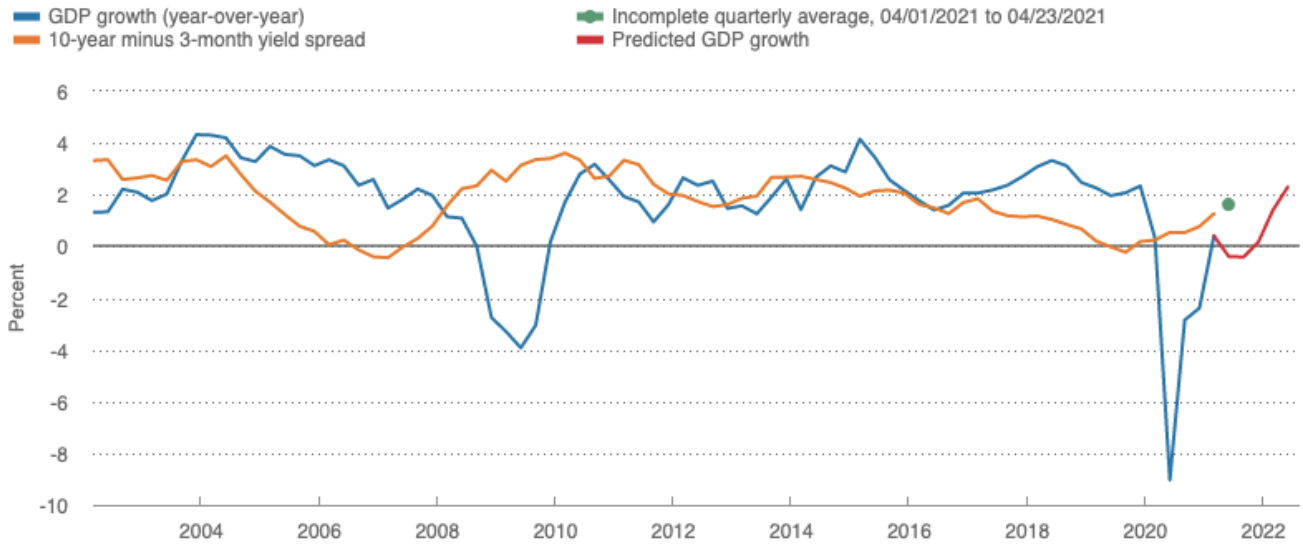
On the first Friday of every month, the U.S. BLS (Bureau of Labor Statistics) releases its report on employment data, and arguably most importantly, the unemployment rate for the previous month. This cyclical event plays a large factor in determining what the bond market might look like. The reason is because the employment data is analogous to a routine physical checkup at a doctor's office; it's how we gauge the overall health of the economy. In an article by Thomas Kenny in The Balance, he goes on to explain, "It is both an indicator of economic health – since a strong economy prompts companies to hire more workers – and an engine of growth, since higher employment means more dollars available to be spent on goods and services. Without job growth, overall economic growth is likely to be limited no matter what else is happening in other areas of the economy" (Thomas Kenny).

It's well established that the job market is correlated with the bond market and given recent events during the Covid-19 pandemic, the economy saw a rise in unemployment rates. The goal of this paper is to estimate the effect that unemployment rates had on treasury rates during the pandemic as well as how other independent variables effected treasury rates during the pandemic. The data I used for my regression analyses include unemployment rates from March 1, 2020, to February 1, 2021, and 10-year treasury rates from March 1, 2020, to February 1, 2021. In my data, I had 12 observations for unemployment rates for the 12-month period with an average rate of 8.56% a month and 12 observations for 10-year treasury yields for the 12-month period with an average rate of 0.82%. When modeling the single linear regression, holding unemployment rates as the independent variable and 10-year treasury rates as the dependent variables, I got a moderate negative correlation between the two variables with values R=-0.6218 and R-Squared=0.3866.

However, there are other variables that affect treasury rates; therefore, for modeling the multiple linear regression, I added two more independent variables: US Monthly GDP and federal

fund rates from a 12-month period (March 1, 2020, to February 1, 2021). In my data, I had 12 observations for federal fund rates for the 12-month period with an average rate of 0.13% a month and 12 observations for US monthly GDP for the 12-month period with an average GDP of $20.93 trillion per month. I added these two independent variables to the regression model because they both have an established effect on treasury rates. To elaborate, the federal fund rates have an inverse relationship with the bond market. As John Edwards explains in his article, "Assume an investor owns a bond that pays a 5% annual coupon rate. If interest rates go up to 6%, new bonds being issued reflect these higher rates. Investors naturally want bonds with a higher interest rate. This reduces the desirability of bonds with lower rates, including that bond paying only 5% interest. Therefore, the price for those bonds goes down to coincide with the lower demand" (John Edwards).

