A NEW PERSPECTIVE ON THE ANOMALIES IN THE MONTHLY CLOSINGS OF THE DOW JONES INDUSTRIAL AVERAGE

Shaikh A. Hamid*
Associate Professor
School of Business
Southern New Hampshire University

Tej S. Dhakar
Associate Professor
School of Business
Southern New Hampshire University

Working Paper No. 2003-04

*Please direct all inquiries and correspondence to Shaikh Hamid at s.hamid@snhu.edu or 603-644-3198. We would like to thank the School of Business, Southern New Hampshire University for support.

A NEW PERSPECTIVE ON THE ANOMALIES IN THE MONTHLY CLOSINGS OF THE DOW JONES INDUSTRIAL AVERAGE

ABSTRACT

This study explores three types of month effects in the Dow Jones Industrial Average: (a) for a given period, if the mean of monthly percentage changes of each month was different from zero, (b) for a given period, if the mean of monthly percentage changes for a month was different from the means of all the other months, and (c) for a given period, if the variance of the monthly percentage changes for a month was different from the variances of all the other months. For our entire data set (May 1896 to December 2002) we find that the means of monthly percentage changes of only July, August, January and December were significantly greater than zero (months put in descending order). But the means of none of these three months were significantly higher compared to the means of all the other months. With a mean percentage change of -1.25%, only September appears with significant negative returns. And this mean is significantly lower compared to the means of all the other months. In other words, for the entire data set, we have a negative September effect.

Month effect with respect to variance (variance of monthly percentage changes for a month being significantly different from all the other months) was found for January, February and December (lower variances), and April (higher variance).

When we look at the first half of the twentieth century versus the second half, we see more pronounced month effects in the second half – considering all three types of effects we analyze. December exhibited all three types of effects in this period.

When we sub-divide the last century into four 25-year periods, we find more pronounced month effects in the last quarter than in the previous three quarters.

When we sub-divide the data into 10-year periods, we do not find any consistent and discernible pattern. The month effect varies with the time period we consider and the type of effect we analyze. Though one would expect the DJIA stocks to be free from seasonal patterns since each one of them are closely followed by a large number of analysts, the existence of any type of month effect is surprising. However, given that no discernible pattern is detectable is a reflection of efficiency of the DJIA stocks to a large degree.

A NEW PERSPECTIVE ON THE ANOMALIES IN THE MONTHLY CLOSINGS OF THE DOW JONES INDUSTRIAL AVERAGE

Since the time stock exchanges were first established, traders and investors have exhaustively looked for patterns in stock prices that they could exploit to realize superior returns. However, as early as 1900, Bachelier characterized security prices as being efficient. Over thirty years later came the landmark work by Cowles (1933) in which he documented the inability of forty-five professional agencies to forecast stock prices. The conclusion was that stock prices are random – in general they do not exhibit patterns. This was followed by the researches of Working (1934), Cowles and Jones (1937), Kendall (1953), and Osborne (1959, 1962). They documented that stock and commodity prices behave like a random walk – as if they are independent random drawings. These empirical works were buttressed by the theoretical work by Samuelson (1965) and Mandelbrot (1966). Fama (1965) also contributed to this body of literature which came to be termed the 'random walk hypothesis'. In 1970, Fama came up with the 'efficient markets hypothesis' (EMH).[1] This hypothesis postulates that stock prices reflect all available information; they change in response to new information; since new information by definition cannot be deduced from previous information, new information must be independent over time; if the arrival of new information is random, stock price changes are random, i.e., the changes cannot be anticipated; hence it is not possible to generate risk-adjusted abnormal returns from stocks. Bernstein (1992) provides an overview of the developments of the EMH.

[1] In economics, Muth (1961) developed this hypothesis independently which was termed rational expectations hypothesis.

The overall finding is that it is difficult to earn above-average profits by trading on publicly available information because it is already incorporated in securities prices.

However, some researchers have been able to identify profitable opportunities or anomalies that go against the concept of efficient markets. As a result, some academics have denounced the concept. The adherents of the new camp may possibly be increasing. Among the various anomalies discovered, the January effect is possibly the most well-known. It has been documented for financial markets across the globe. The first evidence of returns in January exceeding those of other months comes from Wachtel (1942). After thirty-three years, Officer (1975) presented further evidence followed by Rozeff and Kinney (1976).[2] These findings challenged the concept of efficient markets hypothesis that securities markets reflect all available information and hence it is not possible to *garner* positive risk-adjusted returns.

Reinganum (1983) has advanced the hypothesis that January experiences rebound in stock prices after tax-loss selling that is undertaken in December. The hypothesis is that before the end of the tax year, people sell stocks that have declined in price during the previous months so they may realize the capital losses; these investors put back the proceeds into the market in January; the higher demand for stocks push stock prices up creating the January effect. Reinganum found that within firm size classes, firms for which price decline was more pronounced had larger January returns. Ritter (1988) has documented that the ratio of stock purchases to sales of individual investors hits an annual low at the end of December and an annual high at the beginning of January.

Haugen and Lakonishok (1988) have advanced the hypothesis that the January effect is a result of simultaneous reentry into aggressive investment strategy by professional fund managers

[2] Wachtel introduced the concept of January effect in 1942, but Rozeff and Kinney's article in the widely respected Journal of Financial Economics was the first evidence of January effect that attracted widespread attention.

who have parked money in their performance benchmarks so as to lock in their investment performance during the previous year.

A major finding that comes out of the researches is the size effect: small-capitalization firms earn higher returns than large-capitalization firms. Banz (1981) and Reinganum (1981) were the first researchers to discover the small-firm effect. Their finding was supported by Brown, Keim, Kelidon and Marsh (1983), Kato and Schallheim (1985), Fama and French (1992), Berk (1995), Baker and Limmack (1998), and Garza-Gromez, Hodoshima and Kunimura (1998). Keim (1983), Reinganum (1983), Blume and Stambaugh (1983) and Roll (1983) find that majority of the return of small-capitalization stocks occurs in January -- in the first two weeks of the month. This phenomenon came to be known as the small-firm-in-January effect. Keim found that small firms outperformed large firms in every year from 1963 to 1979.

It may be argued that the January effect is most pronounced for the smaller firms because the small firms are more volatile and more prone to price declines and hence more subject to tax-loss selling.

Arbel and Strebel (1983) found that the January effect was largest for firms neglected by institutional investors. This was termed the neglected-firm effect. The hypothesis is that small firms tend to be neglected by large institutional traders; this causes information deficiency which makes them riskier prompting investors to require higher returns.

Haugen and Jorion (1996) use center for Research in Security Prices data for the stocks in New York Stock Exchange form 1926 to 1993 and find that for smaller stocks January returns are significantly larger than for other months. The return for stocks in the smallest decile (decile 1) is 12.4 percent and it decreases monotonically to 0.5 percent for stocks in the largest decile

(decile 10). This work also indicates, as well as work by Riepe (1998, 2001) that excess returns in January may be declining in latter years.

Agrawal and Tandon (1994) find for nineteen countries covering data for 1970's and 1980's that the mean January returns are high – significantly high for eleven countries. Hawawini and Keim (2000) survey international findings and show that the high returns for January relative to other months, if used as explanatory variable, better accounts for cross-sectional returns of stocks than the CAPM beta or some other data-driven models proposed in recent times.

We intend to contribute to this growing literature by exploring month effect in the Dow Jones Industrial Average – the most popular stock index in the world. The stocks in the DJIA being among the most closely followed should render them efficiently priced. Hence, one would not expect anomalies like month effect to be exhibited by the DJIA.

An earlier work using the same index is by Lakonishok and Smidt (1988). It uses data from 1897 to 1986. Not only do we use a longer data set, but we also use different statistical tests to analyze month effect. Lakonishok and Smidt's primary concern is to explore anomalies in returns around the turn of the week, around the turn of the month, around the turn of the year, and around holidays. They do not rigorously explore month effects as we do. They test if the means of monthly percentage changes are significantly different from zero and also do a sign test on the percentage of positive returns. We explore month effect over May 1896 to December 2002 from three perspectives: (a) for a given period, if the mean of monthly percentage changes of each month was different from zero, (b) for a given period, if the mean of monthly percentage changes for a month was different from the means of all the other months, and (c) for a given period, if the variance of the monthly percentage changes for a month was different from the

variances of all the other months. We also explore month effect over two fifty-year periods, four twenty-five periods, and ten ten-year periods. For the entire data set of about hundred and seven years, January mean return was the third highest after July and August. December mean return was fourth. Lakonishok and Smidt find January mean return to be fourth highest after July, August and December. These findings reinforce the conclusions that the January effect is pronounced in the case of small firms and not in the case of large firms.

When we look for month effect in each decade of our data period, we find it has varied over different months and the incidence of effects is sparse.

The next section describes the DJIA, followed by the methodology used, description of data and descriptive statistics, analysis of results, and finally we summarize and conclude.

1. THE DOW JONES INDUSTRIAL AVERAGE

The Dow Jones Industrial Average consists of thirty stocks that are leaders in their respective industries, widely held by individual and institutional investors, and have a record of high dividend payments (one exception to this is Microsoft which was recently added as another stock was dropped; Microsoft was included to provide fair representation to the technology sector in which it has been a major player). The DJIA stocks are termed blue-chip stocks since they are very large and are household names. Data on the DJIA is available from May 1896 onwards. As an indicator of the health of the U.S. stock markets it has the longest history and is etched in the American imagination. It was computed based on twelve stocks until October 3, 1916. Thereafter, it was broadened to twenty stocks. On October 1, 1928 ten more stocks were added so that for the last three-quarters of a century we have thirty stocks in the DJIA. Stocks were

dropped and new stocks added as fortune of companies changed with changing economic and industry dynamics. This happened more often in the earlier days.

