THE REACTION OF THE IMPLIED VOLATILITY OF STOCK PRICES TO MANAGEMENT CHANGES

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ABSTRACT

The Reaction of the Implied Volatility of Stock Prices to Management Changes

Darren Da Silva

In this paper, the impact of managerial change announcements on implied volatilities is studied. The use of the option's market allowed a measure of market reaction not available in past studies using share price data. The methodology of our study is designed to obtain changes in the variances of common stock return, which differs from studies which have focused on daily excess returns. This study focuses on investor's evaluation of the signalling process instead of their reaction to particular signal realizations. Thus, this should bring a new light to the impact of managerial changes.

The top-level managerial changes were obtained from FORBES annual list of 800 highest paid executives for January 84 to December 88. Data were limited to firms trading on the Chicago Board Option Exchange.

The study revealed, through several multiple regressions

performed on the pre, during and post event periods, that for a database of large firms, the market demonstrates an indifference to top level managerial changes. This finding seems to confirm the hypothesis that the market views a managerial change as scapegoating, with no real impact on performance.

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1. INTRODUCTION

Empirical evidence has established that capital markets are usually informationally efficient in the semi-strong form (Fama, 1991). That is, all publicly held information is fully and unbiasedly reflected in market prices. It can be argued that top management performs the most vital functions relating to the growth and prosperity of a firm[1], therefore the markets should react to any changes in the composition of a firm's top management team.

Management turnover has long been an attractive subject for analysis. It has, therefore, generated a substantial body of research. Specifically the world of finance has been interested in market reactions to an announcement of managerial change. In the past, the market reaction has mostly been measured by observing daily excess returns, therefore only evaluating price reactions at announcement of a managerial change. This study's research methodology differs. I will evaluate if the market anticipates changes in

[1]See Furtado and Karan.

volatilities around the event of managerial change. This should bring a new light to our knowledge about the market's reaction to managerial change. A shift in volatility would be an important finding, for which option traders would have great interest, since volatility is one of the factors that determines option prices.

An event study will be used to identify any changes in implied volatilities around a firm's change in top-level management. Call options are a particularly appropriate instrument for our research since their value as a contingent claim is based on the investors beliefs about the future stochastic behaviour of the underlying stock price over the remaining life of the option contract. Therefore, a time series of option prices can reveal the anticipated increase in security price variability even if, ex post, the announced signal has little or no effect on stock price.

Information on management turnover was obtained through the FORBES magazine annual issue of the 800 top paid U.S. firms executives. Other news events were obtained through the F&S News Release Index. Finally, the Berkeley Options Database

provided the specific variables needed to obtain the implied volatilities for stocks with options trading on the Chicago Board Options Exchange.

2. LITERATURE REVIEW

Management turnover in any type of organization has always captivated a great deal of attention. It has been studied by researchers from varied fields, such as sociology, organizational behaviour, accounting and finance (Furtado & Karan, 1990). The underlying theme of these studies has been to increase our understanding of the forces that cause these changes and their overall effect on corporate control transfers. Several finance researchers have attempted to measure shareholder wealth effects (Bonnier & Bruner (1989), Denis & Denis (1994), Furtado & Rozeff (1987)).

The results from this wide variety of studies sometimes conflict, however they have managed to move forward our understanding of the subject. Some of those findings follow.

When a news event occurs, in an efficient market, the reaction will reflect the revised prospects of the firm. Brown (1982) presented three different hypotheses for the market reaction to a top level managerial change:

-The vicious circle; a change represents instability, disruptiveness and tensions, which have a negative impact on the firm. It also increases the possibility of further managerial changes.

-The scapegoating ritual; a change has little or no effect. This conclusion is drawn from the hypothesis that leadership has no causal effect on performance. since the major impacts on performance are social and environmental.

-The great person; a change can have a positive result. This theory implies that senior management can influence organizational outcomes.

Fama (1980) argued that management changes and market performance should not be linked. He suggested that managers face the discipline of the labour markets not of the capital markets. Shareholders do not have significant control (power) over a firm since they are participating in a larger capital market which allows them to move from one firm to the next with few barriers. This results in low involvement on the part of investors.

Furtado and Rozeff (1987) found that a firm's past performance does influence the likelihood of a management change. Firms with consecutive poor results are more likely to institute a change. In those that become financially distressed the probability of departure of top executives becomes extremely high. The past performance also seems to influence the origins of the successor, with poorly performing firms leaning to an outside appointment.

Jensen and Warner (1988) surveyed seventeen papers on management turnover and concluded that it is inversely related to share price performance. They suggest that stock price performance is used as an indicator of managerial performance during evaluations. They are indicating a causality of poor stock price performance precipitating management replacement.

The literature pertaining to event studies found varying results along with the amount of aggregation in the data base. Several studies found insignificant price changes in the overall results but were able to find significant positive or negative changes for specific subsets of data. For example, Reinganum (1985) studied changes in the offices of the

chairman and/or president of firms trading on the NYSE and AMEX for 1978 and 1979. He argued that a turnover in these offices signalled a major change in policies and strategies for the firm. He concluded that three variables, the size of the firm, the origin of the successor, and the disposition of the predecessor, determine the results of executive succession. He found improved performance only in small firms with an outside appointment and a departing predecessor[2]. He postulated the lack of effect in large firms was due to environmental and social constraints present in these type of complex organizations[3].

Bonnier and Bruner (1989) had one of the strongest findings. In their study, that limited itself to distressed firms, a change in top management was met with a significant abnormal return of +2,48% in the window of t-1 and t=0[4].

Denis and Denis (1994) presented evidence that forced top management changes are preceded by large and significant

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[2]Consistent with the great person hypothesis.

[3]Consistent with the scapegoating hypothesis.

[4]Consistent with the great person hypothesis.

declines and followed by significant improvements in operating performances. They also demonstrated that these firms significantly downsized their operations. After a turnover, there was a decline in employment, capital expenditures and total assets.

Mahajan and Lummer (1993) examined shareholder wealth effects of management changes. They found evidence to support their hypothesis that management departures cause instability which adversely affects corporate performance. Their results also lend support to the inference that management reshuffles are not perceived to be in the shareholders' best interest and that, at the time of change, shareholders negatively evaluate the previous management team's performance.

