

US Historical Yield Curve, Gold, and Real GDP Analysis

10.2.22

In times of economic downturn, changes in the bond yield curve are observable. Below, I will demonstrate different periods of recession by using constant maturity treasury rates compared to gold prices and real GDP during each consecutive time period. I would also like to see if these indicators warn of a coming recession today. Gold tends to be a hedge against recession, and in recent weeks I have noticed a massive uptick in gold advertisements. My hypothesis is that analysts and financial institutions are more aware of the coming recession than the layman, and they are trying to take advantage of the massive financial opportunity that a downturn can provide. I also think institutions are engaging in arbitrage during this volatile time that consumers who are unsure about market and economic conditions are attempting to navigate.

With inverted yield curves historically signaling recessions with only two exceptions, is the current inverted yield curve a sign of worse things to come?

```
In [1]: # Import dependencies
import pandas as pd
import hvplot.pandas

# Function for combining graphs
def overlay(df, df2):
    return df * df2

In [2]: # Import Constant Maturity Treasury Rate
treasuries = pd.read_csv(
    "constant_maturity_treasury_rates.csv",
    index_col="Date",
    parse_dates=True,
    infer_datetime_format=True
)

# Import Historic Gold Prices
gold = pd.read_csv(
    "goldx.csv",
    index_col="Date",
    parse_dates=True,
    infer_datetime_format=True
)

# Import Current Gold Prices
gold_current = pd.read_csv(
    "current_gold.csv",
    index_col="Date",
    parse_dates=True,
    infer_datetime_format=True
)

# Import Real GDP
gdp = pd.read_csv(
    "real_gdp.csv",
    index_col="Date",
    parse_dates=True,
    infer_datetime_format=True
)

# Rename GDP Columns and get percent change of DataFrame
gdp = gdp.rename(columns={"GDP1": "Billions of Dollars"})
gdp = gdp.pct_change()
```

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In [3]: # Clean data
treasuries = treasuries.fillna(0)

# Replace strings
treasuries = treasuries.replace(to_replace="ND", value=0)

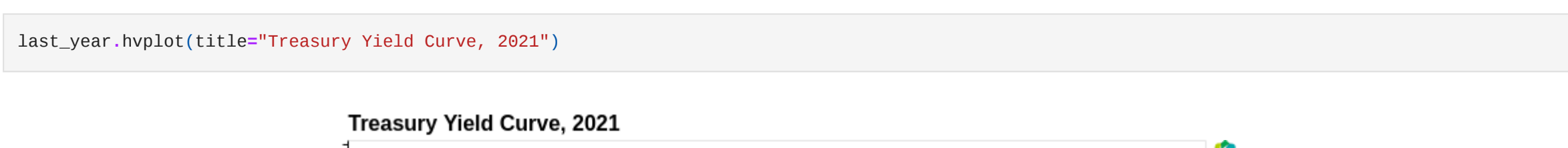
# Convert values to float
treasuries = treasuries.astype(float)
```

Below it can be observed that the yield curve over the last year has begun to invert, which is when the rates of shorter term bonds are higher than longer term bonds. This reflects bond investors' expectations for a decline in longer-term interest rates, typically associated with recessions and times of uncertain economic conditions. The inversion is caused by investors moving money out of shorter-term bonds and into longer-term ones, a strong signal of less confidence of economic prosperity in the near future.

```
In [4]: # Create variables for recent dates
today = treasuries.iloc[-1:]
fifty_days = treasuries.iloc[-50:]
half_year = treasuries.iloc[-182:]
last_year = treasuries.iloc[-365:]

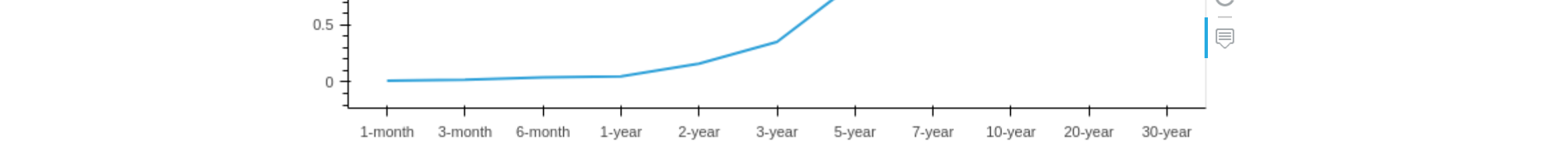
# Create the DataFrame
recent_df = pd.concat([today, fifty_days, half_year, last_year], axis=1)
recent_df.columns = ['Today', 'Fifty Days Ago', 'Half a Year Ago', 'Last Year']

