BM60112: Corporate Finance & Financial Accounting (CFFA)

Relationship of Stock Prices with Macroeconomic Variables and Financial Factors

Automobile Industry

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INTRODUCTION

Stock prices have been considered as one of the best indicators of a firm's position in the market and economic activity fluctuations. In the last two decades, there has been a lot of empirical studies to understand how stock prices affect an economy and vice versa. The linkage of the macroeconomic variables with the stock market has always been a matter of investigation amongst researchers, investors, and policymakers to study the implications of economic activity on stock markets and firms' value. The stock market indicators reflect the potential opportunities in the Indian economy. Stock prices of firms get influenced by an extensive group of macroeconomic variables like Inflation, Volatility Index, Oil and Gold prices, Index of Industrial Production, etc. Therefore, it is expected that the performance of an economy gets reflected in its financial markets which in turn attracts more investors. India, being an emerging and developing economy carries huge expectations for the investors. The stock markets show volatile behavior over time. Excessive volatility adversely affects the economies and also disrupts the smooth functioning of financial markets. This excessive volatility may result in the shift of the investors' behavior to invest in risk-free assets compared to riskier ones. Therefore, understanding the dynamics of stock markets becomes necessary for macroeconomists, financial analysts, and policymakers so that necessary policy measures can be taken. Since, the volatility patterns guide the investment spending by investors, identifying and thus accordingly designing the policies help to develop greater confidence in investors.

Research gap and research problem

The need and motivation for this study are driven to examine the impact of sentiments on stock returns to understand Indian capital market behavior and its influence on the Automobile Industry along with an attempt to understand the impact of macroeconomic determinants on the stock prices. Moreover, inadequate studies in the Indian context make it more imperative to analyze investor behavior so that policy planners can take corrective measures proactively for the overall good of capital markets and investors can make more informed decisions while trading to optimize their returns.

AUTOMOBILE INDUSTRY & MARKET

The automobile industry is one of the most important drivers of the economic growth of India and one with high participation in global value chains. The growth of this sector has been on the back of strong government support which has helped it carve a unique path among the manufacturing sectors of India. The automobiles produced in the country uniquely cater to the demands of low- and middle-income groups of the population which makes this sector stand out among the other automobile-producing countries. Most of the global players have set up business in India. India is one of the world's fastest-growing passenger car markets and a two-wheeler manufacturer. The Automobile industry in India is a significant driver of macroeconomic growth and technological development. The Automobile industry holds a 7.1% share of India's GDP. India is projected to be the world's third-largest automotive market in terms of volume by 2026. Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles and the National Electric Mobility Mission Plan (NEMMP 2020) have been initiated to support hybrid/electric vehicles market development and ecosystem. Private players like Hyundai, Suzuki, General Motors are interested in setting up an R&D base in India. Foreign manufacturers are keen to set up their facilities due to the presence of a large pool of skilled and semi-skilled workers and a strong educational system. It is an important and crucial factor for generating employment in the country. It provides around 37 million direct and indirect jobs. India's automobile manufacturing sector has a bolstering 40% share in global R & D and a 4.3% share in India's export.

Taking into consideration the Financial Year of 2020, the automobile industry was hit hard in FY 2019-20 as sales fell across vehicle segments. According to data released by SIAM, the Indian automobile industry recorded a 20.3% decline in domestic sales in FY20 as compared to a 5.9% growth in FY19. The Passenger Vehicle segment declined 17.3% in FY20 (as compared to 2.8% growth in FY19) due to weak consumer sentiment, the rising cost of vehicle ownership, and general economic slowdown. The Commercial Vehicle industry in India registered a 30.0% decline in FY20 compared to 17.1% growth in FY19, as a result of subdued demand, and higher capacity arising from the transition to BSVI. After an outstanding growth in FY19, the Indian industry's domestic sales of motorcycles FY20 saw a decline of 17.5%. It was not just the relative lack of demand as the motorcycle industry was subjected to several regulations which significantly increased the cost of ownership. After enjoying a growth of over 10% in FY19, it fell by 9.2% in FY20. The Covid-19 pandemic also cast a long shadow over a much anticipated mild recovery in the automobile industry. The COVID-19 pandemic has cast a long shadow on the sector over a much anticipated mild recovery. Keeping up with the scope of research, the report consists of dependencies and relations of macroeconomic factors and other financial aspects on **TATA MOTORS** and **MAHINDRA & MAHINDRA** stock prices.

TATA MOTORS-MARKET EXPECTATIONS AND FINANCIAL ASPECTS

Tata Motors incorporated in the year as TATA Engineering and Locomotive Company (TELCO) and used to manufacture locomotive steam engines and other engineering products. It gained entry into the commercial vehicle segment independently in 1977 in Pune. Currently, the company is a market giant in the commercial vehicle segment in India with a share of over 37%. In 2008, the company acquired the Jaguar Land Rover(JLR) segment from Ford Motors to enter foreign markets completely. Today, the company has manufacturing and R&D facilities in the leading economies of the world covering China, the UK, the USA, South Korea, and many other countries. The Product range of the company covers a wide spectrum of passenger cars, utility vehicles, trucks, commercial passenger vehicles, luxury cars, and many more.

FINANCIAL ANALYSIS

- JLR segment contributes 77.76% of the company's revenues majorly coming from China, Europe, and the USA.
- 19.09% of the total revenue constitutes of TATA Motors Standalone business out of which 11.61% is from Commercial Vehicle segment and 7.48% is from Passenger Vehicle segment. Recently, with the launch of new passenger vehicles, TATA Motors has succeeded in increasing its market share in the PV segment.
- TATA Motors incurs around 2.01% of the total revenue from vehicle financing under the name TATA Motors Finance Limited (TMFL).
- The net cash flow position for the company is in the negative region for the last few fiscal years. Although in FY19 it reported a net cash flow of Rs 8010.03 Cr., this was led by increasing huge long-term and short-term debt (financing cash flow).
- However, Tata Motors is a debt-laden firm with a debt of around 1.18 lakh crores and the D-E ratio is featuring at an alarming rate of 1.91 recently.

STRENGTH, WEAKNESS, OPPORTUNITY, AND THREAT ANALYSIS

STRENGTH: Tata Motors has a well-diversified portfolio of vehicles which includes right from economical passenger vehicles to luxury cars and the penetration of TATA Motors into the commercial vehicle segment is also very impressive. It creates brand loyalty for the company.