Thus, the DJIA is a good indicator of the health of the large capitalization U.S. stocks. The thirty stocks in the DJIA had a market capitalization of about $2.7 trillion as of December, 2002. This represents about 65% of the market values of the S&P 500 companies. The DJIA thirty stocks are very actively traded. This helps to minimize issues created by nonsynchronous trading.

The data for DJIA is not available from August 1, 1914 until December 12, 1914 since the market was closed on account of the First World War. Saturday trading was held until May 31, 1952. For some years prior to that Saturday trading was suspended at certain times primarily during summer months. The last six months of 1968 saw Wednesday closure of the exchange; this was to allow back-office operations of brokers to catch up with the volume of trading.

2. **RESEARCH METHODOLOGY**

Our data consists of the percentage changes in the monthly closing values of the Dow Jones Industrial Average (DJIA) from May 1896 until December 2002. The DJIA is stock-price weighted and hence does not include dividends. It may seem that analysis of month effect will be affected by the omission of dividends. Lakonishok and Smidt (1988) find that this omission does not seem to affect their results with respect to month effect. Hence we do not include dividends.

With $DJIA_t$ as the closing value of Dow Jones Industrial Average on the last trading day of month t, we computed the month over month percentage change as follows:

$$\Delta DJIA_t = \frac{DJIA_t - DJIA_{t-1}}{DJIA_{t-1}} x100$$

In addition to analyzing the data for the single period (May 1896 to December 2002), we divided the entire period into the following sub-periods to gain deeper insight into the performance of DJIA:

Entire data set:

May 1896 to December 1900

Two fifty-year periods:

January 1900 to December 1949

January 1950 to December 1999

Four twenty-five year periods:

January 1900 to December 1924

January 1925 to December 1949

January 1950 to December 1974

January 1975 to December 1999

Ten ten-year periods

January 1900 to December 1909

January 1910 to December 1919

….

January 1980 to December 1989

January 1990 to December 1999

Thus, in addition to the entire period, we have 16 sub-periods. We hope to show that the month effect is sensitive to the time period under study. We also want to analyze the performance of the DJIA over the entire period as well as in different sub-periods.

We study the month effect in three different ways:

1. If the mean of monthly changes is different from zero for the sample as well as for each month within the sample. We test each mean percentage change for its significance. We do this by subjecting the mean percentage change for a given month *i* to the following hypothesis test: H_o: $\mu_i = 0$ vs. H_o: $\mu_i \neq 0$. We conduct this test by computing the p-value for the t-statistic associated with the mean percentage change. This test tells us whether a given value of mean percentage change was significant or not.

2. If there is a month effect based on the means of the monthly percentage changes. We study this month effect by comparing the mean percentage change for a given month with the mean percentage change over all the remaining eleven months for the same period. We do this by conducting the following hypothesis test for a given month *i*: H_o: $\mu_i = \mu_j$ vs. H_o: $\mu_i \neq \mu_j$. Since we found the variances for the periods i and j to be unequal in many cases, we decided to use the more conservative t-test assuming unequal variances. We report the p-values for this test. Thus, this test tells us whether the mean percentage change in a given month is significantly different from mean percentage change of the remaining eleven months.

3. If there is a month effect based on the variances of the monthly percentage changes. We compare the variance of percentage changes for a given month with the variances of percentage changes of the other months. We do this by conducting the following hypothesis test for a given month *i*: H_o: $\sigma_i^2 = \sigma_j^2$ vs. H_o: $\sigma_i^2 \neq \sigma_j^2$. We report the p-values for this test. Thus, this test tells us if the variability of the percentage changes for a given month is significantly

different from the remaining eleven months. The variability is a measure of the predictability of the percentage change for a given month.

We first look at the statistical descriptives for the single period from May 1896 to December 2002 as well as for each of the sub-periods. Each value of mean percentage change was subjected to hypothesis test as described earlier in order to test its significance. We present some of the statistical highlights for the entire period as well as the individual periods.

We present a distribution of the percentage changes and test the distribution for normality through the Jarques-Bera statistic. This widely used statistics is based on the values of skewness and kurtosis of sample data. For large n, (say, over 30) with skewness S and kurtosis K under the normality condition, the Jarques-Bera statistic $= \frac{n}{6}\left(S^2 + \frac{(K-3)^2}{4} \right)$ follows a Chi-square distribution with 2 degrees of freedom.

We then look at the descriptives for two 50-year periods, four 25-year periods, and ten ten-year periods from 1900 to 1999. For each of the periods, we compute the mean, the median, the minimum, the maximum, the range, the standard deviation, and the sample variance.

3. THE DATA AND DESCRIPTIVE STATISTICS

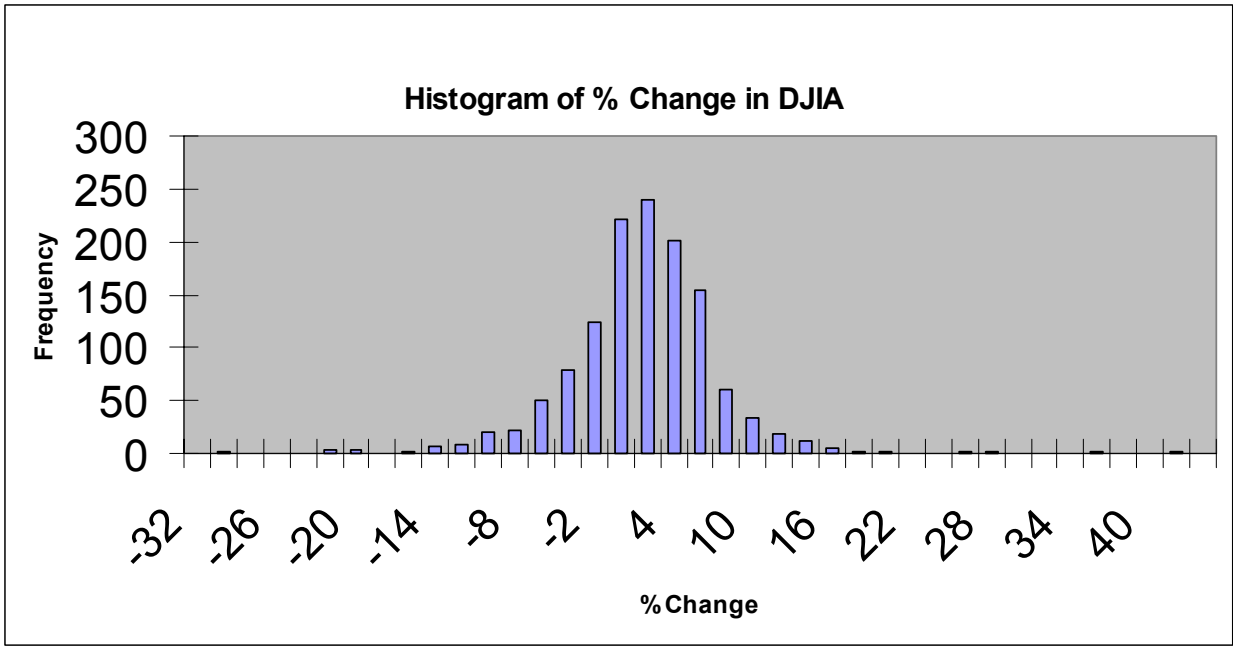
The data consists of 1275 values of monthly percentage changes in DJIA from the time DJIA was first computed in May 1896 until December 2002. August through November of 1914 are not included in the data set as the stock market was closed because of the First World War.

Over this period, the value of DJIA has increased from 40.63 at the end of May 1896 to 8341.63 at the end of December 2002 -- by a factor of 204 or by 20,431% -- at an average linear rate of 0.57% per month or 6.88% per year. The mean monthly percentage change in the DJIA for the total period is highly significant (p=0.00). The standard deviation of the monthly

percentage changes is 5.54% or 19.19% annualized, which is close to the 20.50% standard deviation of the annual returns of the S&P 500 Index for the period 1926 to 2002. The summary statistics of the monthly percentage changes for the entire period are given below.

% Change in DJIA	
Observations	1275
Mean	0.57
Median	0.84
Minimum	-30.70
Maximum	40.18
Range	70.88
Standard Deviation	5.54
Sample Variance	30.74
Skewness	-0.0475
Kurtosis	5.705
p-value (μ=0)	0.000

As we can see in the histogram below of the monthly percentage changes in the DJIA for the entire period, the distribution is slightly skewed to the left as the mean of 0.57% is smaller than the median of 0.84% per month. The skewness equals –0.0475 and the kurtosis equals 5.705. Jarques-Bera statistic equals 3.27 for a p-value of 0.19. Since the p-value is not less than 0.05, the normality assumption is not violated. Therefore, transformation of the data by using log or other functions is really not necessary. Assuming normal distribution, the probability that DJIA would increase in a certain month is 54% vs. 46% probability that the DJIA would decrease in the same month.



Exhibits 1A shows the frequency of monthly increases every decade that were more than 10% and Exhibit 1B shows the frequency of monthly decreases that were larger than -10%. There were a total of 88 such instances from 1896 to 2002. Of those, 38 occurred prior to 1930, 32 occurred during 1930-39 alone, just two occurred during 1940-1969 period and the remaining 16 occurred during 1970-2002 period. Over the entire period, August and November each have experienced 6 increases larger than 10% followed by April and June with 5 such increases. Over the entire period, September has suffered 8 decreases larger than 10% followed by October (7), November (6), and December (5). The significantly negative September mean percentage change for the entire period may be attributable to a large extent to these 8 big drops.

Looking at individual values of the monthly percentage changes, the DJIA increased by as much as 40.18% during April 1933 and declined by as much as 30.70% in September 1931. Post-Second World War, the biggest increase was 14.41% in January 1976 and the biggest decline was 23.22% in October 1987 (the month that included “Black Monday”).

