TESTING FOR ASYMMETRY IN STOCK PRICES

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ABSTRACT

Testing symmetry is important in many statistical and economic problems and there is considerable research relating to the asymmetry of price transmission within spatial markets and vertical price transmission within a marketing channel. Asymmetric price research has often focused on commodity markets, however, this study tests for asymmetry in stock price changes for the 30 stocks that comprise the Dow Jones Industrial Average for the period January 1987 to December 2002. Asymmetry is examined through the use of two tests: the sum of coefficients test and the speed of adjustment test. A Monte Carlo study is used to compare coefficients from observed daily price changes in International Business Machine (IBM) versus a random series of price changes from a normal distribution, in order to ensure that asymmetry results are reliable.

The results show that some asymmetry is present in stock price changes. The first symmetry hypothesis that the overall impact increases is equal to price decreases is rejected for daily J.P. Morgan and Chase and 3M. Monthly Eastman Kodak, Exxon Mobile, Procter and Gamble and SBC Communications also exhibited asymmetry in the overall impact of price increases and decreases. The second symmetry hypothesis, the speed of adjustment, is rejected for daily Altria, AT&T, DuPont, Exxon Mobil, Hewlett-Packard, Home Depot, Honeywell, J.P. Morgan Chase, Johnson and Johnson, McDonald's, Procter and Gamble, SBC Communications, United Technologies and Walt Disney. Monthly Alcoa, Exxon Mobil, General Motors and McDonald's also show evidence of asymmetry in the speed of adjustment.

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CHAPTER 1

INTRODUCTION

The objective of this study is to determine whether or not there is asymmetry in stock price changes. Price asymmetry is the phenomenon whereby prices tend to move differently depending on their direction. Asymmetry will be examined through the use of two tests: the sum of coefficients test and the speed of adjustment test. The first hypothesis will test whether past negative and positive price changes have identical effects on current price changes. The second one will test whether the speed of adjustment for past price changes will be the same for increases and decreases. A Monte Carlo study will be performed to ensure the reliability of the asymmetry results.

Considerable research is devoted to investigating whether price changes in central markets are transmitted to local market in asymmetrical fashion (Bailey and Brorsen, 1989; Punyawadee, Boyd and Faminow, 1991). Others have researched the possibility of asymmetry in vertical channels (Boyd and Brorsen, 1988; Griffith and Piggott, 1994). Another area of research is the behaviour of price changes within the same market, which is the subject of this study. Do current price changes react differently to past price increases compared to past price decreases? Is the average price increase equal to the average price decrease in absolute terms? To date, little research is documented on asymmetric behaviour of price changes in stock markets. Kang and Brorsen (1995) tested for asymmetry in Kansas City daily wheat futures and find that the total impact of past rising prices is not significantly different from that of past

falling prices, however, the speed of adjustment is significantly different for price increases than for price decreases. Gravelines and Boyd (1999) performed a similar analysis using daily, weekly and monthly prices of commodity prices from a variety of groups such as agricultural, metals, and financials and their results showed that there was at least some degree of asymmetry.

Asymmetry has a number of implications for markets. First, if such behaviour can be confirmed, market regulators and policy-makers may wish to improve the functioning of various markets to more symmetrical behaviour. This may help avoid market crashes and sudden unexpected price adjustments adversely affecting market participants. Second, if price changes are asymmetric, this implies that they contain valuable past information affecting current prices and forecasters and investors may find this information useful for improved decision making. For example, investors may remain for a longer time on the buying side of a market and a short time on the selling side if they feel a particular market is subject to some asymmetry with prices moving down faster than they move up. This in turn implies that because markets contain this useful past price information for trading, then markets are no longer weak form efficient (Fama, 1965). Third, the traditional Black-Scholes option pricing model is based upon the assumption that stock prices are distributed normally. Research has confirmed that stock price changes are not normal and contain kurtosis, skewness, and conditional heteroskedasticity. Improvements to the Black-Scholes model have been proposed and do provide better estimates for deep in-the-money and deep out-of-the-money options. Asymmetric price changes may

be the next characteristic incorporated into an option pricing model in order to obtain better estimates.

The objective of this research study is to test for asymmetry in Dow Jones Industrial Average (DJIA) stock price changes. Stocks are tested over daily and monthly prices to provide a common foundation to make comparisons between stocks from different industries. Asymmetry will be examined through the use of two tests: the Sum of Coefficients test and the Speed of Adjustment test. Given this, the thesis proceeds as follows. Chapter 2 introduces the methodology of price asymmetry testing model as the conceptual frame work used to meet the objective of this study, data used, and reviews the related literature. Econometric estimates and results of asymmetry tests are shown and discussed in Chapter 3. Chapter 4 summarizes the thesis, describes how the knowledge gained through this study can be used by the financial industry, states the limitations of the study and identifies opportunities for further research.

CHAPTER 2

DESIGNING A MODEL AND TESTING FOR ASYMMETRY

Literature Review

The question of whether there is a symmetric response to price changes is not new. A distinct separation of thought persists in economics regarding the dynamic adjustments of prices. In Classical theory, markets are continuously cleared by flexible prices with instantaneous adjustments of prices to agents' perceptions of monetary policy. In contrast, Keynesian theory suggests non-auction prices are slow to adjust to equilibrium with short-run clearing achieved by adjustments of transacted quantities. A sufficient reason for the continued split in descriptions is that both views are supported by empirical evidence. On the one hand, the case for sticky prices is not easily squared with the rapid movements of prices in inflationary episodes, as reviewed by Sargent (1982). On the other hand, the assumption of instantaneously flexible producer prices seems inconsistent with the lengthy spells of rigid prices documented in Carlton (1986) and Blinder (1991) and the sluggish price responses estimated by Sims (1992) and Christiano, Eichenbaum, and Evans (1994). A third alternative is that both Classical and Keynesian characterizations may be describing price behaviour in different stages of business cycles. If producers respond asymmetrically to positive and negative deviations from trends, this may prompt producer corrections of prices that are below trends, and can account for the essential classical features of flexible price responses to expected inflation. Conversely, resistance to margin reductions for prices that are above trends can support the

Keynesian description of sluggish adjustment that leaves prices at excessively high levels over extended intervals.

This sharp difference of opinion about dynamic adjustments of prices has led to close scrutiny of stock market price movements. The phenomenon of stock price movements has always been of great interest for many researchers, since it helps to investigate the efficiency of the stock market. Numerous studies have attempted to explain the occurrence, and foresee possible consequences of those movements in order to examine whether the efficient market hypothesis holds. This has resulted in considerable work devoted to this idea and closely related topics. Thus, at present, there are a wide range of research studies examining whether stock prices fluctuate excessively due to changes in fundamentals, or whether some other factors, such as bubbles, fads, incomplete information and learning, play a significant role in determining instability of stock prices. The stock market surge in the closing years of the twentieth century renewed the debate on the influence of fundamentally versus non-fundamentally justified stock price movements and whether price asymmetry exists in the stock markets.

While there has been only limited analysis of asymmetry in financial markets, there is considerable research on asymmetry in the agricultural literature and gasoline markets. Kinnucan and Forker (1987), Hahn (1990), Willett, Hansmire and Bernard (1997), Borenstein, Cameron, and Gilbert (1997), and Peltzman (2000) found that price increases are more rapid and fully transmitted than price decreases. In contrast, Ward (1982), Blinder (1994), and

Levy, Dutta, Bergen, and Venable (1998) found that price decreases were transmitted more fully than price increases. Kinnucan and Forker (1987) study prices transmission from farm to retail for dairy product. They find that retail dairy product prices adjust more rapidly and more fully to increases in the farm price of milk than to decreases. Willett, Hansmire and Bernard (1997) conclude that shipping point prices are asymmetric in response to changes in wholesale and retail market prices in their study of red delicious apples. Parrott, Eastwood, and Brooker (2001) look at the Florida fresh tomatoes marketing channel and find no evidence of asymmetry. Boyd and Brorsen (1988) also look at the U.S. pork marketing channel and find no evidence of asymmetry contrary to Hahn's study (1990), which finds asymmetry in both the U.S. pork and beef marketing channels. Griffith and Piggott (1994) confirm Freebairn's (1985) conclusion relating to the absence of price asymmetry for pork, but not for beef and lamb in the Australian marketing channel. Mohanty, Peterson and Kruse (1995) look at the world wheat market and find that major exporting countries respond asymmetrically to U.S. price changes. According to their results, Argentina and the European Union show greater response to falling prices than to rising prices, while the opposite is true for Canada and Australia. While most of the literature relates to agricultural products, gasoline markets and prices, it also concentrates on price transmission in spatial markets and vertical transmission in a marketing channel. Kang and Brorsen (1995) test for asymmetry within the same market, and they report that the Kansas City Wheat futures market had asymmetry in the speed of the adjustment. Gravelines and Boyd (1999) also test for asymmetry in

futures price changes using commodities from a variety of group such as agricultural, metals, and financial and they report that every commodity analyzed shows at least some degree of asymmetry.

The efficient markets theory states that market prices reflect the knowledge and expectations of all investors. As a consequence, this theory predicts, according to Fama (1965), that the market would react quickly to such a discovery and these patterns would be modified instantly. Since most stock markets are highly competitive, prices are often assumed to follow a random walk. The first difference of prices is thus simply a random series, or white noise, with no systemic differences between price increases and decreases; however, human behaviour does not always coincide with rational behaviour. Speculative bubbles are an example of irrational behaviour, which causes a price to increase contrary to rational behaviour (Kindleberger 1989). Individuals realize that a price today is abnormally high, and despite this knowledge, they still bid the price higher because they do not want to miss out on potential capital gains from the price going even higher tomorrow. Eventually the bubble bursts and the price drops rapidly.

Investors or traders sometime act as a herd psychologically because under certain circumstances the action of a few is duplicated by the whole (Keynes 1936). Humans can also become slowly attached to their assets and increase their investment over time for psychological and emotional reasons, however, the initial reluctance to sell may be due to factors such as the endowment effect (Kahneman, Knetsch and Thaler 1990). Individuals are

believed to be initially reluctant to their goods, and wish a higher price than the price they are willing to accept. Eventually, after sales begin, the value of the asset decreases, which causes more sales, and fuels the downward price spiral. This downward selling pressure and counter reaction to the attachment of assets and the endowment effect can result in a large liquidation very quickly.

Methodology

Tweeten and Quance (1969) were the first to develop a model to test for asymmetry. This model was later modified by Wolffram (1971) and Houck (1977). These models differed in the way the independent variable was segmented into increasing and decreasing phases. The static nature of these models has been criticized for not fully accounting for price changes that take longer than one time period (Boyd and Brorsen 1988). Dynamic models have been used on several occasions to test for asymmetry in price adjustment (Boyd and Brorsen 1988; Kinnucan and Forker 1987; Bailey and Brorsen 1989). Kang and Brorsen (1995) and Gravelines and Boyd (1999) added dummy variables to capture the day of the week effect and trigonometric functions in an attempt to model seasonality. This study regresses percentage price changes (PPC), the dependent variable, against both positive (PPPC) and negative (NPPC) lagged percentage price changes within the same series, which are the independent variables. The asymmetry model is obtained by segmenting lagged percentage price changes into two sets, one for positive lagged percentage price increases and another for

lagged percentage price decreases. The percentage price changes, PPC_t, are segmented as,

$$PPPC_t = \begin{cases} PPC_t, & PPC_t \geq 0 \\ 0, \text{otherwise}, \end{cases}$$

$$NPPC_t = \begin{cases} PPC_t, \text{PPC}_t < 0 \\ 0, \text{ otherwise}, \end{cases}$$

Where PPC_t is the difference of returns at time t. The following is the model to be estimated which is similar to Gravelines and Boyd (1999). Equations 1 and 2 are for the daily and monthly analysis respectively.

$$PPC_t = a_0 + \sum_{i=1}^{6} \lambda_i PPPC_{t-i} + \sum_{i=1}^{6} \gamma_i NPPC_{t-i} + a_1 D_{MON} + a_2 D_{TUE} + a_3 D_{WED} + a_3 D_{THU} + \varepsilon_t \quad (1)$$

$$PPC_t = a_0 + \sum_{i=1}^{6} \lambda_i PPPC_{t-i} + \sum_{i=1}^{6} \gamma_i NPPC_{t-i} + a_1 D_{JAN} + a_2 D_{FEB} + a_3 D_{MAR} + a_4 D_{APR} + a_5 D_{MAY} + a_6 D_{JUN} + a_7 D_{JUL} + a_8 D_{AUG} + a_9 D_{SEP} + a_{10} D_{OCT} + a_{11} D_{NOV} + \varepsilon_t \quad (2)$$

Where λ_i and γ_i represent the net effect of the i^{th} positive and negative changes of PPC_t, respectively, and 6 is the number of lags. The lag length of six periods was chosen for equation 1 and equation 2 by the Akaike Information Criterion (AIC) method, used by Nutngo and Boyd (1998) and developed by Akaike (1981). By keeping the lag period constant across stocks, comparisons can be made between the models and results. D represents dummy variables for each

day of the week, each month of the year; D_{MON} = 1 if Monday and 0 otherwise, D_{TUE} =1 if Tuesday and 0 otherwise, D_{WED} = 1 if Wednesday and 0 otherwise, D_{THU} = 1 if Thursday and 0 otherwise. D_{JAN} =1 if January and 0 otherwise, D_{FEB} = 1 if February and 0 otherwise, D_{MAR} = 1 if March and 0 otherwise, D_{APR} =1 if April and 0 otherwise, D_{MAY} =1 if May and 0 otherwise, D_{JUN} =1 if June and 0 otherwise, D_{JUL} = 1 if July and 0 otherwise, D_{AUG} =1 if August and 0 otherwise, D_{SEP} = 1 if September and 0 otherwise, D_{OCT} =1 if October and 0 otherwise, and D_{NOV} =1 if November and 0 otherwise.

For the daily and monthly stock price changes sixty equations over sixteen years, are estimated using ordinary least squares procedures. Autocorrelation is not a significant problem with the data since first differences are used. The two traditional tests for asymmetry are evaluated for the rejection of the null hypothesis that price changes are symmetrical. The sum of coefficients, the first hypothesis, tests the aggregate impact of past price increases and decreases to determine whether they are different:

$$H_0 : \sum_{i=1}^{6} \lambda_i = \sum_{i=1}^{6} \gamma_i \qquad (3)$$
$$H_A : H_0 \text{ is not true}$$

The first hypothesis test implies that the market reacts differently to the total impact of past rising prices than past falling prices. In conventional autoregressive models, current price changes are regressed against lagged price changes. This forces the coefficients for a certain lag to be the same for increase

and decreases. Separating past price changes into positive and negative changes allows the coefficient for increases to differ from that of decreases. Asymmetry is reflected by a difference between the coefficients for increases and decreases. Positive regression coefficients are expected to have positive signs if past price changes are positively correlated with current price changes and negative regression coefficients are expected to have negative signs if past price changes are negatively correlated with current price changes. Coefficients can differ in two respects. The first is when the positive and negative coefficients of the same lag period have different magnitudes but the same sign. The second possible way that asymmetry can be present is if the signs of the coefficients are different for increases and decreases. Opposite signs for the same lag period implies that a past increase affects the current price change in the same direction as a decrease.

The second hypothesis tests whether the speed of adjustment is different for both price increases and decreases

$$\begin{aligned} H_0 &: \lambda_i = \gamma_i, \text{ for all } i \\ H_1 &: H_0 \text{ is not true} \end{aligned} \qquad (4)$$

In other words, for each equation, each of the individual lagged price increase coefficients are tested against each of the corresponding lagged price decrease coefficients to see if they are the same. The speed of adjustment test involves a joint test pairs of coefficients. Rejection of this hypothesis forces the inspection of the individual coefficients for an appropriate explanation of the

asymmetry. In some case, it may be difficult to determine whether there is a faster speed of adjustment for increases rather than decreases.

Data Description

This study focuses on the 30 stocks that are included in the Dow Jones Industrial Average (DJIA). DJIA stocks are of particular interest as they account for a substantial fraction (25% - 30%) of the total market value of all U.S. stocks. The Dow does not literally "represent" the entire U.S. market, rather, it is a blue chip index representing the leading companies in the industries driving the U.S. stock market. As a result, its performance is highly correlated with other indexes comprised of hundreds or thousands more stocks. The data used were obtained from the database of Centre for Research in Security Prices (CRSP), Graduate School of Business, University of Chicago for the period January 1, 1987 to December 31, 2002. It consists of daily and monthly closing stock prices for each stock. Choosing all 30 stocks over the same time horizon (Daily, Monthly), comparisons can be made to determine if asymmetry is found in stock prices. The models are estimated using the first difference of the percentage change of closing stock prices for the particular stock. Most studies including Fama (1965) used the first differences of natural logarithmic closing prices, arguing that changes less than $\pm$ 15 % the change in the log price are very close to the percentage price changes, and for many purposes it is convenient to look at the data in terms of percentage price changes. However, due to the stock market surge and recent large fluctuation of the stock markets (i.e. actual changes were

larger than ± 15 percent) to avoid wrong conclusions the actual percentage price changes were used to do the study. The stock splits dates are removed from the data set to avoid spurious price jumps from one day to the next. The monthly data is obtained from the daily series by choosing the last trading day in each month. Table 2.2 contains the correlation matrix for daily percentage price changes of Eastman and Kodak and it is representative of the other stocks. It indicates no high correlation or multicollinearity problems in the estimation of equations 1 and 2.

Table 2.1 As of 2003, the Dow Jones Industrial Average consists of the following 30 companies.

Company Name	Industry Group	Ticker
Alcoa Incorporated	Aluminum	AA
Altria Group, Incorporated (formerly Philip Morris)	Tobacco	MO
American Express Company	Financial Services	AXP
AT & T Corporation	Telecommunications	T
Boeing Company	Aviation and Aerospace	BA
Caterpillar Incorporated	Heavy Equipment	CAT
Citigroup Incorporated	Financial Services	C
Coca-Cola Company	Beverage	KO
DuPont	Chemical	DD
Eastman Kodak Company	Photographic Equipment	EK
Exxon Mobile Corporation	Petroleum	XOM
General Electric Company	Electronics, Financial Services	GE
General Motors Corporation	Automobile	GM
Hewlett-Packard Company	Computer Hardware, Printer	HPQ
Home Depot Incorporated	Retail, Home Improvement	HD
Honeywell International Incorporated	Electronics	HON
Intel Corporation	Microprocessors	INTC
International Business Machines	Hardware, Software and Services	IBM
International Paper Company	Paper, Packaging	IP
J.P. Morgan Chase and Company	Financial Services	JPM
Johnson and Johnson Corporation	Pharmaceuticals	JNJ
McDonald's Corporation	Fast Food Franchise	MCD
Merck and Company	Pharmaceuticals	MRK
Microsoft Corporation	Software	MSFT
3M Company	Material, Electronics	MMM
Procter and Gamble Company	Household Supplies, Pharmaceuticals	PC
SBC Communications Incorporated	Telecommunications	SBC
United Technologies	Aerospace, Defense	UTX
Wal-Mart Stores Incorporated	Retail	WMT
Walt Disney Company	Entertainment	DIS

* For general company information and business line see appendix.

Table 2.2

Daily Eastman & Kodak Stocks Percentage Price Change Variable Correlations, January 1987 through December 2002

Stock Price Variable	POS_{t-1}	POS_{t-2}	POS_{t-3}	POS_{t-4}	POS_{t-5}	POS_{t-6}	NEG_{t-1}	NEG_{t-2}	NEG_{t-2}	NEG_{t-4}	NEG_{t-5}	NEG_{t-6}
PPC_t	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POS_{t-1}		0.1893	0.0301	0.1121	0.0343	-0.0394	-0.0255	0.1859	0.0083	-0.0132	0.2412	0.0687
POS_{t-2}			-0.0250	0.1162	0.0888	0.5763	-0.0323	0.0175	-0.0503	0.0008	0.0869	-0.0511
POS_{t-3}				0.0624	-0.0603	0.1025	-0.0388	-0.0757	-0.0578	0.0093	-0.0029	-0.0009
POS_{t-4}					0.0149	0.0819	-0.0168	0.0332	-0.1332	-0.0505	-0.0697	0.0719
POS_{t-5}						0.0247	0.1109	0.0097	-0.1329	-0.0304	-0.1098	-0.0841
POS_{t-6}							0.4096	0.3194	0.2983	0.3651	0.1903	0.3734
NEG_{t-1}								0.0346	-0.0956	-0.0207	0.0151	-0.0842
NEG_{t-2}									-0.1478	0.0199	0.0089	-0.0786
NEG_{t-2}										-0.1113	-0.0096	0.0549
NEG_{t-4}											-0.1051	-0.1122
NEG_{t-5}												-0.0593

PPC_t = dependent variable percentage price change

POS_t = positive percentage change, POS_{t-m}=lagged m days.

NEG_t = negative percentage price change, NEG_{t-m} = lagged m days.

CHAPTER 3

EMPIRICAL RESULTS

In all, sixty two equations are estimated, with two time horizons for each of the thirty stocks. The equations are of the form specified in Equations 1 and 2. Augmented Dickey-Fuller unit-root tests are conducted for stock prices, for the percentage changes of the stock prices, and for percentage difference of stock prices. All stocks have significant statistics, which indicates stationarity of the variables. Table 3.1 presents the results of the unit-root tests for daily Microsoft prices and is representative of the other stocks as well.

Aggregate Impact Test

The first hypothesis, the impact test, is shown at the bottom "Sum F-value" in each of Table 3.2 through 3.31 for the various stocks. The results suggest that there is evidence of asymmetry in stock markets, based on the first hypothesis, that the total impact of past increases is the same as past decreases. The hypothesis is rejected under six situations, including daily J.P. Morgan and Chase and 3M and monthly Eastman and Kodak, Exxon Mobile, Procter and Gamble, and SBC Communications. In the results for J.P. Morgan and Chase for example, the sum of the positive changes is larger in absolute terms than negative changes for daily prices. Closer inspection of the coefficients shed some light onto the interpretation.

For monthly J.P. Morgan and Chase percentage price changes, no POS coefficients are significantly different from zero, therefore, the sum of positive change coefficients is negative but essentially zero. The sum of the NEG

coefficients is negative and one of the coefficients is significant. This implies that past price decreases have positive effects on the current price change.

Another situation in which the total impact is not the same is daily 3M. Table 3.26 shows the results for 3M and the signs are the same for the sums of the positive and negative coefficients. The sum of positive changes is greater than that for negative changes implying that past price increases have larger impacts on the current price change than do decreases. One reason for this is the fact that NEG1 is positive and NEG2 is negative and are of comparable magnitude, therefore cancelling each other out when the sum is calculated. POS5 is the only significant coefficient for POS coefficients therefore it has a larger impact than the NEG coefficients.

These daily, along with monthly stocks of Eastman and Kodak, Exxon Mobile, Procter and Gamble and SBC Communications were rejected by the null hypothesis of the impact on current price changes, as being the same for past increases and decreases. By calculating the sums of the positive and negative lagged coefficients, one can observe that the sum of the negative coefficients is greater than that of the positive coefficients in absolute terms. This implies that current price changes are affected by past price decreases and past price increases have no effect on current price changes.

Speed of Adjustment Test

The result of the second hypothesis test, that the coefficients for each lag will be the same for increases as for decreases, reported as "Identical F-Value" at the bottom of Table 3.2 through 3.31 for various stocks, was rejected for eighteen of the sixty situations. These rejections include daily data in Altria, AT &T, DuPont, Exxon Mobil, Hewlett-Packard, Home Depot, Honeywell, J. P. Morgan Chase, Johnson & Johnson, McDonald's, Procter & Gamble, SBC Communications, United Technologies and Walt Disney, and monthly data Alcoa, Exxon Mobil, General Motors and McDonald's, where asymmetry was detected. Fourteen of the eighteen situations involve daily data; this was expected because asymmetry has often been found in the short run. An insight as to which direction the asymmetry is affecting the price changes can be gained by looking at the daily J. P. Morgan Chase results in Table. 3.21. Focusing on the difference between the coefficients POS2, NEG2 and POS3, NEG3 may give an indication as to how to interpret the asymmetry.

By looking at the difference between POS2 and NEG2 (greater than zero) and looking at the individual coefficients, it can be seen that POS2 is greater than zero and that NEG2 is less than zero. The coefficients indicate a positive price change two periods ago will have a positive effect on today's price change, but a negative price change two periods ago has a greater impact on today's price change and surprisingly will tend to cause it to be positive. This result may be due to the events that occurred during the week of October 19, 1987 to October 23, 1987. On Monday, October 21, 1987, the stock market crashed, plummeting

more than 80 points in a single day and two days later the market rebounded with relatively large positive change on Wednesday, October 23, 1987 of approximately 40 points. The 1987 crash may be considered an anomaly; it may be that the coefficients are being influenced by this one extreme event. Table 3.34 contains the daily coefficients for Walt Disney with and without the 1987 crash. Obviously the crash has an effect on the coefficients; POS3 is significant when the crash is included and is insignificant when it is removed. The inclusion of the crash is important in the sense that models should be aware of the possibility of these drastic market adjustments. On the other hand, since a cause can be assigned to the outlier and has a large influence on the coefficients, it should be removed to better represent the majority of the data.

The following analysis on daily Walt Disney uses the data set with the market crash removed (see Table 3.33). With the crash removed, the hypothesis is still rejected. The first period lags have statistically different coefficients, POS1 is insignificant meaning that if the price went up last period there is no effect on today's price change. The same cannot be said about NEG1, if the index dropped last period today's price will tend to rise, all other things being equal. The third lag rejects the asymmetry hypothesis as well, if the stock market went up three periods ago, it can be expected it will fall this period. NEG3 is also significant and indicates that the current price will drop if the price fell three periods earlier. In this case the asymmetry occurs because the current price will decrease regardless of the directional change three periods ago. The price will decrease with a greater magnitude if the price increases rather than decreases

three periods ago. This analysis assumes, however, that everything else remains constant, the price does not change for any other lag and there are no other factors affecting the price change. The other situations can be analyzed in a similar fashion as outlined above. By testing each set of POS and NEG coefficients an insight can be gained as to which way the market adjusts asymmetrically to past price changes.

DESCRIPTIVE STATISTICS

To provide a general understanding of the nature of the percentage price changes, the number of increases and decreases and the average size of the positive and negative changes are presented in Table 3.34 A and B. A two sample pooled t-test is used to verify any statistical differences between the means for the positive changes and negative changes. Daily Alcoa, AT & T, American Express, Boeing, Caterpillar, Citigroup, Coca Cola, DuPont, General Electric, General Motors, Hewlett-Packard, Home Depot, Intel, International Papers, Johnson & Johnson, McDonald's, Merck, Microsoft, Procter & Gamble, SBC Communications, United Technologies, Wal-Mart, and Walt Disney are stocks that rejected the hypothesis of equal means. It should be noted that these statistics are only testing certain characteristics of a distribution and percentage price change behaviour. Having the same number of increases and decreases with the same average change does not necessarily confirm symmetry within a series. A simple example that demonstrates this is as follows: assume there are ten periods in a series. In the first period the price rises 4 units, second period decreases 2 units, third period increases 4 units, fourth period decreases 2

units... ninth period increases 4 units, tenth period decreases 12 units. The number of increases is 5, number of decreases is 5, average increase is 4, and average decrease is 4. The summary statistics seem to suggest that increases behave in the same manner as decreases. This is obviously misleading because there is a large decrease at the end, which happens to combine with the smaller decreases to equal the average increase. A frequency distribution is able to display any difference if the distribution for the increases is overlayed on the distribution for the decreases.

Figures A.1 to A.30 show the empirical distribution of positive and negative percentage price changes of the thirty stocks. Except for a few stocks, the relationship between negative and positive percentage price changes seems to follow the same pattern. The negative distribution is clearly different due to the fact that it is below the positive distribution for smaller changes and above for larger changes. The two price change distributions are different, implying asymmetry within the series.

Tables 3.36 consist of summary statistics of daily and monthly percentage price changes for the sixty data series analyzed. The statistics include percentage price changes for mean (μ), standard deviation (σ), skewness (S), and excess kurtosis (κ). It is well documented that stock price changes are leptokurtic, meaning a high level of positive kurtosis (Hall, Brorsen, and Irwin, 1989; Hudson, Leuthold and Sarassoro, 1987; Kang and Brorsen, 1995). A large kurtosis is a result of more observations in the tails and around the mean than

that of normal distribution. The stocks with the largest kurtosis were daily Atria, AT & T, Walt Disney, DuPont, and SBC Communications.

