DATS 6401

Visualization of Complex Data

Dr. Anya Mendenhall

Team 1 Project Part IV on

Recession Analysis

by

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1. Introduction/Background

In September 2022, the World Bank had warned the globe of an impending "string of financial crises in emerging markets and developing economies ('Risk of Global Recession', 2022)." Nowadays, people across the world are experiencing the effects of economic uncertainty, including whether a recession is imminent or has already begun. Unpredictable changes are occurring in the stock market, and layoffs from top tech companies have drawn attention towards a possible recession. The average price of gasoline had peaked in the summer of 2022, alongside some of the highest monthly interest and inflation rates in the United States since the 80s. These timings coincided with the lowest voter sentiment and consumer confidence percentiles of the year (Badger & Washington, 2022). The inversion of the yield curve on April 1st, 2022, signals a potential economic downturn, which markets have already begun taking into account ("Treasury Yields Invert", 2023). Moreover, recent fluctuations in housing prices parallel the events of the 2008 Great Recession, which resulted in one of the greatest economic downturns for the United States since WWII (Bennett & Kochhar, 2019). The aim of our project is to answer the question "***How could the United States' gross domestic product (GDP), unemployment rates, gas prices, inflation and interest rates, and stock and debt markets serve as indicators of a potential recession?***" We hope that this analysis will be able to deliver a clear and concise message to a wide variety of audiences on what these key indicators visually show in the development of a potential recession. Using the results of our project, individuals will be able to take preventative financial actions in preparation for any future economic downturns.

2. Datasets

We intend to use the World Bank GDP dataset as one of our datasets for our analysis. The data is collected by the World Bank through various channels, including national statistical offices, central banks, and other government agencies (World Bank, 2022). The data is then compiled and processed by the World Bank to create a consistent and comparable set of GDP estimates across various countries over time. The World Bank raises money for development at the lowest rates by tapping into the world's capital markets. The World Bank GDP dataset has a long lineage, dating back to the early 1960s. Over the years, the dataset has expanded to include more countries, improving the quality, quantity, and applications of the data. The most recent dataset includes data up until 2022 for most available countries.

The World Bank GDP dataset has been used in a wide range of publications over the years, including academic research papers, government reports, and policy briefs. Some important publications associated with the dataset are the World Development Indicators, which is published annually and provides a comprehensive set of economic and social indicators for countries around the world. The World Bank GDP dataset includes 66 variables and 266 rows. The variables in the dataset represent the yearly GDP spanning from 1960 to 2022, while the rows correspond to individual countries or groups of countries. The World Bank GDP dataset includes data for 217 countries and territories around the world. These locations range from small island nations to large, populous countries and represent a diverse range of economic, political, and social contexts. However, the dataset primarily provides data at the national level and does not typically include data at the sub-national or city/county level.

We supplemented our World Bank datasets with various open government data sources, data provided by private non-profit and for-profit businesses, as well as data collected from user-compiled open online sources. For example, our gas price data is sourced from the EIA, which serves to collect and disseminate United States energy information through statistics and current event news, and will also be sourced from the FRED, which provides all types of economic datasets and resources for economic research, and even the AAA, a non-profit federation of motor clubs across North America that serves more than 57 million members and tracks gas and automobile insurance prices. The gas price datasets include over 50 observations in accordance with each state. Furthermore, our inflation and interest rate

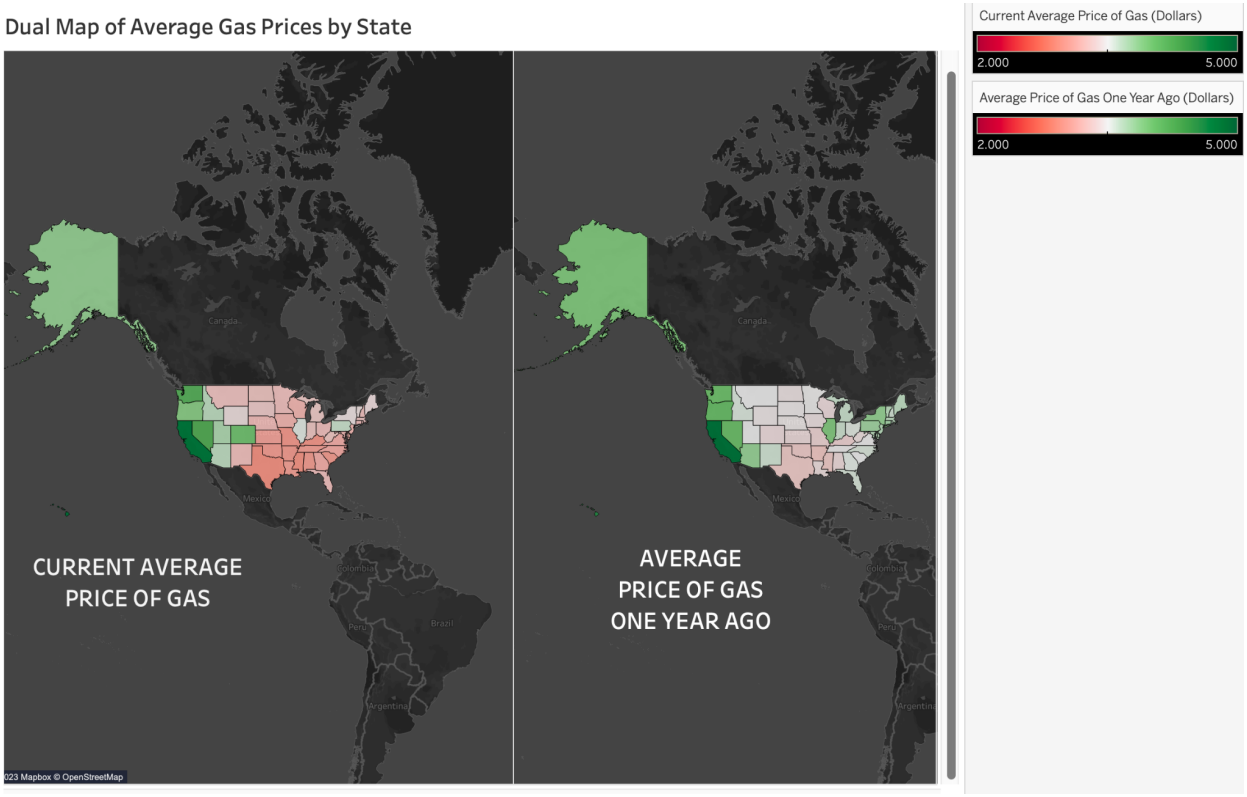
datasets are collected from the OECD, an international organization that aims to promote economic growth, prosperity, and sustainable development through cooperation and data-driven policy analysis.

For our stock market visual analysis, we will source our dataset from Yahoo Finance, which includes daily indicators (i.e. open, close) for companies on the NYSE and many other markets around the globe, like the NSE (Indian Stock Exchange) and London Stock Exchange. We will primarily focus on the indexes that are more representative of the financial market as a whole.

3. Data Story

3.1. Gas Price

Figure 3.1. Dual Axis Map of Average Gas Prices



Gas prices have changed dramatically over the past year due to various factors, but most notably, from the invasion of Ukraine by Russian forces in early 2022. United States and European sanctions hindered Russia's ability to sell crude oil which resulted in a sharp increase in average U.S. gas prices (Isidore, 2022). The variables in the visualization above include all 50 U.S. states and their average price of gas from March 2022, to their average price of gas from March 2023. These observations come from the roadside assistance company, AAA, which keeps daily records of the national average gas prices at the country and state level. When comparing the two maps, it appears that the average state-level price of gas has slightly decreased since March 2022 as indicated by many states shifting from green (higher prices) to red (lower prices). Mirroring the events of the 2008 Great Recession, gas prices tend to increase prior to a recession and quickly decline in the midst of a recession (Isidore, 2022). Though our visuals show a slight decrease in gas prices over the past year, it is important to note the events that occurred during early 2022 which resulted in an unexpected and drastic increase in gas prices. Gas prices are still considered higher than normal which aligns with the signs of a potential recession. If a recession does

occur in the near future, our results will be better supported if we see a decrease in gas prices during this time.

