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Effect of Automation in Banks as Regulatory Intervention in the Indian Bourses: New Evidence from India

Dr. Chandrabhanu Das (Corresponding Author)
Assistant Professor
School of Business, GITAM Deemed to be University, Hyderabad Campus, Rudraram, Patancheru, Sanga Reddy Dist. Telangana, India

Dr. Rajeev Sengupta
Associate Professor
School of Business, Dr. Vishwanath Karad MIT World Peace University, Kothrud, Pune, India

Dr. Ameya Patil
Assistant Professor
School of Business, Dr. Vishwanath Karad MIT World Peace University, Kothrud, Pune, India

Dr. Rakesh Yadav
Assistant Professor
School of Business, Dr. Vishwanath Karad MIT World Peace University, Kothrud, Pune, India

****Dr. Chandrabhanu Das (Corresponding Author)**

Abstract
The paper aims to investigate whether the automation of NPA as a regulatory intervention by RBI has effect on banking and finance sector indices. This study takes the BSE Bankex and BSE Finance in Bombay stock exchange (BSE) as sample for the period when RBI initiated the regulatory intervention. Findings from this study indicate that investors welcome the digitization through NPA automation as effective method to improve bank performance. However the initial introduction of NPA automation is not considered as a welcome step for banking sector. Similar effect is not observed in financial services sector. This indicates that since the automation of NPA is focused on banks in specific, hence no visible reaction is observed in financial services industry. This study is among few studies on effect of regulatory intervention on market returns. The impact of reforms at a policy level on financial markets has been explored through this study.

Keywords: Automation, NPA, Banks, Regulation, financial services

1. Introduction

The financial services industry is crucial to a country's gross domestic product (GDP) and makes a sizable contribution to the economy, although it has been hit hard by the global digital revolution. This industry has enthusiastically embraced technology developments as a means to increase profits and save expenses. The banking business has been one of the primary beneficiaries of the revolutionary effects of developing technologies, which have led to greater productivity, lower expenses, and higher profits. As technology develops at a breakneck pace, the term "automation" has become increasingly common terminology. Banking services have been automated as a result of extensive technological adoption, moving away from a labor-intensive approach and towards a more efficient man-machine interface. The financial services industry has benefited from this automation by seeing decreases in the cost of both labor and the cost of establishing new branches. The advent of digital technology has made robotic processing of financial transactions inevitable. The financial sector is increasingly depending on automation to predict future trends due to the critical nature of forecasting in today's highly competitive business environment. The effects of automation on the banking business model have been investigated at length before, but their significance in the present-day research landscape cannot be overstated (Agboola 2003; Villar & Khan 2021). Risk management in banking has become increasingly important in the wake of the global financial crisis. Particularly in the financial sector where money is at stake, the necessity of addressing risks as organizations grow cannot be overstated. Since risk management is so important to the continued health of financial institutions, it has risen to the forefront of banking-related discussions (Van Liebergen 2017; Leo et al., 2019).

Therefore, the predictive power of automation must be utilized in the risk management function of banks. Banks are involved in the process of risk management to identify and mitigate these risks. Credit risk has been one of the largest risks for the banks. Even after several regulatory restrictions on lending and monitoring rules in place, credit risk cannot be avoided. Hence the importance of technology in identifying and mitigation of risks becomes an important concern. Credit risk leads to NPA a potential problem for banks. Banks with higher NPAs has to struggle for finance for survival of their businesses unit. Higher NPAs also affect the credit growth in the economy. All of this envisages for great due diligence and forecasting ability for banks. Several turbulences like financial crisis, covid pandemic has raised a concern for banks to identify NPA and monitor the risk of default (Apostolik et al., 2009). This paper explores the market reaction to risk management from perspective of NPA management through technology as a regulatory integration.

The financial market facilitates capital formation and management in the financial industry. Market responses to government interventions in the technological revolution are thus of paramount importance. The goal of this research is to understand the regulatory response to technological change in the financial sector. Since this decade has seen a great deal of technology reform and regulation, it is India that has been the regulatory environment's primary focus. The article examines the views of investors in the Indian capital market on the impact of technological interventions on financial institutions.

2. Literature review

Digital revolution has created a platform for encompassing emerging trends in accounting procedures and practices. Subsequently financial sector has embraced this new technology for efficiency, cost management, profitability and risk management. This being an emerging and nascent area, studies and implications are very limited and recent in nature (Al-Okaily et al., 2022) have studied the effect of digital account systems on decision quality of banking industry. The findings reveal that quality of information plays a crucial role in decision making. However, technologies like RPA (Robotic Process Automation) have recently became an advanced tool for preventing frauds and reducing human errors (Thekkethil et al., 2021).