Other findings include:

-Financial markets can influence a change in control within a firm. For instance, the turnover rate is increased by mergers and takeovers, proxy contest (both successful and unsuccessful) and finally by block trades.

-The effects of succession on accounting performance often have been inconclusive. However, the greatest profitability arises in firms that planned for succession.

-The appointment of an outsider results in a greater amount of change; and new management often purposefully takes an accounting earnings bath to be able to report subsequent improved performance. Regardless, studies using sales, income, and profit margins as measures of performance found little effect from turnover.

A review of the literature on managerial turnover, does not provide a conclusive result. In fact the results often conflict. These differences may be due to differences in the design of the studies, the varying definitions of top management change, and the sample selection processes.

3.DATA COLLECTION

Past studies on managerial changes have obtained their data in various manners, however a popular method has been to rely on the annual publication of the 800 highest paid executives employed by U.S. firms published in FORBES magazine. The data set used for this study extends from January 1984 to December 1988. A list of all executives[5] with tenure of 1 year or less was drawn from the FORBES information. The total possible events equalled 223. Only the firms with options trading on the Chicago Board Options Exchange were retained. Next, the events needed to be identified as a significant news happening, complete with a date. The F&S news index was used for this purpose. When multiple news releases existed about the managerial change, the earliest possible date was retained to capture the initial market reaction to a change.

The study now contained 53 events (exhibit 1). The CBOE was accessed for every event. All the call option trades, for

[5]President, CEO and/or Chairman.

each event's window, from 14:15 onward were retrieved[6]. The data were then sorted by time of trade so that only the last trade of a specific option (unique expiration and strike price) was kept[7]. The data were resorted by event and expiration month. The database now contained, for every day in each event window, the following information for every call option:

-the closing bid price and ask price

-the strike price

-the concurrent stock price[8]

-the present date

-the expiration month

The first step to complete the database was to calculate the mid-point between the bid price and the ask price[9]. The use of the mid-point avoids the noise effect of a bouncing in the bid-ask spread. Next, the present date had to be converted to days left to maturity based on the expiration month

[6]The Chicago Board Options Exchange closes at 15:30.

[7]Fortran routine.

[8]Past studies have had a problem with obtaining concurrent data.

[9]See Donders & Vorst (1994).

information. An Excel sub-routine was written to perform this task. Finally the two inputs not supplied by the CBOE, the risk free rate[10] and dividend yields were added (exhibit 2). For the risk free rate, the closest expiring US T-Bill rate was used. The dividend yields were obtained by first recording the last paid quarterly dividend for each firm[11]. The yield was then calculated the following way:

$$\{(\text{Quarterly Dividend}/\text{Stock Price})+1\}^{4}-1$$

All the necessary inputs were now available to obtain an implied volatility for each observation.

[10]Federal Reserve Bank of St-Louis.

[11]Moody's dividend record.

4.DESCRIPTION and METHODOLOGY

This study is an event analysis on the effect of a top-level managerial change on implied volatility. Past event studies have tested whether the price of a stock reacted at the announcement of a managerial change. However, an event may affect the riskiness of a stock without affecting its current price. Therefore, our analysis tests whether the riskiness of a stock shifts at the announcement of a managerial change. This type of analysis is possible because call option prices reflect the average standard deviation of the return on the underlying stock over the remaining life of the option. We are therefore combining the importance of managerial change with the information on risk revealed in call option prices.

Turnover, whether voluntary or involuntary, represents a major event for the firm and can determine its subsequent performance and direction. The importance of the event is shown in the market reaction at or prior to its announcement. Hence, our approach encompasses those market figures.

The use of implied volatility, as an estimate of the standard deviation of the return on the underlying asset, can be traced back to 1973, when two significant events occurred. The Black and Scholes (B&S) option pricing model was published and the Chicago Board Options Exchange was organized. The B&S model specified the dynamic portfolio trading strategy that would replicate the return of an option. This allowed the principles of arbitrage to be applied in this new market. The model specifies the price of a European call option(C) on a non-dividend-paying stock as a function of the stock price(S), time to maturity(T), exercise price(X), risk free rate(r) and finally standard deviation of the return on the underlying stock(σ):

$$C = N(d1)S - N(d2)Xe^{-rT}$$

$$d1 = \frac{\ln(S/X) + (r+\sigma^2/2)T}{\sigma T^{1/2}}$$

$$d2 = d1 - \sigma T^{1/2}$$

The price of the option and the levels of the variables, other than the standard deviation, are all observable. The B&S model cannot be directly solved for the standard deviation. However, a numerical method can be used to solve for the

standard deviation. This solution is called an "implied volatility".

The B&S model assumes that σ is a constant, however Merton (1973) generalized the model to allow for a non-stochastic σ. This generalization allows the implied volatility provided by B&S to be an estimate of the average standard deviation of the return on the underlying asset over the remaining life of the option. Merton also extended the model to incorporate a constant continuous dividend yield(d). Merton's dividend-adjusted formula is:

$$C = N(d1)Se^{-dt} - N(d2)Xe^{-rT}$$

$$d1 = \frac{\ln(S/X) + (r-d+\sigma^2/2)T}{\sigma T^{1/2}}$$

$$d2 = d1 - \sigma T^{1/2}$$

It is well known that both σ and d cannot be known and vary stochastically over time. However, the dividend-adjusted B&S model still provides an implied volatility that is a reliable indicator of investors' expectation for the volatility of an option over its remaining life. In fact, as

seen by examining the B&S formula, market participants who disagree about the expected return on a stock, but agree on its estimated σ, will still come to consensus on the price for its options.

