

Story 2

Andrew Bowen

2023-09-16

Story 2

Introduction

Inflation and its economic effects have been in the news recently. The Fed's goal has been to curb inflation (the general rise in the price of goods and services) and maintain a low unemployment rate – the number of active job-seekers out of work. The Phillips Curve is an economic principle stating the general negative relationship between these two variables. Simply put, economies with higher inflation tend to have lower unemployment, and vice versa.

The Federal Reserve (Fed) is central bank of the United States, and is tasked with leveraging monetary policy to curb both these factors. This means the Fed can face the difficult choice of *either* reducing inflation *or* curbing unemployment. The main way the Fed can do this is via monetary policy, or the control of interest rates, which in theory can impact the amount of spending & investment in an economy. Jerome Powell, the Federal Reserve chairman, has stated a goal of accomplishing both these goals, something that the Phillips curve states is impossible.

In this RMarkdown notebook we'll take a look at interest rate, unemployment, and inflation data to see if the Fed has accomplished these goals.

Data Sources

We'll be using the API from the St Louis Federal Reserve for interest rate data - FRED API - - BLS Data API - used for unemployment data as well as consumer price index data

To use the above APIs, one needs to register for requisite API keys. You can learn more about registering for the FRED API [here](#) and the BLS API [here](#). To follow best practices, I'll be setting my API keys as R environment variables within my local environment, and pulling the values below for my API calls. You can set your token via the R `Sys.setenv` built-in function.

```
# Retrieve FRED and BLS API Keys
registration_key = Sys.getenv("BLS_API_KEY")
fed_api_key <- Sys.getenv("FED_API_KEY")
```

Getting CPI time series data

First we'll pull data on the Consumer Price Index (CPI) from the BLS API. CPI is a measure of the general prices for a basket of goods at a given point in time. As such, it can serve as a good proxy measure for inflation (the general increase of price for goods and services) within an economy.

```

# Call CPI data from BLS
registration_key <- Sys.getenv("BLS_API_KEY")
series_id <- 'APU0000702111'
series_url <- glue("https://api.bls.gov/publicAPI/v2/timeseries/data/{series_id}?registrationkey={registration_key}")

response <- GET(series_url)

# Format CPI data
response_txt <- content(response, "text", encoding = "UTF-8")
json <- fromJSON(response_txt, flatten = TRUE)

cpi <- as.data.frame(json[[4]])$series.data[[1]]
head(cpi)

```

```
##   year period periodName value footnotes
## 1 2022    M12    December 1.873      NULL
## 2 2022    M11     November 1.847      NULL
## 3 2022    M10     October 1.814      NULL
## 4 2022    M09     September 1.749      NULL
## 5 2022    M08       August 1.756      NULL
## 6 2022    M07        July 1.715      NULL
```

We'll need to pull an additional 5 years of CPI data to

```

series_url <= glue("https://api.bls.gov/publicAPI/v2/timeseries/data/{series_id}?registrationkey={registration_key}")

## [1] FALSE

response <- GET(series_url)
response_txt <- content(response, "text", encoding = "UTF-8")
json <- fromJSON(response_txt, flatten = TRUE)

cpi_older <- as.data.frame(json[[4]])$series.data[[1]]

```

```

# Combining our CPI data
cpi_df <- rbind(cpi, cpi_older)

# Converting dates from BLS format
cpi_df$date <- str_c(cpi_df$periodName, " ", cpi_df$year)
cpi_df$date <- myd(cpi_df$date, truncated=1)

# cast types
cpi_df$cpi <- as.double(cpi$value)

