The Rollout of GST and its Impact on the Auto Sector Stocks of National Stock Exchange

M. Muthukamu [1]
R. Amudha [2]

Abstract

The most awaited and the biggest indirect tax reform in India – Goods and Services Tax (GST) was finally introduced on July 1, 2017. On contrary to the expectations, the automobile industry had severe hiccups during the latter part of 2018, and experienced negative sales growth and the people were jittery about the process of implementation of GST in India. The present study was dedicated to assess and compare the returns rendered by the auto sector stocks listed in the Indian equity market, pre-and post-implementation of GST in India and to understand the level of volatility in the price behaviour of the selected stocks during the study period. To achieve this, we used the daily closing prices of the constituent stocks of auto sector index of National Stock Exchange for 90 trading days pre and post the execution of GST (from February 20, 2017 – November 9, 2017) and relevantly applied the GARCH family models to understand the existence and extent of symmetric and asymmetric volatility in the auto sector stocks. We found that the implementation of GST in India showed a negative impact on the returns delivered by the auto sector stocks and also found abnormal and heightened volatility during the post GST period.

Keywords : volatility, GARCH models, Goods and Services Tax, auto sector stocks

JEL Classification: G10, G11, G12, G15

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The biggest tax reform of post-independence in India, the single comprehensive indirect tax – Goods and Services Tax, was finally introduced on July 1, 2017. It was a historic moment for India, a nation which saw a very long journey, roughly 15 years, to make it possible. The journey started in December 2002 by Kelkar Task Force Committee to suggest a comprehensive tax system to replace the existing indirect tax regime which had a multiplicity of taxing structures. To avoid the existing taxation system which had 17 taxes and 23 cesses, the new indirect tax system, that is, the GST was introduced. It came as a big positive move for both the government and common man that this has subsumed all the taxes and cesses followed earlier in the Indian tax system and brought to halt the cascading effect of taxes, that is, the effect of tax on tax. When the landmark tax system – GST comes into effect, it was viewed that this would bring prosperity to the economy of the nation better than the previous tax structure. The officials from the Government of India were so enthusiastic and optimistic about the performance to be rendered by the GST. They were expecting that the implementation of the GST Bill will hike the taxes in the services sector too, and this will increase the tax revenue of the government. As expected,

[1] *Associate Professor & Head (Corresponding Author),* Department of Business Administration, APSA College, Thiruppattur - 630 211, Tamil Nadu. (Email : mmuthukamu@gmail.com) ; ORCID iD : https://orcid.org/0000-0002-3784-9476
[2] *Associate Professor,* Department of Management Studies, Karunya Institute of Technology, Coimbatore - 641 114, Tamil Nadu. (Email : amudha@karunya.edu) ; ORCID iD : https://orcid.org/0000-0002-5326-8946

the average gross GST collection in fiscal 2018 – 19 was ₹ 97, 555 crores. In 2017–18, it was only ₹ 89, 885 crores. It was an increase of 9.18% compared to the previous fiscal year (Press Information Bureau, 2018). Normally, a transition from one regime to another is always a tough task and it is no different in this case too. Post-implementation of GST had a fair amount of hiccups, and till now, many tricky issues are yet to be solved, even after having many revisits on the tax slabs by the powerful GST council.

The Indian auto industry is one sector which delivered an extraordinary performance before the implementation of GST and it is expected to become a leader in shared mobility by 2030, providing opportunities for electric and autonomous vehicles. India was the fourth largest manufacturer of passenger vehicles in the world and was the seventh largest manufacturer of commercial vehicles in 2018. The auto industry is one among the key employment generators in India, and the industry had given employment opportunities to more than 3 crore people both directly and indirectly till 2018. Every vehicle produced was able to generate employment for a few number of employees, that is, the industry gave employment to 13 people for each truck produced, six persons for each car, four persons for each three-wheeler, and one person for each two-wheeler produced. The total domestic sales in the financial year 2018 – 19 stood at 26,267,763 units, of which 3,377,436 were passenger vehicles, 1,007,319 were commercial vehicles, 711,011 were three - wheelers, and 21,181,997 were two-wheelers (Society of Indian Automobile Manufacturers, 2018). The Indian automobile industry received FDI worth of ₹ 149,424 crore (US$ 21.3 billion) between April 2000 and March 2019. It was estimated that if the industry produces vehicles as per its present installed capacity, it could generate employment roughly for 35 million people by 2022 (India Brand Equity Foundation, 2018).

It has been viewed that the implementation of GST will reduce the tax rate to the auto sector and the extent of reduction is expected to fluctuate between 30 – 35%. Hence, people expected that this may increase the demand by reducing the cost for the end-user by more than 10%. Apart from this, the cost of logistics and supply chain inventory will be cut down considerably and the overall transportation cost and time will be reduced, as the goods will be transferred from one state to another easily by avoiding OCTROI and the delay in many checkpoints. People were expecting that the automobile sector will surely be benefited from the implementation of GST. But a downtrend in sales of the auto sector companies during the later part of the year 2018 delivered a shock to the policymakers and the captains of the auto sector companies. A group of people have started accusing that the implementation of GST is responsible for a hit in the growth of the auto sector.

On contrary to this view, some people say that this slowdown is the outcome of the global economic recession scenario and the technology transition phase from diesel and petrol using vehicles to electric vehicles. This controversial scenario has urged us to gain clarity on this issue, and more specifically, to study the reactions of equity investors in the Indian equity market by understanding the price behaviour of the stocks of the Indian automobile sector, pre and post the implementation of GST in India. Our research work in this context may deliver the answers for the questions aroused in the minds of the investing community that whether the implementation of GST had delivered any adverse effect on the returns of auto sector stocks, contrary to as expected by everyone, and whether this activity has triggered the volatility in the price behaviour of the auto sector stocks of NSE.

