



ISSN 2278 – 0211 (Online)

Arbitrage Opportunities around Key Monetary Rate Announcements: An Event Study Methodology

Deepak R.

Assistant Professor, M. P. Birla Institute of Management
Associate Bharatiya Vidya Bhavan, No. 43 Race Course Road, Bangalore, India

Jai Krishna. P. S.

Alumni, M. P. Birla Institute of Management
Associate Bharatiya Vidya Bhavan, No. 43 Race Course Road, Bangalore, India

Abstract:

The study examines the impact of stock market returns to the announcement of monetary policy changes with respect to key rates such as CRR Rate, Repo rate and Reverse repo rate. If the markets are semi-strong efficient as assumed by the market efficiency theories, then investors would not have any opportunities to make abnormal profits by forming various trading strategies considering the various announcements declared by companies, governments or central bank of India. The central Bank of India plays a very important role in tackling the monetary issues in the country. The study is exhaustive enough in encompassing major events. The study thus aims at examining the impact of monetary steps taken by central bank of India in the form of changes to monetary rates on the stock market returns. Banks are always assumed in the literature to be impacted by the monetary changes first and foremost since they are linked directly with the credit delivery. Standard Event study methodology and sample t-test for equal means was used to analyse the impact of changes in the Key monetary rates mainly the CRR, Repo and Reverse Repo rate. 448 event studies were conducted considering 14 bank stock prices for a period 2006-2013. From the analysis, we find no significant differences in the stock mean returns around the announcement dates. Thus we infer that, the markets are semi-strong efficient and Investors should consider fundamental intrinsic strength of the companies before making decisions. The retail investors and institutional investors should thus avoid these rallies around the announcement dates and should consider policies with long term vision in selection of portfolios.

Keywords: Cash Reserve Ratio, Event Study, Repo rates, Reverse Repo rates, Market efficiency

1. Introduction

Economic reforms of 1990 lead to liberal policies and economic progress of several sectors in India. Along with other sectors, Indian banking industry thrived under strict surveillance of Reserve Bank of India. Indian Banking industry is governed by the Banking Regulation Act of India (1949). According to an IBA-FICCI-BCG report, India's gross domestic product (GDP) growth will make the Indian banking industry the third largest in the world by 2025. According to the report, the domestic banking industry is set for an exponential growth in coming years with its asset size poised to touch USD 28,500 billion by the turn of the 2025. Such is the potential of the Indian banking industry today. To bring every citizen into the holding of Indian financial system, sincere efforts have been undertaken and are found to be successful. It is always kept in mind that the banking affairs will not be prejudicial to the depositor's interests.

The Indian banking industry can be summarised in the Figure 1 shown below. The Indian Banking Industry consists of two major categories, mainly Scheduled banks and Unscheduled Banks. According to Dun and Bradstreet report on structure of the Indian Banking industry, Scheduled commercial banks (SCBs) account for a major proportion of the business of the scheduled banks. As at end-March, 2009, 80 SCBs were operational in India. The Scheduled commercial Banks (SCBs) in India are categorized into five groups based on their ownership and/or their nature of operations as shown in the Figure. Nationalized banks (10) and SBI and associates (7), together form the public sector banks group and control around 70% of the total credit and deposits businesses in India. IDBI Ltd. has been included in the nationalized banks group since December 2004. Private sector banks were incorporated according to the revised guidelines issued by the RBI regarding the entry of private sector banks in 1993. As at end-March 2009, there were 22 private sector banks operating in India. The impact of liberalization can be further realized by observing the presence of foreign banks.

At end-June 2009, 32 foreign banks were operating in India with 293 branches. Besides, 43 foreign banks were also operating in India through representative offices. To provide banking services to the rural people and help them come out of poverty and to develop characteristics of co-operative working, Regional Rural Banks (RRBs) were set up in September 1975. The equity holding is jointly held in the proportion 50:15:35 by the Central government, state government and sponsor bank. Between 1975 and 1987, 196 RRBs were established and they have covered 585 out of the 622 districts of the country.

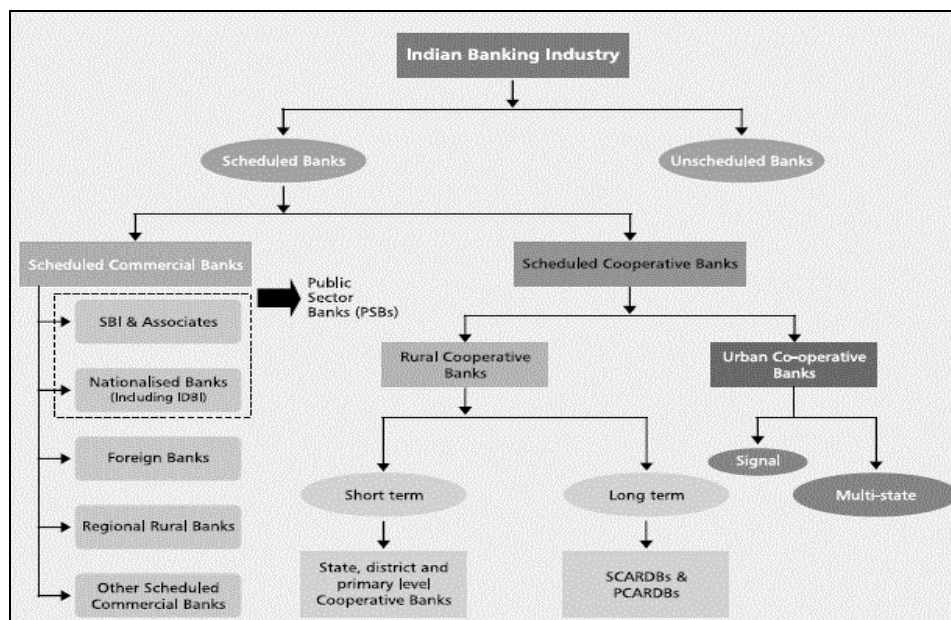


Figure 1: Structure of Indian banking system

Source: Dun & Bradstreet Newsletters

As a result of consolidation and state wise amalgamation of RRBs sponsored by the same sponsor bank, the number of RRBs fell to 86 by end March 2009. Scheduled cooperative banks in India can be broadly classified into urban credit cooperative institutions and rural cooperative credit institutions. Rural cooperative banks undertake long term as well as short term lending. Credit cooperatives in most states have a three tier structure (primary, district and state level). The Non-Scheduled banks are formed as Local Area Banks. By 2009, 4 local Area Banks were operating in India. These banks help in mobilization of funds in rural and semi-urban districts. Several factors contributed to the growth of the banking sector in India. Higher incomes and changing the attitude of the consumers towards credit has changed the scenario in India. The advent of information technology and acceptance of this technology by the consumers has slowly changed the perception of risk. Though we see such phenomenal growth, still there exist huge untapped customers. More emphasis is provided for spreading the message of the benefits of banking to the rural people through several steps such as Know Your Customer (KYC) etc. With growth comes responsibility to see that customers' money is protected. RBI has taken several steps in this regard. With More banks in the country and with seamless benefits to the customers, there was required an authority to regulate and take the prime responsibility for controlling the money supply in the economy. Thus RBI was designed to maintain the price stability and money supply by exercising its control over interest rates. The RBI was also given the responsibility of controlled expansion of bank credit, promotion of fixed investments, restriction towards over-stocking and prevention of companies accumulating the idle money, facilitating trade and promotion of exports, avoidance of equivocal distribution of money, RBI has been aiming at increasing the efficiency of the financial system by incorporating structural changes such as deregulating interest rates and introducing new money market instruments. Several steps are taken to encourage autonomy, competitive environment and discipline in the operations of the financial system.

