

Story 2 - Data 608

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Loading the libraries and setting API Key

```
library(fredr)
library(ggplot2)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##   filter, lag

## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union
```

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'

## The following objects are masked from 'package:base':
##
##   date, intersect, setdiff, union
```

```
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'

## The following object is masked from 'package:dplyr':
##
##   combine
```

```
library(tidyr)
fredr_set_key("9e5a59c0d108491bcf3bd175e017d034")
```

Loading Data files from FRED

To conduct the analysis, we are going to retrieve datasets concerning the Unemployment Rate, Inflation Rate, Consumer Price Index, and Price Consumption Expenditures. The latter three datasets serve as indicators for inflation.

```
# Retrieve Unemployment Rate data
unrate_data <- fredr(
  series_id = "UNRATE",
  observation_start = as.Date("1999-01-01"),
  observation_end = as.Date("2024-01-01"))

# Retrieve Consumer Price Index (CPI) data
cpi_data <- fredr(
  series_id = "CPIAUCNS",
  observation_start = as.Date("1999-01-01"),
  observation_end = as.Date("2024-01-01"))

# Retrieve Personal Consumption Expenditures (PCE) data
pce_data <- fredr(
  series_id = "PCE",
  observation_start = as.Date("1999-01-01"),
  observation_end = as.Date("2024-01-01"))

# Retrieve Inflation Rate
inflation_data <- fredr(
  series_id = "FPCPITOTLZGUSA",
  observation_start = as.Date("1999-01-01"),
  observation_end = as.Date("2024-01-01"))
```

Unemployment and Inflation Rates

The fluctuations in both of these rates suggest that these two economic indicators are volatile forces beyond the control of the Federal Reserve (FED). Over a 25 year period, they have oscillated between highs and lows in reaction to economic forces outside the FED's influence.

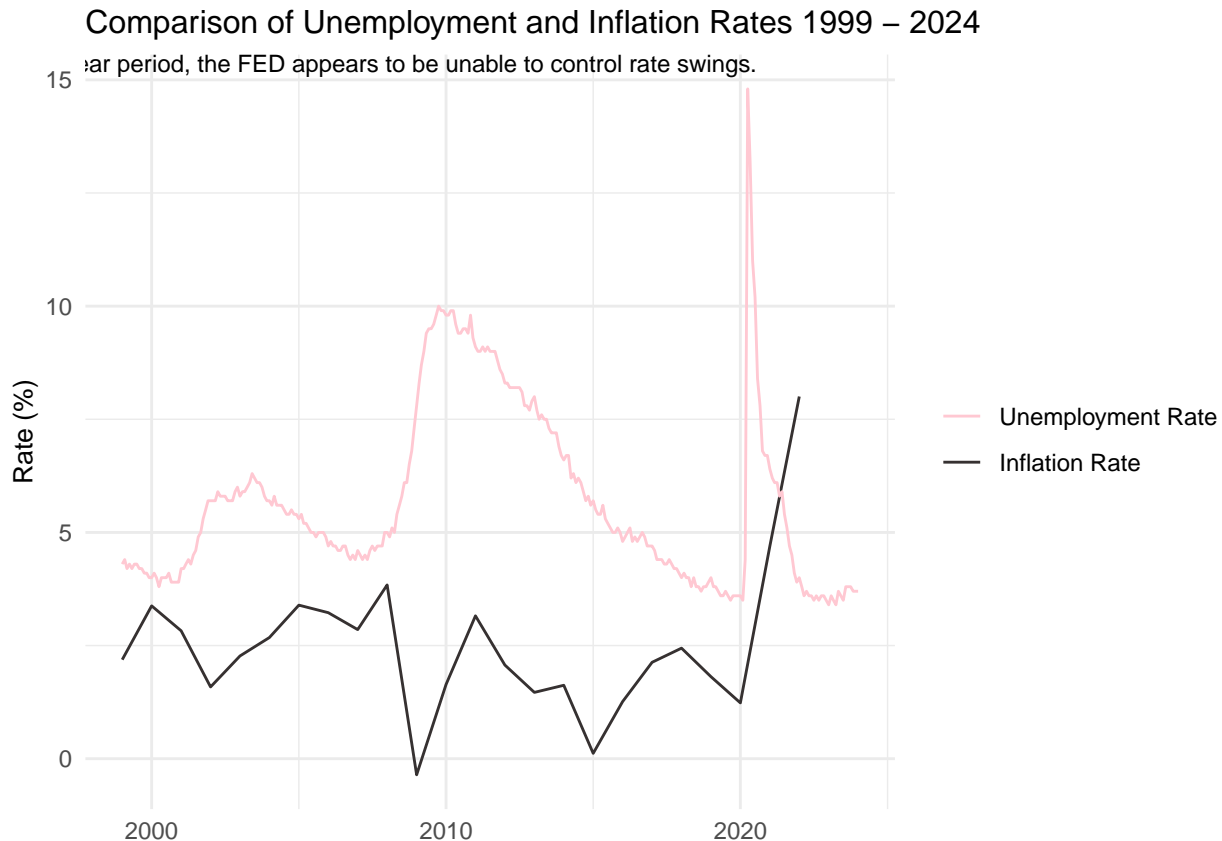
```
# Combine the Unemployment Rate and Inflation Rate data to create a single data frame
combined_data <- bind_rows(
  unrate_data %>% mutate(type = "Unemployment Rate"),
  inflation_data %>% mutate(type = "Inflation Rate")
)

