# An Empirical Investigation of High End-of-Day Transaction Returns between 1978-1985

by

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(ABSTRACT)

Using a random sample of transactions data from the time period of September 1, 1978 through August 31, 1985, the high end-of-day transaction returns noted by Wood, McInish and Ord and by Harris were examined to determine their persistence over time and their relationship to a commonly used measure of daily security performance. Additionally, final transactions were classified by type of price change-reversal or continuation-in order to document whether the high end-of-day returns are the result of security price appreciation or the result of increases in transactions at the ask price. New information provided by this study can be summarized as follows:

1. The end-of-day anomaly persisted over the time period of the study and appeared to be strongest in the last three years.

2. A Friday effect was found in that the mean return to the final transaction on Friday was at least as great or greater than the mean final transaction returns on the other days of the week.

3. A relationship was found to exist between CRSP excess return level (good day/bad day) and the final transaction return, and there was evidence that the final transaction may have had a large impact on the CRSP excess return.

4. Reversals are more frequent than continuations on the final trade, particularly after 3:56pm, and the mean return to reversals is greater than the mean return to continuations.

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, I thank you.

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# Chapter 1 Introduction

The pattern of intradaily returns has received relatively little attention in the financial literature. This lack of attention is most likely due to the difficulty and expense of obtaining the necessary transactions data. In order to gain insights into the intradaily return generating process of common stocks, Harris (1986a) examined the weekly and intradaily price patterns of all NYSE securities over a fourteen month period from December 1981 through January 1983. Similarly, Wood, McInish and Ord (1985) examined the intradaily return patterns of an equally weighted index for the periods September 1971 through February 1972 and the 1982 calendar year. While each of these studies uncovered systematic intradaily return patterns--particularly at the open and close of the trading day--neither study explores the possible causes of the patterns nor documents the persistence of the patterns over time.

Of the reported systematic patterns, the most interesting is Harris' and Wood et. al.'s findings of extreme price movements at the close of the trading day. Harris reported finding the average return on the final trade of the day to be five to 10 times greater than the average return on the preceding nine transactions. Similarly, Wood et. al. reported that the mean return to an equally weighted index of NYSE securities was significantly

greater during the last five minutes of the trading day than during the rest of the day. It is this unusual pattern of stock returns at the end of the day that will be the main focus of this study.

## *Purpose and Justification*

Prior to Harris and Wood et. al. there were few studies that employed transactions data. Early research was primarily directed at the time series nature of successive price changes. Neiderhoffer (1965,1966) used transactions data to examine the "stickiness" of stock prices at different price levels. Neiderhoffer and Osborne (1966) found that reversals, i.e. price changes in the direction opposite of the most recent price change, outnumbered continuations, i.e. price changes in the same direction as the most recent change, approximately 2 to 1. Simmons (1971), Carey and Sherr (1974), Garbade and Lieber (1977), Epps and Epps (1976), Epps (1979) and Smidt (1979) provided further insight into the time series and distributional properties of transactions data. However, none of these studies suggested the existence of an end of day phenomenon.

The first studies to present evidence of high end-of-day returns were by Wood, McInish and Ord (1985) and Harris (1986a). Using transactions data over two time periods--September 1971 to February 1972 and the year of 1982--Wood et. al. built an equally weighted minute by minute NYSE market index. The index for the early time period consisted of 946 firms while the later period index consisted of 1138 firms. Their findings suggest that returns to the market indexes were from four different distributions--overnight, the first 30 trading minutes, the last five trading minutes, and the rest of the trading day. They reported that transaction returns during the day exclu-

sive of the opening 30 minutes and the closing five minutes appeared to be normally distributed with little serial correlation. Unfortunately, the authors did not test the closing five minute transaction returns for departures from normality, but they did compute means and variances. Of particular interest is the authors' finding that the average index return during the closing five minutes was much greater than the average during the middle of the day.