Figure A.1
Daily Alcoa Empirical Distribution of Positive and Negative Percentage Price Changes

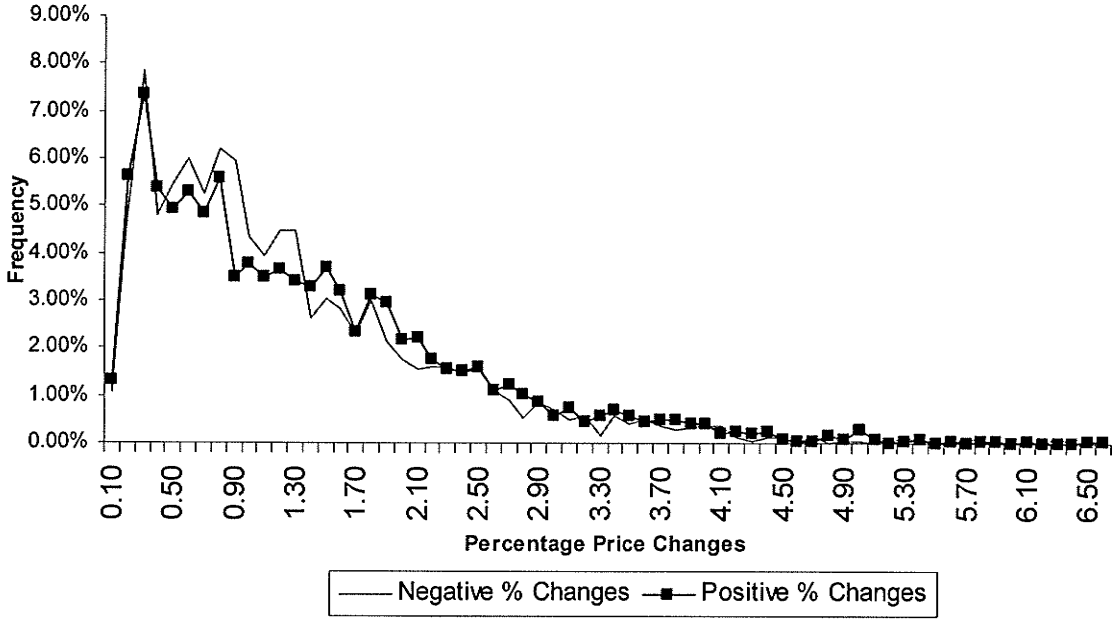


Figure A.2
Daily Altria Empirical Distribution of Positive and Negative Percentage Price Changes

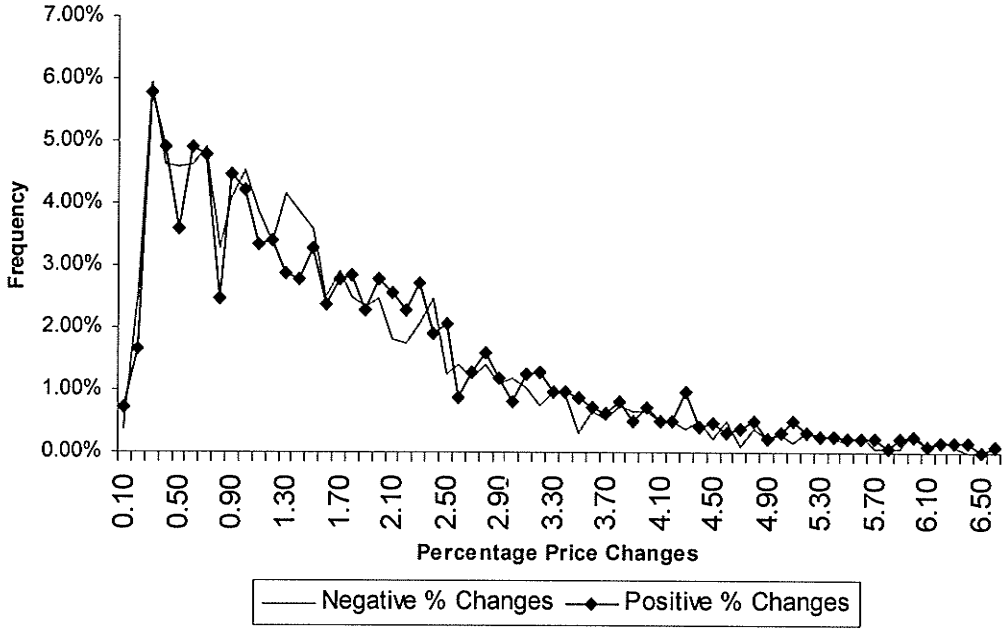


Figure A.3
Daily American Express Empirical Distribution of Positive and Negative Percentage Price Changes

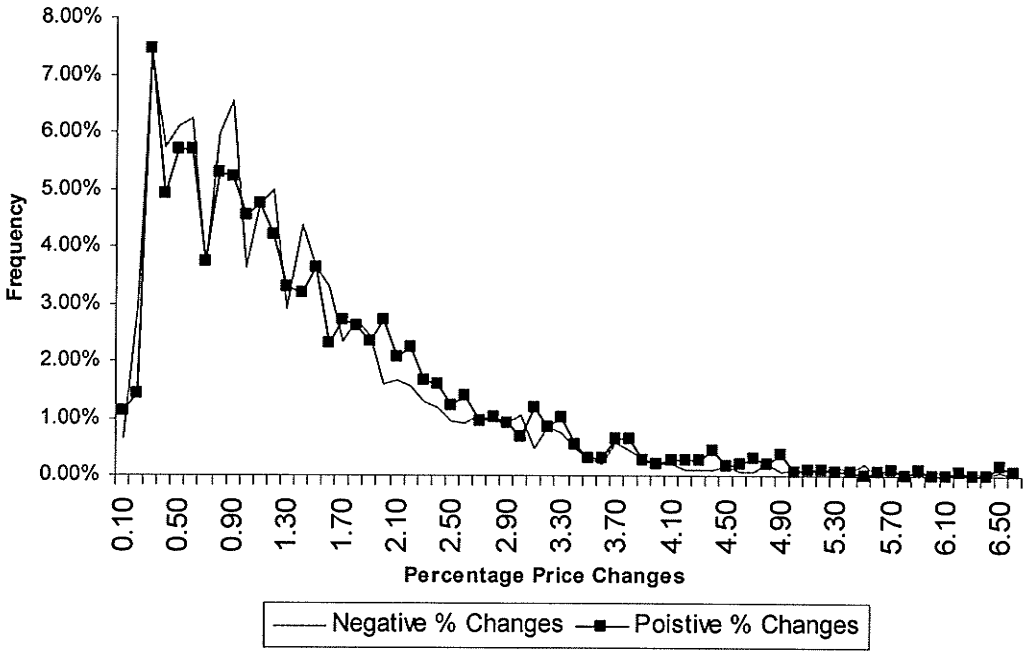


Figure A.4
Daily AT & T Empirical Distribution of Positive and Negative Percentage Price Changes

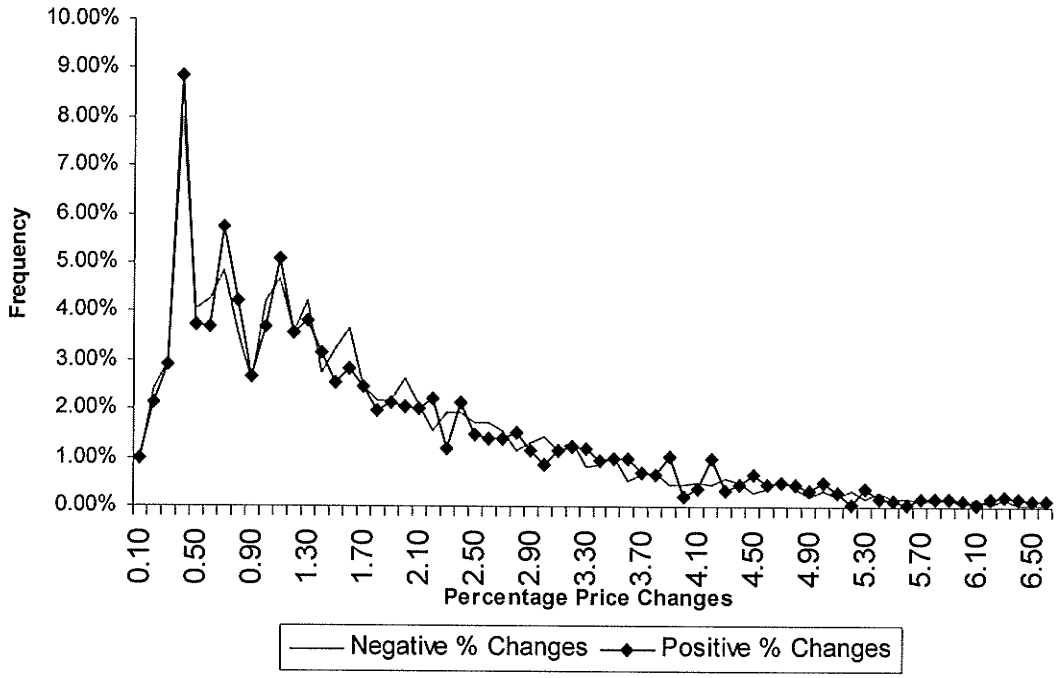


Figure A.5
Daily Boeing Empirical Distribution of Positive and Negative Percentage Price Changes

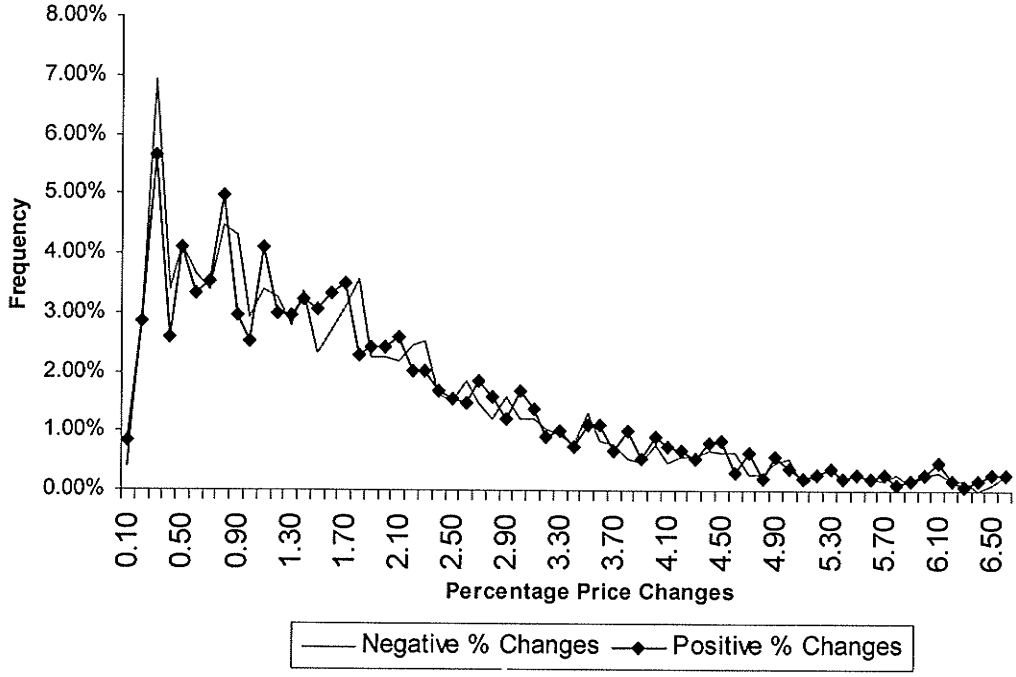


Figure A.6
Daily Caterpillar Empirical Distribution of Positive and Negative Percentage Price Changes

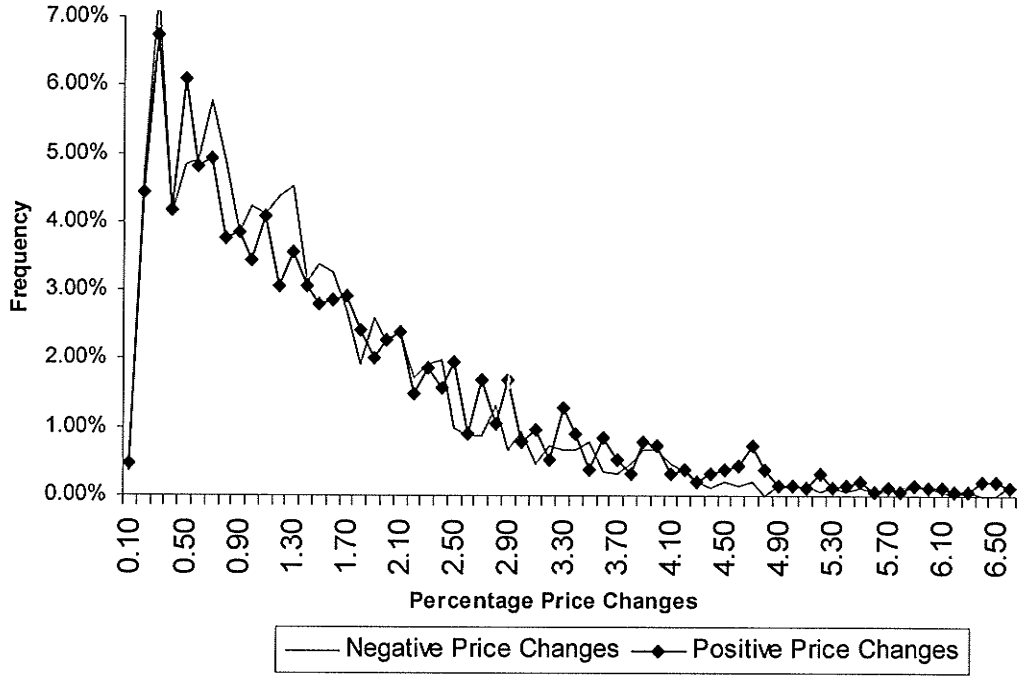


Figure A.7
Daily Citigroup Empirical Distribution of Positive and Negative Percentage Price Changes

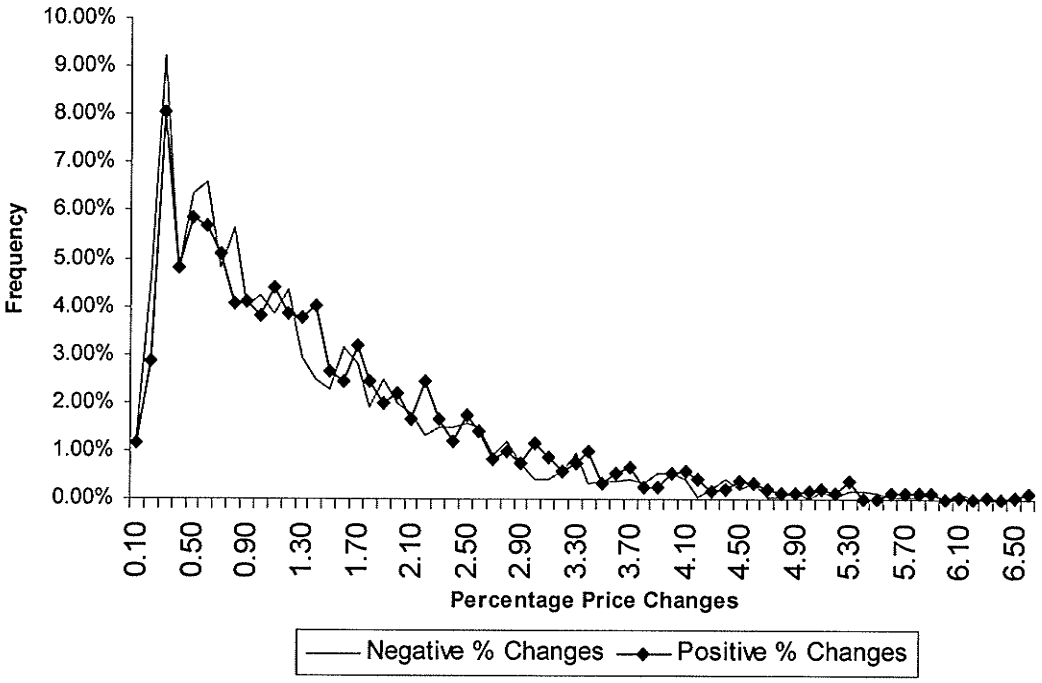


Figure A.8
Daily Coca Cola Empirical Distribution of Positive and Negative Percentage Price Changes

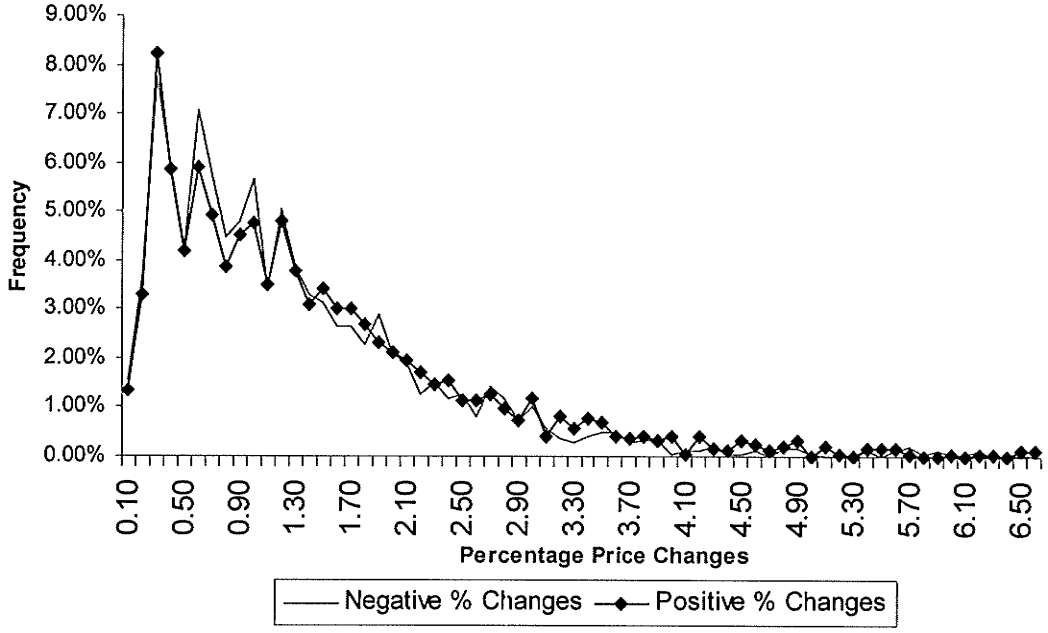


Figure A.9
Daily DuPont Empirical Distribution of Positive and Negative Percentage Price Changes

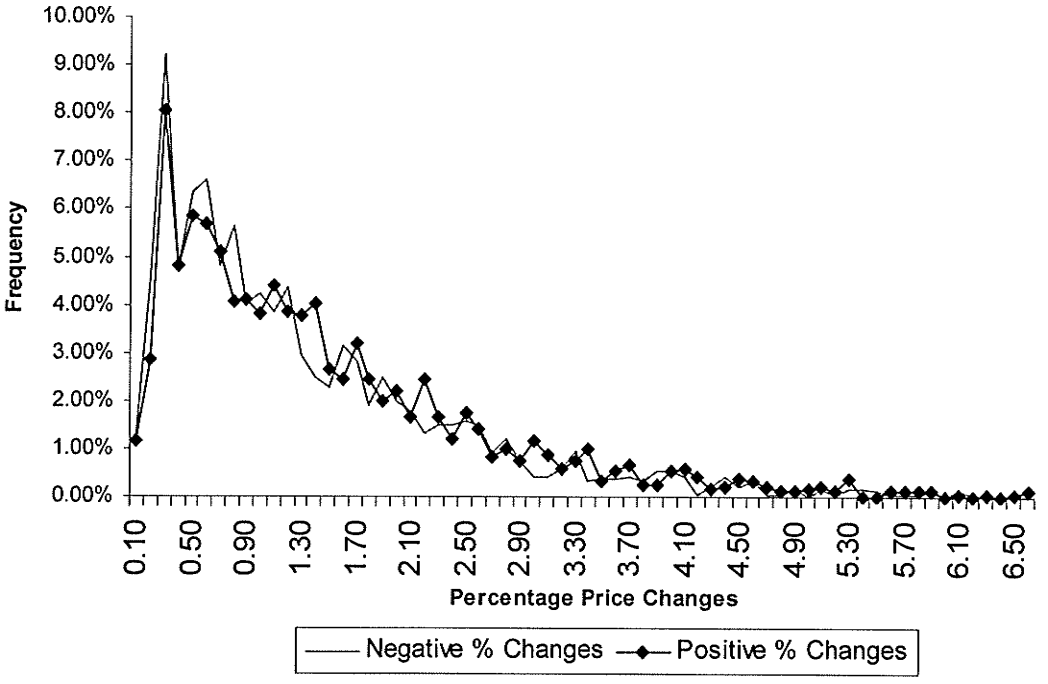


Figure A.10
Daily Eastman Kodak Empirical Distribution of Positive and Negative Percentage Price Changes

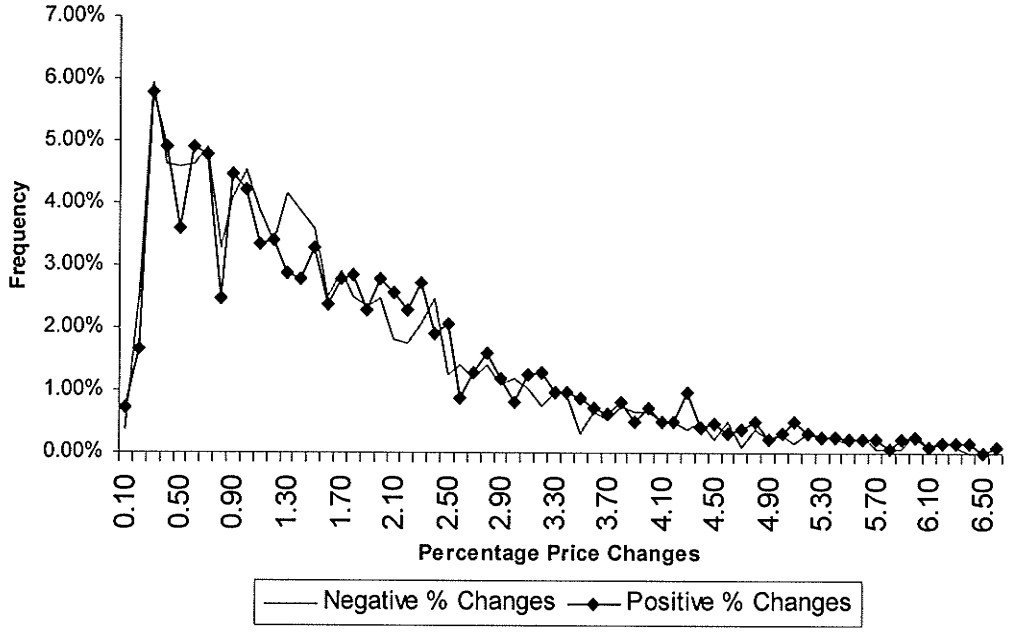


Figure A.11
Daily Exxon Mobile Empirical Distribution of Positive and Negative Percentage Price Changes

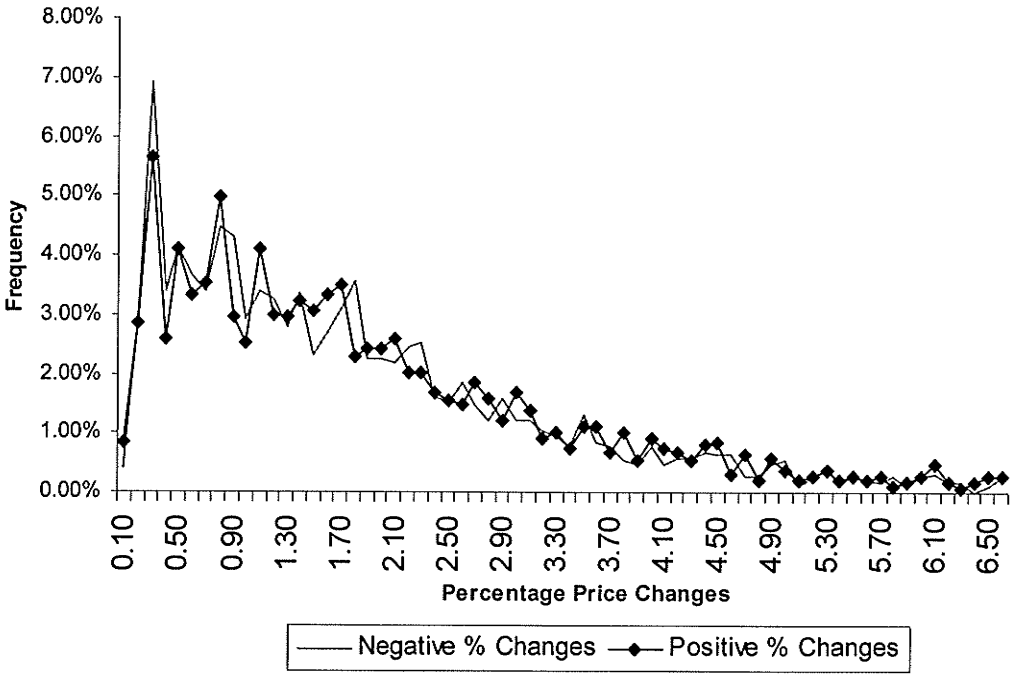


Figure A.12
Daily General Electric Empirical Distribution of Positive and Negative Percentage Price Changes

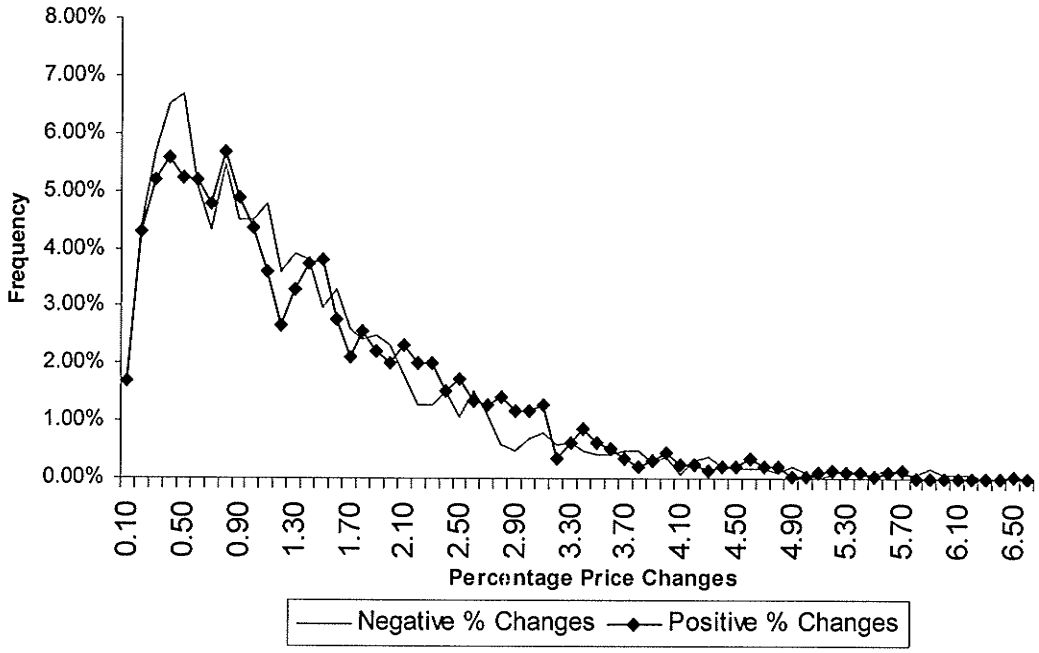


Figure A.13
Daily General Motors Empirical Distribution of Positive and Negative Percentage Price Changes

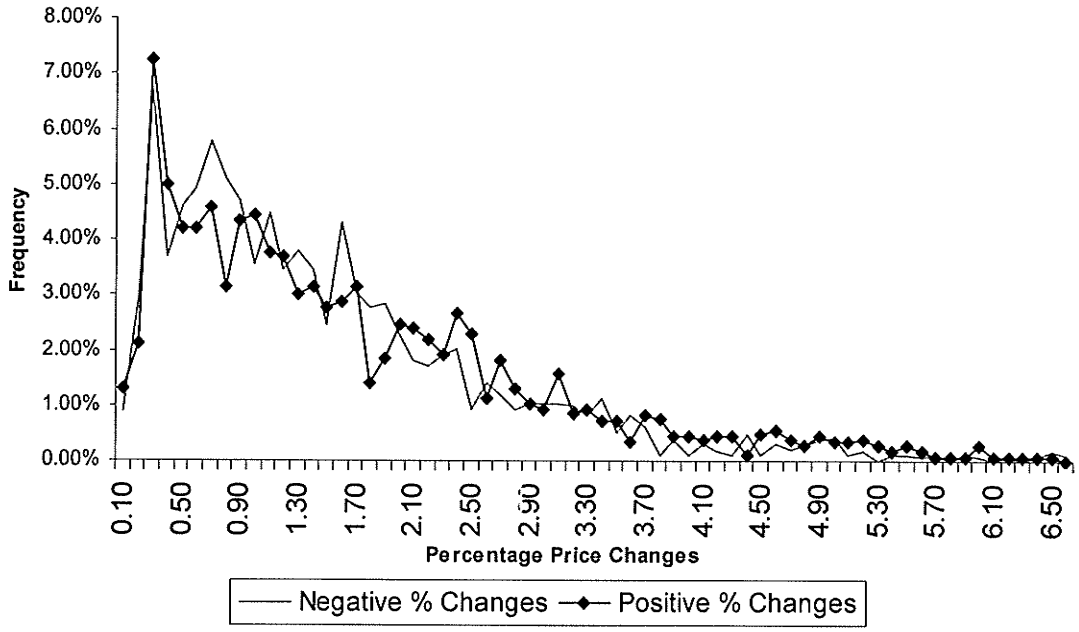


Figure A.14
Daily Hewlett-Packard Empirical Distribution of Positive and Negative Percentage Price Changes

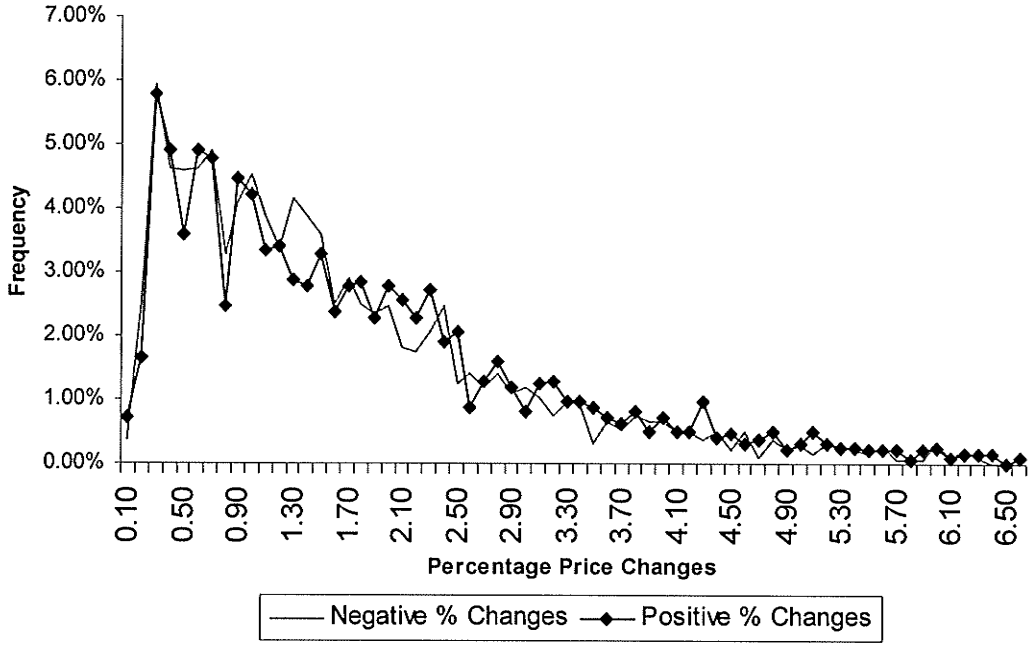


Figure A.15
Daily Home Depot Empirical Distribution of Positive and Negative Percentage Price Changes

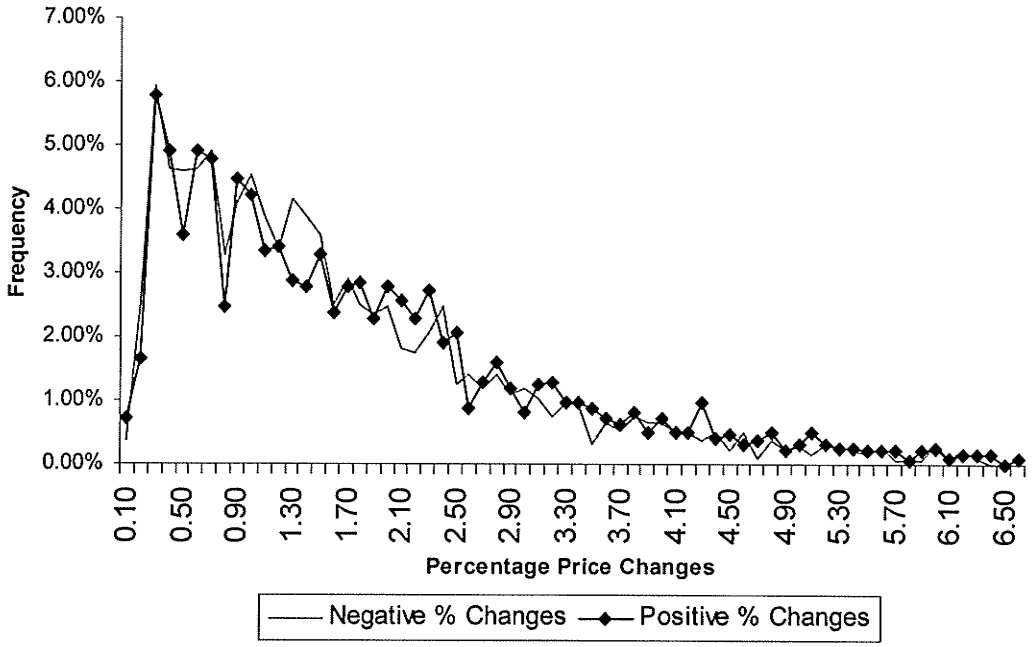


Figure A.16
Daily Honeywell International Empirical Distribution of Positive and Negative Percentage Price Changes