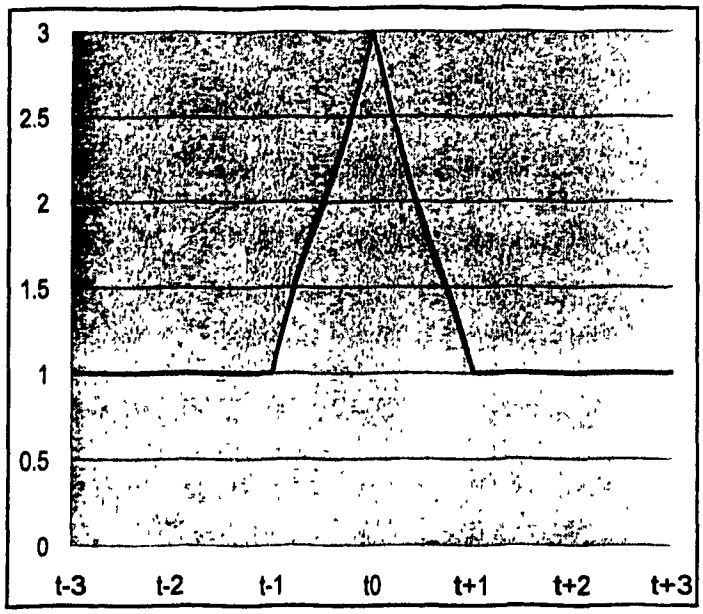
This study's goal is to derive the implied volatility rates on the underlying stock, of the event firms, at various points in time, immediately preceding and following the announcement of a managerial change. By examining a time series of implied volatilities, one can attempt to identify a volatility shift around the management change.

This methodology was first applied by Patell and Wolfson (1979). They used an anticipated significant news release[12]. They were therefore able to postulate a simple variance profile as seen below.

[12]Annual earnings announcement.

FIGURE 1

Patel & Wolson's Proposed Implied Volatility Structure around a scheduled news event.



They actually found that implied volatility gradually increases as time to the announcement approaches, hitting its peak at announcement and then sharply returning to normal levels by t+1. This pattern has come to be expected with anticipated significant news releases.

In this study, we estimate each stock's implied volatility for each day surrounding the announcement of a managerial change. We then calculate the day-to-day change in this implied volatility. These differences give us an estimate

of the slope of the implied volatility curve in the days surrounding the announcement. For example, if the implied volatility structure should conform to the one proposed by Patell & Wolfson, then, on average, these differences would be positive immediately before the announcement and negative immediately after the announcement.

Finally, since this study's event is a managerial change, which, by its nature, is not scheduled, we are not attempting to predict a particular volatility pattern. The gradual increase in volatility that accompany's a greatly anticipated scheduled news announcement will not necessarily be present with our event. Therefore, we are instead attempting to identify, without prejudice, a positive or negative shift in volatility surrounding a change in management.

5. RESULTS

The first step for obtaining results, from the completed data base, was to calculate an implied volatility for each observation. As previously stated, B&S cannot be directly solved for σ, therefore an iterative search was needed. A macro program[13] incorporated into Excel was able to accomplish this task.

The database was now reclassified by event and expiration month. To best evaluate the results, for each event, the closest to expiration, with sufficient data volume, was extracted. Patell & Wolfson demonstrated that the volatility shift around a news release will be more pronounced with shorter maturities. However, there is a limitation to the closeness of expiration, since very close to maturity options tend to have unstable volatility. To avoid this problem, no option was selected with an event window attaining 10 or fewer days left to maturity. The data base now had a selected option maturity for each event. An example of the data can be seen in

[13]The macro is OPTION.XLA!, created by Michigan State University PHD candidate Ray M. Steele.

exhibit 3.

To obtain a unique observed volatility for each event day, all available options, with different exercise prices but identical expiration dates, were equally weighted[14]. Each of the retained options has the same maturity. B&S's implied volatility represents an estimate of the average volatility for the firm over the remaining life of the option. By combining information from several such estimates, the WISD should be the best estimate for implied volatility.

Before proceeding with the analysis, the data were re-examined. The data relating to nine events were removed from the data set. The data for the events of Citicorp, Diamond Shamrock R&M, Gencorp and Union Camp were removed for insufficient volume. The Cigna data was lost due to error. Honeywell, Rockwell International and Tecktronix all coincided with the 1987 market crash. They were removed, both because trading was interrupted and the event's news release would have been swamped by this large macro event. Sears was removed

[14]Weighted Implied Standard Deviation or WISD.

because no news release data were available.

The data were examined to determine if there was a clustering problem, as has often occurred in past studies using scheduled events[15]. If a clustering problem exist, then any finding might only be attributable to a market factor occurring at the same time as the clustered events. As can be seen in exhibit 4, due to the unscheduled nature of this study's events, there is no clustering problem.

To evaluate if a shift has occurred in the WISD, a cross sectional difference was taken. For example, the data for t-11 was the difference between the t-12 WISD and the t-11 WISD. An example is provided in exhibit 5. The object of the study is not to evaluate the actual level of implied volatility for the event but rather if a shift has occurred.

To see whether these differences are significant, the following test was performed:

[15]Often earning announcements.

$$E(\Delta IV)_{jt} = \alpha_0 + \alpha_1 x_{j1t} + \alpha_2 x_{j2t} + \epsilon_{jt}$$

where:

$E(\Delta IV)_{jt}$ is the expected change in implied volatility.

x_{j1t} is dummy variable 1 (DV1).

x_{j2t} is dummy variable 2 (DV2).

DV1 was given a value of 1 during the event period, otherwise 0 and DV2 was given a value of 1 post event period, otherwise 0.

This multiple regression is effectively splitting the data into three time periods. The pre-event window is captured by the intercept of α_0, since both dummies are equal to 0. The event window is contained in α_1, where DV1 is equal to 1 and DV2 is equal to 0. Finally, the same principle is used for the post-event period.

The regression's α coefficients and T-values will be examined to determine if the volatilities in the three sub-periods are statistically different.

Several multiple regressions were performed. First a

regression was run on each event for the full available window. The data had been retrieved for t-12 to t+12. As previously stated the goal of this study is to determine if a shift in volatility has occurred, therefore the cross-sectional difference in WISD were used. This eliminates t-12 as the first difference is taken at t-11. The determination for the best event window to use, was t-1 to t0. The publication date is at t0, however it is likely that some leakage of the news has occurred earlier. By incorporating t-1 into the event window, it is hoped that the full market reaction to the announcement will be captured. This meant that most of the regressions were run on 10 pre-event, 2 event and 12 post-event data points. An example can be seen in exhibit 6. The results in all cases failed to provided significant results (t-values).

Based on Donders & Vorst, in an attempt to increase significance, the pre and post event windows were shortened to 3 and 4 days respectively. The regressions were again performed on all events. This was followed by a single regression on all the data at once. The following regression equation was obtained:

$$E(\triangle IV)_{jt} = -0.00184 + 0.01254\ x_{j1t} - 0.004628\ x_{j2t} + \epsilon_{jt}$$

$$(-0.1495) \quad (0.6328) \quad (-0.2842)$$[16]

The full results can be seen in the following table:

TABLE 1

Summary of Regression Statistics.