```

Now let's make a simple plot of our CPI data over time. With this scaling we can see a steady increase of prices since the start of 2020.

```

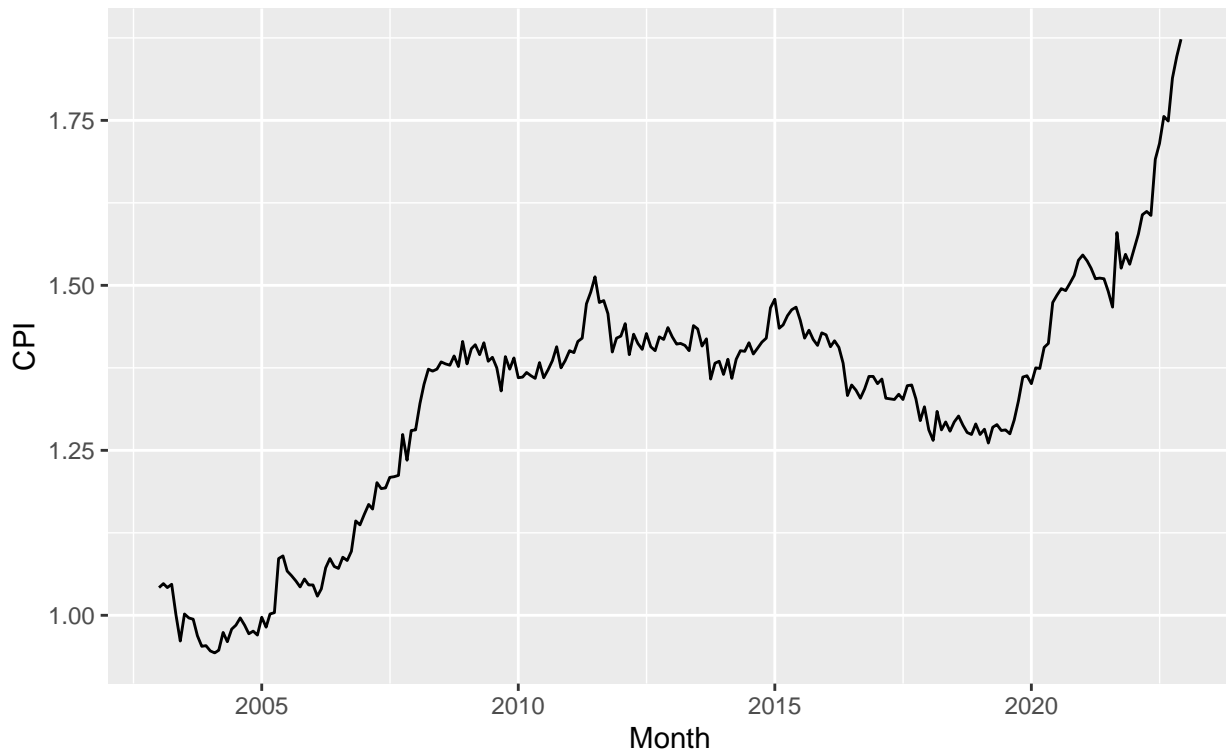
cpi_plot <- ggplot(cpi_df, aes(x=date, y=cpi)) + geom_line() +
  labs(x="Month", y="CPI", title="Consumer Price Index over Time - All US", subtitle="The CPI has shown")

cpi_plot

```

Consumer Price Index over Time – All US

The CPI has shown a steady increase over the past few years post-COVID



Grabbing Interest Rate Data

Grabbing interest rate data from the St Louis Fed API (FRED). The endpoint I'm using contains information about the Federal Effective Funds rate, which is the interest rate charged to banks borrowing overnight to meet their reserve requirements. This is often an economic lever the Federal Reserve (Fed) can pull in order to curb inflation or encourage spending in the economy.

```
url <- glue("https://api.stlouisfed.org/fred/series/observations?series_id=EFFR&api_key={fed_api_key}&f")  
  
# Pull data from FRED API  
fed_response <- GET(url)
```

Let's do some basic data wrangling of our FRED API response to get it into a good format for plotting (i.e., an R `data.frame`)

```
# Wrangle response data into an R dataframe  
fed_response_txt <- content(fed_response, "text", encoding = "UTF-8")  
fed_json <- json <- fromJSON(fed_response_txt, flatten = TRUE)  
fed <- fed_json$observations
```

Let's clean up our federal funds rate data, we'll eventually want to merge this data with our CPI and Unemployment data, so consistent data typing will be needed