# Plot the data
line_plot = recent_df.hvplot(title="Treasury Yield Curve, %", grid=True, xlabel="Bond Maturity", ylabel="Yield (%)")
scatter_plot = recent_df.hvplot.scatter()
overlay(line_plot, scatter_plot)
```



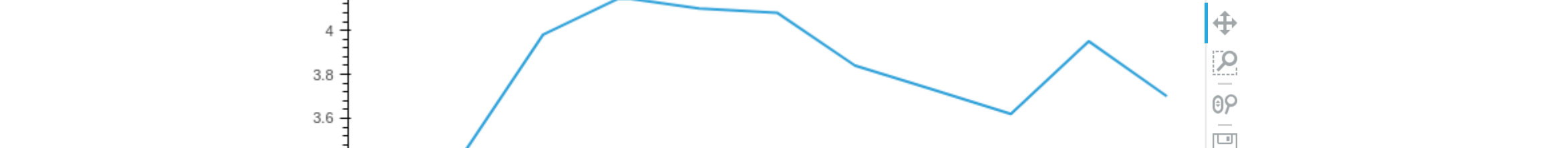
This is how a normal bond yield curve should look.

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In [5]: last_year.hvplot(title="Treasury Yield Curve, 2021")
```



And this is how it looks today. Note the inversion.

```
In [6]: today.hvplot(title="Treasury Yield Curve, 2022")
```



Demonstrated below is the most recent time before today that the yield curve inverted. Shortly following the inversion, the US subsequently went into a recession.

The yield curve began to invert in the second quarter of 2019, and the next quarter the US saw two consecutive periods of negative real GDP growth. See in the graphs below that there was a massive drop from the beginning of 2020 to the second quarter. This is attributed by some to COVID-19, but it can be seen that the yield curve began to invert well before the virus began to spread. The following steady positive growth was a result of massive Quantitative Easing.

```
In [7]: # Plot recent GDP
recent_gdp = gdp[289:382].hvplot(title="Real GDP 2019-04-01 to 2022-04-01", ylabel="Percent Change")
display(recent_gdp)

# Plot 2019 yield curve
recent_treasuries = treasuries.iloc[14999:].hvplot(title="Yield Curve, 2019-07-01", xlabel="Maturity", ylabel="Rate")
display(recent_treasuries)
```



The following cells will show GDP, gold price, and yield curves for each of the following: the 2008 mortgage crisis, the 2000 DotCom bubble burst, the 1980s recession, and a closer look at the 2019 financial crisis (above).

2000 DotCom Crash

The 2000 DotCom crash occurred due to a massive speculative bubble from 1995 to 2000. The use and adoption of the internet swelled, and many companies rose and fell. I'm going to take a look at the bond yield curve during a few periods in the years leading up to it. GDP will be in the range of 1996-2001, and the price of gold will be in the same timeframe.