In addition, US Monthly GDP and treasury yields are also highly correlated. As shown in the graph below, they follow a very similar curve. There are of course anomalies in the data given extraordinary events such as the recession from 2008-2010 and the recent pandemic from 2020-2021. Nevertheless, they generally follow a similar trend.



Source: Bureau of Economic Analysis, Federal Reserve Board, Federal Reserve Bank of Cleveland, Haver Analytics

I used a variable natural logarithm of monthly treasury rates, LTreasury in the data set, as the dependent variable and chose a log-linear functional form for my model. The log-linear functional form allows to interpret effects that independent variables have on treasury rates in percentage terms and to capture some curvature in the relationships between treasury rates and the independent variables.

Since federal fund rates have a more established effect on treasury rates, my base regression model for estimating the rate of return on unemployment rates will be given by:

$$Ln(Treasury)_i=\beta_0+\beta_1 Unempl_i+\beta_2 FFR_i+\varepsilon_i$$

Table 3 shows the results of this equation. All the variables except for unemployment rates are significant at the 5% level; before making the conclusion that unemployment rates had no effect on 10-year treasury rates during the pandemic, I'm going to first add all the variables into the model before jumping to any conclusions. In addition, since the adjusted R^2=0.35726374, the results of this regression show that the model explains 35.73% of variance in log of monthly 10-year treasury rates in the sample.

Before taking all the independent variables into consideration, the next regression is modeled to see the effects of switching the federal fund rates out with US monthly GDP:

$$Ln(Treasury)_i=\beta_0+\beta_1 Unempl_i+\beta_2 Gdp_i+\varepsilon_i$$

Table 4 shows the results of this equation. Despite the fact that the adjusted R^2 decreased to 30.6% and the sum of squared residuals increased from 0.28638708 to 0.309199309, no variables here are statistically significant given that each variables respectable p-values are greater than 0.05.

The results so far don't seem promising. Finally, I ran the regression with all three independent variables:

$Ln(Treasury)_i=\beta_0+\beta_1 Unempl_i+\beta_2 Gdp_i+\beta_3 FFR_i+\varepsilon_i$

Table 5 shows the results of this equation. Similarly, even though the adjusted R^2 increased to 39.89% and the sum of squared residuals decreased to 0.238092852, none of the variables are statistically significant given that all the p-values are greater than 0.05.

We can further fortify this notion by conducting the F-test to check the overall adequacy of the model for predicting 10-year treasury rates:

H_0: $\beta_1=\beta_2=\beta_3=0$

H_A: At least one of the coefficients is not equal to 0.

$r=3$ $\quad$ $d.f=8$ $\quad$ $\alpha=0.05$

Test Statistics:

$F=3.43$

Rejection region:

$F> 4.0662$

We do not reject the null hypothesis at the 5% significance level since the F value is not in the rejection region. This indicates that the model is not adequate for explaining variability of 10-year treasury rates during the pandemic.

Furthermore, we'll perform the t-test to further show that unemployment rates, during the 12 months of the pandemic, had no positive effect on 10-year treasury rates:

H_0: $\beta_1=0$

H_A: $\beta_1>0$

$d.f=8$ $\quad$ $\alpha=0.05$ $\quad$ $t_{0.05}=1.859548$

Test statistics:

$$t=\frac{-14.41706548-0}{7.259444376}=-1.985973682$$

We, yet again, do not reject the null hypothesis at the 5% significance level since the t value is not in the rejection region. This confirms that unemployment rates (during the pandemic) didn't have a positive effect on 10-year treasury rates.

Conclusion

Under normal circumstances, the three independent variables used in this project (unemployment rates, US monthly GDP, and federal fund rates), have an effect on treasury rates. This is backed by historical data and other empirical evidence as already described above. However, like many other types of data, it's important to account for anomalies. This project did exactly that. It showed that given extraordinary events, in this case a pandemic due to Covid-19, anomalies in the data arise and sometimes making sense of them is harder than it seems. My regression analyses showed that during the 12 months of the pandemic (March 1, 2020, to February 1, 2021), variables such as unemployment rates, US monthly GDP, and federal fund rates, which usually effect treasury rates, were not statistically significant during the pandemic in terms of predicting treasury rates.