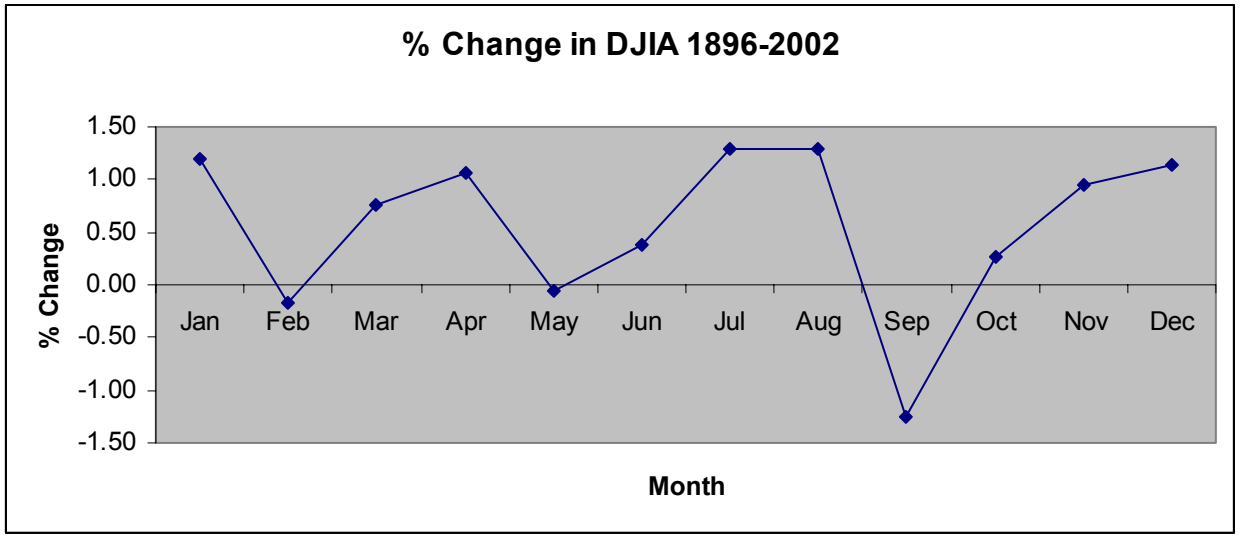
4. ANALYSIS OF RESULTS

4.1 Means of monthly percentage changes

1896 to 2002

The month-wise statistics for the DJIA for the entire period (May 1896 to December 2002) are shown as Exhibit 2. We have 106 to 107 monthly percentage changes for each of the twelve months. As noted earlier, the mean monthly percentage change for the entire data set (0.57%) is significantly different from zero (p = 0.00).

The months with significant mean percentage increases in the DJIA are July with 1.29%, followed by August with 1.28%, January with 1.19%, and December with 1.15%. Thus the two-month periods July-August and December-January have experienced the most mean percentage increases in the DJIA. The only month that experienced significantly negative monthly change was September (-1.25%) – which is significant at 4% level. Means of monthly percentage changes from 1896 to 2002 are shown in the graph below.



1900-1949 vs. 1950-1999

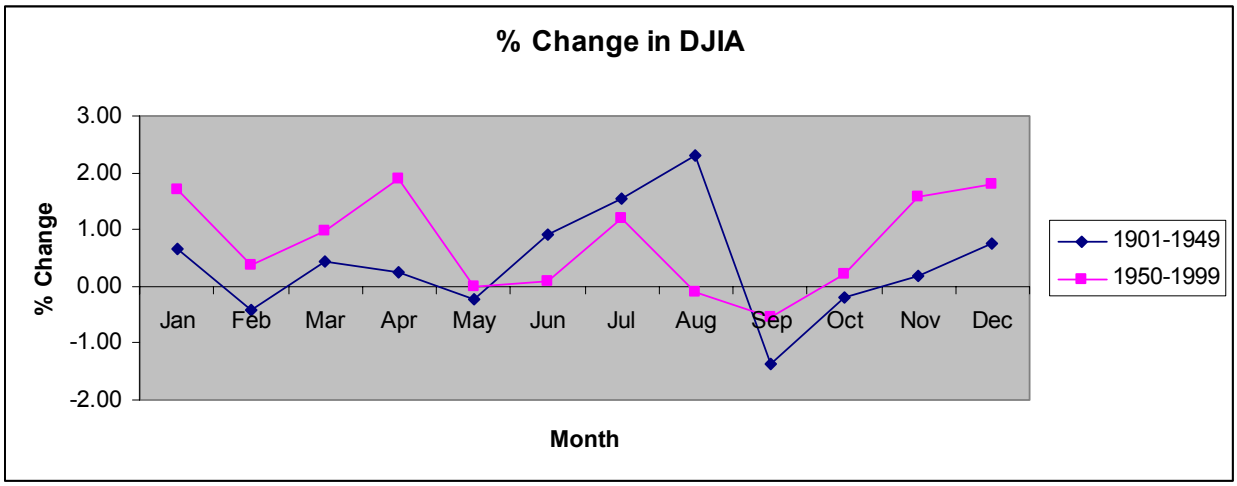
Exhibit 3 shows that the mean change of 0.40% per month for 1900 to 1949 is not significantly different from zero. The means of monthwise changes show significant positive mean for only August (2.30%) – which is significant at 2% level. The 50-year period is further sub-divided into two 25-year periods: 1900-1924 and 1925-1949. The means of changes for the two sub-periods are rather close (0.35% and 0.46%) and not significantly different from zero. For 1900-1924 sub-period, the means of monthwise changes (Exhibit 4) show significant positive mean for only March (2.43%) – which is significant at 4% level. For 1925-1949 sub-period, the means of monthwise changes for months (Exhibit 5) show significant positive mean for only August (3.36%) – which is significant at 5% level. The means of changes for June and July are 2.53% and 2.75%, which are not significant though. (In is interesting however that among the four 25-year sub-periods, only for this sub-period the means of changes of three months -- June, July and August -- are above 2.50%.) Thus, the significantly positive mean change for August in the 1900-1949 period is due to the large positive mean change in the 1925-1949 sub-period.

The mean percentage change of the next fifty years -- 1950-1999 (Exhibit 6) -- is a highly significant 0.76% (p=0.00). Six of the months – January, March, April, July, November and December – experienced significant positive changes. This 50-year period was also sub-divided into two 25-year sub-periods: 1950-1974 (Exhibit 7) and 1975-1999 (Exhibit 8). The mean monthly changes of both the sub-periods (0.45% and 1.08%) are significantly different from zero – at respectively 4% and 0% levels. However, the means of monthwise changes of the second sub-period (1975-1999) rather closely match the significance pattern that we saw for the 50-year period: changes for January, April, November and December are significantly positive. A

strategy of buying at the end of October, and selling after three months at the end of January would have yielded significant positive returns over the 1975-1999 period.

Another point to note is that monthly changes for the four 25-year sub-periods have been respectively 0.35% (p=0.27), 0.46% (p=0.30), 0.45% (p=0.04), and 1.08% (p=0.00) – which show an increasing trend.

The graph below shows an interesting contrast of the means of monthly changes for 1901-1949 versus 1950-1999. Firstly, the trend lines have close correlation. Secondly, the means of monthly changes have been higher over the second half of the century compared to the first half from January through May and again from September through December – and lower in June, July and August. Mean of monthly changes of 596 months of the first half of the century was 0.40% and not significantly different from zero (p=0.135). The mean for the 600 months of the second half of the century was 0.76% -- about twice that of the first half -- and significantly different from zero (p=0.00). If we compare this graph with that earlier for the entire data period (1896-2002), we can see a striking similarity in all three: on average, February suffers a dip, then there is rising trend; May suffers a dip, then there is rising trend; September suffers a significant dip, and then there is rising trend.



4. 2 Month effect: Comparison of means

Under this, we analyze if the mean monthly percentage change for a month was significantly different compared to the means of the other eleven months.

For the entire data set, the mean monthly percentage change for September (-1.25%) is significantly lower than the mean changes of the other months (p value of t-test=0.00). That is the only significant mean when the entire period is analyzed.

The month effect for the various sub-periods in terms of mean of a month being different from the means of the other months shows the following patterns:

1900-1949: Positive August (p=0.04)

1900-1924: Positive March (p=0.06)

1925-1949: Positive August (p=0.07)

1950-1999: Positive April (p=0.03), negative September (p=0.02), positive December (p=0.01)

1950-1974: Positive December (p=0.01), negative May (p=0.055), negative June (p=0.053)

1975-1999: Negative September (p=0.01), positive April (p=0.06), positive January (p=0.104)

The first half of the last century exhibited positive month effect which was confined to a single month. When we divide this half century into two quarters, it turns out that the mean percentage change of none of the months is significantly different.

In the second half of the last century, three months exhibited month effect: April (higher mean), September (negative mean) and December (higher mean). For 1950-1974 sub-period we December effect (higher mean), and for 1975-1999 sub-period, we have September effect (negative mean).

Negative September effect was significant not in the first half of the last century, rather in the second half. Negative September effect was significant not in the third quarter of the century but in the last quarter.

During the last quarter of the century, January's mean monthly change was the highest -- 2.89% -- and it was significantly different from zero (p=0.02). However, January's mean is not significantly higher than the means of other months even at 10% level (p=0.104).

4.3 Month effect: Comparison of variances

We also explore month effect from the perspective of variance. For the entire data set, standard deviation of monthly percentage changes (Exhibit 2) has ranged from 4.14% (for February) to 6.52% (for April). The standard deviations of the monthly percentage changes of January (4.58%), February (4.14%), and December (4.76%) are significantly lower than the standard deviations for the other months (p-values of F-test are between 0.00 and 0.02). The standard deviation of the monthly percentage changes of April (6.52%) is significantly higher than the standard deviations for the other months (p-value of F-test = 0.01).

