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# **The effect of mergers and acquisitions on shareholder wealth: the case of European banks**

Abdourahmane DIAW<sup>1</sup>

## **Abstract:**

In this paper we investigate the effect of announcements of mergers and acquisitions on bank shareholder wealth. Despite the major impact of the phenomenon of mergers and acquisitions on the future of the European banking industry, there are currently few studies that investigated this area. This is largely due to the fact that it is a relatively recent phenomenon since it began to grow in 1997. Based on a sample of 97 European banks over the period 1997-2008, our study showed that the European banking mergers and acquisitions create value but all of this value created by the purchaser's bid is received by the shareholders of the target. These appear to be the main beneficiaries of mergers and acquisition. However, shareholders of acquiring banks, meanwhile, are not harmed by the operations of mergers and acquisitions initiated by their leaders.

**Keywords:** Mergers and acquisitions, bank mergers and acquisition, European banking market

**JEL Classification:** G14 G24 G34

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## **1. Introduction**

From the second half of the 1990s we are witnessing an unprecedented wave of mergers and acquisitions in Europe. Although the phenomenon is not new, its extent and the forms it takes appear somewhat unusual. Financial globalization and increased competition have favored the rise of mergers and acquisitions of large firms which is also influenced by technological changes. These mergers and acquisitions are not confined to the industrial sector so alone, but rather of concern to overall economy and in particular the banking sector (Berger et al. 2001). Moreover, deregulation and acceleration of financial innovation process have contributed to the complexity of forms of financing mergers and acquisitions and gave shareholders a key role in the implementation of such operations. This trend is mainly due to technological and financial innovations, the global movement of financial deregulation, the process of financial integration in Europe, favorable economic and financial conditions and finally the need to create value for the shareholders (Berger et al. (1999), Group of Ten (2001) Amel et al. (2004) and Jones and Critchfield (2005)). The creation of shareholder value now remains the main objective of these mergers and acquisitions. However, the vast majority of mergers and acquisitions took place within national borders (domestic M &A), but since 2005 a few have taken place across borders (border M & A).

The epoch of 90s was also marked by an increase in "Megamergers ". The report of the Group of Ten (2001) also indicates that the 246 mega-mergers that have taken place over the period 1990-1999 and more than 80 % of them took place between 1995 and 1999. Moreover, in Europe the market share of bank mergers and acquisitions experienced an extraordinary boom. In fact, it increased from 1.4 % in 1990 to 18.7% in 2007 (Thomson One Banker). These mergers have resulted in a remarkable decrease in the number of credit institutions. In 1997 the European Union had 8,637 establishments; while in 2007 there were 6128 establishments which are around 29.04 % less (ECB, 2009). In addition, mergers and

acquisitions have taken place primarily at the national level with the emergence of the great "domestic champions" in most European countries in 1997.

Globally, the number of mergers and acquisitions is increasing rapidly. The year 2000 had broken records with 40,000 agreements. Figure 1 shows the number of operations and the value of all mergers and acquisitions in the world over the period 1990-2007. The market for mergers and acquisitions has a new record in terms of activity in 2007 with a total of 46,523 transactions representing an increase of approximately 60% as compared to 1997 transactions. In terms of value, global figure of mergers and acquisitions have reached a record level of \$5,269.032 billion in 2007, an increase of 21% as compared to 2006 and 177 % as compared to 1997. The years 2001-2002 recorded a decrease in activity in mergers and acquisitions: \$1,305.487 billion in 2002 compared to \$4,281.180 billion compared to 1999 a decrease of 69.5 %. This decline was largely due to the bursting of the Internet companies bubble (2001) and incident of 11/11 in US. However, since 2003, we are seeing a revival of mergers and acquisitions worldwide until 2007.

Year 2007 identifies a total of 11,826 transactions in Europe, which represents a 48.29% increase as compared to 1997 and 160% as compared to 1990 (Thomson Financial Data). In terms of value, mergers and acquisitions in Europe totaled more than \$ 2 billion in 2007, which is three times as compared to 1997 and eight times as compared to 1990. In the financial sector 2007 saw an unprecedented increase in mergers and acquisitions in value: \$485,787.88 in 2007 with an increase of 184 % as compared to 1997. In the banking sector, the value of the transaction for the year 2007 broke all the records, with \$343,193.75 more than triple in 1997 even though in terms of the number of deals far outweighed 227 operations in 1997 against 179 deals in 2007. Despite the dynamism of the market for mergers and acquisitions in the world and in the European banking sector in particular, over three-quarters of mergers and acquisitions in Europe are of a domestic nature (Group of Ten 2001).

The acceleration of banking M&A has encouraged the researchers to do empirical studies to determine whether it results in a better performance of merging banks. Generally two perspectives are preferred by the economic and financial analysts. The first approach is to determine the impact of M&A on business performance of merging firms. The seminal work is done by Williamson (1968) showing that two effects result from external growth strategies. The first one is the lower production costs through economies of scale, technological progress and synergies between the merging firms (efficiency effect). The second effect is often the point of view of the welfare of consumers, relating to increase in selling prices (market power effect). Moreover, the work of Berger, Demsetz and Strahan (1999) showed that the domestic banking M&A increases the level of concentration.

The second approach is more focused on establishing the short-term impact of mergers and acquisitions on shareholder wealth. The method is to evaluate the performance of merging banks. This method consists of examining the impact of transaction announcement on the evolution of market valuation and to determine if there are abnormal fluctuations in stock prices and its effects on shareholders wealth. The method used is that of event studies: it is measured in a time interval that includes the date of the announcement of the merger, the difference between the actual return on assets and the theoretical share price that would have been observed if the merger had not taken place. The "event studies" provide first report of how the merger is perceived by the market, insofar as it reveals managers' expectations of future profits of the bank. In addition, this method also tests the hypothesis whether managers responds correctly to the objectives of the shareholders or not.

The paper is organized as follows. The first section presents the literature review (section 2). The following section defines the approach of the study, namely the method of data collection, the samples obtained and the estimation models of abnormal returns (Section 3).

The final section presents the results for the effect of banks M&A on European shareholder wealth obtained from event studies (Section 4).

## **2. LITERATURE REVIEW**

Some studies have examined the abnormal returns of the "acquiring" and "target" banks separately while others have analyzed the total change in shareholder wealth. According to Jensen and Ruback (1983) M&A create value but the main beneficiaries are the shareholders of the target companies and acquiring companies do not lose. Rhoades (1993) made a literature review of all empirical studies in the United States from 1980 to 1993 and the results are mixed.

More recently, researchers have found different results to the previous studies. Whether we consider the acquirer and the acquiree, shareholders of the merging banks earn this operation, the creation of global wealth is however tempered by academic research. Zhang (1995) found an increase in total value. Hugues et al. ( 1999 ) show that the recent consolidation was accompanied by an increase in the equity market performance of securities new banking entities , including bank mergers established in different countries due to a substantial gain in geographic diversification. The empirical results in Europe especially Cybo-Ottone and Murgia (2000) show that abnormal returns, although negative for the acquirer, remain positive for the target. DeLong (2003) obtained similar results in non-US banks with significantly higher returns for acquiring non-US banks and significantly lower for target banks when compared to U.S. banks. Tourani -Rad and Van Beek (1999) found that shareholders of target banks earned more positive abnormal returns than acquirer banks. They argue that the larger the target bank, the higher is the returns. Lepetit et al. (2004) studying banking M&A during the period 1991-2001 in 13 European countries, examine the market reaction to the announcement of the merger. They found that the announcement of mergers and acquisitions positively affect the returns of the merged banks. Diaz et al. (2004) using panel data over the period 1993 to 2004 on a sample of 1,629 banks, 181 acquisitions were identified. They found

that the acquisitions of financial institutions by European banks can improve their profitability. Table 1 lists the European banking M&A events that have been studied in this paper.