Figure 3.2. US Table of Average Gas Prices over Time per State

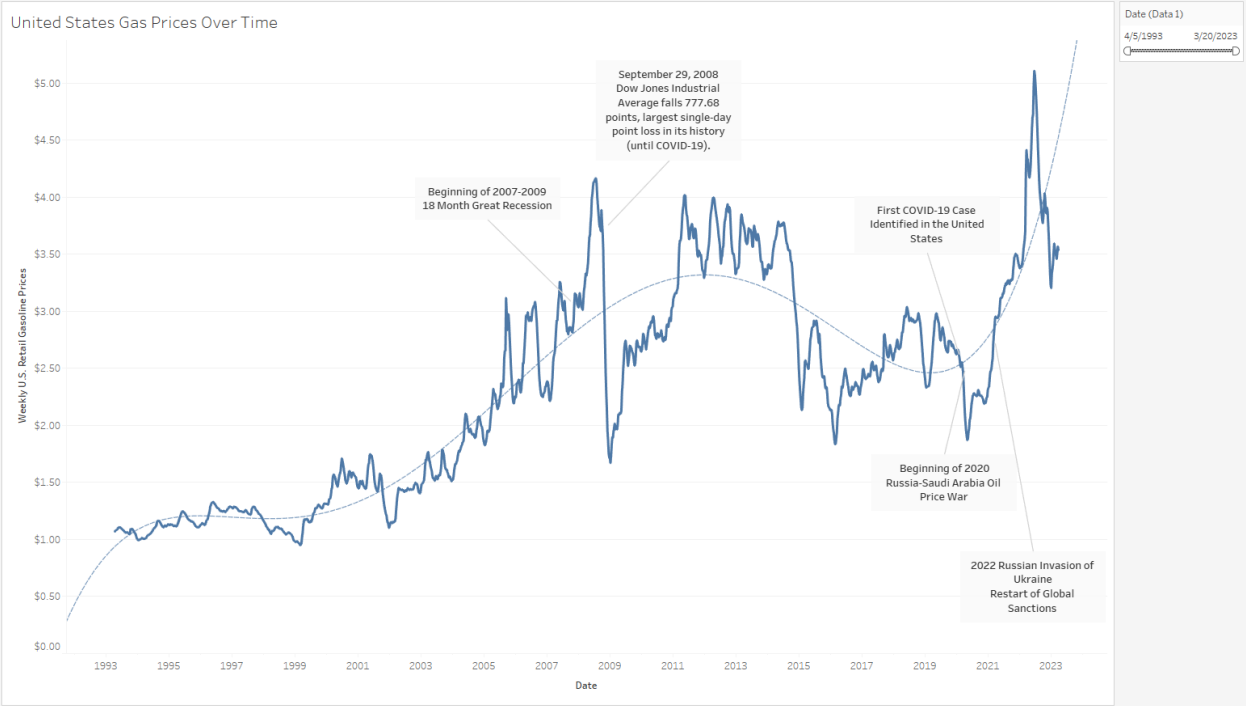
Gas Prices per State from 2004 to 2022

	California	Colorado	Florida	Massachusetts	Minnesota	New York	Ohio	Texas	Washington
2004	$2.17	$1.86	1.91	$1.91	$1.80	$2.04	$1.84	$1.77	$1.99
2005	$2.52	$2.30	2.36	$2.31	$2.17	$2.46	$2.25	$2.22	$2.41
2006	$2.86	$2.59	2.64	$2.62	$2.52	$2.80	$2.54	$2.51	$2.75
2007	$3.12	$2.83	2.84	$2.77	$2.77	$3.00	$2.81	$2.71	$3.01
2008	$3.56	$3.21	3.33	$3.23	$3.13	$3.50	$3.21	$3.17	$3.45
2009	$2.73	$2.30	2.42	$2.36	$2.32	$2.57	$2.36	$2.27	$2.63
2010	$3.14	$2.71	2.83	$2.80	$2.79	$3.00	$2.77	$2.69	$3.06
2011	$3.86	$3.45	3.55	$3.59	$3.55	$3.80	$3.51	$3.43	$3.77
2012	$4.08	$3.53	3.63	$3.72	$3.56	$3.94	$3.61	$3.49	$3.88
2013	$3.93	$3.47	3.57	$3.62	$3.50	$3.84	$3.51	$3.39	$3.69
2014	$3.79	$3.39	3.42	$3.48	$3.30	$3.70	$3.38	$3.23	$3.61
2015	$3.22	$2.41	2.44	$2.46	$2.40	$2.67	$2.41	$2.26	$2.75
2016	$2.78	$2.14	2.22	$2.22	$2.09	$2.36	$2.19	$2.02	$2.53
2017	$3.08	$2.43	2.49	$2.51	$2.39	$2.62	$2.38	$2.29	$2.91
2018	$3.55	$2.75	2.70	$2.82	$2.65	$2.90	$2.62	$2.53	$3.27
2019	$3.68	$2.66	2.51	$2.67	$2.50	$2.73	$2.54	$2.36	$3.19
2020	$3.13	$2.34	2.15	$2.23	$2.05	$2.32	$2.08	$1.90	$2.73
2021	$4.10	$3.27	2.96	$3.01	$2.87	$3.11	$2.93	$2.73	$3.52
2022	$5.41	$3.89	3.81	$4.10	$3.82	$4.11	$3.83	$3.55	$4.66

This table shows the gas prices per year for 9 different states spread across the US. While we will go further in depth about the average gas prices of the whole United States in the last three decades in the line chart displayed later, this table serves to visualize the state-level events that have influenced gas prices between 2004 and 2022. For example, gas prices tend to be higher throughout the two decades in western states, like Washington, and especially California. One possible explanation/reason is that most refineries that process crude oil in the United States are located in Texas and Louisiana (Gregg, 2022). This also explains why Texas and midwestern states have lower gas prices compared to the rest of the United States, as the transportation of gasoline to western states is another hidden cost. While eastern states like New York have infrastructure in the form of pipeline networks in place to lower the transportation cost of gasoline and fuel, the Rocky Mountains (much more obstructive than the Appalachian Mountains of the east coast) prevent similar pipelines from being constructed.

The high state fuel taxes on the West Coast are another possible explanation for the high gas prices in California and Washington. For example, at the beginning of 2022, the individual state fuel tax rates caused California drivers to pay an additional 57 cents per gallon, and for Washington drivers, an additional 49 cents per gallon, which landed both states in the top 3 highest state fuel tax rates in the US. This tax rate has only risen in the past year, with a new Washington state tax on CO2 emissions (which took effect at the beginning of 2023) raising gas prices by an estimated 25 cents per gallon relative to other West Coast states (Myers, 2023). All in all, the table shows that not all differences and trends in gas prices are indicative of a national event or crisis, and could be due to policy changes at the state level.

Figure 3.3. Average Gas Price of the United States since 1993



This line chart shows the price of gas in the United States over time, from 1993 to 2023. A few notable global events were annotated on the graph. In particular, in the years of 2007 to 2009, there was the Great Recession and real-estate bubble. At the time, the Dow Jones Industrial Average had the largest single-day loss in history until the beginning of Covid-19 (History, 2019). Still, there was a small break between the recognized start of the Great Recession before the large decrease in gasoline prices and Dow Jones Industrial Average. This can be attributed to the inelastic government response, where consumers were waiting on Congress to decide on the $700 billion dollar bailout bill of Wall Street. After it failed to pass, the consumer confidence in the nearly frozen credit markets collapsed, and the stock market plunge coincided with the gas price plunge in 2008 as well. This is possibly explained by the decrease in demand for energy, due to the increased unemployment and widespread layoffs with little credit to make purchases (Investopedia, 2022). The events captured by the line chart in 2007-2009 stand to show that gasoline prices and less demand in the energy sector as a whole can be a strong indicator of a recession.