Harris (1986a) used transactions data over a fourteen month time period from December 1982 through January 1983 to investigate the "weekend effect" and weekday patterns of fifteen minute intradaily returns. One of the hypotheses he tested was that the "weekend effect" resulted from an upward bias in the Friday closing price. While he failed to find support for this hypothesis, he did find that the mean final transaction return for each weekday was significantly greater than the mean return of the previous nine trades. He also found that the final trade each day occurred on average 26 to 28 minutes before close.

The findings of Wood, et. al. and Harris together suggest that the high end of day returns may be caused by a relatively few transactions being executed near the close of the trading day. In attempting to characterize the end-of-day phenomenon Harris (1986b) found that the last transaction return was greater the closer the ultimate and penultimate transactions to the close of the trading day. When ultimate transaction price changes were classed, based upon whether the ultimate trade occurred in the final five minutes of the day or not, significant differences were found between the mean price changes of the two classes.

Harris tested for relationships between end-of-day returns and security attributes. He found a significant inverse relationship between price level and end-of-day price changes. Harris tested for changes in the frequency of transactions occurring at the ask price. He found that about half of the price changes were the result of increased ask price

frequency, the other half were the result of movements in the equilibrium prices. In testing for an upward bias in the closing price, Harris failed to find negative returns between the closing trade and the opening trade the following day.

The purpose of this dissertation is to more thoroughly document the end-of-day phenomenon. The time periods of the three previous studies are fairly short with Harris' sample encompassing a year of the Wood et. al. sample. This study will examine the data over a longer time period to determine if the anomaly persists. If it is found that the anomaly persists the study will attempt to determine if it is changing over time.

The previous studies have not offered an explanation of the high end-of-day returns. This study offers several scenarios that would be consistent with the observed anomaly. First, the returns may be related to information flows into the market. If firms release good news while the market is open and bad news while the market is closed as suggested by Patell and Wolfson (1982), then there would be a higher probability that end-of-day transaction returns would be positive than negative. Second, if specialists must meet daily inventory requirements, then buying pressure resulting in depletion of their inventories may result in the raising of the bid and ask prices to induce traders to sell their holdings. If either of these scenarios have merit, then there should be a relationship between good days and bad days for a security in the market and the end-of-day transaction return. The present study will examine this relationship.

## *Outline of the Study*

The study is organized as follows. Chapter two contains a review of the literature relevant to the examination of end-of-day returns. The review encompasses the literature

pertaining to the specialist system and the theoretical and empirical literature on intra-daily price distributions. This is followed by a review of the three previous studies which have documented the end-of-day anomaly. The major emphasis of the literature review is placed on these three studies as they are the most relevant to the present study.

The data to be used in the study and the statistical methodology are presented in Chapter three. This includes a discussion of the choice of return calculation methodology and a general outline of the tests to be performed.

The results of the tests are discussed in Chapter four. Some of the results spawned additional tests which are also contained in this chapter.

Finally, a summary of the results and recommendations for further research are presented in Chapter 5.

# Chapter 2 Literature Review

## *Introduction*

The purpose of this section is to review the literature dealing with intraday price distributions. There are two areas of research to be considered. The first area concerns literature on the market in which prices are generated and the important elements of this market which impact intraday price distributions. Of particular interest in this area is the role of the market maker. The second area of research concerns the intraday distribution of prices. The literature dealing with this topic is divided into two groups--that dealing theoretically with intraday distributions and that dealing empirically with said distributions.

## *The Market and its Maker*

The New York Stock Exchange (NYSE), similar to many other organized exchanges, is a continuous auction market. The majority of all orders executed on the exchange are one of two types. The first is a market order to buy or sell a stated amount of stock for the best price available at the time the order is executed. The second order type is a limit order to buy or sell a stated amount of stock at the best price available so long as the price is at least as good as the limiting price stated in the order.