In order to perform its functions, RBI is entrusted with tools for monetary control in India. These regulatory tools are shown in Figure 2.

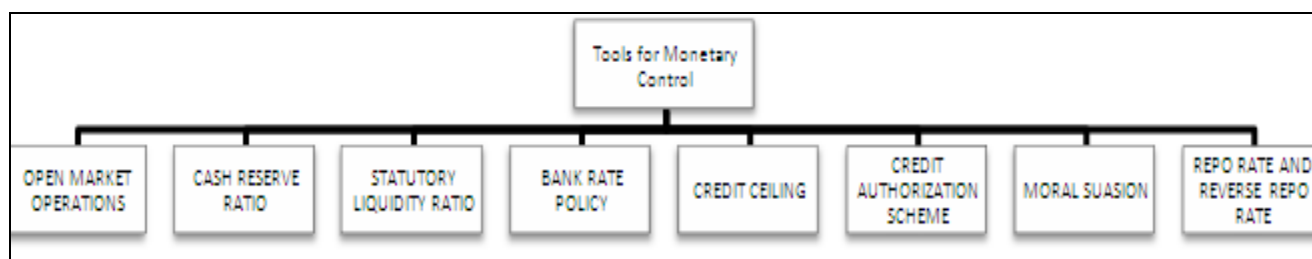


Figure 2: Tools of Monetary control used in India

Source: Dun & Bradstreet Newsletters

- **Open Market Operations:** Open market operation helps in making bank rate policies effective in nature and in maintaining stability in government securities markets. This is an instrument which involves buying or selling of government securities from or to the public and banks and thus influencing the reserve position of the banks, yield on government securities and cost of bank credit. By doing so, the central bank would contract and increase cash flow by selling and buying government securities respectively.
- **Cash Reserve Ratio:** The liquidity in the system can be varied by assessing the Cash Reserve Ratio. Cash Reserve Ratio is a certain percentage of bank deposits which banks are required to keep with RBI in the form of reserves or balances. If the CRR ratio is higher, it means that liquidity in the system is less, and if the CRR is lower, liquidity will be higher in the system. RBI is empowered to vary CRR between 15 per cent and 3 per cent. As on July 2013, the CRR is 4.00 percent. The CRR has varied from 15 percent in the year 1990 to 5 per cent in year 2002.
- **Statutory Liquidity Ratio:** Statutory Liquidity Ratio refers to quantity of liquid assets that financial institutions should possess in comparison to their total time and demand liabilities at any point of time. These liquid assets can be cash, precious metals, bonds and other approved securities etc. This ratio is presently 23 percent. Due to Narshiman committee, there was a reduction of SLR from 38.5% to 25%.
- **Bank Rate Policy:** The supply of money can be judged by the Bank rate in the system. Bank rate also known as Discount rate is the interest charged by central bank for providing fund or loans to financial institutes in the banking system. Funds are provided either through lending directly or rediscounting or buying money market instruments like commercial bills and treasury bills. Tightening in the system can be done by increasing the bank rate, which increases the cost of borrowing by financial institution and thus in turn results into the reduction in credit volumes to the banks. As of 19th July, 2013, the bank rate was 10.25%.
- **Credit Ceiling:** By limiting the credit to the sectors by the banks, RBI restricts the money supply advanced to the sectors. Thus ceiling is provided to the sectors such as agriculture and other sectors. Credit authorization scheme is also an instrument of credit regulation wherein the central bank issues guidelines which authorizes the banks to advance loans to desired sectors. Other monetary control followed by the central bank is Moral Suasion. It is just a request by the central bank to the commercial banks not to give loans for unproductive purposes so that the sectors which actually require the money can be provided the much needed capital.
- **Repo Rate and Reverse Repo Rate:** Repo rate is the rate at which RBI lends to commercial banks generally against government securities. Reduction in Repo rate helps the commercial banks to get money at a cheaper rate and increase in Repo rate discourages the commercial banks to get money as the rate increases and becomes expensive. Reverse Repo rate is the rate at which RBI borrows money from the commercial banks. The increase in the Repo rate will increase the cost of borrowing and lending of the banks which will discourage the public to borrow money and will encourage them to deposit. As the rates are high the availability of credit and demand decreases resulting to decrease in inflation. This increase in Repo Rate and Reverse Repo rate is a symbol of tightening of the policy. As of July 2013, the repo rate was 7.25 percent and reverse repo rate was 6.25%.

The markets are said to be efficient in nature. This refers to a challenge wherein stocks always would trade at their fair price on the stock exchanges reflecting the intrinsic value of the company and it would not be possible for the investors to make abnormal profits by either buying or selling activity. Thus, according to investment theory, if the markets are efficient, the share prices of the companies would always incorporate and reflect all relevant information and would be impossible to outperform either through stock picking or selecting the market timing for purchase or sale of securities. Thus, investors would obtain higher returns by opting for higher risky investments which in turn depends on the risk aversion of the investor. Mixed results exist between textbooks and practice. Though many believe that finding an undervalued or overvalued stock is difficult, since the markets are efficient, few investors and academicians don't agree to the theory. Investors such as Warren Buffett have been successful in making above average returns over longer periods of time which is a contradiction to the theory. The markets are said to be efficient in three forms mainly Weak Form Efficiency, Semi-Strong Form Efficiency and Strong Form Efficiency. According to weak form of efficiency, No excess returns can be earned by using investment strategies based on historical share prices or other financial data thus indicating that technical analysis tools and techniques cannot be useful in making abnormal returns. The weak form efficiency believes that the current share prices are the best, unbiased estimates of company's stock prices. Thus, it gives more weightage to fundamental analysis. According to semi-strong form of efficiency, share prices adjust instantaneously and in an unbiased way to publicly available new

information. Thus according to the hypothesis no excess returns would be possible to earn by trading using the publicly available new information. In the literature, the semi-strong form of efficiency was understood by observing the adjustments to previously unknown news and the news should be of reasonable size and must be instantaneous. Thus most of the studies include event study methodology, wherein consistent upward or downward adjustments would be noticed in the price levels after the initial change. If there exists some changes, then it would suggest that investors had considered this information in a prejudiced manner. Unlike the weak form and strong form of efficiency, strong form of efficiency implies that every information is known and reflected in the stock prices and thus it would be impossible to make excess returns except for insider information which is not yet publicly available. Insider trading has been observed in the recent times where the accused has been jailed for few years.

Thus the study tries to reflect on both the weak form and semi-strong form of efficiency based on the news which is announced by the central bank of India (RBI) on the banking stocks which are part of the BSE Bankex index. The tools of monetary policy used by RBI in the form of changes to key rates would have an impact on the liquidity and money supply in the nation. The study thus tries to understand if share prices adjust instantaneously and in an unbiased fashion to the announcement of changes in the key rates and if there is any probability of making abnormal profits in the anticipation of these events. To test for this, consistent upward or downward adjustments after the initial change must be looked for. If there are any such adjustments it would suggest that investors had interpreted the information in a biased fashion and hence in an inefficient manner.

2. Literature Review

Various studies in the literature have concentrated on the understanding the nature of the stock markets and their behaviour to announcements. Testing of market efficiency with respect to announcements of news were initially studied and tested by Fama, Fisher, Jensen and Roll (1968). Cumulative average abnormal returns or residual errors methodology was used to examine the markets in US i.e., New York Stock Exchange stocks reaction to stock splits and there was found enough evidence in support of the proposition that the NYSE was semi-strong efficient. The methodology used by Fama (1969) was used for developing Abnormal Performance Index methodology by Ball and Brown (1968) to examine the market's reaction to earnings announcements.