ANOVA				
	df	*SS*	*MS*	*F*
Regression	2	0.01629718	0.00814859	0.416900969
Residual	379	7.407791834	0.019545625	
Total	381	7.424089013		
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-0.001840335	0.012309203	-0.149508885	0.881231625
X Variable 1	0.012541047	0.019819699	0.632756655	0.527274141
X Variable 2	-0.004628108	0.016283545	-0.284219935	0.776397056

The results show a spike in the event window, however, none of the time periods coefficients are significant. It therefore cannot, on the overall data, be said that a shift in volatility occurs with an announcement of managerial change.

The tests were then performed on different subsets of data. The first subset eliminated firms which had other significant news event near the managerial change. The events

[16]T-values.

for Atlantic Richfield, BankAmerica, Ford, IBM, International Paper and PennZoil were removed. The result are shown below:

TABLE 2

Summary of Regression Statistics.

ANOVA				
	df	*SS*	*MS*	*F*
Regression	2	0.011633513	0.005816757	0.278393637
Residual	325	6.790549975	0.020894	
Total	327	6.802183489		
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-0.006622892	0.013719848	-0.482723402	0.629617128
X Variable 1	0.015897553	0.022159554	0.71741305	0.473634578
X Variable 2	0.002802883	0.018149653	0.154431763	0.877365167

Again there appears to be a spike in the event window, however none the variables are significant.

The next subset of data consisted of pulling out firms who's new appointment was external[17]. They were Alcoa, American Stores, Black & Decker, Burlington Northern, CBS, Walt Disney and General Dynamics. The results were:

[17]5 years or less of tenure.

TABLE 3

Summary of Regression Statistics.

ANOVA				
	df	*SS*	*MS*	*F*
Regression	2	0.003931261	0.001965631	0.367727363
Residual	59	0.315375512	0.005345348	
Total	61	0.319306773		
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-0.001036893	0.015954321	-0.064991349	0.9484006
X Variable 1	0.008710002	0.025801569	0.337576443	0.73688051
X Variable 2	-0.011378762	0.021105583	-0.539135159	0.591822327

The same conclusion can be drawn.

The data was also evaluated with a non-parametric test. The Wilcoxon rank test can be generalized to be used beyond a simple pair test. The WISD differences, for the entire data, were sorted in ascending order, given a rank, and finally reclassified by period (exhibit 7). A one way anova F test was performed:

TABLE 4

Summary Statistics for Non-Parametric Test.

Anova: Single Factor				
SUMMARY				
Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	129	24140	187.1317829	11224.97469
Column 2	81	16774	207.0864198	11654.22994
Column 3	172	32239	187.4360465	13164.32922
ANOVA				
Source of Variation	*SS*	*df*	*MS*	*F*
Between Groups	24980.04874	2	12490.02437	1.024562338
Within Groups	4620235.451	379	12190.59486	
Total	4645215.5	381		

Again the event window demonstrated a higher coefficient but still no significance was found.

6.CONCLUSION

In this study, the Black & Scholes option pricing model's implied volatility was used to determine the market's reaction to a top level managerial change. The events were identified using the annual FORBES publication of the top 800 paid executives in the U.S. The event list was confirmed using the F&S news index. The database was obtained through the Berkeley Options Database. The final data set consisted of 43 events for which the data were complete.

The data were tested for a shift in volatility. For this purpose a cross sectional difference of the weighted implied volatility was used. Several multiple regressions, using dummy variables to split the data into different time periods, were run.

The regressions, no matter the degree of aggregation, all yielded similar results. They all demonstrated a positive spike in the event window, however none of the regressions coefficients were significant.

These results seem to confirm the scapegoating ritual hypothesis (Brown, 1982), which states that a change in management has little or no effect, since the major impact on firm performance stems from social and environmental factors.

A non-parametric test was performed. It also confirmed the previous results.

Previous studies had obtained mixed results. One of the influencing factors seems to be firm size. This study's event firms are definitely skewed toward the larger firms. By using firms traded on the CBOE and the FORBES annual list of *highest paid executives*, it cannot be otherwise. Given the results, the Brown (1982) hypotheses, the data skewness, this study concludes that, in the overall, for large firms, a top level managerial change will be met with market indifference.

Given the continued fascination of the public with managerial change, it would be interesting to duplicate this study's methodology on a differently sourced event list. A database focusing on small capitalized firms might reveal some

interesting differences with this study. A larger event list might help in establishing significant results. Also, as Brown & Warner (1980) have indicated, a better pinpointing of the exact time at which the news hit the market would be useful in measuring any market reaction.

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Exhibit 1
Event List *

#	Company Name	Symbol	Executive Name	Age	Tenure	Event Identification	
						Publication	Date
1	Alcoa	AA	Paul H. O'Neil	52	1	WSJ	4/21/87
2	Alexandre&Alexandre	AAL	Tinsley H. Irun	55	35	WSJ	2/23/87
3	Atlantic Richfield	ARC	Ludwrick M. CooK	58	29	WSJ	6/24/85
4	American Stores	ASC	Jonanthan L. Scott	59	2	WSJ	12/7/88
5	Avon Products	AVP	James E. Preston	56	25	WSJ	9/2/88
6	Boeing	BA	Frank A. Shrentz	55	29	WSJ	2/26/85
7	BankAmerica	BAC	Alden W. Claussen	64	37	WSJ	10/10/86
8	Black&Decker	BDK	Nolan Darchibald	44	1	WSJ	3/21/86
9	Bell Atlantic	BEL	Raymond W. Smith	51	30	WSJ	8/24/88
10	Burlington Northern	BNI	Gerald Grinstein	56	2	WSJ	10/21/88
11	Bethlehem Steel	BS	Walter F. Williams	58	36	WSJ	2/18/86
12	CBS	CBS	Laurence A. Tisch	64	1	AdAge	9/15/86
13	Citicorp	CCI	John S. Reed	46	20	WSJ	6/20/84
14	Control Data	CDA	Robert M. Price	56	26	WSJ	1/18/86
15	Cigna	CI	Wilson H. Taylor	45	25	WSJ	7/28/88
16	Delta Airlines	DAL	Ronald W. Allen	46	25	WSJ	7/24/87
17	El duPont deNemours	DD	Edgar S. Woodard Jr.	55	31	WSJ	9/15/88
18	El duPont deNemours	DD	Richard E. Heckert	63	38	WSJ	8/29/85
19	Walt Disney	DIS	Michael D. Eisner	43	1	WSJ	9/10/84
20	Diamond Sham R&M	DRM	Roger R. Hemminghaus	51	4	Bus Wk	2/16/87
21	Engelhard	EC	Orin R. Smith	49	13	AmMtl Mkt	2/23/84
22	Eaton	ETN	James R. Stover	60	31	WSJ	1/8/86
23	Ford Motor	F	Donald E. Peterson	59	36	WSJ	10/30/84
24	Fluor	FLR	David S. Tappan Jr.	63	33	AmMtlMkt	9/11/84
25	FreePort-McMoran	FTX	James B. Moffet	46	15	WSJ	8/2/84
26	General Dynamics	GD	Stanley C. Pace	65	2	ElecNews	5/27/85
27	Grumman	GQ	John O'Brien	57	34	WSJ	5/16/86
28	GenCorp	GY	A. William Reynolds	53	1	WSJ	6/7/85