The standard deviations of the monthly percentage changes for the first half of the last century (Exhibit 3) show pattern somewhat similar to what we find for the entire data set: January and February have significantly lower variances and April have significantly higher variance compared to the other months. The pattern of standard deviations of the monthly percentage changes for the 25-year period – 1925-1949 (Exhibit 5) – is what we find for the entire data set: significantly lower for January, February and December, and significantly higher for April -- compared to the rest of the months. The 25-year period 1900-1924 (Exhibit 4) shows

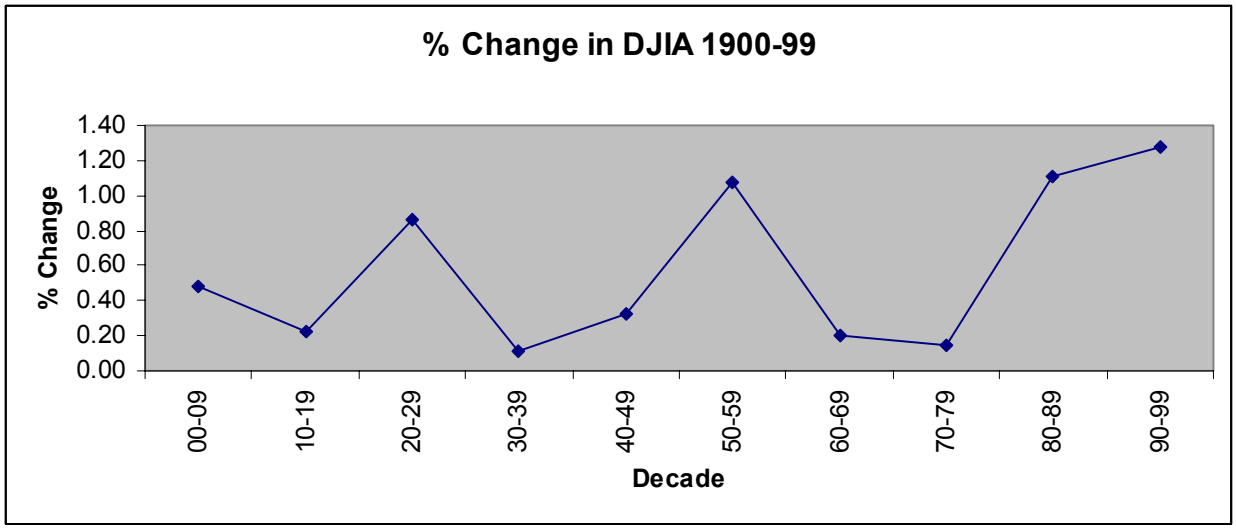
only February exhibiting significantly lower variance (p value of F-test = 0.04) compared to the other months; no month shows significantly higher variance.

The second half of the last century (Exhibit 6) shows significant month effect in terms of variance. Three months had significantly higher variances, and four significantly lower variances, compared to the other months. This was largely the effect of the last quarter of the century (Exhibit 8).

If any consistent pattern emerges in terms of month effect with respect to variance, it is the following: in the first half of the last century, February saw lower variance compared to the rest of the months; in the second half of the century, December saw lower variance. In the last quarter of the last century, variance changed gears from being higher in January, to lower in June, to higher in August, to lower in September, to higher in October, to lower in December – higher or lower compared to the other months and statistically significant. The periodicity we saw in case of means of percentage changes appears to be present in case of variances.

4.4 Month effect through the decades

If we divide the data for the last century into decades, we can get some interesting historical overview as shown in Exhibit 9. The means of monthly percentage changes were positive in every decade from a measly 0.11% for the 1930s to an impressive 1.28% for the 1990s. The decade of the 1930s with the lowest mean percentage change experienced the month-over-month variability with a standard deviation almost twice as high as the average for the century. The following graph shows the mean percentage change over the decades of the last century.



In the next section we look at month effects in each decade based on significance of means of percentage changes, means of changes for a month compared to other months, variances of the changes for a month compared to other months.

Means of monthly percentage changes

The descriptive statistics and results of statistical tests for the ten decades are shown as Exhibits 10 through 19. As we can see from the summary table below, in none of the decades the means of monthly percentage changes of January through April, June, September and October were significantly different from zero at 5% level. December's mean monthly percentage changes were significantly positive in five of the ten decades.

Mean % Change (H_o: $\mu_i = 0$ vs. H_a: $\mu_i \neq 0$)

Decade	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1900-09												
1910-19												
1920-29							Positive	Positive				Positive
1930-39												
1940-49												Positive
1950-59							Positive				Positive	Positive
1960-69												
1970-79					Negative							Positive
1980-89												
1990-99					Positive							Positive

Note: "Positive" implies the mean percentage change was significantly greater than zero and "Negative" implies the mean percentage change was significantly less than zero.

Five of the decades did not produce a month which had significant mean percentage changes. The 1980s, which displayed very impressive stock price run-ups, failed to produce a month whose mean percentage change was significant.

Month effect: Comparison of means

If we look decade by decade, the month effect is not so pronounced and no consistent pattern emerges. During five of the ten decades no single month experienced mean percentage change significantly different from the other months. In fact, the only month that exhibited strong month effect in the first four decades is August – a positive effect. In none of the decades, January through April displayed month effect and neither did June, October or November. The summary table below presents the positive and negative month effects during different decades. As we can see, there are six incidences of month effects – two in the 1970s.

Month Effect - Mean (H_o: $\mu_i = \mu_j$ vs. H_a: $\mu_i \neq \mu_j$)

Decade	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1900-09												
1910-19												
1920-29								Positive				
1930-39												
1940-49												Positive
1950-59							Positive					
1960-69												
1970-79					Negative							Positive
1980-89									Negative			
1990-99												

Note: "Positive" implies that the mean percentage change was positive and significantly greater than the rest of the months in the same decade. "Negative" implies that the mean percentage change was negative and significantly smaller than the rest of the months in the same decade.

In other words, there has been a month effect in terms of mean percentage change of a month during a decade being different from the means of other months, but no month has exhibited the effect consistently over decades and no discernible pattern is evident.

Month effect: Comparison of variances

The 1930s appear to have exhibited the highest monthly volatility – January's standard deviation was 4.48%, and for the other months it has ranged from 7.1% to 17.1% (Exhibit 13) -- rather high when compared to the standard deviations of returns for the various months in other decades. As we can see from Exhibits 14 through 16, monthly standard deviations decreased in the next three decades – the 1940s, 1950s and the 1960s. The standard deviation in those three decades ranged only from 2.0% to 5.3% except for May of the 1940s, which was adversely affected by a 21.7% decline in May of 1940. In the 1970s, standard deviation of monthly returns increased somewhat, ranging from 2.2% to 7.8% (Exhibit 17). It ranged from 2.5% to 8.9% in the 1980s (Exhibit 18), and went down somewhat in the 1990s (Exhibit 19), ranging from 2.9% to 6.3%. Based on the range of the standard deviations of monthly returns, 1920s and 1930s

seem to have exhibited higher monthly volatility than recent decades. It is not surprising since the 1930s and prior decades have suffered so many large monthly increases as well as decreases (Exhibits 1A and 1B) which contribute significantly to volatility.

The 1920s and 1930s also exhibit high month-to-month variability in the means of the monthly returns.

If we compare the summary table below based on test of variances to the previous two summary tables, an interesting pattern emerges: contrasted to the month effect with respect to means, the variance effect was pronounced in the first six months of the year. The opposite is the case with the two mean-related effects. It appears that more pronounced is the mean effect, less is the variance effect.

Month Effect – Variance (H_o: $\sigma_i^2 = \sigma_j^2$ vs. H_a: $\sigma_i^2 \neq \sigma_j^2$)

Decade	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1900-09		Smaller										
1910-19		Smaller										
1920-29	Smaller											
1930-39	Smaller			Larger								
1940-49					Larger							
1950-59												
1960-69												
1970-79	Larger		Smaller		Smaller							
1980-89						Smaller				Larger		Smaller
1990-99								Larger				

Note: "Larger" implies that the variance of percentage changes for the month was larger than for the other months. "Smaller" implies that the variance of percentage changes for the month was smaller than for the other months.

5. Summary and conclusion

We have explored three types of anomalies in the DJIA – if the mean monthly percentage change of each month over a period was different from zero, if the mean monthly percentage change for a month during a period is different from the means of all the other months in the period, and if the variance of the monthly percentage changes for a month during a period was different from

the variances of all the other months in that period. For the 106½ years of data in our study, we find that the mean monthly percentage change was a significant 0.57% -- or 6.88% annualized. We find that the only significant month effect occurred in September (mean of monthly percentage changes being negative and significantly less than for the other eleven months) with a mean decline of 1.25%. July experienced the largest mean increase of 1.29% followed by August (1.28%), January (1.19%) and December (1.15%). These means are significantly greater than zero. But none of these means are significantly different from the mean percentage changes for the other months.

For the entire data set, month effect with respect to variance (variance of monthly percentages changes for a month significantly different compared to all the other months) is found for January, February and December (lower variances), and April (higher variance).

When we look at the first half of the twentieth century versus the second half, we see more pronounced month effects in the second half – considering all three types of effects we analyze. December exhibited all three types of effects in this period.

When we sub-divide the last century into four 25-year periods, we find more pronounced month effects in the last quarter than in the previous three quarters. The incidence of the three types of month effects increased with every quarter: two incidences in the first quarter, five in the second, eight in the third, and twelve in the fourth. Half of the twelve incidences of month effects in the last quarter were related to variability: variance of the monthly percentage changes for a month during a period was different from the variances of all the other months in that period. It reflects the increase in the variability of the markets in recent years. However, the increase in variability is not uniformly spread across months. That creates a phenomenon which we term as month effect with respect to variance.