The gas-related events of 2020 include the initial onset of COVID-19, as well as the break-down of negotiations in OPEC+ which led to the 2020 Russia-Saudi Arabia oil price war. As these two events coincided in their timelines, it is difficult to attribute the average gas price drop at the time to either of the events. For example, one possible explanation for the drop in gasoline price is that the demand for gasoline fell as COVID-19 a large percentage of laborers and education to remote, as the country, states, and individual companies begin to take measures to contain the spread of the virus. Another possible explanation was the incredible fall of crude oil price internationally and in the U.S., to the point where the crude oil price was literally in the negatives. However, from the line chart, it can be seen that gas prices were already at a decade low, possibly due to a widespread implementation of fracking by domestic U.S. oil drilling companies (Thomas, 2023). Thus, it was possible that the refineries were already maxed out on crude oil, and even though the resource was in great supply, the price of gasoline simply could not fall further. What is also visible on this line chart is the steep and sudden increase in gas price that we have already mentioned as the impact of the Russian invasion of Ukraine in 2022. Still, this event coincided

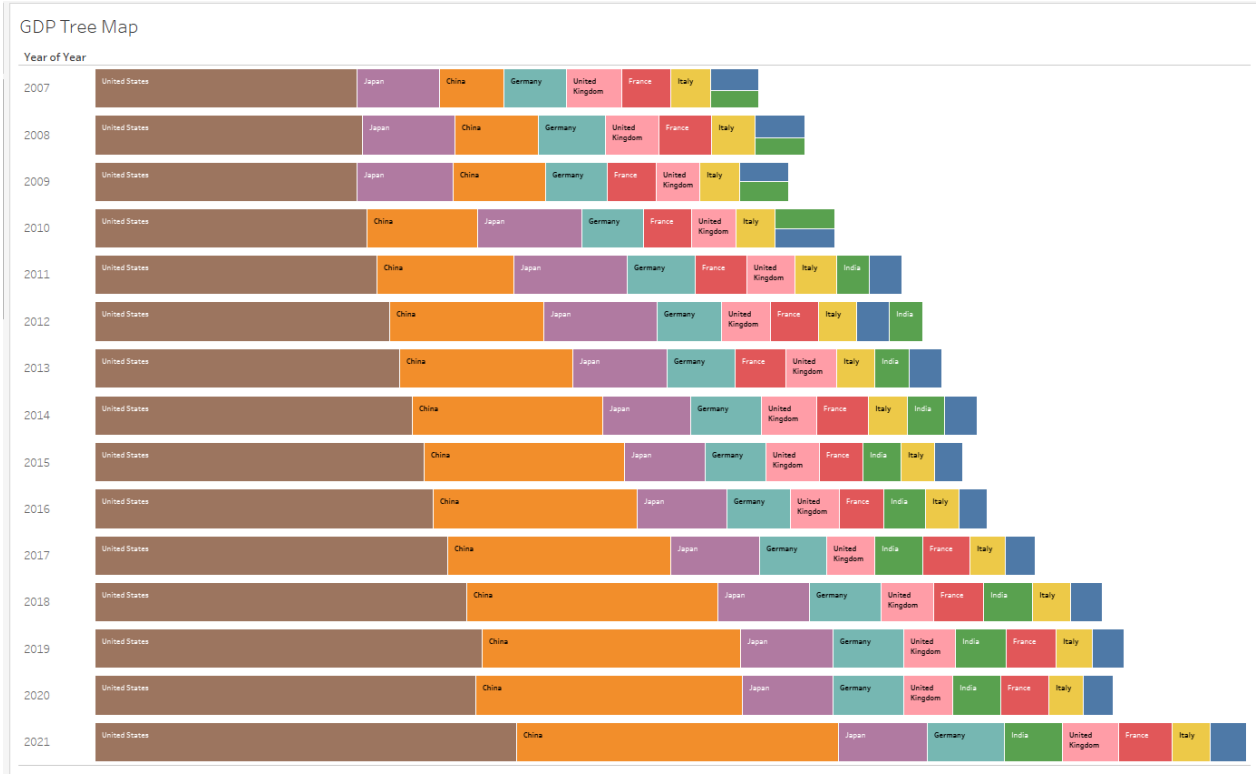
with the end of the international oil price war, which would imply that crude oil would naturally increase in price. At that point, the domestic U.S. oil drilling companies had also laid off many of their laborers (again, possibly due to the onset of Covid 19, or due to the price war making oil drilling extremely unprofitable), with most domestic companies having no intention to rehire workers or buy back their oil drilling equipment even in 2022 to 2023 (Thomas 2023). Thus, from the line chart, we can see that gas price as an indicator for a recession can sometimes be unreliable, due to the impact of global and national events, as well as the regulations/events of the foreign countries that control crude oil prices.

3.2. GDP & Unemployment Rate

Figures 3.4. Top Countries in the world by GDP

In order to analyze a recession, it is important to evaluate the Gross Domestic Product (GDP) of the country. GDP is a measure of a country's economic activity and productivity. It is defined as the monetary value of all goods and services produced within a country during a specified period of time, typically a year. The GDP of a country is a crucial indicator to analyze its economic situation and the impact the country has on the world market. A graph of the GDP for all countries shows that the United States has the highest GDP, followed by China. Given the significant impact the US economy has on the global market, analyzing the US's GDP is crucial to understand the effects of a recession worldwide.

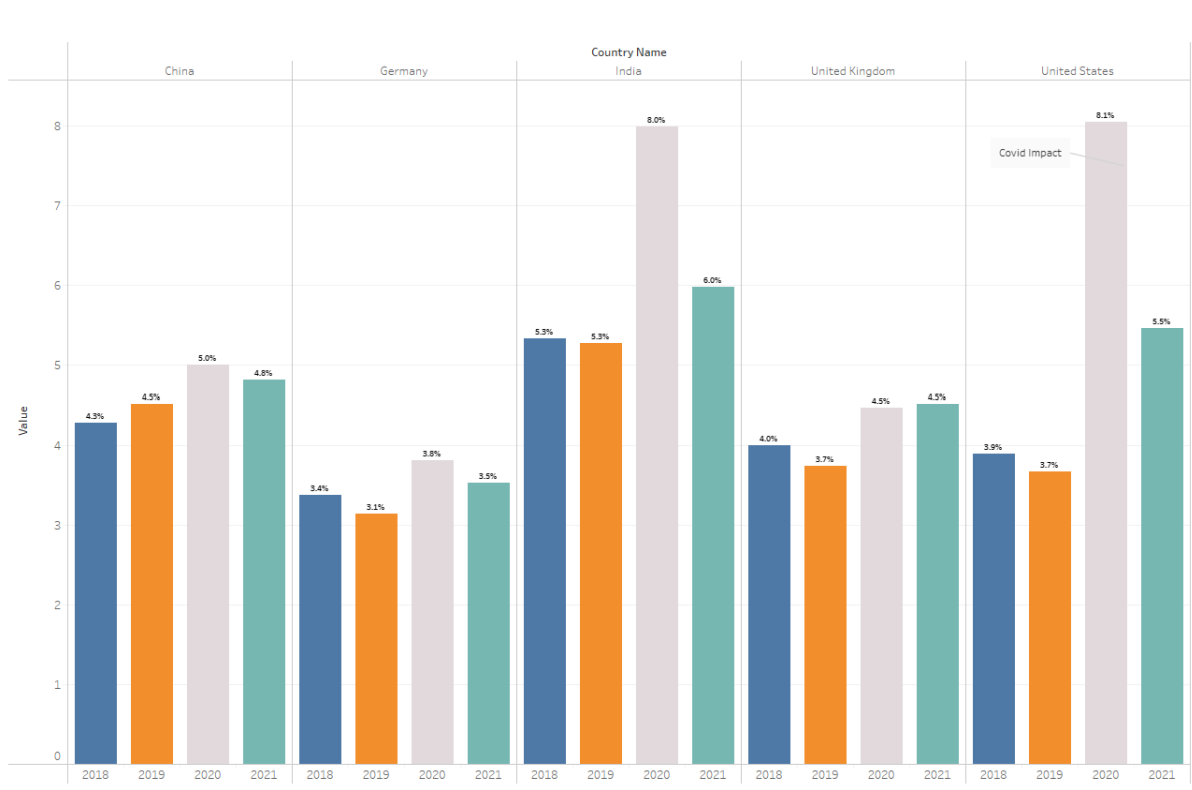
Figures 3.5. GDP Tree Map of the Highest GDP Countries



The tree map analysis of GDP contribution from 2007 to 2021 of the countries with the highest GDPs reveals that the United States consistently performs well and has a significantly higher contribution than any other country. The recession caused a decrease in GDP from 2008 to 2009. However, the United States has been able to maintain its position as the world's leading economy. The tree map visualization is a useful tool in analyzing changes in the contribution of each country to the global GDP over the years.