* alphabetical by symbol

Exhibit 1 (continued)
Event List *

#	Company Name	Symbol	Executive Name	Age	Tenure	Event Identification	
						Publication	Date
29	Honeywell	HON	James J. Renier	58	32	WSJ	10/21/87
30	Harris Corp	HRS	John T. Hartley	57	30	WSJ	4/1/86
31	IBM	IBM	John F. Ackers	51	25	WSJ	9/26/84
32	International Paper	IP	John A. Georges	54	6	WSJ	8/15/84
33	Johnson&Johnson	JNJ	Ralph S. Larsen	50	27	WSJ	10/25/88
34	KMart	KM	Joseph E. Antonini	46	24	WSJ	9/15/87
35	Litton Industries	LIT	Orion L. Hoch	58	30	WSJ	11/19/86
36	McDonald's	MCD	Michael R. Quinlan	43	22	WSJ	10/21/86
37	Merrill Lynch	MER	William A. Schreyer	57	37	WSJ	6/6/84
38	Minn Mining&Mfg	MMM	Allen F. Jacobsen	60	39	WSJ	2/11/86
39	Mobil	MOB	Allen E. Murray	58	34	Ind Wk	12/9/85
40	Norfolk	NSC	Arnold B. McKinnon	60	37	WSJ	6/25/86
41	PepsiCo	PEP	D. Wayne Calloway	51	20	NATnsRestr	5/19/86
42	Polaroid	PRD	I. MacAllister Booth	55	29	WSJ	12/18/85
43	PennZoil	PZL	Randal B. McDonald	57	/	WSJ	12/10/87
44	Rockwell Intl	ROK	Donald R. Beall	49	27	Bus Wk	10/19/87
45	Sears Roebuck	S	Edward A. Brennan	53	31	WSJ	10/2/85
46	American Tel&Tel	T	Robert E. Allen	53	31	WSJ	4/19/88
47	American Tel&Tel	T	James E. Olson	61	43	WSJ	3/24/86
48	Tektronix	TEK	David P. Friedley	48	14	WSJ	10/22/87
49	Texas Instruments	TXN	Jerry R. Junkins	49	27	ElecNews	5/25/85
50	Union Camp	UCC	Raymond E. Cartledge	58	30	WSJ	2/28/85
51	UpJohn	UPJ	Theodore Cooper	59	8	WSJ	5/20/87
52	United Technologies	UTX	Robert F. Daniel	53	31	Mgmt Today	10/1/86
53	Whirpool	WHR	David R. Whitnam	46	20	WSJ	5/8/87

* alphabetical by symbol

Exhibit 2
Dividends

#	Company Name	Symbol	Event Date	Quarterly Dividend ($)
1	Alcoa	AA	4/21/87	0.300
2	Alexandre&Alexandre	AAL	2/23/87	0.250
3	Atlantic Richfield	ARC	6/24/85	1.000
4	American Stores	ASC	12/7/88	0.250
5	Avon Products	AVP	9/2/88	0.250
6	Boeing	BA	2/26/85	0.350
7	BankAmerica	BAC	10/10/86	0.000
8	Black&Decker	BDK	3/21/86	0.160
9	Bell Atlantic	BEL	8/24/88	1.020
10	Burlington Northern	BNI	10/21/88	0.550
11	Bethlehem Steel	BS	2/18/86	arrears
12	CBS	CBS	9/15/86	0.750
13	Citicorp	CCI	6/20/84	0.515
14	Control Data	CDA	1/18/86	rights
15	Cigna	CI	7/28/88	0.740
16	Delta Airlines	DAL	7/24/87	0.300
17	El duPont deNemours	DD	9/15/88	0.750
18	El duPont deNemours	DD	8/29/85	0.750
19	Walt Disney	DIS	9/10/84	0.300
20	Diamond Sham R&M	DRM	2/16/87	rights
21	Engelhand	EC	2/23/84	0.160
22	Eaton	ETN	1/8/86	0.400
23	Ford Motor	F	10/30/84	0.400
24	Fluor	FLR	9/11/84	0.100
25	FreePort-McMoran	FTX	8/2/84	0.150
26	General Dynamics	GD	5/27/85	0.250
27	Grumman	GQ	5/16/86	0.250
28	GenCorp	GY	6/7/85	0.375
29	Honeywell	HON	10/21/87	0.525
30	Harris Corp	HRS	4/1/86	0.220
31	IBM	IBM	9/26/84	1.100
32	International Paper	IP	8/15/84	0.600
33	Johnson&Johnson	JNJ	10/25/88	0.500
34	KMart	KM	9/15/87	0.290
35	Litton Industries	LIT	11/19/86	0.500
36	McDonald's	MCD	10/21/86	0.165
37	Merrill Lynch	MER	6/6/84	0.200
38	Minn Mining&Mfg	MMM	2/11/86	0.900
39	Mobil	MOB	12/9/85	0.550
40	Norfolk	NSC	6/25/86	0.850
41	PepsiCo	PEP	5/19/86	3/1SPLIT
42	Polaroid	PRD	12/18/85	0.250
43	PennZoil	PZL	12/10/87	0.550
44	Rockwell Intl	ROK	10/19/87	0.165