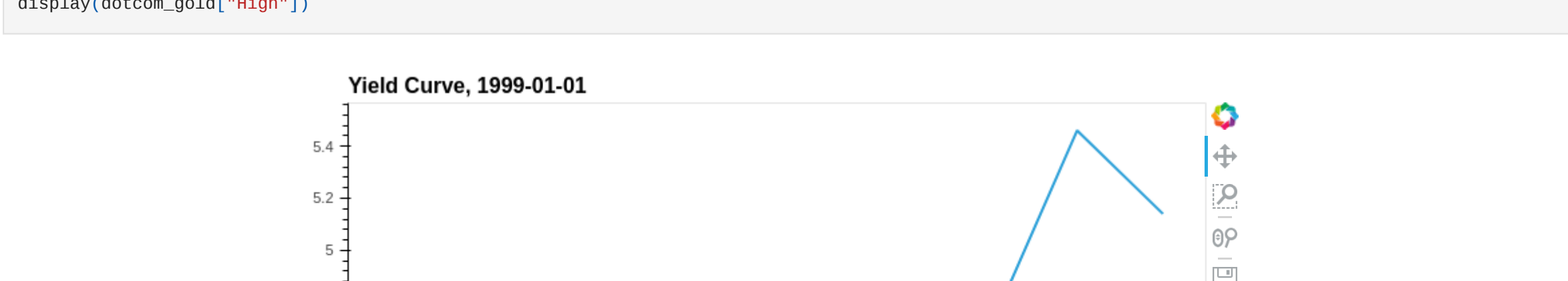
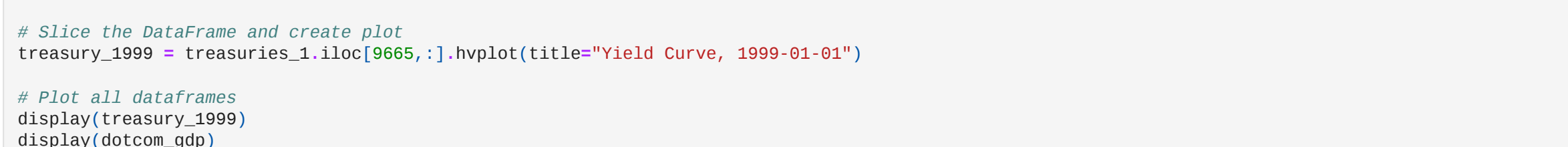
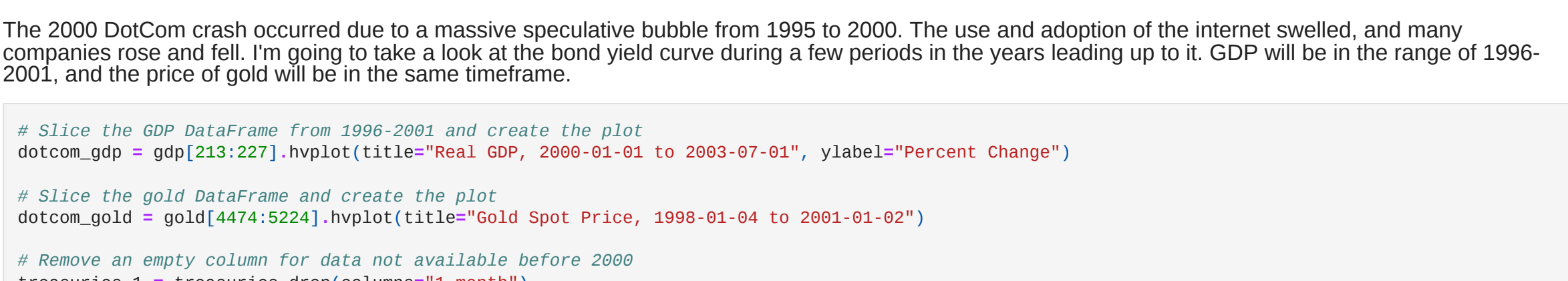
```
In [8]: # Slice the GDP DataFrame from 1996-2001 and create the plot
dotcom_gdp = gdp[213:227].hvplot(title="Real GDP, 2000-01-01 to 2003-07-01", ylabel="Percent Change")

# Slice the gold DataFrame and create the plot
dotcom_gold = gold[4474:5224].hvplot(title="Gold Spot Price, 1998-01-04 to 2001-01-02")

# Remove an empty column for data not available before 2000
treasuries_1 = treasuries.drop(columns="1-month")

# Slice the DataFrame and create plot
treasury_1999 = treasuries_1.iloc[9665:].hvplot(title="Yield Curve, 1999-01-01")

# Plot all dataframes
display(treasury_1999)
display(dotcom_gdp)
display(dotcom_gold["High"])
```



