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Merger Induced Volatility changes: Evidence from the Indian Banking Sector

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Abstract:

Indian Banking Sector is undergoing stress lately, with shortfalls in capital adequacy ratios and a steep rise in stressed assets. This led to mergers of various banks, either through private interventions or government interventions. This research aims to study the effect of these mergers on the volatilities of the acquiring firms. This study is essential as volatility affects valuation. The study aims to use panel data with 4 mergers. The study uses DCC-GARCH and modifications of GJR-GARCH to assess the volatility changes pre and post the merger. Cross-sectional techniques of abnormal volatilities show a significant increase in post-merger returns as compared to pre-merger returns.

Keywords: Volatility, DCC-GARCH, GJR-GARCH, Cross-Sectional abnormal volatility

JEL Code: G14, C21, C32

Introduction

Indian Banking sector has been under a lot of stress lately, owing to many regulations as well as the current conditions, specially in the post pandemic environment. Increasing NPA's (Non-Performing Assets) combined with the approaching deadline to incorporate Basel III norms, have forced many scheduled banks in India to undergo mergers to fulfill BASEL-III capital adequacy norms. One of the important reasons behind mergers and acquisitions can be said to be the non-availability of capital and huge amount of NPAs. To overcome this problem banks are going under a process of merger and acquisition and Basel III norms are the ones that are protecting the bank against systematic risk, *BIS* (2017). Mergers bring about changes in the perception of stakeholders towards the concerned organizations. One such stakeholder is the shareholder of both merging companies. Many studies have tried to analyze the effect of mergers on returns, through CAR (Cumulative Abnormal Return), based on the efficient market approach (*Liargovas, P., & Repousis, S.* (2011)). The aim of this paper is to assess the impact of mergers on volatility of returns. Volatility is found to be an important indicator of the financial health of the equity of the organization. This is crucial, like when calculating the risk for and hedging a portfolio. Investors can get an important edge on the market if they are able to correctly predict the volatilities, (*Tim Andersson-Säll & Johan S. Lindskog (*2019)). Unconditional volatility according to efficient market hypothesis remains unchanged, therefore conditional heteroscedastic models were used to identify the volatility switches pre and post mergers. The paper deals with the case of four private bank mergers that had happened in the Indian banking sector.

Literature Review

Researchers have tried to study the effect of events on returns of equity from long back as the first paper in this regard was written by *James Dolley* (1933). This study focused on the effect of stock splits on 95 companies from 1921 to 1931.

Event-study methodologies became an important tool for analysis in empirical research in the areas of economics, finance and accounting since the time seminal research were published by *Beaver* (1968), *Ball and Brown* (1968) and *Fama et al*. (1969).

Jensen and *Ruback* (1983) and *Jarrell, Brickley* and *Netter* (1988) determined the profitability by seeing the impact of merger announcement on stock price by using abnormal returns and they found that shareholder of target firm earns positive abnormal return and shareholder of acquirer firm earn a neutral amount of return.

Significant number of efforts is given to stock volatility after the stock returns by researchers all over the globe in emerging market and significant number of studies have been performed to understand the relationship between stock merger and stock spread, *Langetieg et al.* (1980) *French and Roll* (1986), *Barclay* (1990) *Levy and Yoder* (1993) *Smith* (1997), *Bharath and Wu* (2005), *Geppert & Kamerschen* (2008). As per *Zhu et al and Stunda* (2014) there is no significant understanding from finding in Merger and acquisition and stock volatility spread in banking sector. This comes in addition with *Ramey and Ramey* (1995) which signifies the importance of difference between volatility which is related toward growth and volatility of innovation toward growth, where innovation toward growth is more uncertain and this also leads to development of different macroeconomic theories for volatility.

Several modifications were introduced (*Campbell et al.*, 1997). These modifications arose due to constant violation of statistical assumptions used in the traditional methods to analyze and test the significance of abnormal returns and significant importance is given to assumption of constant volatility of abnormal returns (*Brown and Warner*, 1980,1985; *Corrado*, 1989; *Boehmer at al.*, 1991). When the assumption of constant volatility is not valid the power of statistical test significance is reduced, and results are having less value. The previous studies have given appropriate emphasis on the importance of event-based volatility and developed impactful cross-sectional test to understand significance of changes in uncertain volatility during an event but there is huge amount of evidence that heteroscedasticity is present and while modelling this concept should also be used during modelling of methodology.

Lee J. (2010) advised a fixed-effects dynamic panel data model with GARCH (Generalized Autoregressive Conditional Heteroscedasticity) model in favor of the hypothesis that higher output growth is associated with higher volatility of the innovations to growth but there is no strong evidence that higher growth leads to more economic uncertainty.