Exhibit 2 (continued)
Dividends

#	Company Name	Symbol	Event Date	Quarterly Dividend ($)
45	Sears Roebuck	S	10/2/85	0.440
46	American Tel&Tel	T	4/19/88	0.300
47	American Tel&Tel	T	3/24/86	0.300
48	Tektronix	TEK	10/22/87	0.150
49	Texas Instruments	TXN	5/25/85	0.500
50	Union Camp	UCC	2/28/85	0.410
51	UpJohn	UPJ	5/20/87	0.740
52	United Technologies	UTX	10/1/86	0.350
53	Whirpool	WHR	5/8/87	0.275

Exhibit 3
Example of Data

S	X	C mid-point	r	Dividend Yield	T Days Left	Name	Date Excel #	Date	X Date Excel #	X m
4240	3000	1313	0.056	0.028604	106	AA	31869	870402	31975	7
4240	3500	850	0.056	0.028604	106	AA	31869	870402	31975	7
4240	4000	413	0.056	0.028604	106	AA	31869	870402	31975	7
4240	4500	194	0.056	0.028604	106	AA	31869	870402	31975	7
4440	3000	1486	0.0556	0.027302	105	AA	31870	870403	31975	7
4440	3500	1013	0.0556	0.027302	105	AA	31870	870403	31975	7
4440	4000	544	0.0556	0.027302	105	AA	31870	870403	31975	7
4430	4500	301	0.0556	0.027364	105	AA	31870	870403	31975	7
4440	5000	151	0.0556	0.027302	105	AA	31870	870403	31975	7
4510	3000	1576	0.0556	0.026874	102	AA	31873	870406	31975	7
4510	3500	1063	0.0556	0.026874	102	AA	31873	870406	31975	7
4510	4000	625	0.0556	0.026874	102	AA	31873	870406	31975	7
4470	4500	294	0.0556	0.027117	102	AA	31873	870406	31975	7
4510	5000	151	0.0556	0.026874	102	AA	31873	870406	31975	7
4360	3000	1463	0.0556	0.027808	101	AA	31874	870407	31975	7
4420	4000	525	0.0556	0.027427	101	AA	31874	870407	31975	7
4360	4500	213	0.0556	0.027808	101	AA	31874	870407	31975	7
4360	5000	87.5	0.0556	0.027808	101	AA	31874	870407	31975	7
4410	3000	1476	0.0556	0.02749	100	AA	31875	870408	31975	7
4410	4000	525	0.0556	0.02749	100	AA	31875	870408	31975	7
4410	4500	247	0.0556	0.02749	100	AA	31875	870408	31975	7
4360	5000	110	0.0556	0.027808	100	AA	31875	870408	31975	7
4260	3000	1313	0.0556	0.028468	99	AA	31876	870409	31975	7
4310	4000	463	0.0556	0.028134	99	AA	31876	870409	31975	7
4260	4500	213	0.0556	0.028468	99	AA	31876	870409	31975	7
4370	3000	1451	0.0562	0.027744	98	AA	31877	870410	31975	7
4370	4000	538	0.0562	0.027744	98	AA	31877	870410	31975	7
4370	4500	213	0.0562	0.027744	98	AA	31877	870410	31975	7
4370	5000	107	0.0562	0.027744	98	AA	31877	870410	31975	7
4470	3000	1538	0.0562	0.027117	95	AA	31880	870413	31975	7

Exhibit 3 (continued)
Example of Data

S	X	C mid-point	r	Dividend Yield	T Days Left	Name	Date Excel #	Date	X Date Excel #	X m
4510	4000	625	0.0562	0.026874	95	AA	31880	870413	31975	7
4470	4500	300	0.0562	0.027117	95	AA	31880	870413	31975	7
4500	5000	147	0.0562	0.026935	95	AA	31880	870413	31975	7
4440	3000	1501	0.0562	0.027302	94	AA	31881	870414	31975	7
4440	4000	575	0.0562	0.027302	94	AA	31881	870414	31975	7
4440	4500	257	0.0562	0.027302	94	AA	31881	870414	31975	7
4420	5000	94	0.0562	0.027427	94	AA	31881	870414	31975	7
4530	3000	1601	0.0562	0.026754	93	AA	31882	870415	31975	7
4530	3500	1063	0.0562	0.026754	93	AA	31882	870415	31975	7
4530	4000	675	0.0562	0.026754	93	AA	31882	870415	31975	7
4530	4500	301	0.0562	0.026754	93	AA	31882	870415	31975	7
4630	3000	1688	0.0562	0.026171	92	AA	31883	870416	31975	7
4650	4000	713	0.0562	0.026057	92	AA	31883	870416	31975	7
4640	4500	363	0.0562	0.026114	92	AA	31883	870416	31975	7
4640	5000	191	0.0562	0.026114	92	AA	31883	870416	31975	7
4760	3000	1813	0.058	0.025449	88	AA	31887	870420	31975	7
4760	3500	1325	0.058	0.025449	88	AA	31887	870420	31975	7
4760	4000	838	0.058	0.025449	88	AA	31887	870420	31975	7
4760	4500	432	0.058	0.025449	88	AA	31887	870420	31975	7
4760	5000	210	0.058	0.025449	88	AA	31887	870420	31975	7
4870	3000	1907	0.058	0.024869	87	AA	31888	870421	31975	7
4870	3500	1407	0.058	0.024869	87	AA	31888	870421	31975	7
4870	4000	925	0.058	0.024869	87	AA	31888	870421	31975	7
4870	4500	513	0.058	0.024869	87	AA	31888	870421	31975	7
4870	5000	269	0.058	0.024869	87	AA	31888	870421	31975	7
4830	3000	1863	0.058	0.025077	86	AA	31889	870422	31975	7
4830	3500	1369	0.058	0.025077	86	AA	31889	870422	31975	7
4830	4000	888	0.058	0.025077	86	AA	31889	870422	31975	7
4830	4500	444	0.058	0.025077	86	AA	31889	870422	31975	7
4830	5000	226	0.058	0.025077	86	AA	31889	870422	31975	7