Fatade, Babatunde Lateef, Adedeji, A.G.M (2006), analysed the impact of several macroeconomic news and public announcements of few European bank stocks for the period 1997 and 1998. The period tries to understand the impact of Asian and Russian financial crisis news on the European bank stocks. Many of the important events were considered for the study and their impact was analysed. Devaluation of Thai bath, Devaluation of Taiwan currency, Dresdner bank announcing its exposures, modification of exchange rate regimes in Russia and suspension of interest payments in public debt, Several banks announcement to their exposure to Russia were some of the many events considered for the study, For the study, Event study methodology based on Market model was used to test for the presence of abnormal returns during Russian and Asian crisis. Multivariate regression model based on Zellner's(1962) was used to deal with clustering effects and industry induced correlation of returns. About 22 events were considered for the study which was designated by dummy variables to identify the presence or absence of the events. The study observed mixed results. The banking systems of Austria, Greece, Netherlands and Switzerland experienced negative significant reaction to Asian crisis, which are not consistent with the semi-strong form of efficiency hypothesis. but significant reaction was observed for Russian crisis. On an individual level, out of 109 European banks, majority of the banks were found to be impacted by the Russian crisis. Thus, the study finds significant impact between bank stock prices and bank news respectively.

Anthony Richards and David Deddouche (1999), examined the impact of rating changes by the international agencies on the emerging market bank stocks. The study rejects the semi-strong form of efficiency theory wherein it observes negative and positive response by bank stock prices to the changes in the grades by international agencies. The data for the period January 6th, 1989 to June 12th, 1998 was collected from Emerging Market Database (EMDB) of the International Finance Corporation (IFC). Rating was considered from three international agencies mainly IBCA, Moody's and Standard and Poor's. 49 banks from fifteen countries were considered for the study with 219 ratings for the study. Three types of standard event study methodology was followed. The tests on average abnormal returns, tests on standardized abnormal returns and non-parametric test for the proportion of positive and negative abnormal returns around the event were the tests conducted. The study confirms the previous studies conducted in US, that downgrades have a negative impact on the bank's stock prices. But, during upgrades mixed results are obtained. It was also observed that, for both downgrades and upgrades, The magnitude of abnormal returns witnessed over the previous years has become small. Thus, the study concludes that stock prices appear to reflect most of the information contained in the ratings changes as time progresses.

Jeremy C Goh and Louis H Ederington, 2001, examine the impact of bond rating changes on stock prices. The paper tries to differentiate the impact of bond ratings due to a positive news and negative news. The authors are of the opinion that, any news associated with deteriorating financial performance of the company will have a negative impact on the stock prices and the news associated with changes in the firm's leverage will not have any impact. For the study, 1078 rating changes announced by Moody's during the period 1984 to 1986 was considered. To ensure an uncontaminated sample, around the event window of three days, and another announcement was looked for. If there exists another announcement around the event window period, that event was eliminated. Thus the study considers only 428 rating changes which mainly comprises of 243 downgrades and 185 upgrades. Standard event study methodology was used to calculate cumulative abnormal returns. Z-statistic and T-statistic was used to test whether the cumulative abnormal returns were significantly different from zero. It was observed that change in the leverage was observed positively by the shareholders when compared to changes in the financial prospects.

Ederington and Yawitz (1987) observe that not all the changes in the stock prices can be predicted from publicly available information, but most of the times an anticipation of the news can result in negative impact on the stock prices. The study also observe

negative reactions to the announcements in the rating changes. The study is found to be in line with the findings of Houthausen and Leftwich (1986) and Wansley and Clauretie (1985) wherein they too observed significant negative returns prior to the announcements indicating some anticipation which is always a pessimistic in nature.

Venkata Vijay Kumar Pasupuleti and Piyush Kumar Singh examine the contribution of the Bombay Stock Exchange (BSE) sectoral indices on the broader index i.e., BSE Sensex. The paper attempts to understand the variance of sectoral index returns in relation to BSE returns. The study aimed at finding a causal relationship between sectoral indices with the market index returns and to find the liquidity impact of sectoral indices returns with market index returns. For the study, twelve sectoral indices weekly returns data along with BSE Sensex weekly returns data was considered for the study. The step wise multiple regression methodology was utilized. Multicollinearity tests and ARIMA model was also considered to understand the correlation and influence of sectoral indices past returns on the present sensex returns respectively. Garch model was also used to understand the nature of volatility of indices considered. From the analysis, the study concludes that sectoral indices definitely act as a benchmark in explaining the sensex returns. For forecasting, Auto regressive model of order one was a better fit with health and consumer durable indices moving earning against the market index returns direction. The Technology, Oil, Capital goods and Banking sector indices were found to move along with market index returns. This also concludes that, with the introduction of power and realty sector indices, there is lower volatility clustering as seen from the Garch Models. Various studies have tried to analyse the impact of monetary policy changes by the central bank on various factors like inflation, long term interest rates and the reaction of stock markets to the news.

Vikram k. Joshi (2012) analyses the steps taken the central bank of India through the monetary policies such as changes in repo rate, reverse repo rate and cash reserve ratio in tackling the supernormal growth in inflation during the period 2009-2011. Monetary policy refers to “the deliberate effort by the Central Bank to influence economic activity by variations in the money supply, in availability of credit or in the interest rates consistent with specific national objectives”. During the period 2009-2011, the major efforts of the RBI were towards reducing the inflation rates which were hovering around 9-14 percent. To bring down the inflation various steps were taken mainly in the form of changes in CRR, repo and reverse repo rates which have direct influence on the money supply in the economy. During the year 2009-11, the rates were changed sixteen times. The impact of these changes was examined in the study. Paired two sample test for means, Analysis of variance test and regression method was conducted to test the influence of monetary policies on inflation. The test concludes that repo and reverse repo rates play a significant impact on inflation when compared to CRR rates.

Gianluca benigno and pierpaulo benign (2001), examined the monetary policy which can be adopted in an open kind of economy. It was found that, the nominal exchange rate is non-stationary in nature if the monetary policies react only plainly to domestic objectives. On the other hand, when at least one country’s monetary policy rule reacts to the deviations of the nominal exchange rate from a target, exchange rate volatility is reduced. The study concludes in finding the relationship between foreign exchange and dealings with monetary policies.

3. Problem Statement

From the literature review, it is evident that stock prices reflect the new information fairly efficiently and the news is assimilated very quickly to show the impact of the new information with respect to company, industry or the economy. Changes in credit ratings, changes in monetary policies and change in the financial prospects of a company can have varied response by the stock prices. Period 2006 to 2013 is considered to the period of volatility in stock prices, inflation, interest rates and other macro-economic parameters. Several steps were taken during the period by the central bank of India (RBI) to sustain growth and price stability. The monetary steps taken aimed at regulation of money supply, interest rates and aggregate credit in the economy during the period. In the pre-reform periods, central bank used direct instrument of monetary policy such as cash reserve ratio (CRR), Statutory Liquidity Ratio (SLR), and interest rates to regulate money supply and hence inflation. With the advancements in information technology, the steps taken by the RBI can be analysed directly in the stock prices reaction taking into the consideration, efficient market hypothesis into perspective. Is there a response of these frequent changes in the monetary key rates on bank stock prices was felt a necessity as it can serve as an opportunity to the investors to make short term gains in the event window period. Thus the study was conducted to analyse the impact of key monetary rate changes on the bank stock prices using event study methodology.