Review of Literature

Earlier studies conducted in this arena have been reviewed and few of them are highlighted in this section to have more clarity about GST implementation in India and across the world.

A study by Ahmad and Poddar (2009) recommended that the introduction and effective implementation of GST in India would be a positive move and may yield revenues higher than the expected one as it happened in New Zealand when GST was implemented in the year 1987. They anticipated that the implementation of GST would

deliver a win-win proposition for both taxpayers and the Government as it was experienced by the countries like New Zealand, Singapore, and Japan. In his study, Vasanthagopal (2011) advocated the need for the implementation of GST in India. He concluded that the switch over to a flawless GST would be a big leap in the indirect taxation system of India and would also help in booming the economy of the nation. He also pointed out that buoyed by the success of GST, more than 140 countries have implemented GST in some form or other and the GST is becoming the preferred form of indirect tax system in the Asia - Pacific region.

Li (2013), in his study, stated that in China, the implementation of GST made housing costly, as the extra cost of sunk input tax was passed in the form of increased mortgaged cost. This finding was supported by the study conducted by Zhou, Tam, and Heng (2013). Their study found an increase in consumer price index in Australia after the implementation of GST in the year 2000. Their study also concluded that the implementation of GST in Malaysia will put upward pressure on the cost of living through inflation at least in the initial stage. To appraise the Goods and Services tax of Papua New Guinea, Agogo (2014) conducted a study and came with the result that the low-income countries cannot afford to implement the GST tax structure. From the outcome of his study, he concluded that the implementation of GST does not provide growth drive to poor countries like Papua New Guinea.

Kadir, Yusof, and Hassan (2015) conducted a study to examine the group that would be affected more from GST implementation in Malaysia and found that the most affected income group from GST implementation was the low-income group, due to their high sensitivity towards consumption patterns, particularly on basic goods. The findings of the study revealed that the low-income group was burdened with more tax than the middle- and high-income groups. The study also suggested that the Government of Malaysia should consider waiving indirect taxes on necessity goods and basic goods. The government should consider setting up items under zero-rated and exempt supplies for certain necessities to minimize the tax burden on the poor and to ensure that the income is equally distributed. However, a study conducted in India by Adhana (2015) concluded that the implementation of GST in other countries helped in simplifying their tax system and reducing the tax burden on the corporates, and hence, helped much in reducing the cost burden. It was further anticipated that the implementation of GST would be a solution for the tough situations faced by the Indian economy.

On contrary to this view, Mehra (2015), in his research article, pointed that the present proposed setup of GST in India will not increase growth and instead will push up the consumer price inflation and may not result in increased tax revenue collection. The study concluded that the Asian countries which introduced GST between 1977 and 2015 experienced higher average retail inflation to the tune of 1.1% after the implementation of GST. A study by Dani (2016) also advocated that the present form of GST would hamper the growth of the Indian economy. He pointed out that India has adopted dual GST instead of national GST. This has made the entire structure of GST fairly complicated in India. He also pointed out that the proposed GST rates of 12% for concessional goods, 17 – 18% for standard goods, and 40% for luxury goods is much higher than the previous tax rate of 14%. Hence, such an initiative is likely to lead to inflationary pressure. However, on the contrary to this view, a study by Sharma (2016) concluded that the effective implementation of GST will work as a powerful tool in eliminating the loopholes in the previous taxation system and may also give benefits like increased GDP, employment, better markets, more exports, lower costs, and so on. The author concluded that although there are lots of challenges in floating GST in India, the benefits that will be received after implementing it properly will outweigh its cost, and hence, it should be executed in its full spirit.

Shokeen, Banwari, and Singh (2017) conducted a study on the impact of GST Bill on the Indian economy well before the present form of GST Bill was introduced. Their study was completely based on hypothetical knowledge as the GST Bill had not been introduced, and based on the ongoing discussions surrounding the GST Bill, they attempted to estimate the impact of GST Bill on the Indian economy in general and for small, medium, and large

enterprises in specific. They concluded that the introduction of the GST Bill would deliver a positive impact on the Indian economy and to all the selected enterprises.

Vijisha (2017) also concluded that the introduction of GST in India will lead to an improvement in the growth and development of the Indian economy. Reducing the tax burden will minimize the cost of products and services, which will lead to enhancement in the trade across the country. The study concluded that the effective implementation of GST will also improve the competitiveness of Indian goods and services in the global market and will promote India's export trade. In their study, Nayyar and Singh (2018) highlighted the background of the earlier taxation system in India, the Goods and Services Tax concept along with its working pattern, and comparison of Indian GST rates with the GST rates of economies from other parts of the world. They conducted an in-depth coverage regarding the advantages to the various sectors of the Indian economy after the implementation of GST and concluded that the implementation of GST delivered a significant positive impact on the Indian economy and to various other sectors by reducing the cascading effect of taxes, which led to an increase in the profitability of the companies by lowering the overall tax burden on goods and services during the early period of implementation. However, a study conducted by Shukla and Singh (2018) obtained contradictory findings. They attempted to analyze the impact of GST on the performance of the selected 192 companies listed on the BSE after one year of implementation of GST. The financial parameters like total assets, profit, and market capitalization and the demographic variables like size and experience of the companies were considered for the analytical purposes. Their findings revealed that there was no positive change in the profits and market capitalization of the selected companies post one year of GST implementation. They also found that the companies which were larger in size saw a decrease in their profits and the market capitalization when compared with the smaller companies.