Exhibit 3 (continued)
Example of Data

S	X	C mid-point	r	Dividend Yield	T Days Left	Name	Date Excel #	Date	X Date Excel #	X m
4730	3000	1757	0.058	0.025612	85	AA	31890	870423	31975	7
4730	3500	1257	0.058	0.025612	85	AA	31890	870423	31975	7
4730	4000	750	0.058	0.025612	85	AA	31890	870423	31975	7
4730	4500	425	0.058	0.025612	85	AA	31890	870423	31975	7
4750	5000	213	0.058	0.025504	85	AA	31890	870423	31975	7
4670	3000	1713	0.0554	0.025945	84	AA	31891	870424	31975	7
4670	3500	1213	0.0554	0.025945	84	AA	31891	870424	31975	7
4670	4000	725	0.0554	0.025945	84	AA	31891	870424	31975	7
4670	4500	388	0.0554	0.025945	84	AA	31891	870424	31975	7
4670	5000	188	0.0554	0.025945	84	AA	31891	870424	31975	7
4670	4500	419	0.0554	0.025945	81	AA	31894	870427	31975	7
4670	5000	213	0.0554	0.025945	81	AA	31894	870427	31975	7
4750	3000	1850	0.0554	0.025504	80	AA	31895	870428	31975	7
4770	4000	844	0.0554	0.025396	80	AA	31895	870428	31975	7
4750	5000	238	0.0554	0.025504	80	AA	31895	870428	31975	7
4720	3000	1763	0.0554	0.025667	79	AA	31896	870429	31975	7
4720	3500	1263	0.0554	0.025667	79	AA	31896	870429	31975	7
4710	4000	775	0.0554	0.025722	79	AA	31896	870429	31975	7
4720	4500	400	0.0554	0.025667	79	AA	31896	870429	31975	7
4710	5000	191	0.0554	0.025722	79	AA	31896	870429	31975	7
4730	4000	838	0.0554	0.025612	78	AA	31897	870430	31975	7
4730	4500	426	0.0554	0.025612	78	AA	31897	870430	31975	7
4730	5000	207	0.0554	0.025612	78	AA	31897	870430	31975	7
4750	3500	1313	0.0569	0.025504	77	AA	31898	870501	31975	7
4750	4000	832	0.0569	0.025504	77	AA	31898	870501	31975	7
4730	4500	425	0.0569	0.025612	77	AA	31898	870501	31975	7
4750	5000	213	0.0569	0.025504	77	AA	31898	870501	31975	7
4850	3000	1925	0.0569	0.024973	74	AA	31901	870504	31975	7
4850	3500	1394	0.0569	0.024973	74	AA	31901	870504	31975	7
4850	4000	938	0.0569	0.024973	74	AA	31901	870504	31975	7

Exhibit 3 (continued)
Example of Data

S	X	C mid-point	r	Dividend Yield	T Days Left	Name	Date Excel #	Date	X Date Excel #	X m
4850	4500	482	0.0569	0.024973	74	AA	31901	870504	31975	7
4850	5000	244	0.0569	0.024973	74	AA	31901	870504	31975	7
4910	3500	1457	0.0569	0.024665	73	AA	31902	870505	31975	7
4910	4000	963	0.0569	0.024665	73	AA	31902	870505	31975	7
4910	4500	538	0.0569	0.024665	73	AA	31902	870505	31975	7
4910	5000	257	0.0569	0.024665	73	AA	31902	870505	31975	7
5070	3000	2150	0.0569	0.02388	72	AA	31903	870506	31975	7
5100	3500	1688	0.0569	0.023738	72	AA	31903	870506	31975	7
5100	4000	1188	0.0569	0.023738	72	AA	31903	870506	31975	7
5100	4500	694	0.0569	0.023738	72	AA	31903	870506	31975	7
5100	5000	369	0.0569	0.023738	72	AA	31903	870506	31975	7
5160	3000	2219	0.0569	0.023459	71	AA	31904	870507	31975	7
5160	3500	1719	0.0569	0.023459	71	AA	31904	870507	31975	7
5160	4000	1238	0.0569	0.023459	71	AA	31904	870507	31975	7
5160	4500	750	0.0569	0.023459	71	AA	31904	870507	31975	7
5150	5000	413	0.0569	0.023505	71	AA	31904	870507	31975	7
5160	5500	163	0.0569	0.023459	71	AA	31904	870507	31975	7