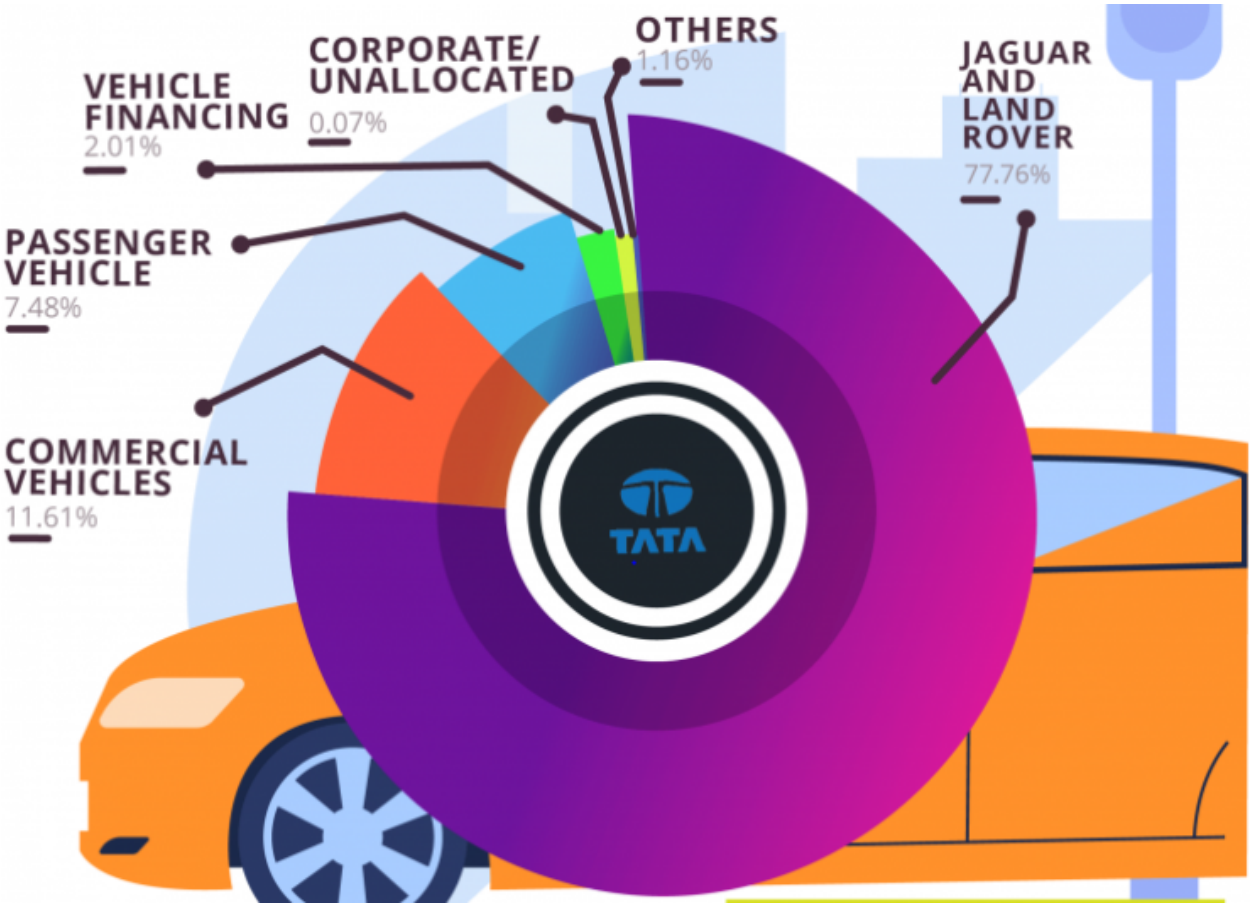
WEAKNESS: The revenue of Tata Motors is heavily dependent on the JLR segment, which can hit the business and profitability if a slowdown occurs in this segment. In 2019 such situations occurred for the company when there was a massive decline in demand for JLR in Chinese and European markets and the rest was fueled by the pandemic in 2020.

OPPORTUNITY: With the emergence and dawn of Electric Vehicles in India and other nations, TATA Motors can foster advancements and take advantage of its innovative legacy to increase its market share in the EV segment. With the inordinate heritage, the TATAs hold, they can homogenize with the TATA POWER to create an eminent EV environment.

THREAT: The government's increasing concern for the environment has posed various threats for the company as various policies (BS-VI) have been implemented in the past to reduce pollution which has caused an overall slowdown in the industry. International issues like Brexit, Chinese Economy Slowdown, US import tariff, trade wars, and pandemic can severely affect the company in the future as it has also done in recent years.

TATA MOTORS

REVENUE BREAKDOWN - Q2FY21



MAHINDRA & MAHINDRA-MARKET EXPECTATIONS AND FINANCIAL ASPECTS

Mahindra and Mahindra (M&M) is one of the largest private companies in India dominating the automobile industry for decades. M&M is known as a farm equipment unit and is also the 3rd largest producer of tractors in the world and it has two major operating divisions that produce more than 100,000 tractors a year. It is the flagship company of the Mahindra group, operating in the global tractor industry and the Indian utility vehicles market. Through its subsidiaries, the company operates in industries such as aerospace, aftermarket, agribusiness, automotive, components, construction equipment, consulting services, defense, energy, farm equipment, finance and insurance, industrial equipment, information technology, leisure and hospitality, logistics, real estate, retail, and two-wheelers. The company's portfolio comprises a wide spectrum of vehicles from two-wheelers to heavy trucks, SUVs to school buses. Its services include maintenance and repairs, customization, providing spares, and manufacturing and engineering. The company specializes in consulting on automotive style, engineering, computer-aided engineering, and project management. It also offers concept definitions for two-wheelers, passenger vehicles, and light and heavy trucks. The company manufactures a wide range of light commercial vehicles and heavy commercial vehicles that are rugged, reliable, environmentally friendly, and fuel-efficient. Through a joint venture with Navistar Inc, it produces diesel engines for medium and heavy commercial vehicles in India.

