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The Economic Effect of Privacy Breach Announcements on Stocks: A Comprehensive Empirical Investigation

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ABSTRACT

The 2009 CSI Computer Crime and Security Survey indicate that the financial fraud costs about $450,000 per victim organization. A comprehensive empirical investigation was conducted on the effect of publicly announced privacy breaches on the market value of breached companies. We use the abnormal returns, risk factors, and volumes to measure the market effect on the breached firms. Our results show that the cumulative abnormal return (CAR) due to a privacy breach is -1.5 percent at the .05 level. Our results also show that the mean risk factor for the breached firms increases by about 4 percent on the event day compare to the 250 pre-event days Finally, our results show that the volume of the event stocks are higher during the event days relative to the pre-event 60 days. None of the research studies in the information privacy breach area has investigated the abnormal risk and abnormal volume patterns around the privacy breach announcements.

Keywords: Privacy breaches, event studies, abnormal returns, abnormal risks, and abnormal volumes.

INTRODUCTION

Information privacy and security breaches have been a consistent problem for organizations worldwide. Miyazaki and Fernandez (2001) had asserted that organizations whether government or industry all stated that their major obstacles in relation to e-commerce were privacy and security. According to the 2009 Verizon Data Breach Investigations Report (Verizon Business, 2009), 60% of the businesses in their sample confirmed that they had suffered from information breaches. These breaches encompassed an astounding 285 million compromised records. Roughly, 20 percent of organizations in the sample suffered from more than one breach. Seventy four percent of the breaches came from external sources. Information privacy and security breaches cost millions of dollars to businesses every year. According to the 2009 CSI Computer Crime and Security Survey, financial fraud cost about $450,000 per victim organization (Richardson, 2009). As more and more tools become available to help automate and accelerate the attack process, this amount is very likely to rise in the future. An FTC report (2000) indicated that 67 percent of consumers are concerned about the privacy of their information provided on the Internet.

In the present research, we focus on the impact of privacy breaches on a company's market value. We define information privacy breaches as, following the guidelines suggested by Straub (1990) and Ettredge and Richardson (2001), those infringements that occur in the form of unauthorized access and use of computer services, purposeful interruption of computer services, theft or modification of computer codes, and destruction of data by computer viruses. Several studies in the past have investigated the impact of privacy breaches on a company's market value. Prior research in the area has, however, provided conflicting results. Acquisti, Friedman, and Telang (2006), for example, find a negative and significant effect of privacy violations on a company's stock performance. Campbell, Gordon, Loeb, and Zhou (2003) and Hovav and D'Arcy (2003), on the other hand, find no significant effect of privacy breaches on a company's financial position in the stock market (Campbell et al, 2003).

The economic effect of corporate privacy violations, as such, remains an area worthy of further empirical research. Our study investigates the stock market reaction to newspaper reports of information privacy breaches on firms listed on one of the two US stock exchanges, NASDAQ and NYSE, between the years 2000 and 2010. In the process we expect the

present research to clarify the confusion that exist in the present literature with regard to whether a privacy breach negatively affect stock prices of a breached company.

Literature Review

Lau, Rubin, Smith, and Trajkovic (2000) lead a number of studies on privacy breaches by examining denial-of-service attacks. The research, even though not an event study, is worth mentioning here since the authors introduce the Denial-of-Service (DOS) assaults which are the most common form of privacy breach attacks. The objective of these attacks is to overwhelm a system with bogus requests so that legitimate users cannot get access to the system. The authors provide characteristics of and methods for DOS attacks. They conclude by suggesting queuing algorithms as a possible remedy to DOS attacks.

Hovav and D'Arcy (2003) extended the work done by Lau, Rubin, Smith, and Trajkovic (2000) by conducting one of the first event studies in the privacy area. The authors, using five separate event periods, investigated the financial impact of 23 DOS attack announcements on the market value of attacked companies. Only announcements involving companies publicly traded on one of the two US stock exchanges were included. They found no significant negative overall financial impact of DOS attacks on companies. They, however, noted that the Internet-specific companies suffered larger negative abnormal returns than brick and mortar companies.