Exhibit 4
Clustering Chart of Event Dates

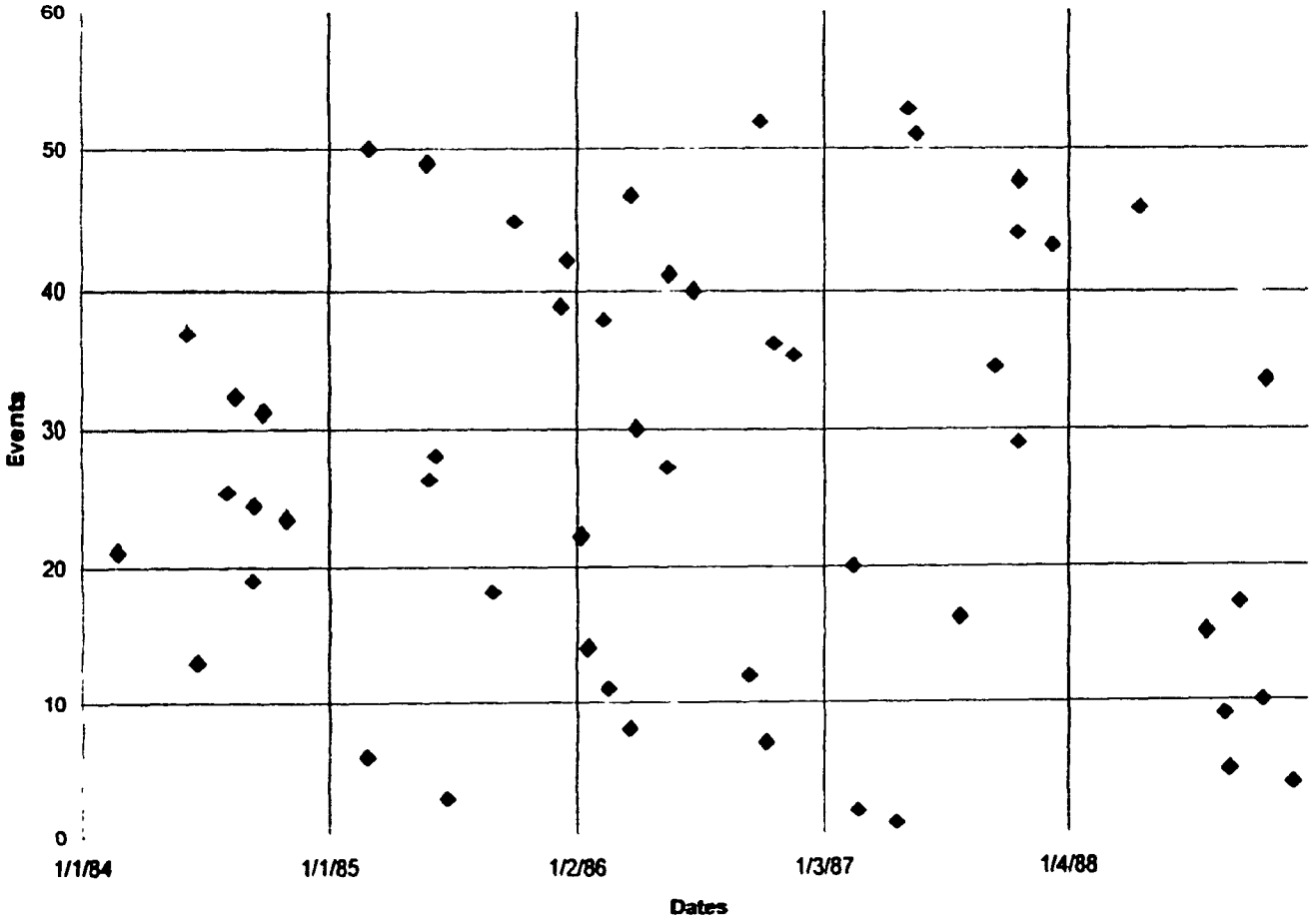

Exhibit 5
Table of WISD Differences

T days left	WISD	WISD difference	DV 1	DV 2
106	0.394895			
105	0.376595	-0.0183	0	0
102	0.386963	0.010368	0	0
101	0.384088	-0.00288	0	0
100	0.378053	-0.00603	0	0
99	0.387802	0.009749	0	0
98	0.399353	0.011551	0	0
95	0.406368	0.007015	0	0
94	0.385843	-0.02053	0	0
93	0.415533	0.02969	0	0
92	0.389025	-0.02651	0	0
88	0.421829	0.032804	1	0
87	0.395585	-0.02624	1	0
86	0.376843	-0.01874	0	1
85	0.305656	-0.07119	0	1
84	0.398425	0.092769	0	1
81	0.37115	-0.02728	0	1
80	0.530452	0.159302	0	1
79	0.416181	-0.11427	0	1
78	0.368498	-0.04768	0	1
77	0.397695	0.029197	0	1
74	0.481611	0.083916	0	1
73	0.383825	-0.09779	0	1
72	0.559887	0.176062	0	1
71	0.501932	-0.05796	0	1

Exhibit 6
Example of Final Data

WISD Table for F				
T	WISD	WISD	DV 1	DV 2
days left		difference		
71	0.278768			
70	0.252038	-0.02673	0	0
67	0.30231	0.050272	0	0
66	0.251216	-0.05109	0	0
65	0.161235	-0.08998	0	0
64	0.120398	-0.04084	0	0
63	0.12884	0.008442	0	0
60	0.153848	0.025008	0	0
59	0.153059	-0.00079	0	0
58	0.158243	0.005183	0	0
57	0.150204	-0.00804	0	0
56	0.421878	0.271674	0	0
53	0.413778	-0.0081	1	0
52	0.47416	0.060382	1	0
51	0.330079	-0.14408	0	1
50	0.243298	-0.08678	0	1
49	0.424332	0.181033	0	1
46	0.463998	0.039667	0	1
45	0.224515	-0.23948	0	1
44	0.438342	0.213827	0	1
43	0.327976	-0.30856	0	1
42	0.129783	0.011467	0	1
39	0.141249	-0.04024	0	1
38	0.101012	0.186026	0	1
37	0.287038	-0.14919	0	1
36	0.137849	-0.13785	0	1

Exhibit 7
Ranking by WISD Differences

pre-event			event		post-event			
4	162	304	2	278	1	105	233	353
12	164	307	14	281	3	108	234	360
13	169	313	25	282	5	109	240	362
15	170	315	28	288	6	114	242	364
17	173	318	31	289	7	115	243	365
19	174	328	32	291	8	119	244	368
23	176	329	33	294	9	121	245	369
24	178	337	45	299	10	122	248	371
26	179	342	48	303	11	123	249	372
30	181	344	66	305	16	124	253	374
35	182	347	72	308	18	126	254	379
36	183	349	75	309	20	129	255	380
39	185	354	81	311	21	131	260	382
40	186	355	86	314	22	135	265	
43	187	356	88	317	27	137	266	
51	188	358	89	323	29	140	267	
53	190	359	92	324	34	141	269	
54	196	361	93	326	37	143	276	
56	198	366	98	330	38	146	280	
58	200	370	107	333	41	147	283	
59	202	375	110	334	42	150	285	
62	203	376	118	338	44	151	287	
63	206	377	120	357	46	152	290	
70	207		125	363	47	153	292	
73	211		136	367	49	156	293	
76	216		138	373	50	158	295	
77	223		144	378	52	165	298	
79	225		145	381	55	166	300	
82	228		159		57	167	302	
85	230		163		60	168	306	
91	235		172		61	171	310	
95	236		175		64	177	312	
106	237		180		65	184	316	
111	239		191		67	189	319	
112	241		193		68	192	320	
113	247		194		69	197	321	
116	250		195		71	199	322	
117	251		201		74	204	325	
127	252		208		78	205	327	
128	256		212		80	209	331	
130	257		218		83	210	332	
132	259		219		84	213	335	
133	262		226		87	214	336	
134	263		238		90	215	339	
139	270		246		94	217	340	
142	271		258		96	220	341	
148	275		261		97	221	343	
149	279		264		99	222	345	
154	284		268		100	224	346	
155	286		272		101	227	348	
157	296		273		102	229	350	
160	297		274		103	231	351	
161	301		277		104	232	352	
Means:		187.1318		207.0864				187.436