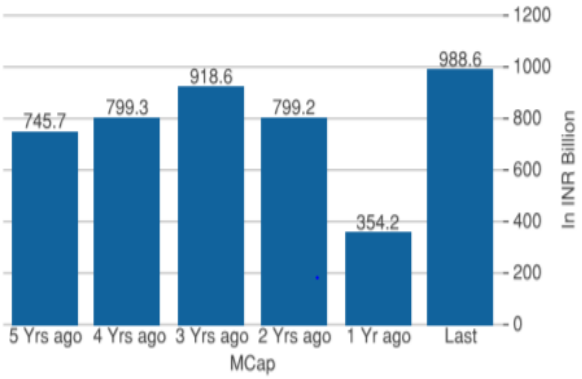
FINANCIAL ANALYSIS

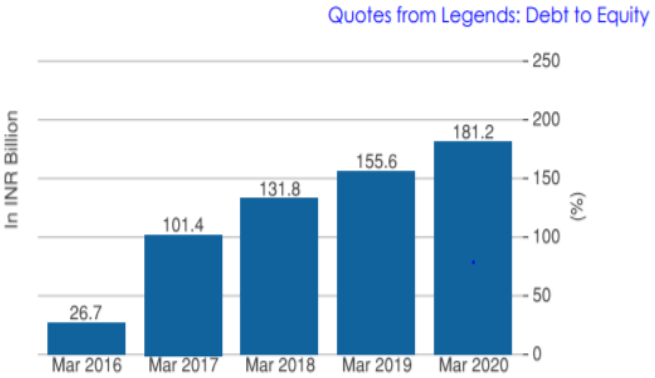
- Mahindra & Mahindra is ranked number 2 out of 4 listed cars & utility vehicles companies in India with a market capitalization of Rs988.9 billion ($13.5 billion). In the cars & utility vehicles companies, it has the 3rd highest total assets and 3rd highest revenues.
- In the past 5 years Market Capitalization has increased by Rs237.7 billion (32%) from Rs751.2 billion to Rs988.9 billion.
- In the past five years, Volume Weighted Average Price (VWAP) has decreased by 3.7% to Rs616.85. The earnings per share growth rate have shown signs of deterioration in recent years. The EPS growth value has shown a decline from -29 (FY19) to -98 (FY20).
- The debt-to-equity ratio of 181.2% is above a safe benchmark figure of 70%. Moreover, it has deteriorated in the past four years which is an alarming concern.
- The Average turnover was observed as below average. The Annual Share Turnover was INR 1047 billion.

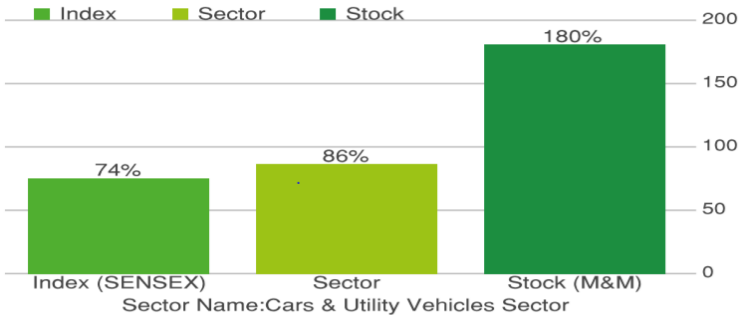
- In the past 5 years, annual dividends have decreased by INR 3.6from INR6.0 to INR2.4. Based on a start date of 5 years ago, there have been only three rises in dividends over the last 5 years.

SWOT ANALYSIS

- **STRENGTH-** There has been a growth in Net Profit with increasing Profit Margin (QoQ). Also, the company has seen increasing profits every quarter for the past 3 quarters.
- **WEAKNESS-** High-Interest Payments Compared to Earnings**.** The company is inefficient in using its capital and assets to generate profits. It's also on the list of companies with high rising debt.
- **OPPORTUNITIES-** The Indian automotive industry is growing year on year with over 12% growth from the previous 3 years. The industry is expected to grow at a CAGR of 13% in the next 4 years. This growth can be beneficial for M&M. Also, the emergence and increasing demand for Hybrid Electric Vehicles. M&M has a strong portfolio of HCVs and is set to be benefited from the growing demand.
- **THREATS-** M&M faces intense competition from various automotive companies such as Tata Motors, Ford, Volvo, and General Motors, etc. This can affect M&M's market share and put pressure to constantly innovate on M&M. The firm also faces strong competition in other businesses as well. For example, its IT business faces competition from IT giants such as Infosys. This reduces market share and increases competitive pressure.







OBJECTIVES OF THE STUDY

- **To understand and identify key macroeconomic variables that influence stock prices.**
- **To explore the dynamic relationship between investor sentiment and stock prices.**
- **To understand how different macro variables including investor sentiment impact the stock prices.**

Methodology and Selection of Variables

The study employs statistical econometric techniques to study the relationship between the stock prices of **TATA Motors** and **Mahindra & Mahindra** from the automobile industry and selected macro variables **(Foreign Exchange Rate (Forex, USD->INR), Gross Domestic Product (GDP), Industrial Production Level, Gold Prices, Crude Oil Prices, Gross Fiscal Deficit and investor sentiment proxied by Volatility Index (VIX))**. Also, variables and factors like stocks of **rubber tire companies (JK Tyre, MRF)** and **stocks of steel-producing companies (SAIL)** are taken into consideration for efficient market analysis.

The monthly data was collected from March 2009 to March 2020 and post-March2020, from different sources like NSE, RBI, Gold Council, Ministry of Statistics, World Bank, and other search engine-powered financial services (Google Finance, Yahoo Finance). The period is chosen based on the availability of the data. The study also embraces analysis of the post-COVID-19 scenario of dependencies exhibiting possible differences happening due to pandemic.

Data Description

S.No	Variable	Description	Units	Period
1	Gold Prices	Gold futures contracts	INR/gm	Monthly
2	VIX	Volatility Index of India	index	Monthly
3	FOREX	Foreign exchange rate - (USD-INR)	INR	Monthly
4	GDP	Gross Domestic Product growth rate	%-age	Quarterly
5	Crude Oil	Indian Basket Crude Oil prices	USD/bbl	Monthly
6	GFD	Gross Fiscal Deficit	INR(in cr)	Monthly
7	IIP	Industrial Production Level of India	index	Monthly
8	CPI	Consumer Price Index (Inflation)	index	Monthly
9	Other Relevant Stock	JK Tyre, MRF, SAIL, JSW, Realty	INR	Daily

MACROECONOMIC VARIABLES AND FINANCIAL FACTORS

1. **STOCK MARKET :**

Stock prices were considered a dependent variable whose correlation with various factors was examined. It plays a major role in the economy of a country. Through a stock market, fund mobilization is possible and hence the development of a stock market is important from the industry's as well as the investor's viewpoint. For this project, the stock prices of **TATA Motors** and **Mahindra & Mahindra** were monitored on a daily and monthly basis.

