

Project Assignment

Report VPDA 2023

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Introduction

Theme justification

In the current socio-economic landscape, people are confronted with a hard reality: rising prices of essential goods like food, housing, and petrol, as well as concerns about recession, increased taxes, fees, and unemployment. These issues dominate the news cycle and impact our daily lives, but the underlying causes can often seem elusive and difficult to comprehend. The language used by financial analysts and policymakers can be full of complex terminology, leaving the general population feeling disconnected from the root causes of these economic changes.

In response to this challenge, we embarked on an extensive exploration to unveil the fundamental factors behind these economic shifts. We delved deep into the economic data, aiming to provide a visual tool that helps to understand the dynamics driving recessions and the key variables that significantly influence them.

Briefly, our goal is driven by a commitment to simplify the intricate world of finance and economics. We recognize the need to bridge the gap between complex financial concepts and the understanding of the general population, offering accessible insights into the forces shaping our economic landscape. Through data visualization and clear, concise explanations, we strive to empower individuals with the knowledge to make informed decisions and engage in meaningful discussions about the economic challenges we face today.

We are aware that while our visualization is not intended for a broad audience, it's more to individuals with a foundational understanding of economics, as we offer explanatory guidance for the terminology employed.

Goals

Our project addresses the following key questions:

- Are we currently facing the potential risk of recession?
- To what extent is the yield spread correlated with the unemployment rate?

Dataset and pre-processing steps

For our analysis, we selected a number of datasets sourced from the online database of the Federal Reserve Bank of St. Louis.

1.

We selected our primary dataset, labeled as "10-Year Treasury Constant Maturity Minus 3-Month Treasury Constant Maturity". This dataset represents the daily spread between the 10-Year treasury note yield and the 3-Month treasury bill yield since 1982 until the present day. These are rates of return for two different US government debt instruments. Since this was a very large dataset in terms of time span, we decided to only use monthly data instead. For this, we grouped the whole dataset by month and chose to use the figure presented on the first day of each month, as it is commonly presented in other monthly datasets with similar data. We discarded the data from 1982 through 1987 because we didn't find any value in it. The pattern we want to show is not present during the first few years available so this data was not adding anything of importance.

2.

Following the initial steps, we ensured that the dates were in the correct format and manually identified the years of recession basing ourselves in a different dataset with binary classification by quarter of whether the country was in recession or not.

After recognizing the significance of distinguishing between positive and negative values of the yield curve, we made the decision to visualize these areas using distinct colors. However, this required data processing to introduce zero-value points between dates where the spread between rates transitioned from positive to negative and vice versa.

3.

Subsequently, we incorporated an additional plot of the unemployment rate, enabling a comparison of trends and their similarities. We harmonized the data so that the years aligned in both graphics.

4.

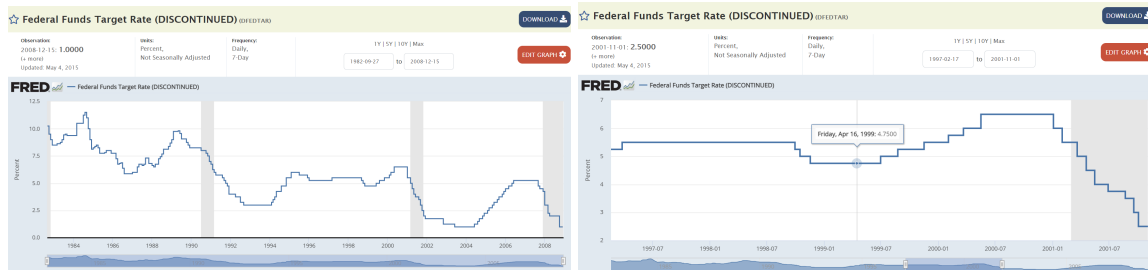
In the next phase, we conscientiously inserted four grey boxes manually into both graphics to indicate the recession periods. During this process, we selected colors with sufficient contrast and aesthetic appeal for our visual representation.

5.

Then we developed an additional visualization: "Federal Funds Rate changes in percentage points in different hiking cycles."

We imported data from two datasets originating from the same database: "Federal Funds Target Range - Upper Limit," containing recent data, and "Federal Funds Target Rate (Discontinued)," with older data. To ensure a seamless integration of information, we

combined these datasets and isolated the relevant data for different periods in which the Federal Reserve was hiking the interest rates. Notably, we performed adjustments to standardize the data in a manner that aligns the minimum value for each sequence with zero.



For instance, in the case of the 1999 data series, we applied an adjustment by subtracting 4.75.

After this, we displayed the interest rate changes in different hiking cycles. The x-axis represents the number of months since the first rate hike, and the y-axis shows the interest rates changes since the hiking cycle began. The lines in the plot are color-coded to distinguish the different hiking cycles.

6.

With all the essential plots, we proceeded to apply a consistent theme across all of them.

7.

In the final stage, we gathered all the plots into a unified visualization. We incorporated explanatory information to enhance comprehension, conducting informal testing with our family and friends to validate our design concepts.

During this process, we explored both horizontal and vertical versions but ultimately chose a horizontal orientation to accommodate PC screen dimensions, as this is the primary viewing device. Responding to valuable feedback, we integrated keywords to aid interpretation and refined the placement of legends based on feedback regarding legibility and user-friendliness.