Mergers and acquisitions raise many questions and uncertainties regarding their impact in terms of value creation and the results recorded after mergers are very mixed. It therefore seems legitimate to engage in investigation of European banking M&A announcements on shareholder wealth.

### **3. METHODOLOGY**

#### **3.1. DATA COLLECTION**

The event studies based on how quick are the price reaction at the announcement merger information. In our case, it will be the announcement of bank mergers and acquisitions. To judge the efficiency of the market in a merger announcement, we must analyze the reaction of the stock price of the securities concerned on the date of the announcement and the following days. The market is efficient if the price immediately adjusts to the merger information. In this case, we say that there is an abnormal return on the day of the announcement. The term refers to an “abnormal” return variation which would be "normal" in the absence of information. The study of abnormal returns and cumulative abnormal returns can highlight the market's reaction to the announcement of the event.

To do this, a study of events is conducted on the basis of a sample of 97 banks that were involved in mergers and acquisitions from January 1997 to December 2008. This methodology is based on the idea that the stock market reacts immediately to the announcements or events that are supposed to affect the future performance of merging banks. The event study is to test empirically the impact of the occurrence of a given economic event on the price of shares of a bank. The null hypothesis ( $H_0$ ) and alternative ( $H_1$ ) normally used are:

: | | (1)



:

(2)

Where  $R_i$  means the profitability of security  $i$  during the event period,  $E(R_i)$  is the expected return of security  $i$ ,  $y_i$  is the information that is likely to influence the security  $i$  during the event window;  $E(R_i | y_i)$  is the expected return of security  $i$  conditional to the information contained in the  $\varepsilon_i$  event window, the abnormal return of security  $i$ . The alternative hypothesis states that event gives  $H_1$  has no informational content  $y_i$  when the abnormal return of security  $i$  is nonzero. To test this hypothesis, the first approach is to take homogeneous samples, specify the model calculations and do tests of abnormal returns. Finally, the collected data contains a fairly large sample including all announcements of mergers and acquisitions by European banks within the European Union region from January 1997 to December 2008. (See Table 1)

**Table 1-Number of Acquiring and Target Banks**

Year	Total per Year	Domestic M&A	Cross Border M&A
1997	1	1	0
1998	1	1	0
1999	7	5	2
2000	3	0	3
2001	4	2	2
2002	5	4	1
2003	2	2	0
2004	3	0	3
2005	2	0	2
2006	4	2	2
2007	3	2	1
2008	10	6	4
Total	45	25	20

The table shows that in our sample, cross-border transactions are less likely than domestic operations and 55% of mergers and acquisitions are made within national borders. The

following table (Table 2) describes all of our data and the various sources of information associated with each of the sample transaction.

**Table 2-Study sample**

Acquiring Bank	Target Bank	Date	Amount (mil \$)	Target Country	Acquiring Country
Alandsbanken Abp	Kaupthing Bank Sverige	18/12/2008	48,7	Sweden	Finland
BNP Paribas SA	Fortis Bank SA/NV	06/10/2008	12765,28	Belgium	France
Banco Popular Espanol SA	Banco de Credito Balear SA	25/09/2008	144,98	Spain	Spain
Banco Popular Espanol SA	Banco de Galicia SA	25/09/2008	49,79	Spain	Spain
Svenska Handelsbanken	Lokalbanken Nordsjaellen	15/09/2008	152,05	Denmark	Sweden
Lloyds TSB Group Plc	HBOS Plc	17/09/2008	25 439,45	UK	UK
Nykredit Realkredit A/S	Forstaedernes Bank A/S	17/09/2008	375,19	Denmark	Denmark
Deutsche Bank AG	Deutsche Postbank AG	15/09/2008	3 839,04	Germany	Germany
BPER	Meliorbanca SpA	25/08/2008	439,96	Italy	Italy
Banco Santander SA	Alliance&Leicester Plc	14/07/2008	2517,95	UK	Spain
Defpa BK Plc	Hypo Real Estate Holding AG	23/07/2007	7847,11	Ireland	Germany
Unicredito Italiano SpA	Capitalia SpA	15/05/2007	29 528,09	Italy	Italy
RFS Holdings BV (Fortis, RBS,BSCH)	ABN-AMRO Holding NV	25/04/2007	98189,19	Netherland	UK Belgium Spain
Banche Popolari Unite Scrl	Banca Lombarda e	14/11/2006	7 801,46	Italy	Italy
Banca Intesa SpA	SanPaolo IMI SpA	26/08/2006	37 624,24	Italy	Italy
Crédit-Agricole SA	Emporik Bank SA	13/06/2006	2 650,24	Greece	France
BNP-Paribas SA	Banca Nazionale del Lavoro	03/02/2006	5 944,13	Italy	France
Unicredito Italiano SpA	Bayerische Hypo- und Vereins	30/06/2005	1 8256,50	Germany	Italy
Unicredito Italiano SpA	Bank Austria Creditanstalt AG	12/06/2005	3 268,41	Austria	Italy
Almanij NV	Kredietbank Luxembourg	23/12/2004	785,40	Luxembourg	Belgium
Banco Santander Central Hipano SA	Abbey National Plc	23 /07/2004	15 787,49	UK	Spain
Societe Generale SA	General Hellenic Bank	01/19/2004	110,15	France	Greece
Banco de Sabadell SA	Banco Atlantico SA	19/12/2003	1 840,57	Spain	Spain
Den Norske Bank	Gjensidige NOR ASA	18/03/2003	3 805,84	Norway	Norway
Den Norske Banken Corporate	Nordlandsbanken A/S	20/12/2002	147,95	Norway	Norway
Credit Agricole	Credit Lyonnais SA	16/12/2002	16 242,82	France	France
Banca Popolare di Bergamo	Banca Popolare Commercio	15/12/2002	1 306,36	Italy	Italy
Deutsche Hypothekenbank	Rheinische Hypothekenbank	30/10/2001	1 831,94	Germany	Germany
Nordea AB	Petrobank(LG Group)	05/07/2002	53,39	Poland	Sweden
Société Générale	Komercni Banka AS	28/06/2001	1 020,00	République Thèque	France
Halifax Group PLC	Bank of Scotland PLC	04/05/2001	14 904,44	UK	UK
Svenska handelsbanken AB	Midtbank A/S	11/04/2001	262,55	Denmark	Sweden
Allianz AG	Dresdner Bank AG	01/04/2001	19 655,94	Germany	Germany
Bayerische Hypo-Vereins	Bank Austria AG	22/07/2000	7317,01	Austria	Germany
MeritaNordbanken	Unidanmark A/S	06/03/2000	4 425,78	Denmark	Finland
HSBC Holdings PLC {HSBC}	Crédit Commercial de France	01/04/2000	11 100,00	France	UK

