# Test of Asset Pricing Models on Cruise Industry Stocks during Covid -19 Pandemic

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Abstract: This study investigates the performance of three predominant asset pricing models on three cruise line stocks (NCLH, CCL and RCL) before and after the covid -19 pandemic begun. I find that cruise line stocks' sensitivity to market volatility increased statistically significantly post covid-19 emergence period. Most factor coefficients in both Fama-French models increased during post covid 19 period. Three asset pricing models' performance in explaining excess returns increased post covid-19 period.

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*Keywords: CAPM, Fama-French factor model, Covid-19*

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## Introduction:

Covid-19 pandemic had adverse impact on different industries, specially, on the cruising industry. Cruise industry, which is a capital intensive industry, came to a standstill due to lockdowns imposed by the government. Coming from a peak on February 19, 2020 ,the pandemic induced a freefall of stock prices in the stock market. On March 1, 2020, stock price of Royal Caribbean Group (an industry leader in cruising industry) fell 75.9% from a peak attained just four months ago. Several studies tested the efficiency of asset pricing models during economic recessions. This paper attempts to investigate the explanatory power of three asset pricing models: CAPM, Fama-French 3 factor model and Fama-French 5 factor model during pre and post pandemic period. The industry chosen to test three asset pricing models, cruising industry, was specially hit hard by the pandemic. In this paper, I test the three models on three individual cruise ship stocks: Norwegian Cruise Line Holding Ltd. (NCLH), Carnival Corporation & PLC(CCL) and Royal Caribbean Group (RCL) before and after the pandemic had begun. Daily holding period return of the stocks were collected for the 6 months pre-Covid period (from August 1,2019 to January 31,2020) and 5 months post- Covid period(from February 1, 2020, to June 30,2020). Since WHO declared covid-19 a global pandemic on January 31, 2020, this day was chosen to be starting day of post covid-19 period in our analysis.

## Literature Review:

William Sharpe (1964) and John Lintner (1965) introduced the Capital Asset Pricing Model which has since been widely used in Asset Pricing to measure risk and to describe the relationship between risk and investment return. However, poor empirical tests suggests that CAPM is not ideal for application to real world problems (Fama and French,2004). Several empirical studies suggest

that explanation provided by beta coefficient includes several variables such as firm size, price ratios and market momentum. Fama and French (1993) argued that higher average return of small stocks and high book-to-market stocks begets the conclusion that these are unidentified state variables that must be priced separately than market betas and produces undiversifiable risks in returns. They find evidence that covariance in between smaller firms' stocks are higher than covariance between small and large firms' stocks, also, covariance in between value stocks are larger than covariance between value and growth firms' stocks. Based on the evidence, Fama and French (1992,1996) proposed a three-factor model of stock returns incorporating difference in returns of diversified portfolios of small and big sized firms' stocks and difference in returns of diversified portfolios of high and low book to market stocks. They find that much of the unexplained variation in returns by CAPM model, size and book to market equity, can be explained through this model. Moreover, Fama and French (1998) show that international version of the three-factor model performs better than international version of CAPM model. Novy-Marx (2003) showed that while explaining average return profitability (as measured by gross-profits to assets) high minus low has same prediction capability as book-to- market ratio. Despite having higher valuation ratio, profitable firms enjoy higher returns than unprofitable firms. Value strategies shows better outcomes in large and liquid stocks when controlled for profitability. Controlling for profitability also explains most of the earning related anomaly. Titman, Wei and Xie (2004) show that firms that increase their capital investment tends to receive lower return than the benchmark prediction over the following five-year period even though it received higher return over the previous period. The evidence provided in the paper suggest that investors incorrectly assess firms' empire building strategy. The variation in average returns related to profitability and investment was not explained by the three-factor model which led Fama and French (2015) to propose a model

that incorporates profitability and investment factors to the market, firm size, and book-to-market factors of the three-factor model. Fama and French (2014,2015,2017) finds that: The five-factors model does not fully resolve the anomalies resulting from cross sectional studies. Both three and five-factors model fail to explain less than average performance of small value growth stocks. In a five-factor model HML is redundant for explaining average returns as four factors model without HML derives same results. Although, five factors model performs well regionally it fails to replicate its performance globally. All five factors are significant for describing North American average returns for the period 1990-2015. In other regions, not all factors are important. In Europe and the Asia-Pacific region, small stocks that have low profitability and high investment earned low average returns.