This controversial view urged us to have insight on this aspect, and more particularly, the statements by the captains of the auto sector companies accusing the implementation of GST for the downward sales in the auto sector forced us to compare the performance of the auto sector stocks in the Indian equity market pre and post the implementation of GST in India.

We believe that this research work is unique in the sense that the earlier research studies conducted in India to understand the impact of GST on the Indian equity market did not focus exclusively on the behaviour of the auto sector stocks of the Indian equity market. Hence, to fill this gap, we have chosen this untouched area and the reason behind choosing this sector is that this is the only sector which is expected to produce employment opportunities for roughly 35 million people residing in India. Hence, understanding the impact of GST on this sector would be more beneficial to our economy and society.

Objectives of the Study

The primary focus of our study is to assess and compare the performance of returns rendered by the auto sector stocks listed in the Indian equity market, pre and post GST implementation in India and to understand the level of symmetric and asymmetric volatility triggered in the price behaviour of the stocks selected during the study period.

Hypotheses of the Study

The following are the null and alternative hypotheses of the study :

✤ **H_{01} :** The price behavior data of the selected stocks are not stationary in nature.
✤ **H_{a1} :** The price behavior data of the selected stocks are stationary in nature.

↳ **H₀₂ :** The price behavior data series of the selected stocks are not normally distributed.

↳ **Hₐ₂ :** The price behavior data series of the selected stocks are normally distributed.

↳ **H₀₃ :** The price behavior data series of the selected stocks do not possess the ARCH effect.

↳ **Hₐ₃ :** The price behavior data series of the selected stocks do possess the ARCH effect.

↳ **H₀₄ :** There is no ARCH effect in the residuals of the data series of the selected stocks.

↳ **Hₐ₄ :** There is ARCH effect in the residuals of the data series of the selected stocks.

↳ **H₀₅ :** There is no leverage effect in the data series of the stocks selected for the study.

↳ **Hₐ₅ :** There is leverage effect in the data series of the stocks selected for the study.

Data, Study Period, and Research Design of the Study

To achieve the objectives of this study, we collected the data on the closing prices of the constituent stocks of the auto sector index of NSE from February 20, 2017 – November 9, 2017 on a daily basis and the same were collected from the official website of NSE (www.nseindia.com). The period of the study were selected in such a manner that it consisted of the price behaviour data for 90 trading days, that is, pre (from February 20, 2017 – June 30, 2017) and post (July 2, 2017 – November 9, 2017) GST implementation. The constituent stocks of the auto sector index of NSE are Amara Raja Batteries Ltd., Apollo Tyres Ltd., Ashok Leyland Ltd., Bajaj Auto Ltd., Bharat Forge Ltd., Bosch Ltd., Eicher Motors Ltd., Exide Industries Ltd., Hero Motocorp Ltd., MRF Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., Motherson Sumi Systems Ltd., TVS Motor Company Ltd., and Tata Motors Ltd.

The data collected are analyzed by applying various statistical tools like descriptive statistics, Jarque – Bera test, Ljung – Box test, Augmented Dickey – Fuller test, heteroskedasticity test, GARCH (1,1), and ARCH – LM test. The continuously compounded rate of return of the selected stocks, computed as the first difference of the natural logarithm of the daily closing values, were arrived by using the formula $Rt = In\ (Pt/\ Pt-1)*100$, where Rt is the return of the stock selected for the time t, $Pt-1$ is the previous day closing price of the selected stock, and Pt is the closing price of the stock on the present day.

To understand the distributional properties of the stocks selected for the study, descriptive statistical tools like mean, standard deviation, kurtosis, and skewness were applied. Tools like Jarque – Bera test and Ljung – Box test are used to check whether the return series of the selected stocks are normally distributed or not. To confirm whether the return series of the selected stocks are stationary, Augmented Dickey – Fuller test has been ascertained ; to check the presence of heteroskedasticity (ARCH effect), the Lagrange multiplier test and ARCH – LM test have been employed. In the process of understanding the level of volatility (symmetric) delivered by the selected return series, GARCH (1, 1) statistical tool is applied and to check the adequacy of GARCH (1,1) model, the ARCH – LM test has been applied. To ascertain the existence of asymmetric volatility, we have applied the EGARCH (1, 1) model and ARCH – LM test is applied to know the adequacy of the selected model to specify the existence of the asymmetric volatility in the selected return series.

Analysis and Results

The distributional properties of the selected stocks during the study period have been analyzed by employing descriptive statistical tools like mean, standard deviation, skewness, and kurtosis and the calculated values are displayed in Table 1.