2. **EXCHANGE RATE (FOREX) :**

A nation's international trade in its economy, as well as the degree of the trade balance, determines the impact of the exchange rate on stock prices. Several studies can be found in the literature supporting the hypothesis of the existence of a causal relationship between stock prices and exchange rates. As suggested by 'goods market approaches', the changes in exchange rates affect the competitiveness of a firm. As many firms borrow in foreign currency, the exchange rate fluctuations affect the value of their earnings and costs. Hence, affecting the stock price. Also, the exchange rate movements affect a firm's transaction exposure as future receivables and payables, denominated in foreign currency, get affected. An alternate explanation for the relationship comes from the 'portfolio balance approach'. It is based on the fact that exchange rates are determined by the demand and supply of a currency. Thus, blooming markets or rising stock prices would attract capital flows from foreign investors causing an increase in the demand for domestic currency. Whereas, falling stock prices would induce investors to shift their funds out of the country leading to the depreciation of the domestic currency.

Since the **US Dollar** is considered to be one of the most dominating foreign currencies for investment and trading, the present study has considered the US **Dollar against the Indian Rupee**.

3. **GOLD PRICES :**

Gold is a substitute speculation road for Indian financial specialists. The significance of gold has been expanded in the present world because of the monetary emergency in the present financial world. The financial specialists are putting resources into the Gold. Gold is dealt with as an elective speculation road. It is frequently expressed that gold is the best protection for acquiring power over the long haul.

There are two different theories on the relationship between income and gold demand. A positive relationship between real income and gold prices is supported by the classical theory, while an inverse relationship is supported by the Keynesian theory arguing that more demand means more economic backwardness hence low income. The variable is of significant importance because according to the World Gold Council (WGC), **11% of the global stock of Gold is owned by Indians (more than 18,000 tons of gold).**

4. **CRUDE OIL :**

Oil prices play a major role in affecting the economy. Higher crude oil prices adversely impact the current account and fiscal deficits. An increase in oil prices affects via two effects i.e. an income and a production cost effect, which leads to changes in aggregate output. As a result of increased production costs, the discretionary household income is lowered because the prices for heating oil and Gasoline increase.

This results in lower consumption which in turn affects the aggregate output adversely, which further leads to lower labor demand. Thus, the terms of trade for an oil-importing economy get affected adversely when there is an increase in oil prices which further results in a negative wealth effect on consumption because of a decrease in income, and in turn to lower aggregate demand.

5. **GROSS FISCAL DEFICIT**

It is believed that high budget balances should impact negatively the performance of the stock markets. This can be partly attributed to the fact that a country that runs a huge budget deficit will have to attract more foreign capital to finance its operations in the form of loans and hence these may lead to relatively high interest rates which will negatively impact the stock market.

6. **VIX and INFLATION (CPI)**

VIX is a measure of implied volatility. This indicator is known as the **“investor fear gauge”**. It reflects investors’ best predictions of near-term volatility or risk. It rises during a time of market turmoil and lessens as investors become complacent. A high VIX reflects increased investor fear and a low VIX suggests complacency. In the present study, VIX has been used as a proxy for market expectations.

Inflation is defined as a persistent rise in the general level of prices of several items over a while. It is measured by the inflation rate; the annualized percentage change in the general price index over time. The index used in this study is the Consumer Price Index (CPI). An increasing inflation rate is a threat to an economy, thus by increasing interest rates, the central bank tries to control it hoping to siphon off the excess system liquidity. Because of increased interest rates, the

investors are attracted towards fixed income instruments which result in less liquidity thereby less speculative demand for goods and hence slowing the general prices increase.

7. INDEX OF INDUSTRIAL PRODUCTION :

The **index of industrial production (IIP)** is a measurement that represents the status of production in the industrial sector for a given period compared to a reference period. The logical relationship between Industrial Production and the stock market is a direct one. When there is a lower demand situation, consumer spending also drops. This results in producers cutting down on the production which further affects the corporate sales and profits adversely, hence directly affecting the stock prices.

8. OTHER FINANCIAL ASPECTS - STOCK PRICES OF FIRMS COVERING TYRE AND STEEL INDUSTRIES

Certain other factors like stock prices of firms from the tire and steel industry like (JK Tyre, JSW, SAIL, MRF) may incur some of the other correlation with the automobile industry which may have a substantial say in the financial decision making and income of the firm. This choice of variable is taken on an experimental basis to claim some sort of inference. Even, the dependency of the **Realty** sector is being examined to draw out the integration between financial aspects.

9. GROSS DOMESTIC PRODUCT (GDP) GROWTH

Gross Domestic Product (GDP) is the quantitative life of the overall financial movement in an economy. Insignificantly more particular terms, GDP speaks to the money-related estimation of the considerable number of products and services created or produced in an economy within a timeframe and inside a country's land limit. Gross domestic product measures help in estimating the execution of an economy. Below is the excel snippet of a part of the dataset used -