Several studies have tested the efficiency of asset pricing models before and after the covid 19 pandemic. Horváth and Wang (2021) finds that covid 19 pandemic induced market downturn has led to decrease in R-squared from the Fama-French regression on us stock markets. Applying Fama French 5 factor model on service industry Liu (2020) showed that all five factors' betas were statistically significant during the COVID-19 period. Hou and Chen (2021) applied Fama-French 5-factor model on US steel industry and find changes in coefficients before and after the COVID-19 pandemic. Li and Duan (2021) used both the three factor and five factor model on thirty U.S. based industry portfolios and find that significance of all the factor coefficients have increased after the pandemic whereas five-factor model fared better than the three-factor model. Sun (2021) applied Fama-French five factor model on 49 Fama-French portfolios and finds that all the factor coefficients had strengthened after the pandemic had begun. Li, Bai and He (2020) showed both the factor models performed better post pandemic period when applied to US game industry.

**Empirical Method:**

Sharpe (1964) and Lintner's (1965) CAPM model can be written as:

$$R_{it} - R_{Ft} = a_i + b_i(R_{Mt} - R_{Ft}) + e_{it}$$

Where $R_{it}$ is the return on security or portfolio $i$ for period $t$, $R_{Ft}$ is the risk-free return, $R_{Mt}$ is the return on the value-weight market portfolio and $e_{it}$ is a zero-mean residual.

Fama and French (1993) three factor model can be written as:

$$R_{it} - R_{Ft} = a_i + b_i(R_{Mt} - R_{Ft}) + s_i SMB_t + h_i HML_t + e_{it}$$

Where, $SMB_t$ is the return on a diversified portfolio of small stocks minus the return on a diversified portfolio of big stocks, $HML_t$ is the difference between the returns on diversified portfolios of high and low book-to market stocks,

Lastly, Fama and French (2015) five factor model can be written as:

$$R_{it} - R_{Ft} = a_i + b_i(R_{Mt} - R_{Ft}) + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + e_{it}$$

Where, $RMW_t$ is the difference between the returns on diversified portfolios of stocks with robust and weak profitability, $CMA_t$ is the difference between the returns on diversified portfolios of the stocks of low and high investment firms. If the exposures to the five factors, $b_i$, $s_i$, $h_i$, $r_i$, and $c_i$, capture all variation in expected returns, the intercept $a_i$ in the equation is zero for all securities and portfolios $i$.

## Data:

Daily individual stock holding period returns are obtained from WRDS-CRSP database. Fama-French factors data are obtained from Kenneth French's data website[1].

## Results:

### A. Results from CAPM regression:

Table 1(a) and 1(b) below provides the result of CAPM regression for all three stocks.

***Table 1(a): CAPM regression results for the three stocks during pre-covid period***

| Ticker | | Coefficient | Std. Error | t-value | P-value | $R^2$ | S.E. of regression |
|---|---|---|---|---|---|---|---|
| NCLH | Alpha | 0.002 | 0.105 | 0.019 | 0.985 | 0.402 | 1.176 |
| | Beta | 1.146*** | 0.125 | 9.169 | 0.000 | | |
| CCL | Alpha | -0.112 | 0.142 | -0.791 | 0.430 | 0.308 | 1.593 |
| | Beta | 1.263*** | 0.169 | 7.455 | 0.000 | | |
| RCL | Alpha | -0.061 | 0.109 | -0.565 | 0.573 | .473 | 1.219 |
| | Beta | 1.373 | 0.130 | 10.595 | 0.000 | | |

***Table 1(b): CAPM regression results for the three stocks during post-covid period***

| Ticker | | Coefficient | Std. Error | t-value | P-value | $R^2$ | S.E. of regression |
|---|---|---|---|---|---|---|---|
| NCLH | Alpha | -0.526 | -0.916 | -0.574 | 0.567 | 0.353 | 9.34 |
| | Beta | 2.167*** | 0.291 | 7.460 | 0.000 | | |
| CCL | Alpha | -0.472 | 0.734 | -0.642 | 0.522 | 0.430 | 7.484 |
| | Beta | 2.043*** | 0.233 | 8.777 | 0.000 | | |
| RCL | Alpha | -0.368 | 0.761 | -0.483 | 0.63 | 0.379 | 7.757 |
| | Beta | 1.903*** | 0.241 | 7.889 | 0.000 | | |