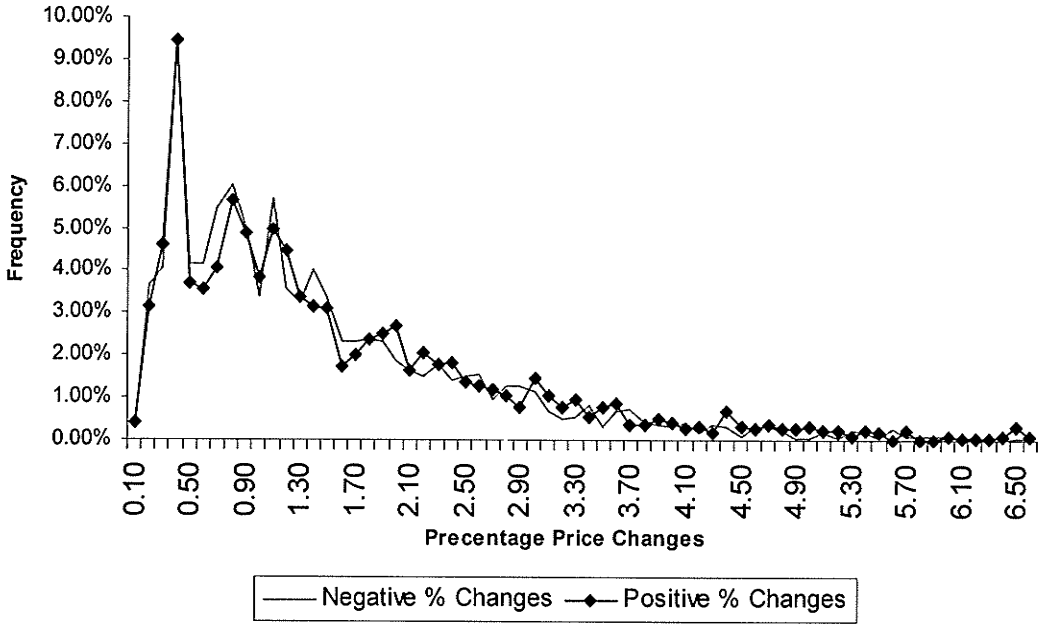


Figure A.17
Daily Intel Empirical Distribution of Positive and Negative Percentage Price Changes

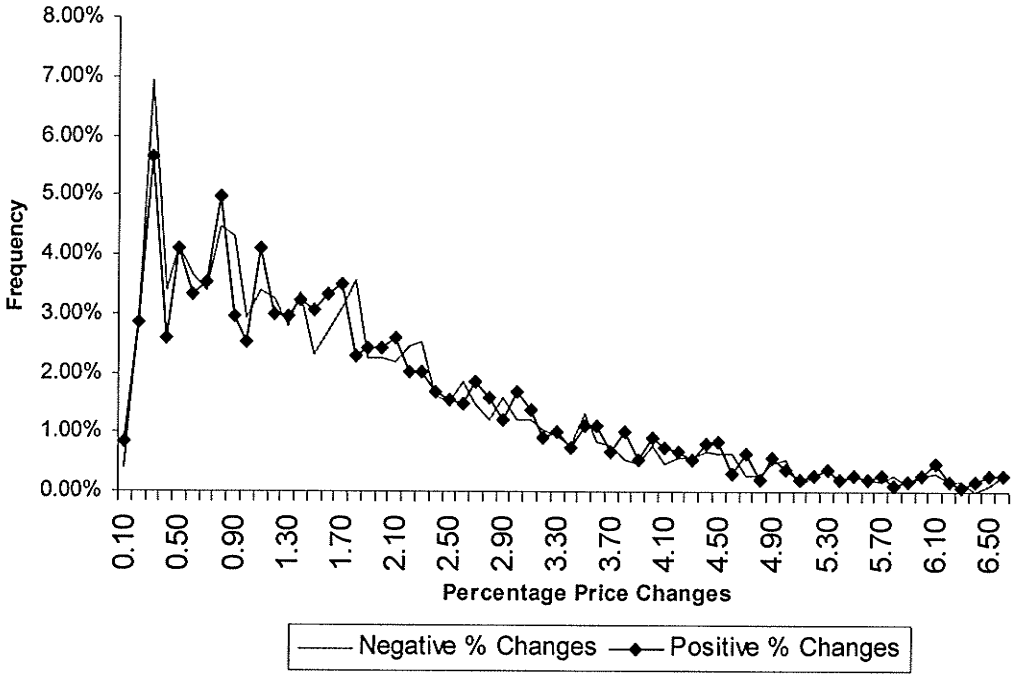


Figure A.18
Daily IBM Empirical Distribution of Positive and Negative Percentage Price Changes

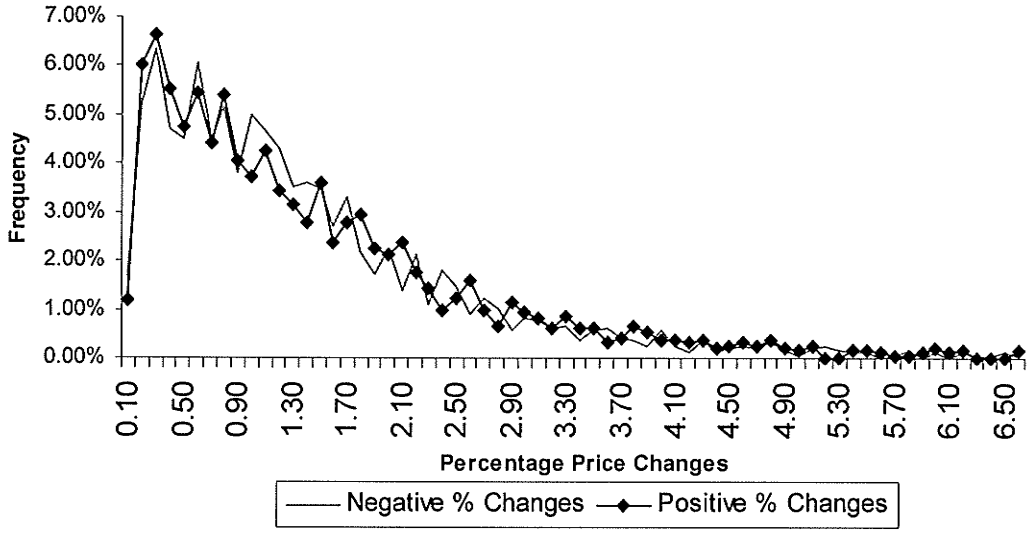


Figure A.19
Daily International Paper Empirical Distribution of Positive and Negative Percentage Price Changes

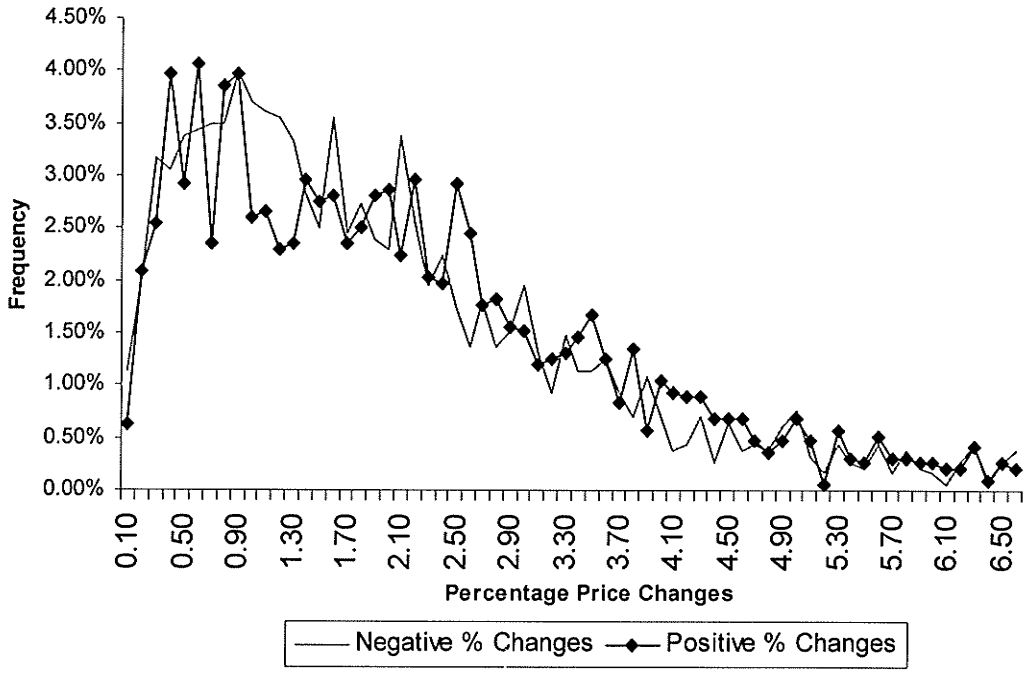


Figure A.20
Daily J.P. Morgan Chase Empirical Distribution of Positive and Negative Percentage Price Changes

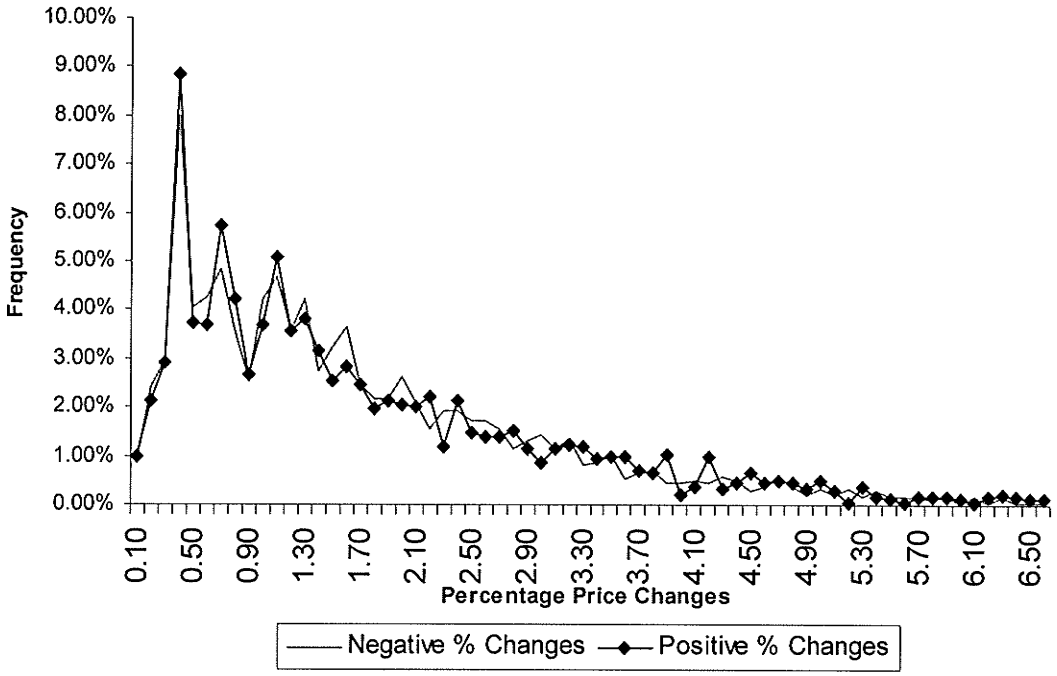


Figure A.21
Daily Johnson and Johnson Empirical Distribution of Positive and Negative Percentage Price Changes

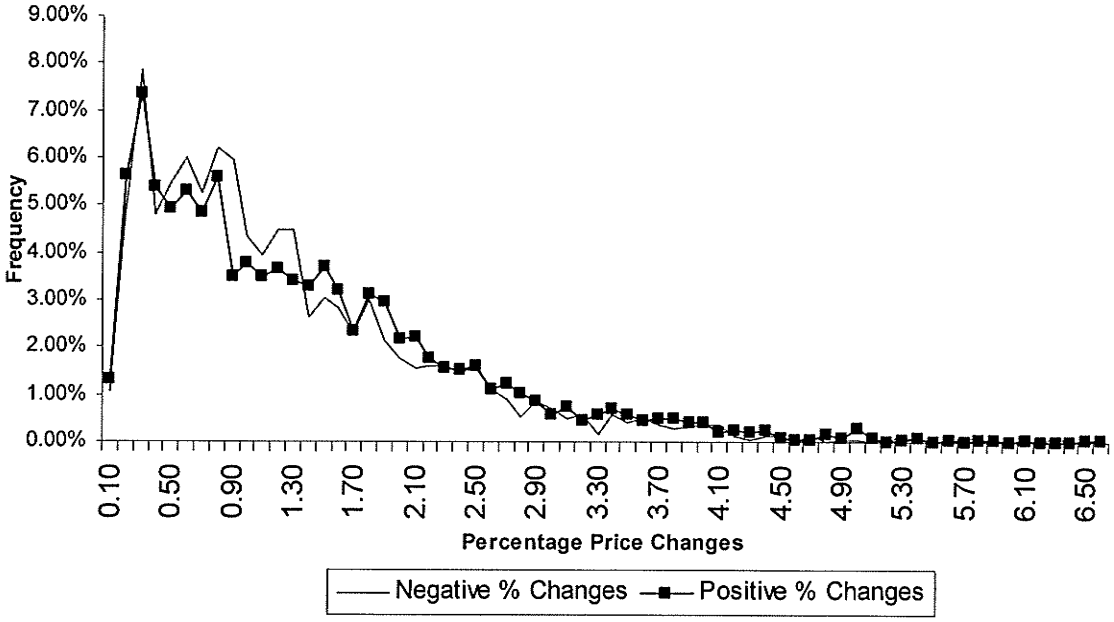


Figure A.22
Daily McDonald's Empirical Distribution of Positive and Negative Percentage Price Changes

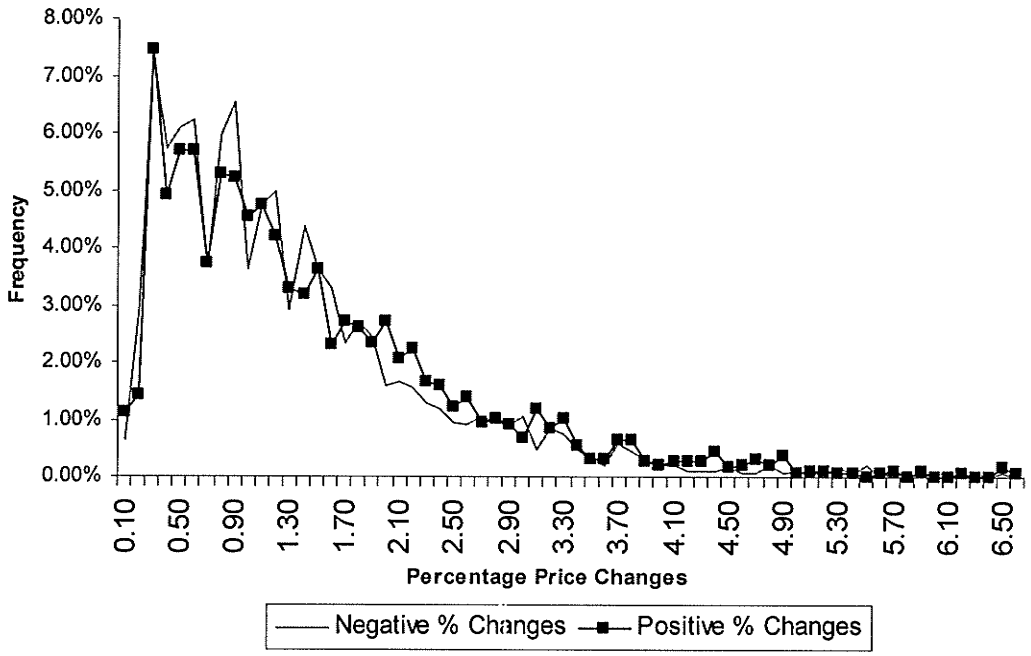


Figure A.23
Daily Merck Empirical Distribution of Positive and Negative Percentage Price Changes

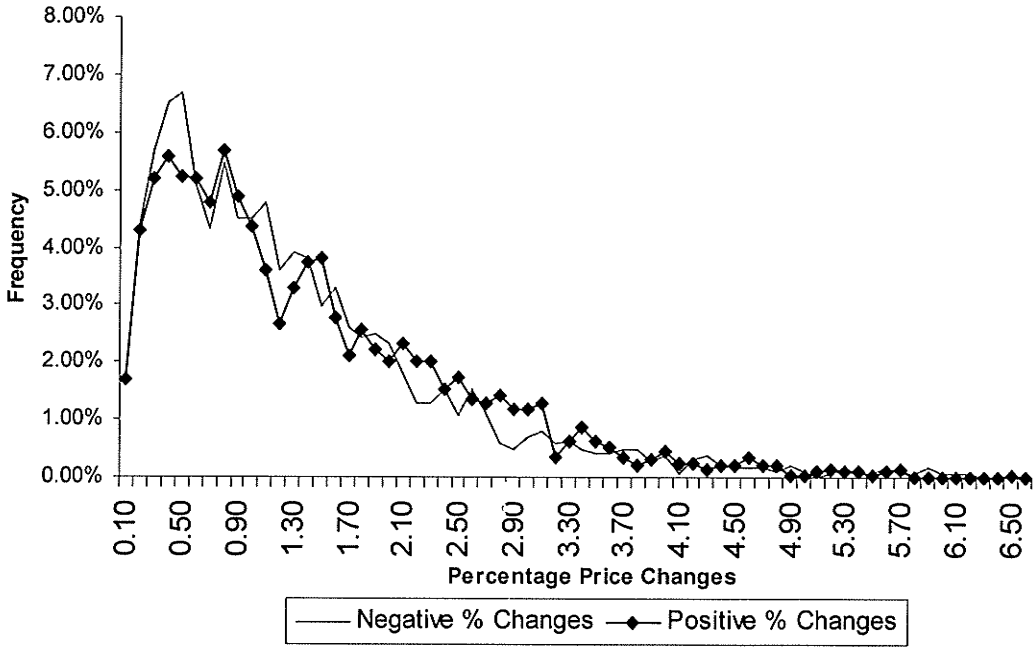


Figure A.24
Daily Microsoft Empirical Distribution of Positive and Negative Percentage Price Changes

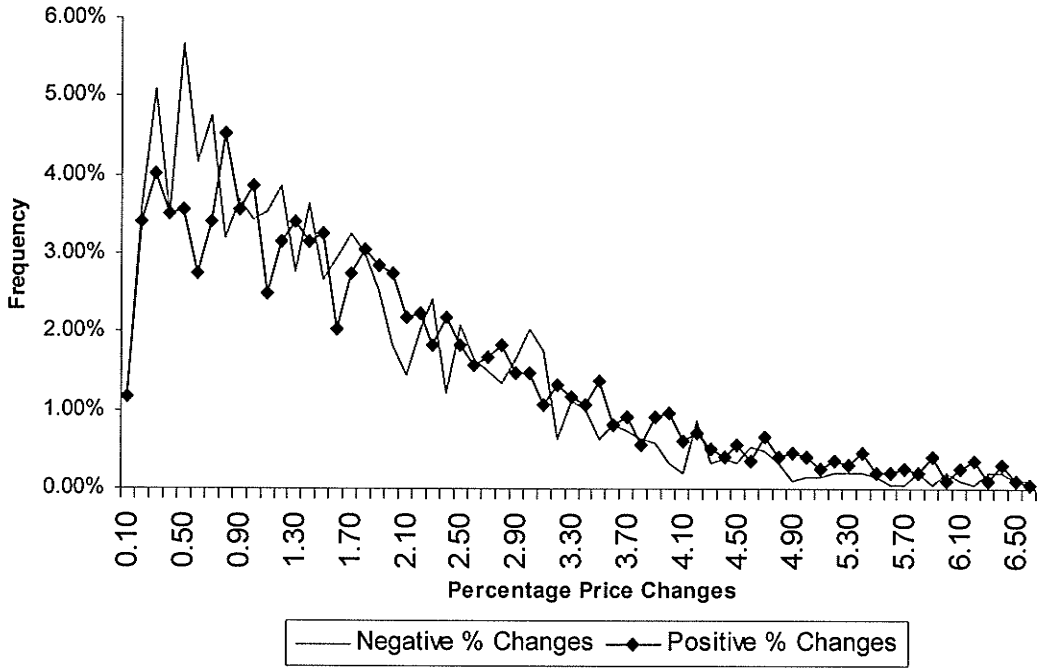


Figure A.25
Daily 3M Empirical Distribution of Positive and Negative Percentage Price Changes

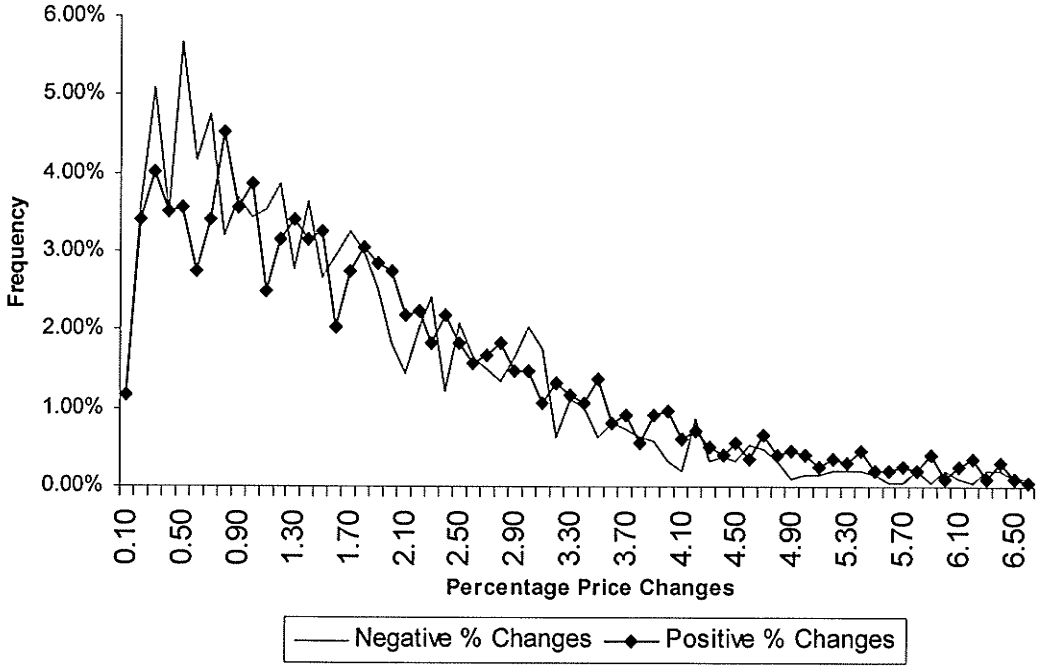


Figure A.26
Daily Procter and Gamble Empirical Distribution of Positive and Negative Percentage Price Changes

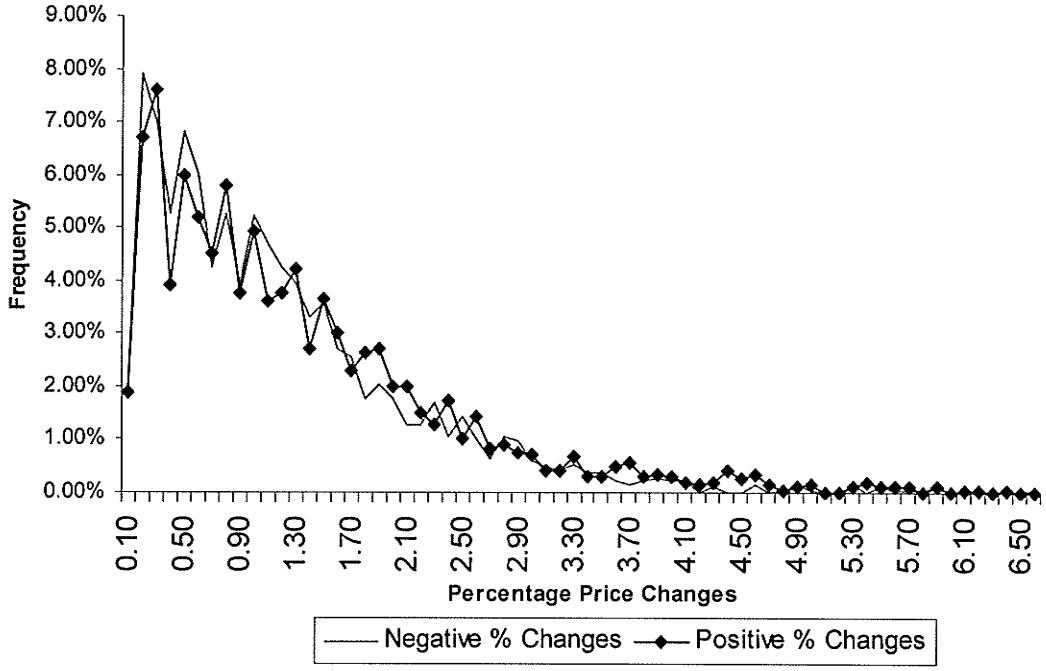


Figure A.27
Daily SBC Communications Empirical Distribution of Positive and Negative Percentage Price Changes

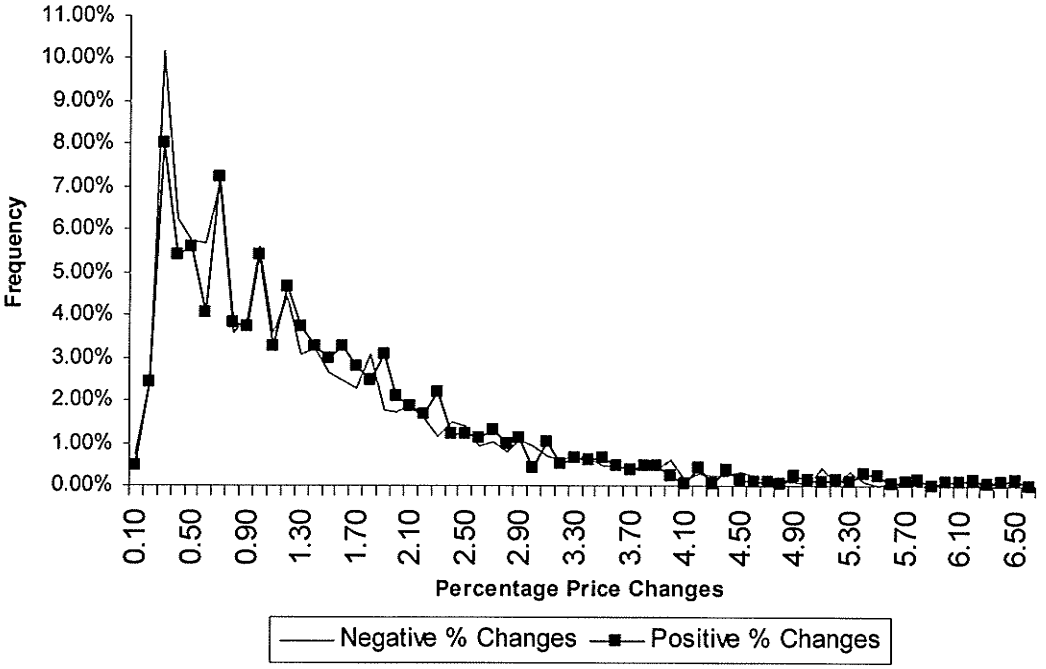


Figure A.28
Daily United Technologies Empirical Distribution of Positive and Negative Percentage Price Changes

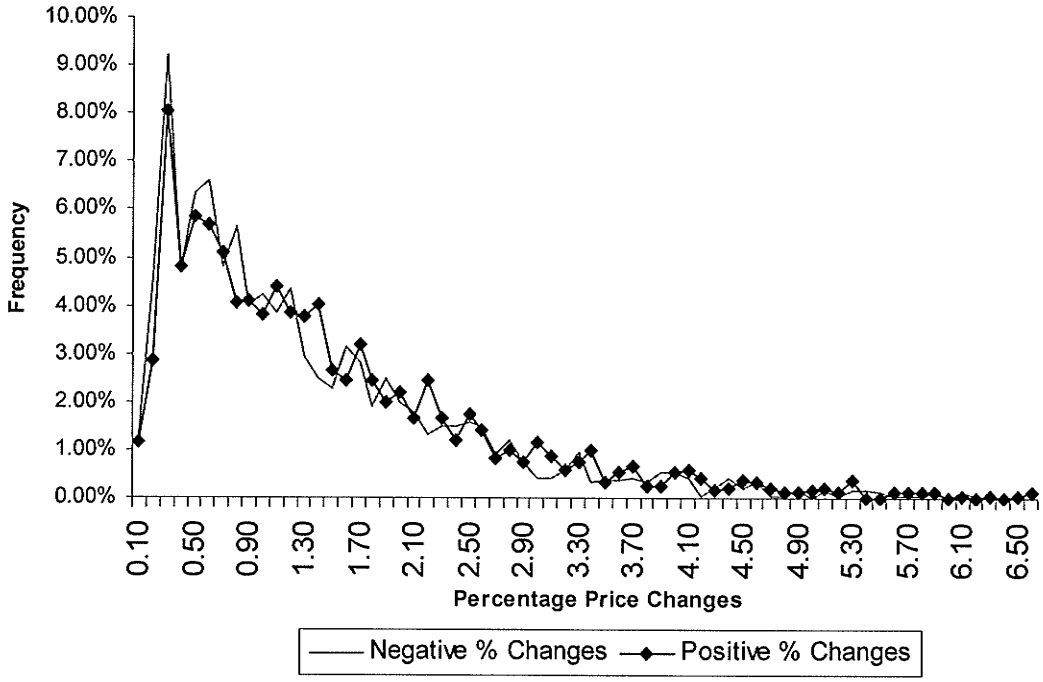


Figure A.29
Daily Wal-Mart Stores Empirical Distribution of Positive and Negative Percentage Price Changes