Campbell et al (2003) conducted a similar event study and found a mixed evidence of the impact of privacy and security breaches on stock prices of the effected firms listed on one of the US stock exchanges. Using a sample of 43 privacy and security violation events and a three-day event window, the authors find that the breached companies suffered no significant negative abnormal returns.

Acquisti et al. (2006) also conducted an event study on privacy breaches similar to Hovav and D'Arcy (2003) and Campbell et al (2003). The authors used in their study a sample of 79 privacy breach events on companies listed on one of the US stock exchanges and a one-day event window. Acquisti, et al. (2006) found a negative and statistically significant impact of privacy breaches on the market value of the breached companies. On the event day and the day after, the mean abnormal return produces a negative return and reaches cumulatively abnormal returns close to 6%.

In the international arena, Ishiguro, Tanaka, Matsuura, and Murase (2006) investigated the impact of privacy breaches on stocks of companies listed on the Tokyo stock exchange. Using a sample of 70 privacy breach incidents and seven-day event window, the authors found no significant impact of privacy breaches on the market value of companies listed in the Japanese market. The authors noted that the slow reaction to privacy violations is common in the Japanese market.

Studies on the effect of privacy violations, to summarize, provided conflicting results. With the exception of Acquisti et al. (2006), most studies found no significant impact of privacy violations on the market value of breached companies. A possible reason for confounding results in the previous studies is that the security and privacy breaches were not clearly defined and separated. In order to investigate the competing arguments concerning economic impact of information privacy breaches, we believe security and privacy breaches must be clearly identified and separated before one could conduct a meaningful research in the area.

In order for a research study to be more comprehensive and useful, we believe one must also examine the risk factor (beta) for individual stocks. Patton and Verardo (2009) find that stock's beta significantly increases during both positive and negative news surprises. Bell and Kothari (1991) document an average increase in beta of .067 around earning announcements. Ohlson and Penman (1985) also find that the stock risk for a company increases by about 30 percent prior to and subsequent to the split of its stock.

In order to demonstrate rather unambiguously the effect of privacy breaches on stock returns, we believe one must also examine the abnormal volume effect. Yun and Kim (2010) investigated the effect of inclusion or declusion of a Korean stock in the KOSPI 200 index on abnormal return, volume, and risk of the stock.

The objective of the present research is to conduct a detailed comprehensive event study on the effect of privacy breaches on stocks listed on one of the US stock exchanges. The research is important for several reasons: first, it represents the first attempt in providing a comprehensive analysis of the effect of privacy breach effects on market value of stocks by including the volume and risk analyses. Second, in order to alleviate some of the problems suffered by previous studies in

the area, we have clearly and explicitly defined privacy breaches as attacks inflicted by DOS, the computer viruses, and customer list and website alterations. Most of the prior research studies in the area, as stated earlier, are confounded.

HYPOTHESES

Hovav and D'Arcy (2003) and Cambell, Gordon, Loeb, and Zohou (2003) found mixed results on the effect of privacy breaches on firms listed on the US stock market. Ishiguro, Tanaka, Matsuura, and Murase (2006) did not find significant negative impact of privacy breaches on stocks of companies listed on the Japanese stock market. We argue that that a seven-day event window used by the authors is too long. Acquisti, et al. (2006) found a statistically significant negative impact of privacy breaches on the market value of companies listed on the US stock market on the event day and the day after. We argue that negative abnormal returns will be felt as early as the day before the announcements because some information is very likely to be leaked the day before the breach announcements are madeThe efficient market theory states that the stock market's effectiveness is based on known information. Based on the aforementioned discussion and theory, we propose the following hypothesis:

H1: Publicly announced privacy breach incidents suffered by a company listed on one of the US stock exchanges will result in a loss in its market value.

