Robustness of Fama-French Three-factor Model in Indian Automobile Industry

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Abstract

The basic objective of the present study is to test the robustness of FAMA French Three Factor Model in Indian Automobile Industry. For the same, companies listed in National Stock Exchange (NSE) are considered. Monthly stock price of sample companies have been taken from October 2010 to October 2018. The Fama French Model has been examined constituting portfolios based on size effect and value effect. The size effect and value effect are measured by market capitalization and book-to-market equity ratio. It has been observed that market factor; SMB and HML are associated with portfolio return significantly.

Key Words: *Risk and return, Fama-French three factor model, Value effect, Size effect*

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1. INTRODUCTION

The price movements of the stock market are analysed by various investors and other portfolio managers in the hope of earning abnormal returns. The notion of Efficient Market Hypothesis given by Fama stating that the stock markets are efficient and no individual can make abnormal returns based on the past, present and the inside information of the company stands controversial due the presence of the various anomalies and investors making above average returns using technical analysis i.e. past trends and Fundamental analysis i.e. using company's information such as revenues, growth, size etc. to value the stocks. Harry Markowitz's contributions in financial economics lead to the establishment of the Modern Portfolio Theory. He gave a framework for investment in the portfolios in 1952 (Mangram, 2013). Prior to this, portfolios were constructed by assessing the risk and returns of the individual securities. Markowitz Portfolio theory being too cumbersome with the increase in data size, Sharpe and Linter came up with a single factor model Capital Asset Pricing Model (CAPM) that was used widely for about half a century to calculate the return on the securities based on the market return and the Beta factors (Iqbal et.al,2017). CAPM is built on the Markowitz theory. CAPM clearly establishes a relationship between risk and return of the capital. The beta model of CAPM is used to measure the systematic risk. The model helps to identify the over and under-priced assets. CAPM helps in building a diversified portfolio that eliminates the unsystematic risk. Bajpai & Sharma (2015) considered CAPM as the most fundamental and popular method for asset pricing and used it in their study in Indian equity market from 2004 – 2013 and found that CAPM performs better than the traditional method. It provided a clear understanding of the interaction between the systematic risk, unsystematic risk and returns. Later in the year 1976, it was exclaimed that other factors such as economic factors, fundamental factors of the firm or other statistical factors also play an important role in pricing of the assets. However, according to the arbitrage model, any difference in the prices return back to its equilibrium level as the arbitragers will make use of this imbalance. Therefore this model gave similar results as that of the CAPM. However, the model failed due to the presence of various anomalies in the market with respect to the size of the companies, proportion of leverage, earning price ratios etc. Finally, an entirely different approach was given by Fama and French for asset pricing in 1993 named "The Three Factor Model" wherein the returns were related with three different variables namely excess return on the market portfolio, differences in the returns of small and big firms and differences in the returns of the firms with High – Low Book Market values. The model is represented as below:

$$E(R_p)\text{-RFR} = \beta_1(R_m - \text{RFR}) + \beta_2\,(\text{SMB}) + \beta_3\,(\text{HML})$$

Where, SMB and HML refer to Small minus Big firms and High minus low firms respectively. $E(R_m)$ – RFR is the excess returns on the market portfolio, SMB and HML are considered to be the expected premiums for small minus big firms and high minus low firms respectively. β_1, β_2 and β_3 are the regression coefficients estimated by ordinary least square regression analysis. Small and big firms measures the size and High – Low firms measures the value premium in regards to the Book to Market ratio. The present paper attempts to validate the model in Indian stock market during the current period by testing that regression coefficients β_2 and β_3 are significantly different from zero.

2. LITERATURE REVIEW

The literature with regards to the asset pricing starts from the Markowitz theory, use of CAPM and then coming up of the FAMA three factor and then five factor model. Some of the embarking studies have been discussed here. Fama and French (1992) examined all non-financial firms listed on NYSE, AMEX or NASDAQ from 1963 – 1989 as prior to this, the data suffered from selection biasness. Size and BE/ME, Leverage and Earnings to Price ratio variables are used simultaneously to capture the cross sectional returns. It was found that Book to Market effect strongly explained the variations but Beta failed to explain the variations. However, Black (1992) stated that the failure of beta could be because of Data Mining. He further mentioned that Book to Market Effect is also a result of data mining and will eventually fade away. The model was tested in India by Connor and Sehgal (2001) on the monthly closing prices of 364 companies forming CRISIL

