



# AUA

American University  
*of Armenia*

MORE THAN AN EDUCATION - A COMMITMENT

## Time Series Analysis

Analyzing the Impact of COVID-19 on Netflix's Stock Price"

Student: Ardash Kilejian  
Instructor: Narek Ohanyan

**Dilijan 2023**

## **Abstract**

This study aimed to investigate the relationship between the S&P 500 and Netflix stock prices, as well as the impact of the COVID-19 lockdown on Netflix's stock price. We found a significant positive correlation between the S&P 500 and Netflix stock prices using time series analysis. Specifically, for every one-unit increase in the S&P 500, Netflix stock prices increased by 10 percent. Additionally, our study revealed that the COVID-19 lockdown affected the rise in Netflix's stock price, but the results was not significant. However, after the reopening of stores and the resumption of everyday activities, the Netflix stock price began to decline. These findings suggest that the S&P 500 plays an essential role in influencing the stock price of Netflix and that external factors, such as the COVID-19 lockdown, can have both positive and negative effects on Netflix's stock price.

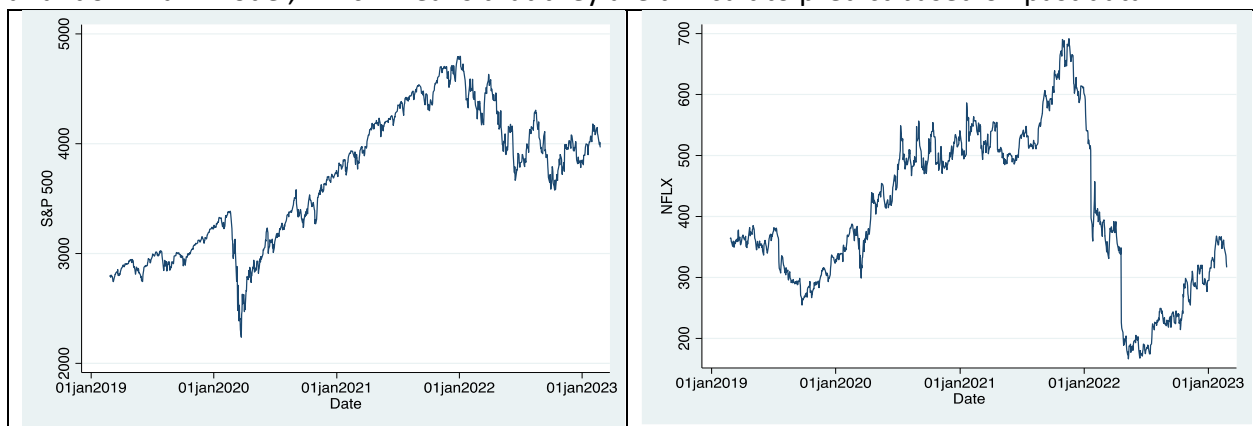
## **Methodology and Data**

This study used data from Yahoo Finance to investigate the impact of the S&P 500 and lockdown measures on Netflix's stock price. The study employed time series analysis and regression techniques to analyze the data. The results showed a significant positive correlation between the S&P 500 and Netflix's stock price. Specifically, for every one-unit increase in the S&P 500, Netflix's stock price increased by 11 unit. However, after the reopening of stores and the resumption of everyday activities, the Netflix stock price began to decline. These findings suggest that external factor such as the S&P 500 measures play a significant role in determining the stock price of Netflix on the other hand COVID-19 lockdown did not significantly effect. Overall, this study highlights the importance of considering external factors in understanding the dynamics of stock prices

$$NFLX = \beta_0 + \beta_1 \times SP500 + \beta_2 \times \text{Lockdown}$$

To investigate the autocorrelation between different lags of the stock price, we can conduct an autocorrelation test. This will help us understand if there is any significant correlation between the stock price at different points in time, and if so, what the nature of that correlation might be. By analyzing the results of the autocorrelation test, we can gain insight into the underlying patterns of the stock price data and potentially make more informed investment decisions.

As we see in the graphs we have a random walk, stock prices are generally considered to follow a random walk model, which means that they are difficult to predict based on past data



<pre>. corrgram SP500, noplot lags(8) (note: time series has 215 gaps)</pre>					<pre>. corrgram NFLX, noplot lags(8) (note: time series has 215 gaps)</pre>				
LAG	AC	PAC	Q	Prob>Q	LAG	AC	PAC	Q	Prob>Q
1	0.7855	0.9964	624.47	0.0000	1	0.7836	0.9952	621.4	0.0000
2	0.5844	0.1108	970.38	0.0000	2	0.5795	0.0382	961.55	0.0000
3	0.5605	0.0456	1288.9	0.0000	3	0.5508	0.0627	1269.2	0.0000
4	0.5592	-0.0115	1606.3	0.0000	4	0.5518	-0.0278	1578.3	0.0000
5	0.5784	.	1946.2	0.0000	5	0.5772	.	1916.8	0.0000
6	0.7739	.	2555.3	0.0000	6	0.7728	.	2524.2	0.0000
7	0.9515	.	3477	0.0000	7	0.9477	.	3438.6	0.0000
8	0.7711	.	4082.9	0.0000	8	0.7702	.	4043.1	0.0000
					.				