[1] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html

The alpha coefficient is statistically not different from zero (in both periods) which supports the CAPM assumption that alpha is equal to zero. Betas of all three stocks are statistically significant at 1% level during both pre and post pandemic period. During pre-covid period all three betas were greater than 1 suggesting cruise line stocks are very sensitive to market volatility. During post-covid period all three betas almost doubled, suggesting cruise line stocks became more sensitive to market volatility post-covid outbreak. Which is not surprising since cruise industry was one of the industries that were affected most by the economic downturn induced by the coronavirus pandemic.

**B. Results from Fama-French 3-factor regressions:**

Table 2 below provides estimates of Fama-French regression on stocks data:

***Table 2(a): Fama-French 3-factor regression results for the three stocks pre-covid period***

| Ticker | | Coefficient | Std. Error | t-value | P-value | $R^2$ | S.E. of regression |
|---|---|---|---|---|---|---|---|
| NCLH | MKT | 1.107*** | 0.126 | 8.803 | 0.000 | 0.423 | 1.165 |
| | SMB | 0.122 | 0.242 | 0.503 | 0.616 | | |
| | HML | 0.314 | 0.198 | 1.585 | 0.116 | | |
| CCL | MKT | 1.157*** | 0.164 | 7.039 | 0.000 | 0.378 | 1.522 |
| | SMB | 0.659* | 0.316 | 2.089 | 0.039 | | |
| | HML | 0.468 | 0.259 | 1.811 | 0.073 | | |
| RCL | MKT | 1.307*** | 0.127 | 10.281 | 0.000 | 0.517 | 1.177 |
| | SMB | 0.273 | 0.244 | 1.119 | 0.265 | | |
| | HML | 0.457* | 0.200 | 2.285 | 0.024 | | |

***Table 2(b): Fama-French 3-factor regression results for the three stocks post-covid period***

| Ticker | | Coefficient | Std. Error | t-value | P-value | $R^2$ | S.E. of regression |
|---|---|---|---|---|---|---|---|
| NCLH | MKT | 1.376*** | 0.270 | 5.107 | 0.000 | 0.567 | 7.715 |
| | SMB | 1.777* | 0.721 | 2.465 | 0.015 | | |
| | HML | 2.232*** | 0.540 | 4.132 | 0.000 | | |
| CCL | MKT | 1.448*** | 0.218 | 6.655 | 0.000 | 0.613 | 6.230 |
| | SMB | 1.752** | 0.582 | 3.009 | 0.003 | | |
| | HML | 1.521*** | 0.436 | 3.485 | 0.000 | | |
| RCL | MKT | 1.330*** | 0.653 | 5.804 | 0.000 | 0.565 | 6.559 |
| | SMB | 1.975** | 0.613 | 3.222 | 0.002 | | |
| | HML | 1.358** | 0.459 | 2.956 | 0.004 | | |

Intercept coefficients in all the regressions are statistically not different from zero. Betas on MKT is statistically significant at 1% level for all the stocks during both pre and post covid period. As compared to pre-covid period MKT betas of NCLH, CCL and RCL increased by 24.3%, 25.2% and 1.75% respectively during post-covid period. Which again suggests the susceptibility of cruise stocks towards economic recession caused by COVID-19 pandemic. SMB factor captures the movement of stocks in response to size premium enjoyed by the small cap firms. During pre-covid period only SMB coefficient on CCL stock was statistically significant whereas SMB coefficients on all three stocks has shown to be statistically significant after the pandemic had started. HML factor describes the movement of a stock as compared to book-to-market premium. Post covid HML factor coefficients, while being highly statistically significant, demonstrates high increase as compared to the pre covid period. R-squared of the FF-3 regressions on all three stocks increased

significantly post covid period. Maintaining findings from previous studies that Fama-French may explain stock returns more efficiently during recession.