4. Objectives of the Study

- To examine the impact of CRR rates on Banks stock prices during the period 2006-2013.
- To examine the impact of REPO rates on Banks stock prices during the period 2006-2013.
- To examine the impact of Reverse Repo rates on Banks stock prices during the period 2006-2013.

5. Hypotheses of the Study

- H_{01} : There exists no significant relationship in the bank stock prices returns before and after the CRR announcement.
- H_{02} : There exists no significant relationship in the bank stock prices returns before and after the CRR announcement.
- H_{03} : There exists no significant relationship in the bank stock prices returns before and after the CRR announcement.

6. Data Collection

For the study, the data on CRR, REPO, REVERSE REPO AND SLR rates was collected from June 2006 to February 2013. The Key Monetary rates changes for the period 2006-2013 is shown in Table 1 below. Totally 36 events were considered for the study. In order

to analyse the impact of the events on the stock prices, Bank stock prices of the following companies were collected on a daily basis namely, Axis Bank Ltd, Bank of Baroda, Bank of India Ltd, Canara Bank Ltd, Federal Bank Ltd, HDFC Bank Ltd, ICICI Bank Ltd, IDBI Bank Ltd, IndusInd Bank Ltd, Kotak Mahindra Bank Ltd, Punjab National Bank, State Bank of India, Union Bank Of India, Yes Bank Ltd. Totally 448 event studies were conducted considering all the banking stocks.

<i>Date</i>	<i>CRR RATE</i>	<i>Date</i>	<i>Repo RATE</i>	<i>Date</i>	<i>Reverse Repo Rate</i>
22-Jun-06	5	08-Jun-06	6.75	08-Jun-06	5.75
06-Jan-07	5.5	31-Jan-07	7.5	25-Jul-06	6
03-Mar-07	6	30-Mar-07	7.75	25-Jul-06	6
24-May-08	8.25	12-Jun-08	8	25-Jul-06	6
19-Jul-08	8.75	30-Jul-08	9	25-Jul-06	6
25-Oct-08	6	20-Oct-08	8	25-Jul-06	6
08-Nov-08	5.5	03-Nov-08	7.5	08-Dec-08	5
17-Jan-09	5	05-Jan-09	5.5	05-Jan-09	4
27-Feb-10	5.75	19-Mar-10	5	19-Mar-10	3.5
24-Apr-10	6	20-Apr-10	5.25	20-Apr-10	3.75
10-Mar-12	4.75	17-Apr-12	8	17-Apr-12	7
09-Feb-13	4	29-Jan-13	7.75	29-Jan-13	6.75

Table 1: Data on Monetary key rates during the period 2006-2013.

Source: Authors

7. Methodology

This study is based on Event Study Methodology (Brown and Warner, 1985). Event study methodology is based on the concept of market efficiency. If the markets are efficient, security prices would be able to reflect all currently available information, and thus price changes will reflect only new information. Thus importance of an event is understood by examining the price changes during the period in which the event occurs.

Event Study Methodology describes the technique of empirically assessing the impact of a particular event on a firm's stock price or industry's average stock price represented by indices.

The event study methodology enables to compute cumulative abnormal returns (CAR) of the respective share indices during the days surrounding the announcement. To statistically understand whether there was significant difference in the distribution pattern of abnormal returns before and after the announcement, parametric t-test was conducted. If there existed possibility to gain abnormal returns due to the announcement, then the markets can be said to inefficient. Analysing the impact of any particular event is difficult, since stock prices respond to wide range of macroeconomic news such as forecasts of corporate profitability, Gross Domestic Product, inflation rates, interest rates, global news etc. Isolating the part of a stock price movement that is attributable to a specific event is always a challenge. To isolate the stock price movements from the specific event, general approach followed is to find a proxy for what the stock's return would have been in the absence of the event. The abnormal return due to the event is estimated as the difference between the stock's actual return and this benchmark. The approach followed in this study, is to find the normal returns using the asset pricing model such as the CAPM. The researchers often use the 'market model' or the single- index model, which holds that stock returns are determined by a market factor and a firm-specific factor.

The stock return, r_{it} , during a given period t , would be expressed mathematically as

$$\bar{r}_{it} = \alpha_i + \beta_i \bar{r}_{mt} + \xi_{it}$$

Where

\bar{r}_{it} = expected return of stock price returns on day t

\bar{r}_{mt} = Market's rate of return during the period

β_i = systematic risk component or it measures sensitivity to the market return

α_i = Intercept term or average return of the stock in case of zero market return

ξ_{it} = white noise error term on day t with zero mean and constant variance.

The deviation of actual return from the expected return is regarded as the abnormal return. The determination of the abnormal return in a given period is expressed mathematically as shown below;

$$AR_{it} = r_{it} - (\alpha_i + \beta_i \bar{r}_{mt})$$

Where, AR_{it} = abnormal return of stock 'i' on day 't'
 r_{it} = actual return on stock 'i' on day 't'

The abnormal return is the stock's return over and above what one would predict based on broad market movements in that period, given the stock's sensitivity to the market.

The parametric 't' test for the equality of means for the abnormal returns before and after the announcement date is conducted to test the hypothesis of no difference in the means of abnormal returns.

7.1. T-TEST for testing difference between sample means

Here under the null hypothesis of no difference in the returns before and after the event day, the t-test was conducted at 0.05 level of significance.

The standard error of the difference between the two means since population standard deviation is unknown was calculated as follows:

$$\hat{\sigma}_{\bar{x}_{after} - \bar{x}_{before}} = \sqrt{\frac{\hat{\sigma}_{after}^2}{n_{after}}} + \sqrt{\frac{\hat{\sigma}_{before}^2}{n_{before}}}$$

To estimate the common variance or an unbiased estimator of population variance, the weighted average of sample variances were considered with weights being equal to degrees of freedom used. Thus pooled estimate of population variance was estimated as shown below:

$$S_p^2 = \frac{(n_{after} - 1)S_{after}^2 + (n_{before} - 1)S_{before}^2}{n_{before} + n_{after} - 2}$$

Thus degree of freedom would be equal to number of sample before and after the event minus two. Because we are doing upper tailed test at 0.05 level of significance, the critical value of t is 1.671.

Thus standardized 't' statistic is calculated as shown below:

$$t = \frac{(\bar{x}_{after} - \bar{x}_{before}) - (\mu_{after} - \mu_{before})}{\hat{\sigma}_{\bar{x}_{after} - \bar{x}_{before}}} H_0$$

If the standardized difference between the two samples means lies within the acceptance region, we would accept the null hypothesis of no difference between the means of returns before and after the event day. The p-values of the t-test were often used to accept or reject the null hypothesis. In the methodology, The dates when monetary policy rates were changes were considered as the "event day". 30 days surrounding the event day (15 days before and 15 days after the event) has been denoted as "event window". 15 days prior to the last day of the event window (-16 to -30 days from the event day) has been considered the "estimation window/benchmark period". BSE Sensex index was taken as proxies for the overall market.