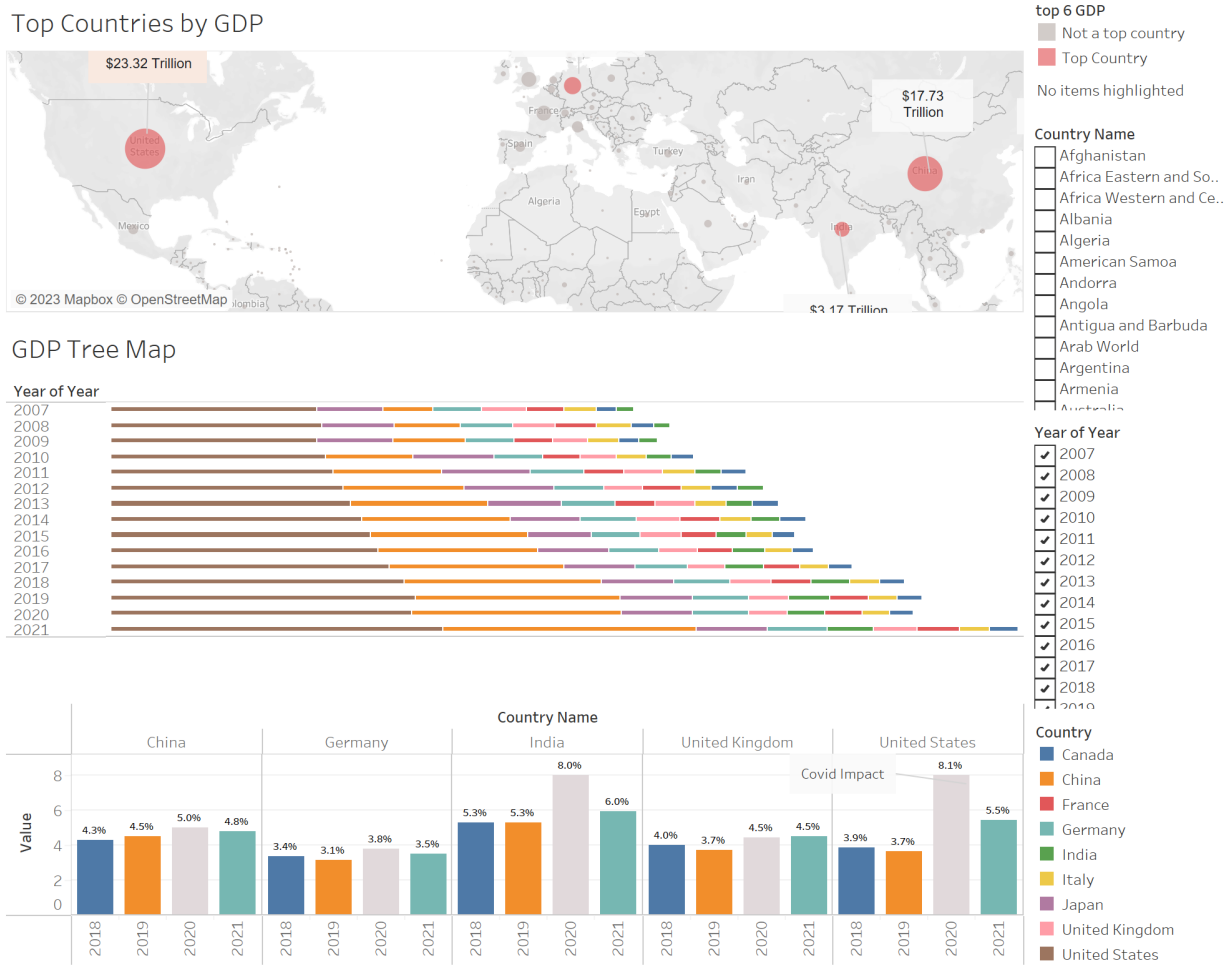
In order to gain a clearer picture of the recession, it is crucial to analyze the current factors for which live data is available. Such factors include the stock market, interest rates, oil and gas prices, and others. Studying these factors would provide a more comprehensive understanding of the current economic situation.

Figures 3.6. Unemployment Rates over Four Years



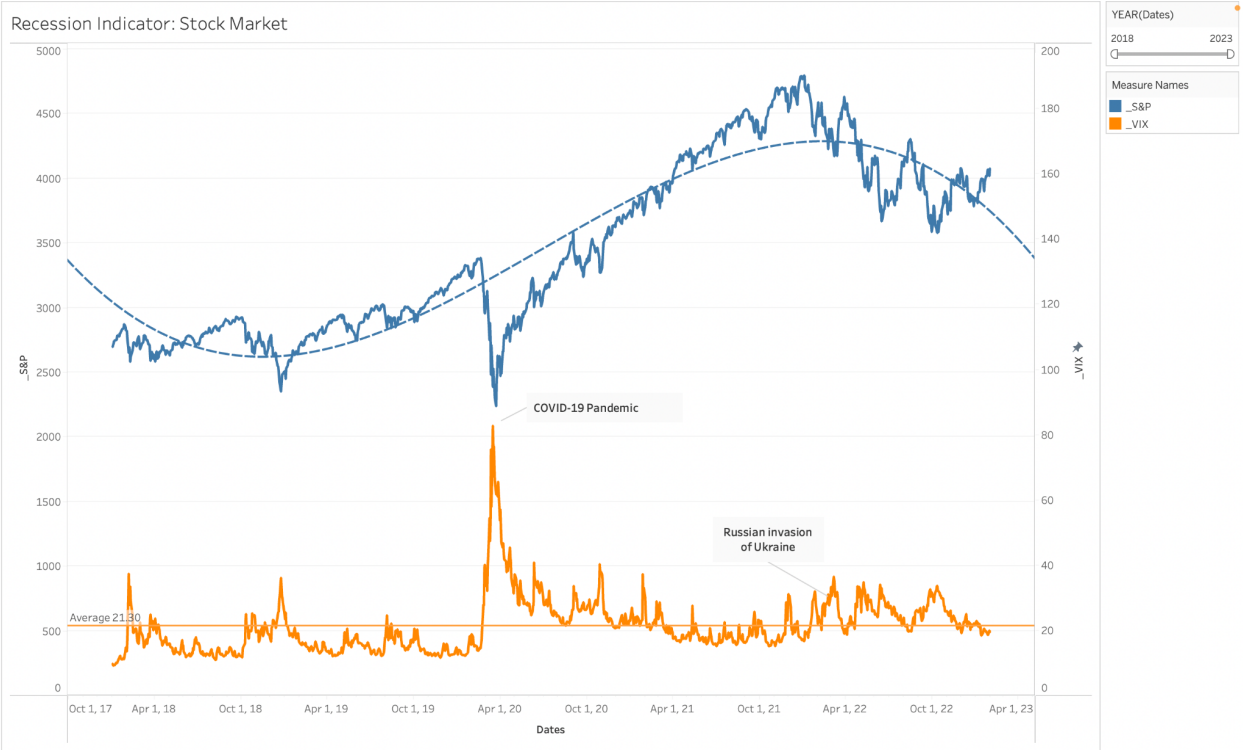
After studying the GDP of all countries, we will now focus on the unemployment rates of five of the highest GDP countries. In 2020, we witnessed high unemployment rates for every country due to the impact of the COVID-19 pandemic. However, after comparing the unemployment rates for 2021 with 2019, we observed that unemployment rates were still higher in 2021, even though the impact of COVID-19 had reduced and economies were revitalizing. High unemployment rates are considered to be good indicators of a recession.