## C. Results from Fama-French 3-factor regressions:

***Table 3(a): Fama-French 5-factor regression results for the three stocks pre-covid period***

| Ticker | | Coefficient | Std. Error | t-value | P-value | $R^2$ | S.E. of regression |
|---|---|---|---|---|---|---|---|
| NCLH | MKT | 1.040*** | 0.138 | 7.545 | 0.000 | 0.430 | 1.167 |
| | SMB | 0.162 | 0.245 | 0.663 | 0.508 | | |
| | HML | 0.233 | 0.244 | 0.958 | 0.340 | | |
| | RMW | 0.550 | 0.440 | 1.349 | 0.214 | | |
| | CMA | -0.214 | 0.531 | -0.403 | 0.687 | | |
| CCL | MKT | 1.041*** | 0.179 | 5.826 | 0.000 | 0.396 | 1.513 |
| | SMB | 0.747* | 0.317 | 2.353 | 0.020 | | |
| | HML | 0.235 | 0.316 | 0.745 | 0.458 | | |
| | RMW | 1.036 | 0.571 | 1.814 | 0.072 | | |
| | CMA | -0.056 | 0.688 | -0.081 | 0.935 | | |
| RCL | MKT | 1.205*** | 0.138 | 8.745 | 0.000 | 0.533 | 1.167 |
| | SMB | 0.347 | 0.245 | 1.415 | .160 | | |
| | HML | 0.272 | 0.244 | 1.114 | 0.267 | | |
| | RMW | 0.892* | 0.440 | 2.027 | 0.045 | | |
| | CMA | -0.113 | 0.531 | -0.213 | 0.832 | | |

***Table 3(b): Fama- French 5-factor regression result for the three stocks post-covid period***

| Ticker | | Coefficient | Std. Error | t-value | P-value | $R^2$ | S.E. of regression |
|---|---|---|---|---|---|---|---|
| NCLH | MKT | 1.169*** | 0.261 | 4.485 | 0.000 | 0.636 | 7.143 |
| | SMB | 1.175 | 0.801 | 1.467 | 0.156 | | |
| | HML | 2.287*** | 0.648 | 3.530 | 0.000 | | |
| | RMW | 4.891*** | 1.274 | 3.840 | 0.000 | | |
| | CMA | -5.059* | 1.976 | -2.560 | 0.012 | | |
| CCL | MKT | 1.237*** | 0.213 | 5.811 | 0.000 | 0.667 | 5.835 |
| | SMB | 0.865 | 0.654 | 1.322 | 0.189 | | |
| | HML | 2.007*** | 0.529 | 3.794 | 0.000 | | |
| | RMW | 2.854** | 1.041 | 2.743 | 0.007 | | |
| | CMA | -5.343** | 1.614 | -3.310 | 0.001 | | |
| RCL | MKT | 1.121*** | 0.214 | 5.250 | 0.000 | 0.660 | 5.852 |
| | SMB | 1.359* | 0.656 | 2.070 | 0.041 | | |
| | HML | 1.428** | 0.531 | 2.690 | 0.008 | | |
| | RMW | 4.855*** | 1.044 | 4.652 | 0.000 | | |
| | CMA | -5.105** | 1.619 | -3.153 | 0.002 | | |

The results of five factor regression are almost similar to the three factor model results presented earlier. Coefficients of the new factor RMW which captures profitability premium (the return spread between profitable and unprofitable firm) changes from being insignificant (apart from RCL stock) in pre-covid time period to become statistically highly significant post-covid time period. The values of the coefficients also showed sharp increase during post covid time period.

Which suggests that volatility in profitability premium in the market are highly correlated with the return of cruise stocks during post-covid time period. Another new factor CMA (which captures the return spread between high investment firms and low investment firms), were negatively correlated with the cruise line stocks. Although, coefficients of CMA factor were statistically insignificant for all the three stocks during pre-covid period, they were statistically highly significant post-covid period with striking increase in absolute value for all the three stocks. R-squared values of the three regressions, which explains the explanatory power of FF-5 model, have increased substantially during post-covid period.

## Conclusion:

Cruise line industry was one of the most vulnerable sectors to the covid-19 pandemic. This paper finds that existing asset pricing models performs better in explaining the excess return enjoyed by individual cruise line stocks in post pandemic period as opposed to the pre pandemic period. Also, further studies could investigate efficiency of the existing asset pricing models on sectors that were affected most by a particular economic recession.