A number of research studies in the information privacy and security area have investigated the economic consequences suffered by a company (Acquisti et al., 2006; Campbell et al., 2003; and Hovav & D'Arcy, 2003) but few reviewed the risk, which is as significantly important because it reflects in many ways the company can experience a loss. Verardo and Patton (2009) stated that the systematic risk, as defined by the beta of individual stocks, significantly increases on a day firm-specific announcements are made. Ball and Kothari (1991) analyzed the behavior of betas around earning announcements and found these to be related to the betas. Yun and Kim (2010) investigated the effect of stock index constitution changes on the market value of affected stocks in terms of risk and found this to be related to the index change announcements.

Historical financial studies have demonstrated that the market earnings and risk are related (Basu, 1977). Ball (1978) points out that the market earnings and risks are products of market inefficiency. Hence, the risks associated with the market can result from the existence of market efficiency. These lead to the following hypothesis:

H2: Publicly announced privacy breach incidents suffered by a company listed on one of the US stock exchanges will experience an increase in risk as measured by its beta.

Kuhn et al (2001) argue that a firm's volume reflects the investors' belief about whether the firm's stock is value relevant. Kuhn et al (2001) state firm-specific positive announcements can give a rise to trading volume of the firm. Yun and Kim (2010) investigated the index change effect on a company added to the KOSPI 200 index in terms of trading volume and found it to be higher for the stock during the event period and remained higher relative to the pre-event days. These lead to the following hypothesis:

H3: Publicly announced privacy breach incidents suffered by a company listed on one of the US stock exchanges will experience a negative change in volume.

RESEARCH METHOD

As stated earlier, we defined a privacy breach as a denial-of-service attack, web site outage, unauthorized data access and usage, and web site defacement. We then identified specific actions that met this definition. Our search done on Lexis Nexis was a full text electronic search of periodicals using the aforementioned criteria. The companies selected in the sample announced their privacy breaches in USA Today, The International Herald Times, Computer Weekly, and The Washington Post. These periodicals were chosen because of their popularity and international presence. Subsequent articles were sought to assure that these announcements were also mentioned in international publications such as the Borsen Zeitung, Australian, China Post, New Zealand Herald, and The Guardian (London). In order to assure recency of the privacy breach announcements, firms that suffered privacy breaches between 2000 and 2010 were selected.

This search resulted in the selection of 30 companies based on their public announcements (please see Appendix A). The US ticker symbol, perm number, and event date of these companies are listed in Appendix B. Thirty companies are

obviously a small representative sample of the actual number of breaches occurred in the US. Small sample size is also at least partially caused by the fact that privacy breach announcements are voluntary, and as such, many organizations choose not to disclose these breaches perhaps to avoid financial consequences (Prabhala, 1997).

The event-study methodology, as stated earlier, is used in this research to calculate the abnormal returns. It is based on the strongest version of the efficient market hypotheses (Fama et al. 1969). The idea is that the information related to a stock (in our case, the privacy breach announcements) is common knowledge. The efficient market theory assumes that the price of a stock reflects the information about the firm as understood by the investors. The magnitude of the daily change in the price of a stock should reflect perceived impact of an event (e.g., a privacy breach event), in the absence of confounding news. The strength of the event method lies in its ability to identify such abnormal changes based the overall assessment of the market. The period of interest ("-1, 0, +1") for which we observe the event is known as the event window. We used the day before the breach to capture the impact from any data leaks about the event that may have occurred earlier. We have also used the day after the breach to capture the impact that may still be lingering around. In order to justify that the results were atypical we utilized the concept of abnormal returns. An abnormal return of a stock is the difference between the expected return and the actual return of the stock. We used the market model to generate the abnormal return for the stocks.