Upon observation, it was noted that there is autocorrelation present in both the S&P500 and the Netflix stock price.

In the next step let us run a regression to look at significance level of variables

```
. reg NFLX SP500 Lockdown_b, noconstant
```

Source	SS	df	MS	Number of obs	=	1,009
Model	167490476	2	83745238.1	F(2, 1007)	=	6115.89
Residual	13788900.2	1,007	13693.0488	Prob > F	=	0.0000
				R-squared	=	0.9239
				Adj R-squared	=	0.9238
Total	181279376	1,009	179662.415	Root MSE	=	117.02

NFLX	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
SP500	.1082831	.0010014	108.13	0.000	.1063181	.1102481
Lockdown_b	109.602	17.8576	6.14	0.000	74.55958	144.6443

Upon observation, we noticed an unusual phenomenon where all independent variables were found to be highly significant, and the  $R^2$  value was also very high. However, we also discovered the presence of autocorrelation, which suggests that our results may not be entirely accurate. It might be a spurious regression. We since both stock price of Netflix and SP500 look non-stationary. We ran a Dicky fuller test to check the stationarity

By running Dicky Fuller test:

```
. dfuller NFLX, lags(1) trend
```

Augmented Dickey-Fuller test for unit root                      Number of obs    =        **1007**

Test Statistic	Interpolated Dickey-Fuller		
	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	<b>-1.380</b>	<b>-3.960</b>	<b>-3.410</b>

MacKinnon approximate p-value for Z(t) = **0.8666**

```
. dfuller SP500, lags(1) trend
```

Augmented Dickey-Fuller test for unit root                      Number of obs    =        **1007**

Test Statistic	Interpolated Dickey-Fuller		
	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	<b>-1.550</b>	<b>-3.960</b>	<b>-3.410</b>

MacKinnon approximate p-value for Z(t) = **0.8115**

We see that Netflix and S&P500 are nonstationary

```
. vecrank NFLX SP500, lags(1)
```

Johansen tests for cointegration

Trend: constant    Number of obs =        **1008**  
Sample: 26feb2019 - 24feb2023    Lags =        **1**

maximum		LL	eigenvalue	trace statistic	5% critical
rank	parms				value
<b>0</b>	<b>2</b>	<b>-9128.7918</b>	<b>.</b>	<b>10.0708*</b>	<b>15.41</b>
<b>1</b>	<b>5</b>	<b>-9126.1659</b>	<b>0.00520</b>	<b>4.8190</b>	<b>3.76</b>
<b>2</b>	<b>6</b>	<b>-9123.7564</b>	<b>0.00477</b>		

It indicates that the test statistic exceeds the 5% critical value and suggests insufficient evidence to support the presence of cointegration at the zero ranks.

The trace statistic for rank 1 is 4.8190, below the 5% critical value of 3.76, suggesting evidence of cointegration at the first rank.

The trace statistic for rank 2 is 0.00477, lower than the trace statistic for rank 1, indicating that the second rank only provides significant additional explanatory power beyond the first rank.

We take a difference of dependent and independent variables to make nonstationary data into stationary as we see that p value in both cases are highly significant now, we can say we have two stationary variables now we can run a regression and get precise results.

By running Dicky Fuller test:

```
. dfuller d.SP500, regress lag(0)
```

Dickey-Fuller test for unit root Number of obs = 1007

	Test Statistic	Interpolated Dickey-Fuller		
		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	<b>-36.001</b>	<b>-3.430</b>	<b>-2.860</b>	<b>-2.570</b>

MacKinnon approximate p-value for Z(t) = **0.0000**

D2.SP500	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
SP500						
LD.	-1.126903	.0313016	-36.00	0.000	-1.188327	-1.065479
_cons	1.321232	1.519676	0.87	0.385	-1.660868	4.303333

```
. dfuller d.NFLX, regress lag(0)
```

Dickey-Fuller test for unit root                      Number of obs    =         **1007**

		Interpolated Dickey-Fuller		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	<b>-33.124</b>	<b>-3.430</b>	<b>-2.860</b>	<b>-2.570</b>

MacKinnon approximate p-value for Z(t) = **0.0000**

D2.NFLX	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
NFLX LD.	-1.044	.0315182	-33.12	0.000	-1.105849	-.9821511
_cons	-.0492467	.365469	-0.13	0.893	-.7664165	.6679231