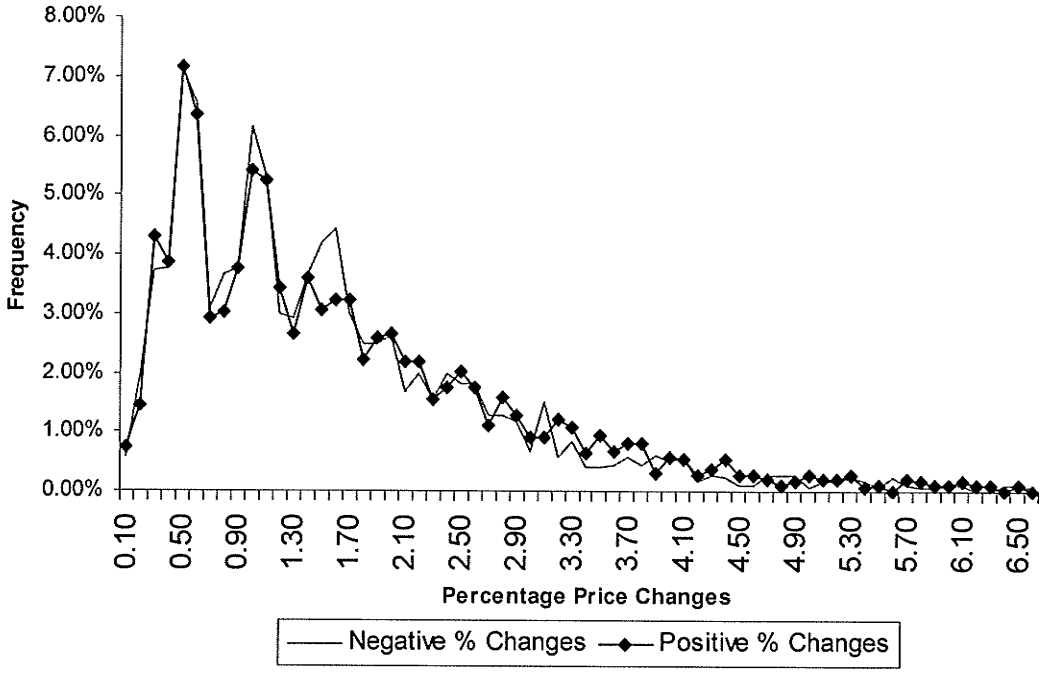
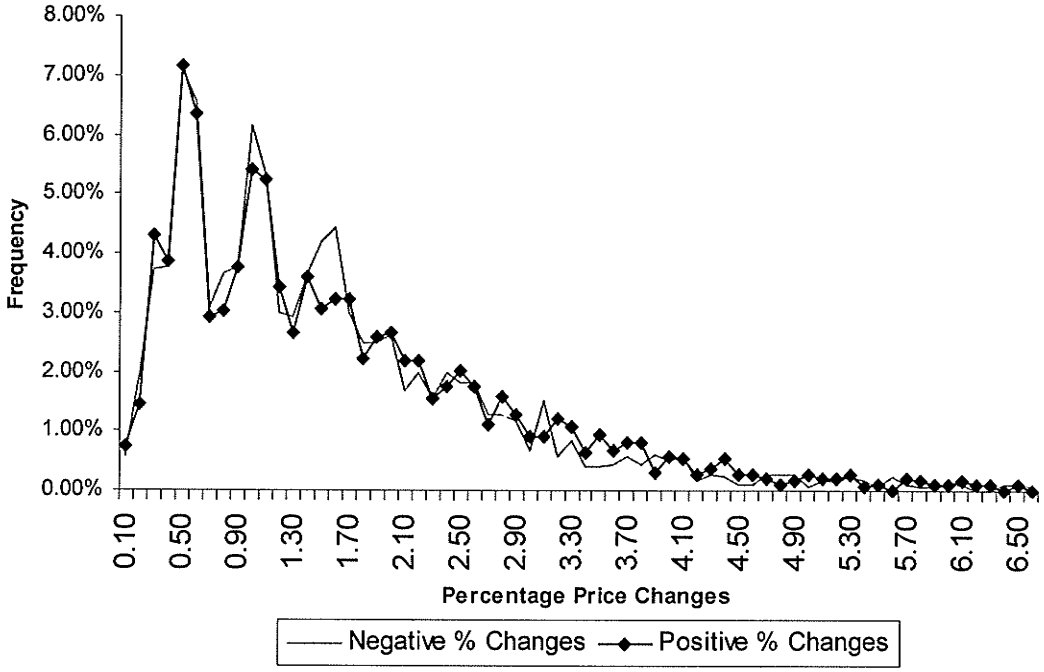


Figure A.30
Daily Walt Disney Empirical Distribution of Positive and Negative Percentage Price Changes



The stock market, for the most part, has a small variability as can be seen in Figures B.1 to B.30. Figures B.1 to B.30 provide insight into the nature of the departures from normality in the empirical distributions. The dotted curve represents the unit normal density function, whereas the smooth curve represents the general shape of the empirical distributions. The curves of the empirical density functions are above the curve for the normal distribution. Before 2.0 standard deviations from the mean, however, the empirical curves cut down through the normal curve from above. Although there is a general excess of relative frequency within 2.0 standard deviations, in twenty-four out of thirty cases the excess is not as great as that within one-half standard deviations. However, the market has been known to correct itself periodically in the past with relatively large decreases. At certain times, such as Monday, October 21, 1987,

the stock market takes a tumble but can rally very quickly pushing up the index, like on Wednesday October 23, 1987. These extreme situations account for more observations in the tails of the distribution. For the most part however, the stock market does not have high variability, the standard deviation is only 2.3142 with large changes included like black Monday and only 1.9512 with changes greater than forty points removed. A small variability signifies more observations near the mean than a normal distribution, thus the stock market changes are leptokurtic.

Figure B.1
Daily Alcoa Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

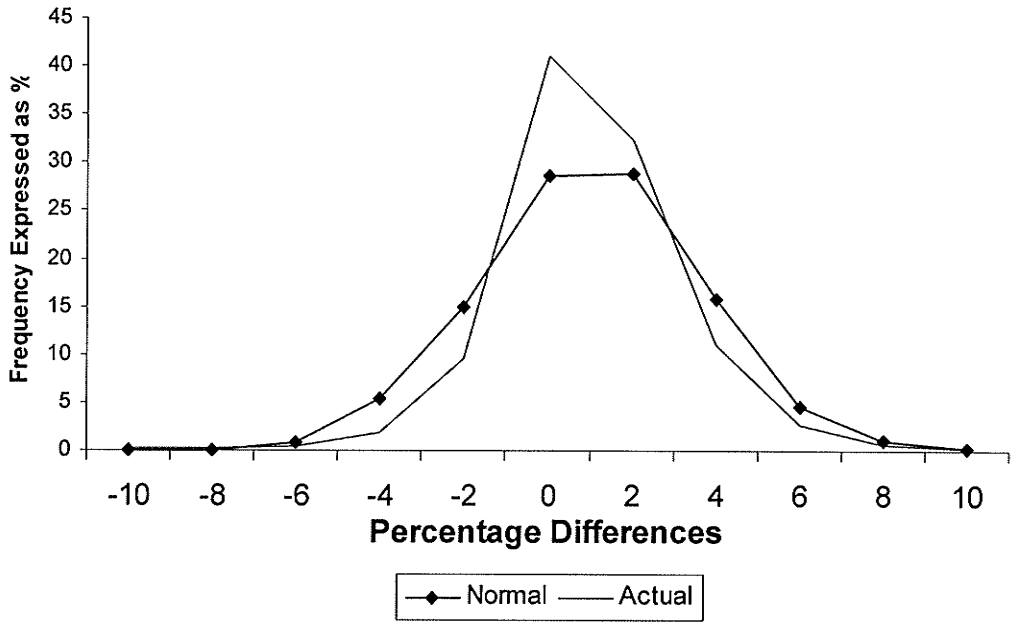


Figure B.2
Daily Altria Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

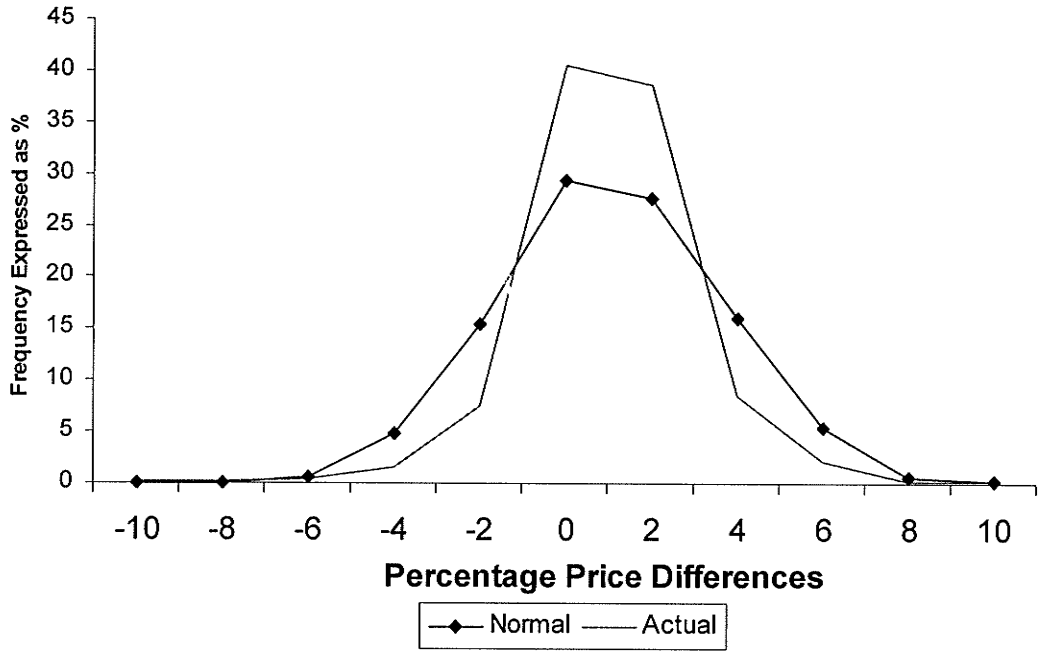


Figure B.3
Daily American Express Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

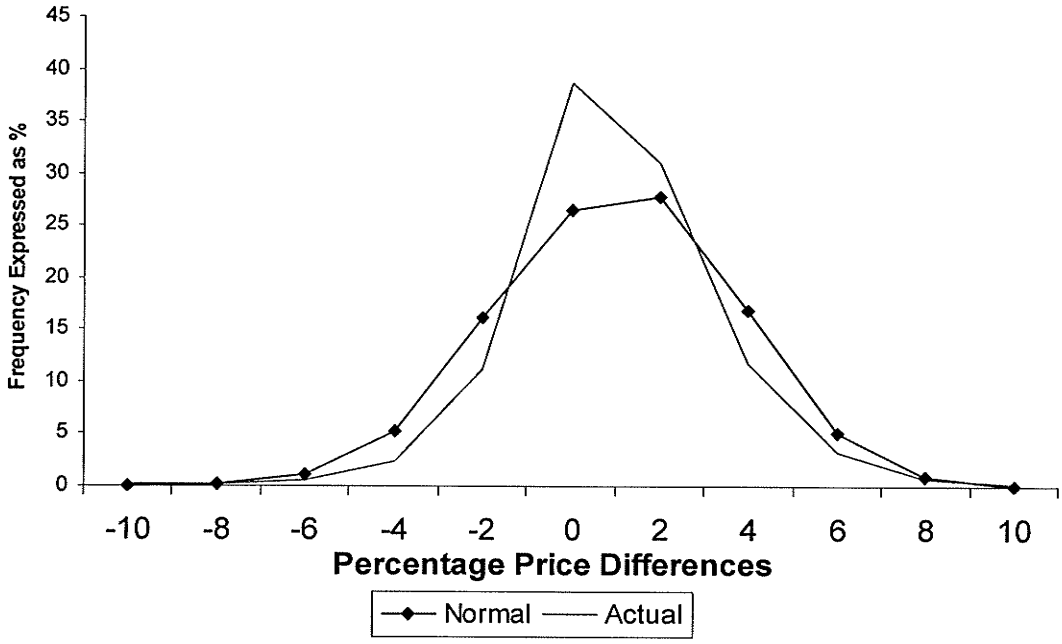


Figure B.4
Daily AT & T Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

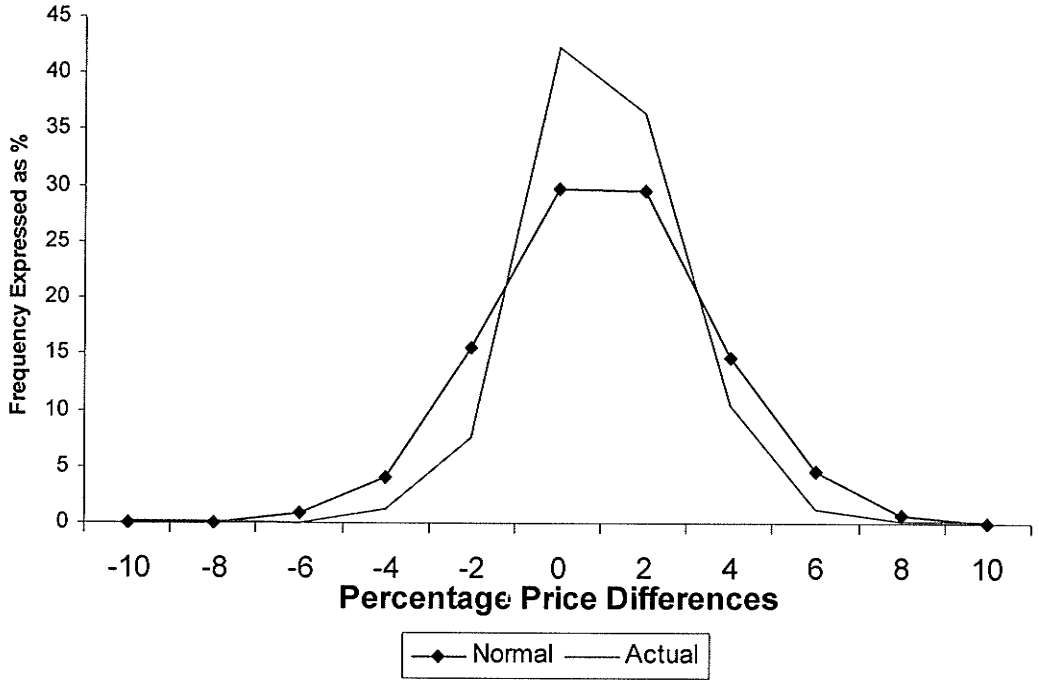


Figure B.5
Daily Boeing Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

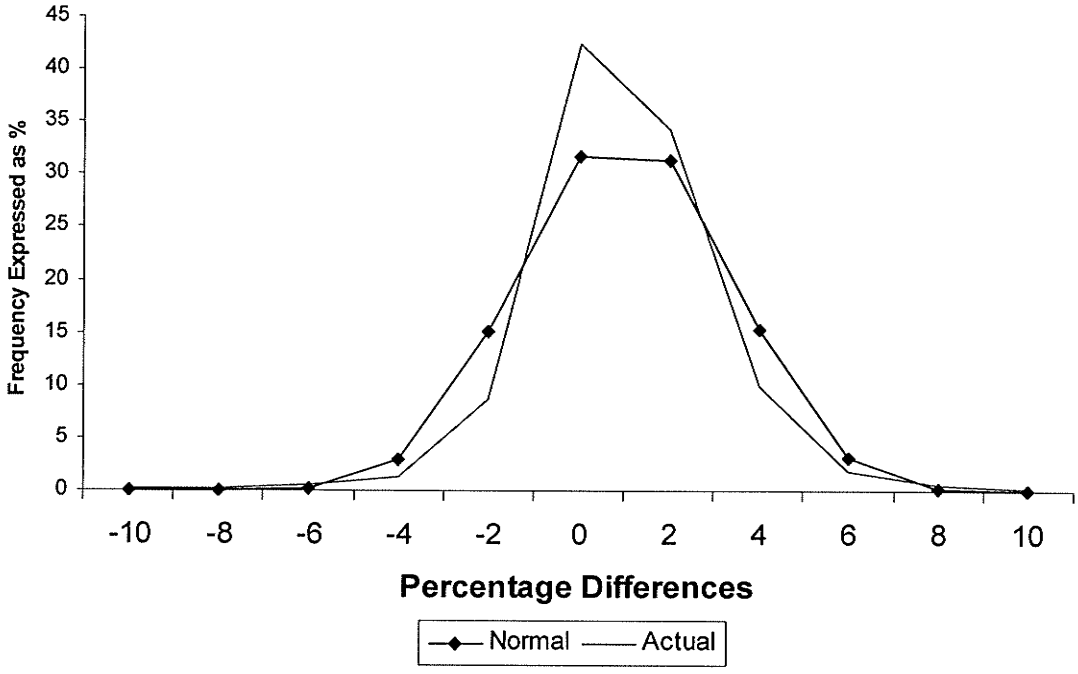


Figure B.6
Daily Caterpillar Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

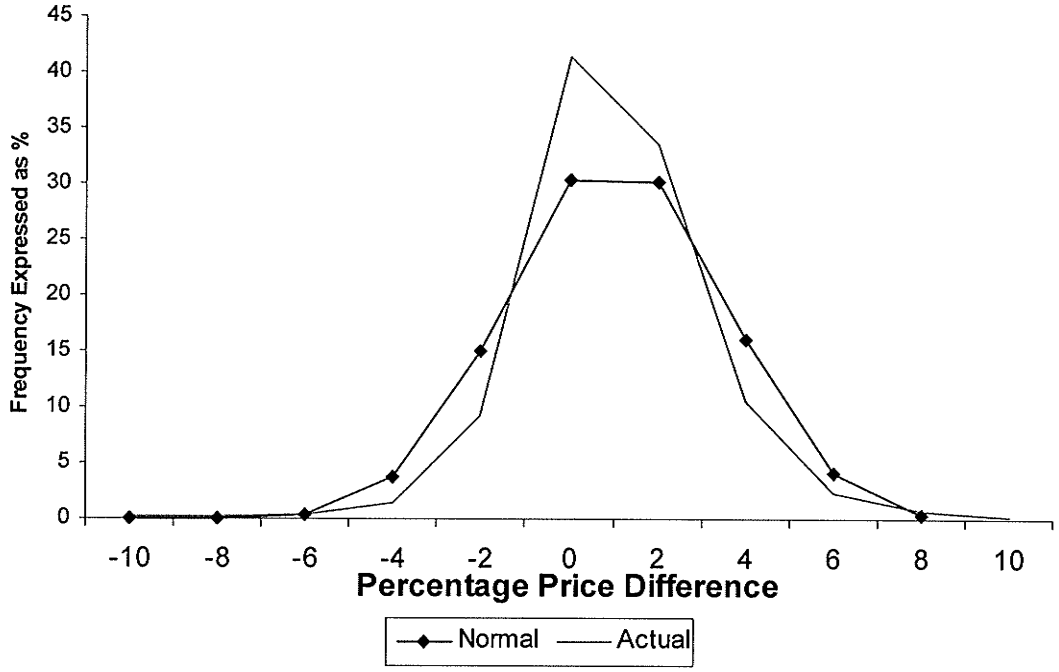


Figure B.7
Daily Citigroup Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

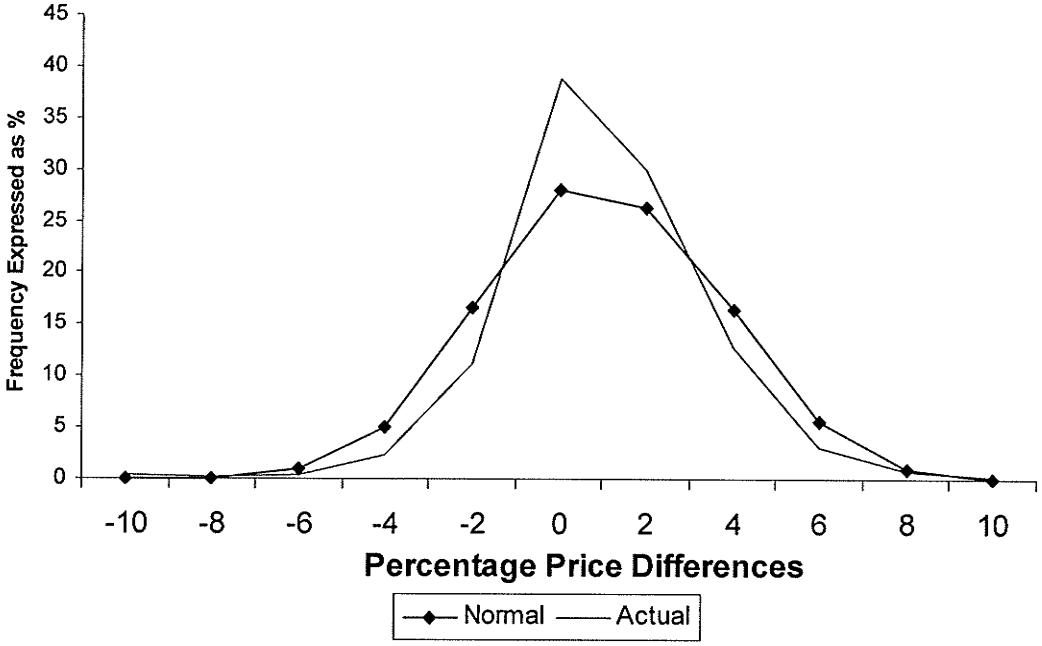


Figure B.8
Daily Coca-Cola Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

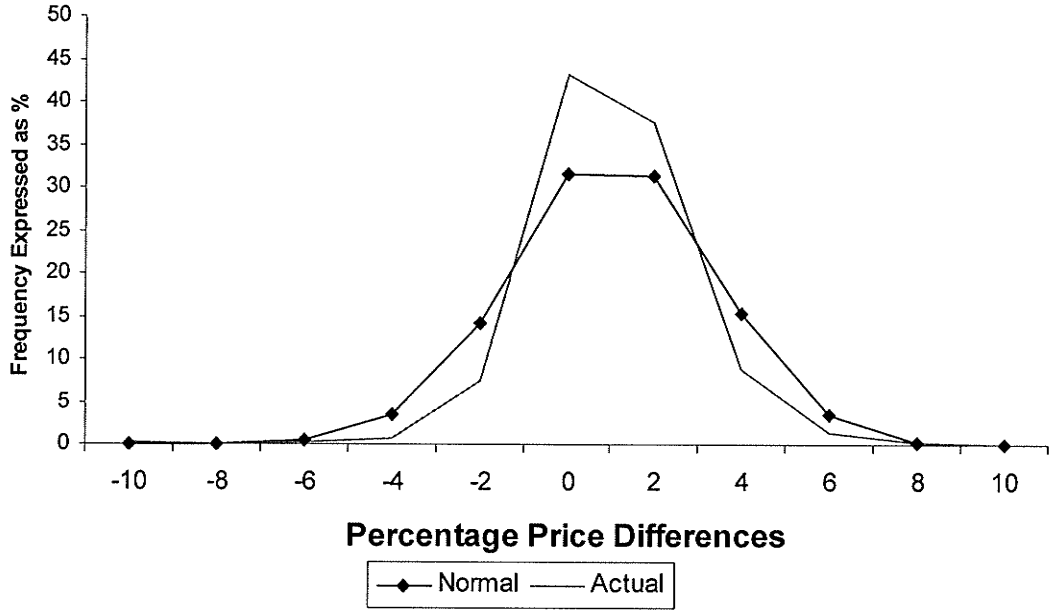


Figure B.9
Daily DuPont Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

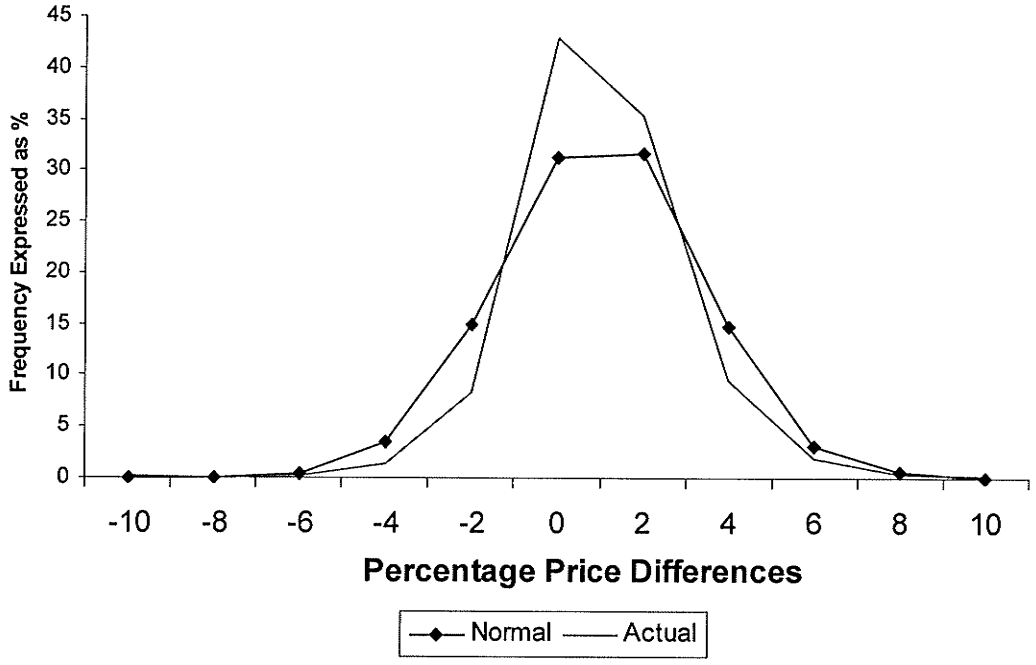


Figure B.10
Daily Eastman Kodak Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

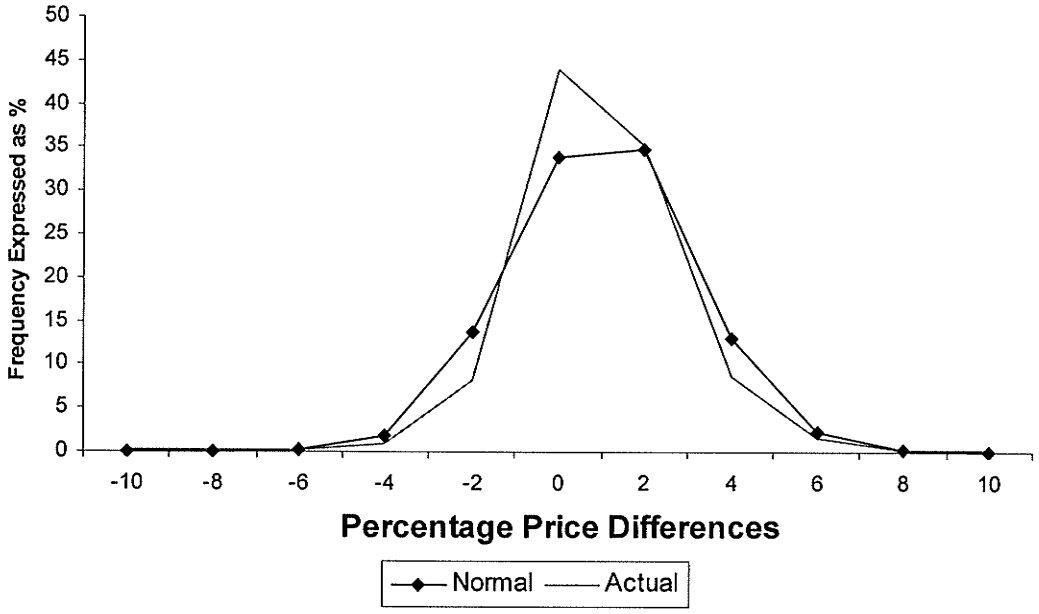


Figure B.11
Daily Exxon Mobile Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

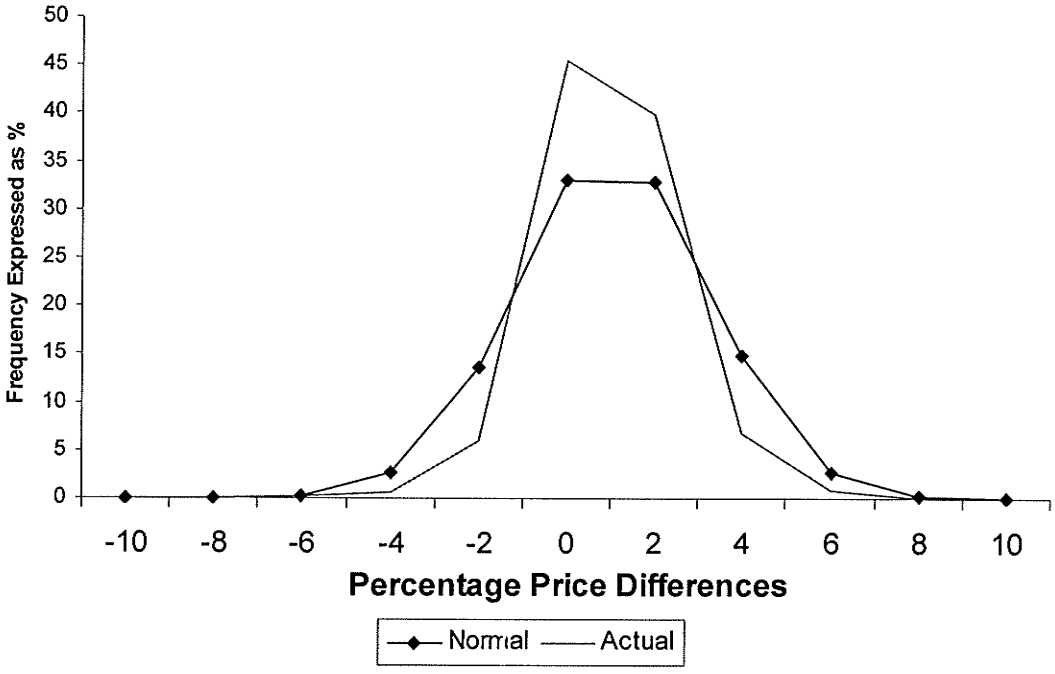


Figure B.12
Daily General Electric Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

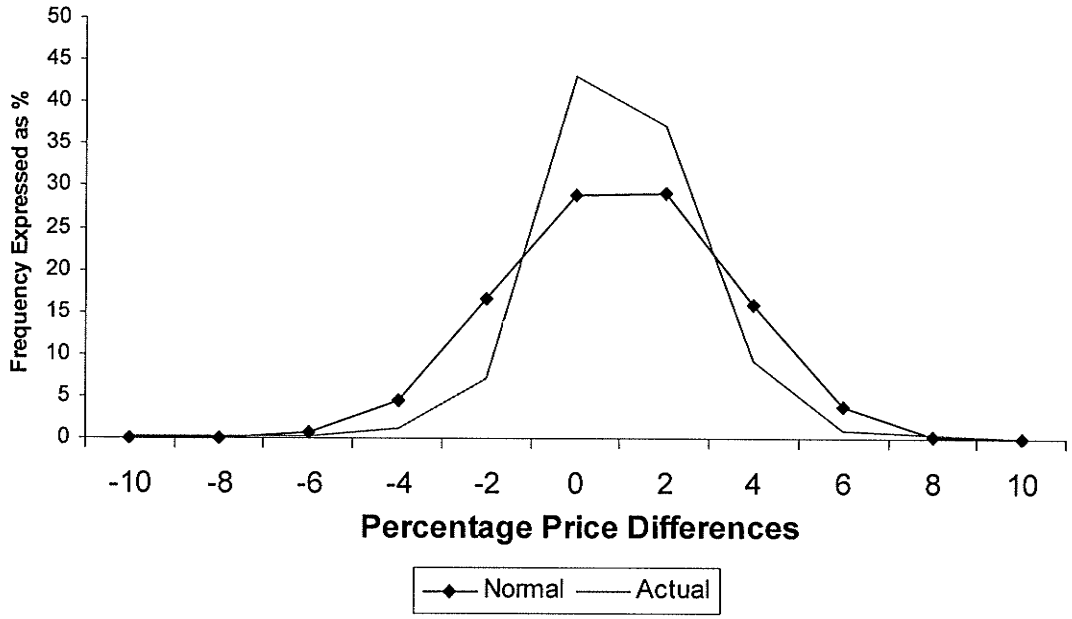


Figure B.13
Daily General Motors Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