Table 1. *Descriptive Statistics of the Auto Sector Stocks of NSE*

Name of the Stock	Pre GST				Post GST			
	Average	Standard Deviation	Skewness	Kurtosis	Average	Standard Deviation	Skewness	Kurtosis
Amara Raja	–0.019634	1.265298	0.110393	4.789143	–0.153340	1.615608	0.811204	7.356840
Apollo Tyres	0.329636	1.889691	0.322939	3.591855	–0.098890	1.950542	0.960798	6.005103
Ashok Leyland	–0.000598	1.638039	0.832365	4.683538	0.157085	1.879828	0.036198	3.848006
Bajaj Auto	0.004962	1.045508	–0.005461	3.949984	0.154317	1.125974	0.751305	4.360168
Bharat Forge	0.032974	1,799855	–0.070910	4.177857	0.291487	1.637655	0.099545	3.530302
Bosch Ltd.	0.069959	1.236967	0.117563	4.117011	–0.120021	1.316115	0.112149	3.872807
Eicher Motors	0.086302	1.454568	0.846537	4.499300	0.118430	1.463356	–0.017031	4.269281
Exide Industries	0.054285	1.674314	0.564908	4.170562	–0.111977	1.720884	0.247974	3.643555
Hero Motors	0.203857	1.201803	0.196029	4.740657	–0.054363	1.134233	0.192229	3.158961
MRF Ltd.	0.348566	1.712931	0.870706	4.470532	–0.097081	1.267120	0.014945	3.790732
Mahindra & Mahindra	0.026513	1.156411	1.033306	4.701593	–0.004243	1.222612	0.046870	3.841366
Maruti Suzuki	0.2095520	1.144082	0.985296	4.199861	0.123006	0.910823	0.223820	3.772843
Motherson Sumi	0.312588	1.475248	0.389352	3.066485	0.185043	1.450562	–0.112559	3.764148
TVS Motor	0.286211	1.276395	0.908426	3.658857	0.257072	1.628938	–0.815869	9.526484
Tata Motors	–0.051780	1.461182	–0.004490	3.469204	0.025561	1.93634	–0.712189	7.147286

Among the 15 selected stocks, only three stocks, that is, Amara Raja (–0.019634), Ashok Leyland (–0.000598), and Tata Motors (–0.051780) delivered negative daily average returns during the pre-GST period. However, during the post GST period, all seven stocks, that is, Amara Raja (–0.153340), Apollo Tyres (–0.098890), Bosch Ltd. (–0.120021), Exide Industries (–0.111977), Hero Motors (–0.054363), MRF Ltd. (–0.097081), and Mahindra & Mahindra (–0.004243) delivered negative daily average returns. The standard deviation values of the 10 selected stocks are much higher during the post GST period, which reveals that the return series of the stocks are more volatile during the post GST period. The standard deviation values of Apollo Tyres (1.950542), Tata Motors (1.93634), Ashok Leyland (1.879828), and Exide Industries (1.720884) are comparatively higher during the post GST period and Bharat Forge (1.799855) and MRF Ltd. (1.712931) show higher standard deviation values during the pre-GST period.

The skewness values of all the selected stocks are positive during the pre-GST period except for Bajaj Auto (–0.005461), Bharat Forge (–0.070910), and Tata Motors (–0.004490). It indicates that the share prices of the selected stocks were increasing more frequently during the pre-GST period. In the same way, during the post GST period too, the calculated skewness values of all the selected stocks are positive except in the case of Eicher Motors (–0.017031), Motherson Sumi (–0.112559), TVS Motors (–0.815869), and Tata Motors (–0.712189). The kurtosis values of all the stocks during both pre and post GST periods are greater than 3, which indicates that the selected return series are leptokurtic, and it implies that the return series are fat-tailed and has not followed the normal distribution during the study period.

To confirm whether the selected series are not normally distributed, we have applied the Jarque – Bera test and Ljung – Box test up to 36 lags and the calculated statistical values with its probability values are shown in Table 2.

It is noted that the calculated Jarque – Bera values for all the selected series are positive during both the periods, and their corresponding probability values are less than 0.05. The decision rule to reject the null hypothesis is that the probability value should be less than 0.05. As per the decision rule, the null hypothesis H_{01} is rejected

Table 2. *Test for Normality in the Return Series of the Selected Auto Sector Stocks*

Name of the Stock	Pre GST				Post GST			
	Jarque – Bera		Ljung Box Lag 36		Jarque – Bera		Ljung Box Lag 36	
	JB value	Prob	*Q* Stat	Prob	JB value	Prob	*Q* Stat	Prob
Amara Raja	12.05126	0.002416	56.559	0.016	80.15289	0.000000	32.921	0.006
Apollo Tyres	28.45963	0.002491	33.962	0.046	47.18175	0.000000	32.300	0.006
Ashok Leyland	20.7762	0.000031	33.867	0.005	6.686154	0.002610	42.386	0.002
Bajaj Auto	33.47104	0.001875	42.958	0.001	15.23344	0.000492	56.239	0.017
Bharat Forge	15.21934	0.007321	30.600	0.007	11.88461	0.005516	45.415	0.001
Bosch Ltd.	48.31952	0.008928	17.799	0.009	30.11542	0.002218	32.611	0.006
Eicher Motors	18.96590	0.000076	32.393	0.006	59.78704	0.005032	36.481	0.004
Exide Industries	9.814845	0.007392	36.686	0.004	8.447975	0.000294	42.853	0.002
Hero Motors	11.80584	0.002731	52.388	0.038	6.41825	0.007254	36.733	0.004
MRF Ltd.	19.26471	0.000006	29.862	0.007	2.321974	0.003131	38.409	0.003
Mahindra & Mahindra	26.57505	0.000002	36.260	0.004	2.657700	0.002647	39.011	0.003
Maruti Suzuki	19.73909	0.000052	24.241	0.009	9.344351	0.006267	38.007	0.003
Motherson Sumi	22.65047	0.003222	36.109	0.004	3.942111	0.008211	75.002	0.000
TVS Motor	13.85079	0.000983	25.928	0.008	16.78301	0.000000	37.914	0.003
Tata Motors	18.16699	0.000664	31.691	0.006	17.30694	0.000000	37.132	0.004

and the alternative hypothesis H_{a1} is accepted. Hence, it is confirmed that the selected return series are not normally distributed during both pre and post GST periods. For our further confirmation, we have employed the Ljung – Box test up to 36 lags. We find that the calculated Q-statistics values from the applied test are positive, and their probability values are less than 0.05 during both pre and post GST periods. To accept that the selected series are not normally distributed, it is important that the calculated Q-statistics values are positive and their corresponding values should be less than 0.05. Since the calculated values are in line with the requirements, we confirm that the selected values are not normally distributed.