8. Data Analysis and Interpretation

The analysis was conducted on all the banking stocks taking into consideration the events wherein the monetary rates were changed. As observed in Table 2, the changes in the CRR rate by the RBI did not have any significant impact on the stock prices of the banks. Thus the results suggest acceptance of the null hypothesis that "there is no difference in the distribution patterns of the returns between before and after the announcement on changes in CRR. The Figures 3 to 13 depict the cumulative abnormal returns around the announcements.

date					Acceptance/Rejection of Null hypothesis
22-Jun-06	Before mean	0.0025246	p-value	0.915148	Acceptance of Null Hypothesis
	After mean	0.0042971			
06-Jan-07	Before mean	0.00082585	p-value	0.734986	Acceptance of Null Hypothesis
	After mean	0.00402687			
03-Mar-07	Before mean	-0.0246786	p-value	0.041215	Rejection of Null Hypothesis
	After mean	0.0040431			
24-May-08	Before mean	-0.0179411	p-value	0.55995	Acceptance of Null Hypothesis
	After mean	-0.0096218			
19-Jul-08	Before mean	-0.00032	p-value	0.262285	Acceptance of Null Hypothesis
	After mean	-0.01833			
25-Oct-08	Before mean	-0.0255831	p-value	0.626016	Acceptance of Null Hypothesis
	After mean	-0.0103009			
08-Nov-08	Before mean	-0.000177	p-value	0.170203	Acceptance of Null Hypothesis
	After mean	-0.026444			
17-Jan-09	Before mean	-0.004126	p-value	0.863211	Acceptance of Null Hypothesis
	After mean	-0.001544			
27-Feb-10	Before mean	0.0056967	p-value	0.390023	Acceptance of Null Hypothesis
	After mean	0.0006431			
24-Apr-10	Before mean	0.0001251	p-value	0.394048	Acceptance of Null Hypothesis
	After mean	-0.006193			
10-Mar-12	Before mean	-0.0167447	p-value	0.964327	Acceptance of Null Hypothesis
	After mean	-0.0171443			
09-Feb-13	Before mean	0.0022029	p-value	0.160022	Acceptance of Null Hypothesis
	After mean	-0.006136			

Table 2: Analysis of Impact of changes in CRR rate on Axis Bank stock returns
Source: Authors