Discussions on the application of technology to risk management have been inspired by the widely held belief in the efficacy-boosting potential of technology. Credit risk has grown increasingly important in the banking and financial services industry. To automate its fraud detection procedure, Barclays previously used Blue Prism technology (G. Barnett, 2015). Non-performing assets are frequently born out of credit risk, a major and inevitable risk. In the past, artificial intelligence technologies were used to address this problem and reduce dangers associated with fraud (Jindal and Kaur, 2021). Non-performing assets (NPA) have become a major problem in India's business world, causing new banks to lose a lot of money. When the NPA limit goes over 10% of the country's GDP, the banking problem in India starts. Banks make a lot less money because of the higher provisioning needs caused by NPA (Sarma, 1996; Khan & Bishnoi, 2001). As per (Rajput et al., 2012) detection and identification of defaulters, which leads to a reduction in the need for action by bank managers. In addition, the authors discover that numerous PSU banks in India have already begun the transition to core banking technologies in order to identify NPAs. The banking system in India was still struggling to make effective use of technology to identify warning signals of impending default.

A recent study conducted by Goswami and Gulati (2020) explained that the Indian banking system was grappling with the usage of technology to detect early warning signals of default. The study highlighted that as governments in emerging economies aimed to promote financial inclusion, the risk of credit defaults also increased. However, despite the recognition of the importance of technology adoption, the Indian banking system faced challenges in effectively utilizing technology for early warning signal detection (Vallabh et al., 2016). Nevertheless, NPA was a serious concern for Indian banking sector due to growth trend year after year (Arthi and Akoramurthy, 2018). Some studies have suggested usage of various techniques to manage NPAs (Attigeri et al.,; Saha et al., 2016; Bawa et al, 2019). Failure in NPA management can lead to hindrances in credit creation which is vital for economic growth. Therefore, regulatory intervention was required for NPA management in an efficient manner. According to (Dinesh, et al., 2020) digital technologies for NPA management have found that majority of bankers agree that technology upgradation is required for identifying bad loans. They also mentioned about RBI regulations requiring banks to go for automation in data management for managing NPA. In a recent study in India, (Bhasin and Rajesh., 2022) suggested the usage of advanced technologies like data analytics and basic tools such as MIS reports to solve NPA issues. Gormely et al. (2012) in their study mentioned about sector specific changes in business

model in reaction to policy changes. Fewer studies in India have explored market reaction to such type of events. Investor reaction indicates risk and return associated with a particular firm. The study intends to fill this research gap and contribute to studies on event study methodology based on regulatory interventions.

3. Data and Methodology

This study examines the reaction of banking and finance sector to RBI regulations on NPA automation and also explores the change in systematic risk for these sectors due to regulatory interventions for NPA automation.
The approach of Sorokina and Thornton (2016) was employed to explore the sector reaction to NPA automation. Sorokina and Thornton (2016) used this model to study the impact on stocks for announcement over a period of time. This methodology has scope to estimate the cumulative abnormal returns and change in systematic risk due to NPA automation.
The model was depicted as follows:

$$R_{Xt} = \propto_0 + \propto_{1i} (INT) + \propto_{2i} (REM) + \beta_{1i}(INT * R_{St}) + \beta_{2i}(REM * R_{St}) + \beta_{3ia}(ET_a) + \beta_{4i}(R_{St}) + \beta_{5i}(F_{Xt}) + \beta_{6i}(Y_{lt}) + \in_{it} \quad (1)$$

The index returns (R_{Xt}) were response variables and regressed on the predictors which are explained below:
R_{Xt} was calculated as follows:

$$R_{Xt} = \frac{\ln P_{Xt}}{\ln P_{Xt-1}}$$

Where P_{Xt} = Daily closing price of Index at time t
and P_{Xt-1} = Daily closing price of Index at time t-1.

The predictors were measured as mentioned below.
R_{St} was calculated as follows:

$$R_{St} = \frac{\ln P_{St}}{\ln P_{St-1}}$$

Where P_{St} = Daily closing price of BSE Sensex at time t
and P_{St-1} = Daily closing price of BSE Sensex at time t-1.

F_{Xt} was calculated as follows:

$$F_{Xt} = \frac{\ln E_{Xt}}{\ln E_{Xt-1}}$$

Where E_{Xt} = Daily closing price of Dollar Rupee exchange rate at time t.
and E_{Xt-1} = Daily closing price of Dollar Rupee at time t-1.