When we sub-divide the data into 10-year periods, we find:

- a December effect (in the case of five decades, the means of December monthly percentage changes were positive and greater than zero);
- five of the ten decades show no month for which the mean of monthly percentage changes was significantly different from the means of the other months;
- in two of the ten decades December monthly percentage changes were significantly greater than the changes in the rest of the months within respective decades;
- variances of monthly percentage changes appear to have increased since the 1970s.

We also find that in the case of all three effects, positive effects were more prevalent (mean for a month significantly greater than zero, mean for a month significantly greater than for all the other months, and variance for a month significantly greater than for other months).

The negative September effect (mean monthly percentage change being negative and significantly lower compared to the means of all the other months) for the entire data set was more a result of the monthly percentage changes in the second half of the last century, more specifically of the last quarter century. The first half of the last century does not show a September effect, even when the period is divided into 25-year periods. No decade shows for September any of the three types of effects except the 1980s – a negative month effect for comparison of means.

So the month effect varies with the time period we consider and the type of effect we analyze. No month has exhibited the three types of effects consistently over time and no discernible pattern is evident. One would expect the DJIA stocks to be free from seasonal

patterns since each one of them are closely followed by a large number of analysts, and the existence of month effect would be surprising. However, given that no discernible pattern is detectable is a reflection of efficiency of the DJIA stocks to a large degree.

Exhibit 1A - Number of Monthly Increases Larger than 10%

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1896-99			1		1	1		2	1				6
1900-09			1				1				2	1	5
1910-19			1	1	1				2				5
1920-29			1			1		1			1		4
1930-39		1		2	1	3	1	2	1		2		13
1940-49													0
1950-59													0
1960-69											1		1
1970-79	2			1									3
1980-89	1							1		1			3
1990-99				1									1
2000-02										1			1
Total	3	1	4	5	3	5	2	6	4	2	6	1	42

Exhibit 1B - Number of Monthly Decreases Larger than 10%

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1896-99					1	1	1		1			1	5
1900-09			1				1		1	1			4
1910-19							1			1	1	2	5
1920-29		1								1	2	0	4
1930-39		1	3	2	2	1			3	3	2	2	19
1940-49					1								1
1950-59													0
1960-69													0
1970-79								1	1		1		3
1980-89										1			1
1990-99								2					2
2000-02									2				2
Total	0	2	4	2	4	2	3	3	8	7	6	5	46

Exhibit 2
% Change in DJIA from 1896 to 2002

Period 1896-2002	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	1275	106	106	106	106	106	107	107	106	106	106	106	107
Mean	0.57	1.19	-0.16	0.75	1.07	-0.06	0.39	1.29	1.28	-1.25	0.27	0.95	1.15
Median	0.84	1.06	0.02	1.45	0.67	0.21	0.03	1.58	1.44	-0.72	0.83	1.11	1.79
Minimum	-30.70	-8.64	-15.62	-23.67	-23.43	-21.70	-17.72	-14.08	-15.13	-30.70	-23.22	-14.04	-23.58
Maximum	40.18	14.41	13.20	12.59	40.18	14.65	24.26	26.66	34.83	13.49	10.65	16.35	10.78
Range	70.88	23.06	28.81	36.27	63.61	36.35	41.98	40.74	49.96	44.19	33.87	30.39	34.36
Standard Deviation	5.54	4.58	4.14	5.23	6.52	5.56	5.46	5.59	6.05	6.14	5.94	5.78	4.76
Sample Variance	30.74	20.97	17.11	27.39	42.45	30.93	29.84	31.20	36.62	37.68	35.27	33.42	22.68
p-value (μ=0)	0.000	0.009	0.688	0.142	0.095	0.905	0.466	0.018	0.031	0.039	0.638	0.092	0.014
p-value (t test)		0.159	0.067	0.715	0.412	0.219	0.712	0.165	0.207	0.002	0.584	0.478	0.204
p-value (F test)		0.004	0.000	0.207	0.010	0.496	0.425	0.469	0.103	0.063	0.163	0.280	0.016
Mean % Change	Positive	Positive						Positive	Positive	Negative			Positive
Month Effect (Mean)										Lower			
Month Effect (Var)		Lower	Lower		Higher								Lower

Exhibit 3
% Change in DJIA from 1900-1949

Period 1900-1949	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	596	50	50	50	50	50	50	50	49	49	49	49	50
Mean	0.40	0.65	-0.42	0.44	0.25	-0.22	0.91	1.55	2.30	-1.36	-0.20	0.18	0.76
Median	0.72	0.72	-0.52	1.00	-0.72	0.16	0.31	2.47	1.78	-0.20	0.79	0.38	2.19
Minimum	-30.70	-8.64	-15.62	-23.67	-23.43	-21.70	-17.72	-14.08	-9.10	-30.70	-20.36	-12.88	-23.58
Maximum	40.18	7.51	13.20	12.59	40.18	13.59	24.26	26.66	34.83	13.49	9.45	16.35	10.78
Range	70.88	16.15	28.81	36.27	63.61	35.29	41.98	40.74	43.93	44.19	29.81	29.23	34.36
Standard Deviation	6.58	4.09	4.71	6.66	8.57	6.79	6.83	6.79	6.62	7.37	6.64	6.85	5.90
Sample Variance	43.29	16.71	22.18	44.32	73.39	46.12	46.67	46.10	43.88	54.30	44.06	46.98	34.85
p-value (μ=0)	0.135	0.265	0.530	0.644	0.837	0.822	0.353	0.113	0.019	0.203	0.832	0.854	0.369
p-value (t test)		0.676	0.219	0.970	0.893	0.500	0.589	0.216	0.041	0.083	0.507	0.812	0.663
p-value (F test)		0.000	0.001	0.479	0.006	0.397	0.374	0.394	0.485	0.137	0.490	0.365	0.154
Mean % Change									Positive				
Month Effect (Mean)									Higher				
Month Effect (Var)		Lower	Lower		Higher								

Exhibit 4
% Change in DJIA from 1900-1924

Period 1900-1924	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	296	25	25	25	25	25	25	25	24	24	24	24	25
Mean	0.35	0.38	-0.93	2.43	0.07	-0.06	-0.72	0.35	1.19	-0.51	0.50	0.92	0.63
Median	0.49	0.25	-0.71	3.22	-0.27	-0.20	-1.12	0.17	2.03	-0.07	0.80	0.81	2.38
Minimum	-23.58	-8.64	-12.05	-11.48	-9.02	-9.91	-9.93	-14.08	-9.10	-13.89	-14.80	-12.88	-23.58
Maximum	18.00	7.29	6.64	12.59	18.00	13.59	8.33	10.68	7.78	11.55	9.45	14.26	10.78
Range	41.58	15.93	18.69	24.07	27.02	23.49	18.26	24.76	16.88	25.45	24.24	27.15	34.36
Standard Deviation	5.41	4.42	4.08	5.45	5.71	4.78	4.67	6.04	4.56	6.13	5.51	6.48	6.78
Sample Variance	29.32	19.51	16.64	29.75	32.57	22.86	21.85	36.46	20.81	37.52	30.34	42.01	45.95
p-value (μ=0)	0.265	0.673	0.265	0.036	0.954	0.950	0.451	0.773	0.215	0.687	0.660	0.494	0.645
p-value (t test)		0.976	0.122	0.056	0.795	0.660	0.249	0.999	0.365	0.474	0.890	0.653	0.827
p-value (F test)		0.099	0.040	0.498	0.390	0.218	0.180	0.251	0.147	0.225	0.491	0.130	0.073
Mean % Change				Positive									
Month Effect (Mean)													
Month Effect (Var)			Lower										

Exhibit 5
% Change in DJIA from 1925-1949

Period 1925-1949	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	300	25	25	25	25	25	25	25	25	25	25	25	25
Mean	0.46	0.93	0.09	-1.55	0.43	-0.37	2.53	2.75	3.36	-2.18	-0.88	-0.53	0.88
Median	0.88	1.03	-0.03	-0.95	-0.81	1.09	1.83	3.38	1.32	-0.25	0.79	0.02	2.11
Minimum	-30.70	-7.11	-15.62	-23.67	-23.43	-21.70	-17.72	-9.85	-6.18	-30.70	-20.36	-12.64	-17.01
Maximum	40.18	7.51	13.20	9.53	40.18	13.46	24.26	26.66	34.83	13.49	9.13	16.35	6.35
Range	70.88	14.62	28.81	33.21	63.61	35.16	41.98	36.51	41.01	44.19	29.49	28.98	23.37
Standard Deviation	7.56	3.80	5.30	7.25	10.83	8.44	8.24	7.39	8.09	8.44	7.62	7.25	5.02
Sample Variance	57.23	14.45	28.10	52.50	117.20	71.26	67.96	54.67	65.39	71.23	58.06	52.63	25.18
p-value (μ=0)	0.298	0.234	0.933	0.295	0.842	0.826	0.138	0.075	0.048	0.210	0.570	0.719	0.388
p-value (t test)		0.568	0.732	0.161	0.992	0.608	0.197	0.117	0.070	0.112	0.368	0.486	0.677
p-value (F test)		0.000	0.015	0.417	0.010	0.248	0.296	0.476	0.335	0.238	0.514	0.413	0.007
Mean % Change									Positive				
Month Effect (Mean)													
Month Effect (Var)		Lower	Lower		Higher								Lower