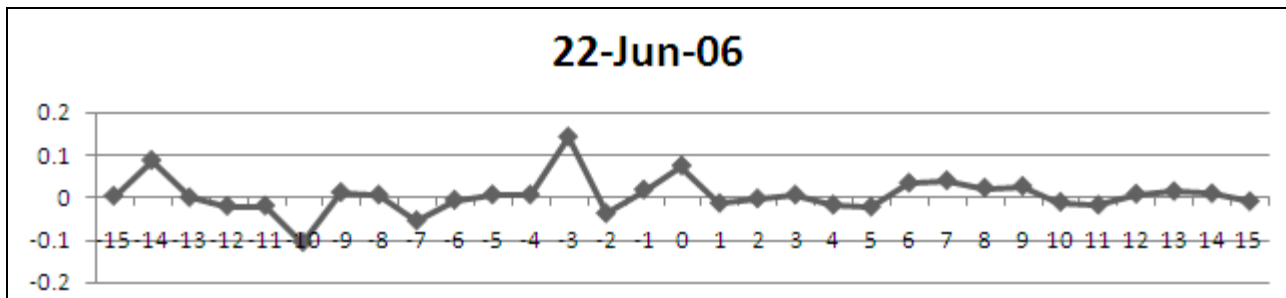


Figure 3: Axis bank CAR returns performance to the CRR change on 22 Jun 2006

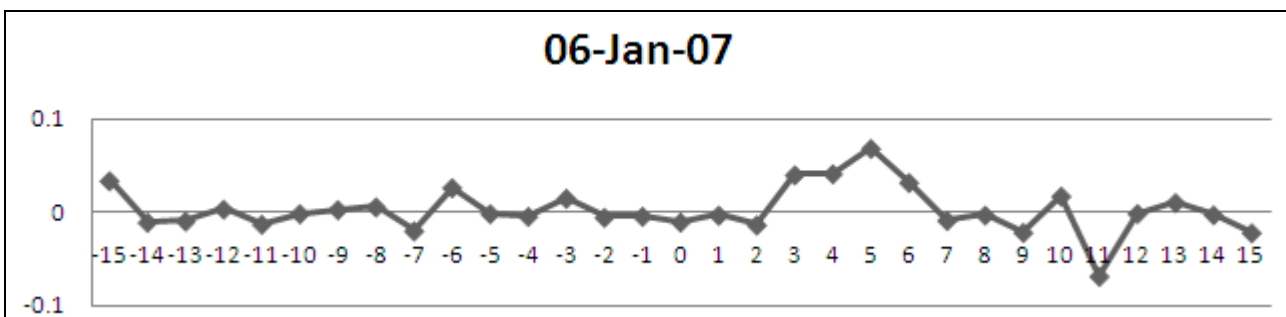


Figure 4: Axis bank CAR returns performance to the CRR change on 06 Jan 2007

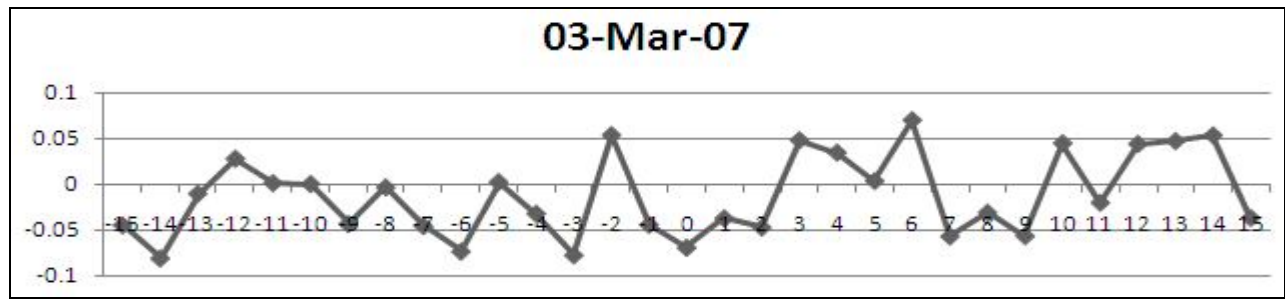


Figure 5: Axis bank CAR returns performance to the CRR change on 03 March 2007

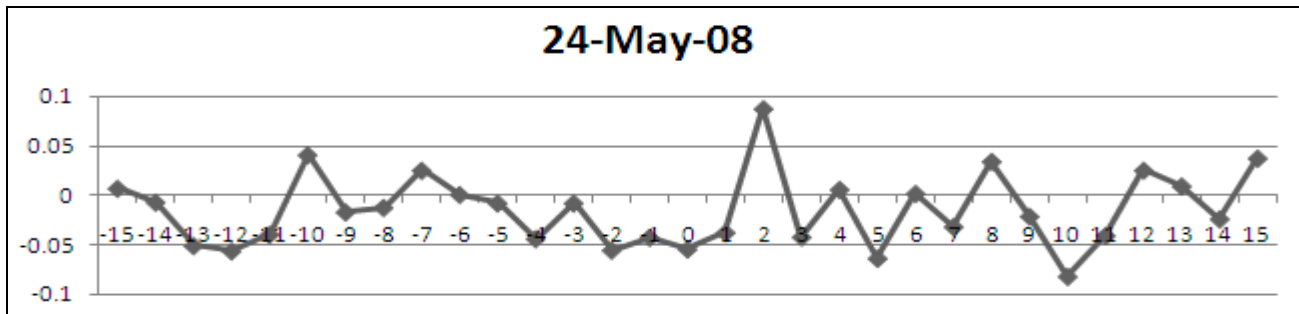


Figure 6: Axis bank CAR returns performance to the CRR change on 24 May 2008

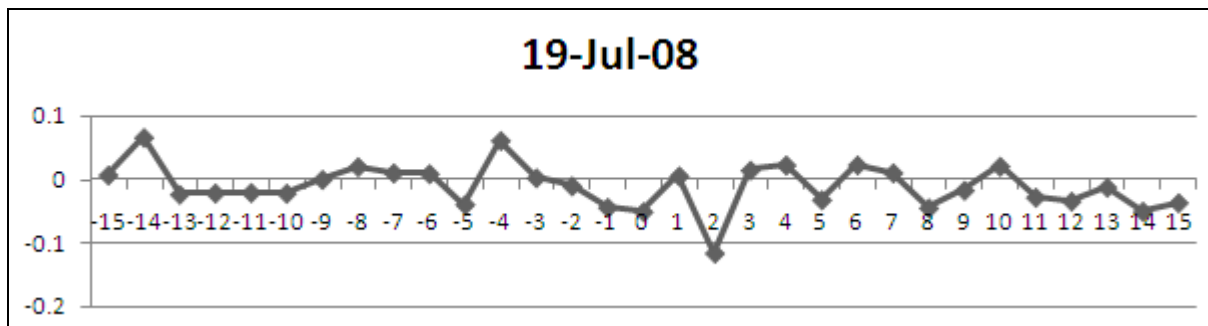


Figure 7: Axis bank CAR returns performance to the CRR change on 19 July 2008

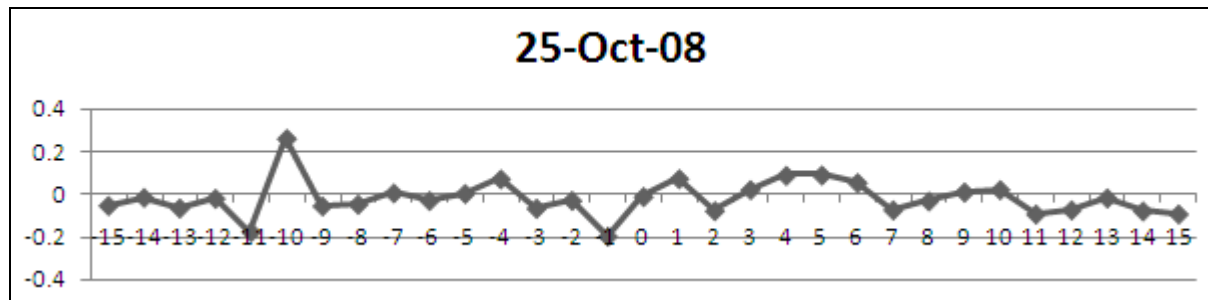


Figure 8: Axis bank CAR returns performance to the CRR change on 25th October 2008 .

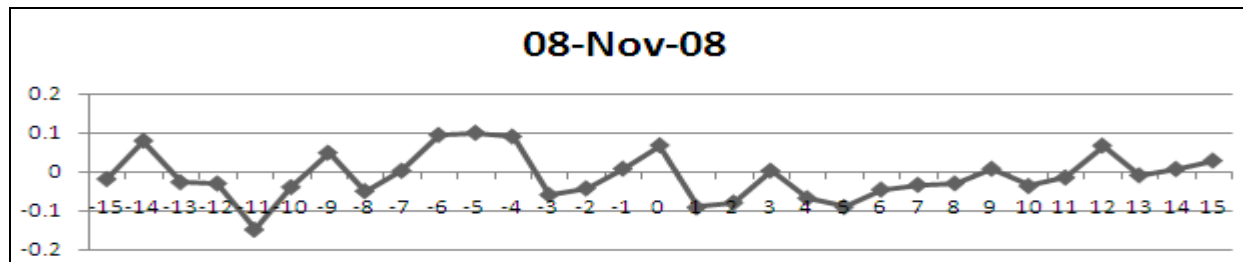


Figure 9: Axis bank CAR returns performance to the CRR change on 8th Nov 2008

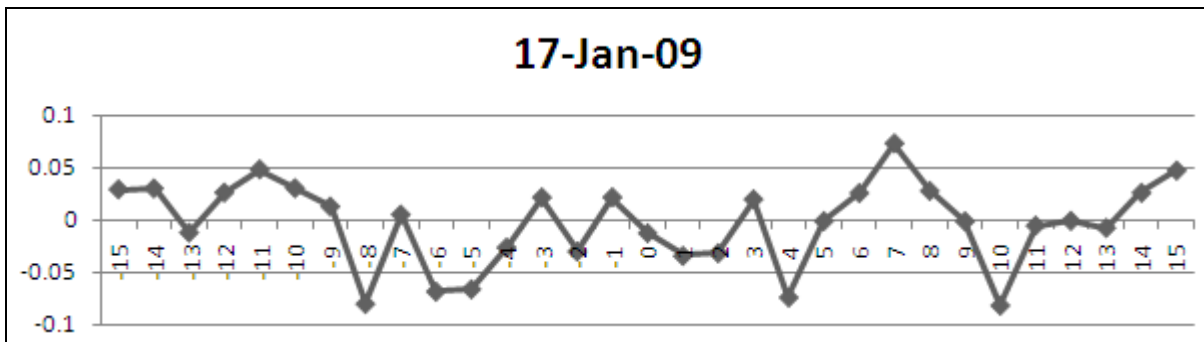


Figure 10: Axis bank CAR returns performance to the CRR change on 17th Jan 2009 .

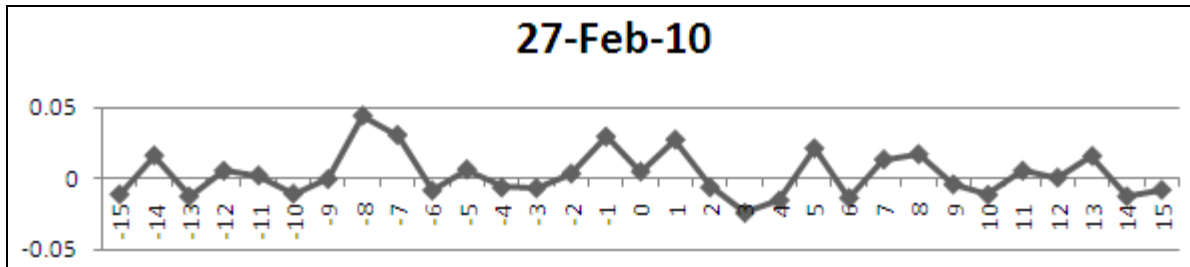


Figure 11: Axis bank CAR returns performance to the CRR change on 27th Feb 2010

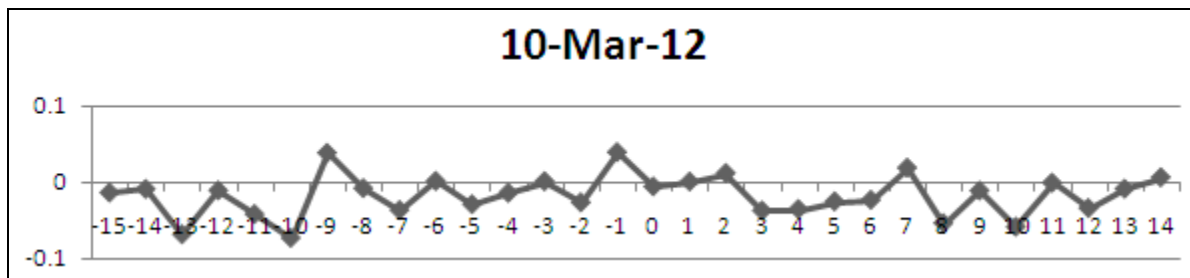


Figure 12: Axis bank CAR returns performance to the CRR change on 10th March 2012