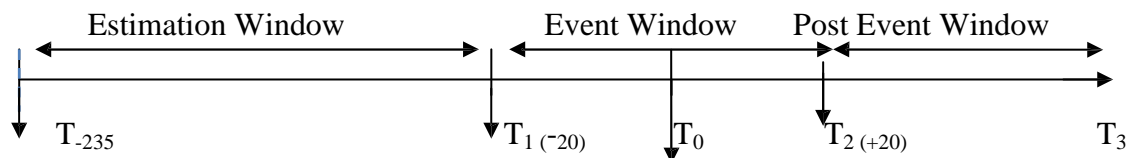
Royal Bank of Scotland Group	National Westminster Bank	29/11/1999	38 412,86	UK	UK
Erste Bank der	Ceska Sporitelna Savings Bank	29/10/1999	527,91	République Thèque	Austria
Banca Intesa SpA	Banca Commerciale Italiana	31/05/1999	12 790,63	Italy	Italy
Svenska Handelsbanken	Bergensbanken ASA	03/05/1999	182,73	Sweden	Norway
BNP	Paribas SA	09/03/1999	12 531,31	France	France
Banco Santander SA	Banco C Hispanoamericano	15/01/1999	11 320,76	Spain	Spain
Storebrand ASA	Finansbanken ASA	06/01/1999	189,37	Norway	Norway
Banco de Santander SA	Banesto	19/02/1998	3 849,77	Spain	Spain
Bayerische Vereinsbank AG	Bayerische Hypotheken	21/07/1997	7 001,15	Germany	Germany

Source: Thomson One Banker, 2010

Once the transactions collected and samples constituted, the event study analysis is set up to assess the market reaction to announcements of M&A. Measuring the impact of an announcement is made through the calculation of abnormal returns around the announcement date. The study of the average abnormal return will be complemented by a study of how cumulative abnormal returns are calculated. The latter examines the impact of announcement on shareholders wealth. The performances were estimated over a period of 255 days to 19 days before the event window.

### 3.2. SPECIFICATION OF THE MODEL

The returns are indexed to a time index  $\tau$  noted.  $\tau = 0$  is the event date,  $t_1 \leq \tau \leq t_2$  designates the beginning and the end of the event window;  $t_0 < t_1$  is the beginning of the estimation window,  $t_1 - 1$  is the end of number of days in the estimation window,  $m_2 = t_2 - t_1 + 1$  is the number of days in the event window while  $m_1 = t_1 - t_0$  is the number of days in the estimation window.



**Figure 1: Different event windows studied**

Once the event and its date of implementation is identified, the chosen event time interval  $X =$

$[t_1 + 1, \dots, t_2]$  is centered on that date. Outside this interval range the rate of return are assumed normal. The assessment of the response as an event is observed through the analysis of returns over the interval  $I$ . The abnormal return (AR) of each bank corresponds to excess returns caused by M&A announcement. It is the difference between the observed and theoretical returns that would have occurred in the absence of the occurrence of M&A. This theoretical efficiency is estimated by time series regression on the estimation period so that the model parameters are not affected by the occurrence of the event  $[-255, -21]$ .

The market model assumes that the expected returns are a linear function of the returns of the market index on the same date. For security  $i$  at time  $t$ , we have:

(3)

$R_{it}$  is the return of the security in period  $t$ ,  $R_{mt}$  is the market return in period  $t$  while  $\varepsilon_{it}$  is the error term.  $R_{mt}$  is independent of the error term  $\varepsilon_{it}$ . The abnormal returns (AR) are obtained as follows. For security  $i$  at time  $t$ , we have:

(4)

$R_{it}$  is profitability as observed at day,  $\alpha$  and  $\beta$  are the parameters of the regression line representing the market model for security  $i$ .  $R_{m\tau}$  is the profitability of the market index Dow Jones Stoxx Bank in day  $\tau$ . Regression parameters were estimated over a period of 255 days and 21 days before the event date. The event period extends from -20 days to 20 days around the announcement date and 0 is the announcement date (the unit time interval chosen for the study is the day to view more accurately the day announcement produces its effects). cumulative abnormal returns are also calculated on the intervals  $[-20,0]$ ,  $[-5,5]$ ,  $[-1,0]$ ,  $[-1,1]$   $[-10,1]$   $[-10,10]$  and  $[-20,20]$ .

The first phase of our work consists in identifying the acquisition date which is the date of official announcement on Datastream. The second phase of our research is to evaluate the theoretical returns on equity prices in our sample. We collected the stock prices of individual

banks (adjusted with dividends), the value of the Dow Jones Stoxx Bank of 255 days prior to the date of announcement.

Profitability of the title ( $R_{it}$ ) and the market index ( $R_{mt}$ ) calculated:

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}} \quad (5) \quad R_{mt} = \frac{P_{mt} - P_{mt-1}}{P_{mt-1}} \quad (6)$$

It allows highlighting the beta ( $\beta_i$ ) or sensitivity of rate of return of stock to the rate of return on the market index.

$\alpha_i = R_{it} - \beta_i R_{mt}$  and  $\beta_i$  is the sensitivity of the rate of return of a stock with respect to fluctuations in the rate of return of the overall market. It is estimated historical way by performing a linear regression of the rate of return on stock  $i$  on those of the market index

$$\beta_i = \frac{\sum_{t=1}^T (R_{it} - \bar{R}_i)(R_{mt} - \bar{R}_m)}{\sum_{t=1}^T (R_{mt} - \bar{R}_m)^2} \quad (7)$$

Where  $R_{mt}$  is the return of the market index (DJ Stoxx Bank) at time  $t$ . The assumptions that we want to test is the nullity of abnormal returns for each day of the event window  $[-20, 20]$  and secondly the average cumulative abnormal return over the period  $[t_1, t_2]$ .

We used three statistical methods: two are parametric and nonparametric tests. To test the significance of the average abnormal returns we used Brown and Warner [1980] and Brown and Warner [1985] who suggest using the variance based on the estimation period:

$$t = \frac{\bar{AR}}{\sqrt{\frac{1}{T} \sum_{t=1}^T AR^2}} \quad (8) \quad t = \frac{\bar{AR}}{\sqrt{\frac{1}{T} \sum_{t=1}^T AR^2}} \quad (9)$$

$$t = \frac{\bar{AR}}{\sqrt{\frac{1}{T} \sum_{t=1}^T AR^2}} \quad (10)$$

$$T\text{-statistic for } \tau \text{ day event window is: } t = \frac{\bar{AR}}{\sqrt{\frac{1}{T} \sum_{t=1}^T AR^2}} \quad (11)$$

The statistical significance of the cumulative abnormal returns is determined as follows:

$$t = \frac{\bar{AR}}{\sqrt{\frac{1}{T} \sum_{t=1}^T AR^2}} \quad (12)$$

Note that in the above test variance is estimated outside event and temporarily variances may undergo modifications. The method that is used to solve the problem is the standardized

abnormal returns by Patell (1976). Standardized abnormal returns are estimated by dividing the abnormal return of each title by the estimator of their standard deviation:

$$B_i = \frac{SAR_{it}}{\sqrt{\hat{\sigma}_{it}^2}} \quad (12)$$

$$\hat{\sigma}_{it}^2 = \frac{1}{N-2} \sum_{k=-265}^{-21} (R_{it} - R_{mk})^2 \quad (13)$$

$\hat{\sigma}_{it}^2$  is the maximum likelihood estimator of the variance. Under the assumption each  $SAR_{it}$  follows a student with  $N-2$  degrees of freedom.  $R_{m\tau}$  is the return of the market index for the event day  $\tau$ ;  $R_{mk}$  is the return of the market index for day  $k$ ;  $\bar{R}_m$  is the return of the market index calculated on the estimation window  $[-265, -21]$ . Under the null hypothesis, the statistic

$$T_P = \frac{\sum_{i=1}^N B_i}{\sqrt{N}} \quad (14)$$

Statistical standardized cumulative abnormal returns are as follows:

$$=L, 2 \quad \frac{\sum_{i=1}^N B_i^2}{N} \quad (15)$$

Finally, to measure the overall impact of the event, the average abnormal returns are accumulated to obtain the cumulative average abnormal returns (CAAR-Cumulate Average Abnormal return).

$$@ \quad \sum_{i=1}^N B_i \quad (16)$$

This last calculation is to monitor the impact of the event studied over time and is especially useful when the uncertainty about the announcement date is relatively large. The average cumulative abnormal returns are also subject to the same tests (parametric and non-parametric tests).