It is a well-known fact that only those financial time series which are stationary alone may be used for the application of the statistical tools in the process of finding out the associated volatility. Hence, to check whether the selected return series are stationary or not, we have applied the Augmented Dickey – Fuller test (ADF Test) and the results obtained are exhibited in Table 3.

The calculated t-statistic values (At Level) for all the three test equations, that is, (a) intercept, (b) trend and intercept, and (c) none are compared with the McKinnon test's critical values at the 5% level. The decision rule to reject the null hypothesis is that the calculated absolute t - statistic values should be higher than the corresponding absolute test critical values. It is found that the calculated absolute t-statistic values for all the selected series during both the periods are higher than the corresponding absolute test critical values (ignoring signs), and hence, we reject the null hypothesis H_{02} and accept the alternative hypothesis H_{a2}. This has confirmed that the selected return series are stationary during both the periods, that is, pre and post GST.

In the process of finding out the symmetric and asymmetric volatility of the selected series, we have checked the presence of ARCH effect in the selected series by applying the heteroskedasticity test. It is a prerequisite process that has to be done before applying the GARCH family models to specify the volatility. Hence, as necessitated, we have applied the heteroskedasticity test on the series of the stocks selected for the study during

Table 3. *Tests for Unit Root Problem Using Augmented Dickey – Fuller Test*

Name of the Stock	Pre GST			Post GST		
	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None
Amara Raja	–8.123350	–8.098049	–8.165868	–9.022065	–9.045539	–9.022065
Apollo Tyres	–9.051767	–9.194476	–8.841906	–9.231936	–9.307031	–9.232289
Ashok Leyland	–7.701641	–7.820565	–7.746130	–8.753405	–8.840226	–8.736552
Bajaj Auto	–7.950610	–7.954661	–7.997117	–7.427327	–7.383738	–7.338406
Bharat Forge	–8.985951	–8.932048	–9.037244	–10.69600	–10.74264	–10.33933
Bosch Ltd.	–8.758565	–8.756554	–8.773404	–8.260462	–8.206848	–8.237237
Eicher Motors	–7.581200	–7.544766	–7.607312	–7.663220	–7.800093	–7.645643
Exide Industries	–8.541878	–8.626798	–8.587501	–8.632138	–8.582042	–8.638136
Hero Motors	–8.772938	–8.739286	–8.601093	–8.668639	–8.809062	–8.713368
MRF Ltd.	–9.261178	–9.419361	–8.958476	–8.313914	–8.446618	–8.281755
Mahindra & Mahindra	–8.955997	–8.903195	–9.003008	–10.11631	–10.06339	–10.17483
Maruti Suzuki	–9.147633	–9.115391	–8.958197	–8.295003	–8.247666	–8.215791
Motherson Sumi	–10.86759	–10.80380	–10.39378	–11.49493	–11.42824	–11.31758
TVS Motors	–9.008489	–8.958010	–8.637204	–9.845084	–9.794379	–9.640927
Tata Motors	–9.324755	–9.331201	–9.364107	–8.264603	–8.254817	–8.310133

Table 4. *Testing of the Heteroskedasticity Effect*

Name of the Stock	Pre GST				Post GST			
	F-statistic	Prob - *F*	Observed *R*-squared	Prob. Chi-Square	*F*-statistic	Prob - *F*	Observed *R*-squared	Prob. Chi-Square
Amara Raja	16.48976	0.0089	16.38692	0.0088	17.49040	0.0038	17.39841	0.0037
Apollo Tyres	48.55621	0.0082	47.49657	0.0082	50.02365	0.0048	50.01110	0.0047
Ashok Leyland	6.945885	0.0100	6.576277	0.0103	16.62431	0.0068	16.97841	0.0068
Bajaj Auto	18.74786	0.0017	18.67458	0.0017	5.085379	0.0267	4.913119	0.0267
Bharat Forge	5.925341	0.0043	5.812449	0.0043	25.39675	0.0011	25.24194	0.0011
Bosch Ltd.	26.95701	0.0060	25.74978	0.0060	26.30048	0.0139	26.00693	0.0142
Eicher Motors	10.06231	0.0075	10.02843	0.0074	9.911111	0.0075	9.810129	0.0075
Exide Industries	5.584609	0.0204	5.366028	0.0205	2.231671	0.0063	2.227766	0.0063
Hero Motors	3.68221	0.0084	3.376620	0.0084	6.535681	0.0079	6.436682	0.0079
MRF Ltd.	2.417061	0.0062	2.466341	0.0061	6.721389	0.0112	6.379135	0.0115
Mahindra & Mahindra	3.192147	0.0077	3.149481	0.0076	4.487711	0.0083	4.389721	0.0083
Maruti Suzuki	7.160021	0.0097	7.032451	0.0097	2.492664	0.0118	2.478787	0.0115
Motherson Sumi	7.982531	0.0037	7.890305	0.0036	10.25560	0.0031	10.17043	0.0030
TVS Motors	4.653811	0.0049	4.5973640	0.0049	11.53556	0.0028	11.64760	0.0028
Tata Motors	3.133517	0.0071	3.130641	0.0071	3.324106	0.0057	3.310398	0.0056

both the periods that is, pre and post GST, and the findings are displayed in Table 4. The decision rule to confirm whether a series suffers from ARCH effect, the calculated *F*-statistics values should be greater than the

corresponding observed *R*-squared values and the probability values should be less than 0.05. The calculated *F*-statistics values and the corresponding observed *R*-squared values for all the selected series during both the periods (pre and post GST) are compared with each other, and it is found that the calculated *F*-statistics values are higher than the observed *R*-squared values and the probability values are less than 0.05, as required. Hence, as per the decision rule, we have rejected the null hypothesis H_{03} and accepted the alternative hypothesis H_{a3}. This confirms the presence of the ARCH effect in the selected series during both periods.