The Market Model

The Market Model first estimates what the firms' stock return would have been if there were no announcements. The market model is based on the capital asset pricing model (CAPM). CAPM is often used to estimate the returns on a company's stock (Dos Santos et al, 1993).

$$AR_{it} = R_{it} - [\alpha_i + \beta_i R_{mt} + \varepsilon_i t]$$

R_{it} Rate of return for firm *i*
R_{mt} Rate of return on the market portfolio
α_i Market model intercept parameter for firm *i*
β_i Market model slope parameter for firm *i*
ε_{it} Noise term

The coefficients to compute expected returns during the event study were estimated under the assumption that those markets are efficient with respect to the publicly announced privacy breaches. We used the market model with 250 trading days prior to the event as the estimation period and [-1, 0, +1] as the event window. The abnormal return observations must be aggregated in order to draw overall inferences for the event of interest. We computed CAR by summing up abnormal returns in the event window for -1, 0, and +1 days of the event. In general, CAR is calculated using the following formula:

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it}$$

where: [t1, t2] = the event period.

PRELIMINARY FINDINGS

The results for H1 is presented in Table 1. The mean CAR is negative 1.5 percent and is statistically significant at the .05 level. We are, therefore, able to accept H1. On the average, 76 percent of the announcements resulted in CAR (please see Appendix C).

Table 1: The Means Test for Cumulative Abnormal Returns

N	Mean	t-Value	Pr > |t|
29	-0.0148436	-2.09	0.0459

The behavior of betas (risk factors) around the breach announcements was analyzed next. We used the univariate CAPM model, as explained by Yun and Kim (2010), to calculate pre-event beta by using the 250 trading days prior to the event and post-event beta by using the 250 trading days following the event. The means test results for the prior- and post-

event betas are shown in Table 2. The results show that the beta of firms with security breaches has significantly increased after the breach event announcements. Overall, the risk factor for breached firms has increased by about 4 percent after the event (see Table 2).

Table 2: The Means Test for Beta

N	Mean	t Value	Pr > |t|
29	1.1812786	10.56	<.0001 (Pre-event Day)
29	1.2156673	10.55	<.0001 (Event Day)

We have also used the same univariate CAPM model and the same aforementioned procedure to calculate pre-event and post-event betas for each breached company (please see Appendix D and E). An interesting finding for the breached firms is that about 50% of the companies had experienced an increased risk during the 250 post-event trading days.

We next analyze the trading volume volatility encountered by the breached companies. We have tried to follow the Yun and Kim (2010) method to calculate the abnormal volume for each breached company but since the CRSP does not provide us with the market volume data, we used an alternative volume measure supported by the literature (Yadav 1992). Using this method, we have calculated the volume for the pre-event 60 trading days and the volume for the event window [-1, 0, +1] for each company. Using this measure, we see that the mean volume for companies included in the sample during the event days has increased significantly relative to the mean volume during the pre-event 60 days. This indicates there is an increase in volatility during the event window period compared to pre-event period. (please see Table 3).

Table 3: Volume Means Test Results

Period	N	Obs	Mean	t Value	Pr > |t|
3 (event window)	29	29	8.9346643	5.73	<0.0001
60 (before event)	29	29	8.6821922	5.85	<0.0001

DISCUSSIONS

The results of the present research show that publicly announced privacy breach incidents cause companies to loose market value. Our research findings support the findings of Acquisti, et al. (2006) when they also find a negative and statistically significant impact of privacy breaches on the market value of the breached companies. Our research does not support the privacy breach findings of Hovav and D'Arcy (2003), Campbell et al (2003), and Ishiguro, Tanaka, Matsuura, and Murase (2006).

None of the research studies in the information privacy and security area, to the best of knowledge, has investigated the risk suffered by a company's stock from privacy breaches we are, therefore, unable to compare our results to any research in the information systems area. Our results do, however, agree with Verardo and Patton (2009) when they stated that the systematic risk, as defined by beta of individual stocks, significantly increases on days of firm-specific announcements such as earning announcements (Ball and Kothari, 1991) and changes in stock index constitution announcements (Yun and Kim, 2010).