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## Appendix

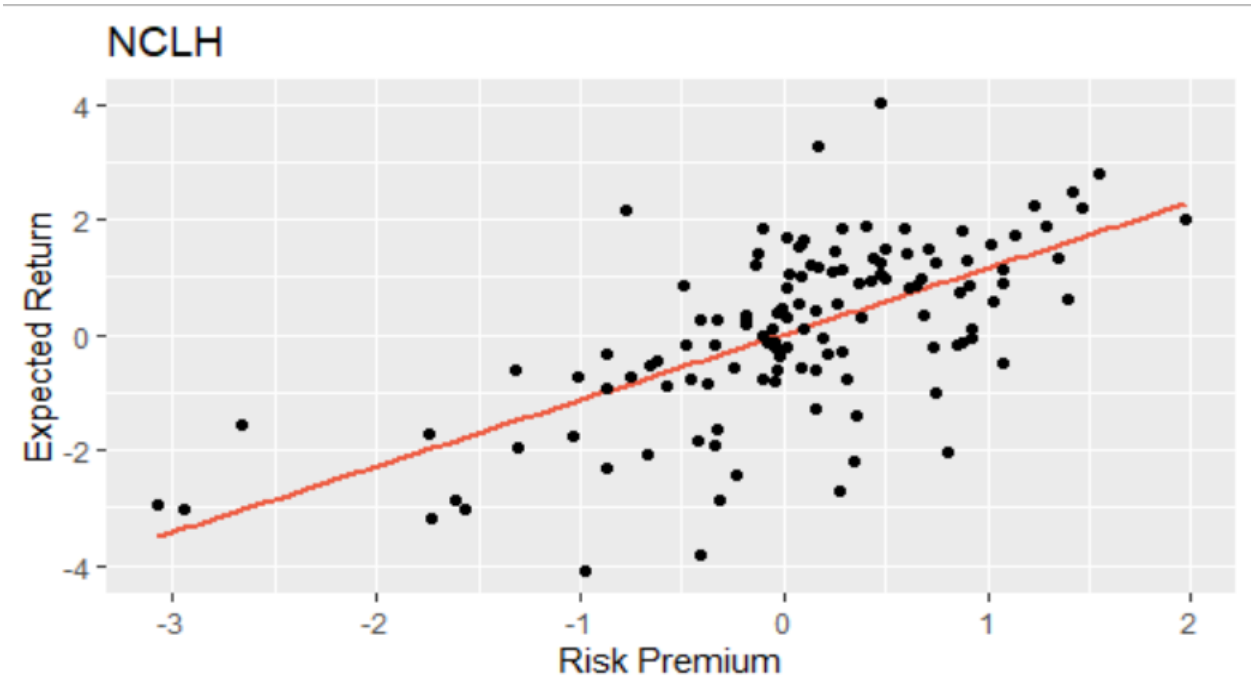


Figure 1(a): Plot of fitted CAPM regression on NCLH Pre- COVID return