Balaban (2006) in his study argued that the widespread use of the event-study methodology be it in finance and accounting or economics along with its extensions in other fields as well is known, and their findings have significant implications about the design of event studies and the calibration of significance tests for abnormal performance. *Balaban* also suggested the researchers that they should incorporate time-varying volatility into the return-generating process and test for both abnormal returns and abnormal volatility around the event.

This paper tries to incorporate the suggestions of *Balaban* (2006) and *Lee J* (2010), in studying the mergers which happened in the Indian banking sector. Much research has been there to study the anomalous nature of the Indian Banking sector, as per *Sim* (2016), bank efficiency improved across the board over the research period, except for India. Thailand's average bank efficiency improved the highest, but Indian banks had the worst results by the end of the time. Surprisingly, bank performance differed on a systemic level between countries.

Numerous efforts and refinement strategies have been laid out in past 2 decades but the research that have been associated, fail to categorize risks reflecting banks portfolio causing an increase in systematic risk, *Acharya and Richardson* (2009), *Hellwig* (2010), and *Vallascas and Hagendorff* (2013)). To overcome this kind of problem new regulatory framework of Basel III norms known as minimum leverage ratio is introduced defined as Capital Adequacy Tier 1 capital over the exposure which is not dependent on risk assessment (Ingves 2014).

This paper tries to cover the volatility induced risk owing to the mergers of the Bank for fulfilling Capital Adequacy ratios as per BASEL III norms.

Methodology & Data

The main purpose of this methodology is to observe the behavior of companies' stock prices around corporate events by measuring abnormal volatilities and to determine their statistical significance.

Data from four mergers that happened during the time period of 2005-2020 were taken as a sample. These four mergers were HDFC bank and Centurion Bank of Punjab Merger (2008), Kotak Mahindra and ING Vyasa Bank merger (2014), ICICI bank and Bank of Rajasthan Merger (2010) and IDFC Bank and Capital First Merger (2018). Return series was calculated using the differenced log series as it is a more robust estimate (Quigley, L., & Ramsey, D. (2008)).

$$R = \frac{ln(Price)}{ln(Price_{t-1})}$$

The descriptive data for the Price and return series of all the four mergers pre and post merger is given by Table 1 and Table 2 respectively.

Price (1.a) Stock Price

Bank (Pre-Merger)	Mean	Median	Mode	Variance	Std-Deviation	Skewness	Kurtosis
IDFC	44.8063	43.700001	41	55.9791	7.4819	0.6385	-0.1334
HDFC	10.5395	10.586	8.308	3.0421	1.7441	0.2167	-1.1195
ICICI	152.0754	153.23	133.36	236.3544	15.3738	-0.2869	-0.9133
Kotak Mahindra	429.1171	430.35	323.625	4725.576	68.74283	0.252119	-1.14036

Price (1.b)

Bank (Post-Merger)	Mean	Median	Mode	Variance	Std-Deviation	Skewness	Kurtosis
IDFC	44.6594	43.3	42.95	16.63967	4.079176	0.909836	0.368779
HDFC	7.15888	7.1265	7.7	1.7963	1.3402	0.0829	-1.0136
ICICI	188.3381	189.25	175.98	370.4401	19.2468	-0.2616	-0.59554
Kotak Mahindra	7.15888	7.1265	7.7	1.7963	1.3402	0.08294	-1.01361

Return (2.a)

Bank (Pre-Merger)	Mean	Median	Mode	Variance	Std-Deviation	Skewness	Kurtosis
IDFC	10742.26	10679.65	10614.35	150556.67	388.0163	0.6851	-0.08666
HDFC	4190.279	4099.75	3711.55	313145.5	559.5941	0.618163	-0.65554
ICICI	4015.569	4106.4	-	96981.89	311.4192	-0.67141	-0.61166
Kotak Mahindra	5625.801	5776.775	4720.6	502173.9	708.6423	0.002905	-1.60882

Return (2.b)

Bank (Post-Merger)	Mean	Median	Mode	Variance	Std-Deviation	Skewness	Kurtosis
IDFC	11380.52	11427.57	10792.5	194278.04	440.7698	-0.0552	-1.40128
HDFC	2762.754	2605.775	-	364782.8	603.9725	0.3322	-1.4234
ICICI	4614.135	4582	4424.6	70948.86	70948.86	0.239253	-0.79767
Kotak Mahindra	2762.754	2605.775		364782.8	603.9725	0.332214	-1.4234