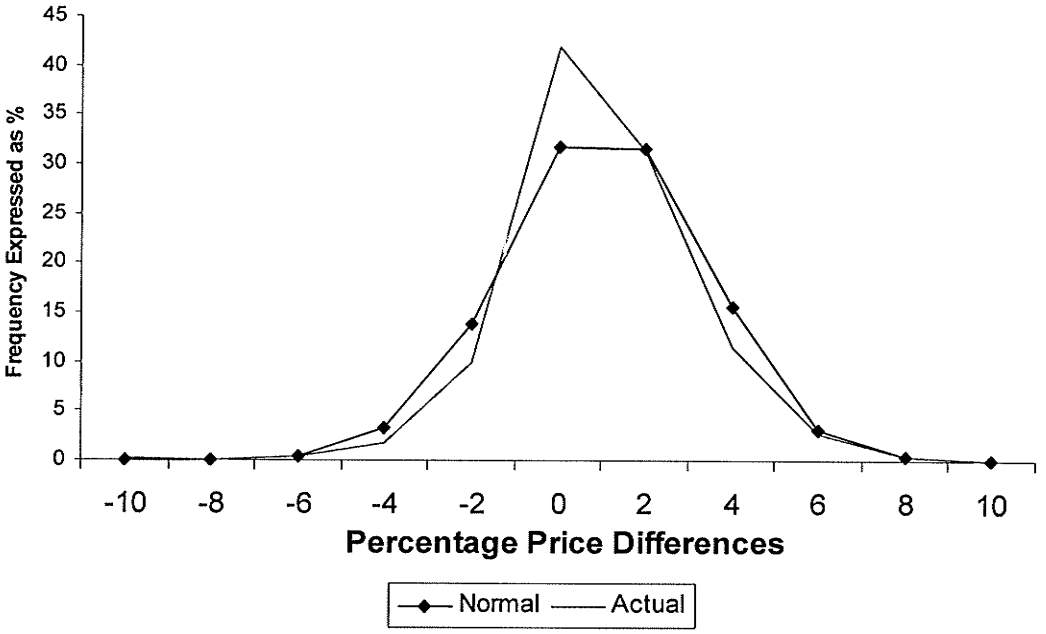


Figure B.14
Daily Hewlett-Packard Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

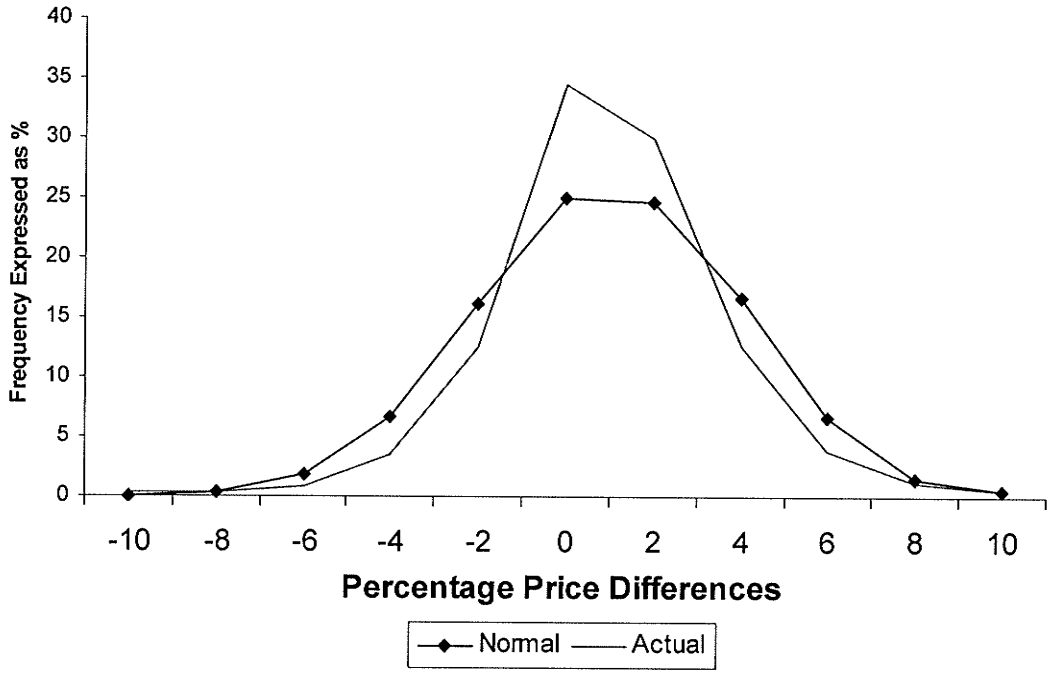


Figure B.15
Daily Home Depot Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

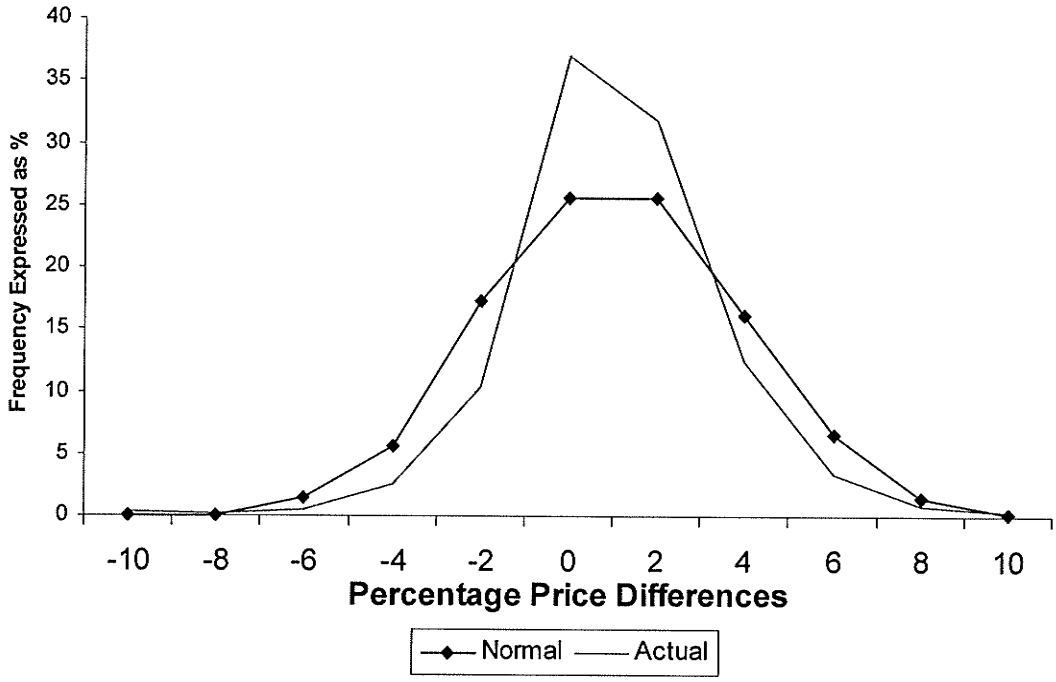


Figure B.16
Daily Honeywell International Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

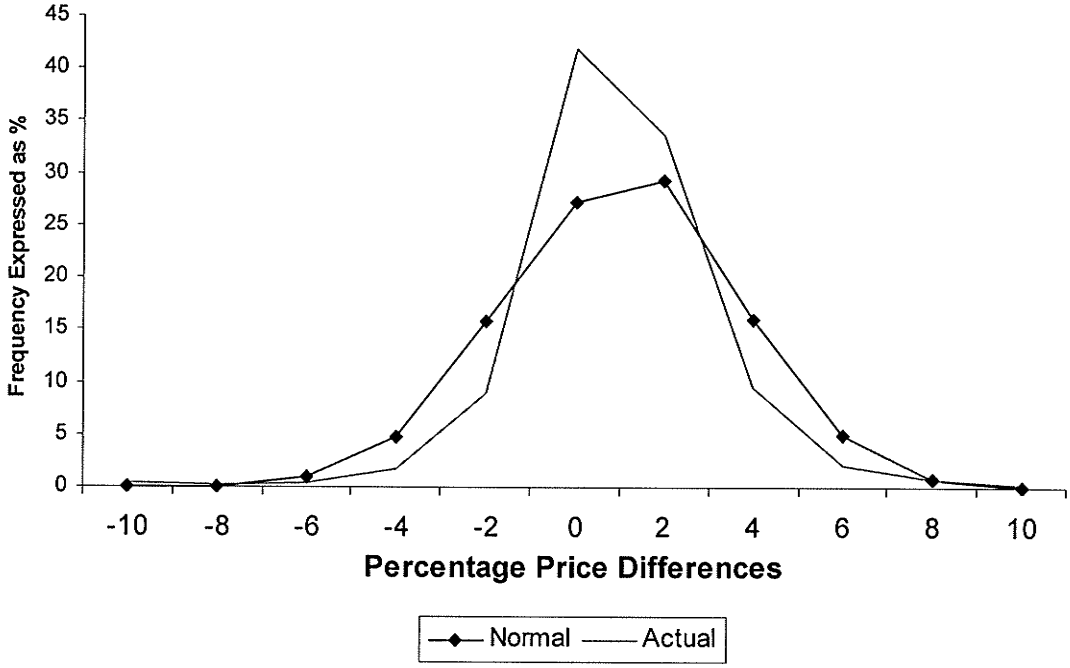


Figure B.17
Daily Intel Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

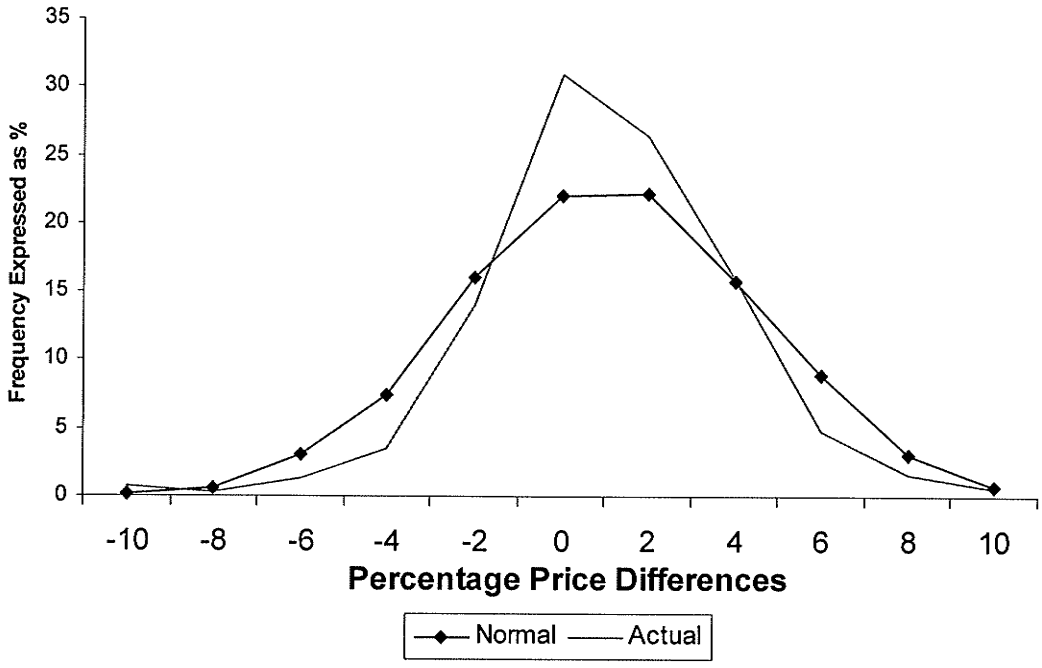


Figure B.18
Daily IBM Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

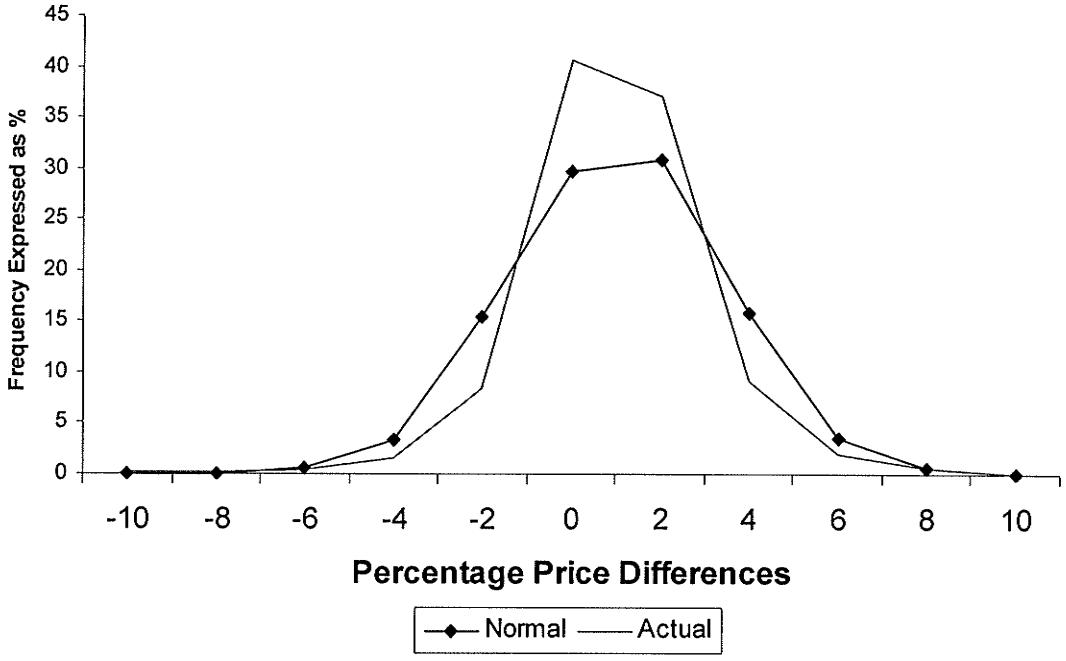


Figure B.19
Daily International Paper Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

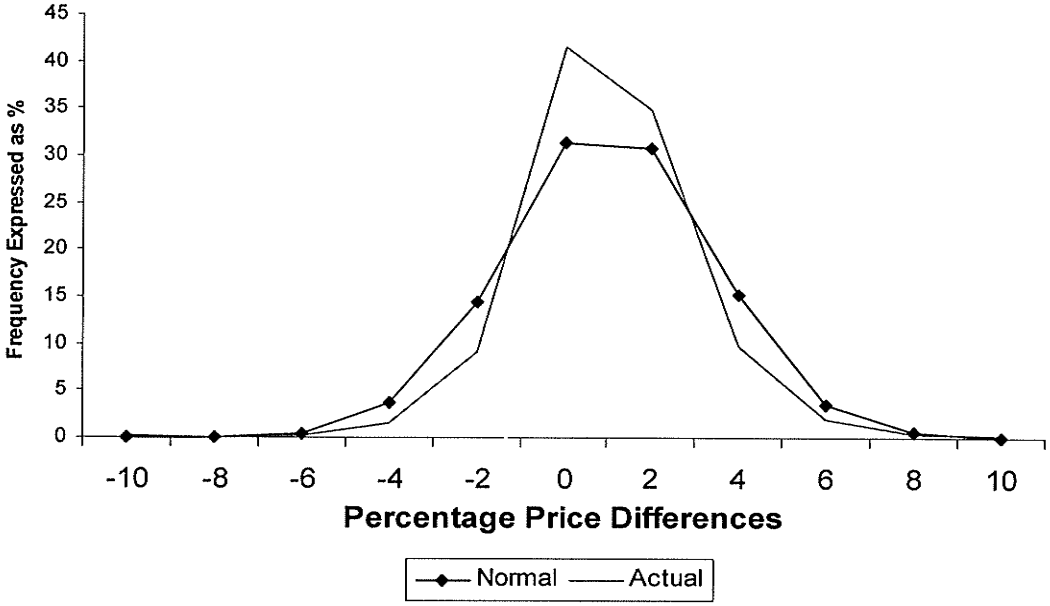


Figure B.20
Daily J.P. Morgan Chase Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

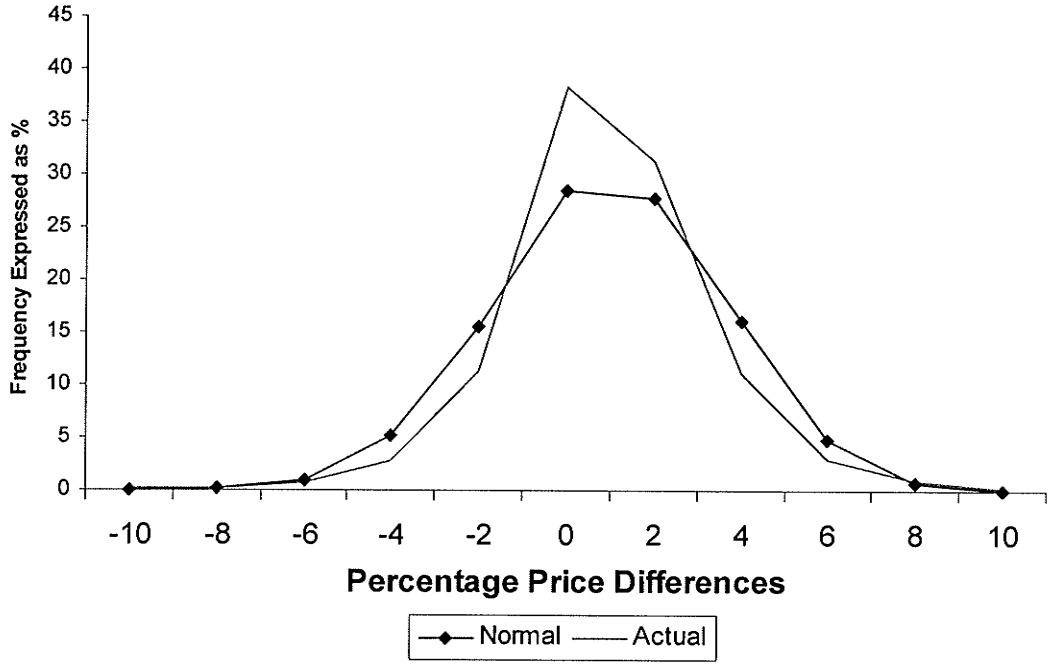


Figure B.21
Daily Johnson & Johnson Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

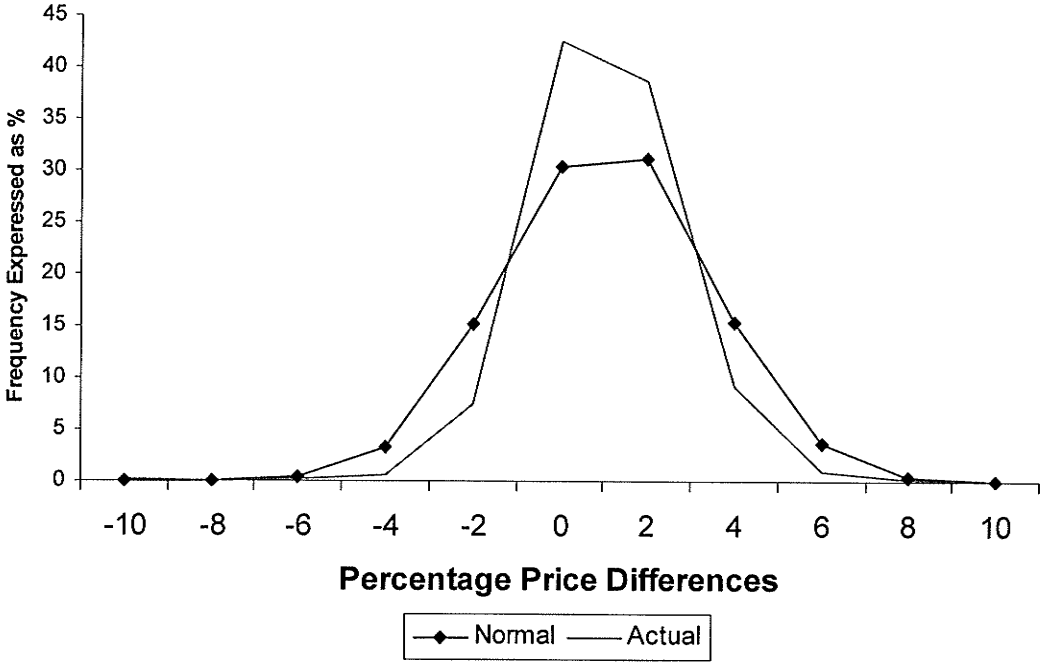


Figure B.22
Daily McDonald's Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

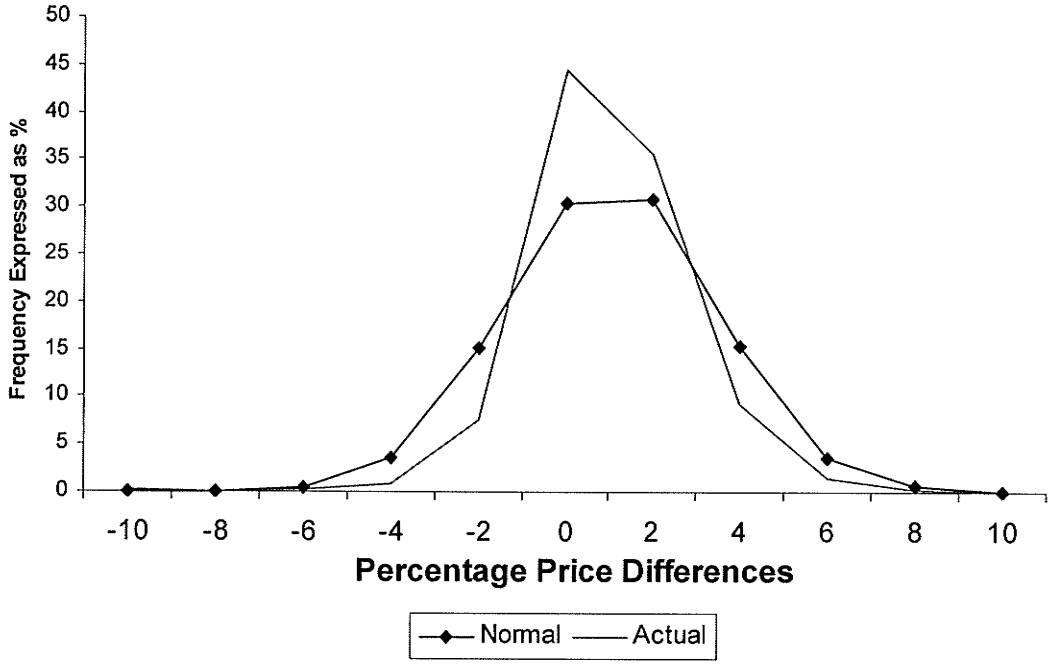


Figure B.23
Daily Merck Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

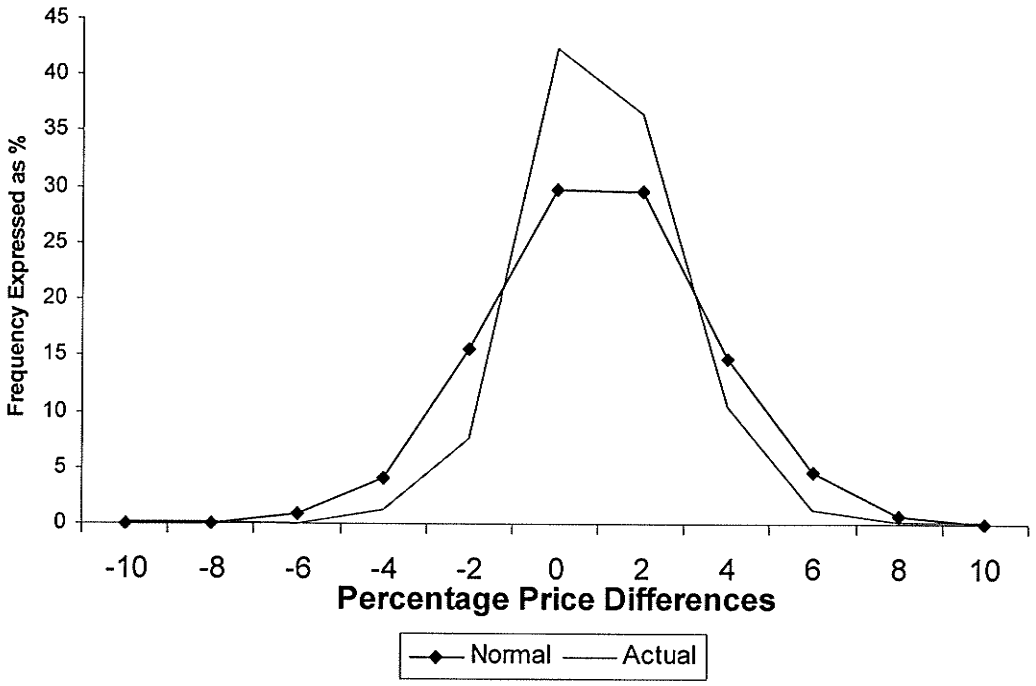


Figure B.24
Daily Microsoft Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

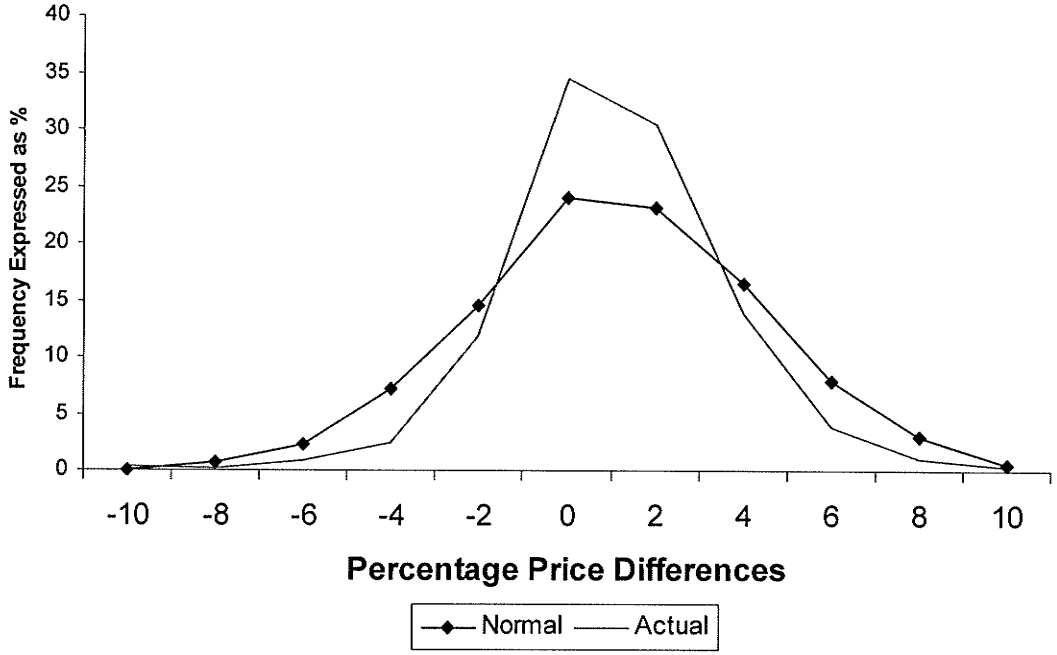


Figure B.25
Daily 3M Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

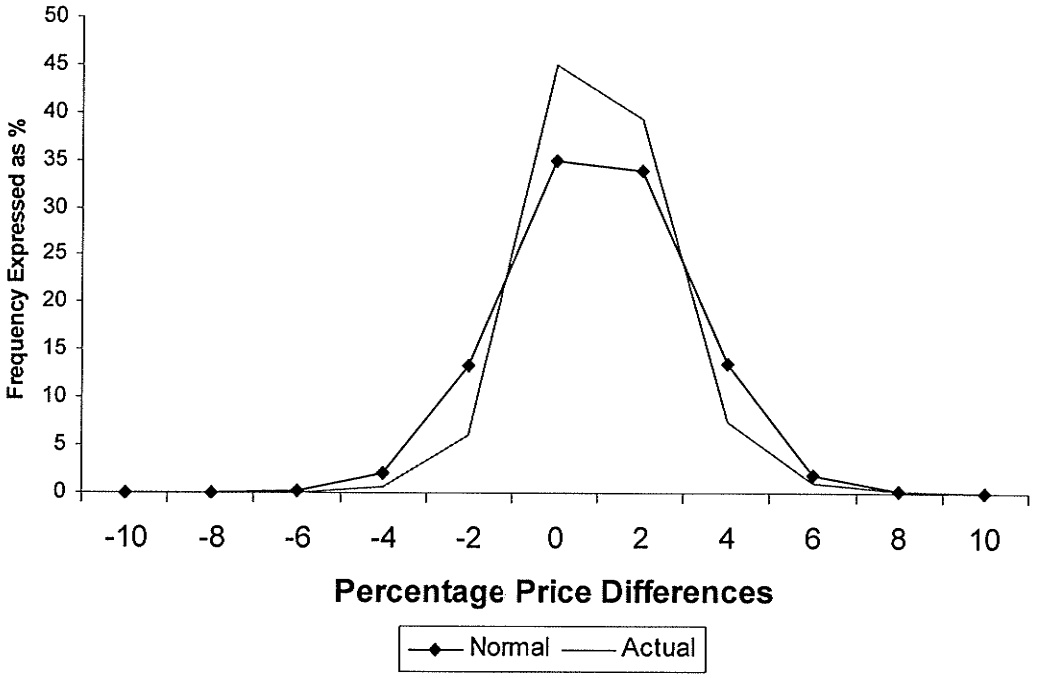


Figure B.26
Daily Procter and Gamble Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