500 from June 1989 – March 1999 and the results supported the model stating that market, size and book to market equity ratio better explain the cross sectional returns as compared to the Beta alone. They further recognised that their study was not able to identify few aspects about the model such as its applicability on wider range of portfolio, evidences of any other relevant factors, underlying theory behind the size and value premium and reliability of the results if different sample or methods are used. Bahl (2006) tested the Fama model for stocks listed on BSE 100 sorted on the basis of size and B/E – M/E ratio and found that the Fama model captures the portfolio returns better than the CAPM model. However, Fama model failed to perform well during the financial disturbances in the Swedish market. Taneja (2010) has tried to validate the efficiency of the Fama model over the CAPM model in terms of predicting returns using a sample of 187 companies selected on the basis of their presence in S&P CNX 500from last 10 years. The results support the applicability of two factors i.e. market and either size or value. Phong and Hoang (2012) in their study proved that the superiority of the Fama model to the CAPM model from 2007 – 11 in Vietnam's stock market. However, they stated that the calculation of average return of each month of the SMB and HML portfolios is a tedious task therefore; in spite of the edge of FAMA model over the CAPM model in terms of accuracy of results, CAPM is still used. Odera (2013) studied Fama and French Model at Nairobi Stock Exchange from 2008 – 2012 using nine portfolios made of 60 companies and found that the model had limited potential in explaining the portfolio returns. Nanda kumar & Damodaran (2014) studied the effectiveness of the Fama model in the Indian Stock Market in respect of Oil and Gas firms and found that the returns are better predicted by the Fama model rather than the market factor alone. Bhatt and Rajaram (2014) tested the workability of Fama model in predicting the returns for the socks listed on Dow Jones Index especially during the crisis period and found that the model was able to efficiently capture the market risk. Abbas (2015) et. al. tested the explanatory power of the Fama model in stock market of Pakistan for the stocks constituting the KSE- 100 index for a period ranging from 2004- 2014 and the results supported the literature. Rehnby (2016) attempted to find the effectiveness of the Fama model and Carhart four factor model in comparison with the CAPM model for predicting the portfolio returns using the companies listed on NASDAQ OMX large or mid cap list during 2010 – 2015. Kianpoor and Dehghani (2016) in their study used Fama model to select stocks in Tehran Security and Exchange Organisation during 2008 – 2012. Achola and Murinu (2016) found that the portfolio returns predicted using Fama factor model were true when tested on six portfolios of Nairobi Stock Exchange sorted by B/E – M/E ratio and size for Fama model and size and trade concentration ratio for augmented model from 2004 –2014. Sattar (2017) attempted to compare the edge of Fama model over CAPM model in regards to the effectiveness and practical implication using five listed companies of Cement Industry in Bangladesh during 2004 – 2014 and found that Fama model carries more explanatory power to predict returns as compared to single factor Beta of CAPM. Similar results about superiority of the Fama Model over the CAPM model in explaining the returns were found in the markets of United Kingdom by Bhatnagar and Ramlogan (2012). Manjuanatha and Mallikarjunappa (2016) tested the Fama and French factors in Indian Capital Market on continuously traded Nifty stocks from 1996 – 2010 and found that Fama Factors model can be used selectively such as for stocks with low BE/ ME only market can be used to explain the returns whereas for firms with medium and high B/E and M/E all the three factors i.e. size, value and market factors will explain the results in a better way. Sobti (2016) in her study explored the superiority of the FAMA model over the CAPM model and found that the size factor persists more in the Indian equity market rather than the value for the period of 2005 – 2015. Kari & Gausselmann (2017) undertaken similar study in US markets with a sample of 120 high tech companies and found that the Fama three factor model outperformed the CAPM model due to the presence of Size factor measured as (Small Minus Big). However, Fama model is said to hold true during stable economic period and may not perfectly work during economic disturbances in predicting returns. Datta and Chakraborty (2018) attempted to examine the working of Fama model in capturing the excess returns by applying it on the stocks constituting NIFTY finance and compared

the results with those obtained from the NIFTY auto-index which acts as a benchmark. The results concluded that Fama model works for the Indian financial sector as well.