# Generate a single plot displaying both the Unemployment Rate and Inflation Rate lines overlaid.
overlay_plot <- ggplot(combined_data, aes(x = date, y = value, color = type)) +
  geom_line() +
  ggtitle("Comparison of Unemployment and Inflation Rates 1999 - 2024") +
  ylab("Rate (%)") +
  scale_color_manual(values = c("#ffc8d2", "#363131"),
```

```

breaks = c("Unemployment Rate", "Inflation Rate")) +
theme_minimal() +
theme(axis.title.x = element_blank(), ## Remove x-axis label
      plot.title = element_text(size = 12),
      axis.title.y = element_text(size = 10),
      legend.title = element_blank()) +
annotate("text", x = as.Date("2024-01-01"), y = Inf, label = "Over a 30-year period, the FED appears to be unable to control rate swings.",
         hjust = 1.125, vjust = 1, size = 3, color = "black")
## Display the overlay plot
print(overlay_plot)

```



At first glance, this pattern appears similar with CPI and PCE indicators.

Taking into account CPI and PCE indicators reveals a consistent upward trend over 25 years. Despite occasional successes in managing inflation and unemployment, consumer expenses have continued to rise steadily over decades. Does this signify a failure in the Fed's mission?

```

# Plot Unemployment Rate with Kicker
unrate_plot <- ggplot(unrate_data, aes(x = date, y = value)) +
  geom_line() +
  ggtitle("Unemployment Rate") +
  annotate("text", x = max(unrate_data$date), y = Inf, label = "Unemployment % Fluctuates Over 25 Years",
         hjust = 2.68, vjust = 1.0, size = 3, color = "#f99965") +
  ylab("UNR (%)") +
  ylim(0, max(unrate_data$value) + 1) +

```

```

theme_minimal() +
theme(axis.title.x = element_blank())+
theme(axis.title.x = element_blank(),
      axis.text.x = element_blank(),
      plot.title = element_text(size = 10),
      axis.title.y = element_text(size = 8))