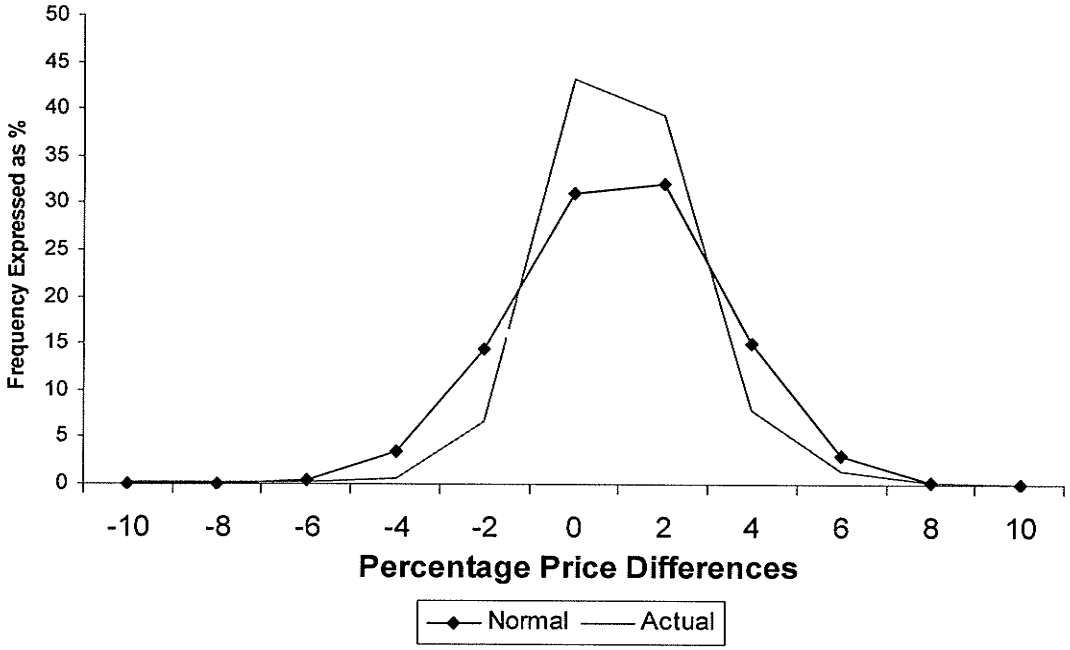


Figure B.27
Daily SBC Communications Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

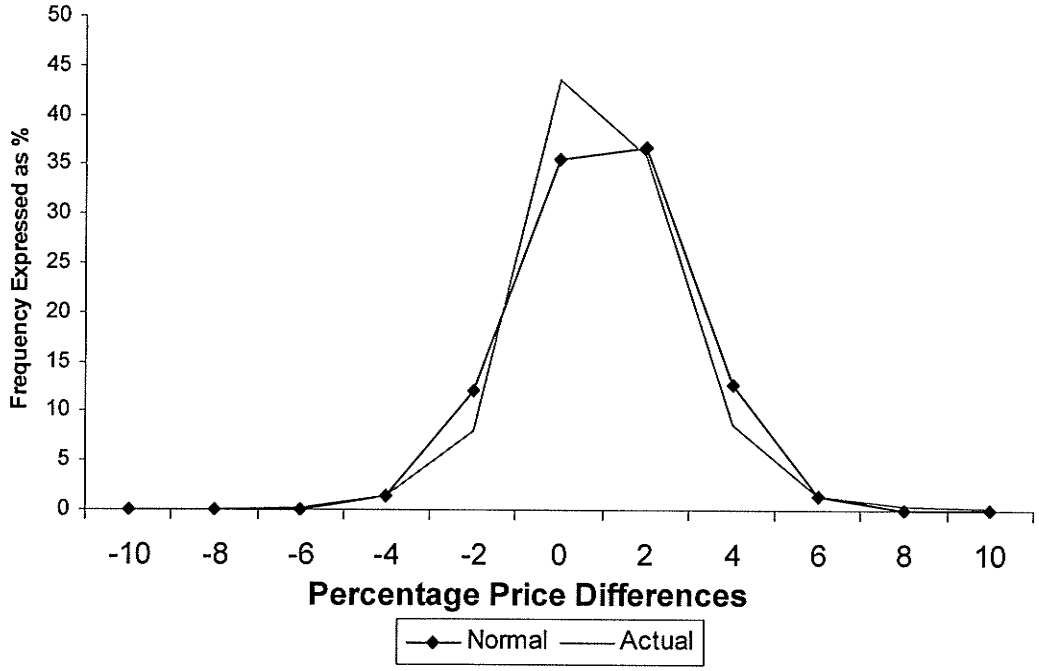


Figure B.28
Daily United Technologies Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

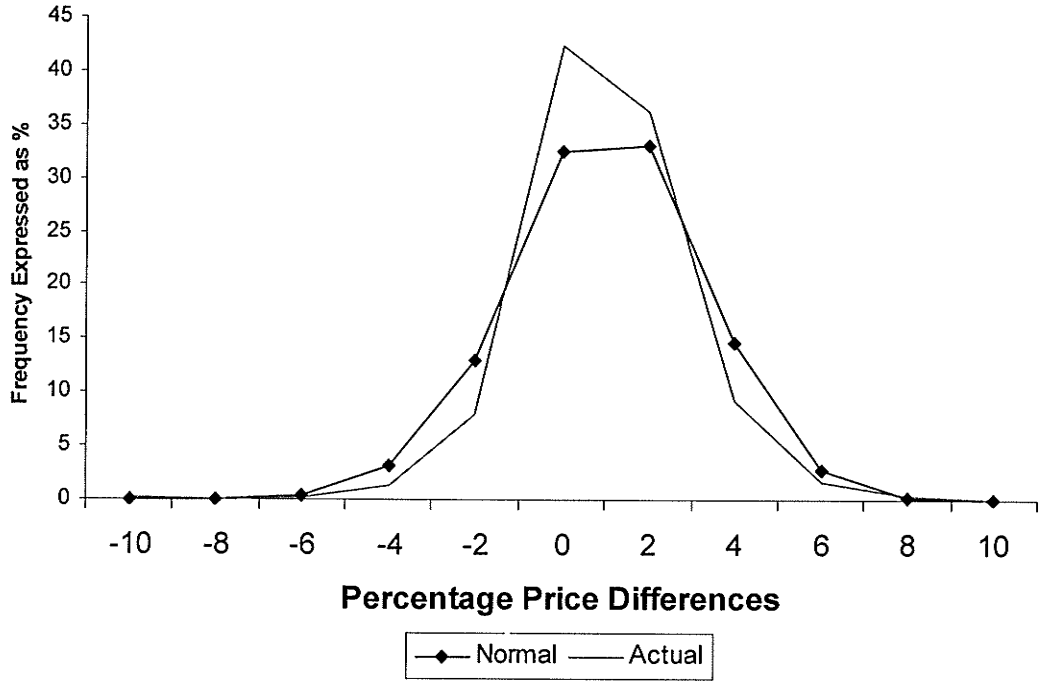


Figure B.29
Daily Wal-Mart Stores Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution

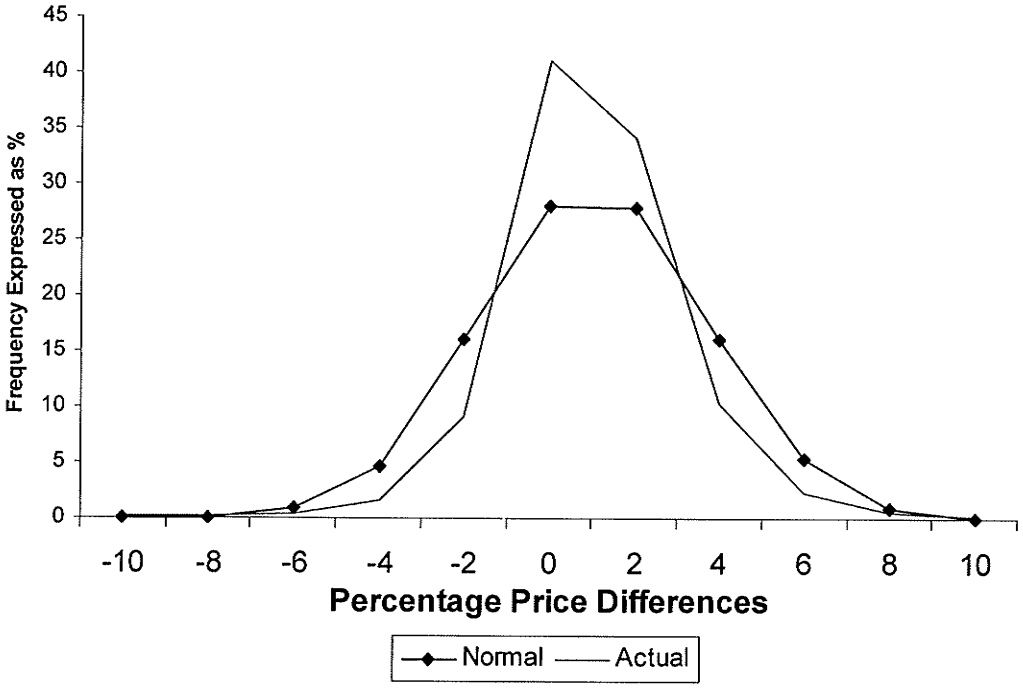
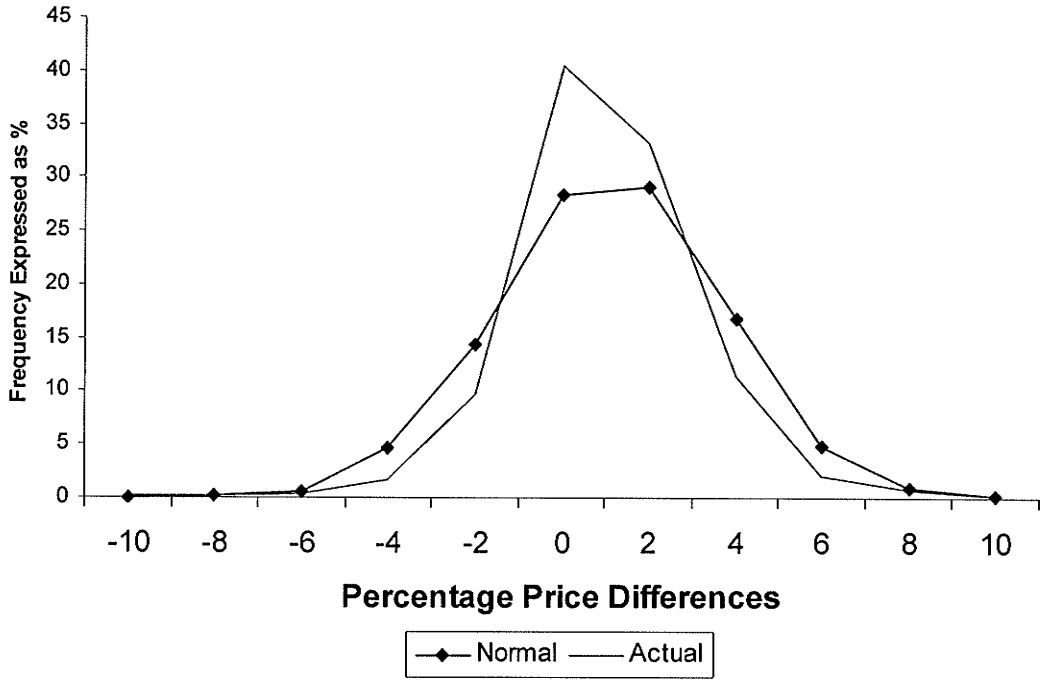


Figure B.30
Daily Walt Disney Empirical Distribution of Percentage Price Changes Relative to a Comparable Random Sample from a Normal Distribution



Day of the Week and Month of Year Effects

In financial markets research there has been the presence and documentation of security price anomalies. Indeed, since the pioneering works of Fama (1965), there have been many anomalies documented concerning the behaviour of security price returns. Three of the most prevalent appear to be a weekend effect (day of the week), where stocks exhibit significantly lower returns over the period between Friday's close and Monday's close; January effect (month of the year effect), where returns are much higher during the month of January than in any other month; and a pre-holiday effect where returns are much higher on trading days immediately prior to holidays. Table 3.35 contains

the results of the tests for day of the week and month of the year effects. Of the thirty stocks examined, only six, 3M, Boeing, Caterpillar, DuPont, Eastman & Kodak, and IBM have a day of the week effect. The variables for Monday and Tuesday are significantly different from zero for daily IBM price changes. The coefficients for these variables are positive, causing the intercept to be positive for these days.

This results in the likelihood of price increases during the beginning of the week and decreases at the end of the week. Daily Eastman Kodak also indicated a day of the week effect. According to the coefficients, only Wednesday is significantly different from the other days. The coefficient is positive resulting in more price increases on Wednesday. Month of the year is detected in seven of the thirty stocks. AT & T, Boeing, Caterpillar, General Motors, Hewlett-Packard, Home Depot, Johnson & Johnson, and Walt Disney are the only monthly stocks that reject the null hypothesis of no month of the year in favour of the alternative (there is month of the year effect). These results are in line with the overwhelming international evidence documented for the stock markets security price anomalies.

Monte Carlo Simulation

The efficient markets hypothesis holds that in a highly competitive and organized market, price changes will be essentially random. The model for such market price behaviour is the random walk theory. The underlying economic foundation for random price changes is that efficient markets are comprised of numerous well-informed participants that should create prices which accurately

reflect all current information. Thus, the stock in question will be priced at a reliable estimate of its true value. However, if a stock shows asymmetry, then past prices influence current prices and the efficient market hypothesis no longer holds.

In order to make sure that asymmetry results truly show asymmetry and are not due purely to chance, a Monte Carlo simulation is used. The Monte Carlo simulation is used to compare the regression results of daily IBM percentage price changes versus 1000 replications from a random sample drawn a normal distribution of the same size with the same mean and standard deviation as daily IBM. Table 3.32 presents the ordinary least squares results for daily IBM and compares them to the estimates obtained from the Monte Carlo simulation. The estimates from the Monte Carlo simulation are obtained from purely random data and thus the expectation is that there will be no information in the data and the estimates should not be significant. A 95% confidence interval is also constructed to obtain a range in which one would expect coefficients to be if the underlying data is random. Four coefficients are significant in the daily IBM Ordinary Least Squares results, POS6, NEG1, D_{MON} and D_{TUE}. However, only two out of these four coefficients fall outside the 95% confidence interval from the Monte Carlo simulation indicating that these two coefficients are different than would be expected. The verification with a Monte Carlo experiment ensures the integrity of the methodology and test procedure used. If asymmetry is found in the random data, this would raise doubt in the model and tests used.

Table 3.1
Unit Root Test of Daily Microsoft Prices, Percentage Prices Change, and Percentage First Differences, January 1987 to December 2002

Null Hypothesis	Test Statistic	Critical Value 10%
	Stock Prices	
Constant, no trend		
A (1) = 0 T-Test	-4.0333	-2.57
A (0) = A (1) = 0	8.1344	3.78
Constant, trend		
A (1) = 0 T-Test	-4.0065	-3.13
A (0) = A (1) = A (2) = 0	5.4225	4.03
A (1) = A (2) = 0	8.1330	5.34
	Percentage Price Change	
Constant, no trend		
A (1) = 0 T-Test	-3.6750	-2.57
A (0) = A (1) = 0	6.7551	3.78
Constant, trend		
A (1) = 0 T-Test	-3.6408	-3.13
A (0) = A (1) = A (2) = 0	4.5225	4.03
A (1) = A (2) = 0	6.7816	5.34
	First Difference of Percentage Price Change	
Constant, no trend		
A (1) = 0 T-Test	-24.349	-2.57
A (0) = A (1) = 0	296.45	3.78
Constant, trend		
A (1) = 0 T-Test	-24.351	-3.13
A (0) = A (1) = A (2) = 0	197.66	4.03
A (1) = A (2) = 0	296.49	5.34

All statistics are significant for the first differenced percentage changes data which indicates stationarity of the variables.

Table 3.2

Ordinary Least Squares Estimates for Alcoa Incorporated Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.1255	4.5087
POS1	0.0495	-0.2301
POS2	-0.0352	0.0775
POS3	-0.0192	-0.0564
POS4	-0.0049	0.0702
POS5	0.0022	-0.2949*
POS6	0.0227	-0.1416
NEG1	0.0327	-0.0177
NEG2	-0.0159	-0.3186*
NEG3	0.0293	0.2499*
NEG4	-0.0599*	-0.3292*
NEG5	0.0149	-0.0031
NEG6	-0.0045	-0.1755
D_{MON}	-0.1376	
D_{TUE}	-0.0885	
D_{WED}	-0.0170	
D_{THU}	-0.1853	
D_{JAN}		-0.7740
D_{FEB}		-10.5180*
D_{MAR}		-6.3491
D_{APR}		-0.1566
D_{MAY}		-0.5705
D_{JUN}		-7.7779*
D_{JUL}		-0.8458
D_{AUG}		-7.0357
D_{SEP}		-5.9881
D_{OCT}		-6.5178
D_{NOV}		-1.7961
Sum F- Value [c]	0.0685	0.0019
Identical F-Value [d]	0.8401	2.3328*

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.3

Ordinary Least Squares Estimates for Altria Group, Incorporated Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.0207	4.7724
POS1	-0.0702*	0.0983
POS2	-0.0530*	0.0125
POS3	-0.0167	-0.2724
POS4	-0.0004	-0.1961
POS5	-0.0319	-0.2470
POS6	0.0096	0.2061
NEG1	0.0189	0.0284
NEG2	0.0203	0.0283
NEG3	-0.0776*	0.1084
NEG4	0.0203	0.0567
NEG5	-0.0291	0.0369
NEG6	-0.0026	-0.1649
D_{MON}	0.3679*	
D_{TUE}	0.2383*	
D_{WED}	0.1811	
D_{THU}	0.0532	
D_{JAN}		-2.5287
D_{FEB}		-1.2932
D_{MAR}		-4.2558
D_{APR}		-8.5041*
D_{MAY}		2.4135
D_{JUN}		-3.8665
D_{JUL}		-0.0896
D_{AUG}		-0.7318
D_{SEP}		-3.9727
D_{OCT}		-7.9551
D_{NOV}		-0.5762
Sum F- Value [c]	2.6238	0.6978
Identical F-Value [d]	2.6085*	1.3323

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, $D_{MON},\ldots, D_{THU}$ are dummy variables for the day of the week, the $D_{JAN}, \ldots, D_{NOV}$ are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.4

Ordinary Least Squares Estimates for American Express Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.1299	1.6419
POS1	-0.0356	-0.0128
POS2	-0.0292	-0.0493
POS3	-0.0706*	-0.0323
POS4	-0.0040	0.1442
POS5	0.0048	0.0546
POS6	-0.0523	0.1264
NEG1	-0.0132	0.1027
NEG2	-0.0518*	-0.0816
NEG3	-0.0083	-0.0459
NEG4	-0.0025	-0.0813
NEG5	-0.0237	-0.0892
NEG6	-0.0003	0.1102
D_{MON}	-0.0122	
D_{TUE}	0.0609	
D_{WED}	0.0439	
D_{THU}	-0.0758	
D_{JAN}		-0.4373
D_{FEB}		-1.7352
D_{MAR}		2.1747
D_{APR}		0.7065
D_{MAY}		-6.4079
D_{JUN}		-1.4047
D_{JUL}		0.6332
D_{AUG}		-5.5129
D_{SEP}		-3.3098
D_{OCT}		-4.8602
D_{NOV}		1.1019
Sum F- Value [c]	1.4731	0.0508
Identical F-Value [d]	0.9869	0.2279

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.5

Ordinary Least Squares Estimates for AT & T Corporation Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.0878	0.6309
POS1	0.0167	0.0815
POS2	0.0029	-0.2568
POS3	-0.0065	0.5512*
POS4	-0.0062	-0.3733
POS5	-0.0249	0.2367
POS6	-0.0212	-0.4044*
NEG1	-0.0462	0.1110
NEG2	-0.0808*	0.0060
NEG3	-0.0389	-0.0550
NEG4	-0.0228	0.0298
NEG5	0.0729*	0.0833
NEG6	-0.0032	0.0031
D_{MON}	0.0198	
D_{TUE}	0.1083	
D_{WED}	0.1009	
D_{THU}	0.0071	
D_{JAN}		6.6345
D_{FEB}		-4.2537
D_{MAR}		3.1034
D_{APR}		-6.3135
D_{MAY}		4.5630
D_{JUN}		-3.0923
D_{JUL}		2.7553
D_{AUG}		-3.3118
D_{SEP}		4.6403
D_{OCT}		-3.2361
D_{NOV}		10.3280*
Sum F- Value [c]	1.7499	0.3770
Identical F-Value [d]	3.5906*	1.2275

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, $D_{MON},\ldots, D_{THU}$ are dummy variables for the day of the week, the $D_{JAN}, \ldots, D_{NOV}$ are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.6

Ordinary Least Squares Estimates for Boeing Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.1431	3.1947
POS1	0.0505	-0.0626
POS2	-0.0763*	0.0866
POS3	-0.0241	-0.0909
POS4	-0.0385	0.0989
POS5	-0.0286	-0.1359
POS6	-0.0075	0.0167
NEG1	-0.0060	0.0331
NEG2	-0.0058	-0.0985
NEG3	-0.0019	0.0311
NEG4	-0.0312	-0.0576
NEG5	-0.0038	-0.0553
NEG6	0.0166	0.0525
D_{MON}	-0.2566*	
D_{TUE}	0.0880	
D_{WED}	0.0476	
D_{THU}	-0.0590	
D_{JAN}		-1.6910
D_{FEB}		-1.4468
D_{MAR}		-1.8360
D_{APR}		-0.5362
D_{MAY}		1.4706
D_{JUN}		-11.5050*
D_{JUL}		-0.1893
D_{AUG}		-7.3496
D_{SEP}		-4.3434
D_{OCT}		-4.8400
D_{NOV}		-2.4072
Sum F- Value [c]	1.4860	0.0003
Identical F-Value [d]	1.1189	0.1968

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, $D_{MON},\ldots, D_{THU}$ are dummy variables for the day of the week, the $D_{JAN}, \ldots, D_{NOV}$ are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.7

Ordinary Least Squares Estimates for Caterpillar Incorporated Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0093	6.1053
POS1	0.0507	-0.3989*
POS2	0.0132	0.0276
POS3	-0.0743*	-0.2049
POS4	-0.0042	0.0434
POS5	0.0129	0.1059
POS6	-0.0035	-0.0862
NEG1	0.0319	-0.1355
NEG2	-0.0379	-0.0315
NEG3	0.0104	0.1567
NEG4	0.0310	0.0469
NEG5	-0.0328	0.0118
NEG6	-0.0204	-0.0176
D_{MON}	0.2662*	
D_{TUE}	-0.0324	
D_{WED}	0.0291	
D_{THU}	-0.0404	
D_{JAN}		-3.2349
D_{FEB}		-0.6249
D_{MAR}		-1.8751
D_{APR}		1.8295
D_{MAY}		-0.2933
D_{JUN}		-6.9073
D_{JUL}		-7.9062*
D_{AUG}		-7.4946
D_{SEP}		-10.4440*
D_{OCT}		-4.3794
D_{NOV}		-1.1018
Sum F- Value [c]	0.0174	1.0512
Identical F-Value [d]	1.4860	0.7173

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.8

Ordinary Least Squares Estimates for Citigroup Incorporated Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.0209	0.3456
POS1	0.0201	-0.1289
POS2	0.0109	-0.1552
POS3	-0.0729*	0.0702
POS4	-0.0189	-0.1547
POS5	-0.0052	-0.0069
POS6	0.0194	0.0034
NEG1	0.0119	0.0389
NEG2	-0.0453*	-0.1268
NEG3	-0.0049	-0.2796*
NEG4	-0.0256	-0.1722
NEG5	-0.0173	-0.1014
NEG6	-0.0404	-0.0887
D_{MON}	-0.0331	
D_{TUE}	0.1719	
D_{WED}	0.1364	
D_{THU}	0.0069	
D_{JAN}		4.2623
D_{FEB}		-1.1426
D_{MAR}		-0.9671
D_{APR}		0.2243
D_{MAY}		-1.1241
D_{JUN}		-0.8346
D_{JUL}		3.1290
D_{AUG}		-7.9975
D_{SEP}		-2.5154
D_{OCT}		1.3531
D_{NOV}		-3.0706
Sum F- Value [c]	0.9817	0.3537
Identical F-Value [d]	1.2533	0.4636

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.9

Ordinary Least Squares Estimates for Coca-Cola Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.0255	3.5520
POS1	0.0371	0.2189
POS2	-0.0487	-0.1607
POS3	-0.0388	-0.1713
POS4	-0.0453	-0.0156
POS5	0.0184	-0.3267
POS6	0.0298	-0.0511
NEG1	-0.0464*	-0.0704
NEG2	-0.0533*	-0.0087
NEG3	-0.0182	-0.0148
NEG4	-0.0219	0.0727
NEG5	-0.0103	0.0702
NEG6	0.0005	0.0699
D_{MON}	0.0252	
D_{TUE}	0.1148	
D_{WED}	0.0872	
D_{THU}	-0.0702	
D_{JAN}		-2.1767
D_{FEB}		0.4116
D_{MAR}		-0.3767
D_{APR}		0.5676
D_{MAY}		-7.1527*
D_{JUN}		-2.6739
D_{JUL}		08391
D_{AUG}		-3.6774
D_{SEP}		-2.9616
D_{OCT}		2.6640
D_{NOV}		-0.0502
Sum F- Value [c]	2.2105	1.1929
Identical F-Value [d]	1.4553	0.9618

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.10

Ordinary Least Squares Estimates for DuPont Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0341	4.5459
POS1	0.0210	-0.2589
POS2	-0.0698*	-0.0549
POS3	-0.0528*	0.0046
POS4	-0.0083	-0.0964
POS5	-0.0031	-0.4405*
POS6	-0.0461	0.1802
NEG1	-0.0231	-0.0588
NEG2	-0.0045	0.0774
NEG3	0.0311	0.0545
NEG4	-0.0239	-0.0449
NEG5	-0.0179	0.0678
NEG6	0.0003	-0.0982
D_{MON}	0.2529*	
D_{TUE}	0.1223	
D_{WED}	0.0995	
D_{THU}	-0.0071	
D_{JAN}		-6.6467*
D_{FEB}		-2.8676
D_{MAR}		0.6599
D_{APR}		3.5085
D_{MAY}		1.3522
D_{JUN}		-6.1298
D_{JUL}		-4.1550
D_{AUG}		-5.2990
D_{SEP}		-4.6394
D_{OCT}		-3.2829
D_{NOV}		-2.2520
Sum F- Value [c]	2.8116	0.8706
Identical F-Value [d]	2.1627*	1.1291

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.11

Ordinary Least Squares Estimates for Eastman Kodak Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.0629	3.2782
POS1	0.0345	-0.1957
POS2	-0.0008	-0.0348
POS3	-0.0206	-0.2190
POS4	0.0084	-0.3533*
POS5	0.0327	-0.2504
POS6	-0.0627*	-0.1453
NEG1	-0.0709*	-0.0126
NEG2	-0.0635*	-0.1103
NEG3	0.0202	0.2376
NEG4	-0.0121	-0.1017
NEG5	0.0336	-0.1404
NEG6	0.0041	0.0873
D_{MON}	0.2317*	
D_{TUE}	-0.0211	
D_{WED}	0.2472*	
D_{THU}	0.1450	
D_{JAN}		1.6808
D_{FEB}		-0.0848
D_{MAR}		-4.1901
D_{APR}		3.3364
D_{MAY}		3.0023
D_{JUN}		-0.4514
D_{JUL}		0.1965
D_{AUG}		2.3154
D_{SEP}		-3.1407
D_{OCT}		-2.2076
D_{NOV}		-0.5338
Sum F- Value [c]	0.7551	4.5452*
Identical F-Value [d]	0.8897	1.0782

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.12

Ordinary Least Squares Estimates for Exxon Mobil Corporation Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0933	4.9254*
POS1	-0.0608*	-0.5223*
POS2	-0.0905*	0.1068
POS3	-0.0858*	-0.7608*
POS4	-0.0834*	0.0031
POS5	0.0285	-0.1701
POS6	-0.0451	-0.3266
NEG1	-0.0543*	0.1541
NEG2	-0.0359*	-0.0576
NEG3	0.0516	-0.4757
NEG4	-0.0610*	-0.0509
NEG5	-0.0656*	-0.0893
NEG6	0.0424*	0.0518
D_{MON}	0.0184	
D_{TUE}	0.0575	
D_{WED}	0.0009	
D_{THU}	-0.0749	
D_{JAN}		-1.1194
D_{FEB}		-2.7481
D_{MAR}		1.2885
D_{APR}		-1.0596
D_{MAY}		0.3409
D_{JUN}		-1.7048
D_{JUL}		-2.6592
D_{AUG}		-3.3121
D_{SEP}		-4.9820
D_{OCT}		0.6332
D_{NOV}		-3.9984
Sum F- Value [c]	1.5643	6.8271*
Identical F-Value [d]	3.1689*	2.6600*

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.13

Ordinary Least Squares Estimates for General Electric Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0215	7.0344*
POS1	0.0329	-0.4114*
POS2	-0.0519*	-0.1169
POS3	-0.0643*	0.2519
POS4	0.0088	0.0349
POS5	-0.0149	-0.2888
POS6	-0.0056	0.1298
NEG1	-0.0117	0.0756
NEG2	-0.0259	0.0036
NEG3	0.0028	-0.1625
NEG4	-0.0196	0.0199
NEG5	-0.0289*	0.2149*
NEG6	-0.0137	0.1207
D_{MON}	0.0507	
D_{TUE}	0.0883	
D_{WED}	0.0442	
D_{THU}	0.0066	
D_{JAN}		-2.8494
D_{FEB}		-4.4612
D_{MAR}		-5.5905
D_{APR}		-3.3074
D_{MAY}		-12.2030*
D_{JUN}		-4.1911
D_{JUL}		-4.4683
D_{AUG}		-8.8086*
D_{SEP}		-6.2266
D_{OCT}		-3.6516
D_{NOV}		-1.7676
Sum F- Value [c]	0.0010	1.4659
Identical F-Value [d]	1.2222	1.7785

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.14

Ordinary Least Squares Estimates for General Motors Corporation Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.1281	1.5527
POS1	-0.0214	-0.2315
POS2	-0.0153	-0.1366
POS3	-0.0331	-0.1149
POS4	0.0055	-0.0817
POS5	-0.0499	0.0904
POS6	0.0144	-0.4405*
NEG1	-0.0377	0.2480*
NEG2	-0.0579*	-0.1970
NEG3	0.0100	-0.1095
NEG4	0.0094	-0.0941
NEG5	0.0219	-0.2149
NEG6	-0.0035	0.0303
D_{MON}	-0.1544	
D_{TUE}	-0.1814	
D_{WED}	-0.1084	
D_{THU}	0.0823	
D_{JAN}		5.4894
D_{FEB}		3.6841
D_{MAR}		-2.3194
D_{APR}		6.3584
D_{MAY}		0.3979
D_{JUN}		-0.5226
D_{JUL}		2.6657
D_{AUG}		-2.0316
D_{SEP}		-5.6444
D_{OCT}		-1.0298
D_{NOV}		2.1556
Sum F- Value [c]	0.2715	1.2062
Identical F-Value [d]	0.8447	2.1379*