NSE Monthly													
Date	M&M Close	Tata Motors Close	GFD	Gold	VIX	Forex	CPI	Crude Oil	erted all to 2004-20	SAIL	Jindal Steel	MRF	JK Tyre	NSE Realty
2009-01	69.211	27.335	44553.000	1350.250	42.100	48.733		43.990	144.4	67.792297	169.0725	1630.32654	5.600055	
2009-02	71.375	27.271	44318.000	1489.450	40.610	50.893		43.220	138.5	63.103748	170.7423	1591.11353	4.771278	
2009-03	87.851	32.934	29859.000	1523.090	39.480	50.784		46.020	153.5	80.030968	197.3617	1679.34241	5.468379	
2009-04	111.734	44.533	54158.000	1432.920	46.630	49.188		50.140	139.6	90.610504	268.4859	2154.05176	8.210315	
2009-05	153.169	61.530	36600.000	1449.890	40.300	47.113		58.000	144.3	143.30069	342.2213	3081.85303	10.898032	
2009-06	158.287	53.109	33544.000	1452.240	42.540	47.801		69.120	145.7	125.419212	407.7712	3302.13159	10.743119	
2009-07	196.711	77.001	34252.000	1458.440	39.210	47.626		64.820	146.7	145.458084	481.0891	4523.3125	13.554766	
2009-08	200.484	89.450	23736.000	1476.690	34.510	48.750		71.980	149.4	136.000916	512.7836	4179.24902	14.081468	
2009-09	205.022	109.540	15485.000	1553.260	25.270	47.810		67.700	151.0	142.899216	576.5899	5604.60254	21.179644	
2009-10	214.017	105.111	47300.000	1566.990	25.390	46.918		73.060	149.6	137.589615	631.153	5159.27344	23.651667	
2009-11	238.948	122.881	61146.000	1690.400	27.560	46.458		77.390	148.5	164.848343	677.149	5812.97705	24.768066	
2009-12	250.903	146.674	3759.000	1687.860	23.340	46.400		75.020	162.4	202.099106	691.9562	5899.87842	24.608576	
2010-01	236.209	128.663	39558.000	1651.100	26.130	46.098		76.610	163.6	179.355652	617.8215	5662.75	27.439442	
2010-02	233.934	131.785	31363.000	1632.600	24.020	46.068		73.690	157.5	182.700272	622.1998	5522.86328	27.359699	
2010-03	251.333	140.401	31406.000	1627.670	19.870	44.800		78.020	176.5	212.758423	691.7594	6642.91797	31.155445	
2010-04	244.276	161.692	53993.000	1642.270	20.350	44.250		84.080	157.8	183.904831	731.4587	6939.01563	31.490364	
2010-05	265.888	139.901	46914.000	1777.490	26.430	46.358		76.160	156.5	173.96405	643.5497	7174.50147	28.635582	
2010-06	291.260	144.256	-60711.000	1843.960	20.070	46.400		74.330	156.6	162.338364	614.4272	7586.479	25.525618	
2010-07	307.115	156.828	50719.000	1791.450	18.940	46.360		73.540	161.3	171.85791	612.4103	7176.75342	26.251272	
2010-08	291.310	187.217	60510.000	1823.080	18.470	46.873		75.130	156.1	158.57634	673.2135	7435.64307	26.705809	435.15
2010-09	321.431	206.852	-18173.000	1876.900	22.250	44.690		76.090	160.3	174.204666	695.8425	8580.27148	30.126114	491.75
2010-10	341.047	218.324	29084.000	1917.810	20.760	44.420		81.110	166.6	164.904114	687.501	9114.22363	26.632168	481.55
2010-11	355.735	232.631	24186.000	1981.350	20.710	45.800		84.260	158.0	150.040237	627.5276	7692.85352	23.635035	384.95
2010-12	361.732	246.458	15273.000	2015.180	16.560	44.810		89.770	175.6	155.009003	701.7921	7057.43701	21.900276	379.95
2011-01	331.587	216.073	50973.000	1982.750	23.410	45.838	89.5	93.870	175.9	136.66272	653.6951	5937.16553	16.720442	293.75
2011-02	286.220	203.961	52866.000	2004.160	24.400	45.250	88.4	101.620	168.0	130.567581	648.2743	5570.37207	14.171247	262.9
2011-03	325.544	235.155	98503.000	2051.690	22.180	44.610	88.4	110.710	193.1	145.160675	687.2546	6167.98145	15.295173	313.3
2011-04	351.598	232.989	74661.000	2115.900	19.580	44.300	89.1	118.640	166.2	136.344879	645.3176	7006.16748	15.563939	289.3

METHODOLOGY

CORRELATION METHOD

The present study has employed a Correlation method. The platform used to imply this technique is Microsoft Excel. Correlation is a bivariate analysis that measures the strength of association between two variables and the direction of the relationship. In terms of the strength of the relationship, the value of the correlation coefficient varies between +1 and -1. A value of ± 1 indicates a perfect degree of association between the two variables. As the correlation coefficient value goes towards 0, the relationship between the two variables will be weaker. The direction of the relationship is indicated by the sign of the coefficient; a + sign indicates a positive relationship and a – sign indicates a negative relationship. Usually, in statistics, we measure four types of correlations: Pearson correlation, Kendall rank correlation, Spearman correlation, and the Point-Biserial correlation.

Majorly Pearson correlation is used for statistical analysis, and the mathematical relation involved is given as:

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

$$\rho_{X,Y} = corr(X,Y) = \frac{cov(X,Y)}{\sigma_X \sigma_Y}$$

r_{xy} – the correlation coefficient of the linear relationship between the variables x and y

x_i – the values of the x-variable in a sample

$\bar{x}$ – the mean of the values of the x-variable

y_i – the values of the y-variable in a sample

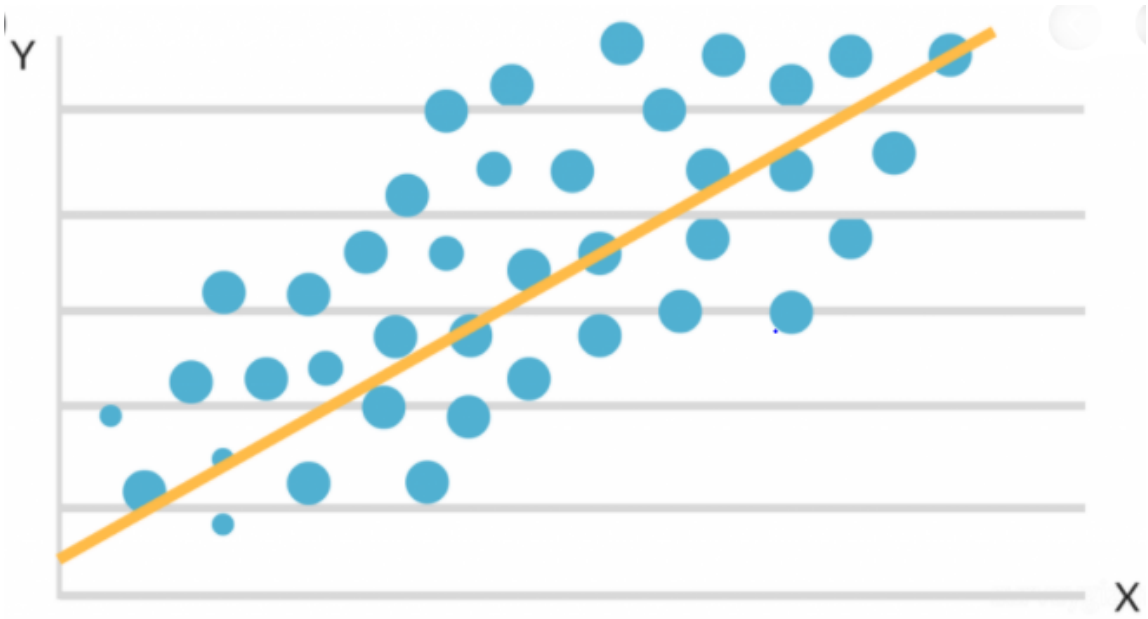
$\bar{y}$ – the mean of the values of the y-variable