The specialist, who is also referred to as the market maker, is entrusted with the responsibility of maintaining a fair and orderly succession of prices. Wolfson and Russo (1970) present a discussion of the role of the specialist on the organized exchanges. This discussion includes the historical development and the legal and economic aspects of specialist behavior in the short, intermediate, and long runs. Of particular interest is the performance of the specialist in the short run. The specialists' primary responsibilities are to provide depth to the market in times of transitory imbalances between supply and demand and to provide continuity of successive prices. As a result the specialists have a significant influence on the bid-ask prices. In a balanced market for a heavily traded issue, the bid-ask spread is normally set by the specialist's limit order book. The bid price will be the price of the highest limit buy order, and the ask price will be that of the lowest limit sell order. If the spread between the marginal buy and sell limit orders is not too large, the specialist will quote these prices to traders coming to the post. If there is a large spread between the marginal orders, or if there are either no limit buys or no limit sells on the book, then the specialist is expected to trade from his own account to make the market. Bagehot (1971) suggests that the bid-ask spread serves to compensate

the specialist for bearing the risk of providing liquidity in the face of uncertain security values.

When trading on his own account the specialist needs to exercise judgment about whether the imbalance between demand and supply is transitory or the result of a shift in the equilibrium value of the security. If the imbalance is the result of a shift in equilibrium, then it is the specialist's responsibility to provide a continuity of prices to its new equilibrium. Extreme price movements between successive transactions are forbidden without approval by the exchange. If the imbalance is viewed as transitory the specialist is expected to stabilize prices near the level prior to the imbalance until the levels of supply and demand are returned to normal. Wolfson and Russo (1970) cite examples of each of the above situations. The first was a transitory increase in supply when President Eisenhower suffered a heart attack. The second was a shift in equilibrium when stock prices fell on May 28, 1962. In each case specialists were net buyers. In the first case prices were stabilized at their pre-event level, but in the second case prices were allowed to fall.

Smidt (1979) proposes that when a specialist's inventories become imbalanced, the specialist will set the bid-ask prices away from where they would be set in equilibrium until the inventories are back to the desired level. This would suggest that if specialists were facing buying pressure resulting in the their inventory being depleted, they would undertake a strategy of raising the bid price beyond the equilibrium value. This high bid price would induce holders of the security to sell and allow the specialists to restore their inventory. The converse would be true in the case of specialists facing selling pressure.

Garbade and Sekaran (1981) study whether opening prices (which are set by specialists) are as good an estimate of the security's value as subsequent transaction prices. The relevance of this to the present paper is the finding of the SEC (1963) that specialists set opening prices near the previous day's closing price. The SEC also found that spe-

cialists would tenaciously stick to what they felt were fair opening prices. It was argued by Garbade and Sekaran that it would be difficult for a specialist to maintain a disequilibrium price for a long period of time such as one half hour or more. This may account for the opening distributions found by Wood et. al. (1985) and Harris (1986a). Garbade and Sekaran use the model developed by Garbade and Lieber (1977) to test whether opening prices are fair with respect to subsequent prices and fail to find any systematic bias for five securities in September 1975 and August 1973. They also fail to find support for the hypothesis that specialists try to validate their opening prices.

In summary, specialists are an important part of the NYSE having the power to set prices and act as both dealers and traders. Additionally, specialists have privy information with regard to supply and demand of for their securities. If specialists must meet certain inventory requirements at the close of the trading day, their day end trading activities may, in part, be responsible for the observed end of day price movements.

## *Intraday Price Distributions*

There have been a number of studies of the distribution of intradaily prices and returns. The earliest of these were primarily concerned with serial correlations and the patterns of reversals and continuations. Any price change can be classified as either a continuation or a reversal, depending upon its direction relative to the most recent previous price change. For example, a price increase that follows a price increase is termed a continuation, and a price increase that follows a price decrease is termed a reversal. In effect, continuations are price changes in the same direction as the previous price change, and reversals are price changes in the opposite direction as the previous price

change. Neiderhoffer and Osborne (1966) report that for any given price change, a reversal is approximately twice as likely as a continuation. They also document the tendency for reversals to be followed by reversals and continuations to be followed by continuations. This tendency is attributed to the market making mechanism, in particular the specialist's book containing limit orders.