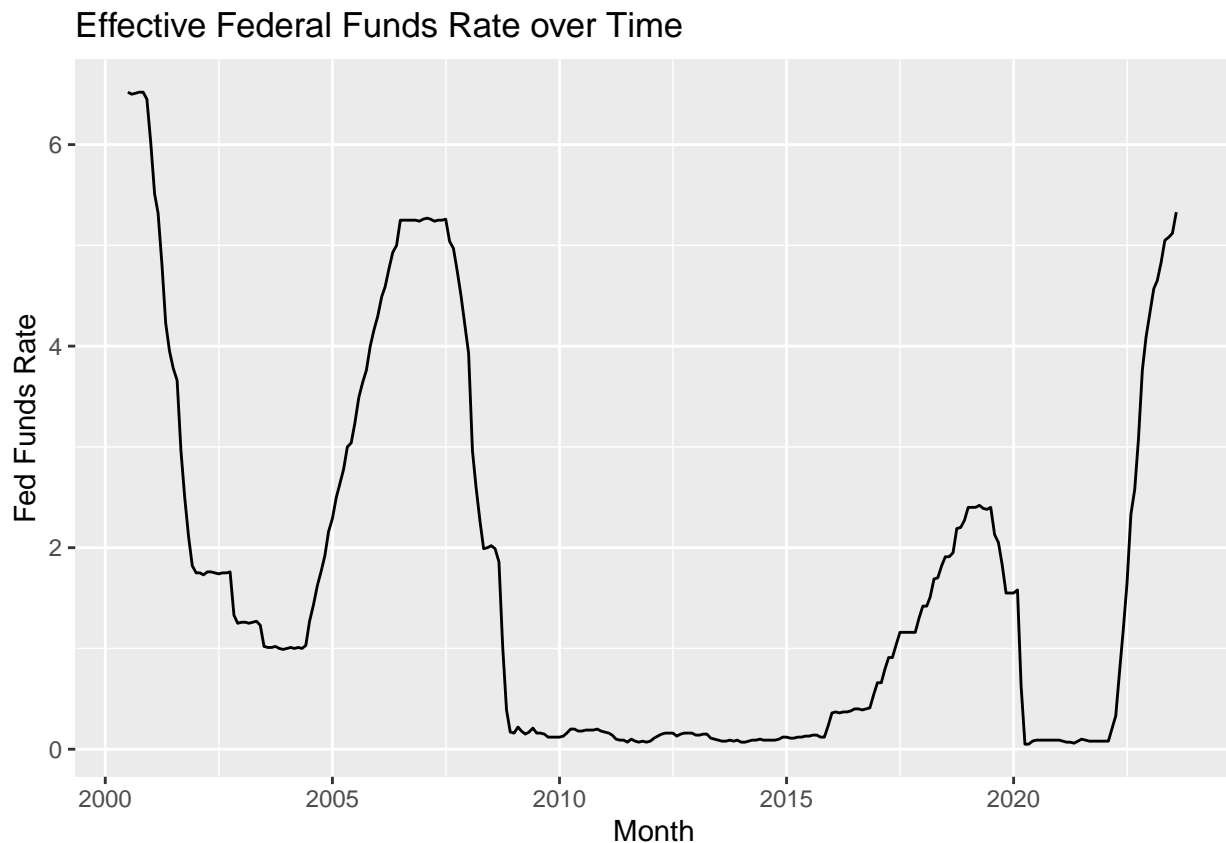
```
# Convert types to align to other datasets
fed$date <- as.Date(fed$date)
fed$fed_funds_rate <- as.double(fed$value)

fed <- fed[, c("date", "fed_funds_rate")]
head(fed, 5)
```

```
##           date fed_funds_rate
## 1 2000-07-01          6.52
## 2 2000-08-01          6.50
## 3 2000-09-01          6.51
## 4 2000-10-01          6.52
## 5 2000-11-01          6.52
```

Now let's plot a simple time series of our federal funds rate date

```
# Plotting Federal Funds Rate over time
fed_rate_plot <- ggplot(fed, aes(x=date, y=fed_funds_rate)) +
  geom_line() + labs(y="Fed Funds Rate", x="Month", title ="Effective Federal Funds Rate over Time", subtitle="")
fed_rate_plot
```



Unemployment Data

I found a CSV file containing seasonally adjusted unemployment data from BLS [here](#)

```
unemployment <- read.csv("https://raw.githubusercontent.com/andrewbowen19/storiesDATA608/main/data/unemployment.csv")
```

As above, we'll need to do some basic cleaning of our unemployment data before merging & plotting.