The Fixed Effects Panel was used to regress calculated returns over market returns and a dummy variable which was created using the Pre-Merger and Post-Merger returns. Where market return was NIFTY50 return on the given day along with the stock return of the bank. Chow's test for structural breaks was performed on the fixed panel to test the effect of the merging companies on the returns. The pooled model and the fixed effects models are represented by Table 3 and Table 4 respectively. The equations 3 and 4, specify pooled data and fixed effects data respectively.

$$R_i = \alpha + \beta Market + \beta_i Merger_i;\ \ where\ Merger_i = (0,1)$$

$$R_{ic} = \alpha + \beta Market + \beta_i Merger + \beta_c Bank; where\ Bank\ refer\ to\ four\ merging\ banks$$

Table 3

Coefficient	Estimate	Standard Error	t-value	p-value
(Intercept)	-0.0031674	0.00081931	-0.3866	0.6991
Market	1.08170567	0.03752712	28.8246	<2e-16 ***
Merger	0.00080659	0.00115750	0.6968	0.4860

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 4

Coefficient:	(Intercept)	Market	Merger
Min.	-0.0014422	0.9777	4.709e-05
1st Qu.	-0.0006581	1.0216	6.276e-04
Median	-0.0001646	1.1758	9.100e-04
Mean	-0.0003654	1.1892	7.751e-04
3rd Qu.	0.0001281	1.3433	1.057e-03
Max.	0.0003097	1.4274	1.233e-03

After making both the models chow's test was performed to assess whether the banks show different characteristics, or if they reflect the same effect on the returns and the data can be pooled. The table 5 shows that we fail to accept null hypothesis of chow's test, that is data can be pooled.

Table5

F-Value	Degree of Freedom Pooled	Degree of Freedom Fixed	p-value
2.5478	9	1921	0.006575

Pooled data regression as shown in table 3 shows that there is no effect of merger on the return's series, whether pooled data is considered or fixed effects panel is considered, this was found to be in accordance with the efficient market hypothesis.

Since we were interested in volatility modelling therefore, we tried to regress the returns square, since volatility of the stock is related with the volatility of the market. Pool test and fixed effects panel regression was done on similar lines as in equation 3

and equation 4, the equations are given by equation 5 and equation 6 respectively. The regression observations are reported in Table 6 and Table 7 respectively.

$$R_i^2 = \alpha + \beta Market^2 + \beta_i Merger_i;\ \ where\ Merger_i = (0,1)$$

$$R_{ic}^2 = \alpha + \beta Market^2 + \beta_i Merger + \beta_c Bank; where\ Bank\ refer\ to\ four\ merging\ banks$$

Table 6

Coefficient	Estimate	Standard Error	t-value	p-value
(Intercept)	5.0460e-04	7.7279e-05	6.5296	8.405e-11 ***
Market2	9.8678e-01	9.8678e-01	18.8516	< 2.2e-16 ***
Merger	3.6910e-04	1.0819e-04	3.4116	0.0006591 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 7

Coefficient:	(Intercept)	Market	Merger
Min.	0.0001765	0.7951	-3.222e-05
1st Qu.	0.0001953	0.8170	5.807e-06
Median	0.0003418	0.9635	3.996e-05
Mean	0.0004623	1.2776	4.339e-04
3rd Qu.	0.0006088	1.4242	4.680e-04
Max.	0.0009892	2.3884	1.688e-03

Chow's Structural break test was performed on the squared returns regression as well, and it was found that fixed effects panel was a better model, signifying different effect of each company on the squared returns (Table 8). Unlike the model specified in Table 3, the model in Table 6, shows a significance of merger variable on the squared returns series. This signifies that though returns are not affected by mergers, volatility does.

Table8

F-Value	Degree of Freedom Pooled	Degree of Freedom Fixed	p-value
22.814	9	1921	2.2e-16

The paper further investigates the presence of volatility shifts in the returns of the respective banking firms with respect to the market returns. We tried to get the long run and short run correlations between the volatilities using DCC-GARCH (Dynamic Conditional Correlation- Generalized Autoregressive Conditional Heteroscedasticity), both pre- and post-merger. The table for the DCC-GARCH estimates is given in Table 9 and Table 10 pre- and post-merger.