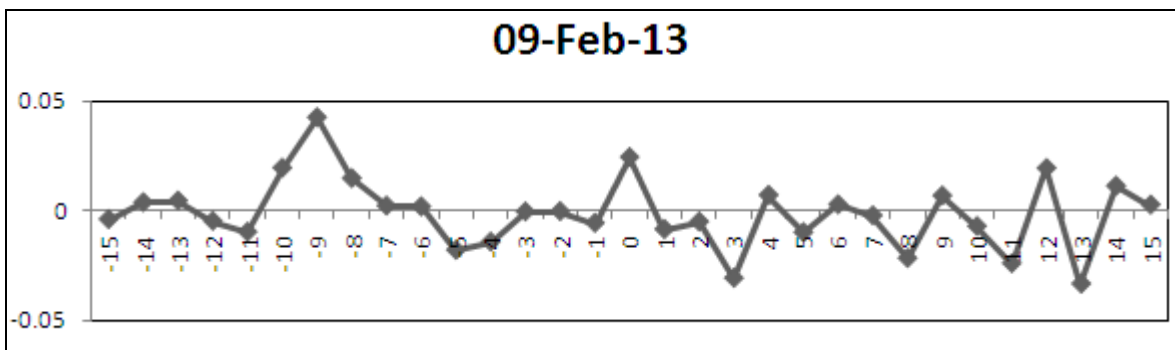


Figure 13: Axis bank CAR returns performance to the CRR change on 9th Feb 2013

Similar tests were conducted to test the impact of announcement of CRR, Repo rates and Reverse repo rates on the all the Bank stock returns. The p-values of the t-test for the equality of the mean returns before and after the monetary rate announcements is shown in Tables 4 to 9 in appendix.

9. Findings of the Study

EVENT STUDY ANALYSIS OF MONETARY RATE CUTS ON BANK STOCK PRICES												
BANKS	CRR				Repo				Reverse repo			
	Accept	Reject		CRR CHANGE	Accept	Reject		REPO RATE CHANGE	Accept	Reject		REVERSE REPO CHANGE
Axis	11	1	3rd March, 2007	↑	12	0			8	0		
Bank of Baroda	12	0			12	0			8	0		
Bank of India	12	0			12	0			8	0		
Canara Bank	11	1	19th July, 2008	↑	12	0			8	0		
Federal Bank	11	1	25th Oct, 2008		10	2	3rd Nov, 2008 & 5th Jan, 2009	↓	7	1	5th Jan 2009	↓
HDFC Bank	12	0			11	1	8th June, 2006	↑	7	1	8th June 2006	↑
ICICI Bank	12	0			12	0			8	0		
IDBI Bank	10	2	3rd March, 2007 & 19th July 2008	↑	12	0			8	0		
IndusInd Bank	12	0			12	0			7	1	25th July 2006	↔
Kotak Mahindra	11	1	9th Feb, 2013	↓	11	1	8th June, 2006	↑	7	1	8th June 2006	↑
PNB	12	0			11	1	5th Jan, 2009	↓	8	0		
SBI	12	0			12	0			8	0		
union bank	11	1	3rd March, 2007	↑	11	1	20th Oct, 2008	↓	8	0		
Yes Bank	12	0			12	0			8	0		
	161	7			162	6			108	4		

Table 3: EVENT STUDY ANALYSIS OF MONETARY RATE CUTS ON BANK STOCK PRICES

Source: Authors

Table 3: Event Study Analysis of Monetary rate cuts on Bank Stock prices
Source: Authors

The results of the event study methodology are presented in Table 3. The table summarises the impact of changes in the monetary rates on the company's stock prices. We see a clear indication of markets being efficient in the semi-strong form. The tests point towards in unison that the null hypothesis that 'there is no difference in the distribution patterns in the returns between before and after the rate announcements' is accepted. We observe that only few bank stock returns were found to be significantly different before and after the announcement. Out of 161 event study analysis, only 7 cases were found to reject the null hypothesis of no difference in the distribution patterns in the returns between before and after the CRR rate announcements. Same trend is also observed for the event studies conducted using Repo rate and Reverse Repo rate announcements. In case of Repo rate and Reverse Repo announcements only 6 cases and 4 cases rejected the null hypothesis for difference in the mean returns before and after the announcement. A point to notice is that, with respect to CRR ratio, the rejection of null hypothesis seems to occur when there is an increase in the ratio. But no clear conclusion can be drawn with respect to the Reverse Repo and Repo rate changes.

The results of Event study conducted for 14 banks are listed in Table 3. The finding obtained with respect to the banks is as follows. For the banks namely, Bank of Baroda, Bank of India, ICICI Bank, State Bank of India and Yes bank, there was seen no difference in the mean returns before and after the monetary rate announcements. Whereas for other nine banks significant differences were observed in the mean return of few event days. In Axis bank, The CRR, Repo and Reverse Repo Change by the central bank seemed to have no impact on the mean returns before and after the announcement. The bank mean returns showed mixed results in response to the events. Out of 32 events, only one event study was found to have mean returns different before and after the event day. For Canara Bank, out of 32 events, in only one event on 19th July, 2008, the mean returns were found to be significantly different on the announcement of CRR change from 8.25 to 8.75 percent. Federal and HDFC bank mean returns were found to respond to changes in the Repo rate and Reverse Repo rates. Significant differences in the mean returns were observed on three occasions and two occasions respectively for each of the companies. Kotak Mahindra bank was found to be the only bank, where the mean returns differed significantly with respect of all three monetary rate cuts. Union Bank, Punjab National Bank and IDBI too showed differences in the returns. Theoretically, such a reaction by the market can only happen, if stock markets tend to predict the announcement of the news and its reaction by the prices of the respective shares. The finding thus confirms the hypothesis of Indian securities market with respect to banking sector to be efficient in semi-strong form. The study thus emphasizes the fact that fundamental analysis may be a very important tool in analysis the companies. Technical analysis would thus be not so important to the investors in making trading strategies to make abnormal profits.

10. Conclusion

The study aims at examining the performance of the Bank stock prices with respect to the announcement of changes in the key monetary rates by the central bank of India (RBI). The study tries to understand whether there exists significant difference in the mean returns on the announcements for changes in CRR, Repo Rate and Reverse repo rate. Signalling hypothesis theoretically assumes that announcement of any new information should surprise the stock markets and hence the markets are efficient in nature. From the analysis we find that, the stock market tends to envisage the announcements of the news and the reaction of the bank prices to the announcements. Out of 448 event studies conducted, only a sample few events are found to surprise the market, giving opportunities for making abnormal profits. The p-values of the t-test for difference in the sample means confirms that patterns in the distribution of returns before and after the announcements date are similar and thus supports the hypothesis that the market is efficient at semi-strong form with respect to Banking sector.

The study aims at examining the performance of the Bank stock prices with respect to the announcement of changes in the key monetary rates by the central bank of India (RBI). The study tries to understand whether there exists significant difference in the mean returns on the announcements for changes in CRR, Repo Rate and Reverse repo rate. Signalling hypothesis theoretically assumes that announcement of any new information should surprise the stock markets and hence the markets are efficient in nature. From the analysis we find that, the stock market tends to envisage the announcements of the news and the reaction of the bank prices to the announcements. Out of 448 event studies conducted, only a sample few events are found to surprise the market, giving opportunities for making abnormal profits. The p-values of the t-test for difference in the sample means confirms that patterns in the distribution of returns before and after the announcements date are similar and thus supports the hypothesis that the market is efficient at semi-strong form with respect to Banking sector. Thus it reinforces the fact that for a long term investor, fundamental analysis should be the key factor in decision making rather than relying on the historical patterns. Thus we conclude that prices of the bank shares incorporate the information prior to the actual announcements.