Exhibit 6
% Change in DJIA from 1950-1999

Period 1950-1999	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	600	50	50	50	50	50	50	50	50	50	50	50	50
Mean	0.76	1.71	0.38	0.97	1.89	-0.01	0.08	1.21	-0.11	-0.55	0.20	1.57	1.79
Median	0.97	1.52	0.78	1.56	1.50	0.31	0.09	0.97	0.87	-0.95	0.27	1.97	1.70
Minimum	-23.22	-8.35	-5.40	-8.97	-6.30	-7.81	-8.49	-6.61	-15.13	-10.42	-23.22	-14.04	-4.20
Maximum	14.41	14.41	8.79	6.60	10.56	8.28	6.24	9.04	11.47	7.34	10.65	10.09	9.47
Range	37.63	22.77	14.19	15.56	16.86	16.09	14.73	15.65	26.60	17.76	33.87	24.14	13.67
Standard Deviation	4.09	5.09	3.34	3.01	3.75	3.54	3.32	3.96	5.02	3.92	5.22	4.64	2.80
Sample Variance	16.76	25.95	11.18	9.05	14.04	12.55	10.99	15.66	25.21	15.33	27.24	21.56	7.82
p-value (μ=0)	0.000	0.022	0.426	0.027	0.001	0.982	0.869	0.035	0.882	0.325	0.784	0.021	0.000
p-value (t test)		0.168	0.412	0.619	0.031	0.118	0.142	0.407	0.200	0.017	0.424	0.200	0.012
p-value (F test)		0.017	0.030	0.003	0.212	0.089	0.026	0.386	0.024	0.362	0.010	0.112	0.000
Mean % Change	Positive	Positive		Positive	Positive			Positive				Positive	Positive
Month Effect (Mean)					Higher					Lower			Higher
Month Effect (Var)		Higher	Lower	Lower			Lower		Higher		Higher		Lower

Exhibit 7
% Change in DJIA from 1950-1974

Period 1950-1974	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	300	25	25	25	25	25	25	25	25	25	25	25	25
Mean	0.45	0.53	-0.22	0.93	1.29	-0.91	-0.93	1.50	-0.12	-0.40	0.66	1.14	1.87
Median	0.87	1.10	0.74	1.28	1.57	-0.46	-1.08	1.93	1.12	-0.51	0.39	1.95	2.38
Minimum	-14.04	-8.35	-4.40	-2.85	-6.30	-7.81	-8.49	-6.61	-10.41	-10.42	-5.43	-14.04	-4.20
Maximum	10.09	8.17	4.51	5.82	8.51	4.24	6.24	7.40	4.87	7.34	9.48	10.09	7.08
Range	24.14	16.52	8.91	8.67	14.81	12.05	14.73	14.01	15.28	17.76	14.92	24.14	11.28
Standard Deviation	3.75	4.15	2.49	2.19	3.74	3.51	3.55	3.91	4.02	4.56	3.37	5.13	2.76
Sample Variance	14.04	17.21	6.18	4.81	13.95	12.35	12.63	15.30	16.15	20.76	11.38	26.32	7.63
p-value (μ=0)	0.040	0.530	0.669	0.044	0.097	0.209	0.203	0.067	0.878	0.666	0.336	0.276	0.002
p-value (t test)		0.918	0.197	0.291	0.247	0.055	0.053	0.168	0.462	0.335	0.744	0.475	0.014
p-value (F test)		0.267	0.007	0.001	0.526	0.368	0.399	0.406	0.341	0.102	0.257	0.021	0.032
Mean % Change	Positive			Positive									Positive
Month Effect (Mean)													Higher
Month Effect (Var)			Lower	Lower								Higher	Lower

Exhibit 8
% Change in DJIA from 1975-1999

Period 1975-1999	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	300	25	25	25	25	25	25	25	25	25	25	25	25
Mean	1.08	2.89	0.97	1.01	2.50	0.89	1.09	0.92	-0.09	-0.70	-0.26	1.99	1.71
Median	1.09	1.93	1.37	1.85	1.26	1.17	1.52	0.53	0.62	-1.02	0.06	2.31	1.09
Minimum	-23.22	-7.37	-5.40	-8.97	-1.90	-5.63	-3.99	-6.20	-15.13	-6.89	-23.22	-8.02	-2.95
Maximum	14.41	14.41	8.79	6.60	10.56	8.28	5.61	9.04	11.47	4.74	10.65	8.17	9.47
Range	37.63	21.78	14.19	15.56	12.46	13.91	9.60	15.24	26.60	11.62	33.87	16.19	12.43
Standard Deviation	4.40	5.73	3.99	3.70	3.74	3.40	2.77	4.06	5.94	3.24	6.62	4.16	2.88
Sample Variance	19.33	32.86	15.91	13.66	13.95	11.59	7.68	16.50	35.31	10.49	43.79	17.33	8.31
p-value (μ=0)	0.000	0.019	0.234	0.183	0.003	0.206	0.062	0.268	0.942	0.289	0.848	0.025	0.007
p-value (t test)		0.104	0.894	0.929	0.060	0.777	0.987	0.843	0.305	0.009	0.290	0.262	0.286
p-value (F test)		0.039	0.274	0.136	0.159	0.055	0.003	0.315	0.024	0.032	0.004	0.383	0.006
Mean % Change	Positive	Positive			Positive							Positive	Positive
Month Effect (Mean)										Lower			
Month Effect (Var)		Higher					Lower		Higher	Lower	Higher		Lower

Exhibit 9
% Change in DJIA from 1900-1999 (By Decade)

Period 1900-1999	All	1900-09	1910-19	1920-29	1930-39	1940-49	1950-59	1960-69	1970-79	1980-89	1990-99
Count	1196	120	116	120	120	120	120	120	120	120	120
Mean	0.58	0.48	0.23	0.87	0.11	0.33	1.08	0.20	0.14	1.11	1.28
Median	0.84	0.65	0.47	0.96	0.86	0.61	1.29	0.45	0.10	0.89	1.61
Minimum	-30.70	-14.80	-23.58	-20.36	-30.70	-21.70	-7.38	-8.49	-14.04	-23.22	-15.13
Maximum	40.18	14.26	18.00	16.35	40.18	7.14	9.83	10.09	14.41	13.82	10.25
Range	70.88	29.06	41.58	36.71	70.88	28.84	17.21	18.58	28.46	37.04	25.38
Standard Deviation	5.48	5.38	5.63	5.71	10.34	4.12	3.29	3.62	4.60	4.72	3.98
Sample Variance	29.99	28.98	31.69	32.60	106.92	17.00	10.82	13.10	21.13	22.26	15.86
p-value (μ=0)	0.000	0.328	0.662	0.099	0.909	0.386	0.000	0.542	0.733	0.011	0.001
p-value (t test)		0.830	0.475	0.566	0.581	0.492	0.115	0.256	0.282	0.209	0.056
p-value (F test)		0.403	0.345	0.264	0.000	0.000	0.000	0.000	0.004	0.012	0.000
Mean % Change	Positive						Positive			Positive	Positive
Decade Effect (Mean)											
Decade Effect (Var)					Higher	Lower	Lower	Lower	Lower	Lower	Lower

Exhibit 10
% Change in DJIA from 1900-1909

Period 1900-1909	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	120	10	10	10	10	10	10	10	10	10	10	10	10
Mean	0.48	0.48	-1.32	2.57	-0.02	-0.84	-0.81	1.56	1.31	-3.17	0.15	3.37	2.52
Median	0.65	0.34	-1.96	3.51	-0.02	-1.08	-0.06	4.15	1.75	-2.89	-0.32	1.80	1.87
Minimum	-14.80	-5.52	-6.70	-11.48	-7.10	-7.35	-7.19	-14.08	-8.36	-13.89	-14.80	-6.06	-3.35
Maximum	14.26	6.72	5.36	11.51	8.41	4.62	3.43	10.68	5.38	5.53	9.45	14.26	10.78
Range	29.06	12.24	12.06	22.99	15.51	11.97	10.62	24.76	13.73	19.43	24.24	20.32	14.13
Standard Deviation	5.38	3.61	3.30	6.21	5.08	4.10	3.98	7.53	3.98	6.00	6.82	6.64	4.45
Sample Variance	28.98	13.03	10.89	38.52	25.79	16.85	15.80	56.67	15.85	35.97	46.50	44.15	19.76
p-value (μ=0)	0.328	0.684	0.237	0.223	0.989	0.533	0.535	0.528	0.325	0.129	0.945	0.143	0.107
p-value (t test)		0.998	0.114	0.288	0.751	0.322	0.320	0.640	0.521	0.070	0.874	0.175	0.167
p-value (F test)		0.082	0.048	0.317	0.450	0.173	0.145	0.110	0.145	0.347	0.203	0.218	0.264
Mean % Change													
Month Effect (Mean)													
Month Effect (Var)			Lower										

Exhibit 11
% Change in DJIA from 1910-1919

Period 1910-1919	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	116	10	10	10	10	10	10	10	9	9	9	9	10
Mean	0.23	-0.23	-0.49	2.26	0.95	1.39	0.39	-1.25	0.49	3.29	0.41	-1.84	-2.49
Median	0.47	-0.69	-0.26	1.59	-0.91	1.49	-0.31	-0.85	2.07	2.22	0.98	-2.48	1.10
Minimum	-23.58	-8.64	-4.06	-4.57	-3.97	-9.91	-5.95	-11.46	-9.10	-3.71	-11.11	-12.88	-23.58
Maximum	18.00	7.29	5.21	10.24	18.00	13.59	8.33	7.54	7.78	11.55	6.73	6.83	3.74
Range	41.58	15.93	9.27	14.80	21.97	23.49	14.29	18.99	16.88	15.26	17.84	19.72	27.32
Standard Deviation	5.63	5.55	2.86	4.72	6.67	5.87	4.48	5.30	5.74	5.48	5.78	5.40	8.56
Sample Variance	31.69	30.79	8.19	22.25	44.55	34.46	20.06	28.06	32.90	30.01	33.44	29.20	73.23
p-value (μ=0)	0.662	0.898	0.605	0.164	0.663	0.474	0.787	0.476	0.805	0.110	0.837	0.337	0.382
p-value (t test)		0.790	0.474	0.190	0.725	0.527	0.907	0.380	0.890	0.116	0.924	0.264	0.309
p-value (F test)		0.523	0.012	0.281	0.286	0.487	0.212	0.450	0.536	0.529	0.523	0.496	0.057
Mean % Change													
Month Effect (Mean)													
Month Effect (Var)			Lower										