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.15

Ordinary Least Squares Estimates for Hewlett-Packard Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0464	6.6579
POS1	-0.0086	-0.1783
POS2	-0.0852*	0.0657
POS3	-0.0261	-0.1368
POS4	-0.0444	0.0214
POS5	0.0016	-0.2583
POS6	0.0724*	0.0550
NEG1	-0.0291	0.1887
NEG2	0.0030	-0.2181
NEG3	-0.0027	0.0642
NEG4	-0.0101	-0.1644
NEG5	0.0204	0.0781
NEG6	-0.0653*	-0.0224
D_{MON}	0.1691	
D_{TUE}	-0.1024	
D_{WED}	0.0713	
D_{THU}	-0.0211	
D_{JAN}		-0.8377
D_{FEB}		0.1832
D_{MAR}		-3.7460
D_{APR}		-4.8857
D_{MAY}		-2.4752
D_{JUN}		-7.5493
D_{JUL}		-8.7887
D_{AUG}		-8.9379
D_{SEP}		-9.3859*
D_{OCT}		-8.4163
D_{NOV}		-1.0660
Sum F- Value [c]	0.0068	0.4343
Identical F-Value [d]	3.0149*	1.3626

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, $D_{MON},\ldots, D_{THU}$ are dummy variables for the day of the week, the $D_{JAN}, \ldots, D_{NOV}$ are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.16

Ordinary Least Squares Estimates for Home Depot Incorporated Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.1488	1.5288
POS1	0.0912*	-0.0692
POS2	-0.0492	-0.2474
POS3	-0.0174	0.1451
POS4	-0.0709*	-0.0256
POS5	-0.0216	-0.1710
POS6	-0.0072	0.0711
NEG1	-0.0069	0.0733
NEG2	-0.0114	-0.1482
NEG3	-0.0188	-0.1909
NEG4	-0.0044	-0.1374
NEG5	0.0201	-0.1569
NEG6	-0.0373*	-0.1061
D_{MON}	-0.0557	
D_{TUE}	-0.0655	
D_{WED}	0.1400	
D_{THU}	-0.0821	
D_{JAN}		-4.1494
D_{FEB}		1.8420
D_{MAR}		0.7064
D_{APR}		-1.1922
D_{MAY}		4.0803
D_{JUN}		-4.0367
D_{JUL}		-11.4750*
D_{AUG}		-2.7845
D_{SEP}		-7.3312
D_{OCT}		-3.1435
D_{NOV}		0.9334
Sum F- Value [c]	0.0488	0.5158
Identical F-Value [d]	2.1012*	0.5095

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.17

Ordinary Least Squares Estimates for Honeywell International Inc. Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0059	-0.8975
POS1	0.0819*	0.0602
POS2	-0.0336	-0.1133
POS3	-0.0721*	-0.1022
POS4	-0.0504	0.0136
POS5	0.0281	-0.0232
POS6	0.0184	0.3083*
NEG1	-0.0959*	0.1847
NEG2	-0.0242	-0.1909
NEG3	0.0322	0.1439
NEG4	-0.0196	-0.3259*
NEG5	0.0022	0.1081
NEG6	0.0019	-0.0730
D_{MON}	-0.1316	
D_{TUE}	0.1023	
D_{WED}	-0.0307	
D_{THU}	-0.0381	
D_{JAN}		-0.4526
D_{FEB}		4.8128
D_{MAR}		-1.8841
D_{APR}		3.7205
D_{MAY}		-0.0824
D_{JUN}		-1.2024
D_{JUL}		3.8429
D_{AUG}		-3.6912
D_{SEP}		-7.0077
D_{OCT}		2.3927
D_{NOV}		2.2469
Sum F- Value [c]	1.2405	0.3808
Identical F-Value [d]	5.0565*	1.5194

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.18

Ordinary Least Squares Estimates for Intel Corporation Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0664	7.9271
POS1	0.0097	-0.0180
POS2	-0.0857*	-0.1264
POS3	-0.0304	-0.2710
POS4	-0.0093	-0.0645
POS5	0.0179	-0.2607
POS6	-0.0195	-0.0661
NEG1	0.0027	-0.0966
NEG2	-0.0010	0.0455
NEG3	-0.0437*	0.1520
NEG4	0.0264	-0.1676
NEG5	0.0067	0.1846
NEG6	0.0073	0.0266
D_{MON}	0.1397	
D_{TUE}	0.2085	
D_{WED}	0.4022*	
D_{THU}	0.1471	
D_{JAN}		11.0930*
D_{FEB}		-0.8657*
D_{MAR}		-1.7802
D_{APR}		-0.4581
D_{MAY}		0.5713
D_{JUN}		-9.4800
D_{JUL}		-5.6961
D_{AUG}		-5.0127
D_{SEP}		-4.6225
D_{OCT}		-4.2529
D_{NOV}		0.5138
Sum F- Value [c]	2.2039	2.9289
Identical F-Value [d]	1.1141	1.2021

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.19

Ordinary Least Squares Estimates for International Business Machines Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.1508	-0.9119
POS1	0.0331	-0.1288
POS2	-0.0122	-0.0355
POS3	-0.0299	0.0151
POS4	0.0077	0.0024
POS5	0.0010	0.0541
POS6	0.0459	-0.3287*
NEG1	-0.0513*	-0.1246
NEG2	-0.0091	-0.0586
NEG3	0.0145	0.1312
NEG4	0.0358	-0.1676
NEG5	-0.0172	0.0308
NEG6	-0.0217	-0.0468
D_{MON}	0.3332*	
D_{TUE}	0.2052*	
D_{WED}	0.0039	
D_{THU}	0.1083	
D_{JAN}		6.4472
D_{FEB}		-0.1226
D_{MAR}		0.4324
D_{APR}		5.3177
D_{MAY}		-1.7270
D_{JUN}		0.6245
D_{JUL}		4.5242
D_{AUG}		1.1636
D_{SEP}		-2.2924
D_{OCT}		3.1055
D_{NOV}		5.0974
Sum F- Value [c]	1.7013	0.1184
Identical F-Value [d]	1.8932	0.3266

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, $D_{MON},\ldots, D_{THU}$ are dummy variables for the day of the week, the $D_{JAN}, \ldots, D_{NOV}$ are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.20

Ordinary Least Squares Estimates for International Paper Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.0288	4.3711
POS1	0.0409	-0.3201*
POS2	0.0022	0.0494
POS3	-0.0583*	-0.2444
POS4	-0.0046	-0.0061
POS5	-0.0152	-0.1434
POS6	-0.0221	0.0746
NEG1	-0.0263	0.0115
NEG2	-0.0341	-0.1739
NEG3	-0.0015	0.1044
NEG4	-0.0186	-0.2107
NEG5	0.0211	0.2154*
NEG6	0.0108	-0.1562
D_{MON}	0.0986	
D_{TUE}	0.0454	
D_{WED}	0.0286	
D_{THU}	0.0148	
D_{JAN}		-3.2677
D_{FEB}		-3.6106
D_{MAR}		-3.6613
D_{APR}		-0.0214
D_{MAY}		-2.0551
D_{JUN}		-5.3275
D_{JUL}		0.7107
D_{AUG}		-5.7817
D_{SEP}		-8.2342*
D_{OCT}		-3.5882
D_{NOV}		-2.7724
Sum F- Value [c]	0.2358	0.7126
Identical F-Value [d]	1.1937	1.8750

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.21

Ordinary Least Squares Estimates for J.P. Morgan Chase Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.1195	-2.1978
POS1	0.0484	0.2224
POS2	0.0189	-0.0534
POS3	-0.0522	-0.0296
POS4	0.0598*	-0.0279
POS5	0.0201	0.0941
POS6	0.0136	0.0357
NEG1	-0.0077	-0.0777
NEG2	-0.0581*	0.2040
NEG3	0.0386	0.1027
NEG4	-0.0423	-0.4687*
NEG5	0.0390	0.0826
NEG6	-0.0264	-0.1460
D_{MON}	0.1031	
D_{TUE}	0.0449	
D_{WED}	0.0274	
D_{THU}	-0.0788	
D_{JAN}		6.2360
D_{FEB}		2.0441
D_{MAR}		-0.1948
D_{APR}		1.6624
D_{MAY}		5.1213
D_{JUN}		-4.4156
D_{JUL}		0.1544
D_{AUG}		0.7354
D_{SEP}		-4.3302
D_{OCT}		-2.8464
D_{NOV}		1.8825
Sum F- Value [c]	4.9093*	1.6280
Identical F-Value [d]	3.1012*	1.2083

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.22

Ordinary Least Squares Estimates for Johnson & Johnson Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.0659	3.8545
POS1	0.1191*	-0.1334
POS2	-0.0723*	0.0283
POS3	-0.1134*	0.0197
POS4	0.0205	-0.2084
POS5	0.0492	0.0874
POS6	-0.0642	-0.3277
NEG1	-0.0382*	-0.0684
NEG2	-0.0338*	-0.0825
NEG3	0.0018	0.0081
NEG4	-0.0187	-0.0648
NEG5	-0.0032	0.0346
NEG6	-0.0157	0.0936
D_{MON}	0.1168	
D_{TUE}	0.1722*	
D_{WED}	0.0001	
D_{THU}		-1.7557
D_{JAN}		-2.3725
D_{FEB}		-2.0139
D_{MAR}		2.1093
D_{APR}		-3.7310
D_{MAY}		-12.1980*
D_{JUN}		-0.7927
D_{JUL}		-2.4236
D_{AUG}		-1.7195
D_{SEP}		0.6142
D_{OCT}		0.5901
D_{NOV}		
Sum F- Value [c]	2.1154	0.4178
Identical F-Value [d]	6.7275*	0.6691

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.23

Ordinary Least Squares Estimates for McDonald's Corporation Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0366	1.7110
POS1	0.0519	-0.0883
POS2	-0.0821*	-0.4214*
POS3	-0.0807*	-0.0666
POS4	-0.0453	0.2893
POS5	-0.0266	-0.4353*
POS6	0.0258	0.1255
NEG1	-0.0097	0.0197
NEG2	-0.0008	0.0936
NEG3	-0.0040	-0.0351
NEG4	-0.0182	-0.1444
NEG5	0.0098	0.1459
NEG6	-0.0089	-0.1701
D_{MON}	0.0113	
D_{TUE}	0.1386	
D_{WED}	0.0395	
D_{THU}	0.0839	
D_{JAN}		2.0271
D_{FEB}		0.3716
D_{MAR}		-0.5598
D_{APR}		2.2513
D_{MAY}		3.8665
D_{JUN}		-7.5315*
D_{JUL}		-1.2479
D_{AUG}		-2.8886
D_{SEP}		-2.8446
D_{OCT}		-0.1917
D_{NOV}		3.7234
Sum F- Value [c]	1.0051	0.7205
Identical F-Value [d]	2.7394*	2.6892*

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.24

Ordinary Least Squares Estimates for Merck & Company, Incorporated Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.0715	1.1058
POS1	0.008*	0.0274
POS2	-0.0102	-0.0025
POS3	-0.0609*	-0.0998
POS4	0.0144	-0.1149
POS5	0.0154	-0.2366
POS6	-0.0609*	0.0719
NEG1	-0.0079	-0.0452
NEG2	-0.0564*	0.0630
NEG3	-0.0330*	0.0080
NEG4	-0.0010	0.0332
NEG5	0.0128	0.1722
NEG6	-0.0122	0.0633
D_{MON}	0.2098*	
D_{TUE}	0.1191	
D_{WED}	0.1269	
D_{THU}	0.0609	
D_{JAN}		3.2653
D_{FEB}		-2.4086
D_{MAR}		-2.2874
D_{APR}		1.9140
D_{MAY}		-4.6799
D_{JUN}		1.5168
D_{JUL}		1.7519
D_{AUG}		-1.0884
D_{SEP}		3.2607
D_{OCT}		5.9559
D_{NOV}		6.4754
Sum F- Value [c]	0.6481	0.9086
Identical F-Value [d]	1.6097	0.5555

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.25

Ordinary Least Squares Estimates for Microsoft Corporation Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0077	2.9499
POS1	0.0559*	-0.5360*
POS2	-0.0489	-0.3041
POS3	-0.0616*	-0.0293
POS4	-0.0077	0.0194
POS5	0.0009	-0.2075
POS6	0.0102	-0.0747
NEG1	-0.0248	-0.0373
NEG2	-0.0404*	-0.0679
NEG3	-0.0141	-0.0376
NEG4	-0.0041	-0.2797*
NEG5	0.0206	-0.1243
NEG6	0.0007	-0.0944
D_{MON}	0.1038	
D_{TUE}	0.1616	
D_{WED}	0.3376*	
D_{THU}	0.0562	
D_{JAN}		10.9260*
D_{FEB}		0.8272
D_{MAR}		1.0524
D_{APR}		-2.6240
D_{MAY}		2.8193
D_{JUN}		2.3177
D_{JUL}		-2.5808
D_{AUG}		-2.9417
D_{SEP}		-2.1221
D_{OCT}		3.4224
D_{NOV}		3.2872
Sum F- Value [c]	0.0274	0.9266
Identical F-Value [d]	1.2409	1.4580

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.26

Ordinary Least Squares Estimates for 3M Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	-0.0689	2.3463
POS1	0.0151	-0.1523
POS2	-0.0536	-0.2198
POS3	-0.0456	0.0573
POS4	-0.0831	0.1659
POS5	0.0229*	-0.1309
POS6	-0.0621	0.1179
NEG1	-0.1231*	-0.0294
NEG2	0.0327*	0.0027
NEG3	0.0318	-0.1667
NEG4	-0.0356*	0.0803
NEG5	0.0279	0.0496
NEG6	-0.0314	-0.0714
D_{MON}	0.1123	
D_{TUE}	0.1103	
D_{WED}	0.1025	
D_{THU}	0.0499	
D_{JAN}		-2.7952
D_{FEB}		-0.7152
D_{MAR}		-3.6099
D_{APR}		-1.0835
D_{MAY}		0.1879
D_{JUN}		-2.5618
D_{JUL}		-2.7899
D_{AUG}		-3.7022
D_{SEP}		-2.2525
D_{OCT}		-1.8227
D_{NOV}		0.9380
Sum F- Value [c]	3.9452*	0.0025
Identical F-Value [d]	1.5104	0.7984

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.27

Ordinary Least Squares Estimates for Procter & Gamble Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0797	6.8030*
POS1	0.0153	0.0092
POS2	-0.0556*	-0.1506
POS3	-0.0058	-0.2353
POS4	-0.0132	-0.3178
POS5	-0.0109	-0.5046*
POS6	-0.0625*	-0.2889
NEG1	-0.0357*	-0.0432
NEG2	0.0057	-0.0056
NEG3	0.0144	-0.0749
NEG4	-0.0648*	0.0148
NEG5	-0.0017	-0.0399
NEG6	0.0171	-0.1276
D_{MON}	0.0908	
D_{TUE}	0.1477	
D_{WED}	0.0226	
D_{THU}	-0.0816	
D_{JAN}		-1.9097
D_{FEB}		-2.0521
D_{MAR}		-3.4971
D_{APR}		-0.4071
D_{MAY}		0.9136
D_{JUN}		-7.3165*
D_{JUL}		-2.6935
D_{AUG}		-3.2060
D_{SEP}		-5.9150
D_{OCT}		2.5793
D_{NOV}		-3.4419
Sum F- Value [c]	0.9306	4.8037*
Identical F-Value [d]	2.1708*	1.1902

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, $D_{MON},\ldots, D_{THU}$ are dummy variables for the day of the week, the $D_{JAN}, \ldots, D_{NOV}$ are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.28

Ordinary Least Squares Estimates for SBC Communications Incorporated Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0387	6.7306*
POS1	0.0249	-0.1823
POS2	0.0114	-0.1625
POS3	-0.0189	-0.2757
POS4	-0.0794*	-0.2542
POS5	-0.0207	-0.1048
POS6	-0.0206	-0.3764*
NEG1	-0.0466*	-0.1104
NEG2	-0.0261	-0.0705
NEG3	-0.0256	-0.0705
NEG4	0.0064	-0.1387
NEG5	0.0089	0.0189
NEG6	-0.0122	0.1865*
D_{MON}	0.0283	0.1312
D_{TUE}	-0.0327	
D_{WED}	-0.0206	
D_{THU}	0.0586	
D_{JAN}		-2.2730
D_{FEB}		-3.7117
D_{MAR}		-4.7157
D_{APR}		-3.2015
D_{MAY}		-5.7483
D_{JUN}		-2.5225
D_{JUL}		-1.9963
D_{AUG}		-6.6344*
D_{SEP}		3.1616
D_{OCT}		1.3945
D_{NOV}		-0.9354
Sum F- Value [c]	0.0144	7.2221*
Identical F-Value [d]	2.1262*	1.6205

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.29

Ordinary Least Squares Estimates for United Technologies Corporation Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0711	3.2600
POS1	0.0524	-0.2210
POS2	-0.0745*	-0.1784
POS3	-0.0614*	0.0341
POS4	-0.0234	-0.4185*
POS5	0.0140	0.1124
POS6	-0.0399	-0.3472*
NEG1	0.0118	-0.1039
NEG2	0.0022	-0.1496
NEG3	0.0392*	-0.1672
NEG4	-0.0268	0.0648
NEG5	-0.0451*	-0.1334
NEG6	-0.0424*	0.0424
D_{MON}	-0.0591	
D_{TUE}	0.1165	
D_{WED}	0.0681	
D_{THU}	0.0665	
D_{JAN}		1.0449
D_{FEB}		2.6553
D_{MAR}		2.0062
D_{APR}		3.8014
D_{MAY}		-2.5055
D_{JUN}		-0.3349
D_{JUL}		1.3547
D_{AUG}		-5.3083
D_{SEP}		-3.5739
D_{OCT}		-0.7032
D_{NOV}		-0.9113
Sum F- Value [c]	0.9449	1.2665
Identical F-Value [d]	2.4847*	1.3785

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.30

Ordinary Least Squares Estimates for Wal-Mart Stores Incorporated Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.0914	2.6585
POS1	-0.0029	-0.2037
POS2	-0.0384	0.0371
POS3	-0.0704*	-0.0606
POS4	-0.0028	-0.1368
POS5	-0.0254	0.0429
POS6	-0.0240	-0.0679
NEG1	-0.0314	0.1217
NEG2	-0.0626*	-0.0170
NEG3	-0.0400*	0.0855
NEG4	-0.0049	0.0407
NEG5	-0.0213	-0.1080
NEG6	0.0098	-0.0946
D_{MON}	0.0515	
D_{TUE}	0.0175	
D_{WED}	0.0486	
D_{THU}	-0.0513	
D_{JAN}		-0.6402
D_{FEB}		-2.0628
D_{MAR}		3.1369
D_{APR}		-5.2125
D_{MAY}		2.5913
D_{JUN}		2.6878
D_{JUL}		-2.3718
D_{AUG}		-3.2820
D_{SEP}		-2.4063
D_{OCT}		-0.3344
D_{NOV}		4.5686
Sum F- Value [c]	0.0338	0.6718
Identical F-Value [d]	0.4486	0.5975

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.31

Ordinary Least Squares Estimates for Walt Disney Company Stock Prices, January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b]	Monthly Coefficients [b]
Intercept	0.1489	1.6146
POS1	0.0821*	0.0047
POS2	-0.0769*	0.1581
POS3	-0.1182*	-0.3653
POS4	0.0213	-0.5177*
POS5	0.0224	-0.1572
POS6	-0.0559*	0.1974
NEG1	-0.0569*	0.1038
NEG2	-0.0023	-0.0189
NEG3	0.0363*	0.0440
NEG4	-0.0157	-0.0332
NEG5	-0.0122	-0.0123
NEG6	0.0219	0.0024
D_{MON}	-0.0411	
D_{TUE}	0.0151	
D_{WED}	0.0411	
D_{THU}	-0.1183	
D_{JAN}		7.5687
D_{FEB}		5.6750
D_{MAR}		0.6197
D_{APR}		5.5046
D_{MAY}		-0.0816
D_{JUN}		-0.5305
D_{JUL}		-6.4159
D_{AUG}		-1.7770
D_{SEP}		-2.2326
D_{OCT}		1.5412
D_{NOV}		3.8108
Sum F- Value [c]	2.1144	2.1660
Identical F-Value [d]	7.6753*	1.5231

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, D_{MON},..., D_{THU} are dummy variables for the day of the week, the D_{JAN}, ...,D_{NOV} are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.32

OLS Estimates and Monte Carlo (N=1000) 95% Confidence Interval for daily IBM Stock Price Changes, January 1987 through December 2002.

Independent Variable [a]	Daily Coefficients [b]	Monte Carlo Coefficients [c]	Monte Carlo 95% Confidence Interval [d] Lower Limit	Upper Limit
Intercept	-0.15081	0.04404	-0.28152	0.3696
POS1	0.03307	-0.00085	-0.05096	0.04903
POS2	-0.01221	0.00003	-0.06251	0.05029
POS3	-0.02991	0.00086	-0.13781	0.05164
POS4	0.00768	0.00092	-0.04342	0.05204
POS5	0.00121	0.00096	-0.05030	0.05222
POS6	0.04592*	0.00009	-0.00623	0.05223
NEG1	-0.05131*	-0.00003	-0.10412	0.05239
NEG2	-0.00913	0.00065	-0.06422	0.05569
NEG3	0.01448	0.00113	-0.04392	0.05495
NEG4	0.03579	-0.00017	-0.11883	0.05439
NEG5	-0.01717	0.00028	-0.06991	0.05298
NEG6	-0.02173	-0.00059	-0.07512	0.05261
D_{MON}	0.33317*	0.00198	0.11881	0.21636
D_{TUE}	0.02052*	-0.00198	-0.18151	0.19832
D_{WED}	0.00393	-0.00372	-0.19372	0.19689
D_{THU}	0.10825	0.00101	-0.09641	0.20561

* Significant at the 5% level, falls outside the 95% Monte Carlo confidence interval.

[a] Where POSi and NEGi are the positive and negative percentage stock price changes in the i^{th} lag, D_{MON}, ..., D_{THU} are dummy variables for the day of the week.

[b] The dependent variable is the percentage price change.

[c] 1000 repeated random sample of size n=4036 from a N(0.0457, 2.048) distribution were used, the coefficients are the average of the 1000 replications.

[d] $\mu \pm 2\sigma$ is used as approximation to the 95% confidence interval for the coefficients.

Table 3.33

Ordinary Least Squares Estimates for Daily Regression Results and Asymmetry Tests for Walt Disney stock percentage price changes, with and without large price changes (> |15%|), January 1987 through December 2002

Independent Variable [a]	Daily Coefficients [b] **with** large changes	Daily Coefficients [b] **without** large changes
Intercept	0.1489	0.1819*
POS1	0.0821*	0.0650
POS2	-0.0769*	-0.0912*
POS3	-0.1182*	0.1233*
POS4	0.0213	0.0194
POS5	0.0224	0.0248
POS6	-0.0559*	-0.0500*
NEG1	-0.0569*	-0.0680*
NEG2	-0.0023	0.0318
NEG3	0.0363*	0.0302
NEG4	-0.0157	-0.0150
NEG5	-0.0122	-0.0104
NEG6	0.0219	0.0184
D_{MON}	-0.0411	0.0026
D_{TUE}	0.0150	0.0160
D_{WED}	0.0410	0.0230
D_{THU}	-0.1183	0.0984
Sum F- Value [c]	2.1144	5.1612*
Identical F-Value [d]	7.6753*	9.7490*

* Significant at 5% level

[a] Where POSi and NEGi are the positive and negative percentage price changes in the i^{th} lag, $D_{MON},\ldots, D_{THU}$ are dummy variables for the day of the week, the $D_{JAN}, \ldots, D_{NOV}$ are dummy variables for the month of the year.

[b] The dependent variable is the percentage price change.

[c] Null Hypothesis is that the total impact of past price increases on current price changes are equal to past decreases.

[d] Null hypothesis is that the speed of adjustment to price increases and price decreases are the same.

Table 3.34.A

Number and Means of percentage increases and decreases in price for Dow Jones Stocks

Stock Price	Increases		Decreases		Stable	T-test
	Number	Mean	Number	Mean		Statistic [a]
Alcoa Incorporated						
Daily	1897	1.6798	1958	-1.497	178	3.8954*
Monthly	111	7.0452	79	-8.8178	0	-1.4219
Altria Group, Inc.						
Daily	2004	1.4316	1877	-1.3885	153	0.9531
Monthly	114	6.207	73	-8.4026	0	-1.7209
American Express Co.						
Daily	1894	1.8292	1893	-1.7082	247	2.3768*
Monthly	107	6.328	80	-7.8078	0	-1.3202
AT&T Corporation						
Daily	1815	1.6225	1917	-1.5027	302	2.3432*
Monthly	93	8.2296	91	-6.8842	0	0.8856
Boeing Company						
Daily	1891	1.5462	1909	-1.4418	233	2.301*
Monthly	104	6.7196	84	-7.6751	0	-0.9542
Caterpillar Incorporated						
Daily	1908	1.6104	1940	-1.462	186	3.2501*
Monthly	107	7.1372	82	-7.922	0	-0.7417
Citigroup Incorporated						
Daily	1889	1.9069	1876	-1.7066	264	3.8353*
Monthly	103	8.158	85	-8.2364	0	-0.0783
Coca Cola Company						
Daily	1942	1.3948	1888	-1.2864	203	2.679*
Monthly	114	5.2806	72	-7.1933	0	-1.9369
DuPont						
Daily	1901	1.4642	1950	-1.3376	183	3.1571*
Monthly	98	6.1425	92	-6.2902	0	-0.1476
Eastman Kodak Company						
Daily	1870	1.4531	1955	-1.3825	211	1.5375
Monthly	101	5.6782	88	-6.553	0	-1.0035
Exxon Mobil Corporation						
Daily	1925	1.2035	1865	-1.1465	243	1.5952
Monthly	100	4.0726	82	-4.9928	0	-0.9292
General Electric Company						
Daily	1943	1.389	1895	-1.296	194	2.3381*
Monthly	99	6.0864	90	-6.7544	0	-0.5575
General Motors Corporation						
Daily	1853	1.6571	1960	-1.5192	222	2.7965*
Monthly	88	8.1312	99	-6.9083	0	1.2525
Hewlett-Packard Company						
Daily	1948	2.051	1949	-1.9232	136	2.1219*
Monthly	**96**	**9.735**	**93**	**-9.3002**	**0**	**0.3276**
Home Depot Incorporated						
Daily	1980	1.8471	1855	-1.7148	193	2.4483*
Monthly	104	8.4978	86	-8.5879	0	-0.0776

* Significant at the 5% level.

Table 3.34.B

Number and Means of percentage increases and decreases in price for Dow Jones Stocks

Stock Price	Increases		Decreases		Stable	T-test
	Number	Mean	Number	Mean		Statistic [a]
Honeywell International Inc.						
Daily	1879	1.6447	1888	-1.5397	267	1.8764
Monthly	103	6.7775	85	-7.5025	0	-0.6032
Intel Corporation						
Daily	1994	2.3144	1893	-2.1825	144	2.0556*
Monthly	110	10.48	80	-12.314	0	-1.2189
International Business Machines						
Daily	1970	1.504	1944	-1.4324	120	1.5159
Monthly	94	8.1	94	-7.5485	0	0.5396
International Papers Company						
Daily	1913	1.547	1946	-1.4469	175	2.1451*
Monthly	96	6.9781	90	-7.2662	0	-0.2688
J.P. Morgan Chase & Company						
Daily	1888	1.8456	1885	-1.759	261	1.5612
Monthly	97	8.5564	89	-8.5026	0	0.0444
Johnson & Johnson						
Daily	1981	1.3401	1876	-1.2487	175	2.5035*
Monthly	112	5.7876	78	-7.319	0	-1.3634
McDonald's Corporation						
Daily	1883	1.4318	1893	-1.3303	256	2.5914*
Monthly	103	5.7275	86	-7.3657	0	-1.5478
Merck & Company, Inc.						
Daily	1958	1.413	1894	-1.318	181	2.541*
Monthly	105	6.3874	83	-7.4952	0	-0.9238
Microsoft Corporation						
Daily	2007	2.0018	1902	-1.7885	119	3.816*
Monthly	111	9.9452	77	-11.86	0	-1.2731
3M Company						
Daily	1936	1.2186	1893	-1.1449	205	1.9566
Monthly	106	4.8317	82	-5.4285	0	-0.6634
Procter & Gamble Company						
Daily	1976	1.304	1885	-1.2165	172	2.0489*
Monthly	102	5.9608	86	-5.8388	0	0.1126
SBC Communications Inc.						
Daily	1875	1.4378	1879	-1.3489	279	2.1037*
Monthly	99	6.0331	89	-6.9592	0	-0.8248
United Technologies Corporation						
Daily	1927	1.4392	1902	-1.3314	205	2.5571*
Monthly	109	6.203	81	-6.766	0	-0.5091
Wal-Mart Stores Incorporated						
Daily	1915	1.685	1821	-1.5786	296	2.3758*
Monthly	115	6.6033	74	-8.5711	0	-1.6865
Walt Disney Company						
Daily	1924	1.6009	1926	-1.4824	184	2.4405*
Monthly	108	6.3542	80	-8.051	0	-1.3365

* Significant at the 5% level.