INT = Previous/after the date on which RBI gave notification for NPA automation in banking firms (0 before the date and 1 after that date).
REM = Previous/after the date on which RBI gave reminder notification for regulatory intervention towards NPA automation in banking firms (0 before the date and 1 after that date)
ET_a = Dummy variable for event window of 3 days. a=1 for initial notification and a = 2 for reminder notification (1 – during window and 0 otherwise).
Y_{lt} = Daily government of India bond rate.

Data has been collected for 108 trading days before start of first event to 108 trading days after the end of last event. The impact of regulations related to NPA automation on banking and financial services sectoral indices from January 2012 to December 2019 has been retrieved for study. The Sector index daily closing prices and Sensex daily closing prices have been downloaded from BSE website. Data on foreign exchange and Government of India bond rate has been retrieved from investing.com website.
The dates of RBI regulations linked to NPA automation is listed below.

Date	Notification
April 17, 2012	IT and MIS framework for banks to identify signs of distress accounts (MPC statement)
September 14. 2012	Reminder about MPC statement

3.1 Model analysis

The model findings can be analyzed as follows:

α_0 the intercept is the market model.

α_{1i} intercept explains the difference between index alpha before and after the initial notification of NPA automation.

α_{2i} intercept explains the difference between index alpha before and after the reminder notification for NPA automation.

β_{1i} intercept explains the systematic risk after the notification for NPA automation.

β_{2i} intercept explains the systematic risk after the intervention through reminder notification for NPA automation.

β_{3ia} intercept explains the cumulative abnormal returns related to event window.

$\beta_{4i,}$ β_{5i} and β_{6i} are coefficient of control variables, the Sensex, dollar – rupee rate and GOI bond yield.

4. Findings

Table 1: Descriptive statistics of Variables

	BSE FINANCE	BSE BANKEX
Mean	-9.435	0.0302
Median	-9.443	0.0237
Std. Dev.	0.568	0.0249
Skewness	0.0366	4.7209
Kurtosis	2.8878	32.6298
Minimum	-11.389	0.0093
Maximum	-7.7296	0.2545

The mean returns of BSE Finance were negative while BSE Bankex has positive returns over the study period. Volatility was also higher in Finance index as evident from standard deviation figures. However, the banking sector has fat tails on right side as indicated by highly positive skewness. This tells the likelihood of positive returns from the banking sector.

Further the maximum return from finance sector is negative while minimum returns from banking sector is positive. Thus, our observations reiterate the claim of holding banking stocks for positive returns.

Table 2: Results of equation (1) for BSE Finance

Determinants	BSE FINANCE			
	Coefficient	Std. error	t-value	p-value
INT	-0.0023	0.00089	-2.63	0.009
REM	0.0020	0.00070	2.89	0.004
SEN	1.359	0.07763	17.51	0.000
YLD	-0.136	0.07199	-1.89	0.060
FX	0.041	0.05826	0.71	0.476
ET1	-0.002	0.00252	-1.02	0.409
ET2	0.008	0.00639	1.28	0.011

INT*SEN	-0.170	0.08796	-1.93	0.039
REM*SEN	0.109	0.09717	1.13	0.307
R-squared	0.8368			
Root MSE	0.00528			

Table 2 measures the effect of automation in NPA announcement for the finance sector. The coefficient of BSE Sensex returns is highly positive and significant which implies the high systematic risk for finance sector. The announcement date of automation has no significance while the reminder date for automation is significant and has positive cumulative abnormal returns. The alpha for reminding the NPA automation is positive and significant.

The INT*SEN coefficient is negative which explains that the market has negative reaction to NPA automation initiative for banks. However, the REM*SEN coefficient is insignificant which suggests that there is no impact on the systematic risk about intervention on NPA automation.

Table 4: VIF test for BSE Finance

Variable	**VIF**
INT	1.21
REM	1.22
SEN	2.28
YLD	1.02
FX	1.31
ET1	1.03
ET2	1.08
INT*SEN	2.43
REM*SEN	1.57

Table 5: Heteroscedasticity test for BSE Finance

Chi square value	**P-value**
0.01	0.9189

Table 3 and Table 4 are multicollinearity and heteroskedastic tests for the model. Results suggest that there is no multicollinearity and absence of heteroskedasticity.