Table 1: Descriptive Statistics

Variables	Description	Mean	Median	Standard Deviation	Minimum	Maximum
Treasury	10-Year Treasury Rate	0.008175	0.0076	0.0018793283	0.0062	0.0126
LTreasury	Natural log of 10-Year Treasury Rate	−4.806674562	−4.879607032	−6.276840853	−5.083205987	−4.374058465
Unempl	Unemployment rate	0.085583333	0.0735	0.029940102	0.044	0.147
GDP	US Monthly GDP (in trillions)	20.92833333	21.255	0.96039778	18.58	21.99
FFR	Federal Fund Rate	0.0012916667	0.0009	0.0015776873	0.0005	0.0065

Table 2: Correlations

	Unempl	GDP	FFR
Unempl	1		
GDP	-0.8668	1	
FFR	-0.4882	0.0531	1

Table 3: Results of regression #1

Regression Statistics	
Multiple R	0.688567265
R Square	0.474124878
Adjusted R Square	0.35726374
Standard Error	0.178383818
Observations	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.258204341	0.12910217	4.057164646	0.055458972
Residual	9	0.28638708	0.031820787		
Total	11	0.54459142			

	Coefficients	***Standard Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***
Intercept	-4.319238913	0.203444168	-21.23058605	5.35899E-09	-4.779461595	-3.859016232
Unempl	-31.79098399	37.39984343	-0.850029868	0.417347225	-116.3953077	52.81333972
FFR	-5.494006204	1.970776773	-2.787736429	0.021131867	-9.952212997	-1.035799411

Table 4: Results of regression #2

Regression Statistics	
Multiple R	0.657446707
R Square	0.432236172
Adjusted R Square	0.306066433
Standard Error	0.18535231
Observations	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.235392111	0.117696056	3.425830745	0.078298734
Residual	9	0.309199309	0.034355479		
Total	11	0.54459142			

	Coefficients	***Standard Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***
Intercept	-4.618775664	2.609593282	-1.769921656	0.11052017	-10.5220858	1.284534472
Unempl	-4.451275014	3.584474069	-1.241820956	0.245688997	-12.5599187	3.657368677
GDP	0.00808631	0.111744865	0.072364038	0.943894857	-0.244698138	0.260870757

Table 5: Results of regression #3

Regression Statistics	
Multiple R	0.750203053
R Square	0.562804621
Adjusted R Square	0.398856354
Standard Error	0.172515525
Observations	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0.306498568	0.102166189	3.432818361	0.072396233
Residual	8	0.238092852	0.029761607		
Total	11	0.54459142			

	Coefficients	***Standard Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***
Intercept	1.813562068	4.818388498	0.376383529	0.71641791	-9.297661734	12.92478587
Unempl	-14.41706548	7.259444376	-1.985973683	0.082284347	-31.15737423	2.323243269
GDP	-0.251948995	0.197784933	-1.273853326	0.238475451	-0.70804187	0.204143879
FFR	-106.3173872	68.7825006	-1.545704013	0.160759138	-264.930118	52.2953436

Bibliography/Data

1. Kenny, Thomas. "Monthly Jobs Report and the Bond Market." The Balance. 23 March 2021 <https://www.thebalance.com/the-monthly-jobs-report-and-its-impact-on-the-bond-market-416878>

2. Edwards, John. "The Effect of Fed Fund Rate Hikes on Your Bond Portfolio." Investopedia. 6 October 2020 **<**https://www.investopedia.com/articles/investing/101515/effect-fed-fund-rate-hikes-your-bond-portfolio.asp>

3. <https://www.multpl.com/10-year-treasury-rate/table/by-month>

4. <https://www.statista.com/statistics/273909/seasonally-adjusted-monthly-unemployment-rate-in-the-us/>

5. <https://fred.stlouisfed.org/series/FEDFUNDS>

6. <https://ycharts.com/indicators/us_monthly_gdp>

7. < https://www.clevelandfed.org/en/our-research/indicators-and-data/yield-curve-and-gdp-growth.aspx>