11. Appendix

date	Axis	Bank of Baroda	Bank of India	Canara Bank	Federal Bank	HDFC Bank	ICICI Bank
22-Jun-06	0.92	0.54	0.81	0.96	0.43	0.71	0.76
06-Jan-07	0.73	0.52	0.27	0.04**	0.72	0.38	0.93
03-Mar-07	0.04**	0.50	0.98	0.50	0.14	0.85	0.27
24-May-08	0.56	0.77	0.55	0.49	0.52	0.56	0.82
19-Jul-08	0.26	1.00	0.13	0.03**	0.17	0.91	0.24
25-Oct-08	0.63	0.20	0.31	0.94	0.02**	0.35	0.14
08-Nov-08	0.17	0.96	0.86	0.32	0.45	0.54	0.27
17-Jan-09	0.86	0.46	0.72	0.59	0.61	0.79	0.91
27-Feb-10	0.39	0.72	0.79	0.94	0.76	0.74	0.81
24-Apr-10	0.39	0.42	0.86	0.17	0.67	0.99	0.43
10-Mar-12	0.96	0.81	0.86	0.95	0.67	0.77	0.81
09-Feb-13	0.16	0.66	0.87	0.32	0.19	0.79	0.91

Table 4: Analysis of Impact of changes in CRR rate on Bank stock returns for the period 2006-13

** Significance at 5 percent level of significance

date	IDBI Bank	IndusInd Bank	Kotak M	PNB	SBI	union bank	Yes Bank
22-Jun-06	0.75	0.06	0.64	0.13	0.69	0.96	0.91
06-Jan-07	0.14	0.33	0.78	0.86	0.52	0.17	0.65
03-Mar-07	0.02**	0.41	0.14	0.19	0.52	0.02**	0.57
24-May-08	0.45	0.96	0.33	0.91	0.84	0.45	0.86
19-Jul-08	0.04**	0.42	0.40	0.53	0.43	0.61	0.56
25-Oct-08	0.87	0.30	0.39	0.88	0.98	0.86	0.18
08-Nov-08	0.45	0.23	0.89	0.82	0.36	0.98	0.46
17-Jan-09	0.99	0.60	0.96	0.99	0.65	0.50	0.36
27-Feb-10	0.11	0.36	0.85	0.66	0.43	0.77	0.99
24-Apr-10	0.24	0.58	0.32	0.99	0.87	1.00	0.67
10-Mar-12	0.97	0.92	0.85	0.60	0.95	0.27	0.88
09-Feb-13	0.88	0.31	0.04**	0.64	0.99	0.37	0.60

Table 5: Analysis of Impact of changes in CRR rate on Bank stock returns for the period 2006-13 (contd.)

** Significance at 5 percent level of significance

Date	Axis	Bank of Baroda	Bank of India	Canara Bank	Federal Bank	HDFC Bank	ICICI Bank
08-Jun-06	0.19	0.37	0.26	0.30	0.25	0.02**	0.11
31-Jan-07	0.73	0.53	0.61	0.34	0.35	0.53	0.90
30-Mar-07	0.59	0.58	0.86	0.59	0.94	0.72	0.59
12-Jun-08	0.98	0.38	0.98	0.21	0.18	0.74	0.77
30-Jul-08	0.97	0.98	0.76	0.76	0.77	0.46	0.22
20-Oct-08	0.77	0.36	0.09	0.75	0.74	0.95	0.37
03-Nov-08	0.11	0.41	0.67	0.91	0.02**	0.33	0.43
05-Jan-09	0.12	0.16	0.21	0.20	0.04**	0.16	0.21
19-Mar-10	0.62	0.74	0.23	1.00	0.84	0.50	0.24
20-Apr-10	0.39	0.60	0.26	0.28	0.18	0.94	0.89
17-Apr-12	0.13	0.12	0.26	0.17	0.18	0.64	0.92
29-Jan-13	0.50	0.48	0.63	0.73	0.48	0.44	0.29

Table 6: Analysis of Impact of changes in Repo rate on Bank stock returns for the period 2006-13
 ** Significance at 5 percent level of significance

Date	IDBI Bank	IndusInd Bank	Kotak M	PNB	SBI	union bank	Yes Bank
08-Jun-06	0.09	0.34	0.03**	0.51	0.79	0.94	0.16
31-Jan-07	0.18	0.79	0.36	0.40	0.16	0.32	0.87
30-Mar-07	0.66	0.55	0.75	0.13	0.42	0.54	0.39
12-Jun-08	0.62	0.83	0.08	0.60	0.78	0.79	0.62
30-Jul-08	0.60	0.99	0.93	0.17	0.63	0.74	0.93
20-Oct-08	0.44	0.59	0.69	0.12	0.24	0.02**	0.21
03-Nov-08	0.25	0.90	0.34	0.11	0.79	0.95	0.61
05-Jan-09	0.18	0.18	0.37	0.03**	0.11	0.76	0.18
19-Mar-10	0.44	0.74	0.80	0.88	0.88	0.67	0.69
20-Apr-10	0.19	0.35	0.79	0.76	0.17	0.20	0.96
17-Apr-12	0.27	0.24	0.29	0.13	0.08	0.95	0.28
29-Jan-13	0.80	0.64	0.69	0.75	0.17	0.21	0.50

Table 7: Analysis of Impact of changes in Repo rate on Bank stock returns for the period 2006-13(contd)
 ** Significance at 5 percent level of significance

Date	Axis	Bank of Baroda	Bank of India	Canara Bank	Federal Bank	HDFC Bank	ICICI Bank
08-Jun-06	0.19	0.37	0.26	0.30	0.25	0.02**	0.11
25-Jul-06	0.73	0.63	0.92	0.77	0.37	0.10	0.88
08-Dec-08	0.40	0.74	0.47	0.20	0.45	0.51	0.28
05-Jan-09	0.12	0.16	0.21	0.20	0.04**	0.16	0.21
19-Mar-10	0.62	0.74	0.23	1.00	0.84	0.50	0.24
20-Apr-10	0.39	0.60	0.26	0.28	0.18	0.94	0.89
17-Apr-12	0.13	0.12	0.26	0.17	0.18	0.64	0.92
29-Jan-13	0.50	0.48	0.63	0.73	0.48	0.44	0.29

Table 8: Analysis of Impact of changes in Reverse Repo rate on Bank stock returns for the period 2006-13
 ** Significance at 5 percent level of significance

Date	IDBI Bank	IndusInd Bank	Kotak M	PNB	SBI	union bank	Yes Bank
08-Jun-06	0.09	0.34	0.03**	0.51	0.79	0.16	0.16
25-Jul-06	0.06	0.01**	0.37	0.32	0.26	0.37	0.54
08-Dec-08	0.75	0.50	0.50	0.77	0.69	0.45	0.89
05-Jan-09	0.18	0.18	0.37	0.04	0.11	0.42	0.18
19-Mar-10	0.44	0.74	0.80	0.88	0.88	0.63	0.69
20-Apr-10	0.19	0.35	0.79	0.76	0.17	0.33	0.96
17-Apr-12	0.27	0.24	0.29	0.13	0.08	0.21	0.28
29-Jan-13	0.80	0.64	0.69	0.75	0.17	0.94	0.50

Table 9: Analysis of Impact of changes in Reverse Repo rate on Bank stock returns for the period 2006-13(contd)

** Significance at 5 percent level of significance

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