Table 6: Results of equation (1) for BSE Bankex

Determinants	**BSE BANKEX**			
	Coefficient	Std. error	t-value	p-value
INT	-0.0027	0.00107	-2.60	0.004
REM	0.0021	0.00078	2.81	0.022
SEN	1.469	0.08743	16.80	0.000
YLD	-0.117	0.06357	-1.38	0.160
FX	0.048	0.00336	0.76	0.485
ET1	-0.002	0.00252	-0.56	0.605
ET2	0.011	0.00645	1.73	0.003

INT*SEN	-0.148	0.10376	-1.43	0.123
REM*SEN	0.056	0.11673	0.49	0.653
R-squared	0.8161			
Root MSE	0.00619			

Table 5 provides the estimate for the effect of NPA automation announcement for the banking sector. The coefficient of BSE Sensex returns is more positive for banking sector than finance sector thereby indicating higher systematic risk for the banking sector. The introduction of NPA automation has no impact on banking sector but intervention about NPA automation has a significant positive impact on banking sector. The cumulative abnormal returns are insignificant around announcement of NPA automation whereas they are positive and significant around intervention for NPA automation. The systematic risk is insignificant for introduction of NPA automation and intervention on NPA automation.

Table 7: VIF test for BSE Bankex

Variable	**VIF**
INT	1.20
REM	1.21
SEN	2.48
YLD	1.01
FX	1.41
ET1	1.03
ET2	1.07
INT*SEN	2.33
REM*SEN	1.53

Table 8: Heteroscedasticity test for BSE Bankex

Chi square value	**P-value**
0.48	0.4887

Table 6 and Table 7 represent multicollinearity and heteroskedasticity tests for the model. From the tables it is observed that there is no multicollinearity and absence of heteroskedasticity, thereby making the models suitable for analysis.

Table 9: Results of Huber white sandwich test for BSE Finance

Determinants	**BSE FINANCE**			
	Coefficient	Std. error	t-value	p-value
INT	-0.0023	0.00081	-2.89	0.004
REM	0.0020	0.00080	2.52	0.012
SEN	1.359	0.59200	22.97	0.000
YLD	-0.136	0.07123	-1.91	0.057
FX	0.041	0.05895	0.71	0.481
ET1	-0.002	0.03111	-0.83	0.423
ET2	0.008	0.31188	2.56	0.011
INT*SEN	-0.170	0.08173	-2.08	0.054
REM*SEN	0.109	0.10712	1.02	0.260

R-squared	0.8368
Root MSE	0.00528

Table 10: Results of Huber white sandwich test for BSE Bankex

Determinants	**BSE BANKEX**			
	Coefficient	Std. error	t-value	p-value
INT	-0.0027	0.00953	-2.92	0.010
REM	0.0021	0.00095	2.30	0.005
SEN	1.469	0.69410	21.17	0.000
YLD	-0.117	0.08351	-1.40	0.169
FX	0.048	0.06911	0.70	0.447
ET1	-0.002	0.00364	-0.52	0.575
ET2	0.011	0.00373	2.99	0.085
INT*SEN	-0.148	0.09583	-1.55	0.155
REM*SEN	0.056	0.12559	0.45	0.628
R-squared	0.8161			
Root MSE	0.00619			

For validity of results, the Huber- White sandwich estimator has been applied. Here, standard errors account for heterogeneity, non-normality, larger residuals or biasness. It is seen from Tables 8 and Table 9 that there has been no change in residuals.

5. Conclusion

Digital initiatives are always considered as a welcome step in the Banking and Financial services sector. However, the extent to which these initiatives are being implemented by financial institutions is still a question. Moreover any digital initiatives or digital infrastructure must have adequate risk management mechanism to address the risks pertinent to these sectors while focusing on profitability. Banks and Financial Institutions are more susceptible to credit risks than any other sector. Since they profit from lending activities they have to predict and monitor the risk of default. This study purpose is to understand the NPA automation initiatives by RBI and how the financial services sector reacts to it by applying the extended market model. Findings from this study provides evidence of reaction of finance stocks to NPA automation as regulatory intervention by RBI.

The study finds banking stocks react positively to RBI intervention on NPA automation. However, the finance stocks in general have no impact on NPA automation intervention. This suggests that since NPA automation is related to banking sector we see reaction in these stocks. The positive impact suggests investor concern for technological interventions in regulations related to distressed assets. The investor sentiment favors digitization as a medium to track NPAs for better profitability in banks. The systematic risk is very high for the finance and banking indices indicating the perceived risk by investors of these stocks. This tells us the riskiness involved in these sectors.

The paper fills a crucial research gap where the impact of digitization reforms is studied for emerging economy like India. It attempts to bring forward the issues on NPA automation and how investor perception is towards this reform. The paper tests systematic risk and cumulative abnormal returns for important events relating to NPA automation regulations in India. Understanding the market reaction to such regulations has implications for retail and institutional investors to know how to make decisions on their portfolio management. The board of management of bank and finance companies can understand how investor sentiment benefit these companies through serious regulatory intervention for automation introduced by RBI and government.

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