country %in% countries)
df$lognominalGDP <- log(df$nominalGDP)
df$logrealGDP <- log(df$realGDP)

df_average <- df %>% group_by(country) %>% summarise("inflation-mean" = mean(inflation),
                                      "inflation-std" = sd(inflation),
                                      "nominal-GDP-mean" = mean(nominalGDP),
                                      "nominal-GDP-std" = sd(nominalGDP),
                                      "real-GDP-mean" = mean(realGDP),
                                      "real-GDP-std" = sd(realGDP),
                                      )
```

Creating a for loop, in which we go through the data for every country and make a separate regression model, and find the values for the τ parameter.

```
tau_values = c()
for(one_country in countries){
  country_data <- filter(df, country == one_country)
  country_data <- country_data %>% arrange(desc(country_data$year))

  change_log_nominalGDP <- diff(country_data$lognominalGDP)
  change_log_nominalGDP = append(change_log_nominalGDP, 0)

  country_data$change_log_nominalGDP = change_log_nominalGDP

  model <- lm(logrealGDP ~ change_log_nominalGDP +  lag(logrealGDP, 1), data = country_data)

  tau_values<- c(tau_values , coefficients(model)[2][["change_log_nominalGDP"]])
  }

df_tau = data.frame(unlist(countries),unlist(tau_values))
names(df_tau) = c("country","tau")
```

1.a)

Give the economic interpretation of τ . What does it mean if τ is low or high?

τ is the output-inflation trade-off which refers to the relationship between the level of economic output (usually measured in GDP), and the rate of inflation. The trade-off is important regarded as a metric that is looked when considering macroeconomi policies, business cycles, long term growth, etc. When the output-inflation