The treasury yield curve for January 1st 1999 was already beginning to invert. Just over a year later, the US experienced a recession. You may notice that the graph of GDP from 2000 to 2003 does not show two consecutive quarters of negative growth. It was instead a period of notable stagnation, and it matches what is called a "U-shaped recession". Growth remained weak for many years. Gold saw explosive growth of roughly 30% over the period of just a couple weeks. While there is no clear evidence that gold is it can at least be extrapolated that gold is viewed as a hedge during

2008 Subprime Mortgage Crash

```
In [9]: # Slice the GDP DataFrame from 1996-2001 and create the plot
subprime_gdp = gdp[237:251].hvplot(title="Real GDP, 2006-01-01 to 2009-07-01", ylabel="Percent Change")

# Slice the gold DataFrame and create the plot
subprime_gold = gold[2474:2979].hvplot(title="Gold Spot Price, 2007-01-02 to 2009-01-02")

# Slice the DataFrame and create plot
treasury_2007 = treasuries.iloc[11740:].hvplot(title="Yield Curve, 2007-01-01")

# Plot all dataframes
display(treasury_2007)
display(subprime_gdp)
display(subprime_gold["High"])
```



Here you can see that the yield curve was already drastically inverted at the very beginning of 2007. The 6-month bond yielded greater returns than the 30-year bond. There was a long period of stagnation and weak growth in GDP before it finally saw multiple consecutive quarters of negative growth. Gold prices rose steadily for a time between 2007 and mid 2008, before becoming volatile again. The US experienced higher inflation during this time, similar to what we are seeing today.

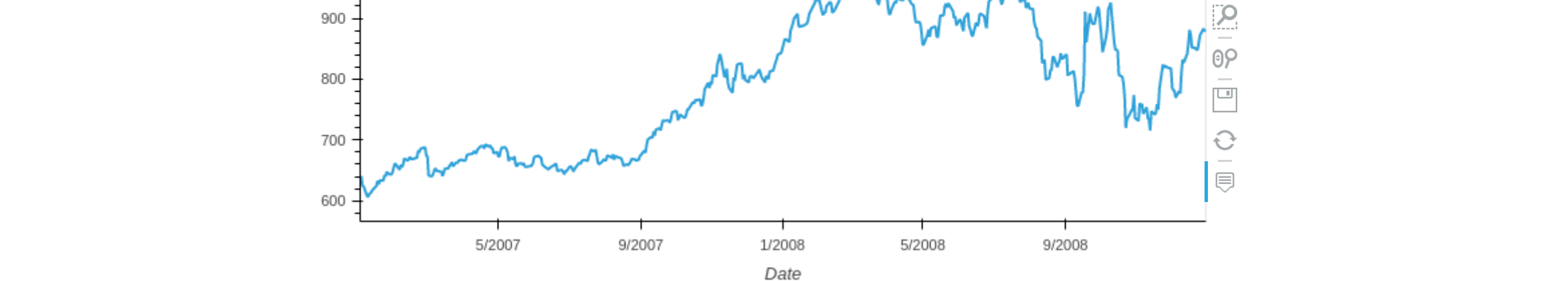
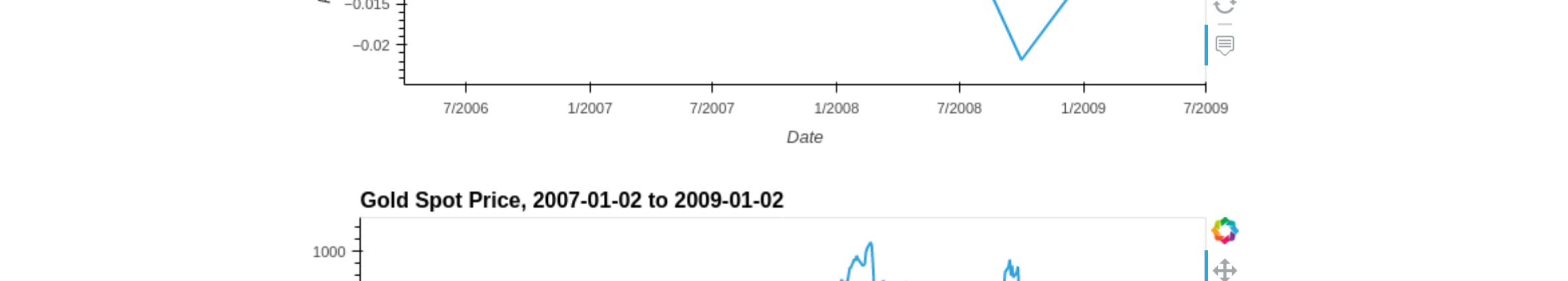
1980's Recession