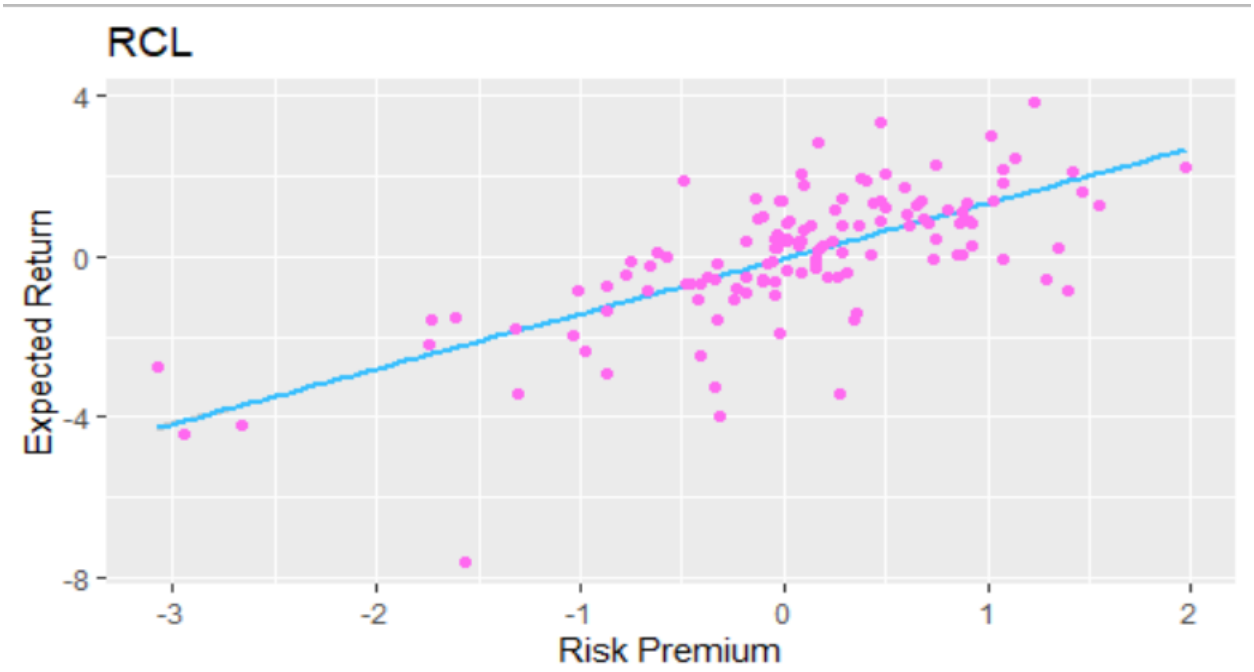


Figure 1(b): Plot of fitted CAPM regression on RCL Pre- COVID return

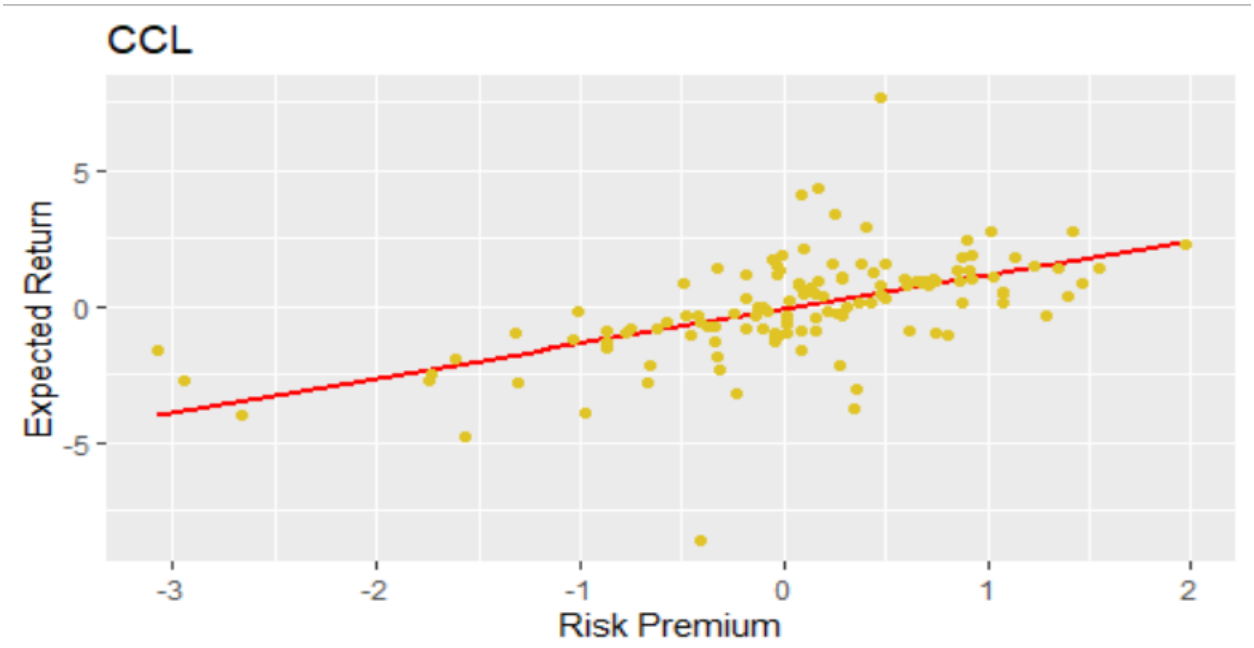


Figure 1(c): Plot of fitted CAPM