Figure 3.7. Dashboard of GDP and Unemployment Rates



3.3. The Financial Market

Figure 3.8. S&P and VIX Line Chart



The dataset for both of these graphs comes from a data extract of the Yahoo Finance API. For the stock market illustration (the figure on the top), the variables being used are `_S&P` and `_VIX` (Recall that `_S&P` represents the an index of the top 500 performing companies in the United States, and `_VIX` represents the price sensitivities to the `_S&P` index). The motivation behind using these two variables, as mentioned in the previous lab, is to visually display investors' sensitivity, or fear, to the overall price swings from the S&P 500 composite. Additionally, the graph marks two of the most impactful events in the last 5-years, in terms of the U.S. economy, to analyze the reactions of the market. Furthermore, by using Tableau's analytics features, the variable `_S&P` has been fitted with a deterministic polynomial model which attempts to capture the underlying trend of the market in the last 5-years, and `_VIX` has an average band that seeks to identify values that are higher or lower than the mean for the S&P 500 composite price sensitivities. To our initial goal of identifying a potential recession, from the graph we can observe that the polynomial band for `_S&P` has a pessimistic outlook for the future, while the `_VIX` has a majority of its values higher than the average band since the COVID-19 pandemic. Perhaps this inability of the `_VIX` to have lower than average values for price swing expectations is an indicator that the U.S. economy has not been fully able to recover from the uncertainty produced by COVID-19. This higher than average uncertainty from the `_VIX` along with the deterministic trend of the polynomial model of the `_S&P` are signals of a looming potential recession, however, whether this is true will entirely depend on the continuation of this pattern.

On the other hand, another important indicator of the economy's strength are its debt markets. Debt markets are primarily formed by different financial instruments that encourage borrowing and lending in exchange for a repayment with interest at a later point in time. One of these financial instruments is a bond. Bonds have different yields to maturity, or repayment dates, usually ranging from

short-term (5-years), medium-term (10-years), and long-term (30-year) rates. Normally, long-term bonds have a higher interest, or payment, than short-term bonds, given that there are higher levels of uncertainty over longer periods of time. However, the relationship between short-term and long-term bonds is not always this case. When 30-year bonds have equal or lower levels of interest relative to 5-year bonds, there is an inverted yield curve, which indicates a potential recession.

For the debt market illustration (the figure below) the classes being used are `5 year T-Bills`,`10 year T-Bills` and `30 year T-Bills`, which are accompanied by Tableau's analytical deterministic polynomial model to, again, get a sense of the overall trend of each of these treasury rates. To our goal of identifying a potential recession, we can clearly observe the inverted yield curve relationship during the COVID-19 pandemic. In this period of uncertainty, rates continued to plummet towards a near 0 percent for 5 year treasury bills (indicating little to no incentive for lending and borrowing). Since the previously mentioned occurrence, these bond rates have continued to increase in an unprecedented manner, to which Barrons reported in *The Bond Market's Recession Siren Roars Louder as Rates Rise* on March 2nd, 2023, admitting that: "The bond market is also signaling a recession will hit within 12 months. The indicator is the spread, or difference in yields, between 2 and 10-year Treasuries. That spread is now inverted, with 2-year yields well above 10-year yields. Since 1990, every recession has been preceded by an inverted yield curve in the 2- and 10-year Treasuries." (Barrons) From our graph, we can see the inversion of long-term bonds and short-term bonds in the polynomial trend model, as well as the current figures. The `5 year T-Bills` are expected to continue to rise faster than `10 year T-Bills` and `30 year T-Bills`. This might be an indicator that we are already in the beginning phase of a recession, again, however, for this to be true there needs to be a continuation of this pattern.