Table 9: Pre-Merger (p value in bracket and estimate without bracket)

	KOTAK	ICICI	HDFC	IDFC
μ	0.001631 (0.128655)	0.000916 (0.57824)	0.001645 (0.414988)	-0.001338 (0.333790)
ω	0.000000 (0.947525)	0.000019 (0.40903)	0.000099 (0.273261)	0.000163 (0.041532)
α_1	0.000000 (1.000000)	0.051909 (0.21916)	0.172669 (0.051887)	0.174169 (0.114851)
β_1	0.999000 (0.000000)	0.916083 (0.00000)	0.764990 (0.000000)	0.537654 (0.002453)
μ_m	0.001497 (0.006377)	0.000835 (0.27905)	0.003545 (0.013765)	0.000887 (0.051217)
ω_m	0.000000 (0.317966)	0.000006 (0.83350)	0.000047 (0.105311)	0.000006 (0.001843)
α_m	0.000228 (0.530991)	0.119902 (0.37893)	0.430134 (0.105866)	0.191297 (0.000000)
β_m	0.997443 (0.000000)	0.848512 (0.00000)	0.568866 (0.000010)	0.725459 (0.000000)
Short Run Correlation	0.022592 (0.139094)	0.205730 (0.10219)	0.044346 (0.350547)	0.077530 (0.037522)
Long Run Correlation	0.947814 (0.000000)	0.000000 (1.00000)	0.647034 (0.001266)	0.779061 (0.000000)

Fig. in bracket are p-values.

Table 10: Post-Merger (p value in bracket and estimate without bracket)

	KOTAK	ICICI	HDFC	IDFC
μ	.008 (0.504210)	0.000765 (0.546097)	-0.000071 (0.983552)	0.000393 (0.80880)
ω	0.000001 (0.000002)	0.000001 (0.000091)	0.000181 (0.032405)	0.000000 (0.91295)
α_1	0.000030 (0.955280)	0.000000 (0.999999)	0.064367 (0.016512)	0.000000 (1.00000)
β_1	0.996856 (0.000000)	0.998987 (0.000000)	0.883867 (0.000000)	0.999000 (0.00000)
μ_m	-0.000043 (0.945907)	0.000923 (0.163242)	-0.000469 (0.781866)	0.000695 (0.34153)
ω_m	0.000018 (0.025435)	0.000002 (0.629084)	0.000072 (0.011301)	0.000040 (0.12343)
α_m	0.048950 (0.265105)	0.099587 (0.169951)	0.051050 (0.163490)	0.330237 (0.34222)
β_m	0.788112 (0.000000)	0.879956 (0.000000)	0.862357 (0.000000)	0.205446 (0.62713)
Short Run Correlation	0.022592 (0.114845)	0.038734 (0.000695)	0.041500 (0.232287)	0.061684 (0.20403)
Long Run Correlation	0.947814 (0.000000)	0.961266 (0.000000)	0.628796 (0.000000)	0.000000 (1.00000)

Fig. in bracket are p-values

The dynamic correlations are plotted in for pre- and post-merger for the concerned four banks, figures 1 to 8.

To study the combined effect of volatility market model with time varying volatility and the dummy variable for mergers is included, for both mean and volatility functions. Specifically, a GARCH (1,1) model was used as proposed by (*Bollerslev*,1986). Equations 7 and 8 form the basic model for GARCH (1,1).

$$R_{i,t} = c_i + \beta_i Market + \gamma_i Merger_{i,t} + \epsilon_{i,t}$$

$$h_{i,t}^2 = \alpha_{i,0} + \alpha_{i,0}\epsilon_{i,t-1}^2 + \lambda_i h_{i,t-1}^2 + \delta Merger_{i,t}$$

Error terms are assumed to be normally distributed with zero mean and $h_{i,t-1}^2$ variance $\sim N(0, h_{i,t-1}^2)$. Firstly, a wide cross-sectional test was conducted for the mean and volatility term considering the dummy variable $Merger$ (*Brown and Warner*, 1980). The test statistics are given by equations 9 and 10.

$$test_1(\hat{\gamma}) = \left(\sum_{i=1}^{n} \hat{\gamma}_i\right) / \left\{\left[\frac{1}{n(n-1)}\right]\sum_{i=1}^{n}\left[\hat{\gamma}_i - \sum_{i=1}^{n}\frac{\hat{\gamma}_i}{n}\right]^2\right\}^{0.5}$$

$$test_2(\hat{\delta}) = \left(\sum_{i=1}^{n} \hat{\delta}_i\right) / \left\{\left[\frac{1}{n(n-1)}\right]\sum_{i=1}^{n}\left[\hat{\delta}_i - \sum_{i=1}^{n}\frac{\hat{\delta}_i}{n}\right]^2\right\}^{0.5}$$

The mean of estimated coefficients was divided by their respective cross-sectional unconditional standard deviations. This approach does not take into account firm specific volatilities.