None of the research studies in the information privacy and security breach area, to the best of knowledge, has investigated the abnormal volume patterns around privacy breach announcements made by a company. We are, therefore, unable to compare our results to any research in this area Our research do, however, agree with Kuhn et al (2001) when they state that a company's stock trading volumes reflect the investors belief about whether the company's stock is value relevant. Our research also agree with Yun and Kim (2010) when they state that a company's stock is higher when it is included in the KOSPI 200 Index.

CONCLUSION

The present seminal research contributes to the privacy breach area in a number of ways: first, it clearly distinguishes between the security and privacy breaches. Second, our research has investigated the risk factor encountered by stocks of a company that suffered from information privacy breaches. Third, the present research has also investigated the effect of privacy breach announcements made by a company on the company's stock trading volumes during the event-period relative to the pre-event 60 days. We hope, by completing the aforementioned, we are able to move in the research in the information privacy breach area forward.

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Appendix A. List of firms that are listed in the top stock market exchange markets

	Company	New York Stock Exchange	Tokyo Stock Exchange	Nasdaq	London Stock Exchange	Euronext	Toronto Stock Exchange	Frankfurt Stock Exchange	Madrid Stock Exchange	Hong Kong Stock Exchange	SWX Swiss Exchange
1	Amazon			x				x			
2	Bayer	x			x			x			
3	Barnes and Noble	x						x			
4	Boeing	x			x			x			x
5	Caterpillar Inc.	x			x	x					
6	Cisco Systems			x		x		x		x	
7	Citigroup	x									
8	Coca cola		X					x			
9	Deutsche telekom					x		x			
10	Dow Chemical	x									
11	General Electric	x			x	x		x			
12	General Motors										
13	Gannett	x						x			
14	Goodyear Tire and Rubber Company	x				x		x			
15	Google			x				x			
16	Hewlett Packard	x									
17	Hsbc	x			x	x	x				
18	Nextel							x			
19	McDonalds	x						x			
20	Mc Graw	x						x			
21	Microsoft			x		x		x		x	
22	New York Times	x						x			
23	News Corporation	x		x							
24	Nike	x				x		x			
25	Oracle							x			
26	Sky West			x	x			x			
27	Union Pacific Co.	x						x			
28	Reebok	x						x			
29	Wal-mart			x		x		x			
30	Yahoo			x		x		x			

Appendix B: US TICKER, PERMNO, AND DATE OF PRIVACY BREACH ANNOUNCEMENTS

	Company	US Ticker	PermNo	Event Date
1	Amazon	AMZN	84788	2/8/2000
2	Bayer	BAYR	17209	8/18/2006
3	Barnes andNoble	BKS	79967	3/5/2001
4	Boeing	BA	19561	11/8/2005
5	Caterpillar Inc.	CAT	18542	9/18/2008
6	Cisco Systems	CSCO	76076	3/8/2000
7	Citigroup	C	70519	6/8/2005
8	Coca cola	COKE	11995	7/16/2008
9	Dell	DELL	11081	2/9/2000
10	Deutsche telekom	DT	84165	7/23/2009
11	General Electric	GE	12060	10/2/2006
12	Gannett	GCI	47941	7/12/2002
13	Goodyear Tire and Rubber Company	GT	16432	10/7/2002
14	Google	GOOG	90319	3/25/2009
15	Hewlett Packard	HPQ	27828	9/14/2006
16	Hsbc	HBC	87033	10/6/2009
17	Nextel	NXTL	77284	12/6/2001
19	McDonalds	MCD	43449	10/16/2006
20	Mc Graw	MHP	17478	2/22/2000
21	Microsoft	MSFT	10107	7/3/2002
22	New York Times	NYT	47466	2/27/2002
23	News Corporation	NWS	69593	6/14/2002
24	Nike	NKE	57665	6/1/2000
25	Oracle	ORCL	10104	10/5/2000
26	Sky West	SKYW	10421	10/2/2000
27	Union Pacific Co.	UNP	48725	6/14/2002
28	Reebok	RBK	91380	6/22/2000
29	Wal-mart	WMT	55976	12/14/2000
30	Yahoo	YHOO	83435	2/7/2000