Figure 3.9

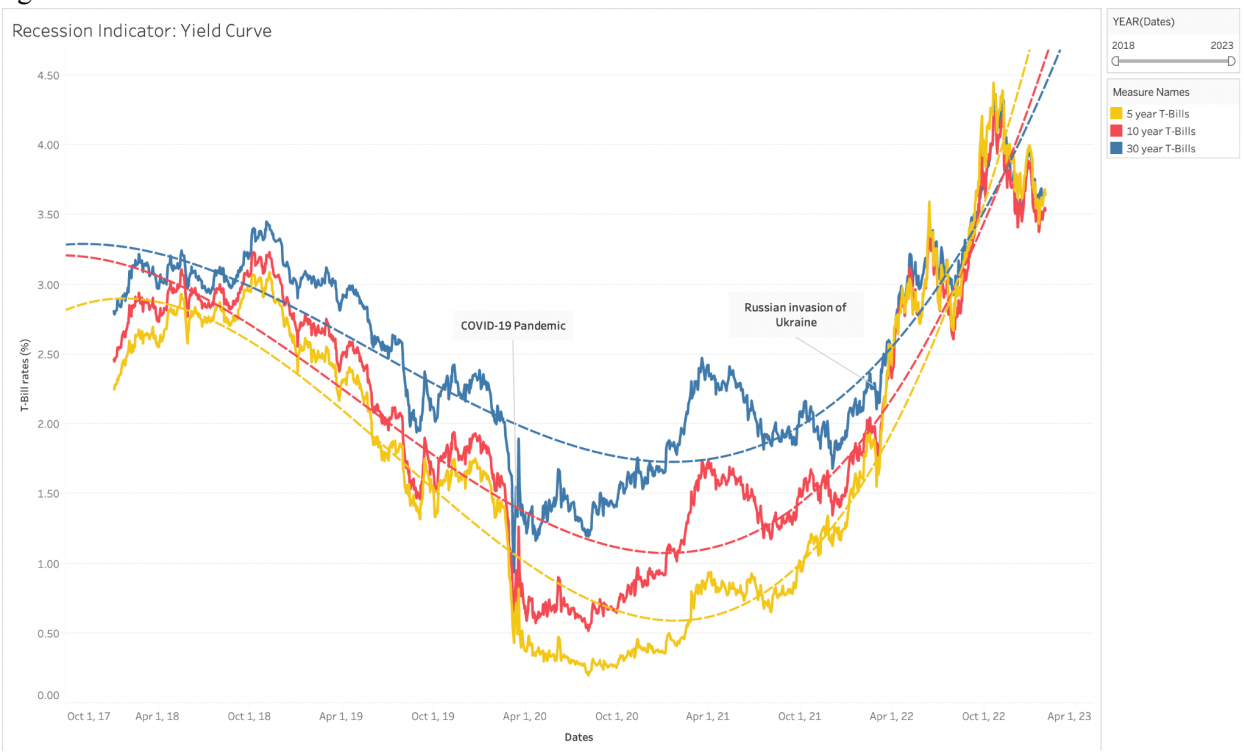


Figure 3.10. Dashboard of the Index/Volume and Yield Curve

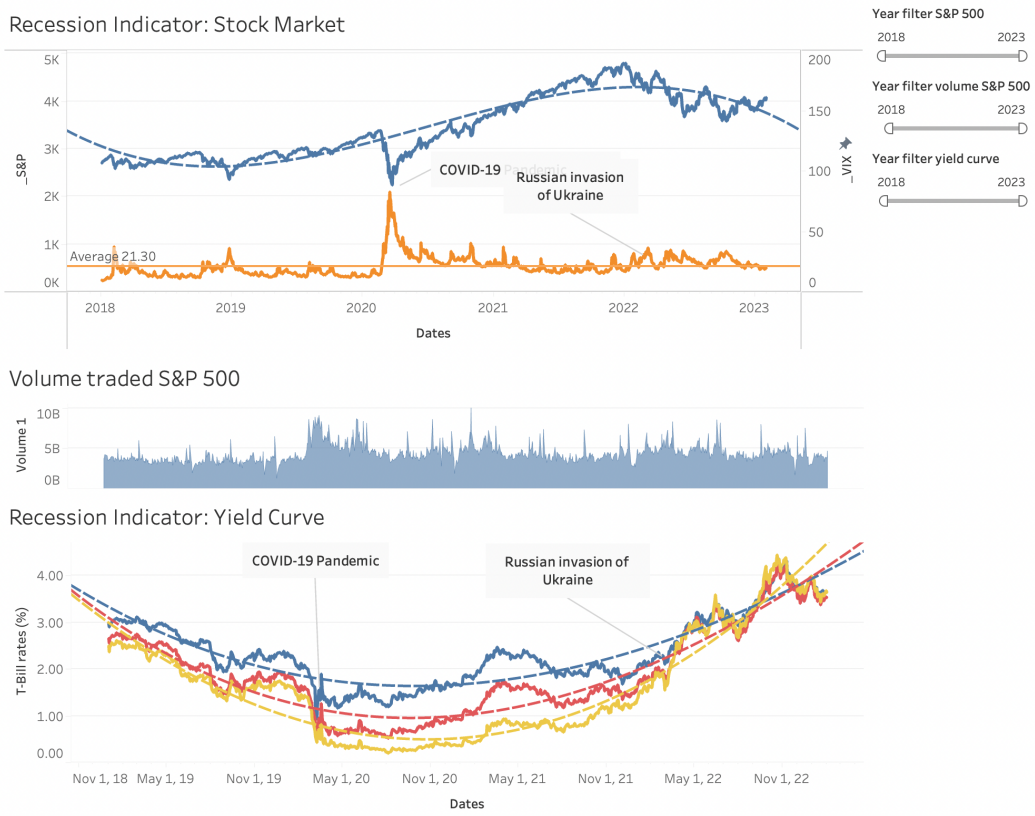
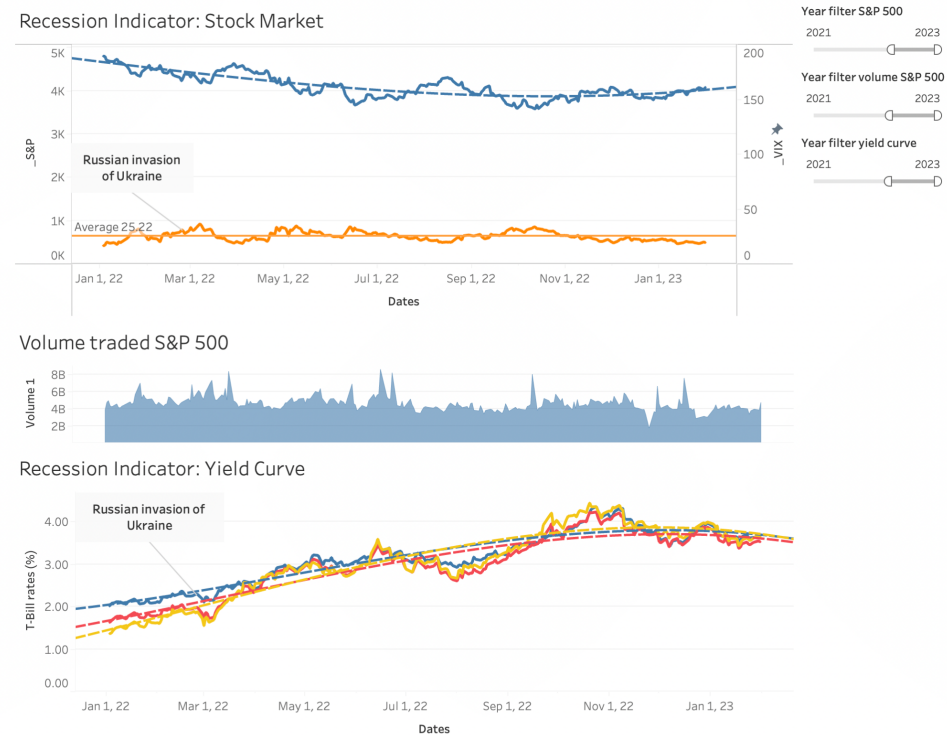


Figure 3.11. Dashboard of the Indexe/Volume and Yield Curve (Since 2021)

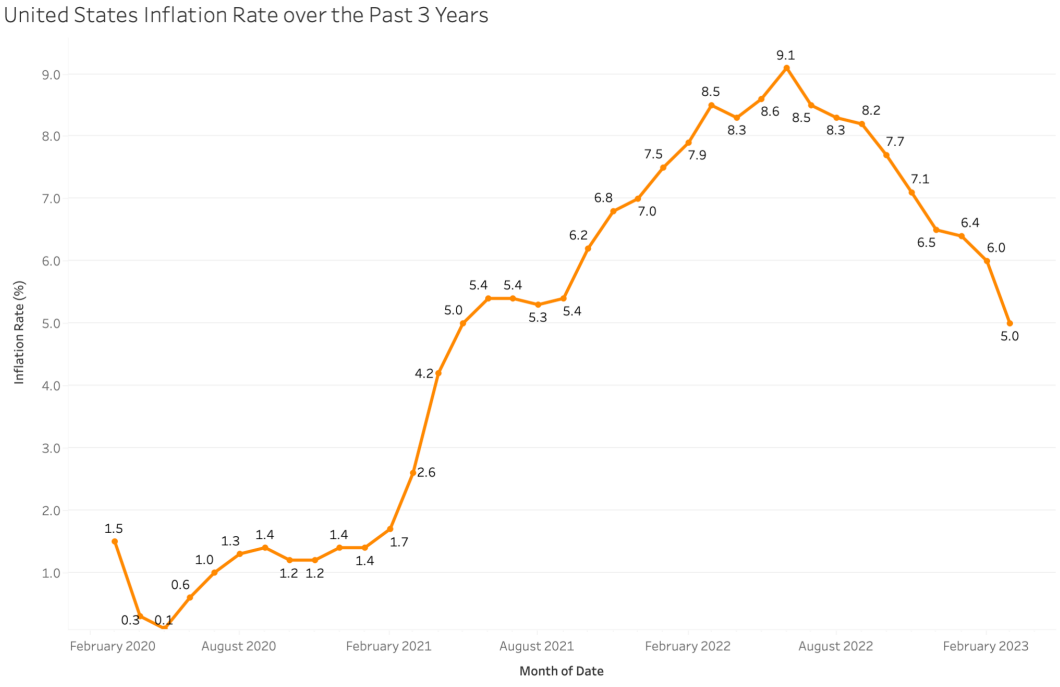


From the previously constructed dashboards, we can reach significant conclusions with respect to the U.S. economy in terms of a potential recession. From the dashboard in Figure 3.10, we are able to see all of the previously discussed graphs under the same scope. The user is able to visualize the effects of the stock market as well as the debt market throughout a 5-year time period to make their own conclusions and analysis. For example, Figure 3.11 shows the last 2-year time period to allow for a prediction on whether or not a recession might be near. Judging from the average 'VIX_' score of 25.2, over the last 2 years, compared to the total average of 21.3, we can confidently say that the economy has been very volatile. When we look at the S&P 500 to spot the volatility, we notice that it has been trying to recover from a downward trend since the beginning of 2022, and its corresponding volume figures follow as well. On the other hand, the debt market seems to be displaying anomalous behavior, since 5, 10, and 30 year bonds are very close to each other, with 5 year bonds offering greater rates than 30 year bonds. All of this is to say that the economy is still trying to recover from shocks such as the COVID-19 pandemic and the Russian invasion of Ukraine, which seem to have put the U.S. economy in an uncertain position.