On confirmation of the presence of ARCH effect in the selected data, we have proceeded our analytical work by applying the GARCH (1, 1) model to assess the symmetric volatility. As it was proved in the earlier studies by Banumathy and Azhagaiah (2015) ; Liu (2016) ; Amudha and Muthukamu (2018) ; Mishra (2019) ; and Jincy, Amudha, and Muthukamu (2019), we have applied the proven best fit model – GARCH (1,1) to find out the symmetric volatility and the outcomes are shown in Table 5.

Table 5. *Symmetric Volatility Estimation by Using GARCH (1,1) Model*

Name of the Stock	Pre GST			Post GST		
	ARCH Value (α)	GARCH Value (β)	α + β	ARCH Value (α)	GARCH Value (β)	α + β
Amara Raja	0.143263	0.664354	0.807617	0.154346	0.759364	0.913710
Apollo Tyres	0.119268	0.806445	0.925713	0.158742	0.677527	0.836269
Ashok Leyland	0.274568	0.638954	0.913522	0.138620	0.802092	0.940712
Bajaj Auto	0.084374	0.728499	0.812873	0.179577	0.699375	0.878952
Bharat Forge	0.098452	0.804435	0.902887	0.076467	0.882009	0.958476
Bosch Ltd.	0.119371	0.585091	0.704462	0.075907	0.858645	0.934552
Eicher Motors	0.084700	0.884714	0.969414	0.034219	0.848576	0.882795
Exide Industries	0.194343	0.691120	0.885463	0.074090	0.873974	0.948064
Hero Motors	0.029292	0.930252	0.959544	0.034539	0.934539	0.969078
MRF Ltd.	0.045309	0.876102	0.921411	0.138087	0.809455	0.947542
Mahindra & Mahindra	0.193975	0.705569	0.899544	0.045894	0.918836	0.964730
Maruti Suzuki	0.100147	0.864662	0.964809	0.163447	0.8171593	0.980606
Motherson Sumi	0.084771	0.876490	0.961261	0.107831	0.874665	0.982496
TVS Motors	0.148941	0.808828	0.957769	0.148629	0.808893	0.957522
Tata Motors	0.106864	0.833181	0.940045	0.245721	0.739912	0.985633

The ARCH (α) and GARCH (β) coefficients for all the selected stocks during both the periods – pre-GST and post GST are found greater than zero, that is, positive. The sum of both ARCH and GARCH coefficients, applied as a measure of the persistence of volatility, is calculated to understand the level of volatility for all the stocks during the selected period. The sum of α and β values are closer to unity (1) and high in the case of Eicher Motors (0.969414) followed by Maruthi Suzuki (0.964809), Motherson Sumi (0.961261), Hero Motors (959544), and TVS Motors (0.957769) during the pre-GST period. This indicates that these stocks were comparatively more volatile during the pre-GST period. In the case of the post GST period, the sum of α and β values are closer to unity (1) for almost all the stocks except for Apollo Tyres (0.836369), Bajaj Auto (0.878952), and Eicher Motors (0.882795). When we compare the volatility level of the selected stocks during pre and post GST periods, we find that among the 15 selected stocks, almost all the stocks except Apollo Tyres, Eicher Motors, and TVS Motors were more volatile during the post GST period.

Table 6. *Checking Adequacy of GARCH (1,1) Model Using ARCH – LM Test*

Name of the Stock	Pre GST				Post GST			
	F-statistic	Prob - *F*	Observed *R*-squared	Prob. Chi-Square	*F*-statistic	Prob - *F*	Observed *R*-squared	Prob. Chi-Square
Amara Raja	0.093866	0.7601	0.05944	0.7568	0.010521	0.9185	0.010764	0.9174
Apollo Tyres	0.036278	0.8494	0.037106	0.8472	0.171991	0.6794	0.175640	0.6751
Ashok Leyland	0.036948	0.8480	0.037791	0.8459	0.101752	0.7505	0.103995	0.7471
Bajaj Auto	0.037977	0.8459	0.038843	0.8438	0.410038	0.5237	0.417583	0.5181
Bharat Forge	0.02818	0.9715	0.024569	0.9711	0.011878	0.9135	0.012153	0.9122
Bosch Ltd.	0.301053	0.5846	0.306980	0.5795	0.189801	0.6642	0.193787	0.6598
Eicher Motors	0.35610	0.5522	0.362886	0.5469	0.004512	0.9466	0.004617	0.9458
Exide Industries	1.744501	0.1901	1.749581	0.1859	0.933114	0.3368	0.944566	0.3311
Hero Motors	0.395837	0.5309	0.403187	0.5254	0.262586	0.6097	0.267874	0.6048
MRF Ltd.	0.212335	0.6461	0.216738	0.6415	1.961206	0.1650	1.962071	0.1613
Mahindra & Mahindra	0.202115	0.6542	0.206330	0.6497	0.879871	0.7675	0.899412	0.7643
Maruti Suzuki	0.879398	0.3510	0.890740	0.3453	0.714051	0.7899	0.730051	0.7870
Motherson Sumi	0.407422	0.5250	0.414931	0.5195	0.103651	0.7483	0.105934	0.7448
TVS Motors	0.086183	0.7698	0.088099	0.7666	0.167157	0.6837	0.170713	0.6795
Tata Motors	0.22515	0.6363	0.229794	0.6317	0.167971	0.6829	0.171542	0.6787

To check the adequacy of the GARCH (1,1) model and to know the level of symmetric volatility, we have employed the ARCH – LM test (Lagrange multiplier test) and the results are exhibited in Table 6.