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In [10]: # Slice the GDP DataFrame from 1996-2001 and create the plot
eighties_gdp = gdp[132:149].hvplot(title="Real GDP, 1979-01-01 to 1984-01-01", ylabel="Percent Change")

# Slice the gold DataFrame and create the plot
eighties_gold = gold[8759:9768].hvplot(title="Gold Spot Price, 1980-01-02 to 1984-01-03")

# Slice the DataFrame and create plot
treasuries_1 = treasuries.drop(columns=["1-month", "3-month", "6-month"])
treasury_1979 = treasuries_1.iloc[4436:].hvplot(title="Yield Curve, 1979-01-02")

# Plot all dataframes
display(treasury_1979)
display(eighties_gdp)
display(eighties_gold["High"])
```



Here you can see that the yield curve was already drastically inverted at the very beginning of 1979. This curve preceded a major slowdown in economic activity. You can see that the GDP remained largely unchanged for four years. It went slightly up and slightly down, but it barely increased during the entire duration. Gold saw a large decrease in price over the period of time plotted above. It lost more than 50% from its high at the time.

This recession was caused in part by contractionary monetary policy, similar to the situation we are in today. The Federal Reserve attempted to combat double digit inflation, as well as the effects of the energy crisis that occurred prior to the recession. Unemployment was also in a worse situation than it was today, which caused a second downturn when it looked like the economy was beginning to recover. This recession was W-shaped, and is the most recent example of this type of recession in the US.

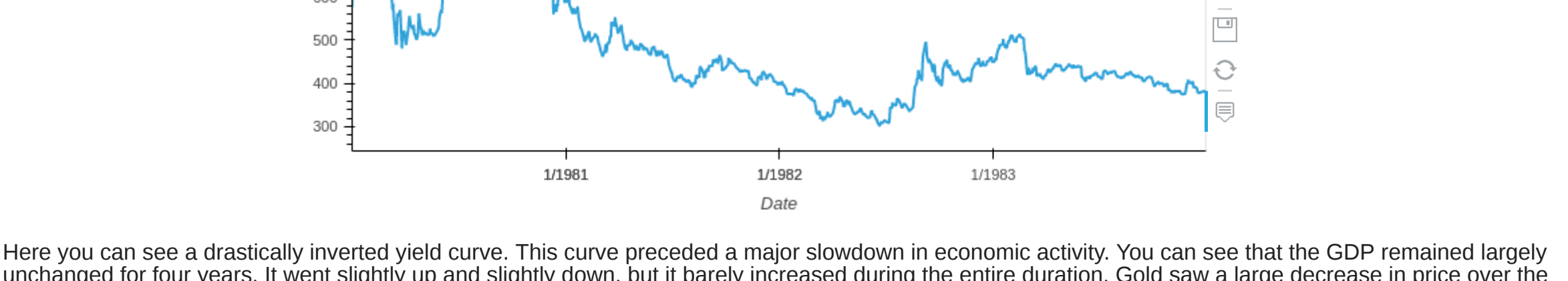
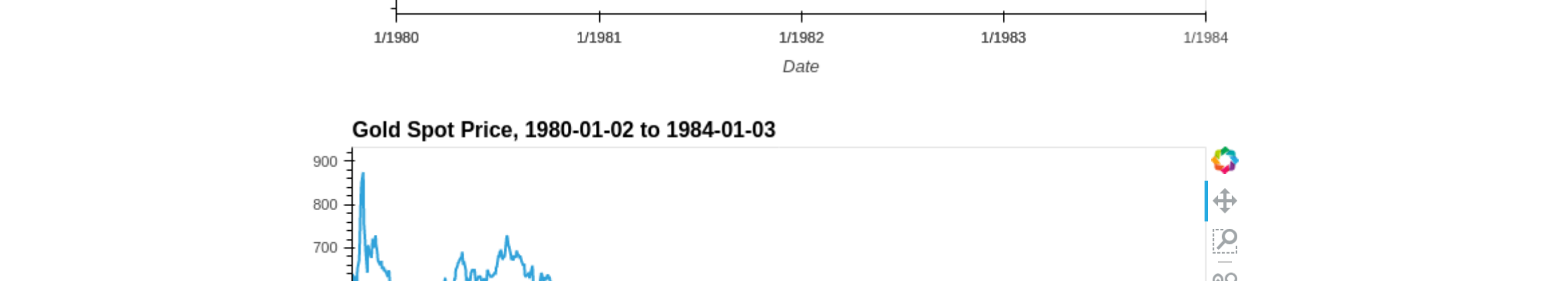
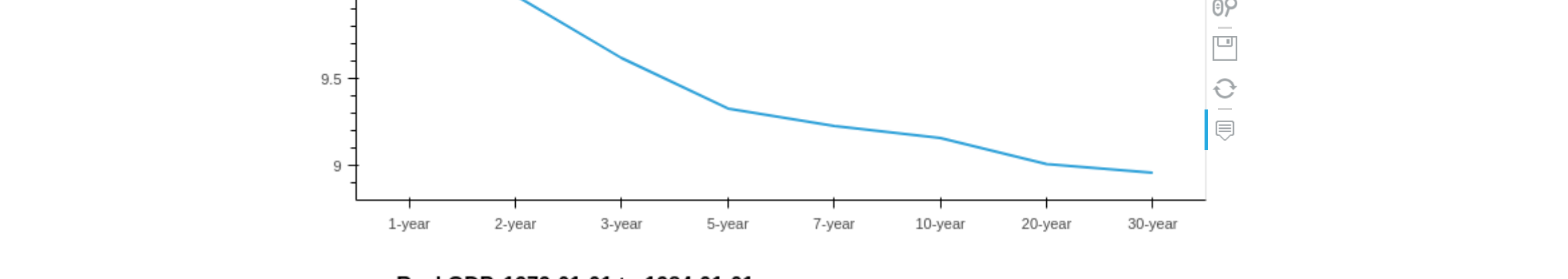
Coronavirus Pandemic Recession - Today