3.4. Inflation Rate

The inflation rate is a critical indicator of a country's economic health. Inflation rate is defined as the change in the price level of goods/services and fall in purchasing power of individual currency (Statista, 2022). The inflationary situation in the US had been severe in the earlier months of 2020 due to a variety of global events, like the Russian invasion of Ukraine, the ongoing COVID-19 pandemic, the imposed sanctions on Russian banks and exports, and the end of the Russian/Saudi Arabian oil price war. When inflation rate rises sharply, it can lead to a decrease in consumer purchasing power and reduced spending, ultimately slowing down the economy. The line chart below shows the monthly inflation rate in the United States for the past three years, measured as a percentage. Over the past three years, the inflation rate in the United States has shown significant fluctuations.

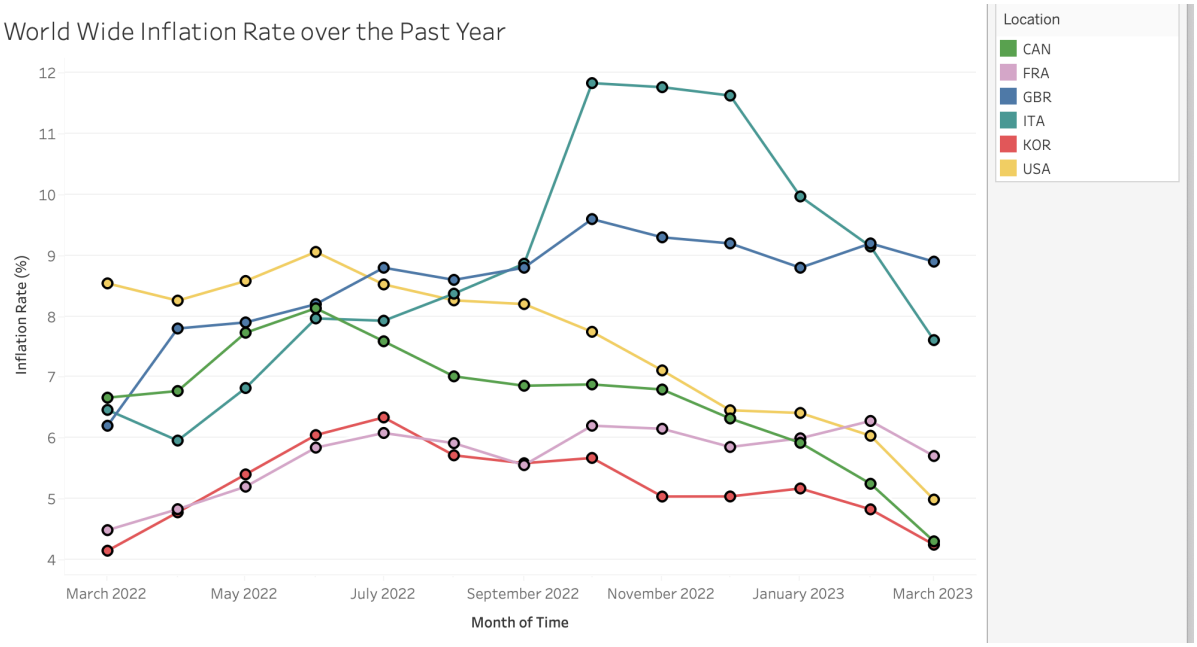
Figure 3.12. Inflation Rate of the United States since 2020



From 2019 to mid-2021, the inflation rate in the US stayed below 2% and remained relatively stable (around 1.3% on average). However, in mid-2021, the inflation rate began to rise steeply, driven by a variety of factors, including the pandemic, supply chain disruptions, and rising commodity prices. By mid-2022, the inflation rate had reached 9%, the highest level in over a decade, which led to concerns about the possibility for a recession.

Since mid-2022, the inflation rate has started to decrease, although it remains above the Federal Reserve's target of 2%. As of April 2023, the inflation rate in the United States is around 5%, indicating that, while the economy is still experiencing inflation, it is no longer at the level of concern seen in mid-2022.

Figure 3.13. Inflation Rate of Different Countries Over the Past Year



This line chart compares inflation rates of different countries, to gain a better understanding of the world-wide trend in inflation rates. Here we examined the inflation rates of six countries: the United Kingdom, Italy, France, Canada, Korea, and the United States, over the past year. Our line chart shows that all six countries have experienced a decrease in inflation rates recently, except for Italy, which showed a drastic change in late 2022. This is a trend similar to the one shown by the previous line chart on the United States inflation rate. Based on this, we can conclude that the ongoing effects of COVID-19 had an influence on the global economy altogether.

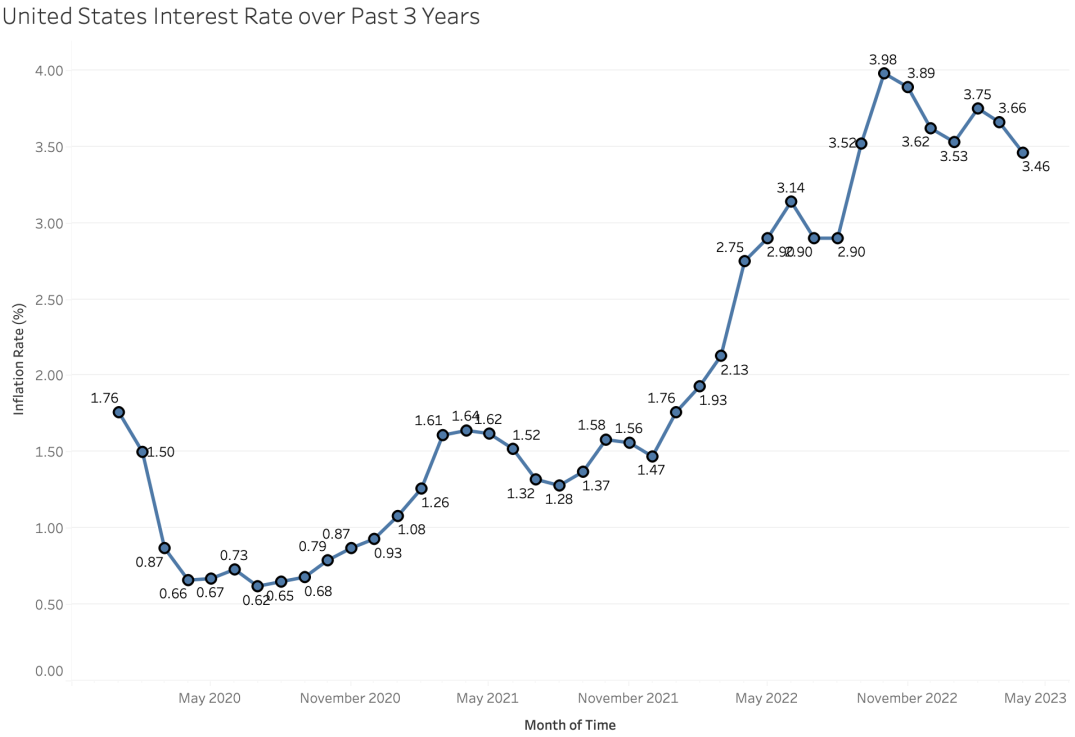
Monitoring changes in the inflation rate is critical in understanding the overall health of the economy and predicting potential recessions. As inflation remains a key concern for policymakers and investors, it is important to continue to monitor this economic indicator closely.

3.5. Interest Rate

Another key indicator of the economy's overall health is interest rate. Interest rates can signal the likelihood of a recession. When interest rates are high, borrowing becomes more expensive, and consumers and businesses may be less likely to spend money. As a result, economic activity may slow down, leading to a recession. Conversely, when interest rates are low, borrowing becomes cheaper, and people and businesses are more likely to spend money, which can stimulate the economy. The line chart

below shows the monthly interest rate for the United States over the past three years, with the long-term interest rate being the average of daily rates measured as a percentage over the period of a month.