By running a new regression, we got

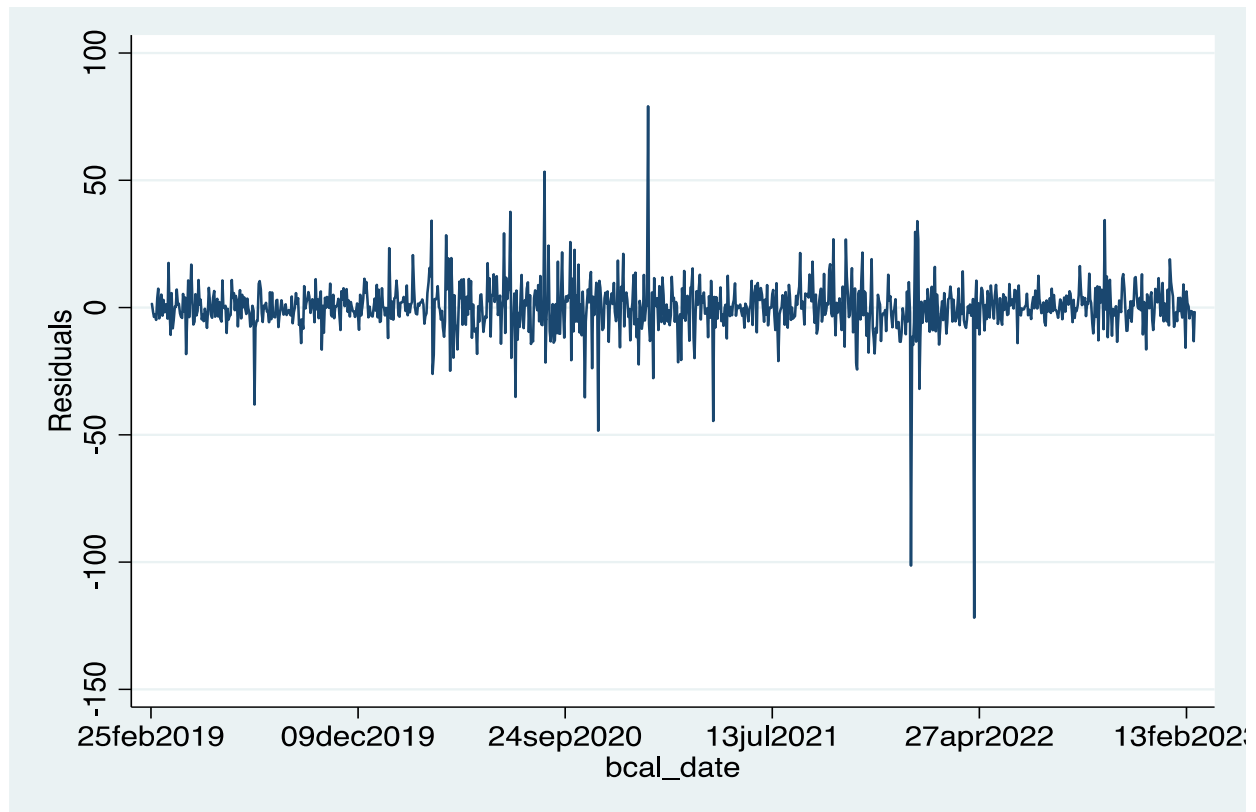
**. reg d.NFLX d.SP500 Lockdown\_b**

Source	SS	df	MS	Number of obs	=	1,008
Model	27635.5469	2	13817.7735	F(2, 1005)	=	128.82
Residual	107801.288	1,005	107.264963	Prob > F	=	0.0000
				R-squared	=	0.2040
				Adj R-squared	=	0.2025
Total	135436.834	1,007	134.495367	Root MSE	=	10.357

D.NFLX	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
SP500 D1.	.107636	.006734	15.98	0.000	.0944217	.1208504
Lockdown_b	.8086203	1.599471	0.51	0.613	-2.330066	3.947306
_cons	-.2070402	.3335927	-0.62	0.535	-.8616582	.4475779

After running a regression analysis with differenced variables, we observed a decrease in the R<sup>2</sup> value. Interestingly, the lockdown variable lost its significance, while the SP500 variable remained highly significant. Specifically, we found that for every one unit increase in the SP500, the stock price of Netflix increased nearly by 11 unit. And we got a Residuals white noise.



## Conclusion

the S&P 500 index had a significant positive correlation with the Netflix stock price. Additionally, the COVID-19 lockdown measures have affected the rise in Netflix's stock price. However, it is not significant, and this effect diminished after the reopening of stores and the resumption of everyday activities. Overall, this study highlights the importance of considering external factors, such as the S&P 500 index and COVID-19 lockdown measures, in understanding the dynamics of stock prices. It also suggests that while the COVID-19 pandemic may have temporarily impacted the stock price of Netflix, the company's long-term success may depend on factors beyond the pandemic.

## Reference

Kshetri, N., & Kshetri, N. (2020). Covid-19 meets big tech. *health*, 2.  
 Pisal, S. (2021). Rise of facebook, amazon, apple, netflix, google during COVID-19 pandemic.  
 Curto, J. D., & Serrasqueiro, P. (2022). The impact of COVID-19 on S&P500 sector indices and FATANG stocks volatility: An expanded APARCH model. *Finance Research Letters*, 46, 102247.