The generalized sign test of Cowan (1992) compares the proportion of abnormal returns around the event date in proportion to the period unaffected by the event. In other words this test examines whether the number of securities with positive abnormal returns over the period

of occurrence is greater than what would be expected in the absence of abnormal performance. The test is formalized as follows:

$$O_p = \frac{Q_{RS}}{!RS \cdot \#S \cdot 2} \quad (17)$$

Where  $w$  is the number of tracks on the event window whose cumulative abnormal return  $TUK_{I_{wVx}}$  is positive,  $p$  is the proportion of positive abnormal returns in the estimation window, it is formalized as follows:

$$S = \frac{1}{N} \sum_{i=1}^N S_{it}; \quad \frac{1}{26} \sum_{t=1}^{26} S_{it} = B \quad (18)$$

With  $S_{it}$  is the abnormal return of security  $i$  at time  $t$  of the estimation period and takes the following values:

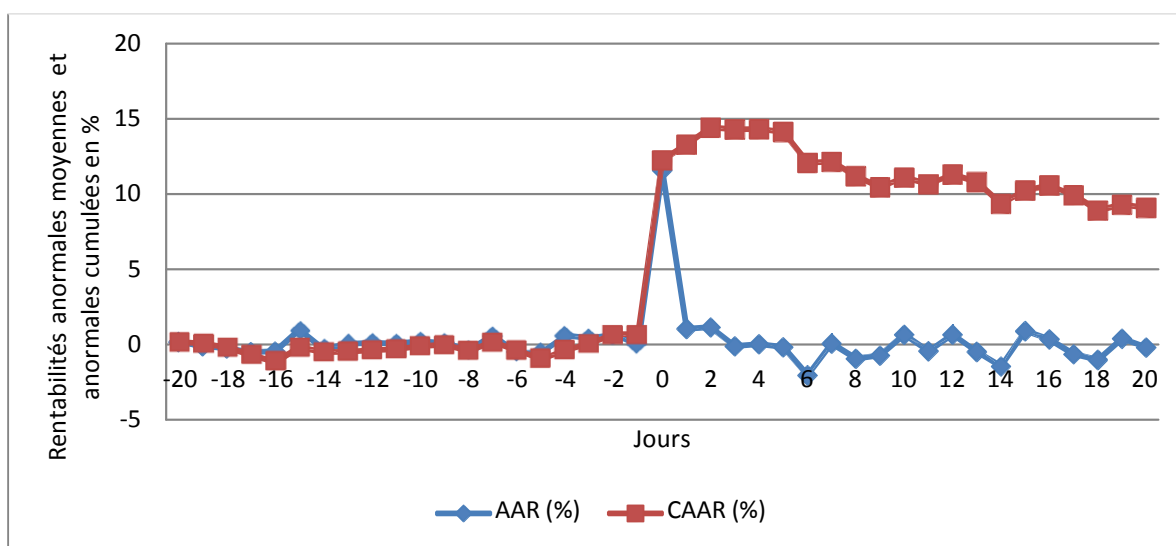
$$B = \frac{1}{N} \sum_{i=1}^N \frac{1}{26} \sum_{t=1}^{26} S_{it} \quad (19)$$

## 4. EMPIRICAL RESULTS

We will present the main results related to the study of events. These results are presented in two forms: graphic trace the evolution of the average abnormal returns (AAR) and cumulative average abnormal returns (CAAR) on event windows and the tables have significances average abnormal returns and abnormal returns cumulative averages, calculated from the parametric tests and nonparametric tests. The average abnormal returns are designed to investigate the impact of the announcement of the merger and acquisition for a given event date day. The evolution of the average cumulative abnormal returns during the event window allows, as it has globally measure the impact of the event on the whole event window. The magnitude of the impact analysis period is 41 days (20 days before and 20 days after the date of announcement) that identifies the expectations and possible corrections in the stock market. In what follows we will measure the performance of target banks (4.1), acquiring (4.2) and the combined entity (4.3) follows announcements of bank mergers and acquisitions

### 4.1. The Case of Target Banks

Visual analysis of Figure 2 and the reading of Table 3 show that the announcements of banking M&A have a positive impact on shareholder wealth of target banks.



**Figure 2-Abnormal returns and cumulative abnormal returns of target banks on the window [-20;20]**

(Insert annex 1) summarizes the results for the target banks in our sample. Regarding the average abnormal returns, the statistics are unanimous: the means accrued over the period of study yields well prove the existence of a positive impact on the profitability of shareholders of the target banks. As the sign test tends to reject the null hypothesis often when abnormal returns are negative (Brown and Warner, 1980), we proceed to the comparison of the sign test in parametric test to better appreciate the significance of the abnormal returns. Statistics TBW, TP and T significant indicates a significant value creation of 11.56% on the day of the announcement of mergers and acquisitions. We find significant value reduction in sixth, eighth, fourteenth and eighteenth day after the announcement. This can be interpreted as a market adjustment of the unknown purchase price.

At the end of the period, i.e.  $J = 20$ , the average accumulated returns (CAAR) amounted to 9.07%. By comparing different event windows :  $[-20,0]$  ,  $[-4,0]$  ,  $[-1,0]$  ,  $[-1,1]$  ,  $[-10,1]$  ,  $[-10,10]$  and  $[-20,20]$  we find that the largest cumulative abnormal return is 13.61% which is recorded on  $[-10,1]$  .



**Table 3-The cumulative abnormal returns of target banks (CAAR %)**

Event Window	CAAR	Stat_ $T_{BW}$	Stat_ $T_p$	Stat_ $T_{Signe}$
[-20,0]	12,237	4,4366***	7,3588***	0,308
[-4,0]	12,693	2,4602**	31,387***	2,828***
[-1,0]	11,077	1,4249	45,377***	2**
[0]	11,812	2,0104**	65,906***	2,319**
[-1,1]	12,086	1,8154*	38,837***	2,449**
[-5,5]	6,8282	1,9448*	21,639***	4,690***
[-10,1]	<b>13,611</b>	<b>2,7091***</b>	<b>22,900***</b>	<b>4,690***</b>
[-10,10]	11,423	1,7240*	13,914***	6,480***
[-20,20]	9,0791	1,6546*	9,5626***	9,486***

AAR: Average abnormal returns; CAAR Cumulative average abnormal return; Stat  $T_{BW}$ : corresponding statistical test of Brown and Warner: it follows 234 degrees of freedom; Stat\_  $T_p$ : corresponding statistical test of Patell: it follows 233 degrees of freedom; Stat\_  $T_{Signe}$ : corresponding statistical test of significance it follows a standard normal distribution and reduced.