As per the CAPM model, higher the risk, higher is the possibility to earn the returns in the efficient markets. However, literature has been available supporting the presence of anomalies in the stock market leading to the coming of Fama model that attempts to predict returns using factors such as size, value, leverage etc (Sobti, 2016). The present study aims to revisit the FAMA model by applying it in the Indian stock market to assess the effectiveness of the size and value factors in predicting the cross sectional returns in the auto index for the current time period.

3. RESEARCH METHODOLOGY

3.1 Data and Model Specification

The time period for the observation period is between October 2010 to October 2018. The monthly closing price of the stock of 14 companies of automobile industry (15 automobile companies are listed, one company has not been considered because of data unavailability) has been considered for testing the robustness of FAMA three factor model. The data of stock price of sample companies has been collected from CMIE Prowess. After collecting the stock the price, the monthly log return is calculated. In present study, the sample companies have been considered from Nifty 50, hence, the Nifty index is used as proxy for the market portfolio. Market capitalization of all the sample companies is an indicator to rank small and big companies. The median of market capitalization is calculated for the same.

The sample companies have been ranked as per the market capitalization. Out of fourteen companies, the market capitalization of seven companies is less than median market capitalization and rest of seven companies have more than median market capitalization. Small companies are denoted by 'S' whereas big companies are denoted by 'B'. In order to categorize constituent stocks of automobile industry in India, the BE/ME is considered. 30% bottom of sample companies is categorized as Low (L), 30% to 70% is Medium (M) and above 70% is High (H).

With the interaction of size and value, six portfolios are constructed namely S/L, S/M, S/H, B/L, B/M and B/H. SL portfolio consists of small market capitalization and low BE/ME companies and B/H signifies big market capitalization and high BE/ME ratio. Weighted returns of these portfolios have been calculated beginning from October of year t to September of year t+1. All the stocks of automobile industry in NSE are ranked on size in October from 2010 to 2018.

3.2 Model Specification

Market factor, Market capitalization, Book to market equity, and stock return are most important variables capital assets pricing model (Fama, 1993). Market factor is calculated differentiating market return (Rm) and risk free return (Rf) at t period. In present study, TERM is applied as proxy for market factor (Chen et al., 1986; Fama, 19930). TERM helps to represent time series variation in share price return (Shanken & Weinstein, 1990). Book to market equity is another most variable to impact the excess return. Companies having high BE/ME leads to realize less earnings on assets and low earnings can continue for longer period of time. A low BE/ME is concerned with high earnings. Size is associated with the earnings. Therefore, BE/ME is controlled with application of size. Small companies stick with low profitability on assets than big companies. SMB (small minus big) tends to impersonate risk element in stock return associated with size.

4. EMPIRICAL RESULTS AND DISCUSSION

Table 1 depicts the descriptive statistics of risk free rate, return on Nifty, HML, SMB and all the portfolio return including HS, LB, LS, MB, MS and HB. The portfolio return has been considered as dependent variable whereas HML, SMB and market factors are considered independent variable in present study. The maximum mean value ranges from 0.0764 to -0.0583 which is of risk free rate and HS. It has been observed that every portfolio is witnessed with negative return where as HML and SMB represents positive return. The maximum return is realised by HB compared to other portfolio and minimum return is by HB itself. The standard deviation of HB is high and RF is low. The Jarque-Bera test is used to check the normality of the series. The null hypothesis for the same is series is normally distributed. As per the result of p-value of Jarque-

Bera, it has been observed that RF and SMB are not normally distributed as their p-value is less 0.05 whereas rest of the variables are normally distributed. The sum of all the returns varies in