Figure 3.14. Interest Rate of the United States since 2020



Over the past three years, the monthly interest rate in the United States has remained relatively low. From 2020 to 2021, interest rates stayed below 2%, likely due to the COVID-19 pandemic and the Federal Reserve's efforts to stimulate the economy through low interest rates. However, in 2022, the interest rate started to rise above 2%, reflecting an improving economic outlook and concerns over inflation. As of April 2023, the interest rate has reached 3.46%, indicating that borrowing is becoming more expensive, which could potentially slow down economic activity. It's important to note that interest rates can be affected by a variety of factors, such as government policies, inflation expectations, and global economic conditions, so changes in the interest rate should be carefully monitored and analyzed.

4. Summary and Conclusions

From the initial gas price table across multiple states, and from the line chart of the average U.S. prices over time, it can be seen that while gas price can be a strong indicator of an upcoming recession, just like during the 2008 Great Recession, one must always be mindful of the confounding events both nationwide and international that may push and pull the gas price directly, without necessarily foretelling a recession.

The analysis of unemployment rates for top GDP countries reveals that even though the impact of the COVID-19 pandemic reduced in 2021, unemployment rates remained high in most countries, suggesting other factors might be contributing to this situation.

Furthermore, the analysis of inflation and interest rates shows that these factors can have a significant impact on the development of a global recession. Consistently monitoring these trends in these two factors going forward will enable us to better anticipate and respond to potential economic challenges and can aid towards ensuring a stable and prosperous global economy for all.

In the context of stock and debt markets, the outlook hints towards the beginning of a recession. However, whether this is true or not depends on the continuation of higher than average uncertainty from the `_VIX`, along with the deterministic trend of the polynomial model of the `_S&P`. And, relative to the debt markets, whether the inversion of long-term bonds and short-term bonds in the polynomial trend model continue.

5. Contributions

Tyler Wallett → Stock and Debt Market Analysis, Stock Dataset Cleaning, Yield Curve/Debt Market Proposal, S&P 500 Graph and Description, Finance and Economy Source
Pranav Chandaliya → GDP and Unemployment Analysis, Original Topic/Idea, GDP World Bank Dataset Cleaning and Description, GDP World Map Graph, GDP Treemap, Unemployment Bar Chart and GDP dashboard.
Kyuri Kim → Inflation and Interest Rate Analysis, Inflation/Interest rate Dataset Cleaning, Inflation Rate Line Graph/Table, Interest Rate Line Graph, Proofread and Formatting
Carrie Magee → Introduction, Background, Objectives/Goals, Gas Price Analysis, Gas Dataset Retrieval and Cleaning, Countrywide Dual Axis Gas Price Map, Reference Page/Citations
Jeffrey Hu → Introduction, EIA Dataset Retrieval and Cleaning, Gas Price Analysis, Gas Price State Table, Gas Price Line Chart National Average, Table/Line Datastory, Gas/Inflation/Stock Research, Proofreader and Format

References

AAA. (2022). *AAA Gas Prices*. AAA Gas Prices. https://gasprices.aaa.com/

Badger, E., & Washington, E. (2022, October 25). Why the Price of Gas Has Such Power Over Us. *The New York Times*. https://www.nytimes.com/2022/10/25/upshot/gas-prices-biden-midterms.html

Bennett, J., & Kochhar, R. (2019, December 13). *Comparing two U.S. economic recessions, recoveries*. Pew Research Center's Social & Demographic Trends Project. https://www.pewresearch.org/social-trends/2019/12/13/two-recessions-two-recoveries-2/

Fonda, D. (2023, March 2). *The bond market's recession siren roars louder as rates rise*. The Bond Market's Recession Siren Roars Louder as Rates Rise | Barron's. Retrieved March 26, 2023, from https://www.barrons.com/articles/bond-yield-curve-stock-market-recession-dc77b93f

FRED, Federal Reserve Bank of St. Louis. https://fred.stlouisfed.org/series/GASREGW

Glossary | DataBank. (n.d.). Databank.worldbank.org. https://databank.worldbank.org/metadataglossary/world-development-indicators/series/NY.GDP.MKTP.KD.ZG

Gregg, A., Karklis, L., & Blanco, A. (2022, June 28). Why gas is so expensive in some U.S. states but not others. *The Washington Post.* Retrieved March 26, 2023, from https://www.washingtonpost.com/business/2022/06/20/gas-prices-by-state-explained/

Hayes, A. (2019). *Yield Curve*. Investopedia. https://www.investopedia.com/terms/y/yieldcurve.asp

History.com. (2019, July 10). Dow suffers largest single-day drop in Great Recession. Retrieved from https://www.history.com/this-day-in-history/dow-suffers-largest-single-day-drop-great-recession

Interest rates - long-term interest rates - OECD data. theOECD. (n.d.). Retrieved May 3, 2023, from https://data.oecd.org/interest/long-term-interest-rates.htm#indicator-chart

Investopedia. (2015, May 27). How Did the Financial Crisis Affect the Oil and Gas Sector? Retrieved from investopedia.com/ask/answers/052715/how-did-financial-crisis-affect-oil-and-gas-sector.asp

Isidore, C., & Hickey, C. (2022, December 29). *Gas prices had a wild ride this year, making 2023 tough to predict | CNN business*. CNN. Retrieved March 26, 2023, from https://www.cnn.com/2022/12/29/energy/oil-gas-prices-2022/index.html

Kuepper, J. (2019). *CBOE Volatility Index (VIX) Definition*. Investopedia. https://www.investopedia.com/terms/v/vix.asp

McFarlane, G. (2022, July 20). *The S&P 500: The Index You Need To Know*. Investopedia. https://www.investopedia.com/articles/investing/090414/sp-500-index-you-need-know.asp

Myers, T. (2023, January 24). Washington's gas prices have jumped 25 cents per gallon since CO2 tax took effect. Washington Policy Center. Retrieved March 26, 2023, from https://www.washingtonpolicy.org/publications/detail/washingtons-gas-prices-have-jumped-25-cents-per-gallon-since-co2-tax-took-effect

Prices - inflation (CPI) - OECD Data. theOECD. (n.d.). Retrieved May 3, 2023, from https://data.oecd.org/price/inflation-cpi.htm

Simonetti, I. (2022, December 8). U.S. Gas Prices Are Now Lower Than a Year Ago. *The New York Times*. https://www.nytimes.com/2022/12/08/business/energy-environment/gasoline-prices.html

Statista. (2022). *United States - monthly inflation rate December 2019/20*. Statista. https://www.statista.com/statistics/273418/unadjusted-monthly-inflation-rate-in-the-us/

Symbol Lookup from Yahoo Finance. (n.d.). Finance.yahoo.com. Retrieved March 5, 2023, from https://finance.yahoo.com/lookup?s=DATA

Thomas, I. (2023, March 9). US won't reach new record oil production ever again: Pioneer CEO. *CNBC*. cnbc.com/2023/03/09/us-wont-reach-new-record-oil-production-ever-again-pioneer-ceo

Treasury Yields Invert as Investors Weigh Risk of Recession | U.S. Bank. (2023, March 1). Www.usbank.com. Retrieved March 5, 2023, from https://www.usbank.com/investing/financial-perspectives/market-news/treasury-yields-invert-as-investors-weigh-risk-of-recession.html

U.S. Energy Information Administration. (1990, August 20). *US Regular All Formulations Gas Price*.

World Bank. (2021). *GDP (current US$)* | *Data*. The World Bank. https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

World Bank Group. (2019). *About us* | *Data*. Worldbank.org. https://data.worldbank.org/about

World Bank. (2021). *Unemployment, total (% of total labor force) (modeled ILO estimate)* | *Data*. Worldbank.org. https://data.worldbank.org/indicator/sl.uem.totl.zs

World Bank. (2022, September 15). *Risk of Global Recession in 2023 Rises Amid Simultaneous Rate Hikes, World Bank*. World Bank. https://www.worldbank.org/en/news/press-release/2022/09/15/risk-of-global-recession-in-2023-rises-amid-simultaneous-rate-hikes