cov - Covariance between X and Y

We can use the CORREL(series1, series2) function in EXCEL to get the correlation between the two series.

REGRESSION ANALYSIS

Microsoft EXCEL has a Data Analytics toolkit add-in that allows users to conduct regression analysis of one series of data with the other.



$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i$$

Y : Dependent variable
β_0 : Intercept
β_i : Slope for X_i
X = Independent variable

The final equation obtained is of the form: $Y = \beta X + C$, where the β coefficient is the degree of change in the outcome variable for every 1-unit of change in the predictor variable. This β is very crucial in determining returns and the valuation of assets and is used in various models like CAPM and APT. Our last topic of study, i.e, **Arbitrage Pricing Theory(APT)** requires a wide variety of β values for different macroeconomic indicators to determine the final returns of the firm.

M&M	GFD	Gold	VIX	Forex	CPI	Crude Oil	verted all to 2004-20	SAIL	Jindal Steel	MRF	JK Tyre	NSE Realty	GDP
beta	-0.000377547	-0.226317482	-0.114999564	-1.270689208	3.329165296	0.170305578	-0.189365248	0.299436263	0.196670737	0.335932194	0.161539467	0.313264406	-0.010346576
correlation	-2.27%	-9.47%	-25.20%	-35.24%	28.13%	15.70%	-12.82%	46.53%	32.99%	41.67%	31.01%	44.79%	-1.15%
Tata Motors													
beta	0.000230574	-0.632228379	-0.203352049	-2.093916425	2.672789161	0.309109526	-0.078157661	0.529975652	0.421954182	0.532584687	0.300438796	0.489170453	0.115493755
correlation	0.87%	-16.52%	-27.83%	-36.28%	13.44%	17.80%	-3.31%	51.45%	44.22%	41.27%	36.03%	41.73%	9.30%

ANALYSIS, RESULTS, AND DISCUSSION

In this study, we have applied the correlation method and regression models to compute the correlation coefficients and betas respectively for the firm's stock and parameters. The parameters have been mentioned before. Along with the usual macro-economic indicators of GDP growth rate, IIP, VIX, FOREX, comparable firms have been used like SAIL, Jindal Steel, MRF, JK Tyre, NSE Realty, and BSE Realty. SAIL AND Jindal Steel are steel-producing companies that account for around 16.5% of the steel produced in India. MRF and JK Tyres account for more than 25% of the tire industry in India. The NSE and BSE Realty index can be seen as an index of customer purchase power - which can potentially relate to the demand for automobiles.

For this study, we have considered correlations whose magnitude is greater than 25%. The 25% - 50% band is seen as moderately correlated and the 50%+ band is seen as strongly correlated parameters.

BEFORE LOCKDOWN

NSE							
M&M	GFD	Gold	VIX	Forex	CPI	Crude Oil	IIP**
beta	-0.000377547	-0.226317482	-0.114999564	-1.270689208	3.329165296	0.170305578	-0.189365248
correlation	-2.27%	-9.47%	-25.20%	-35.24%	28.13%	15.70%	-12.82%
Tata Motors							
beta	0.000230574	-0.632228379	-0.203352049	-2.093916425	2.672789161	0.309109526	-0.078157661
correlation	0.87%	-16.52%	-27.83%	-36.28%	13.44%	17.80%	-3.31%

NSE							
M&M	IIP**	SAIL	Jindal Steel	MRF	JK Tyre	NSE Realty	GDP
beta	-0.189365248	0.299436263	0.196670737	0.335932194	0.161539467	0.31326406	-0.010346576
correlation	-12.82%	46.53%	32.99%	41.67%	31.01%	44.79%	-1.15%
Tata Motors							
beta	-0.078157661	0.529975652	0.421954182	0.532584687	0.300438796	0.489170453	0.115493755
correlation	-3.31%	51.45%	44.22%	41.27%	36.03%	41.73%	9.30%

BSE							
M&M	GFD	Gold	VIX	Forex	CPI	Crude Oil	IIP**
beta	-0.000394587	-0.225108922	-0.115456809	-1.281144211	3.349547467	0.170864852	-0.178460722
correlation	-2.36%	-9.38%	-25.19%	-35.39%	28.41%	15.68%	-12.03%
TM							
beta	0.000215658	-0.626691087	-0.202990115	-2.091841316	2.670441643	0.307084976	-0.073808929
correlation	0.81%	-16.41%	-27.83%	-36.30%	13.46%	17.71%	-3.13%

BSE							
M&M	IIP**	SAIL	Jindal Steel	MRF	JK Tyre	BSE Realty	GDP
beta	-0.178460722	0.305943842	0.196186925	0.3423082	0.165979507	0.394801092	-0.007959594
correlation	-12.03%	47.28%	32.78%	41.90%	31.73%	58.18%	-0.88%
TM							
beta	-0.073808929	0.535852402	0.421724252	0.534319805	0.300981359	0.571964865	0.016098437
correlation	-3.13%	52.02%	44.26%	41.09%	36.15%	52.96%	1.26%

As can be seen from the data the strongest correlation is as follows (in descending order) :

- BSE Realty $\beta \sim 0.48$
- SAIL $\beta \sim 0.45$
- Jindal Steel $\beta \sim 0.3$
- MRF $\beta \sim 0.43$
- NSE Realty $\beta \sim 0.39$
- JK Tyre $\beta \sim 0.23$

Volatility Index (VIX) and FOREX have a strong negative correlation. A high VIX is an indicator of uncertainty in the market while increasing $ to ₹ disparity impacts the company's financials. So it is quite evident that the market is inversely proportional to changes in VIX and FOREX. Moreover, FOREX has a $\beta \sim -1.5$ and VIX has a $\beta \sim -0.15$. The weakening of the rupee against the dollar impacts the market significantly.