Appendix C: Cumulative Abnormal Returns for Each Company

	PERMNO	EVENT_DATE	FREQ	car
1	10104	001005	3	-0.005556959
2	10107	020703	3	0.0162499553
3	10421	001002	3	-0.035924834
4	11081	000209	3	0.0383571041
5	11995	080716	3	0.0109848687
6	12060	061002	3	0.0109144785
7	16432	021007	3	-0.037911285
8	17209	060818	3	-0.020388568
9	17478	000222	3	-0.034956179
10	18542	080918	3	-0.022692829
11	19561	051108	3	-0.007538065
12	27828	060914	3	-0.028498301
13	43449	061016	3	-0.019514886
14	47466	020227	3	-0.007158685
15	47941	020712	3	-0.016859122
16	48725	020614	3	-0.007876734
17	55976	001214	3	-0.00544162
18	57665	000601	3	-0.025816118
19	69593	020614	3	-0.007475783
20	70519	050608	3	-0.002998625
21	76076	000608	3	0.0296892397
22	77284	011206	3	-0.035070589
23	79667	010305	3	-0.056161524
24	83435	000407	3	-0.178969542
25	84165	090723	3	0.0006510849
26	84788	000208	3	0.0268268088
27	87033	091006	3	-0.007240201
28	90319	090325	3	-0.003250681
29	91380	000622	3	0.0031631388

APPENDIX D: BETA BEFORE THE EVENT DAY

	PERMNO	EVENT_DATE	Intercept	Beta
1	10104	001005	0.0044921983	2.0495255365
2	10107	020703	0.0004473555	1.5649273992
3	10421	001002	0.003368261	0.5155969172
4	11081	000209	-0.001835165	1.552437592
5	11995	080716	-0.000808787	1.0022018675
6	12060	061002	0.0001697211	0.6569149101
7	16432	021007	-0.001640912	1.359341447
8	17209	060818	0.001099956	1.4401320471
9	17478	000222	-0.000565116	0.7359198271
10	18542	080918	0.0000668831	1.0343478191
11	19561	051108	0.0006718537	0.9105397704
12	27828	060914	0.0006112791	1.1463935141
13	43449	061016	0.0005283405	0.9052994305
14	47466	020227	0.0005784725	0.6381147065
15	47941	020712	0.0009619008	0.7486797944
16	48725	020614	0.0013066135	0.7357555555
17	55976	001214	-0.000101887	0.6810382963
18	57665	000601	-0.001006302	0.5778848152
19	69593	020614	-0.000368044	1.3220125756
20	70519	050608	-0.000191375	0.9197568051
21	76076	000608	0.0026771478	1.7090523182
22	77284	011206	-0.000679626	2.976951812
23	79667	010305	0.0028606095	0.9124595222
24	83435	000407	0.0013234495	2.1034125763
25	84165	090723	0.0001665723	0.8739167801
26	84788	000208	0.0013489238	2.2866280234
27	87033	091006	-0.001244873	1.1740660438
28	90319	090325	0.0011092213	0.9469005055
29	91380	000622	0.0003411541	0.5386861456

