JPMorgan Chase & Co (NYSE: JPM)

$152.86 / Share (July 22, 2021)

JPMorgan Chase & Co is a global financial services firm that provides products and services to a large and diversified clientele, including corporations, governments, and individuals. The firm operates its business through four segments: Asset & wealth management; consumer & community banking includes consumer & business banking, home lending, and car & auto; corporate & investment banking includes banking, and markets & securities services; commercial banking includes commercial real estate banking, corporate client banking, and middle market banking.

DCF Valuation

Model used: 3-stage dividend discount model

Why 3 stage?

JPM has announced plans to increase their focus on private banking and asset & wealth management. This move will open up new opportunities for the firm to take up more strategic positions. Additionally, the firm plans on strengthening their U.S. retail banks by equipping them with relationship bankers. However, financial institutions are consolidating their capital to enter the investment banking industry. This could cut down the lucrative aspect of JPM's business by reducing fees and introducing increased government regulation, which would likely slow down JPM's growth after 5 years.

Why DDM?

JPM has consistently given out dividends in the past and is likely to continue with regular increasing dividends in the future.

Beta Calculation

For financial firms we do not unlever and relever the beta since D/E of a financial firm does not have the same meaning as nonfinancial firms. Moreover, financial firms are much more homogeneous with respect to capital structure.

Cost of Equity	6.90%
Net Income	$47,827
Earnings per Share	$3.75
Growth rate in EPS	*15.00%*
Payout Ratio for high growth phase	24.02%

	1	2	3	4	5	6	7	8	9	10
Expected Growth Rate	15.00%	15.00%	15.00%	15.00%	15.00%	12.60%	10.20%	7.80%	5.40%	3.00%
Earnings per share	$4.31	$4.96	$5.70	$6.55	$7.54	$8.49	$9.35	$10.08	$10.63	$10.95
Payout ratio	24.02%	24.02%	24.02%	24.02%	24.02%	37.21%	50.41%	63.61%	76.80%	90.00%
Dividends per share	$1.04	$1.19	$1.37	$1.57	$1.81	$3.16	$4.71	$6.41	$8.16	$9.85
Cost of Equity	6.90%	6.90%	6.90%	6.90%	6.90%	6.90%	6.90%	6.90%	6.90%	6.90%
Cumulative Cost of Equity	106.90%	114.27%	122.15%	130.57%	139.57%	149.20%	159.49%	170.49%	182.24%	194.81%
Present Value	$0.97	$1.04	$1.12	$1.21	$1.30	$2.12	$2.96	$3.76	$4.48	$5.06

Growth Rate in Stable Phase	3.00%
Payout Ratio in Stable Phase	90.00%
Cost of Equity in Stable Phase	6.90%
Price at the end of growth phase	$260.44

Value of assets in place	$54.34
Value of stable growth	$34.82
Value of extraordinary growth	$68.52
Value of the stock	**$157.69**

Relative Valuation

I performed a regression on 9 financial institutions with a market cap greater than $100B because they should trade similarly with JPM. I used a Price to Book value ratio because the strength of the relationship between price to book ratios and returns on equity should be stronger for financial service firms than for other firms, because the book value of equity is much more likely to track the market value of equity invested in existing assets. Similarly, the return on equity is less likely to be affected by accounting decisions.

Company	Beta	ROE	Q4 2021 EPS Estimate	Price to Book Ratio	Market Cap (B)
Morgan Stanley	1.38	12.00%	$1.57	1.34	$169.31
Wells Fargo	1.24	1.77%	$0.94	0.76	$184.20
Bank of America	1.31	6.66%	$0.75	1.06	$319.88
HSBC	0.72	2.48%	$0.75	0.61	$110.04
Citi	1.47	5.60%	$1.68	0.71	$137.02
Royal Bank Canada	0.84	13.43%	$2.25	1.64	$140.85
Goldman Sachs	1.24	10.16%	$8.87	1.07	$123.93
HDFC	0.84	16.49%	$0.74	3.92	$106.88
Toronto Dominion	0.9	12.99%	$1.59	1.19	$117.54
Median	***1.24***	***10.16%***	***1.57***	***1.07***	***$137.02***
JPM	*1.19*	*10.72%*	*$2.84*	*1.55*	*$453.22*