Table 1: Descriptive Statistics of portfolio returns of Automobile Industry

	RF	RNIFTY	HML	SMB	HS_RF	LB_RF	LS_RF	MB_RF	MS_RF	HB_RF
Mean	0.0764	0.0064	0.0233	0.0016	-0.0583	-0.0576	-0.0560	-0.0335	-0.0568	-0.0087
Median	0.0756	0.0042	0.0128	0.0013	-0.0657	-0.0567	-0.0603	-0.0463	-0.0553	-0.0146
Maximum	0.1202	0.1172	0.2590	0.1581	0.1464	0.1829	0.2692	0.2644	0.1360	0.4391
Minimum	0.0582	-0.1081	-0.1833	-0.1651	-0.3203	-0.3086	-0.2645	-0.3704	-0.2845	-0.4789
Std. Dev.	0.0115	0.0458	0.1032	0.0502	0.0825	0.0910	0.0957	0.1274	0.0830	0.1933
Skewness	0.7079	-0.1086	0.1679	-0.1245	-0.1606	-0.2525	0.4241	-0.0870	-0.1304	0.0265
Kurtosis	4.3613	2.7698	2.5601	4.2670	3.5212	3.7377	3.6279	2.8194	3.1058	2.5111
Jarque-Bera	15.2702	0.4009	1.2124	6.6691	1.4835	3.1634	4.4081	0.2491	0.3135	0.9574
Probability	0.0005	0.8184	0.5454	0.0356	0.4763	0.2056	0.1104	0.8829	0.8549	0.6196
Sum	7.2586	0.6180	2.2169	0.1500	-5.5402	-5.4752	-5.3205	-3.1827	-5.3978	-0.8253
Sum Sq. Dev.	0.0124	0.1992	1.0006	0.2397	0.6398	0.7781	0.8611	1.5261	0.6475	3.5132
Observations	95.0000	96.0000	95.0000	96.0000	95.0000	95.0000	95.0000	95.0000	95.0000	95.0000

Table 2 represents the degree of association between market factor, SMB and HML. As per the table, the correlation between market factor and SMB is 22%, market factor and HML is 33% and market factor and HML and SMB is 5.4%. The correlation between market factor with SMB and HML is significant whereas the relationship between HML and SMB is not significant. It is noticed that there is no high correlation between these variables. Hence, multicollinearity cannot exist in present study between market factor, SMB and HML. It means these explanatory variables can explain predicted variable.

Table 2: Correlation between IDVS

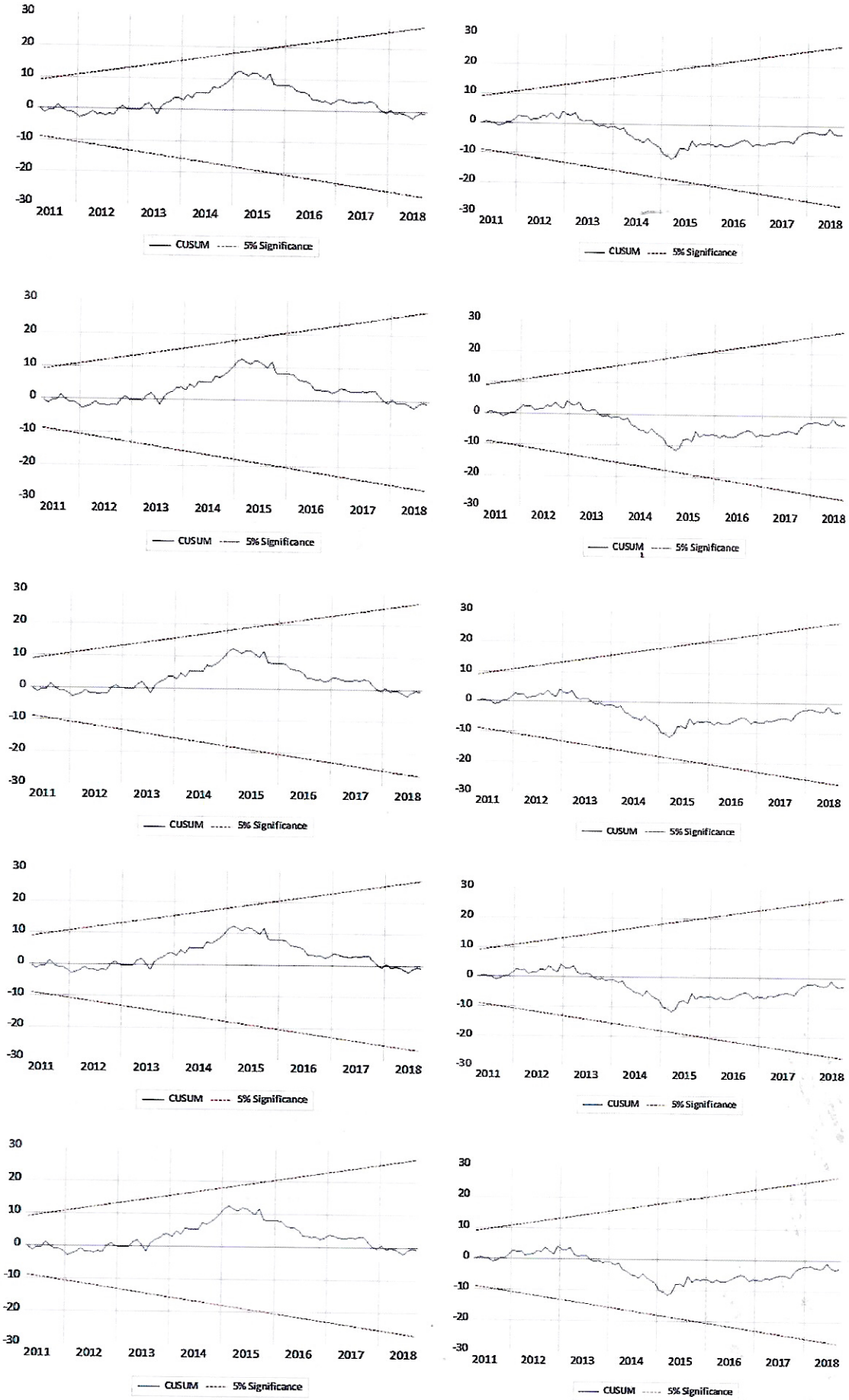
Correlation	Market Factor	SMB	HML
Market Factor t-statistics p-value	1	0.2261 2.2268 0.0284	0.3312 3.3673 0.0011
SMB t-statistics p-value	0.2261 2.2268 0.0284	1	0.05484 0.5268 0.5996
HML t-statistics p-value	0.3312 3.3673 0.0011	0.05484 0.5268 .5996	1