To confirm that the applied GARCH (1, 1) model has aptly specified the symmetric volatility, the residuals obtained from the GARCH (1, 1) model should be free from the ARCH effect. To validate this, the ARCH – LM test has been conducted and the calculated *F*-statistics values and the observed *R*-squared values are compared with each other. The decision rule to reject the null hypothesis, "There is no ARCH effect in the residuals of the data series of the selected stocks" is that the calculated *F*-statistic values should be greater than the corresponding observed *R*-squared values and the probability values should be less than 0.05. It is noted that the calculated *F*-statistics values for all the series during both the periods are less than the corresponding observed *R*-squared values, and the corresponding probability values are also higher than 0.05 as required. Hence, we accept the null hypothesis H_{04} and reject the alternative hypothesis H_{a4}, and it confirms that the selected GARCH (1, 1) model is the best fit model to stipulate the volatility pattern of the selected stocks during both the pre and post GST periods.

Though implementation of GST is viewed as one of the best moves ever implemented in the Indian indirect tax regime by the officials of the Indian government and common man, the expectations of investors in the Indian equity market differ in this aspect, and they have considered that the implementation of GST provides a negative shock to the auto sector of the Indian economy, which is proven from the returns delivered by the auto sector stocks during the post GST period and its associated volatility experienced during the same period. Hence, we have been forced to assess whether the leverage effect exists or not in the price behaviour of auto sector stocks of the Indian equity market. Leverage effect is the tendency for the volatility to rise more following a large price fall than the following price rise of the same magnitude. The presence of asymmetric volatility, termed as leverage effect in financial literature, in the auto sector stocks of the Indian equity market has been assessed by employing EGARCH (1, 1) model and the results obtained are shown in Table 7.

Table 7. *Asymmetric Volatility Estimation by Using E-GARCH (1,1) Model – Post GST Period*

Name of the Stock	α	β	α+ β	γ	p - value
Amara Raja	0.092397	0.845516	0.937913	–0.316748	0.0002
Apollo Tyres	0.189215	0.7919334	0.981148	–0.157208	0.0018
Ashok Leyland	0.230858	0.713970	0.944828	–0.171960	0.0007
Bajaj Auto	0.130800	0.790368	0.921168	–0.144838	0.0064
Bharat Forge	0.162006	0.796562	0.958568	–0.011873	0.0082
Bosch Ltd.	0.201141	0.744987	0.946128	–0.200441	0.0009
Eicher Motors	0.062863	0.904238	0.967101	–0.101943	0.0082
Exide Industries	0.194289	0.746373	0.940662	–0.243931	0.0035
Hero Motors	0.241718	0.643338	0.885056	–0.181968	0.0017
MRF Ltd.	0.107262	0.847729	0.954991	–0.057958	0.0019
Mahindra & Mahindra	0.159583	0.780048	0.939631	–0.084530	0.0093
Maruti Suzuki	0.102069	0.866660	0.968729	–0.180814	0.0082
Motherson Sumi	0.190372	0.725799	0.916171	–0.045540	0.0039
TVS Motors	0.042665	0.941445	0.984110	–0.311373	0.0044
Tata Motors	0.206068	0.7666905	0.972759	–0.118913	0.0059

The decision rule to accept that the selected return series have leverage effect is that the calculated 'γ' value should be negative and the corresponding 'p' value should be less than 0.05. It is observed that the calculated 'γ' value for the return series of the selected stocks during the post GST period is less than zero, that is, negative and the corresponding probability values are less than 0.05. Hence, the null hypothesis H_{05} is rejected and we accept the

Table 8. *Checking Adequacy of E-GARCH (1, 1) Model Using ARCH – LM Test – Post GST Period*

Name of the Stock	F-statistic	Prob - F	Observed R-squared	Prob. Chi-Square
Amara Raja	0.075220	0.9931	0.076930	0.9930
Apollo Tyres	0.027919	0.8677	0.028559	0.8658
Ashok Leyland	0.370815	0.5442	0.377809	0.5388
Bajaj Auto	0.03997	0.9497	0.04089	0.9490
Bharat Forge	0.04785	0.9450	0.04896	0.9442
Bosch Ltd.	0.153235	0.6964	0.156519	0.6924
Eicher Motors	0.101189	0.7512	0.103420	0.7478
Exide Industries	0.014390	0.9048	0.014722	0.9034
Hero Motors	0.036740	0.8484	0.037579	0.8463
MRF Ltd.	0.301530	0.8610	0.3180907	0.8431
Mahindra & Mahindra	0.0830123	0.9977	0.0850262	0.9977
Maruti Suzuki	0.033794	0.8546	0.034567	0.8525
Motherson Sumi	0.002771	0.9868	0.000283	0.9866
TVS Motors	0.061509	0.8047	0.062895	0.8020
Tata Motors	0.042531	0.9984	0.043572	0.9983

alternate hypothesis H$_{a5}$, which confirms that the selected series has the leverage effect during the post GST period. Hence, it is clear that the implementation of GST delivered a negative shock to the auto stocks, which triggered more volatility during the post GST period than the pre-GST period.