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.73	1.37	0.53	0.62	-2.79	4.24
Beta	-0.46	1.04	-0.44	0.68	-3.13	2.21
ROE	14.74	5.54	2.66	0.04	0.49	28.99
Q4 2021 EPS Estimate	-0.09	0.11	-0.83	0.44	-0.37	0.19

Removing the noise and regressing the price to book ratios against the return on equity and beta yields the following:

PBV = 14.74(ROE)

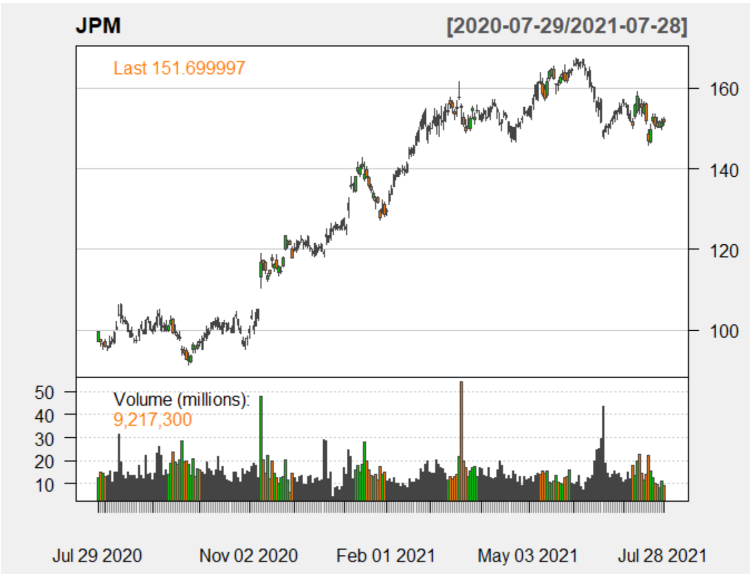
R squared: 65%

Using the equation above, JPM should have a PBV of 1.55, which is similar to its true PBV.

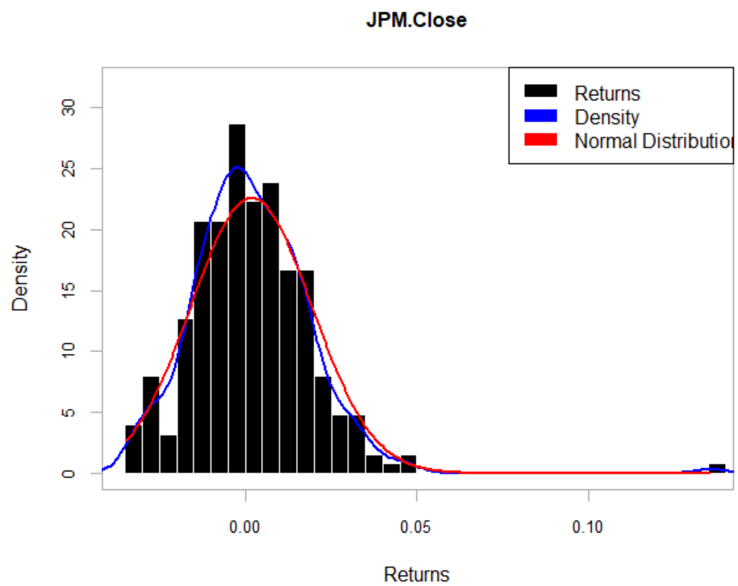
PBV	1.55
Number of Shares	3,036.60
Equity BV	286,386.00
Book Value/ Share	94.31
Market Price/ Share	**146.18**