Insights and explanation

1) Federal Funds Rate and Treasury Yields: The Federal Funds Rate is the target rate set by the US Central Bank - the Federal Reserve. This is the annualized rate at which banks and other financial institutions borrow and lend funds between each other overnight. Theoretically, this rate serves as the floor for all the other rates of US dollar-denominated debt, meaning that any other instruments should have a higher rate of return than the Fed Funds Rate. The Federal Reserve controls this rate based on its forecast for inflation and economic growth with the intention of influencing all the other existing rates, with more impact on short-term rates.

2) Yield Curve Inversion and Rate Hikes: The yield curve is a graphical representation of interest rates on government bonds with different maturities. When it inverts, it means that short-term interest rates are higher than long-term rates, which is often seen as a signal of economic trouble.

Currently, the yield curve inversion is very significant in the US. Many variables contribute to this phenomenon with no single explanation for it. One thing that is certain is that if the Federal Reserve raises its target rate (the Federal Funds Rate), it will have a significant impact on other rates, including government debt rates, but in particular to short-term instruments such as 3-Month Treasury bills.

If the rate hikes by the Central Bank are aggressive enough, the short-term rates will feel the pressure and rise much faster than long-term rates, causing the spread between long-term and short-term rates to decrease, and potentially go negative.

3) Investing in Treasury Bonds: People can typically choose between several maturities, ranging from 1 month to 30 years. The general expectation is that higher maturities should provide higher returns due to the longer commitment. However, in a high-inflation environment, the value of money decreases over time, and real returns on long-term investments are lower.

4) Loss of Confidence in Long-Term Investments: As a consequence of the above factors, people start losing confidence in long-term investments. In such an environment, they begin to withdraw their money from long-term investments to have more readily accessible cash, or liquidity. This is because they are concerned that the returns on their long-term investments will be significantly eroded by inflation, and they want to have money at hand to cope with *rising living costs*.

5) Unemployment: The relationship between yield rates and the unemployment rate is intricately tied to the flow of economic cycles. During economic expansions, the unemployment rate tends to decrease as businesses flourish and there are more job opportunities. In contrast, during economic contractions or recessions, the unemployment rate typically rises as economic challenges lead to job cuts, while yield rates decrease as central banks lower interest rates to rebalance economic activity. This correlation underscores how both indicators act as barometers of economic health and reflect the concerted efforts of central banks to balance economic growth and stability.

Visualization Design

We chose the *Wall Street Journal* theme for our visualizations as it provides a sophisticated and professional aesthetic that aligns with the economic and financial data we present. This theme is widely recognized for its clarity and transmits a sense of credibility and authority, which is important when communicating financial and economic insights. For the same reason, we use the font *Tw Cen MT*, which is the font of the same journal.

For the title of the visualization and the report, we used *DM Serif Display*, because it looks similar and also professional.

Regarding the first plot, where we show the Yield spread and below, the unemployment rate, we added an independent time axis since both graphs are aligned in terms of this variable. It simplifies the overall plot and is also visually pleasing.

Specifically for the Treasury Yield spread plot, the area above the line when the yield spread is negative is in a soft red, so it highlights these particular periods, which are quite rare and usually lead to economic downturns. These economic downturns are represented in both graphs by the shaded areas in the background. This provides a very clear message of when past recessions happened and what preceded them.

When it comes to the second plot, we chose to represent the Fed Fund Rate changes in a way to illustrate and compare the aggressiveness of each hiking cycle. Since every cycle starts at 0 in the graph, this aggressiveness is displayed by the slope of the line that represents the cycle.

The four colors used in the plot of the Fed Funds Rate encode the corresponding starting year, and those same colors are used in the Treasury Yield spread plot to encode the correspondence to the same period of change. This highlights the relationship between Federal Funds Rate changes and the spread of long-term and short-term rates. Furthermore, the chosen colors are selected to ensure inclusivity for viewers with color blindness, prioritizing a user-friendly experience in our visualization.

Our graphics are line plots, and this choice is justified because of their simplicity and ease of comprehension for complex financial and economic information to a diverse audience. Line plots provide a clear and effective means of visualizing time-series data, making them ideal for illustrating trends and changes over time, at regular intervals, facilitating the interpretation of patterns, shifts, and anomalies.

Dataset Sources

[1] Federal Reserve Bank of St. Louis, 10-Year Treasury Constant Maturity Minus 3-Month Treasury Constant Maturity [T10Y3M], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/T10Y3M>, October 29, 2023.

[2] Hamilton, James, Dates of U.S. recessions as inferred by GDP-based recession indicator [JHDUSRGDPBR], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/JHDUSRGDPBR>, October 29, 2023.

[3] U.S. Bureau of Labor Statistics, Unemployment Rate [UNRATE], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/UNRATE>, October 29, 2023.

[4] Board of Governors of the Federal Reserve System (US), Federal Funds Target Rate (DISCONTINUED) [DFEDTAR], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/DFEDTAR>, October 29, 2023.

[5] Board of Governors of the Federal Reserve System (US), Federal Funds Target Range - Upper Limit [DFEDTARU], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/DFEDTARU>, October 29, 2023.