Exhibit 12
% Change in DJIA from 1920-1929

Period 1920-1929	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	120	10	10	10	10	10	10	10	10	10	10	10	10
Mean	0.87	1.31	-0.59	0.42	0.26	0.34	-0.21	2.92	4.24	-1.72	-1.21	1.83	2.80
Median	0.96	0.37	-0.96	-1.13	2.45	-0.50	-2.12	3.38	3.89	-2.28	0.80	4.20	3.57
Minimum	-20.36	-3.18	-12.05	-9.06	-9.02	-6.85	-9.93	-4.31	-2.54	-9.70	-20.36	-12.64	-5.38
Maximum	16.35	5.84	6.64	12.59	4.14	8.28	12.23	9.85	11.30	5.92	9.10	16.35	8.20
Range	36.71	9.02	18.69	21.65	13.16	15.14	22.16	14.16	13.84	15.61	29.47	28.98	13.58
Standard Deviation	5.71	3.34	5.23	6.67	4.36	4.92	6.94	3.93	4.36	4.70	8.27	8.92	3.53
Sample Variance	32.60	11.17	27.33	44.53	18.98	24.25	48.23	15.48	18.98	22.12	68.46	79.55	12.43
p-value (μ=0)	0.099	0.245	0.728	0.848	0.852	0.830	0.925	0.043	0.013	0.278	0.655	0.532	0.033
p-value (t test)		0.690	0.380	0.826	0.666	0.737	0.614	0.125	0.029	0.103	0.418	0.722	0.115
p-value (F test)		0.034	0.406	0.307	0.172	0.313	0.251	0.100	0.187	0.264	0.084	0.050	0.050
Mean % Change								Positive	Positive				Positive
Month Effect (Mean)									Higher				
Month Effect (Var)		Lower											

Exhibit 13
% Change in DJIA from 1930-39

Period 1930-1939	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	120	10	10	10	10	10	10	10	10	10	10	10	10
Mean	0.11	1.45	1.46	-4.08	0.59	-1.93	3.40	4.08	4.90	-4.91	-1.34	-0.90	-1.43
Median	0.86	1.71	1.63	-1.54	-2.49	-0.62	2.57	5.03	2.03	-1.22	0.18	-0.62	1.16
Minimum	-30.70	-7.11	-15.62	-23.67	-23.43	-20.26	-17.72	-9.85	-6.18	-30.70	-13.50	-10.96	-17.01
Maximum	40.18	7.51	13.20	7.80	40.18	13.46	24.26	26.66	34.83	13.49	9.13	11.32	6.35
Range	70.88	14.62	28.81	31.48	63.61	33.72	41.98	36.51	41.01	44.19	22.63	22.28	23.37
Standard Deviation	10.34	4.48	7.53	9.38	17.14	10.09	12.11	10.83	11.77	12.21	8.43	7.97	7.06
Sample Variance	106.92	20.05	56.64	87.98	293.64	101.79	146.75	117.36	138.42	148.97	71.12	63.58	49.87
p-value (μ=0)	0.909	0.332	0.555	0.202	0.916	0.561	0.398	0.264	0.220	0.235	0.628	0.729	0.537
p-value (t test)		0.411	0.579	0.172	0.927	0.521	0.384	0.252	0.204	0.199	0.591	0.692	0.505
p-value (F test)		0.004	0.133	0.398	0.031	0.509	0.297	0.471	0.332	0.278	0.242	0.182	0.092
Mean % Change													
Month Effect (Mean)													
Month Effect (Var)		Lower			Higher								

Exhibit 14
% Change in DJIA from 1940-49

Period 1940-1949	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	120	10	10	10	10	10	10	10	10	10	10	10	10
Mean	0.33	0.25	-1.16	1.03	-0.52	-0.05	1.75	0.44	0.37	0.17	1.03	-1.76	2.39
Median	0.61	0.96	-1.30	1.41	-1.23	2.20	1.68	0.42	0.53	0.99	1.96	-0.47	3.48
Minimum	-21.70	-5.34	-7.12	-6.80	-5.85	-21.70	-3.14	-5.18	-6.14	-8.86	-7.10	-9.24	-2.86
Maximum	7.14	6.10	4.38	5.92	7.14	5.80	6.38	5.08	7.01	4.26	5.79	2.60	4.88
Range	28.84	11.43	11.50	12.72	12.99	27.50	9.51	10.26	13.14	13.12	12.88	11.84	7.74
Standard Deviation	4.12	3.70	3.50	4.03	3.90	8.18	3.26	3.76	3.36	3.73	3.79	3.66	2.54
Sample Variance	17.00	13.68	12.23	16.25	15.19	66.84	10.60	14.13	11.32	13.92	14.38	13.40	6.43
p-value (μ=0)	0.386	0.837	0.320	0.442	0.681	0.984	0.123	0.723	0.736	0.888	0.411	0.163	0.015
p-value (t test)		0.945	0.194	0.581	0.490	0.877	0.187	0.927	0.968	0.894	0.554	0.089	0.026
p-value (F test)		0.369	0.298	0.512	0.456	0.006	0.211	0.394	0.241	0.382	0.410	0.372	0.051
Mean % Change													Positive
Month Effect (Mean)													Higher
Month Effect (Var)						Higher							

Exhibit 15
% Change in DJIA from 1950-1959

Period 1950-1959	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	120	10	10	10	10	10	10	10	10	10	10	10	10
Mean	1.08	0.89	-0.32	1.35	2.21	0.36	0.78	3.47	-0.96	-0.02	-0.26	2.93	2.51
Median	1.29	0.96	0.74	1.42	3.78	1.78	0.91	3.76	-1.58	0.00	-0.55	2.01	3.05
Minimum	-7.38	-4.07	-3.92	-1.63	-4.39	-7.38	-6.40	0.14	-5.14	-5.79	-3.34	-1.47	-3.15
Maximum	9.83	5.70	2.74	5.82	5.21	4.24	6.24	6.27	4.80	7.34	4.46	9.83	5.65
Range	17.21	9.77	6.66	7.45	9.60	11.62	12.65	6.13	9.95	13.13	7.80	11.31	8.80
Standard Deviation	3.29	3.12	2.25	2.41	3.13	3.55	3.75	2.00	3.39	4.53	2.67	3.35	2.62
Sample Variance	10.82	9.73	5.08	5.80	9.77	12.58	14.08	4.02	11.51	20.51	7.12	11.22	6.86
p-value (μ=0)	0.000	0.390	0.668	0.110	0.052	0.756	0.529	0.000	0.394	0.986	0.761	0.022	0.014
p-value (t test)		0.848	0.076	0.725	0.262	0.516	0.795	0.003	0.075	0.433	0.133	0.097	0.106
p-value (F test)		0.458	0.098	0.137	0.470	0.430	0.343	0.052	0.479	0.120	0.243	0.506	0.223
Mean % Change	Positive							Positive				Positive	Positive
Month Effect (Mean)								Higher					
Month Effect (Var)													

Exhibit 16
% Change in DJIA from 1960-1969

Period 1960-69	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	120	10	10	10	10	10	10	10	10	10	10	10	10
Mean	0.20	0.80	-0.70	0.66	1.52	-1.22	-2.25	0.13	0.81	-0.32	1.46	0.97	0.57
Median	0.45	2.20	-0.58	0.83	1.27	-0.90	-1.71	-0.23	1.49	-0.66	1.82	-0.09	0.88
Minimum	-8.49	-8.35	-4.32	-2.85	-5.89	-7.81	-8.49	-6.61	-6.96	-7.32	-5.06	-5.10	-4.20
Maximum	10.09	8.17	2.14	3.34	8.51	3.96	2.42	6.53	4.87	4.44	5.28	10.09	3.35
Range	18.58	16.52	6.46	6.19	14.40	11.77	10.91	13.14	11.83	11.76	10.34	15.20	7.54
Standard Deviation	3.62	5.27	2.31	2.32	4.04	3.78	3.66	4.11	3.10	4.22	2.93	4.10	2.32
Sample Variance	13.10	27.75	5.34	5.38	16.31	14.31	13.38	16.89	9.61	17.78	8.56	16.85	5.38
p-value (μ=0)	0.542	0.644	0.364	0.393	0.264	0.334	0.084	0.923	0.430	0.817	0.150	0.476	0.457
p-value (t test)		0.711	0.248	0.552	0.301	0.240	0.051	0.954	0.538	0.689	0.194	0.549	0.630
p-value (F test)		0.084	0.061	0.062	0.368	0.474	0.507	0.350	0.305	0.311	0.237	0.349	0.062
Mean % Change													
Month Effect (Mean)													
Month Effect (Var)													

Exhibit 17
% Change in DJIA from 1970-1979

Period 1970-1979	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	120	10	10	10	10	10	10	10	10	10	10	10	10
Mean	0.14	1.68	0.04	1.68	1.22	-2.14	0.16	-0.27	0.11	-1.37	-1.16	-0.62	2.40
Median	0.10	0.95	0.15	1.70	0.29	-2.61	-0.52	-1.14	1.07	-1.15	-1.61	0.82	1.37
Minimum	-14.04	-7.37	-4.40	-1.85	-6.30	-4.84	-3.30	-5.61	-10.41	-10.42	-8.47	-14.04	-0.96
Maximum	14.41	14.41	5.02	6.60	10.56	1.33	5.61	7.40	4.87	6.71	9.48	6.56	7.08
Range	28.46	21.78	9.42	8.44	16.86	6.17	8.91	13.01	15.28	17.13	17.96	20.60	8.04
Standard Deviation	4.60	7.79	3.41	2.59	4.90	2.20	2.92	4.51	4.95	4.35	5.54	6.04	2.96
Sample Variance	21.13	60.73	11.63	6.70	23.99	4.83	8.52	20.36	24.49	18.94	30.74	36.45	8.76
p-value (μ=0)	0.733	0.512	0.972	0.071	0.451	0.013	0.865	0.854	0.946	0.344	0.523	0.753	0.030
p-value (t test)		0.519	0.924	0.094	0.482	0.008	0.985	0.769	0.981	0.279	0.448	0.680	0.034
p-value (F test)		0.025	0.147	0.027	0.449	0.009	0.058	0.517	0.436	0.464	0.259	0.164	0.068
Mean % Change						Negative							Positive
Month Effect (Mean)						Lower							Higher
Month Effect (Var)		Higher		Lower		Lower							