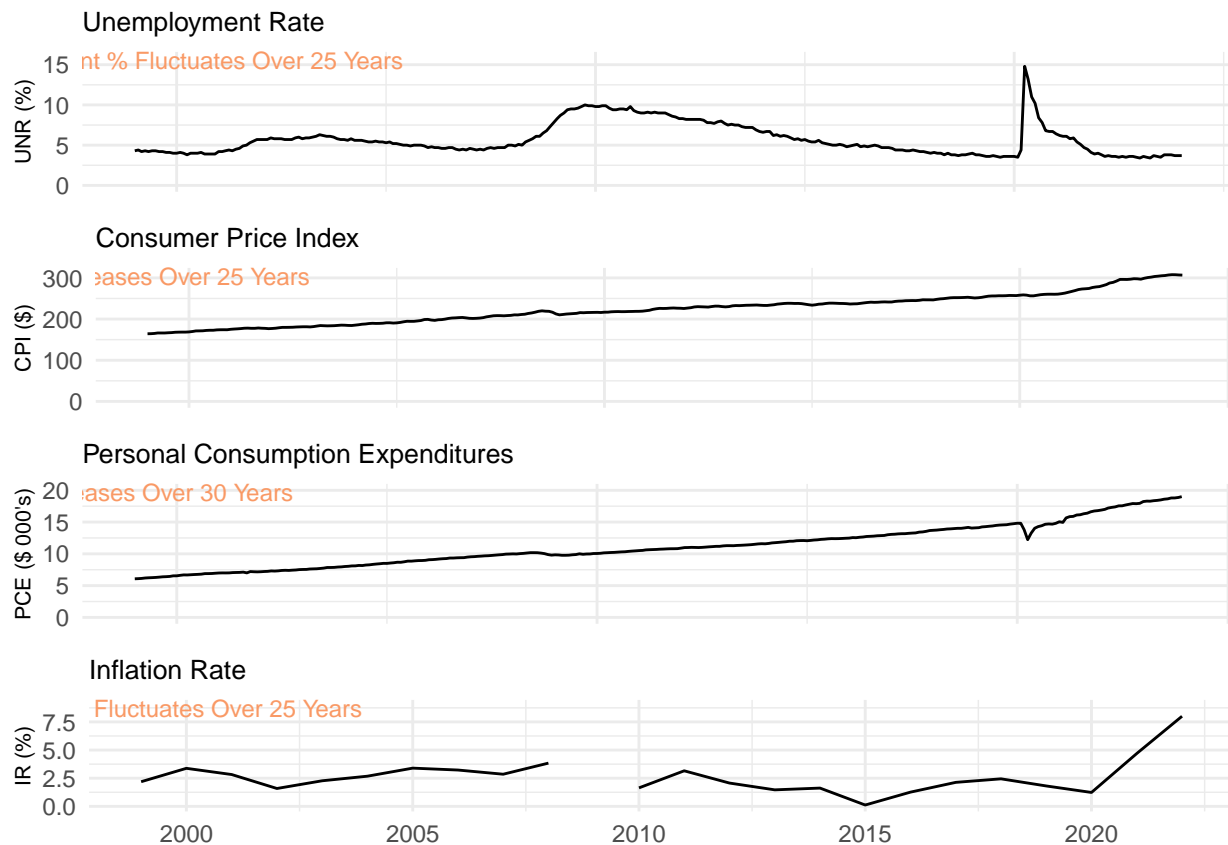
# Plot Consumer Price Index with Kicker
cpi_plot <- ggplot(cpi_data, aes(x = date, y = value)) +
  geom_line() +
  ggtitle("Consumer Price Index") +
  annotate("text", x = max(cpi_data$date), y = Inf, label = "CPI Steadily Increases Over 25 Years",
          hjust = 3.18, vjust = 1.0, size = 3, color = "#f99965") +
  ylab("CPI ($)") +
  ylim(0, max(cpi_data$value) + 1) +
  theme_minimal() +
  theme(axis.title.x = element_blank())+
  theme(axis.title.x = element_blank(),
        axis.text.x = element_blank(),
        plot.title = element_text(size = 10),
        axis.title.y = element_text(size = 8))

# Plot Personal Consumption Expenditures with Kicker
pce_plot <- ggplot(pce_data, aes(x = date, y = value / 1000)) + ## Divide by 1000
  geom_line() +
  ggtitle("Personal Consumption Expenditures") +
  annotate("text", x = max(pce_data$date), y = Inf, label = "PCE Steadily Increases Over 30 Years",
          hjust = 3.17, vjust = 1.0, size = 3, color = "#f99965") +
  ylab("PCE ($ 000's)") + # Update label
  ylim(0, max(pce_data$value / 1000) + 1) + ## Divide by 1000
  theme_minimal() +
  theme(axis.title.x = element_blank(),
        axis.text.x = element_blank(),
        plot.title = element_text(size = 10),
        axis.title.y = element_text(size = 8))

# Plot Inflation Rate with Kicker
inflation_plot <- ggplot(inflation_data, aes(x = date, y = value)) +
  geom_line() +
  ggtitle("Inflation Rate") +
  annotate("text", x = max(inflation_data$date), y = Inf, label = "Inflation Rate Fluctuates Over 25 Years",
          hjust = 2.97, vjust = 1.0, size = 3, color = "#f99965") +
  ylab("IR (%)") +
  ylim(0, max(inflation_data$value) + 1) +
  theme_minimal() +
  theme(axis.title.x = element_blank(),
        plot.title = element_text(size = 10),
        axis.title.y = element_text(size = 8))

# Arrange the four plots in a single column grid
grid.arrange(unrate_plot, cpi_plot, pce_plot, inflation_plot, ncol = 1)

```



Yearly Unemployment, Inflation, CPI, and PCE Economic Indicators rates

The Federal Reserve's objective isn't to maintain rates at zero or entirely halt inflation. Analyzing the rates of change for all four economic indicators over 25 years reveals that the Fed has kept these rates close to a baseline just above zero for all years except during recession periods. This suggests that while the Fed may not prevent recessionary events, it can effectively manage recovery by restoring these rates to baseline levels.