tradeoff is high, it means that a country is able to achieve higher levels of output without experiencing significant increases in inflation. When the output-inflation tradeoff is low, it means that a country experiences significant increases in inflation as it tries to achieve higher levels of output.

1.b)

Choose a subset of three countries and compare your results to those of Ball (1988). Did the parameter τ change under your period of study compared to that by Ball (1988)?

The 3 countries I chose were Austria, United Kingdom, and the United States.

Country	Time-frame	Trade-off value
Austria	1960-2019	-0.01316750
United Kingdom	1960-2019	-0.01204883
United States	1960-2019	-0.06360382

These are the values for the same country from the Bell (1988) paper.

Country	Time-frame	Trade-off value
Austria	1950-86	- 0.0196
United Kingdom	1948-86	-0.0199
United States	1948-86	0.6714

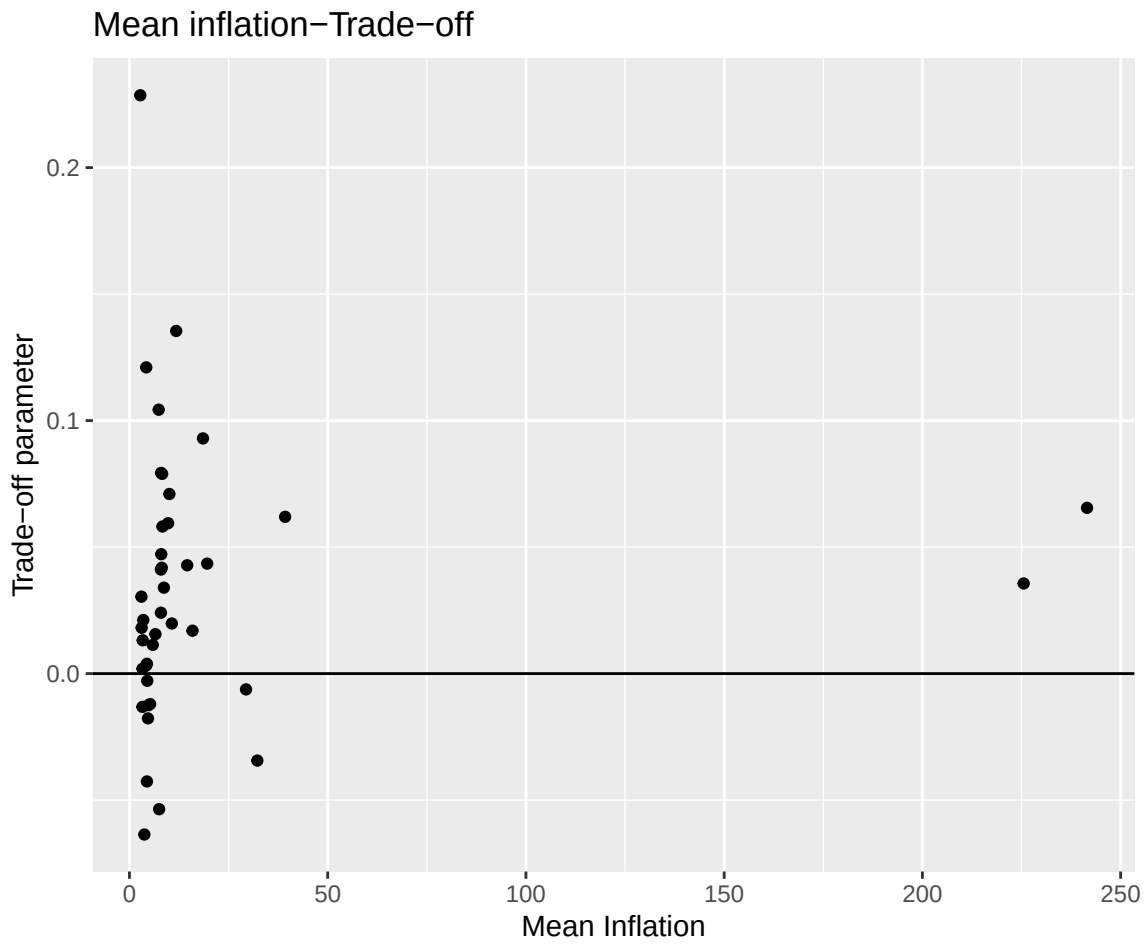
Comparing Austria and the United Kingdom, the value of the trade-off parameter didn't change much, but when comparing the US it changed drastically. We will find an explanation of sorts later on. It's important to note that the trade-off values are not comparable across countries, and also, the trade-off values can change over time, it can be affected by a complex interplay of various factors such as changes in expectations, productivity, monetary policy, and supply shocks.

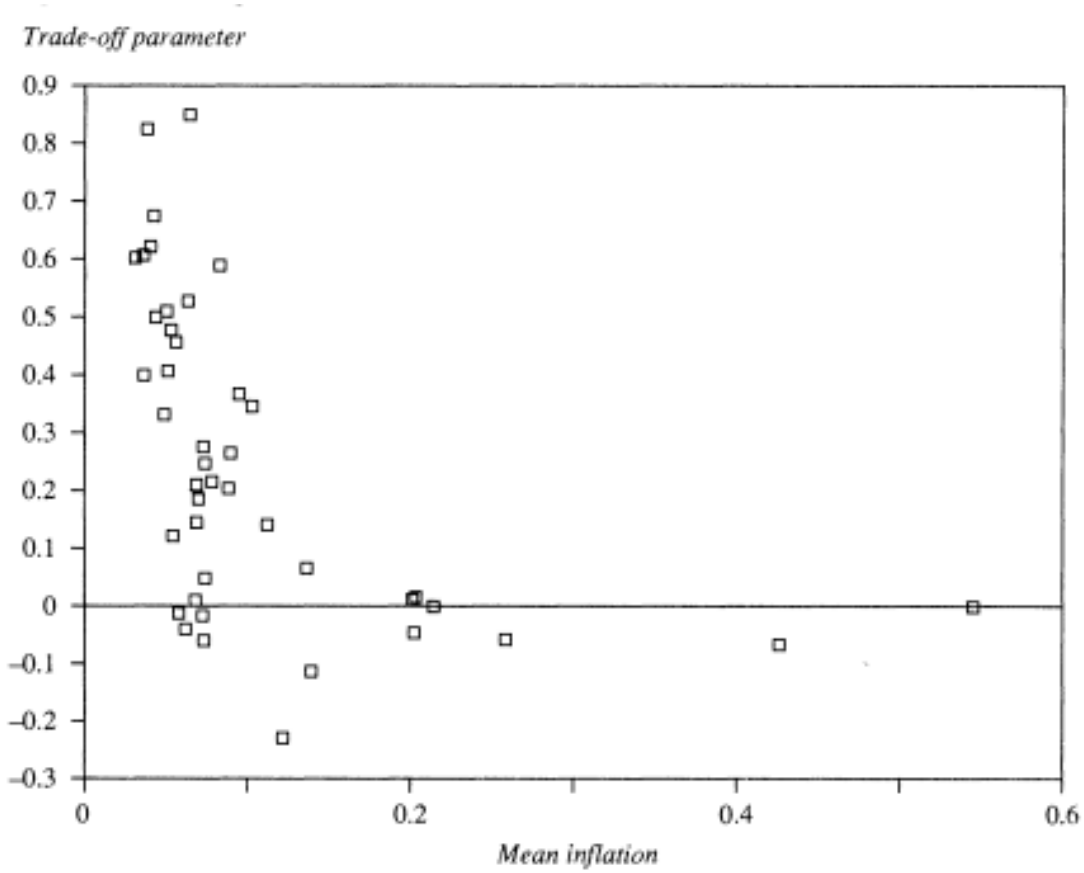
1.c)

Equivalent to Ball (1988) produce a scatterplot where τ is on the y-axis and mean inflation is on the x-axis. How does your graph compare to the one by Ball et al. (1988)?

```
new_df = data.frame(unlist(df_average$`inflation-mean`),unlist(df_tau$tau))
names(new_df) = c("inflation", "tau")

ggplot(new_df, aes(x = inflation , y = tau)) +