To check whether the applied EGARCH (1,1) model is the best fitted one and to exhibit the asymmetric volatility, we have further applied the Lagrange multiplier test (ARCH – LM test) by using the residuals obtained from EGARCH (1,1) and the values arrived are shown in Table 8.

The calculated *F*-statistic values of all the selected return series during the study period are less than the corresponding calculated observed *R* - squared values, and the probability values are greater than 0.05 as required. Since the findings are following the requirements, we confirm that the EGARCH (1, 1) model is the best fit model to assess the leverage effect of the selected auto sector stocks of NSE.

Summary of Findings and Concluding Remarks

The average daily returns of the selected auto sector stocks of NSE delivered better performance during the pre-GST period than the post GST period. Out of 15 selected stocks, we find that 12 stocks delivered poor performance during the post GST period when compared with the pre-GST period. The standard deviation values of majority of the stocks during the post GST period are higher than the pre-GST period, which reveals that the price behaviour of the selected series experienced more swings from their daily average prices during the period of post GST implementation. The skewness values of 12 stocks among the selected 15 stocks are positive during the pre-GST period, and the skewness values of 11 stocks among the selected 15 stocks are positive during the post GST period, which indicates that the stock prices of the selected stocks have increased more frequently (ignoring their magnitude of rise or fall) in their daily price behaviour during both the periods. The kurtosis values of all the stocks, irrespective of the period of implementation of GST, are greater than 3, which indicates that the selected return series are not normally distributed during both the periods. The application of correlogram test – At Level up to 36 lags (Ljung – Box values) and calculated Jarque – Bera values have confirmed that all the return series are not normally distributed during both the periods.

To check whether the selected series are stationary, the Augmented Dickey – Fuller test (ADF Test) has been employed and we find that the selected series of auto sector stocks of NSE are stationary during both pre and post-GST implementation periods. The calculated *t* - statistic values At Level (absolute values) for all the three test equations, that is, (a) intercept, (b) trend and intercept, and (c) none are found greater than the calculated McKinnon test critical values (absolute values) at the 5% level, and the corresponding probability values are less than 0.05 during both the periods. The application of heteroskedasticity test on the return series of the selected stocks has confirmed that all the selected series are suffering from ARCH effect during the pre and post GST periods. Hence, we applied the GARCH (1,1) model to understand the symmetric volatility and we observe that all the selected series are volatile in both periods. The sum of both ARCH and GARCH coefficients, used as a measure of the persistence of volatility, are greater in value (closer to unity) during the post GST period.

When we compare the volatility of the selected stocks during pre and post GST periods, we find that among the selected 15 stocks, 12 stocks are more volatile during the post GST period. In the process of checking the adequacy of the application of GARCH (1,1) model by applying the ARCH – LM Test, we observe that the selected GARCH (1,1) model has well specified the volatility pattern of the selected stocks during the study period. Since the implementation of GST has been viewed as a negative shock to the auto sector by the investing community, we have applied the EGARCH (1,1) model to know the leverage effect and find that the selected auto sector stocks have delivered a high level of volatility to the negative shocks due to the implementation of GST. Hence, from the findings of our study, we conclude that the implementation of GST has delivered a negative impact on the auto

sector of the Indian economy, and delivered more volatility in the price behaviour of the auto sector stocks traded in the Indian equity market.

Implications

It is an accepted fact that the current stock prices in the equity market normally represent the expected future performance of the stocks concerned. It is surprising to note that, as opposed to the expectations of the policymakers, the equity market delivered a negative response to the implementation of the GST as far as the auto sector is concerned. This indicates that the tax slabs fixed and the method of implementation of the GST Bill have slackened the interest of the stakeholders. The outcomes of this study will help the policymakers and the executors of India to understand the reactions rendered by the equity investors on the implementation of GST in India. Since the auto sector in India is feeding millions of people residing in this country, the contribution of this research work may be useful for the policymakers so as to ascertain the reasons behind this negative response and calls to address it appropriately.

Limitations of the Study and Scope for Further Research

This research work suffers from the limitation of the long run and immediate impact of the enactment of GST, since the study period undertaken is limited to only 90 days pre and post GST implementation period, which reveals the impact only to the tune of the selected limited period. Hence, using the outcomes of this study may not be appropriate to understand the long-run impact of GST. Similar research of this kind with the selection of stocks from other sectors of the Indian economy will give a way forward to understand the issues and challenges on the execution of GST specific to other selected sectors.

Authors' Contribution

Dr. M. Muthukamu conceived the idea and developed qualitative and quantitative design to undertake this empirical study. Dr. R. Amudha extracted the research papers with high repute, filtered based on keywords, and generated concepts and codes relevant to the study design. She collected the data from the official sources and verified the analytical methods. Dr. M. Muthukamu conducted the numerical computations using E-views 7.1 version software and wrote the manuscript in consultation with the co - author.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter, or materials discussed in this manuscript.

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About the Authors

Dr. M. Muthukamu is currently working as an Associate Professor & Head in the Department of Business Administration, APSA College, Thiruppattur, Tamil Nadu. He is an active researcher and academician having an experience of 24 years. His teaching and research interests lie in the areas of financial analytics and equity market operations. He has published his research works in journals and conferences of repute worldwide.

Dr. R. Amudha is currently working as an Associate Professor in the Department of Management Studies at Karunya Institute of Technology & Sciences, Coimbatore, Tamil Nadu and has more than 25 years of academic and industry experience. She has published more than 50 publications in journals of repute and has travelled abroad to several countries for chairing and presentation of articles in international conferences.