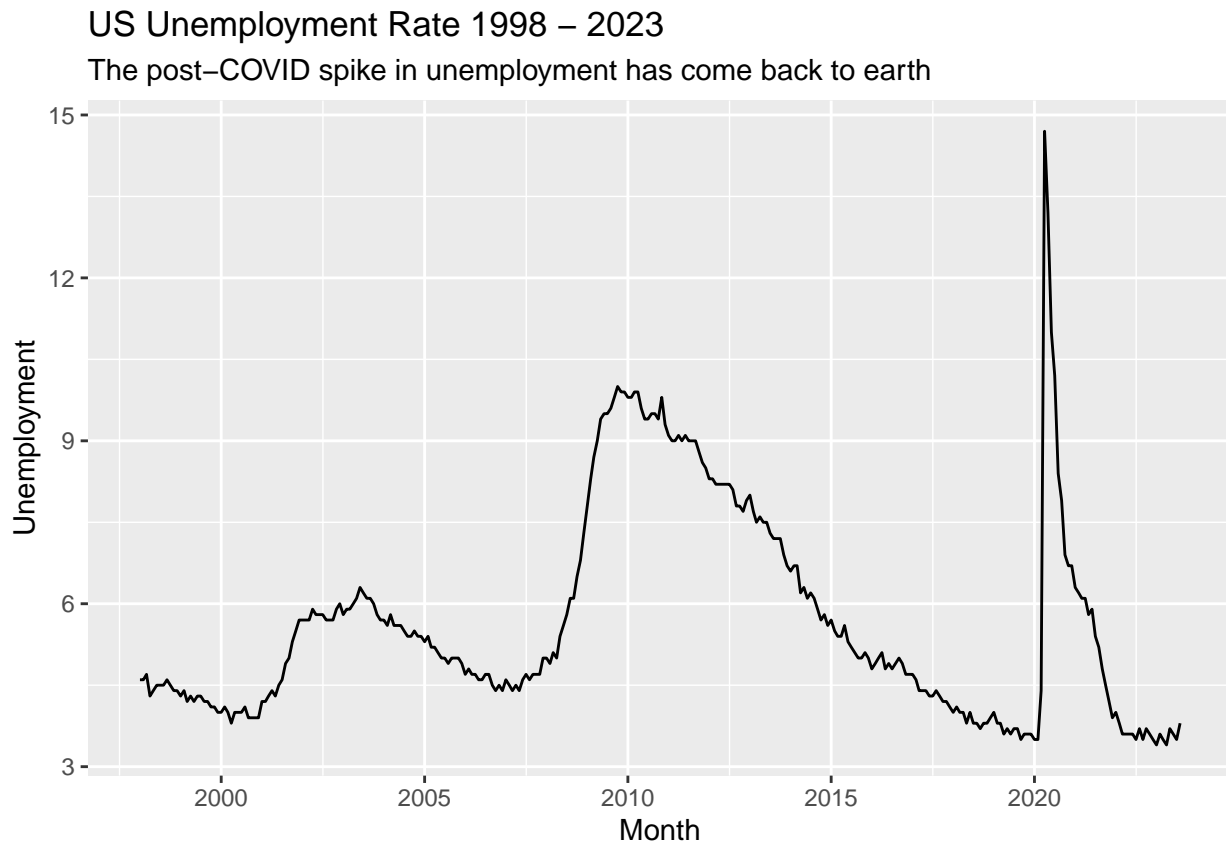
```
unemployment$date <- as.Date(parse_date_time(unemployment$Label, order = "Ym"))
unemployment$unemployment_rate <- unemployment$Value
head(unemployment, 5)
```

```
##      Series.ID Year Period   Label Value      date unemployment_rate
## 1 LNS14000000 1998    M01 1998 Jan   4.6 1998-01-01             4.6
## 2 LNS14000000 1998    M02 1998 Feb   4.6 1998-02-01             4.6
## 3 LNS14000000 1998    M03 1998 Mar   4.7 1998-03-01             4.7
## 4 LNS14000000 1998    M04 1998 Apr   4.3 1998-04-01             4.3
## 5 LNS14000000 1998    M05 1998 May   4.4 1998-05-01             4.4
```