APPENDIX E: BETA AFTER THE EVENT DAY

	PERMNO	EVENT_DATE	Intercept	BETA
1	10104	001005	0.0043289453	2.1006877247
2	10107	020703	0.0002067756	1.6209828814
3	10421	001002	0.0035749038	0.504926545
4	11081	000209	-0.001997755	1.5276116262
5	11995	080716	-0.000812548	1.0133652861
6	12060	061002	0.0001226051	0.6555760096
7	16432	021007	-0.001496262	1.3042344806
8	17209	060818	0.001222504	1.4421030773
9	17478	000222	-0.000514333	0.6905096637
10	18542	080918	0.0003132646	1.115646033
11	19561	051108	0.0005894338	0.9136779286
12	27828	060914	0.0008746304	1.1350594349
13	43449	061016	0.0005920541	0.9044355348
14	47466	020227	0.0005029442	0.6345761767
15	47941	020712	0.0011324658	0.7278175363
16	48725	020614	0.0012172997	0.7573453509
17	55976	001214	-0.00035282	0.6915286714
18	57665	000601	-0.000808325	0.5553856052
19	69593	020614	-0.000284663	1.3134254789
20	70519	050608	-0.000135785	0.9268613325
21	76076	000608	0.0025247308	1.6998246052
22	77284	011206	-0.000433169	2.9765862118
23	79667	010305	0.0032616365	0.9123122507
24	83435	000407	0.0016830649	2.2169992013
25	84165	090723	-0.000011633	0.8723116
26	84788	000208	0.0015647981	2.3044007809
27	87033	091006	-0.001145238	1.1755189474
28	90319	090325	0.0010373679	0.9528859657
29	91380	000622	-0.000501176	0.6104833078

APPENDIX F: TRADING VOLUME AFTER THE EVENT DAY

	EVENT_DATE	_TYPE_	_FREQ_	vol	
1	10104	001005	0	3	9.3504759626
2	10107	020703	0	3	3.1856412577
3	10421	001002	0	3	3.0176319547
4	11081	000209	0	3	18.762151197
5	11995	080716	0	3	4.7406682721
6	12060	061002	0	3	2.4009659388
7	16432	021007	0	3	9.9999591738
8	17209	060818	0	3	2.0125594543
9	17478	000222	0	3	2.0170831209
10	18542	080918	0	3	20.828651347
11	19561	051108	0	3	3.8538769797
12	27828	060914	0	3	4.7916090858
13	43449	061016	0	3	12.664077363
14	47466	020227	0	3	3.1694911597
15	47941	020712	0	3	5.9617130126
16	48725	020614	0	3	2.2877763351
17	55976	001214	0	3	1.9883860059
18	57665	000601	0	3	1.9916039564
19	69593	020614	0	3	5.8498425733
20	70519	050608	0	3	1.7106175057
21	76076	000608	0	3	4.4894265995

22	77284	011206	0	3	16.227057866
23	79667	010305	0	3	10.214528868
24	83435	000407	0	3	16.450626215
25	84165	090723	0	3	11.645190148
26	84788	000208	0	3	38.644095383
27	87033	091006	0	3	14.882359662
28	90319	090325	0	3	20.805836559
29	91380	000622	0	3	5.1613624068

APPENDIX G: TRADING VOLUME BEFORE THE EVENT DAY

PERMNO	EVENT_DATE	_TYPE_	_FREQ_	vol	
1	10104	001005	0	60	3.5123926772
2	10107	020703	0	60	3.4924710445
3	10421	001002	0	60	4.810517327
4	11081	000209	0	60	12.628875959
5	11995	080716	0	60	4.6802578768
6	12060	061002	0	60	2.0693669068
7	16432	021007	0	60	11.478403121
8	17209	060818	0	60	5.0303913929
9	17478	000222	0	60	1.476025651
10	18542	080918	0	60	12.687642438
11	19561	051108	0	60	4.980604468
12	27828	060914	0	60	5.1745412667
13	43449	061016	0	60	7.999469259
14	47466	020227	0	60	4.3673728941
15	47941	020712	0	60	3.8059237727
16	48725	020614	0	60	2.4802920709
17	55976	001214	0	60	2.10925646
18	57665	000601	0	60	3.7030962034
19	69593	020614	0	60	7.960524819