  geom_point() +
  ggtitle("Mean inflation-Trade-off")+
  geom_hline(yintercept = 0) +
  labs(x = "Mean Inflation", y = "Trade-off parameter")
```





They are very similar in the distributions of the points accross the plot, but I probably need to do some sorts of scaling, or take the inflation as the percent of change accros years.

1.d)

What are potential explanations for any cross-country differences in τ?

There are several potential explanations for cross-country differences in the output-inflation trade-off τ. Some of the most common explanations include:

Monetary policy: Different countries may have different monetary policies, which can affect the output-inflation trade-off. For example, a country with a more expansionary monetary policy may have a higher output-inflation trade-off than a country with a more contractionary monetary policy.

Productivity: Countries with higher productivity levels may be able to achieve higher levels of output without experiencing significant increases in inflation, leading to a higher output-inflation trade-off.

Supply shocks: Countries that are more exposed to supply shocks, such as changes in the price of oil, may have a lower output-inflation trade-off than countries that are less exposed to such shocks

Of course, there are plenty of other factors as well that can explai the difference between countries in the trade off coefficient. These include differences in labor market institutions, inflation expectations, the degree

of globalization, and demographic changes. These factors can also interact with each other, making it difficult to isolate the specific causes of cross-country differences in the output-inflation trade-off.

Problem 2

2.a)

Describe the Phillips curve and the relationship between its variables.