The analysis of mean abnormal returns and announcement mergers and acquisitions  $T_0$  effect causes a significant positive stock price reaction. This positive shift of the actual returns compared to the expected returns reflects the creation of value for shareholders of the target bank induced due to M&A announcement. We can deduce that the European banking M&A create value for the shareholders of target banks.

### Comparison with Previous Studies

**Table 4-Cumulative abnormal returns of target banks in comparison with previous studies**

Event Window	CAAR %	Z-test	Test of Significance	DS (2006)	HS (1996)	BSW(2004)
[-20,20]	12,237***	7,358808	0,3086	20,60***		18,16***
[-4,0]	12,693***	31,38772	2,822	15,49***	8,18***	
[-1,0]	11,077***	45,37705	2	13,56***	7,53***	
[0]	11,812***	65,90623	2,31900	12***		
[-1,1]	12,086***	38,8370	2,44948	15,75***	7,30***	15,15***
[-5,5]	6,8282***	21,63950	4,69041	28,89***		
[-10,1]	13,611***	22,9006	4,69041	17,90***	22,22***	
[-10,10]	11,423***	13,9479	6,4807	17,54***		
[-20,20]	9,079***	9,562	9,4863	20,76***		19,68***

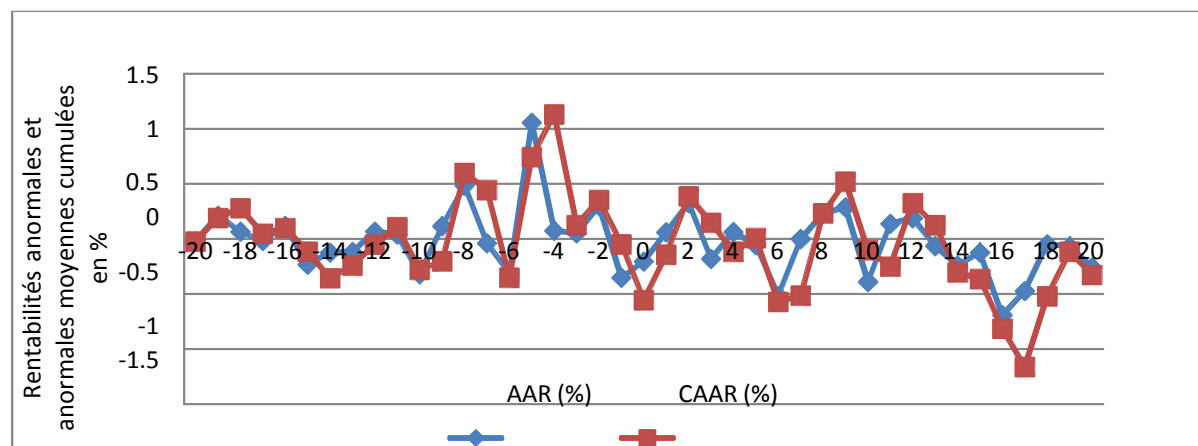
\*, \*\*, \*\*\* Respectively significant at 1%, 5% and 10%

DC (2006) = Dirk Schmautzer (2006), HS= Hudgins and Seifert (1996), BSW=Beitel et al (2004)

## 4.2. The Case of Acquiring Banks

Figure 3, Appendix 2 and Tables 5 show the evolution of abnormal returns and cumulative abnormal returns of acquiring banks. Abnormal returns are close to zero and vary only very little. At the date of official announcement abnormal returns means acquiring banks are not

significant. Despite this lack of significance, various tests show that AAR are positive on the sixth day before the announcement and negative on the sixteenth day before and six days after the official announcement of the merger and acquisition.



**Figure 3- Cumulative abnormal returns of acquiring banks in the window [-20; +20]**

By comparing different windows event we find that the intervals in which the cumulative abnormal return is significantly negative are [-1, 0] and [-1, +1], that is to say, the day before and the day of announcement of the M&A. Note that for 45 acquiring banks the income statement also shows no significant abnormal returns for the window [-20, 20].

**Table 5-Average abnormal returns of acquiring banks accumulated on the window [-20; +20]**

Event Window	CAAR	Stat_T <sub>BW</sub>	Stat_T <sub>P</sub>	Stat_T <sub>Signe</sub>
[-20,0]	0,854	1,94538	1,0961	2,777**
[-4,0]	-0,092	-0,4473	-0,5275	-2,82***
[-1,0]	-0,555	-1,8428*	-1,8628*	-2,44**
[0]	-0,204	-0,6835	-1,2703	-2,68**
[-1,1]	-0,625	-1,8602*	-1,9732**	-1,99**
[-5,5]	1,056	1,7404*	-0,2545	1,279
[-10,1]	0,687	1,19125	1,51473	1,279
[-10,10]	0,228	0,48668	0,9699	0,426
[-20,20]	-0,947	0,4791	-1,5201	0,282

\*, \*\*, \*\*\*Results respectively significant at 10%, 5% and 1%

AAR Average abnormal returns, CAAR Cumulative average abnormal return; Stat\_T<sub>BW</sub> corresponding statistical test of Brown and Warner: it follows 234 degrees of freedom; Stat\_T<sub>P</sub>: corresponding statistical test of Patell: it follows 233 degrees of freedom; Stat\_T<sub>3</sub>: corresponding statistical test of significance: it follows a standard normal distribution and reduced.

Overall, the abnormal returns are not significant with the exception of t-5 (AAR = 1.05%), t-16 (AAR = -0.69%). These results show that M&A have no impact on shareholder wealth of

the acquiring banks. They confirm the null hypothesis of no significant effects on abnormal returns for the window [-20, 20].

Therefore the impact of announcements of M&A appears neutral for acquirers. Note, however, that the reaction is closest to the significance level of 1% for 5 days before the date of the transaction t-5. This is confirmed by both tests Patell and Brown & Warner.

### Comparison with Previous Studies

**Table 6-Average cumulative abnormal returns compared with previous studies  
CAAR found in previous studies (%)**

Fenêtre	CAAR %	DS (2006)	CM (2000)	HS (1996)	BS (2001)	TB	ADS (2002)	BM (2002)	GM (1998)
[-20,20]	0,85	-0,51		-0,45	-0,54				
[-4,0]	-0,09	-0,62		-0,05					
[-1,0]	-0,55*				-0,62	-0,41			-0,29
[0]	-0,20				-0,68	-0,32		0,3	
[-1,1]	-0,62*			0,25		-0,37		-0,90***	-0,32
[-5,5]	1,05 ***					-0,1			
[-10,1]	0,68	-1,04	2			-0,08	- 0,98***		
[-10,10]	0,22	-1							
[-20,20]	-0,94	-0,72							