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In [11]: # Slice the GDP DataFrame from 1996-2001 and create the plot
covid_gdp = gdp[285:382].hvplot(title="Real GDP, 2018-01-01 to 2022-04-01", ylabel="Percent Change")

# Slice the gold DataFrame and create the plot
covid_gold = gold_current["Close/Last"].hvplot(title="Gold Spot Price, 2017-10-06 to 2022-10-06")

# Slice the DataFrame and create plot
treasury_2019 = treasuries.iloc[14872:].hvplot(title="Yield Curve, 2019-01-02")
treasury_2021 = treasuries.iloc[15395:].hvplot(title="Yield Curve, 2021-01-04")

# Plot all dataframes
display(treasury_2019)
display(treasury_2021)
display(covid_gdp)
display(covid_gold)
```



Here it can be seen that the bond yield curve began to invert in early 2019. There was economic stagnation from early 2018 to the middle of 2019, where it began to decline. Growth exploded during 2021 in the midst of the Coronavirus Pandemic, and then began to stagnate again. Now we are experiencing a period of high inflation after multiple quarters of the Federal Interest Rate at zero. Gold prices continued pretty steadily from 2018 to late 2020, and has since been volatile and tumultuous.

In conclusion, I think it can be observed that the bond yield curve inversion is a strong sign of economic downturn at some near period in the future. I think the US will experience a much deeper recession than it currently is, and the inflation metric that we are experiencing now is only the beginning. No solid evidence could be gathered from this data to determine whether institutions are pumping gold to make it more attractive to investors. It does seem to be evident that it is viewed as a hedge against inflationary times, though.

Given all of the data from previous recessions above, it seems quite clear to me that we are on the brink of something much worse than what we are currently experiencing.