regression on CCL Pre- COVID return

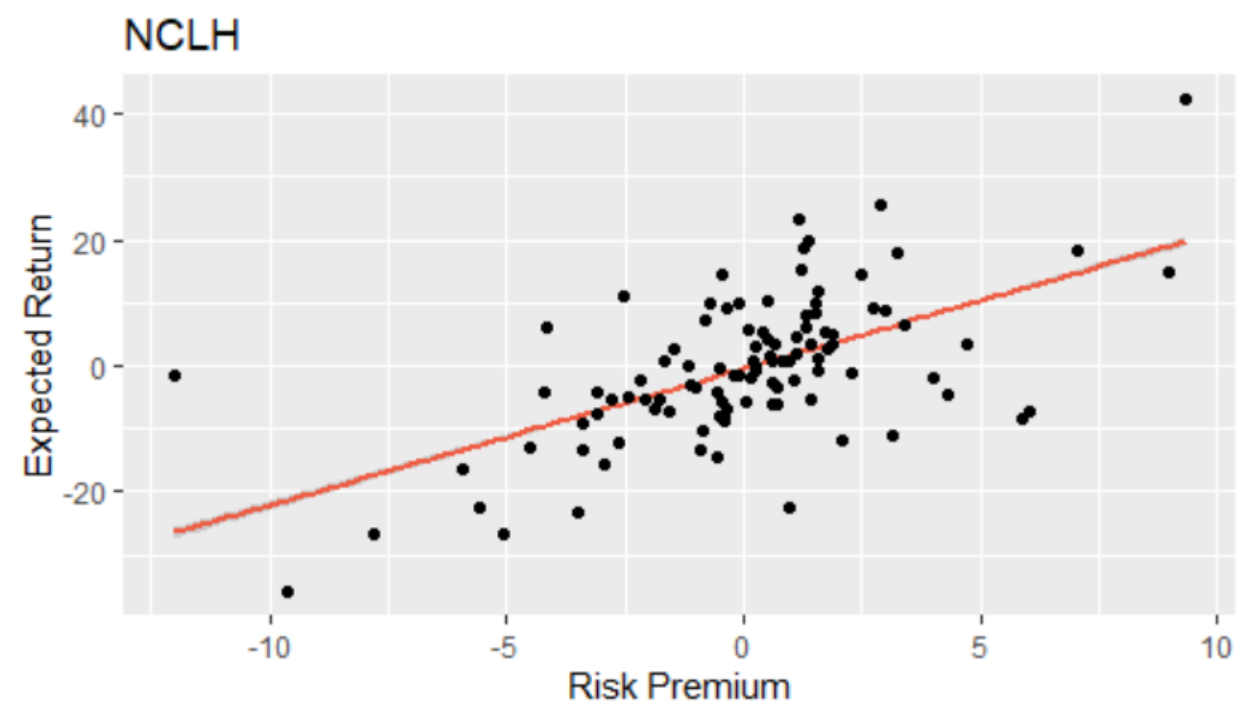


Figure 2(a): Plot of fitted CAPM regression on NCLH Post- COVID return

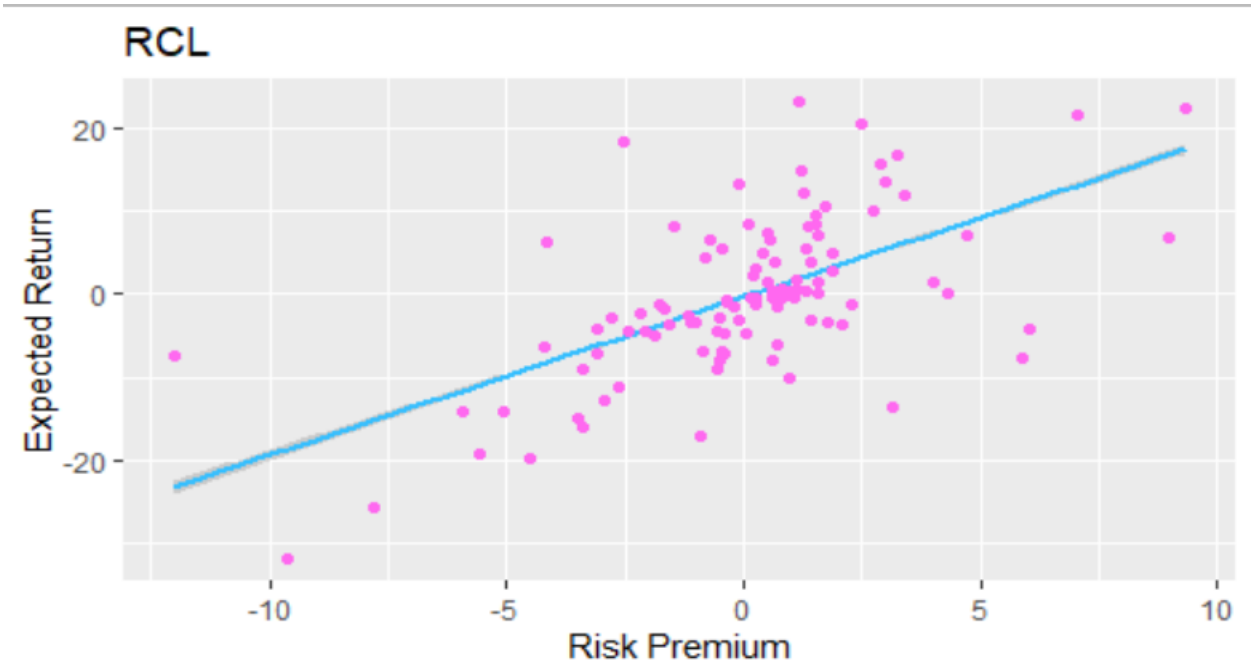