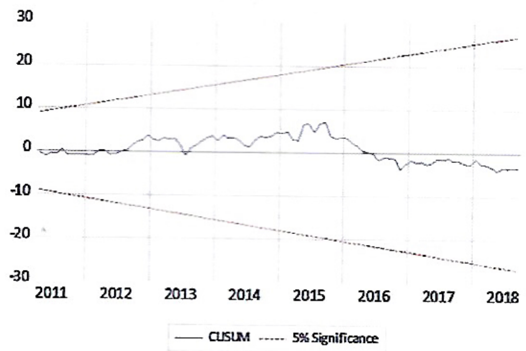
Table 3 presents the result of time series regression based on six portfolios applying Fama-French model. The market factor, HML and SMB have been used as explanatory variables. The p-value of F-statistics of all the six portfolios is significant which means the Fama-French model is fit. Model 1 is concerned with high big companies. Market factor, HML and SMB affect portfolio return. The coefficients of market factor and HML are positive and significant whereas SMB is witnessed negatively and significantly. All these three variables explained the HB return by 91.93%. Model 2 is associated with HS portfolio. The market factor and HML have positive and significant coefficients whereas SMB has negative and significant coefficient. It means SMB is negatively associated with HS portfolio. Model 2 is also fit as its F-statistics is significant. HS portfolio return is explained by 71.53%. Model 3 is also significant as its p-value of F-Statistics is significant. Overall, the portfolio return of MB is explained by 96.8%. All three variables are significant. Market factor and HML are positively associated whereas SMB is negatively associated. Model 4 is related with HS which is significant too. It is similar to Model, 1, Model 2 and Model 3. It means market factor and HML are positive and significant whereas SMB is negative and significant. The model 4 is explained by 76. 43%. Model 5 is related with LB which is fit as its F-Statistics p-value is significant. Market factor is affecting positively and significantly to the LB portfolio return. HML and SMB are influencing negatively as their coefficients are negative. Overall, LB portfolio is explained by 85.32%. Model 6 is associated with LS portfolio return. In this model, only HML is negatively significant whereas HML and SMB are positively significant. It has been observed that market factor affects positively to all the portfolios. Overall, all six portfolios are affected by market factor, HML and SMB. It means value effect and size effect exist in all six models but market factor has more explanatory power compared to HML and SMB. As per the results, it is found that the applicability of Fama French model is robust in Indian automobile industry. Figure 1 depicts the stability of the model. The green line of cusum test is in between two red lines (upper and lower) boundaries. It means all the models have stability which signifies that these models can be forecasted.