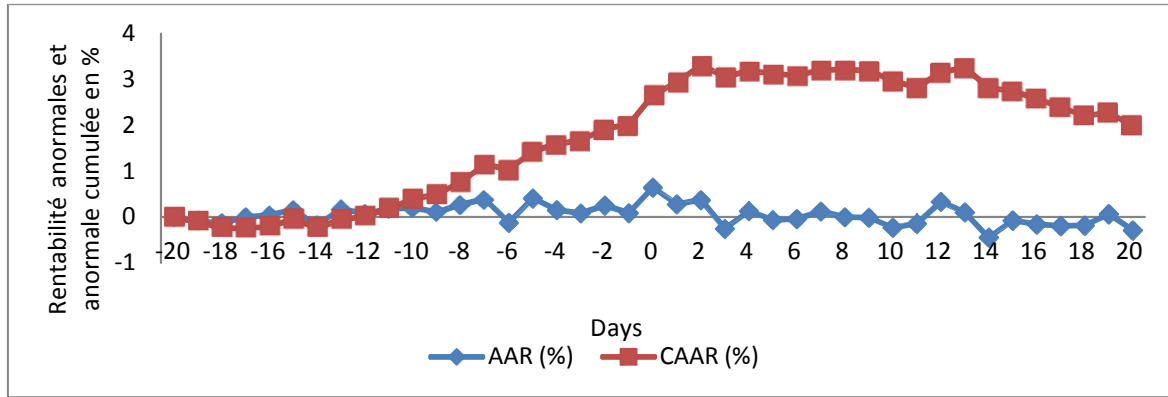
\*, \*\*, \*\*\*\* Respectively significant at 1%, 5% and 10%

DC (2006)= Dirk Schmautzer (2006), ADS= Amihud and al. (2002), BM= Bessler and Murtag (2002), BS (2001)= Beitel and Schiereck (2001), CM= Cybo-Ottone and Murgia (2000), GM= Gleason and Mathur (1998), HS= Hudgins and Seifert (1996), TB= Tourani Rad and Van Beek, VV= Vander Vennet (2002), WM= Waheed et Mathur (1995)

The lack of significance recorded for these parametric tests can then raise the issue of efficiency in European markets. It would seem contrary to the paradigm that these markets adjust slowly to the flow of relevant new information and prices did not include all the information available.

### 4.3. The Case of Combined Entity

The graph in Figure 4 and the following tests show that mergers and acquisitions are well received by the market. We find a significant positive abnormal return of 0.64% on the day of the announcement. The combined entities earn a cumulative abnormal return of 1.98% at t=20, which could mean that bank M&A create value.



**Figure 4: Changes in mean abnormal returns and cumulative abnormal returns average combined banks**

Table 7 shows the development of average and cumulative abnormal returns around the announcement date (20 days before and 20 days after). Regarding the combined banks, we find a significant value creation of 0.64% on the day of the announcement. The combined entities earn a cumulative abnormal return of 1.98% at  $t=20$ , which could mean that bank M&A create value. By comparing different event windows:  $[20,0]$ ,  $[-4,0]$ ,  $[-1,0]$ ,  $[-1,1]$ ,  $[10,1]$ ,  $[-10,10]$  and  $[-20,20]$  we find that the largest cumulative abnormal return is 2.57%, recorded on the window  $[10,1]$ .

**Table 7-Cumulative mean abnormal returns of the acquiring banks in different windows of the study**

Event Window	CAAR	Stat_TBW	Stat_TP	Stat_TSigne
$[-20,0]$	2,658	2,943***	1,796	6,480***
$[-4,0]$	1,300	3,224***	3,902***	3,162***
$[-1,0]$	0,686	1,658	3,254**	2**
$[0]$	0,644	2,878***	1,854*	1,940*
$[-1,1]$	0,904	2,177**	3,501***	2,449***
$[-5,5]$	1,721	2,849***	3,482***	4,690***
$[-10,1]$	2,579	3,267***	5,217***	4,690***
$[-10,10]$	2,292	2,490***	3,355***	6,480***
$[-20,20]$	1,981	1,871*	1,720*	9,486***

\*, \*\*, \*\*\*Results significant at 10%, 5% and 1%

AAR: Average abnormal returns

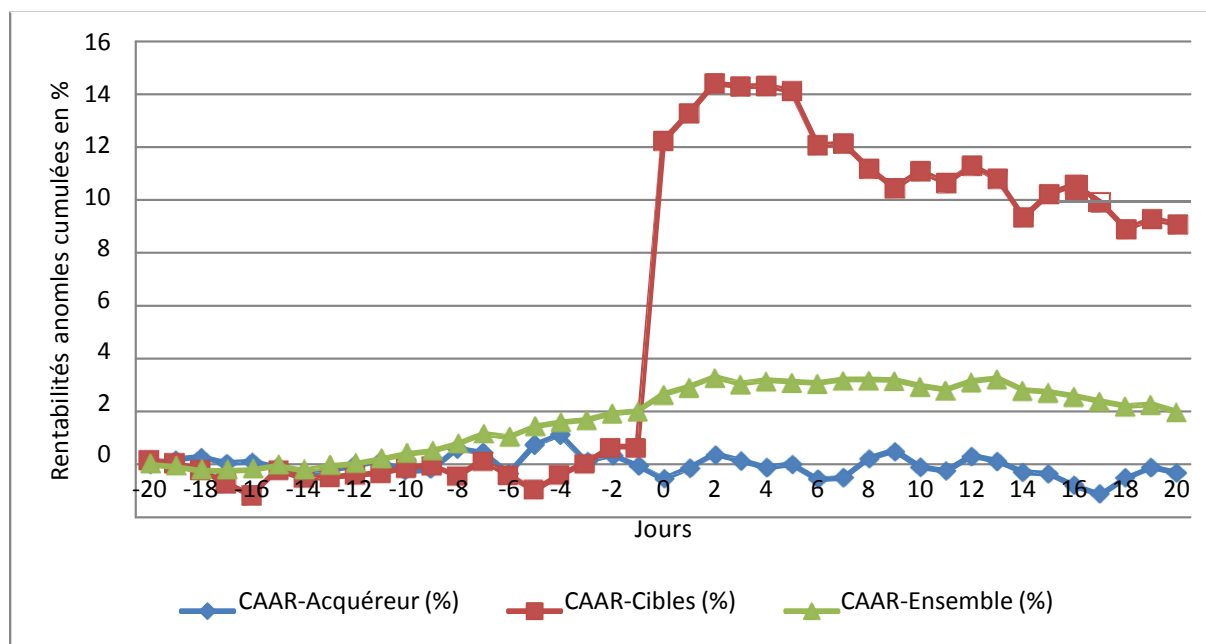
CAAR Cumulative average abnormal return;

Stat\_TBW: corresponding statistical test of Brown and Warner: it follows 234 degrees of freedom

Stat\_TP: corresponding statistical test of Patell: it follows 233 degrees of freedom

Stat\_TSigne: corresponding statistical test of de significance: it follows a standard normal distribution and reduced.

We find that the share price of the target strongly benefits from the transaction. The share price of the acquirer loses an average of the value of the intervals  $[-1, 0]$  and  $[-1, 1]$ , but the whole event window  $[-20, 20]$ , the effect is not significant. The reason is that the financial market will not negatively judge the value of these transactions, but the good part of this transaction purchase price is transferred to the target banks.