Volatility Modelling

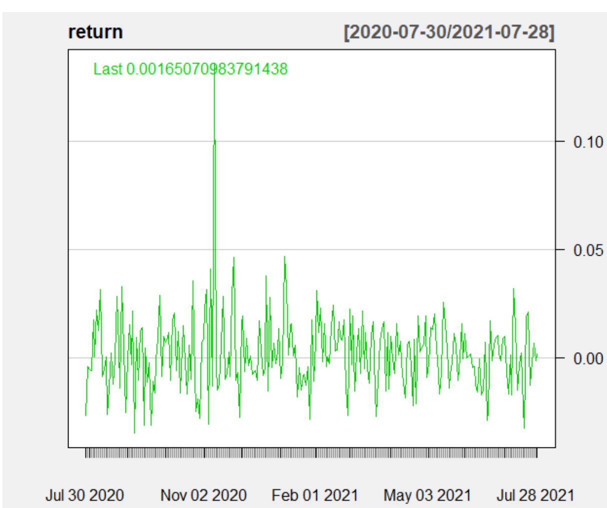
After analyzing the valuations, I applied a Generalized AutoRegressive Conditional Heteroskedasticity (GARCH) model to forecast the volatility of the stock.

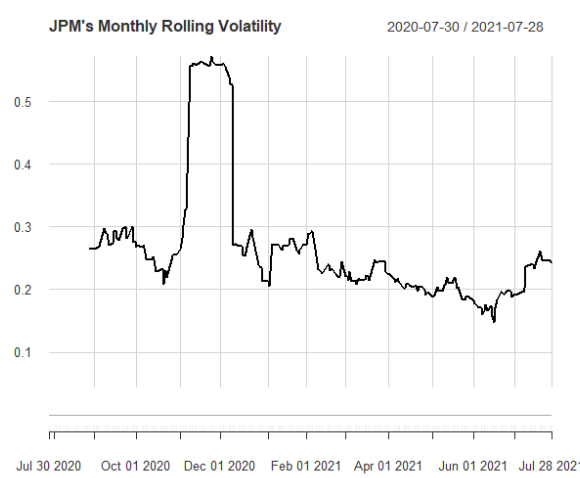


The charts show that returns of JPM are approximately normal, with a mean of zero. JPM's stock received extraordinary growth in Nov. 2020 increasing the stock price by $20. Additionally, I used 1-year historic data to reduce the effect of the Covid-19 pandemic on the volatility of stock prices.



The monthly rolling volatility graph shows the the average volatiliy in JPM's stock in a month (22 trading days) window. The graph has a lot of fluctuations, but we can see that the graph is stationary (constant mean and variance) and has no seasonality or trends.





Fitting the model gives the equations below for JPM's stock:

sGARCH(1,1)