Figure 2(b): Plot of fitted CAPM regression on RCL Post- COVID return

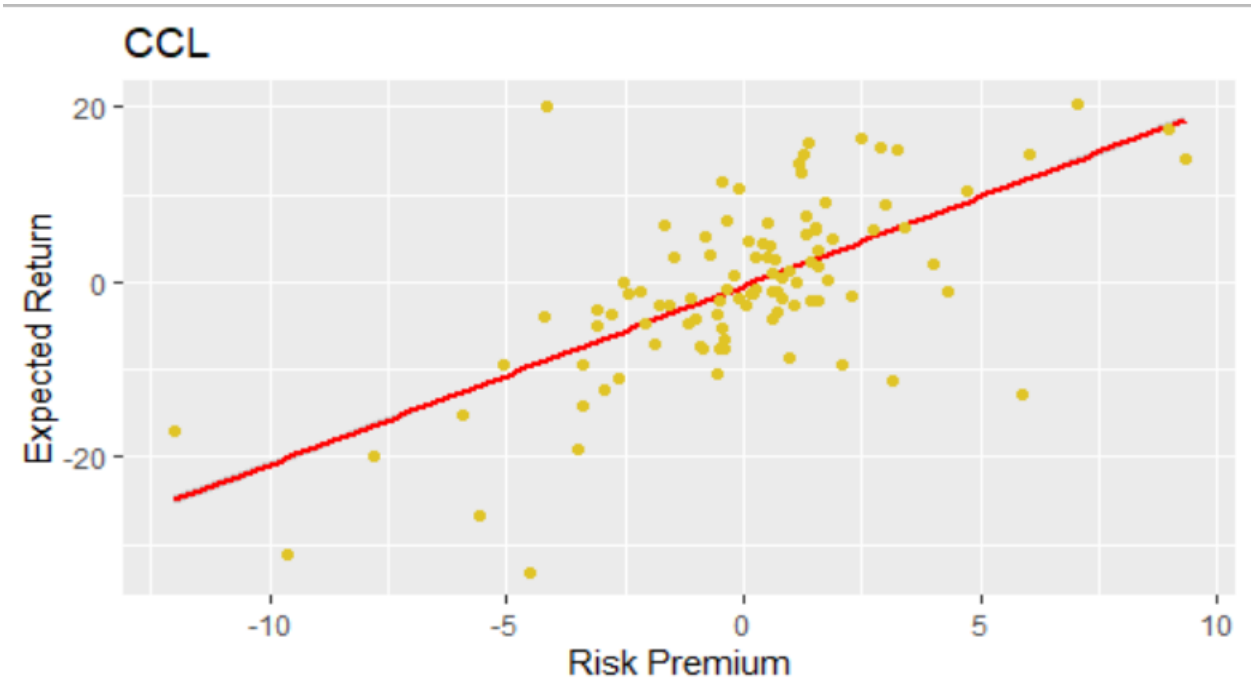


Figure 2(c): Plot of fitted CAPM regression on CCL post- COVID return