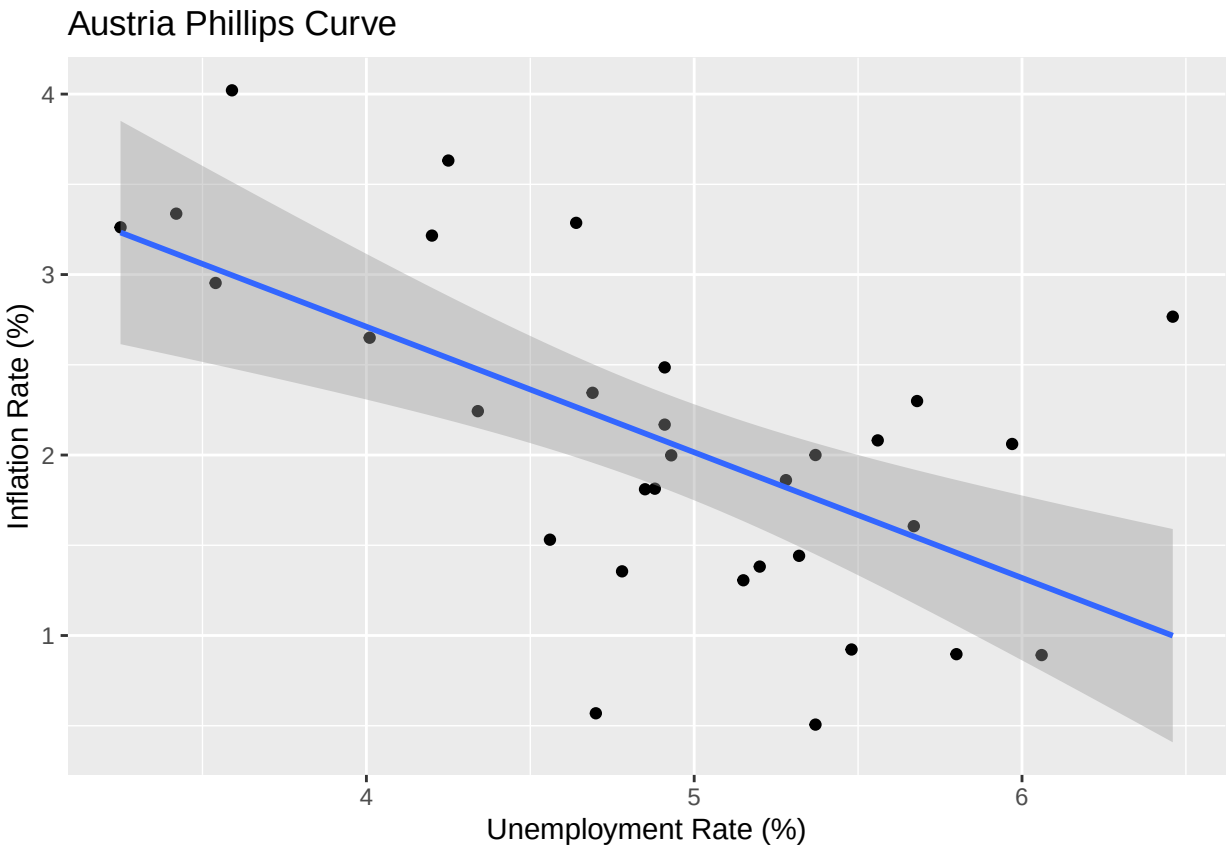
The Phillips curve is an economic concept that describes the relationship between the unemployment rate and the inflation rate. The basic idea behind the Phillips curve is that there is an inverse relationship between unemployment and inflation: when unemployment is low, inflation tends to be high, and when unemployment is high, inflation tends to be low. The Phillips curve is typically represented graphically, with the unemployment rate on the x-axis and the inflation rate on the y-axis. The curve slopes downward, indicating that as unemployment decreases, inflation increases. The relationship between unemployment and inflation described by the Phillips curve is not always stable. In the long-run, the Phillips curve can be vertical and this is known as the natural rate of unemployment, this means that unemployment and inflation are not related in the long-run. Additionally, the Phillips curve can shift due to factors such as changes in expectations, productivity and monetary policy.