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Optimal Parameters
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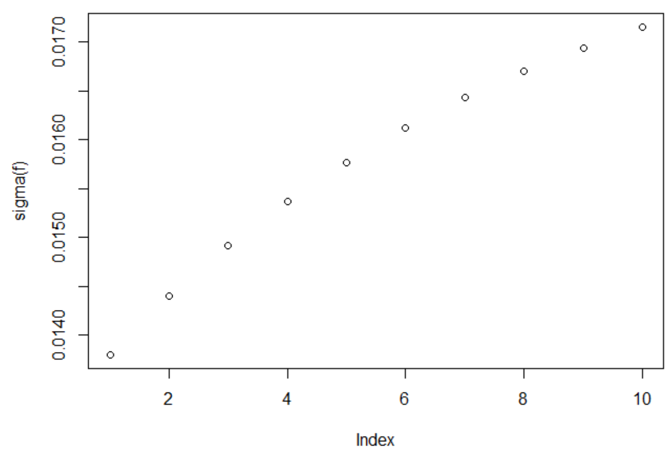
        Estimate  Std. Error  t value Pr(>|t|)
mu      0.001873    0.001011   1.8534 0.063823
omega   0.000036    0.000024   1.4960 0.134653
alpha1  0.191170    0.084755   2.2556 0.024098
beta1   0.709105    0.127609   5.5568 0.000000
```

$$Returns_t = 0.001873 + e_t\,;\ e_t \sim iid(0, \sigma^2)$$

$$\sigma^2 = 0.000036 + 0.191170(e_{t-1})^2 + 0.709105\ (\sigma_{t-1})^2$$



Solving the differential equation recursively to forecast volatility, we can see that over the next 10 days, the model predicts that the volatility of JPM's stock will increase, then slowly decrease exponentially. I chose to forecast the next 10 days because Christoffersen and Diebold (2000) argue that extrapolations greater than 10 days tend to be inaccurate.

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Weighted Ljung-Box Test on Standardized Residuals
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                        statistic p-value
Lag[1]                    0.01893  0.8906
Lag[2*(p+q)+(p+q)-1][2]   0.16546  0.8759
Lag[4*(p+q)+(p+q)-1][5]   0.77366  0.9084
d.o.f=0
H0 : No serial correlation
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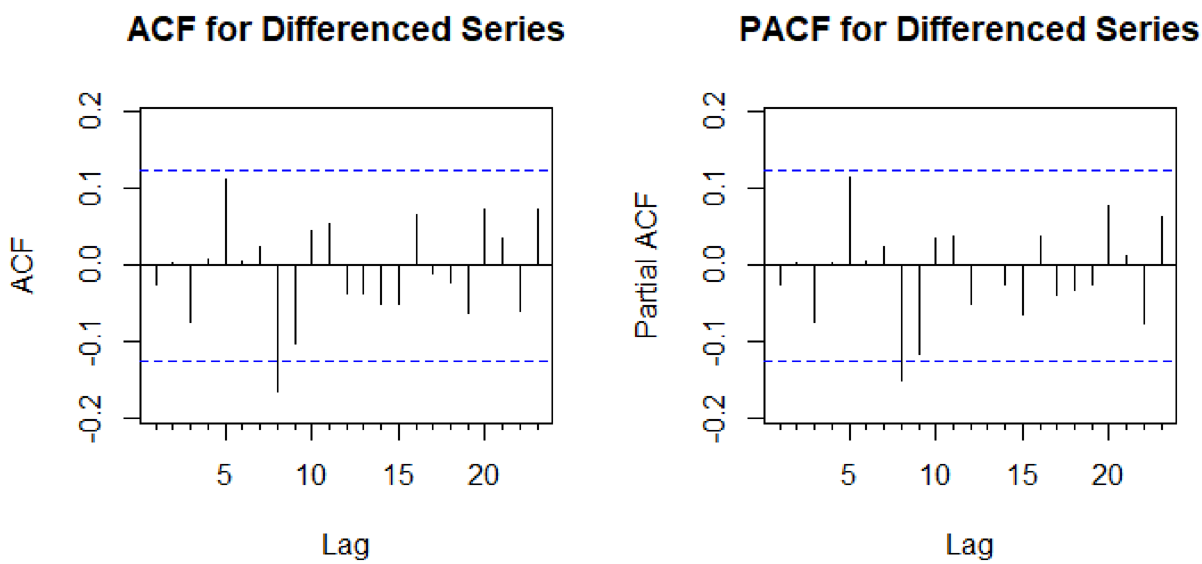
The p-value is higher than 5%, meaning that there is not enough evidence to reject the null hypothesis. Conclusion: There is no serial correlation of the error term.

Forecasting Prices