```
# Function to calculate percentage change from previous year
calculate_pct_change <- function(data) {
  data %>%
    arrange(date) %>%
    mutate(year = year(date)) %>%
    group_by(year) %>%
    summarise(value = mean(value, na.rm = TRUE)) %>%
    ungroup() %>%
    mutate(pct_change = (value / lag(value) - 1) * 100) %>%
    filter(!is.na(pct_change))
}

## Calculate percentage change for each data set
unrate_pct_change <- calculate_pct_change(unrate_data)
cpi_pct_change <- calculate_pct_change(cpi_data)
pce_pct_change <- calculate_pct_change(pce_data)
inflation_pct_change <- calculate_pct_change(inflation_data)

## Create the combined data set for the percentage changes
```

```

combined_pct_change <- bind_rows(
  unrate_pct_change %>% mutate(type = "Unemployment Rate"),
  cpi_pct_change %>% mutate(type = "Consumer Price Index"),
  pce_pct_change %>% mutate(type = "Personal Consumption Expenditures"),
  inflation_pct_change %>% mutate(type = "Inflation Rate")
)

## Add custom labels to the plot
recession_labels <- data.frame(
  year = c(2001, 2008, 2020, 2024),
  label = c("DotCom Recession", "Housing Market Recession", "COVID Recession", "Post COVID"),
  pct_change = c(20, -625, 925, 275)
)

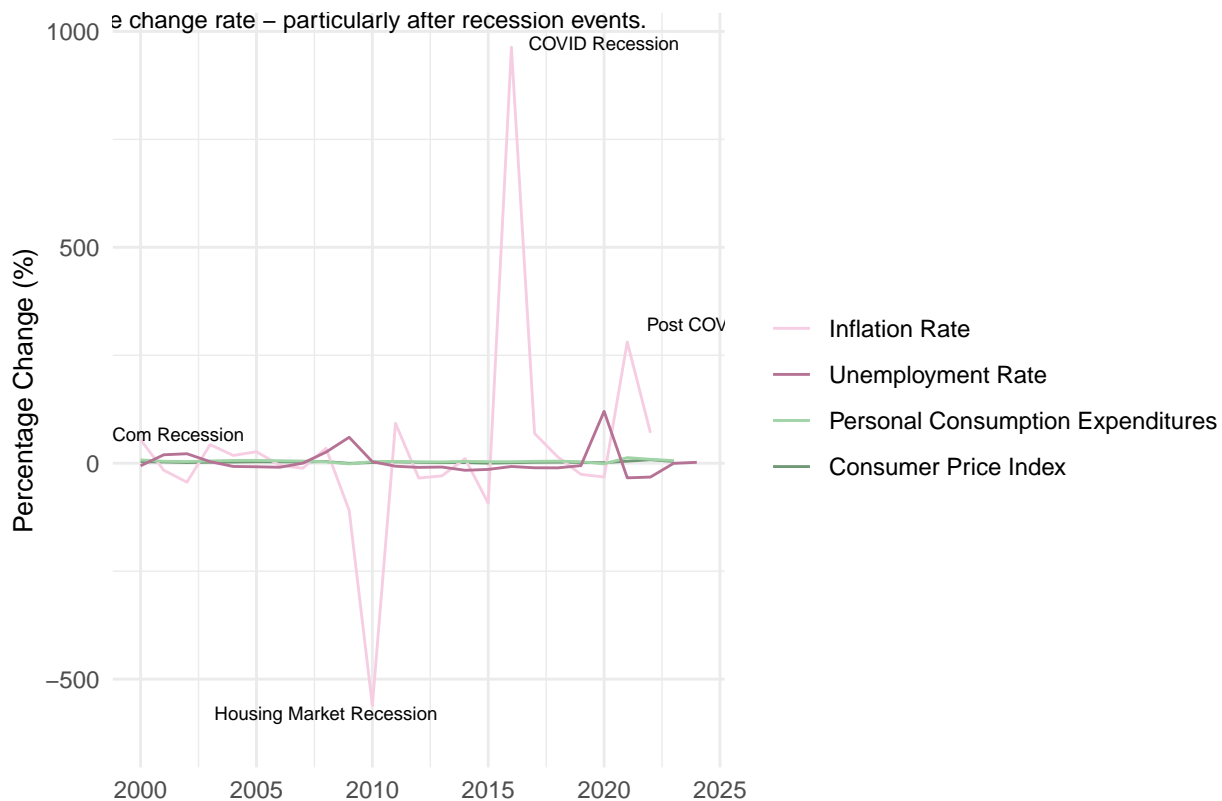
## Update the color scale order
color_scale <- scale_color_manual(
  values = c("#f6cde2", "#b67295", "#a0d4a6", "#709874"),
  breaks = c("Inflation Rate", "Unemployment Rate", "Personal Consumption Expenditures", "Consumer Price Index")
)