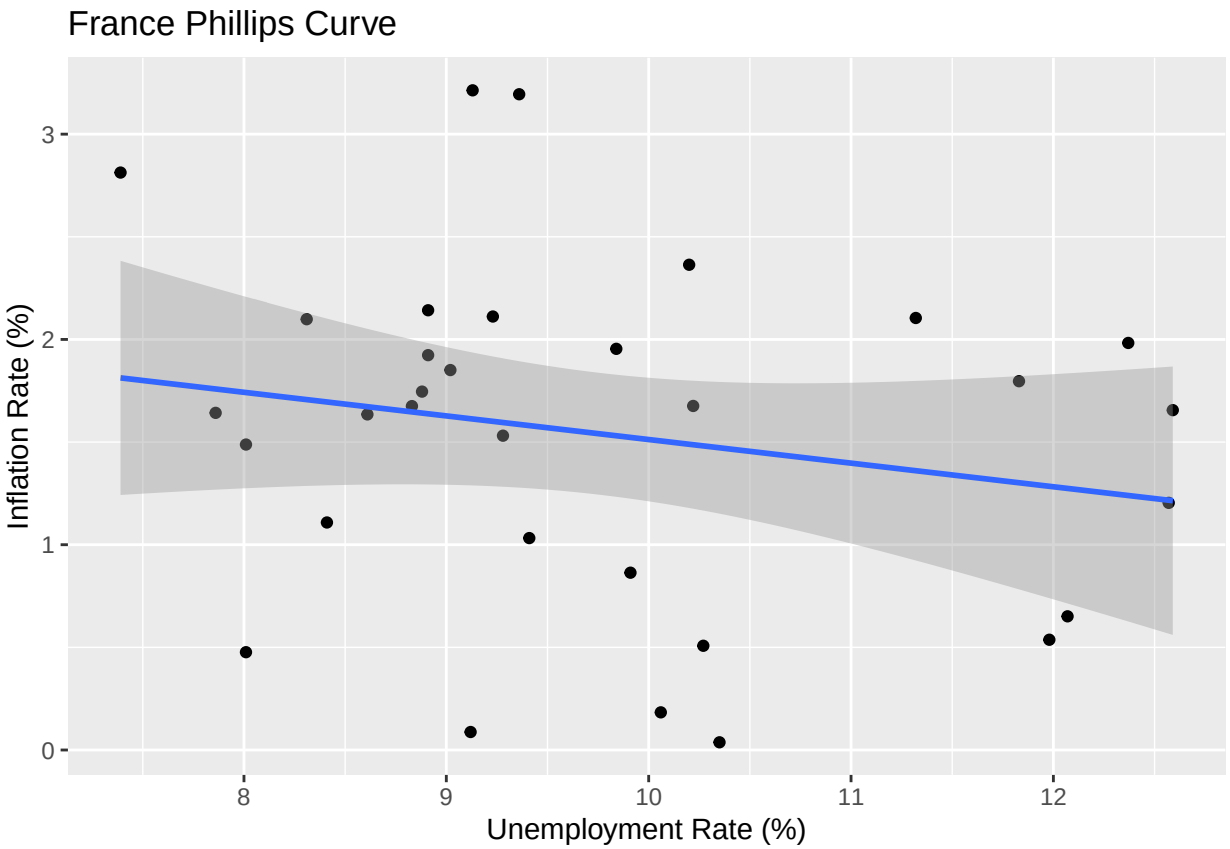
2.b)

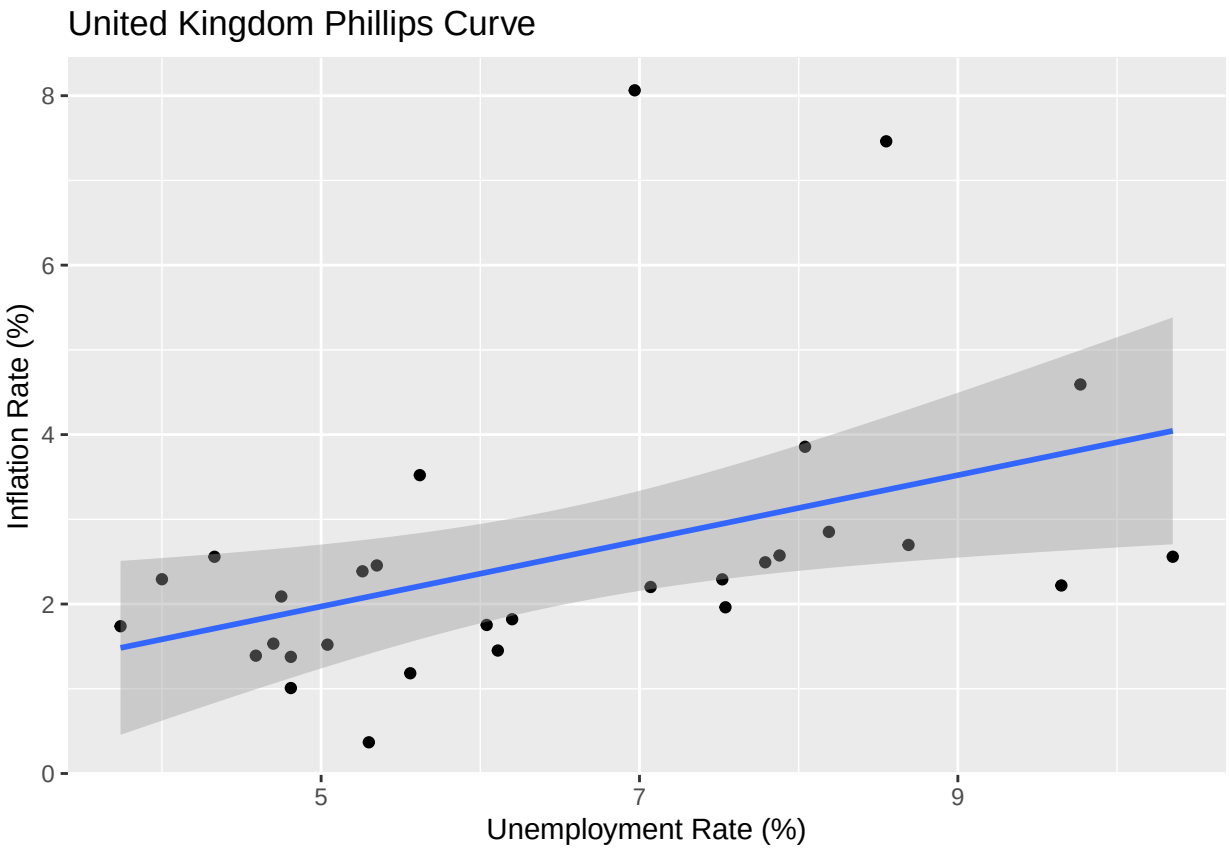
Plot the Phillips curves for Austria, France, the United Kingdom and the United States from 1990 until today. Plot the inflation rate on the y-axis and the unemployment rate on the x-axis.

Getting the appropriate data, storing them in separate data frames so we can use them to create Philipps plots.

```
df <- wb_data(c("NY.GDP.MKTP.CD","NY.GDP.MKTP.KD", "FP.CPI.TOTL.ZG", "SL.UEM.TOTL.NE.ZS"),
              start_date = 1990, end_date=2023, freq="Y")
df <- df[c('country','date','FP.CPI.TOTL.ZG','NY.GDP.MKTP.CD'
           ,'NY.GDP.MKTP.KD', 'SL.UEM.TOTL.NE.ZS')]
names(df) <- c('country','year','inflation','nominalGDP','realGDP', 'unemployment')