Table 3.35

F Statistics for Tests of Day of the Week Effect and Month of the Year Effect for Dow Jones Stocks

Stock	Day of the Week [a]	Month of the Year [b]
Alcoa Incorporated	1.3783	1.6632
Altria Group, Incorporated.	4.4941	1.2298
American Express Company	0.4449	1.2379
AT & T Corporation	0.5041	2.0996*
Boeing Company	3.5967*	1.9656*
Caterpillar Incorporated	3.0148*	1.9919*
Citigroup Incorporated	1.2269	1.1871
Coca-Cola company	1.3719	1.2325
DuPont	2.5587*	1.7582
Eastman Kodak Company	3.3682*	1.0398
Exxon Mobil Corporation	0.7879	0.8958
General Electric Company	0.3300	1.6434
General Motors Corporation	2.3428	1.9719*
Hewlett-Packard Company	1.1498	1.1184
Home Depot Incorporated	1.1897	2.0474*
Honeywell International Incorporated	1.1050	1.6179
Intel Corporation	1.9834	1.5964
International Business Machines	3.7529*	1.1233
International Paper Company	0.2844	1.2188
J. P. Morgan Chase & Company	0.6081	1.2172
Johnson & Johnson	1.6534	1.9231*
McDonald's Corporation	0.8371	1.7563
Merck & Company, Incorporated	1.5898	1.4400
Microsoft Corporation	2.1202	1.0992
3M Company	2.4482*	0.6378
Procter & Gamble Company	1.9408	1.3356
SBC Communications Incorporated	0.3324	1.6262
United Technologies Corporation	1.0848	0.9961
Wal-Mart Stores Incorporated	0.3392	1.1787
Walt Disney Company	0.7142	1.7912*

* Significant at 5% level

[a] Joint test of dummy variable for the day of the week; $D_{MON}=D_{TUE}=D_{WED}=D_{THU}=0$

[b] Joint test of the dummy variable for the month of the year; $D_{JAN}=D_{FEB}=D_{APR}=D_{MAY}=D_{JUN}=D_{JUL}=D_{AUG}=D_{SEP}=D_{OCT}=D_{NOV}=0$

Table 3.36

Summary Statistics on Percentage Differences of Dow Jones Stock Prices

Stock	Sample Size		Mean		Standard Deviation		Skewness		Kurtosis	
	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly
Alcoa Incorporated	4033	190	0.0244	-0.0959	1.1639	7.0669	-0.1658	-2.3740	7.2939	12.8893
Altria Group, Inc.	4034	190	0.0436	-0.2314	1.2262	11.8520	-1.3668	-7.0867	20.3666	65.9866
American Express Com.	4034	190	0.0256	-0.2034	1.4382	9.1059	0.0751	-6.6808	10.8206	65.4165
AT & T Corporation	4034	190	0.0036	0.0190	0.8689	4.5113	-0.6606	-1.3898	22.4356	11.0302
Boeing Company	4034	190	0.0202	-0.1112	1.0149	6.3808	-0.1561	-3.9392	5.2688	26.9074
Caterpillar Incorporated	4033	190	0.0298	-0.0008	1.1393	7.7879	-0.4513	-4.1119	8.5114	29.2856
Citigroup Incorporated	4034	190	0.0358	0.0483	1.0091	5.0305	0.2598	-1.3363	7.3130	4.5032
Coca Cola Company	4029	190	0.0320	-0.0054	0.9617	5.9779	-0.2855	-3.3907	6.7465	18.5989
DuPont	4033	190	0.0235	-0.3032	1.2036	8.5484	-0.9088	-6.1198	15.3154	55.2403
Eastman Kodak Com.	4034	190	-0.0022	-0.2208	1.0948	5.4078	-1.5439	-3.6394	22.1587	27.7969
Exxon Mobil Corp.	4035	190	0.0245	-0.2286	0.9652	6.8639	-0.0361	-5.7934	6.3924	40.3974
General Electric Com.	4033	190	0.0471	-0.4159	1.2468	11.119	0.0810	-5.6160	5.9334	45.6050
General Motors Corp.	4032	190	0.0025	-0.1987	1.1719	6.4357	-0.8261	-2.1509	12.9867	12.4088
Hewlett-Packard Com.	4035	190	0.0275	-0.1975	1.8130	9.7426	-0.3464	-2.5038	13.4940	13.0742
Home Depot, Inc.	4028	190	0.0466	0.0008	1.0771	6.1792	-1.4085	-2.5308	23.3389	12.0664
Honeywell Inter. Inc.	4034	190	0.0154	-0.1158	0.9527	5.8458	-0.3404	-3.5054	14.8307	22.6413
Intel Corporation	4031	190	0.0769	-0.1181	1.8644	12.4280	-0.1422	-2.4712	6.4933	10.2017
International Bus. Mach.	4034	190	0.0404	-0.3263	2.2479	13.0370	-0.2777	-2.6650	18.3578	17.8233
International Paper Co.	4034	190	0.0115	-0.2896	0.9930	6.3854	-0.3947	-4.1790	8.3028	31.1966
J.P. Morgan Ch & Co.	4034	190	0.0187	-0.1184	1.2070	7.0306	0.0814	-3.7232	5.8012	29.7100
Johnson & Johnson	4032	190	0.0445	-0.1713	1.2183	8.6917	-0.4716	-3.5811	8.0362	18.4614
McDonald Corporation	4032	190	0.0219	-0.3167	0.7679	5.5498	0.0002	-4.3161	6.9415	24.8490
Merck & Company, Inc.	4033	190	0.0515	-0.5138	1.6190	13.1280	-0.7529	-5.1337	18.7466	36.0184
Microsoft Corporation	4028	190	0.1166	-0.1318	2.0908	14.9840	-0.1860	-2.0815	4.9655	7.3344
3M Company	4034	190	0.0299	-0.0221	1.4164	7.7099	-0.3589	-3.5431	11.5215	24.3900
Procter & Gamble Com.	4033	190	0.0479	-0.0043	1.4979	9.6861	-2.3785	-4.3119	47.1705	25.4520
SBC Commun., Inc.	4033	190	0.0139	-0.4692	0.8593	7.1708	-0.2687	-6.1638	5.2796	52.7354
United Tech. Corp.	4034	190	0.0380	0.0385	1.2071	9.7427	-0.9481	-5.7409	16.5065	44.4429
Wal-Mart Stores, Inc.	4032	190	0.0342	-0.0223	0.9411	6.3347	0.0674	-3.9073	4.9166	22.8125
Walt Disney Company	4034	190	0.0384	-0.2267	1.2642	10.9450	-0.7523	-6.4087	18.8603	57.6348

CHAPTER 4

SUMMARY

The objective of this study was to test for asymmetry in stock price changes for the 30 stocks that comprise the Dow Jones Industrial Average (DJIA) for the period January 1987 to December 2002. Asymmetry is examined through the use of two tests: the sum of coefficients test and the speed of adjustment test. A Monte Carlo study is used to compare coefficients form observed daily percentage price changes in IBM versus a random series of percentage price changes form a normal distribution, in order to ensure that asymmetry results are reliable.

Literature Review, Methodology and Empirical Results

Chapter two provides a literature review of price asymmetry. It presents the existing theories of asymmetry of price transmission within spatial markets and vertical price transmission within a marketing channel. If asymmetry is present within a market, current price changes may react to past price increases and decreases asymmetrically. Asymmetric price research has mostly focused on commodity markets; however, this study deals with the stock market.

Chapter three showed how the estimation was developed and the asymmetry tests are performed using daily and monthly data of DJIA stock prices. Asymmetry is examined through the use of two tests: the sum of coefficients test and the speed of adjustment test.

In the traditional model, there is only one coefficient for a lagged price change variable, forcing the assumption that past price increases have the same

effects on the current price change as past price decreases. In this study, an asymmetry model distinguishes between price increases and price decreases by creating two variables for lagged price changes. By separating price changes into positive and negative changes, the coefficients are examined to determine (1) whether past price increases affect the current price change in a similar manner as past price decreases and (2) whether the speed of adjustment for past price change will be the same for increases and decreases.

Results of the model and symmetry tests imply that most stocks analyzed in this study feature some degree of asymmetry. Therefore, traditional models in time series may be slightly biased when forecasting future prices because they assume an increase in price has the same effect as a decrease. For J.P. Morgan and Chase, the overall impact of past increases is different from past decreases for daily and monthly prices. The overall impact of past increases and decreases was also found to be asymmetric in daily 3M and monthly Eastman and Kodak, Exxon Mobile, Procter and Gamble, and SBC Communications. The speed of adjustment test for asymmetry was rejected for four from monthly data and fourteen from daily data.

These results have a number of implications. First, asymmetry may imply that the weak form efficient hypothesis appears to be contracted for certain stocks indicating that past prices affect current prices and contain information. Therefore, traders may wish to adjust their trade entry and exit points for stocks that behave asymmetrically. This is in contrast to using entry and exit points that

are symmetrical in the sense that the condition for entering the market is the mirror image of the exit condition.

Second, certain markets are known to crash or suddenly correct themselves from time to time, and the stock market is the most well known. These adjustments are asymmetric because they occur predominantly with a sudden decrease in the value of the underlying stocks or security. Regulators have a role in these markets to avoid such devaluation in such a short period of time. Under these circumstances, if the underlying asset begins to decrease in value, not only does the investor lose money on the investment but also on the capital asset decreasing in value. This in turn causes the market to spiral down further when capital asset decline in value. If regulators are better prepared for downward asymmetric price movements in assets such as stocks and commodities, this information could be used in advance to adjust expectation or forecasts. Informed forecast may help avoid excessive upward price movement, which eventually results in a fast downward movement, with adverse impacts for market participants and the economy as a whole.

Limitations and Suggestions for Future Research

This study showed that there is asymmetry in stock price changes in some of the 30 stocks that comprise the DJIA for the period January 1987 to December 2002. The study could be expanded to other stocks traded on other exchanges with a longer time frame. In addition, a number of possible avenues for future research follow from the results. An obvious extension of the study would be to develop asymmetric models similar to the one presented in this study, to better

specify the underlying data than a traditional autoregressive model that does not separate positive and negative changes. It may also be interesting to find a way to incorporate asymmetry in asset pricing models such CAPM, stock valuation model such as the Present Value and the Black and Scholes option pricing model.

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APPENDIX A

Alcoa is the world's largest aluminium producer. Shipped 7,486,000 metric tons of aluminium in 2002. Ha 25 business units, with more than 300 operating and sales locations in 38 countries. 2002 revenues by business segment: Alumina and Chemicals, 9%; Primary Metals, 16%; Flat-rolled Products, 23%, Engineered Products, 25%; Packaging and Consumer, 14%; other, 13%. Foreign sales accounted for 34% of total. 2002 depreciation rate: 5.6%. Has about 127,000 employees, 273,000 shareholders. Wellington Management owns 7.4% of common stock; officers and directors, less than 1% (2/03 Proxy). Chairman, President & CEO: Alain Beldam. Inc. PA. Address: 201 Isabella Street, Pittsburgh, PA 15212. Telephone: 412-553-4545. Internet: www.alcoa.com

Altria Group, Inc. is a leading consumer products company with four major segments: tobacco (59% of'02 revenuse, 62% of operating profit) includes Marlboro, Benson & Hedges, Merit, Virginia Slims, Lark; food (37%, 36%), include coffee, Post cereals, and packaged foods (Jell-O, Kool-Aid, Oscar Mayer, Kraft, Velveeta, Miracle Whip); Miler beer (3%, 2%); and financial services/real estate (1%, 0%). Sold Miller, 6/02. Has a 50% share of U.S. industry shipments of cigarettes. Acquired Nabisco, 12/00; Kraft, 12/88; Jacobs Suchard AG, 8/90. Has 175,000 employees, 131,700 stockholders. Former Corporation owns 5.6% of stock; Officers and directors, less than 1.0% (3/03 Proxy). Chairman and CEO: Louis C. Camilleri. Inc: VA Address: 120 Park Ave, NY, NY 10017. Telephone: 212-880-5000. Internet: www.altria.com

American Express Company is a travel, financial, and information services company. Principle subsidiaries include travel Related Services (charge and credit cards, traveler's checks, etc.). American Express Financial Advisors (financial planning, insurance, and investment products), and American Express Bank (international banking). Sold AMEX Life, 10/95; remaining 19% interest in Fireman's Fund Corporation, 8/89; Spun off Lehman Brothers to shareholders, 5/94. Has about 75,460 employees, 51,060 shareholders. Officers & directors own 1.1% of Common; Berkshire Hathaway, 11.4% (3/03 Proxy). President and CEO: Kenneth Chenault. Inc.: New York. Address: 200 Vesey Street New York, NY 10285. Telephone 212-640-2000. Internet: www.americanexpress.com

AT & T Corporation (formerly American Telephone and Telegraph), which resulted from a court-ordered break-up of the Bell System in 1984, received about 23% of the former company's assets. AT &T operates in the global telecommunications and information management industry. 2002 revenues: business services, about 70%; consumer services, 30%. Acquired MediaOne in '00; Tele-Communications, Inc. and Vanguard Cellular in '99; Teleport in '98; LIN Broadcasting in '95; McCaw Cell. In '94. Sold AT & T Broadband in '02. 2002 depreciation rate: 8.6%. Has about 62,500 employees, 3.1 million stockholders. Chairman and CEO: David W. Dorman. Inc.: NY. Address: One AT&T Way, Bedminster, NJ 07921. Telephone: 908-221-2000. Internet: www.att.com

The Boeing Company is the leading manufacturer of commercial jet aircraft. Also producers fighters (F-16, F/A-18), C-17 cargo carrier, helicopters (V-22), E-3 AWACS, E-4 command post. E-6 submarine communicator, ground transportation systems, develops the space station, and does work on the F-22 (ATF). Foreign sales: 33%; R & D; 3.3%. 2002 depreciation rate: 7.0%. Absorbed McDonnell Douglas Corporation on August 1, 1997. Has 169,000 employees, 125,000 stockholders. Officers & directors control about 2.3% of stock. State St. Bank and Trust, 11.7%; Wachovia Corporation 5.5% (3/03 Proxy). Chairman: Lewis E. Platt. CEO and President Harry C. Stonecipher. Inc.: DE. Address: 100 North Riverside, Chicago, IL 60606. Telephone: 312-544-2140. Internet: www.boeing.com

Caterpillar Incorporated is the world's largest producer of earthmoving equipment. Major markets include road building, mining, logging, agriculture, petroleum, and general construction. Products include tractors, scrapers, graders, compactors, loaders, off-highway truck engines, and pipe layer. Also makes diesel & turbine engines and lift trucks. Has over 215 dealers, serving 180 countries. International business accounts for about 54% of sales; R&D; 3.3% of sales. Has 68,005 employees, 36,255 stockholders of record. Officers and director own 1.4% of common stock; Capital Research and Management Company, 6.6% (3/03 Proxy). Chairman and CEO: James W. Owens. Inc.: DE. Address: 100 N.E. Adams St. Peoria, IL 61629. Telephone: 309-675-1000. Web: www.cat.com

Citigroup, formed by the merger of Citicorp and Travelers Group in10/98, is a diversified financial services company with operations is consumer and corporate banking, insurance, investment banking, and asset management. Business includes Citibank, Citigroup Global Markets (formerly Salomon Smith Barney), CitiFinancial, Primerica Financial Services, Banamex, and Travelers Life & Annuity. Spun off 23.0% of Travelers Property Casualty, 3/02; spun off 67%, 8/02. Has some 200 million customer accounts in over 100 countries. Officers and directors. Owner approximately 1.7% of common stock (2/03) Proxy). CEO: Charles O. Prince. Chairman: Sanford I. Well. Inc.: DE. Address: 153 East 53rd Street, NY, NY 10043. Telephone: 212-559-1000. Web: www.citigroup.com

The Coca-Cola Company is the world's largest beverage company. Distributes major brands (Coca-Cola, Diet Coke, Sprite, Barq's, Mr. PiBb, Fanta, Fresca, Dasani, Evian, Danone, Powerade, Minute Maid, and others) through bottlers around the world. Business outside North America accounted for 68% of the net sales and 63% of profits in 2002. Coca-Cola Enterprises, 45%-owned soft drink bottler. Advertising costs, 9.8% of sales. Has approximately 38,000 stockholders. Berkshire Hathaway owns 8.1% of stock (3/03) Proxy). Chairman and CEO: Douglas N. Daft. President and COO: Steven J. Heyer. Inc.: Delaware. Address: One Coca-Cola Plaza, Atlanta, Georgia 30313. Telephone: 404-676-2121. Internet: www.coca-coal.com

The Walt Disney Company operates media networks (40% of '03 revenues), including ABC and ESPN; parks and resorts: Disneyland, Walt Disney World (Magic Kingdom, Epcot Centre, Disney-MGM Studios, Animal Kingdom), and a cruise line (24%). Supplies filmed entertainment, books, music (27%). Sells (Dusney Store) and Lic. Consumer. (9%) earns Tokyo Disneyland and Disneyland Paris royalties. Acquired Capital Cities/ABC 2/96. Infoseek Cp. 11/99. Foreign sales: 18% of revenues. '03 depreciation rate: 5.0%. Has about 112,000 employees. Officers/directors own 2.2% of stock (1/04 Proxy). Chairman & CEO: M.D. Eisner. Inc.: Delaware. Address: 500 South Buena Vista St. Burbank, CA 91521-7320. Telephone: 818-560-1000. Internet: www.disney.com

E.I. du Pont de Nemours and Company is the largest chemical company in the U.S. Products: agricultural chemicals, industrial and specially chemicals, titanium dioxide, fluorochemicals, nylon, polyester, acrylic, and other fibres, polymer, films, resins, adhesives, electronic products, automotive paints, coatings, x-ray products, diagnostic equipment, and pharmaceuticals. In 2002: foreign sales, 46% of total: R&D, 5.3% of sales. 2002 depreciation rate: 3.8%. Has approximately 79,000 employees, 116,340 stockholders. Officers and Directors control 1.6% of common stock (3/03 Proxy). President and CEO: Charles O. Holiday, Jr. Incorporated: Delaware. Address: 1007 Market Street, Wilmington, DE 19898. Telephone: 302-774-1000. Internet: www.dupont.com

Eastman Kodak Company is the world's largest producer of photographic products. Segments: Photography (70% of 2002 sales, 60% of operating earnings); Health Imaging (18%, 34%); Commercial Imaging, (11%, 9%); other (1%, -3%). Subsidiaries outside U.S. account for 53% of sales. R & D: 5.9% of sales in 2002 vs. 5.9% in 2001. Labour costs: 31.1% of sales. 2002 depreciation rate: 6.2%. Estimated plant age: 8 years. 2002 employees: 70,000, (including 39,000 in U.S.); has 89,988 shareholders. Officers and Directors own about 1% of stock (3/28/03 Proxy). Chairman and CEO: D. Carp. Pres. and COO: A. Perez. Inc.: Address: 343 State Street, Rochester, NY 14650-0205. Telephone: 585-724-5492. Internet: www.kodak.com

Exxon Mobil Corporation was formed in 1999 following the merger of Exxon and Mobil. It is the largest publicly oil company. Daily production in 2002: crude oil, 2.5 million Barrels; natural gas, 10.5 billion. Cubic feet. Reserves as of 12/31/02: 12.6 billion. Barrels oil; 55.7 trillion. Cu. Ft. nat. gas. Estimated pre-tax present value of reserve, $133 billion. Daily refinery runs, 5.5 million. Bbls; capacity utilization, 87%; product sales, 7.8 million. Bbls. Has 41,786 retail sites. Capital employed: 49% upstream, 30% downstream, 15% chemicals, 6% corp. and other. Owns 70% of Imperial Oil (Canada). Employs 92,000. Has 678,000 shareholders. Chairman and CEO: Lee Raymond. Inc.: NJ. Address: 5959 Las Colinas Blvd. Irving, TX 75039-2298. Telephone: 972-444-1000. Internet: www.exxonmobil.com

General Electric Company is one of the largest & most diversified industrial cos. In the world. Indus. Segments incl Aircraft Engines (15% of '02 revenues; 17% of operating profits); Appliances (8%, 4%); Broadcasting (10%, 10%); Indus. Products & Systems (13%, 12%); incl. Lighting, locomotives, motors, Indus. Systems; Material (11%, 10%); mainly plastic; Power Systems (31%, 34%) turbine-generators' Technical Pdts. & Svcs. (13%, 13%), medical systems, computers svcs. Also has GE Capital (provided $4.6 Bill. In other inc.) Foreign: 50% of sales; R & D, 4.0%. Has about 315,000 employees, 534,000 stockholders. Officers and directors: Own less than 1% of stocks. (3/03 Proxy). Chairman and CEO: Jeffery Lmmelt. Inc.: NY. Address: 335 Easton Turnpike, Fairfield, CT 06431. Telephone: 203-373-221. Internet: www.ge.com

Hewlett-Packard Company provides computing and imaging solutions and services. Operates in five segments. Revenue contribution (and % operating earnings) in'03: Imaging & Printing, 31% (74%); Personal Systems, 29% (less than 1%), Enterprise Systems, 21%: HP Services, 17% (28%); Financing, 2% (2%); other, less than 1% (d3%). Acquired Company Computer 5/02. Agilent Tech. Spun off 6/00. Foreign sales: 46%; R&D: 5.0% of revenue in '03. '02 depreciation rate: 16.9%. Employees : 141,800; stockholders: 160,800. Packard Foundation owns 6.3% of stock: Officers and directors, less than 1% (3/03Proxy). Chairman and CEO: Carly Fiorina. Inc.: DE. Address: 3000 Hanover St. Palo Alto, CA 94304. Telephone: 650-857-1501. Internet: www.hp.com

The Home Depot, Inc. operates a chain of retail building supply/home improvement "warehouse" stores across the U.S. and in Canada. Acquired 75% interest in Aikenhead's (renamed Home Depot Canada) in 2/94. Avg. store size: 108,000 sq. ft. indoor plus 22,000 sq. ft. garden center; items stocked: 45,000. Product lines building mat'ls, lumber, floor/wall coverings; plumbing, heating, and electrical; paint & furniture; seasonal and specialty items; hardware & tools. '02 deprecation rate 4.4%. Has about 280,900 employees. Officers and directors. Own 1.3% of stock (4/03 Proxy). Chairman, President and CEO: Robert L. Nardelli. Incorporated: DE. Address: 2455 Paces Ferry Road N. W. Atalanta, GA 30339. Telephone: 770-433-8211. Internet: www.homedepot.com

Honeywell was formed by the 12/99 merger of Allied Signal Corp, and Honeywell. Segments: Aerospace Solutions (40% of '02 sales), propulsion engines, avionic control and safety instruments, and aftermarket services; Automation & Controls (31%, home and building control and safety systems, and facility & equipment management; Transportation Systems (14%), turbochargers, truck brakes and consumer products; Speciality Materilas (15%), electr. Materials, polymers, fluorins, plastics, films, and fibers. Has interest in petroleum. About 108,000 employees. State Street owns 11.7% of stock; officers and directors, 8% (3/03 Proxy). Chairman, President and CEO: Dave Cote, Inc.: DE Address: 101 Columbia Rd. Morristown, NJ 07962. Telephone: 973-455-2000. Internet: www.honeywell.com

International Business Machines Corporation is the world's largest supplier of advanced information processing technology and communication systems and services and program products. @002 revenue breakdown: Global Services, 45%; Hardware, 34%; Software, 16% Global Financing, 4%; Enterprise investment/other, 1%. Foreign business accounted for 60% of 2002 revenues, R & D, and engineering costs, 5.8% of revenues. '02 dep. Rate: 12.1%. Has 315,890 employees, 680,295, shareholders. Officers and directors control less than 1% of stock (3/03 Proxy). Chairman and CEO: Samuel J. Palmisano. Inc.: NY. Address: New Orchard Road, Armonk, NY 10504. Telephone: 914-499-1900. Internet: www.ibm.com

International Paper Company is the world's largest paper and forest products firm. Products include paper, paper board, pulp, lumber, panels, laminated products, minerals, chemicals, and packaging products. Also distributes paper and office supplies in the U.S. Managers about 11.3 mills, acres of the timberlands. Recent major acquisition: Union Camp, 4/99, Shorewood Packaging, 3/00; Champion Int't, 6/00. Foreign operations generated 25% of '02 sales. '02 depreciation rate 4.5%. Employs 100,000. Officers and directors. Own less than 1% of stock; employee benefit plans, 8.1%; capital Research and Management, 9.7% (3/03 proxy). Chairman and CEO: John Faraci. Inc.: NY. Address: 400 Atlantic Street, Stamford, CT 06921 Telephone: 203-541-8000. Internet: www.internationalpaper.com

Intel Corporation is a leading manufacturer of integrated circuits > markets served: primarily makers of personal computers; also communications, industrial automation, military, and other electronic equipment. Main products: microprocessors (notably, the Pentium series), microcontrollers, and memory chips. Also sells computer modules and boards, and network products. Foreign business: about 71% of '02 sales. R&D: 15.1% of sales. '02 depreciation rate: 12%. Has about 78,700 employees, 240,000 shareholders. Officers and directors own 3.4% of stock (4/03 Proxy). Chairman: A. S. Grove. CEO: C.R. Barrett. Pres: Paul Otellini. Incorporated: Delaware. : Address: 2200 Mission College Blv., Santa Clara, CA 95052-8119. Telephone: 408-765-8080. Web: www.intc.com

Johnson & Johnson manufactures and sells healthcare products. Major lines by segment: Consumer (baby care, non-prescription drugs, sanitary protection, and skin care), Professional (wound closures, minimally invasive surgical instruments, diagnostics, orthopaedics, and contact lenses), and pharmaceutical (contraceptives. And psychiatric, anti-infective, and dermatological drugs). Important brands: Band-Aid, Monistat, Neutrogena, Reach, Stayfree, and Tylenol. International business, 38% of '02 sales. '02 depreciation rate: 11.6%; R&D, 10.9% of sales. Has 101,800 employees, 164,200 stockholders. Officers/dir. Own 0.2% (2/03 Proxy). Chairman and CEO: William Weldon. Inc.: NJ. Address: One Johnson & Johnson Plaza, New Brunswick, NJ 08933. Telephone: 732-524-0400. Internet: www.jnj.com

McDonald's Corporation operates or licences more than 31,000 fats-food restaurant in the U.S., Canada, and overseas, mostly under the McDonald's banner (12/02). About. 57% are operated by franchisees, 29% by the company, and 14% by affiliates. Foreign operation (in more than 100 countries) contribute around 49% of system wide and about 51% of consolidate operating profits. Partner brands include Donatos Pizzeria, Chipotie Mexican grill, and Boston market, which are located primarily in the U.S. '02 depreciation rate 4.0%. Has 413,000 employees, Officers and directors own about 1.05 of common stock (4/03 Proxy). Chairman and CEO: James R. Cantalupo. Inc.: DE. Address: One McDonald's Plaza, Oak Brook, III. 60523. Telephone: 630-623-3000. Web: www.mcdonalds.com

Merck & Company, Inc. is a leading manufacturer of human and animal health care and speciality chemical products. Important products names include Vasotec,, Prinvil (angiotensin converting enzyme (ACE) inhibitors for high blood pressure and angina); Mevacor, Zocor (Cholestrol-lowering agents); Fosamax (osteoporosis); Vioxx (anti-arthritic); Crixivan (HIV/AIDS); Singular (Asthma); and Prilosec (gastor). Medco acq. 11/93 (49.95 of sales), spin off 8/03. R&D, 5.2% of sales; '02 depreciation rate 7.1%. Estimated plant age 19 yrs. Has 77,300 employees, 265,700 stockholders. Directors and officers. Own less than 1% of stock (3/03). Chairman, President and CEO: Rymond V. Gilmartin. Inc.: NJ. Address: P.O.Box 100, Whitehouse Station, NJ 08889. Telephone: 908-423-1000, Internet: www.merck.com

Microsoft Corporation is the largest independent maker of software. It develops and sells software products for a wide range of computing devices. Also sells the Xbox video game console. Revenue sources in fiscal 2003: Information Worker, 28.7% of total; Client, 32.35; Server, 22.2%; MSN (Microsoft network, 6.1%; Home and Entertainment, 8.5%; Business Solutions, 1.8%; Mobile and Embedded, 4%. R&D: 14.5% of sales. 2003 depreciation rate: 23.7%. Has 55, 000 employees; 13,580 stockholders. William H. Gates owns 10.8% of stock, other officers and directors 4.2% (9/03 Proxy). Chairman: William H. Gates. CEO: Steven A. Ballmer. Inc.: WA. Address: One Microsoft way, Redmond, WA 98052-6399. Telephone: 425-882-8080. Internet: www.microsoft.com

3M Company (was Minnesota Mining & Manufacturing) is a diversified manufacturer. It sells more than 50,000 products in 200 countries. The Company is a component of the DJIA. Its six business segments include: Industrial (20% of 2002 sales); Transpiration, Graphics and Safety (24%); Health Care (22%); Consumer and Office (14%); Electro and Communications (12%); Specialty Materials (8%). Diversified National Advertising Company, 8/97; data storage and imaging systems business, 7/97. '02 foreign sales, 52% of total. R&D, 6.9% of sales. '02 depreciation rate: 7.1%. Has about 65,200 employees and approximately 123,745 shareholders. Chairman and CEO: W. James McNemey, jr. Inc.: DE Address: 3M Center, St. Paul, MN 55144-1000. Telephone: 651-733-2204. Internet: www.mmm.com

J.P. Morgan Chase & Company was formed on December 31, 2000, when the former J.P.Morgan & Co. merged with Chase Manhattan Operations, in more than 60 nations, include investment banking, asset management, private equity, consumer banking, private banking, and custody and processing services. Net loan losses: commercial, 1.93% of average loans in '02; consumer loans losses, 2.30%. At 9/30/03, loan loss reserve, 2.05% of loans; nonperforming assets & past due loans, 2.02%. Had about 92,940 full time equivalent employees as of 9/30/03. Directors and officers owned 0.9% of common (Poxy, 3/03). Chairman: D. A. Warner. CEO: W.B. Harrison. Inc.: DE. Address: 270 Park Avenue, New York, NY 10017. Telephone: 212-270-6000. Internet: www.jpmorganchase.com

The Procter & Gamble Company makes detergents, soaps, toiletries, foods, paper, & industrial products. Brands include: Pamper, Tide, Ariel, Always, Whisper, Pantene, Charmin, Bounty, Iams, Crest, Gain, Floggers, Pringles, Downy, Lenor, Bounce, Fixodent, Head & Shoulders, Herbal Essences, Ivory, Metamucil, Old Spice, Pringles, Safeguard, Tampax, Vidal, Sasson, and Zest. Foreign operations: 46% of '03 sales. Has about 98,000 employees, 1,234,000 stockholders, '03 depreciation rate 7.5%. ESOP controls about 7.5% of corn (and equity) shares (8/03 Proxy). CEO and President: Alan Lafley. Incorporated: Ohio. Address 1 Procter and Gamble Plaza, Cincinnati, Ohio 45202. Telephone: 513-983-1100. Internet: www.pg.com

SBC Communication, Inc. is one of the seven regional holding companies (RHCs) formed by AT & T in 1983 to hold its diversified local telephone business. Its principal wireline subsidiaries provide telecom services in 13 states, including California, Texas, Illinois, Michigan, Ohio, Missouri, Connecticut, Indian, Wisconsin, Oklahoma, Kansas, Arkansas, and Nevada, Acquired PacTel, 4/97; SNET, 10/98; Ameritech, 10/99. Access lines served (as of 9/30/03); 55.3 mills. '02 revenue mix: voice, 48%; Data, 19%; Long-distance voice, 4% Wireless subscriber, 15%; Directory advertising, 9%; Other, 5%. Has approximately 172,540 employees. Chairman and CEO: E. Whitacre Jr. Inc.: De Address: 175 E. Houston, San Antonio, TX 78205. Telephone: 210-821-4105. Internet: www.sbc.com

United Technologies Corporation operates in five business segments. Pratt & Whitney (27% of '02 revenues, 335 of operating profits) makes & services aircraft engines. Carrier (30%, 20%) makes heating, ventilating, and air-conditioning equipment. Otis (24%, 27%) manufactures and services elevators. Flight Systems division (19%, 20%) includes helicopters (Sikorsky) and electronic controls (Hamilton Sundstrand), and Chubb (recently acqd.), which provides security and fire protection services. International operations: 42% of 2002 revenues. Directors and officers. Control about 1.95 of voting stock (2/03 proxy). Employees: about 155,000. Chairman and CEO: George David. Inc.: DE Address: One Financial Plaza, Hartford, CT 06101. Telephone: 860-728-7000. Internet: www.utc.com

Wal-Mart Stores, Inc. is the world's largest retailer, operating 1,478 discount stores, 1,471 supercenters (includes sizable grocery departments), 538 Sam's Clubs, and 64 neighbourhood Markets in the U.S., plus 1,355 foreign stores in Latin America, Europe, Canada, and Asia as of 1/31/04. Most stores are leased and are within a 400-mile radius of one of the expanding network of distribution centers. Sold McLean, a grocery-distribution subsidiary, in 5/03. Total store space: about 590 Mill. Sq. ft.; sales per square foot in 2002: $455. Has about 1,400,000 employees. Officers and directors. Own 39.4% of shares (4/03 proxy). Chairman: S. Robson Walton. CEO and President: H. Lee Scott. Inc.: DE. Address: Box 116, Bentonville, AR 72716. Telephone: 501-273-4000. Internet: www.wal-mart.com