**Figure 5 - Impact of mergers and acquisitions on shareholder wealth on the window  $[-20, +20]$  (Target bank, acquirers and combined)**

**Table 8-Summary of results obtained at the end of event studies in the different windows**

Event Window	Target			Acquirer			Combined		
	CAAR	Stat_TBW	Stat_TP	CAAR	Stat_TBW	Stat_TP	CAAR	Stat_TBW	Stat_TP
$[-20,0]$	12,237	4,436***	7,358***	0,854	1,945**	N.S.	2,658	2,943***	1,796*
$[-4,0]$	12,693	2,460**	31,38***	-0,097	N.S.	N.S.	1,300	3,224***	3,90***
$[-1,0]$	11,077	1,424	45,37***	-0,555	-1,842*	-1,862*	0,686	N.S.	3,254**
$[0]$	11,812	2,010**	65,90***	-0,204	N.S.	N.S.	0,644	2,878***	1,854*
$[-1,1]$	12,086	1,815*	38,83***	-0,625	-1,860*	-1,97**	0,904	2,177**	3,50***
$[-5,5]$	6,828	1,944*	21,63***	1,056	1,740*	N.S.	1,721	2,849***	3,48***

[-10,1]	13,611	2,709***	22,90***	0,687	N.S.	N.S.	2,579	3,267***	5,21***
[-10,10]	11,423	1,724*	13,91***	0,228	N.S.	N.S.	2,292	2,490***	3,35***
[-20,20]	9,079	1,654*	9,562***	-0,947	N.S.	N.S.	1,981	1,871*	1,720*

\*, \*\*, \*\*\*results significant at 10%, 5% and 1%

AAR: Average abnormal return

CAAR Cumulative average abnormal return;

Stat\_TBW: corresponding statistical test of Brown et Warner: it follows a 234 degrees of freedom Stat\_TP: corresponding statistical test of

Patell: it follows a 233 degrees of freedom

Stat\_TSigne: corresponding statistical test of significance: it follows a standard normal distribution and reduced.

## CONCLUSION

After studying the performance of target, acquiring and combined banks, we find that M&A create value but the entire value created by the purchaser's bid is received by the shareholders of the target banks. These appear to be the big winners of the M&A transaction with a cumulative average abnormal return of 9.07% at the end of our study period. Shareholders of the acquiring banks, meanwhile, are not harmed by the operations of M&A initiated by their leaders, with a non-significant cumulative average abnormal return of -0.94%. Finally with a cumulative abnormal return of 1.98% over 20 days around the announcement date we can conclude that mergers and acquisitions create value for shareholders.

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**Annexure 1-Target banks average abnormal returns and cumulative average abnormal returns of banks with different statistical tests**

Days	AAR (%)	Stat_ T <sub>BW</sub>	Stat_ T <sub>P</sub>	Stat_ T <sub>signe</sub>	CAAR (%)	Stat_ T <sub>P</sub>	Stat_ T <sub>BW</sub>
-20	0,16707	0,334139	-0,106247	-1,279204	0,16707	0,033324	-0,002415
-19	-0,111356	-0,222711	-0,771046	-2,182179**	0,055714	0,008815	-0,028205
-18	-0,259812	-0,519624	-0,674239	-1,745743*	-0,204098	-0,033231	-0,061091
-17	-0,506731	-1,013461	-1,449256	-3,491486***	-0,710829	-0,118053	-0,136435
-16	-0,457859	-0,915717	-1,692865*	-2,182179**	-1,168688	-0,184602	-0,238592
-15	0,96485	1,929699*	3,14936***	0,220863	-0,203838	-0,036505	-0,085993
-14	-0,317616	-0,63523	-1,316252	-3,234983***	-0,521454	-0,077395	-0,172051
-13	0,032721	0,065442	0,513065	-0,426401	-0,488733	-0,0628	-0,150941
-12	0,092152	0,184304	-0,049101	-2,910428***	-0,396581	-0,049529	-0,163445
-11	0,063918	0,127835	0,797528	-1,897367*	-0,332663	-0,041553	-0,114953
-10	0,215438	0,430875	2,632818***	-0,872872	-0,117225	-0,008031	0,077943
-9	0,080983	0,161965	0,252415	-1,668115*	-0,036242	-0,000172	0,101287
-8	-0,399594	-0,79918	-0,683868	-1,279204	-0,435836	-0,056602	0,049369
-7	0,581049	1,162098	2,593536***	0,210819	0,145213	0,05402	0,271838
-6	-0,555586	-1,111172	-1,412622	-2,740641***	-0,410374	-0,047239	0,157004
-5	-0,566565	-1,13313	-1,047239	-0,632456	-0,976939	-0,158605	0,066925
-4	0,596033	1,192066	2,13834**	-1,104315	-0,380906	-0,053132	0,269414
-3	0,428963	0,857926	1,198853	-0,632456	0,048057	0,006192	0,392852
-2	0,624773	1,249545	3,331253***	1,705606*	0,67283	0,132394	0,733716
-1	-0,002538	-0,005076	1,31976	-0,210819	0,670292	0,147473	0,886951
<b>0</b>	<b>11,56756</b>	<b>23,1351***</b>	<b>65,90623***</b>	<b>2,319004***</b>	<b>12,23785</b>	<b>2,126806**</b>	<b>7,774726***</b>
1	1,040493	2,080986**	3,248603***	0,426401	13,27835	2,308631*	8,304077***
2	1,134797	2,26959**	3,045838***	2,803652***	14,41314	2,512381***	8,82278***
3	-0,119074	-0,238147	-0,09462	-0,436436	14,29407	2,434985***	9,002001***
4	0,015779	0,031558	1,142165	-1,309307	14,30985	2,414803***	9,317454***
5	-0,183501	-0,367002	-1,197475	-0,970143	14,12635	2,343746***	9,363168***
6	-2,051915	-4,103829***	-6,164037***	-4,196398***	12,07443	2,004431**	8,813404***
7	0,059127	0,1182541	-0,012906	-0,662589	12,13356	2,011595**	8,973579***
8	-0,949928	-1,899856*	-2,832124***	-1,745743*	11,18363	1,83523*	8,785702***
9	-0,739319	-1,4786375	-2,19817**	-2,319004***	10,44431	1,69164*	8,662192***
10	0,646899	1,2937989	0,970183	-2,803652***	11,09121	1,775796*	8,928177***
11	-0,443741	-0,8874821	-1,721859*	-0,426401	10,64747	1,708399*	8,849609***
12	0,649442	1,2988847	1,569179	-0,426401	11,29691	1,828659*	9,191743***
13	-0,491723	-0,9834466	-1,054323	-2,618615***	10,80519	1,76419*	9,190215***
14	-1,461334	-2,922667***	-3,518412***	-2,182179*	9,343857	1,508991	8,85119**
15	0,884901	1,76980136*	1,471166	-0,852803	10,22876	1,657446*	9,177411***
16	0,342783	0,6855651	0,776894	-2,618615***	10,57154	1,709055*	9,411431***
17	-0,653329	-1,306657	-1,089677	-1,509659	9,918212	1,5962	9,385062***
18	-1,021895	-2,0437903**	-2,244194**	-3,234983***	8,896317	1,409413	9,189143***
19	0,386036	0,7720721	1,785607*	0,426401	9,282353	1,481285	9,562936***
20	-0,203168	-0,40633559	-0,818031	-1,279204	9,079185	1,442989	9,562659***

\*, \*\*, \*\*\*Results significant at 10%, 5% and 1%

AAR: Average abnormal returns, CAAR Cumulative average abnormal return;  
Stat\_ T<sub>BW</sub> Corresponding statistical test of Brown and Warner: it follows 234 degrees of freedom, Stat\_ T<sub>P</sub> corresponding statistical test of de Patell: it follows 233 degrees of freedom, Stat\_ T<sub>Signe</sub>: corresponding statistical test of significance: it follows standard normal distribution and reduced.