Let's quickly plot the US unemployment rate over time (1998 - 2003)

```
unemployment_plot <- ggplot(unemployment, aes(x=date, y=unemployment_rate)) + geom_line() +
  labs(x="Month", y="Unemployment",
       title="US Unemployment Rate 1998 - 2023",
       subtitle="The post-COVID spike in unemployment has come back to earth")

unemployment_plot
```



Combining our Datasets

Now we can join together our datasets to overlay the data points in a single panel plot

```
dat <- merge(unemployment, fed, by=c("date", "date"))
df <- merge(dat, cpi_df, by=c("date", "date"))
```

Let's plot the time series three variables of interest:

- *Consumer Price Index (CPI)*
- *Unemployment Rate (%)*
- *Federal Funds Rate (%)*

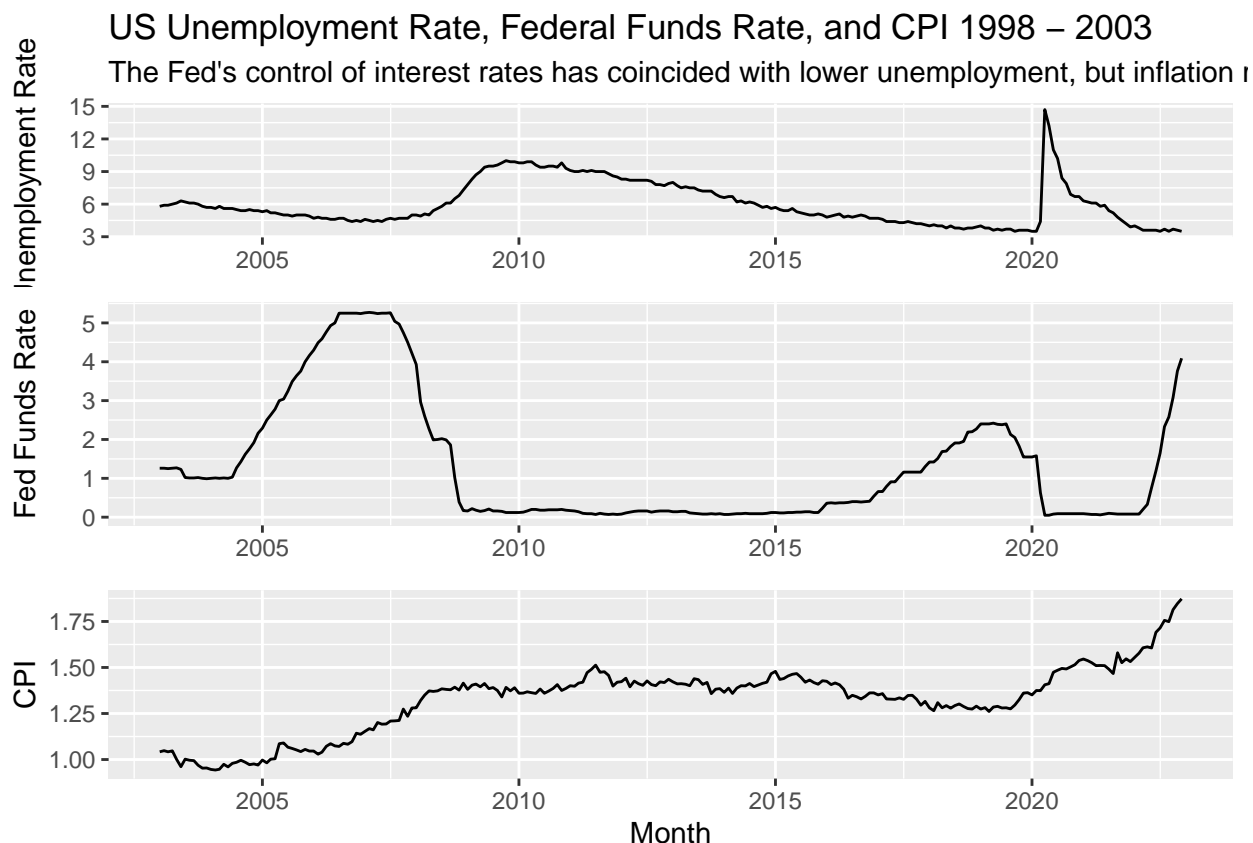
```
# Create Panel plot of our 3 metrics
labels_removed <- labs(x= NULL, title=NULL, subtitle=NULL)

# Unemployment
p1 <- ggplot(df, aes(x=date, y=unemployment_rate)) + geom_line() +
  labs(x=NULL, y="Unemployment Rate",
       title="US Unemployment Rate, Federal Funds Rate, and CPI 1998 - 2003",
       subtitle="The Fed's control of interest rates has coincided with lower unemployment, but inflation")

# Fed Funds Rate Plot
p2 <- ggplot(df, aes(x=date, y=fed_funds_rate)) +
  geom_line() + labs(x=NULL, y="Fed Funds Rate")

p3 <- ggplot(df, aes(x=date, y=cpi)) + geom_line() +
  labs(x="Month", y="CPI")

# Plot unemployment, fed funds rate, and CPI in single panel
plot_grid(p1, p2, p3,
          align="v",
          nrow=3,
          rel_heights = c(1, 1, 1))
```