Gold has not a very large impact on the automotive sector. It is seen as an investment instrument while the automobile is a necessity rather than an investment generally.

GDP growth and decline also didn't impact the automotive industry at large.

Crude Oil is necessary for the factories to operate and the manufactured cars to run. Thus any increase would be increasing the operating costs of factories as well as cars - implying that it should have a negative correlation with stocks. Yet we see a positive though weak correlation.

DURING AND AFTER LOCKDOWN

The stock market had begun to reflect the uncertainty in the market before the lockdown. Sensex fell from 41565.90 on 12th February 2020 to 26674.03 on 24th March 2020. The imposition of lockdown from the 25th of March 2020 brought the entire country to a halt. India's industrial production dropped sharply in April as most factories were not in operation. The Industrial Index of Production contracted by 55.5% compared with the same period a year earlier. Nevertheless, the stock market has shown the steepest V-shaped recovery and the firm's shares in question have surpassed their previous 52-week highs.

NSE							
M&M	Gold(Monthly)	Gold	VIX	EX	CPI	Crude Oil	IIP**
beta	1.049857229	-0.188500457	-0.351430512	-1.575762193	4.388257766	-0.023152808	-0.053775323
correlation	43.29%	-7.77%	-60.05%	-18.75%	34.79%	-4.81%	-13.97%
Tata Motors							
beta	0.816603291	-0.090280183	0.142988684	-1.627115153	-0.32754507	-0.232183286	-0.370915742
correlation	19.39%	-2.93%	14.07%	-15.25%	-1.50%	-27.76%	-56.18%

NSE						
M&M	SAIL	Jindal Steel	MRF	JK Tyre	NSE Realty	GDP
beta	0.293075779	0.37675994	0.612488934	0.269035147	0.686351531	0.454770822
correlation	34.85%	50.97%	41.96%	31.26%	50.61%	46.04%
Tata Motors						
beta	0.394757917	0.365011154	0.827226044	0.405093024	0.987293406	2.537924606
correlation	36.97%	38.89%	44.63%	37.07%	57.34%	90.61%

BSE							
M&M	Gold(Monthly)	Gold	VIX	EX	CPI	Crude Oil	IIP**
beta	1.055223281	-0.188133044	-0.351124276	-1.620946005	4.334415237	-0.022498562	-0.052558116
correlation	43.78%	-7.74%	-60.37%	-19.25%	34.57%	-4.70%	-13.73%
TM							
beta	0.807617468	-0.08286003	0.146015661	-1.622432606	-0.360897513	-0.229108461	-0.368684311
correlation	19.21%	-2.69%	14.39%	-15.22%	-1.65%	-27.44%	-55.96%

BSE						
M&M	SAIL	Jindal Steel	MRF	JK Tyre	BSE Realty	GDP
beta	0.294285114	0.378981846	0.606126119	0.265429205	0.693819051	0.453532932
correlation	34.79%	51.10%	41.39%	30.80%	51.10%	45.82%
TM						
beta	0.397789494	0.366451153	0.823925178	0.404627501	0.983186438	2.538692219
correlation	37.15%	39.03%	44.44%	37.10%	57.20%	90.49%

The parameters strongly correlated to the firm stocks didn't change. However, GDP growth is now the most strongly correlated parameter with stocks. As the lockdown was lifted and industries were once again opened, the GDP recovered and so did the companies in the study here. It can be seen that Tata Motors and GDP had a very strong correlation of 90% and also a very high $\beta \sim 2.5$.

In contrast to long-term relations, Gold had a positive correlation with the stocks. The monthly Gold returns had a correlation of nearly 45% with Mahindra and Mahindra and more importantly the $\beta \sim 1$.

The indices NSE Realty and BSE Realty were in tandem with Tata Motors with $\beta \sim 1$.

The pandemic saw several Foreign Investment Institutions mobilizing their funds in the stock market. This increased the demand for local currency and strengthened it. The correlation between FOREX with the companies was halved.

The volatility index (VIX) has a strong negative correlation of 60% with Mahindra and Mahindra. The VIX touched a high of 65 in March and later as the market recovered crept back to the 20s.

The index of Industrial Production (IIP) can be seen as a precursor to contraction. Uncertainty of demand leads to lower producer confidence. Thus the industrial output decreases and the market reflects this through lower prices. Tata Motors has a strong negative correlation of 50% with IIP.

Consumer Price Index (CPI) measures the average change in prices over time that consumers pay for a basket of goods and services, CPI has a strong positive correlation with Mahindra and Mahindra both before and during the lockdown and it's $\beta > 3$. A possible explanation could be that Mahindra's range has cars for the upper middle class and above. Thus rising inflation makes its price tag justifiable.

The demand for **crude oil** was cut short due to the pandemic. With oil being produced but no storage facilities, prices kept on decreasing. The recovery of crude oil prices was delayed in comparison to the Indian stock market, hence we see an inversion in the correlation pattern of crude oil and the stocks.

ARBITRAGE PRICING THEORY

In this study, we were motivated to calculate the returns of two firms in the automobile sector, TATA Motors and Mahindra & Mahindra using the Arbitrage Pricing Theory. The model helped in understanding how various macroeconomic factors affect the return of an asset. The mathematical model of arbitrage pricing theory takes into account various macroeconomic risks and accordingly determines the risk and return of an asset. The sensitivity of the chosen stocks' prices was analyzed with these factors and Beta was calculated for each asset corresponding to each factor. The risk premium was then calculated corresponding to each factor and all these inputs were pulled in the model's equation to get a yearly return on the assets. The returns on the asset were calculated on both the stock exchanges i.e., BSE and NSE.