We will forecast the prices using an AutoRegressive Integrated Moving Average (ARIMA) model. The historical prices cover 2020-08-01 to 2021-08-01. Initially, I modelled longer historical data, but I found that going back 10 years would place equal importance on 10-year-old stock prices and today's stock prices. When I chose 2 years, the model was getting affected by the significant increase in volatility brought by the Covid-19 pandemic in Q1 2020.

The stock prices have an Augmented Dickey-Fuller Test (ADF) p-value of 0.7394. This means that the series is nonstationary, and that we need to difference it. Differencing the stock prices once gives an ADF Test p-value less than 0.01, which means that the first-order difference is stationary. This suggests we should use ARIMA(p,1,q).

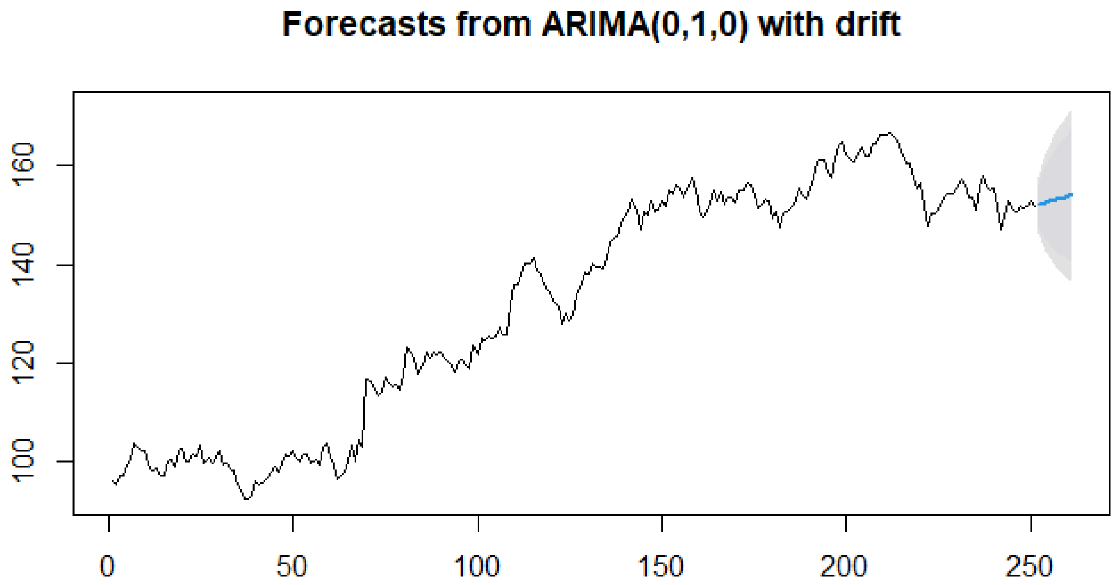


The maximum significant lag values of the correlogram (ACF) gives the possible q values, while the maximum significant lag values of the partial correlogram (PACF) gives the possible q values for the ARMA model. There are p = 1 significant lags in the ACF, and q = 1 significant lags in the PACF. The preliminary analysis suggests the use of ARIMA(1,1,1).

Using the auto.arima() function in R suggests that I should use ARIMA(0,1,0).

	AIC	Log-likelihood
ARIMA(0,1,0)	1097.3	-546.65
ARIMA(1,1,1)	1100.17	-547.08

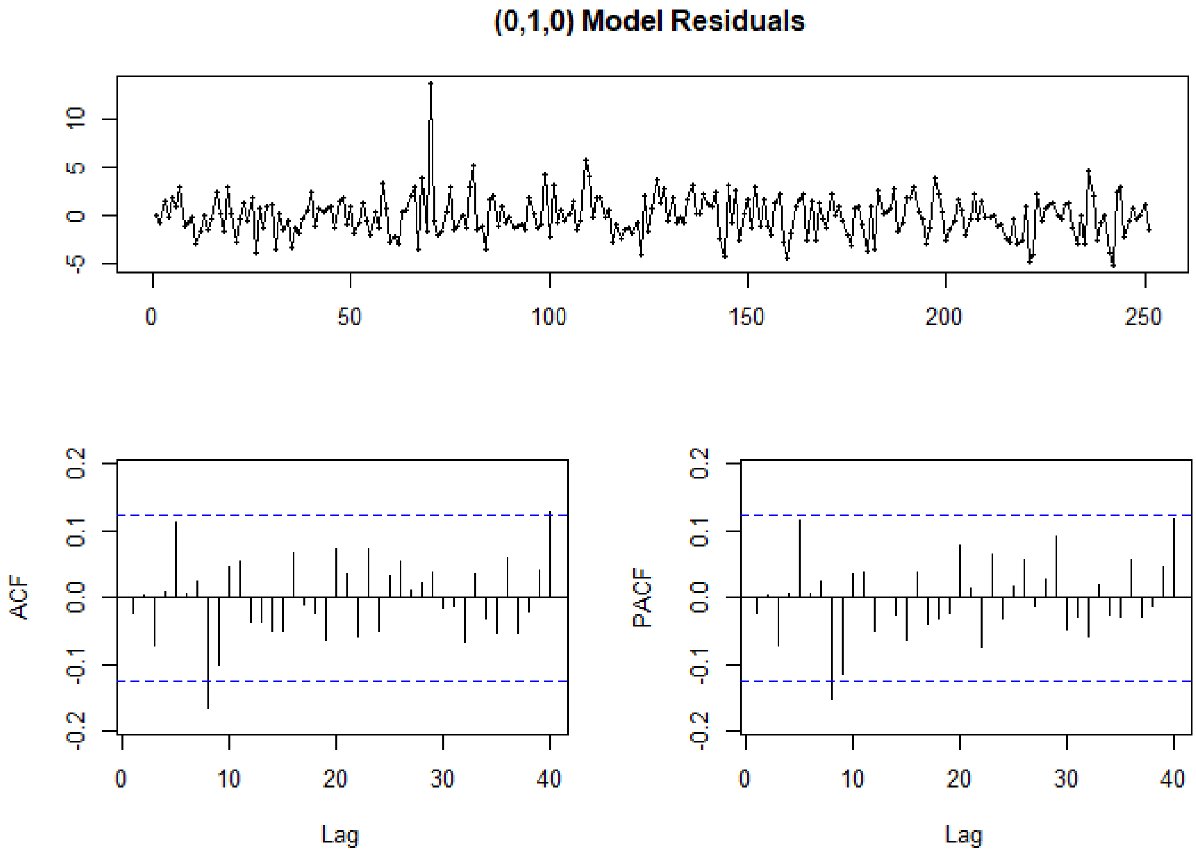
The smaller the AIC value, the higher the accuracy and the better fit. I will be using the ARIMA(0,1,0) since it has a lower AIC.



Point	Forecast	Lo 95	Hi 95	Lo 99	Hi 99