Looking at the panel plot above, we see the period of “easy money” from 2008 - 2016. This came in the wake of the Great Recession, when the Fed was looking to tackle some of the highest levels of national unemployment since the Great Depression. The CPI stays relatively flat during this period, as near-zero interest rates were in place to maximize employment. In simpler terms, the economy had not “super-heated” as a result of low interest rates *yet*, so the Fed kept them low to tackle unemployment.

The natural rate of unemployment in the US is 4.5%, which started to occur around 2016. By this point, inflationary pressures weren’t occurring yet in the CPI panel above.

Economic Indicators During COVID

One time period of interest is 2020-onwards, as the economic effects of COVID-19 are still impacting society today.

```
“{rpanel-plot-covid-era, warning=FALSE} # Filter data to covid-era and create component plots covid <-
df %>% filter(date > date(“2019-12-31”))
```

```
unemp_covid <- ggplot(covid, aes(date, unemployment_rate)) + geom_line() + labs(x=NULL,
y=“Unemployment”) fed_covid <- ggplot(covid, aes(date, fed_funds_rate)) + geom_line() +
labs(x=NULL, y=“Fed Funds Rate”) cpi_covid <- ggplot(covid, aes(date, cpi)) + geom_line() +
labs(x=“Month”, y=“CPI”)
```

Plot covid-era unemployment, fed funds rate, and CPI in single panel

```
plot_grid(unemp_covid, fed_covid, cpi_covid, align=“v”, nrow=3, rel_heights = c(1, 1, 1)) ““
```

From our zoomed-in plot above of economic activity during the COVID era, we see unemployment returning to low levels after an initial spike of layoffs at the beginning of the pandemic. Some of this was the result of federal COVID economic aid, which provided loans and funding to businesses to continue operating with public health measures impacting productivity. While this happened, an initial drop in the federal funds rate was made to encourage public credit and investment in the face of pandemic-induced uncertainty.

This rate increase did coincide with a sharp reduction in unemployment, but also saw a continuation of inflation, as the CPI chart ticked higher throughout the COVID era (even in the face of interest rate hikes beginning in 2022).

Conclusion

Overall, the Fed has the (unenviable) task of keeping *both* low unemployment rates and low inflation. In recent years, the Fed has been able to maintain low unemployment in the face of COVID-related economic impacts. However, inflation has continued to be the thorn in