Cross-Sectional tests were done to identify firm specific volatility changes before and after the merger. A statistic that standardizes $\hat{\gamma}_i$, with the help of conditional standard deviation $h_{i,t}$, was used for testing, which is given by equation 11. (*Savickas* 2003).

$$test_3(\hat{\gamma}) = \left(\sum_{i=1}^{n} S_{i,t}/n\right) / \left\{\left[\frac{1}{n(n-1)}\right]\sum_{i=1}^{n}\left[S_{i,t} - \sum_{i=1}^{n}\frac{S_{j,t}}{n}\right]^2\right\}^{0.5}$$

Where $S_{i,t} = \frac{\hat{\gamma}_i}{\hat{h}_{i,t}}$.

This test is very similar to the statistics developed by (*Boehmer*, 1991). *Savickas* (2003), argues that GARCH based approaches reject the false null hypothesis more than the previously used cross-sectional tests. *Balaban* (2006), developed a model to test the conditional heteroscedastic volatility on the basis of pre- and post-merger, which is standardized over the daily standard deviation of conditional volatility of the bank i, during the pre- and post-merger period. The equation 12 presents the statistic:

$$test_4(\hat{\delta}) = \left(\sum_{i=1}^{n} S_i/n\right) / \left\{\left[\frac{1}{n(n-1)}\right]\sum_{i=1}^{n}\left[S_i - \sum_{i=1}^{n}\frac{S_j}{n}\right]^2\right\}^{0.5}$$

Where $S_i = \hat{\delta}_i/\hat{\sigma}_i$. This statistic, according to *Balaban* (2006), signifies the firm specific volatility changes because of mergers. We did not perform $test_1$ and $test\_2$ as these test are related to the returns, since $test_3 and\ test_4$ are related to the volatility we performed these tests, the results of which are provided in table 12.

Table 12

	Test Value	p-value
Volatility Effects $\hat{\gamma}\ test_3$	-4.25328	6.19719E-05
Volatility Effects $\hat{\delta}\ test_4$	33.80772	6.00787E-95

Result & Conclusion

Analysis of the data collected shows a positive relationship between the merger and the volatility. This suggests that mergers increase the volatility of the returns of the respective banks. This result is in conformance with the study of *Tan, H. B., & Hooy, C. W.* (2004), where increased uncertainty in the market lead to the increased volatility in the market. *Geppert, G., & Kamerschen, D. R.* (2008), suggested that not only stock returns volatility but also implied volatility on stock options change when mergers happen. *Zhu, P., Jog, V., & Otchere, I.* (2014), argues that not only implied volatility but also idiosyncratic volatility gets affected by the mergers of firms. In light of these arguments, we can assume that Indian banking sector also shows positive volatility shifts in post-merger environments. This becomes important as many of the banks in India must compulsorily undergo mergers so as to adhere to the capital adequacy norms of Basel-III framework. The results presented in this paper also suggest that there are no significant changes in the returns of stocks pre- and post-merger, which suggests that market sentiment for the banks in the long run moreover remain the same, however the investor is a bit influenced by the rising uncertainty owing to the merger.

Discussion

This study can be considered not only for the Indian Banking sector but could be considered for global banking sectors as it talks about the volatility of the stocks post-merger with respect to the markets, they are listed in. Volatility has received a considerable amount of attention because it has on efficiency of the market and price of stocks whether we talk about emerging markets or developed ones, *Peng Cheng Zhu et. al.* (2014). Though a lot of studies have been done on volatility in merger and acquisitions but to the best of our knowledge no study has been done particularly keeping in mind the Banking sector and that is what is a unique contribution by our study to the literature. Private information's of the company is what regulates the prices of the stock and that is what makes sure that stock prices are what reflects the fundamental values of the firm, *Chen et al*. (2007*), Durnev et al*. (2003,2004), *Ferreira and Laux* (2007), *Jin and Myers* (2006), *Wurgler* (2000). Whereas some researchers feel that the volatility in the market is related to the sentiments of the investors and a reflection of market's inefficiency, *Jiang et al*. (2009), *Rajgopal and Venkatachalam* (2011). This research can be used in future for merging Banks to predict volatility and conditional correlation changes. This study could be used by banking companies to plan an FPO (Follow-up Public Offer), post-merger as high volatilities result in lower valuation of equity *Dhar, S.* (2012). To take up this research further, public sector mergers of the Indian banking sector could also be analyzed. Also, it would be interesting to identify whether public and private banking stocks behave similarly owing to mergers.

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