The mathematical relation behind APT is given as:

$$ER(x) = Rf + \beta_1 RP_1 + \beta_2 RP_2 + \ldots + \beta_n RP_n$$

- ***ER(x)*** – Expected return on asset
- ***Rf*** – Riskless rate of return
- β_n ***(Beta)*** – The asset's price sensitivity to factor
- RP_n – The risk premium associated with factor

The calculated return on Assets through the APT model applied to M&M and Tata Motors by analyzing the performance of various macroeconomic factors(GFD, GOLD, VIX, Forex, CPI, Crude oil, IIP, GDP) and shares of interacting companies like SAIL, Jindal Steel, MRF, JK Tyre and Realty indices, in the past 8 years(2012-2019) comes nearly equal to the Actual Return on assets for these 8 years(actual return on assets- calculated from the data present in the balance sheet of these companies).

How the company was expected to perform in the past 8 years vs how it performed-

Firms	Actual	Expected(avg of BSE and NSE)
Return on asset (for M&M)	$(\frac{52697.06}{23911.98} - 1) \times 100 = 120.379\%$	$\frac{104.74 + 105.691}{2}\% = 105.215\%$
Return on asset (for Tata Motors)	$(\frac{322121.26}{145382.64} - 1) \times 100 = 121.567\%$	$\frac{90.910 + 94.741}{2}\% = 92.825\%$
Error in calculation/deviation from the actual value		
M&M(percentage error) = $(\frac{120.379}{105.215} - 1) \times 100\%$		14.412% Positively deviated from expected value of return on asset
Tata Motors(percentage error) = $(\frac{121.567}{92.825} - 1) \times 100\%$		30.964% Positively deviated from the expected value of return on asset

The reason for this deviation from expected values of return on assets is maybe the limitation to consider all the macroeconomic factors contributing to the performance of the companies. Only major ones were taken into consideration. The analysis also suggests that the companies have established a wider base in the automotive sector compared to pre-2009 levels. It can primarily be explained by the inherent research, service, and products offered by the company to the public - the true variables determining the company's value.

ARBITRAGE PRICING THEORY (analyzing the return on assets of firms from 2012-19)												
NSE												
Rf	40.00%	{ 5% over a period of 8 years }										
	GFD	Gold	VIX	Forex	CPI	Crude Oil	IIP**	SAIL	Jindal Steel	MRF	JK Tyres	NSE Realty
Beta M&M	-0.00031	-0.10068	-0.03695	-0.39184	3.011523	0.016222	-0.25242	0.02103	-0.01012	0.090322	-0.01028	0.205472
Beta TATA	0.000357	-0.27181	-0.04088	-0.52827	2.896395	0.105926	-0.1198	0.206352	0.125054	0.179917	0.008695	0.072479
Change in MacroEconomic Factors	-154.02%	5.98%	-2.95%	34.66%	45.01%	-42.98%	15.16%	-35.81%	-65.49%	423.36%	512.51%	13.26%
RISK PREMIUM	-194.02%	-34.02%	-42.95%	-5.345%	5.005%	-82.984%	-24.837%	-75.810%	-105.494%	383.356%	472.509%	-26.742%
			RETURNS ON ASSETS - M&		90.910%							
			RETURNS ON ASSETS - TA		104.746%							
BSE												
Rf =	40.00%	{ 5% over a period of 8 years }										
	GFD	Gold	VIX	Forex	CPI	Crude Oil	IIP**	SAIL	Jindal Steel	MRF	JK Tyres	BSE Realty
Beta M&M	-0.00032	-0.0918	-0.03716	-0.39459	3.053384	0.016869	-0.2472	0.017127	-0.01091	0.090866	-0.0057	0.214656
BETA TATA	0.00032	-0.25589	-0.04284	-0.5873	2.943325	0.101837	-0.12037	0.224748	0.127119	0.180576	0.008418	0.036614
Change in MacroEconomic Factors	-154.02%	5.98%	-2.95%	34.66%	45.01%	-42.98%	15.16%	-35.79%	-65.51%	428.93%	494.67%	17.76%
RISK PREMIUM	-194.02%	-34.02%	-42.95%	-5.34%	5.01%	-82.98%	-24.84%	-75.79%	-105.51%	388.93%	454.67%	-22.24%
			RETURNS ON ASSETS - M&		94.741%							
			RETURNS ON ASSETS - TA		105.691%							

Link to Final Excel Workbook consisting of Correlation Analysis and Arbitrage Pricing Theory

https://drive.google.com/file/d/1WTZMmxgGqLDdh0g-RfkkptRZubNL-ygu/view?usp=sharing

CONCLUSION

The study investigated the relationship between the selected macro variables namely industrial production, gold prices, crude oil prices, inflation, gross fiscal deficit, exchange rates, volatility indexes, and other external financial agencies like Tyre, Steel, and Realty firms' (SAIL, MRF, etc) value with that of the stock prices of TATA Motors and Mahindra & Mahindra using the correlation and regression analysis. The results indicate the presence of correlation and association of involved risks among the variables. It is observed that GFD, industrial production, gold, and crude oil prices pose to be insignificant variables whereas stock prices of supplementary companies like SAIL, JSW, MRF, Realty industry along with the Inflation rate (CPI) have a positive significant association with the valuation of TATA Motors and M&M. Also, evident from their detailed behavior in the world of finance, the indices like Volatility Index, FOREX (Foreign Exchange) deliver negative correlation with the Automobile giants.

LIMITATIONS AND FUTURE SCOPE

A limitation of this study includes the parameters used for measuring inflation and indicators for investor sentiments. There could be multiple proxies for defining macro variables that can be used to undertake such studies. Further, the time-series data was used majorly monthly which excluded considering certain macro variables for which frequency of data availability in the Indian context is quarterly or annual. Similar studies can be undertaken by considering sectoral indices to understand the implications of macro variables on sectoral stock indexes.

The study shows the change in the dynamics of the stock market as it adapted to the coronavirus pandemic. The uncertainty behind how the market would recover puzzled many yet what we see is that the market rebounded and has risen over 70% since April. As the second wave hits India the chances of the second series of lockdown are there. Can this study be used to predict the movements? Only time will tell because the uncertainty now lies in how the market reacts considering the investors are now confident of its recovery.

With the conclusion of our study on dependencies of Macroeconomic factors and variables on the Automobile Sector, our group is extremely grateful to our course instructor Prof. Abhijeet Chandra to provide inordinate insights and knowledge of the subject and provide us the opportunity to dive into the research work and gain cognizance of the real world market and its functioning.

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