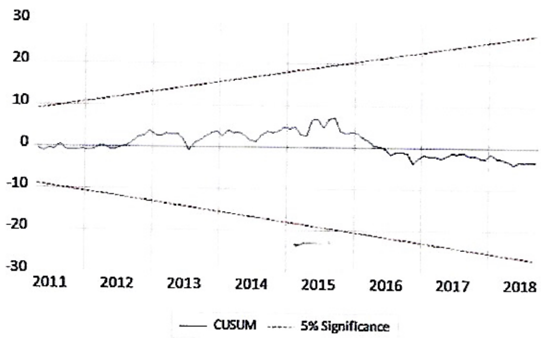
Table 3: Output of Time Series Regression

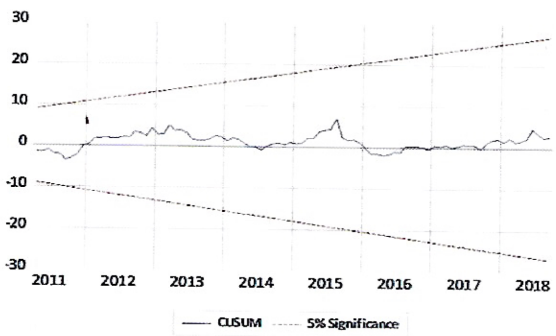
S.N.	Porftolio	Intercept	IDVs	Adj. R Squared	F-Statistics	Model
1.	HB	0.100 (0.00)	Market Factor 2.1428 (0.000) HML 0.9065 (0.000) SMB -0.9022 (0.000)	0.9193	354.56 (0.000)	Model 1
2.	HS	-0.033 (0.000)	Market Factor 0.5864 (0.000) HML 0.4354 (0.000) SMB -0.9022 (0.008)	0.7153	78.92 (0.000)	Model 2
3.	MB	0.033 (0.000)	Market Factor 1.3646 (0.000) HML 0.6710 (0.000) SMB -0.3253(0.000)	0.968	943.98 (0.000)	Model 3
4.	MS	0.461 (0.000)	Market Factor 0.5732 (0.004) HML 0.8613 (0.000) SMB -0.9 (0.008)	0.7643	381.68 (0.000)	Model 4
5.	LB	0.0334 (0.000)	Market Factor 1.3800 (0.000) HML -0.3455 (0.000) SMB -0.8397 (0.000)	0.8532	181.199 (0.000)	Model 5
6.	LS	0.0328 (0.000)	Market Factor 1.3492 (0.000) HML -0.3124 (0.000) SMB 0.1889 (0.008)	0.7583	98.26 (0.000)	Model 6

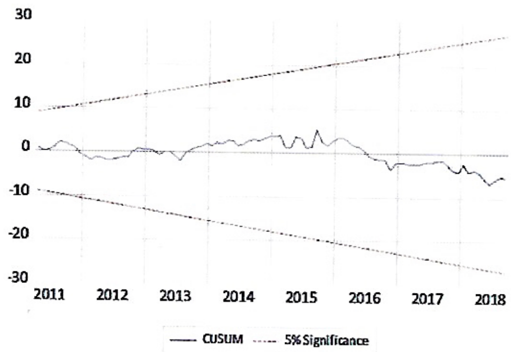
Figure 1: Stability of Model











5. CONCLUSION

In India, auto sector is one of prominent sectors in which contribute to economy a lot. It is necessary to study the either Fama-French model can be applied in this industry or not. For the same purpose, the study has been carried out considering the impact of size and value on portfolio return. The six portfolios have been constructed to examine the impact of size effect and value effect on portfolio return. The goodness of fit of each portfolio is examined by R^2 and F-statistics. It has been observed that market factor affects positively to all the portfolios. Overall, all six portfolios are affected by market factor, HML and SMB. It has been observed that market factor, SMB and HML are associated with portfolio return significantly. It means value effect and size effect exist in all six models but market factor has more explanatory power compared to HML and SMB. As per the results, it is found that the applicability of Fama French model is robust in Indian automobile industry. It is concluded that Fama-French three factor model can be applied in Indian Auto sector. Further, research can be extended applying Carhart model incorporating these factors which can better explain the variation in average return of the auto industry.

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