Exhibit 18
% Change in DJIA from 1980-1989

Period 1980-1989	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	120	10	10	10	10	10	10	10	10	10	10	10	10
Mean	1.11	3.26	0.79	0.25	1.98	0.48	1.56	1.09	2.27	-1.16	-0.41	2.09	1.09
Median	0.89	2.18	1.33	1.22	1.36	0.08	1.68	-0.51	2.15	-1.00	0.18	3.23	1.22
Minimum	-23.22	-3.02	-5.40	-8.97	-1.90	-5.63	-1.62	-6.20	-7.44	-6.89	-23.22	-8.02	-2.95
Maximum	13.82	13.82	8.79	6.41	8.51	5.20	5.54	9.04	11.47	4.00	10.65	7.45	5.74
Range	37.04	16.85	14.19	15.38	10.41	10.83	7.16	15.24	18.91	10.89	33.87	15.47	8.70
Standard Deviation	4.72	5.06	4.79	4.31	3.31	3.61	2.54	4.97	6.00	2.91	8.87	4.71	2.88
Sample Variance	22.26	25.62	22.98	18.54	10.99	13.02	6.47	24.69	35.96	8.46	78.75	22.15	8.27
p-value (μ=0)	0.011	0.072	0.613	0.857	0.092	0.682	0.084	0.504	0.262	0.238	0.887	0.194	0.263
p-value (t test)		0.188	0.832	0.528	0.423	0.589	0.600	0.993	0.531	0.031	0.573	0.507	0.981
p-value (F test)		0.426	0.535	0.398	0.109	0.174	0.019	0.473	0.197	0.051	0.009	0.547	0.044
Mean % Change	Positive												
Month Effect (Mean)										Lower			
Month Effect (Var)							Lower				Higher		Lower

Exhibit 19
% Change in DJIA from 1990-1999

Period 1990-1999	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	120	10	10	10	10	10	10	10	10	10	10	10	10
Mean	1.28	1.92	2.08	0.93	2.54	2.46	0.13	1.63	-2.76	0.13	1.40	2.48	2.39
Median	1.61	1.83	1.55	1.88	2.13	2.50	0.17	1.56	-0.73	-0.22	1.71	3.62	1.50
Minimum	-15.13	-5.91	-3.68	-5.12	-1.86	-2.13	-3.99	-2.88	-15.13	-6.19	-6.33	-5.68	-1.13
Maximum	10.25	5.97	8.08	5.15	10.25	8.28	4.66	7.17	3.96	4.74	9.56	8.17	9.47
Range	25.38	11.88	11.76	10.27	12.11	10.40	8.65	10.04	19.09	10.93	15.89	13.85	10.60
Standard Deviation	3.98	3.61	3.24	3.38	3.76	3.11	2.89	3.11	6.31	3.97	4.13	4.66	3.11
Sample Variance	15.86	13.03	10.48	11.45	14.14	9.70	8.38	9.70	39.78	15.73	17.06	21.72	9.68
p-value (μ=0)	0.001	0.127	0.073	0.407	0.061	0.034	0.889	0.131	0.200	0.922	0.312	0.127	0.038
p-value (t test)		0.572	0.442	0.745	0.295	0.248	0.232	0.720	0.057	0.360	0.925	0.408	0.275
p-value (F test)		0.387	0.239	0.293	0.458	0.199	0.134	0.195	0.030	0.548	0.500	0.299	0.198
Mean % Change	Positive					Positive							Positive
Month Effect (Mean)													
Month Effect (Var)									Higher				

REFERENCES

Agrawal, A. and K. Tandon (1994). "Anomalies or Illusions?: Evidence from Stock Markets in Eighteen Countries." Journal of International Money and Finance **13**: 83 – 106.

Arbel, A. and P. J. Strebel (1983). "Pay Attention to Neglected Firms." Journal of Portfolio Management. (Winter).

Baker, R. and R. Limmack (1998). "Firm Size, Monthly Seasonalities and Tax Loss Selling: Further Evidence from the UK." British Accounting Review **30**: 221 – 248.

Bachelier, L. (1900). Theorie de la Speculation. Paris, Gauthier-Villars. reprinted in P. Cootner (1964). The Random Character of Stock Market Prices. Cambridge, Massachusetts, Massachusetts Institute of Technology: 17 – 78.

Banz, R. (1981). "The Relationship between Return and Market Value of Common Stocks." Journal of Financial Economics **9**(1): 3 – 18.

Berk J. (1995). "A Critique of Size Related Anomalies." Review of Financial Studies **8**(2): 275 – 286.

Bernstein, P. (1992). Capital Ideas: The Improbable Origins of Modern Wall Street. New York, Free Press.

Blume, M. E. and R. F. Stambaugh (1983). "Biases in Computed Returns: An Application to the Size Effect." Journal of Financial Economics.

Brown, P., D. Keim, W. Kelidon and T. Marsh (1983). "Stock Return Seasonalities and the Tax Loss Selling Hypothesis: Analysis of the Arguments and Australian Evidence." Journal of Financial Economics **12**(1): 105 – 123.

Cowles, A. (1933). "Can Economic Forecasters Forecast?" Econometrica **7**(3): 229 – 263.

Cowles, A. I. And H. Jones (1937). "Some a Posteori Probabilities in Stock Market Action." Econometrica **5**: 280 – 294.

Fama, E. (1965). "The Behavior of Stock Market Prices." Journal of Business **38**: 34 – 105.

--- (1970). "Efficient Capital Markets: A Review of Theory and Empirical Work." Journal of Finance **25**(2): 383 – 417.

Fama, E. and K. French (1992). "The Cross-Section of Expected Returns." Journal of Finance **47**: 427 – 465.

Garza-Gomez, X., J. Hodoshima and M. Kunimura (1998). "Does Size Really Matter in Japan." Financial Analysts Journal **54**(November/December): 22 – 34.

Haugen, R. and P. Jorion (1996). "The January Effect: Still Here after All These Years." Financial Analysts Journal (January-February): 27 – 31.

Haugen, R. and J. Lakonishok (1988). "The Incredible January Effect". Homewood, Illinois, Dow Jones Irwin.

Hawawini, G. and D. Keim (2000). The Cross Section of Common Stock Return – a Review of the Evidence and Some New Findings. Security Market Imperfections in World Wide Equity Markets. D. Keim and W. Ziemba. Cambridge, Cambridge University Press: 3 – 44.

Kato, K. and J. Schallheim (1985). "Seasonal and Size Anomalies in the Japanese Stockmarket." Journal of Financial And Quantitative Analysis **20**(2): 243 – 260.

Keim, D. (1983). "Size Related Anomalies and Stock Market Seasonality: Further Empirical Evidence." Journal of Financial Economics **12**: 12 – 32.

Kendall, M. (1953). The Analysis of Economics Time Series: Part 1: Prices. The Random Character of Stock Prices. P. Cootner. Cambridge, MIT Press.

Lakonishok, J. and S. Smidt (1988). "Are Seasonal Anomalies Real? A Ninety Year Perspective." Journal of Financial Studies **1**(4): 403 – 425.

Mandelbrot, B. (1966). "Forecasts of Future Prices, Unbiased Markets, and Martingale Models". Journal of Business **39**: 242 – 255.

Muth, J. (1961). "Rational Expectations and the Theory of Price Movements." Econometrica **29**: 315 – 335.

Officer, R. (1975). "Seasonality in Australian Capital Markets." Journal of Financial Economics **2**: 29 – 51.

Osborne, M. F. M. (1959). "Brownian Motion in the Stock Market." Operations Research **7**: 145 – 173.

--- (1962). "Periodic Structure in the Brownian Motion of Stock Prices." Operations Research **10**: 345 – 379.

Reinganum, M. (1981). "Misspecification of Capital Asset Pricing: Empirical Anomalies Based on Earnings Yield and Market Values." Journal of Financial Economics **9**: 19 – 46.

--- (1983). "The Anomalous Stock Market Behavior of Small Firms in January: Empirical Tests for Tax Loss Selling Effects." Journal of Financial Economics **12(**1) (June): 89 – 104.

Riepe, M. (1998). "Is Publicity Killing the January Effect?" Journal of Financial Planning **11**(February): 64 – 70.

--- (2001). "The January Effect: Not Dead yet but Not at All Well." Journal of Financial Planning **14**(January): 44 – 47.

Ritter, J. R. (1988). "The Buying and Selling Behavior of Individual Investors at the Turn of the Year." Journal of Finance **43**(July): 701 – 717.

Roll, R. (1983). "Vas Is Das?" Journal of Portfolio Management **9**: 18 – 28.

Rozeff, M. and W. Kinney (1976). "Capital Market Seasonality – the Case of Stock Returns." Journal of Financial Economics **3**: 379 – 402.

Samuelson, P. (1965). "Proof That Properly Anticipated Prices Fluctuate Randomly." Industrial Management Review **6**: 41 – 49.

Wachtel, S. B. (1942). "Certain Observations on Seasonal Movements in Stock Prices." Journal of Business **15**: 184 – 193.

Working, H. (1934). "A Random Difference Series for Use in the Analysis of Time Series." Journal of the American Statistical Association **29**: 11 – 24.