## Create a single plot that combines the four lines and adds recession labels
combined_plot <- ggplot(combined_pct_change, aes(x = year, y = pct_change, color = type)) +
  geom_line() +
  geom_text(data = recession_labels, aes(x = year, y = pct_change, label = label),
    vjust = -1, hjust = 0.5, size = 2.5, inherit.aes = FALSE) +
  ggtitle("Yearly Percentage Change in Economic Indicators 1999 - 2024") +
  ylab("Percentage Change (%)") +
  color_scale +
  theme_minimal() +
  theme(axis.title.x = element_blank(),
    plot.title = element_text(size = 12),
    axis.title.y = element_text(size = 10),
    legend.title = element_blank()) +
  annotate("text", x = Inf, y = Inf, label = "FED returns to baseline change rate - particularly after 2020",
    hjust = 1.1, vjust = .9, size = 3, color = "black")

## Display the combined plot
print(combined_plot)

```

Yearly Percentage Change in Economic Indicators 1999 – 2024



Year over Year Inflation vs Unemployment Rates of Change

When the rates of change year over year are compared, one can see that the size of these changes have been largely kept at predictable and steady target levels at or slightly above zero for most of the 25 year period for inflation and unemployment.

Arguably, the most recent recessions triggered by global conditions have destabilized this trend and it appears the FED is in the midst of attempting to return the rates of change back to baseline after sharp economic recoveries.

```
## Function to calculate percentage change from previous year
```

```
calculate_pct_change <- function(data) {
  data %>%
    arrange(date) %>%
    mutate(year = lubridate::year(date)) %>%
    group_by(year) %>%
    summarise(value = mean(value, na.rm = TRUE)) %>%
    ungroup() %>%
    mutate(pct_change = (value / lag(value) - 1) * 100) %>%
    filter(!is.na(pct_change))}

```

```
## Calculate percentage change for each data set
```

```
inflation_pct_change <- calculate_pct_change(inflation_data)
```

```
## Combine the percentage change data into a single data frame
```

```
combined_pct_change <- bind_rows(
```

```

unrate_pct_change %>% mutate(type = "Unemployment Rate"),
inflation_pct_change %>% mutate(type = "Inflation Rate"))

## Calculate the yearly average of percentage change
yearly_avg_pct_change <- combined_pct_change %>%
  group_by(year) %>%
  summarise(avg_pct_change = mean(pct_change, na.rm = TRUE))

## Add custom labels to the plot
recession_labels <- data.frame(
  year = c(2001, 2008, 2020, 2024),
  label = c("DotCom Recession", "Housing Market Recession", "COVID Recession", "Post COVID"),
  pct_change = c(20, -625, 925, 275))

## Create a single plot that overlays the year-over-year percentage change
overlay_pct_change_plot <- ggplot(combined_pct_change, aes(x = year, y = pct_change, color = type)) +
  geom_line() +
  geom_line(data = yearly_avg_pct_change, aes(x = year, y = avg_pct_change, color = "Average"), linetype = "solid") +
  geom_text(data = recession_labels, aes(x = year, y = pct_change, label = label),
            vjust = -1, hjust = 0.5, size = 2.5, inherit.aes = FALSE) + ## Add custom labels
  ggtitle("Year-over-Year Percentage Change in Unemployment and Inflation Rates 1999 - 2024") +
  ylab("Percentage Change (%)") +
  scale_color_manual(name = "",
                     values = c("Unemployment Rate" = "#ffc8d2", "Inflation Rate" = "#363131", "Average" = "#4d8c4d"),
                     breaks = c("Inflation Rate", "Average", "Unemployment Rate")) +
  theme_minimal() +
  theme(axis.title.x = element_blank(), ## Remove x-axis label
        plot.title = element_text(size = 12),
        axis.title.y = element_text(size = 10)) +
  annotate("text", x = Inf, y = Inf, label = "The rate of change have largely held steady and predictable",
           hjust = 1.43, vjust = 1, size = 3, color = "black")

## Display the overlay plot
print(overlay_pct_change_plot)

```


Year-over-Year Percentage Change in Unemployment and Inflation Rates 1999