df <- na.omit(df)
df_austria <- df[df$country == "Austria", ]
df_france <- df[df$country == "France", ]
df_uk <- df[df$country == "United Kingdom", ]
```

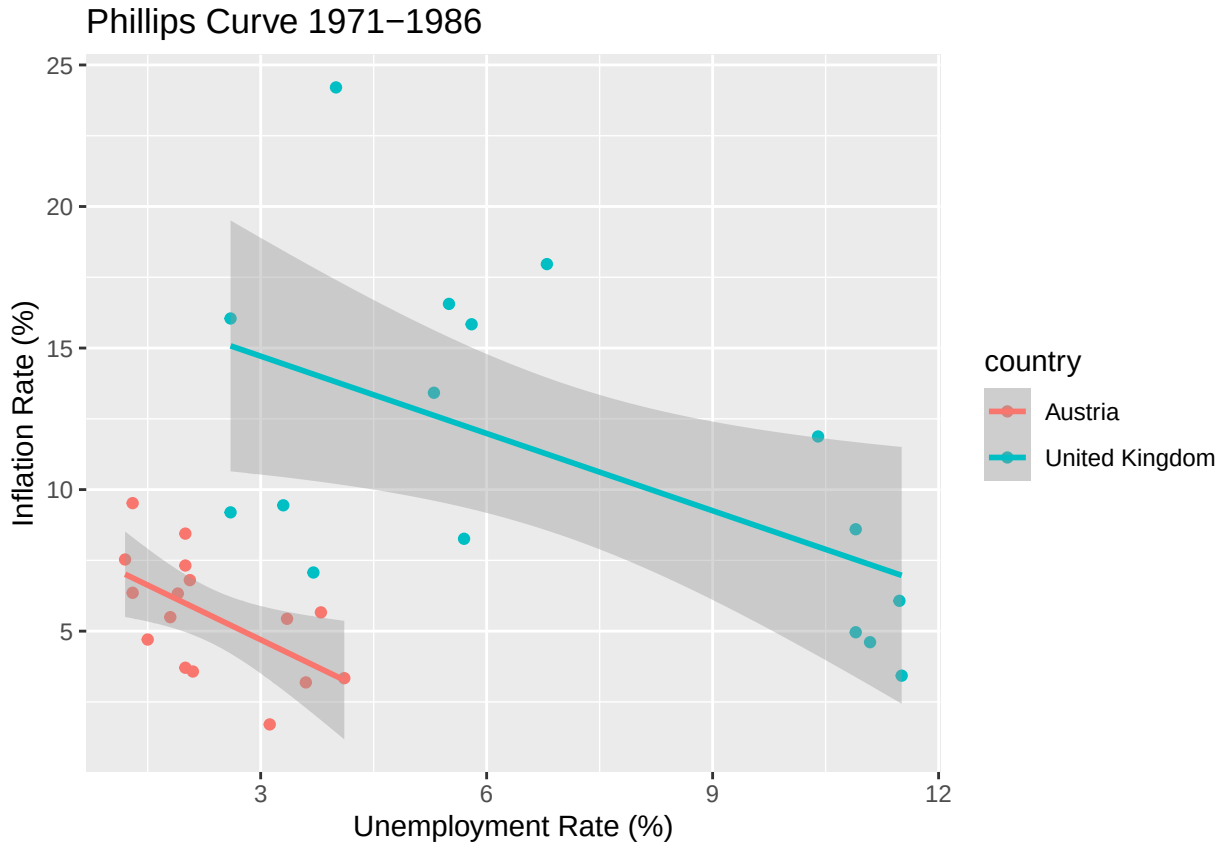

Austria Phillips Curve
Inflation Rate (%)
4
3
2
1
4
5
6
Unemployment Rate (%)


France Phillips Curve
Inflation Rate (%)
Unemployment Rate (%)
0
1
2
3
8
9
10
11
12

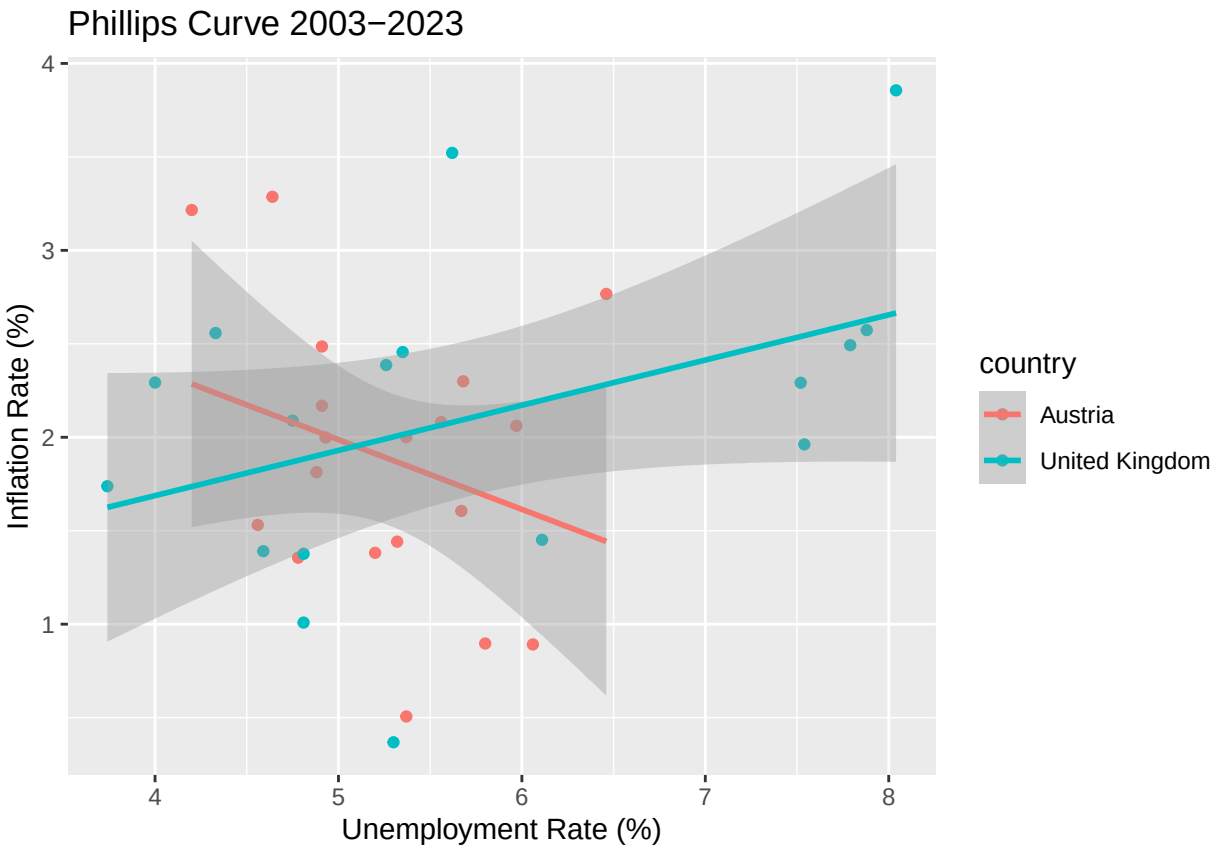

United Kingdom Phillips Curve
Inflation Rate (%)
Unemployment Rate (%)
0
2
4
6
8
5
7
9

2.c)

Check the stability of the Phillips curve through time. Plot the Phillips curve for Austria and the United Kingdom from 1971 to 1986, from 1987 to 2002 and from 2003 until today separately for each country in one graph. Does the Phillips curve change or remain constant? If it changes, explain how.




Phillips Curve 1987−2002
Inflation Rate (%)
8
6
4
2
0
5.0
7.5
10.0
Unemployment Rate (%)
country
Austria
United Kingdom



2.d)

What are possible reasons for a change in the Phillips curve over time?

There are several reasons why the Phillips curve can change over time. Some of the most common reasons include:

Expectations: Changes in inflation expectations can affect the relationship between unemployment and inflation. If people expect inflation to be higher or lower than it actually is, this can shift the Phillips curve.

Productivity: Changes in productivity can affect the relationship between unemployment and inflation. If productivity improves, firms can produce more goods and services with the same number of workers, which can lead to lower unemployment and higher inflation, and cause the Phillips curve to shift.

Supply shocks: Unanticipated changes in the supply of goods and services, such as natural disasters or changes in the price of oil, can cause the Phillips curve to shift. These events can disrupt the balance between unemployment and inflation, causing the curve to move in a different direction.

There are many other factors as well, and the relationship between unemployment and inflation is affected by a complex interplay of various factors and can change over time.