**Annexure 2-Acquiring banks average abnormal returns and cumulative average abnormal returns on bank window [-20;+20]**

Jours	AAR (%)	Stat_TBW	Stat_TP	Stat_Tsigne	CAAR (%)	Stat_TP	Stat_TBW
-20	-0,022945	-0,076787	0,39918	-1,546041	-0,022945	-0,038011	0,39918
-19	0,214277	0,717089	0,533695	0,426401	0,191332	0,306938	0,659642
-18	0,066521	0,222617	-0,67236	1,546041	0,257853	0,413653	0,150408
-17	-0,017448	-0,058391	0,680223	-0,970143	0,240405	0,385662	0,470369
-16	0,117928	0,394651	0,522139	1,67332	0,358333	0,574844	0,654218
-15	-0,232333	-0,777515	-1,370986	0,942809	0,125999	0,20213	0,037514
-14	-0,122751	-0,410792	-1,531865	-1,309307	0,003249	0,005211	-0,544259
-13	-0,11814	-0,395362	0,138072	1,032796	-0,114892	-0,184311	-0,460292
-12	0,068345	0,228721	1,490873	0,762001	-0,046546	-0,07467	0,06299
-11	0,040223	0,134608	0,423281	0,942809	-0,006323	-0,010144	0,193611
-10	-0,319411	-1,068926	-0,12921	-2,357023***	-0,325735	-0,522549	0,145642
-9	0,116512	0,389913	1,10461	0,917663	-0,209223	-0,335639	0,458315
-8	0,483986	1,619684	2,191362**	1,414214	0,274764	0,440781	1,048109
-7	-0,038875	-0,130097	-0,209019	2,752989***	0,235889	0,378417	0,954121
-6	-0,312446	-1,045617	-1,377896	-2,236068**	-0,076557	-0,122815	0,565997
-5	1,056551	3,535799***	4,148912***	2,618615***	0,979993	1,572122	1,585252
-4	0,075121	0,251395	-0,935553	1,745743*	1,055114	1,692632*	1,311016
-3	0,051642	0,172824	0,278445	-0,679366	1,106756	1,775478*	1,339708
-2	0,302662	1,012874	0,304243	0,894427	1,409419	2,261014**	1,373774
-1	-0,350756	-1,173823	0,30528	0,942809	1,058662	1,698325*	1,407252
0	-0,204248	-0,683527	-1,270332	-2,683282***	0,854414	1,370666	1,096128
1	0,061749	0,206648	1,781771*	-0,917663	0,916164	1,469726	1,450802
2	0,326946	1,094142	1,473473	-0,697486	1,24311	1,994219**	1,726152*
3	-0,179841	-0,601847	-0,481977	-0,220863	1,063269	1,705714*	1,591425
4	0,063638	0,212969	-0,99567	0,447214	1,126907	1,807804*	1,360138
5	-0,054826	-0,183478	0,666597	0,662589	1,072081	1,719852*	1,464455
6	-0,515225	-1,724225*	-1,363392	-1,341641	0,556856	0,8939	1,195*
7	0,000766	0,002565	1,659085	0,426401	0,557623	0,894548	1,467065
8	0,232413	0,777782	1,25446	-0,646997	0,790036	1,26739	1,674496
9	0,287854	0,963316	-0,093252	1,132277	1,07789	1,729169*	1,629326
10	-0,389325	-1,302894	-1,550786	-2,87122	0,688	1,104608	1,324302
11	0,138751	0,464338	0,185646	1,835326*	0,827316	1,327195	1,336263
12	0,188442	0,630629	1,996213	0,917663	1,015758	1,629497	1,663357*
13	-0,063472	-0,212412	1,049714	0,226455	0,952286	1,527674	1,818738*
14	-0,239782	-0,802442	-2,094676**	-3,21182***	0,712504	1,143011	1,438503
15	-0,1233	-0,412631	-0,880879	-0,458831	0,589204	0,945211	1,27157
16	-0,690889	-2,312092**	-2,185063**	-0,5547	-0,101685	-0,163125	0,895046
17	-0,471948	-1,579398	-1,030252	-2,87122***	-0,573633	-0,920232	0,716062
18	-0,047524	-0,159041	0,652476	-1,376494	-0,621157	-0,996471	0,811302
19	-0,068084	-0,227846	-0,060656	0,471405	-0,689241	-1,105692	0,791506
20	-0,258382	-0,864688	-1,937645*	-3,299832***	-0,947623	-1,520193	0,479184

\*, \*\*, \*\*\* results significant at 10%, 5% and 10%



**Annexure 3-Combined entity average abnormal returns and abnormal cumulative averages on the window [-20, 20]**

Days	AAR (%)	t-Stat	CAAR (%)	t-Stat2
-20	-0,012939	-0,05887665	-0,01293	-0,00985446
-19	-0,084982	-0,3866957	-0,09792	-0,07462869
-18	-0,141477	-0,6437663	-0,23939	-0,18244856
-17	-0,00996	-0,04532124	-0,24935	-0,19003947
-16	0,039791	0,18106197	-0,20956	-0,15971394
-15	0,155608	0,70806694	-0,05395	-0,04111742
-14	-0,183703	-0,83590832	-0,23766	-0,18113006
-13	0,174035	0,79191578	-0,06362	-0,04848731
-12	0,075717	0,34453694	0,01208	0,00920664
-11	0,172205	0,78358868	0,18429	0,14045468
-10	0,203172	0,92449859	0,38746	0,29529855
-9	0,107317	0,48832721	0,49478	0,37709135
-8	0,267976	1,21937784	0,76276	0,58132948
-7	0,388078	1,76588095	1,15083	0,87709293
-6	-0,1222	-0,55604969	1,02863	0,78395949
-5	0,407807	1,85565431	1,43644	1,09476758
-4	0,153258	0,69737368	1,58969	1,21156544
-3	0,082807	0,37679875	1,6725	1,27467821
-2	0,253708	1,15445381	1,92621	1,46804061
-1	0,088343	0,40198934	2,01455	1,53536801
0	0,644239	2,9314967***	2,65879	2,02636872**
1	0,279205	1,27047344	2,938	2,23916567**
2	0,372635	1,69561028*	3,31063	2,52316169**
3	-0,254524	-1,15816687	3,05611	2,32918196**
4	0,130385	0,5932941	3,18649	2,4285497**
5	-0,062827	-0,28588326	3,12367	2,3806721**
6	-0,040704	-0,18521642	3,08296	2,3496454**
7	0,124742	0,56761662	3,20771	2,4447223**
8	-0,000619	-0,00281665	3,20709	2,44424977**
9	-0,013922	-0,06334962	3,19316	2,43363317**
10	-0,2278	-1,03656399	2,96536	2,26001781**
11	-0,143399	-0,65251203	2,82196	2,15072701**
12	0,332728	1,51402047	3,15469	2,40431367**
13	0,104692	0,4763826	3,25938	2,48410204**
14	-0,444779	-2,02388892**	2,8146	2,14511766**
15	-0,074825	-0,34047805	2,73978	2,08809439**
16	-0,156983	-0,71432364	2,58279	1,96844612*
17	-0,192796	-0,87728442	2,39	1,82151326*
18	-0,18426	-0,83844285	2,20573	1,68107382
19	0,065037	0,29593947	2,27077	1,73064337*
20	-0,28884	-1,31431582	1,98192	1,5104994

\*, \*\*, \*\*\* results significant at 10%, 5% and 1%

AAR: Average abnormal returns; CAAR Cumulative average abnormal return; Stat\_TBW corresponding statistical test of Brown and Warner: it follows 234 degrees of freedom; Stat\_TP corresponding statistical test of Patell: it follows 233 degrees of freedom; Stat\_TSigne: corresponding statistical test of significance: it follows a standard normal distribution and reduced.