252	152.0027	147.7711	156.2343	146.4414	157.5640
253	152.2254	146.2410	158.2099	144.3606	160.0903
254	152.4482	145.1188	159.7776	142.8157	162.0806
255	152.6709	144.2076	161.1341	141.5483	163.7935
256	152.8936	143.4314	162.3558	140.4581	165.3291
257	153.1163	142.7510	163.4817	139.4940	166.7387
258	153.3390	142.1432	164.5349	138.6252	168.0529
259	153.5618	141.5929	165.5306	137.8320	169.2915
260	153.7845	141.0896	166.4794	137.1006	170.4684
261	154.0072	140.6256	167.3888	136.4208	171.5936

The model states that the reference point in 10 days is $154.01 and the 95% confidence interval is from $1140.63 to $167.39

Lastly, we check if the errors in the model are uncorrelated, follow a normal distribution, and have a mean of 0



Tested formally using the Ljung-Box test:

X-squared = 22.171,

df = 20,

p-value = 0.3313

Here, p is greater than 0.05, suggesting that there are NO significant autocorrelations between successive forecasting errors.

This time plot showed that our forecast errors have generally equal variance over time, and that the mean is around zero. (mean = 0.000381981)

Value At Risk

Taking the standard deviation of daily returns from 2020-08-01 to 2021-08-01 yields the following:

Variance (Daily Returns)	0.05%
Std Dev (Daily Returns)	2.16%
Stock Price	$151.70
Value at Risk (99%)	5.03%
Absolute Loss (99%)	**$7.63**
Value at Risk (95%)	3.54%
Absolute Loss (95%)	**$5.37**

We can conclude that a portfolio containing 1 share of JPM stock can expect to lose no more than 3.54% of its value 95% of the time