Neiderhoffer (1965,1966) and Neiderhoffer and Osborne (1966) document the tendency of stocks to trade at even eighths as opposed to odd eighths. Simmons (1971) documents the tendency of large price changes to be followed by large price changes and large volumes to be followed by large volumes. Carey and Sherr (1974) test a Markov model for successive price changes of individual stocks on the NYSE during a bull, a bear, and a stable market. They find that successive transactions do not exhibit independence and that price level is a factor in the dependence exhibited. They additionally find evidence to support their hypothesis that for any given stock, a different dependence exists in different market types.

Garbade and Lieber (1977) present a model of transaction prices that accommodates both a random walk of the equilibrium security price and a random transient term to account for the bid/ask structure of the market. The model has no drift component due to the five day delay in settlement procedures. All transactions in a single day should be perfect substitutes. Using conditional probability theory and a maximum likelihood function, they develop relationships that can be used to test their model. The data used for testing are all transactions for IBM and Potlatch during the month of September 1975. IBM was chosen because of its frequency of trading while Potlatch was chosen for its thinness of trading. When a large order comes to the post, it may be broken into smaller orders which show up as individual transactions. These derivative transactions may be with the crowd, the specialist, the limit order book, or with traders away from the post who view the activity on the ticker. Heavily traded issues, such as

IBM, attract a larger crowd than thinly traded issues, such as Potlatch. The result is that it takes longer for large orders to be completed in thinly traded issues than in heavily traded issues. The manifestation of large orders being broken down into smaller transactions is serial dependence among successive transactions. The authors found transaction prices separated by some minimum amount of time such as 5 to 10 minutes exhibit serial dependence of the magnitude found in daily prices.

Oldfield and Rogalski (1980) develop a multiple component jump process model of stock returns over time. The components of the model are a diffusion process operating continuously through time accompanied by several different jump processes. The first jump process operates at the time a transaction occurs. The other four jump processes operate over nights, weekends, holidays, and holiday weekends. Empirical testing of the model using transaction data for five stocks over a 39 month period found support for the multiple component jump process. The authors report that while there may be a drift in the diffusion component of the model, the data failed to support the existence of a variance in the diffusion component. Stock returns may well be explained by the jump processes alone.

Epps (1975) developed a theoretical model of a market containing Bulls and Bears that exhibit reinforcing-interpretative behavior. This means that small pieces of information modify beliefs only if the information is in line with existing beliefs. In other words, small bits of good news modify Bulls' expectation while being ignored by Bears. The shifts in demand curves resulting from information reaching the market cause an asymmetric volume-price change relationship. Price increases are accompanied by larger volumes than equivalent price declines. Epps (1975) tested the model using bond transaction data and found the data support the model. Epps (1977) used stock transaction data for the week of January 4, 1971 to test the model and found that while the data lent support to the model, the support was not as strong as that given by the bond data.

Epps attributed this to the increased transactions costs in the stock market compared to the bond market. Epps explained that the presence of transactions costs might not only weaken the hypothesized relationship, but it may even reverse the relationship.

Smirlock and Starks (1985a) retested the Epps model using transaction data from the summer of 1981. Their criticisms of Epps' test were that first, the model was based on the reaction of investors to new information and Epps did not consider whether new information was arriving during the time of his test. Second, Epps used the first four trading days of January when the anomalous January effect is at its peak. Smirlock and Starks' test of the model found support for the hypothesized relationship around information arrival, but they failed to find support on days with no information arrival. They also found support for Epps hypothesis that transactions cost reduce the effect.

The first study to examine minute by minute returns to an index was Wood, McInish and Ord (1985) who formed an equally weighted index of all stocks on the NYSE that are contained in COMPUSTAT. To minimize the effects of bid/ask spreads, they required that stock price exceed $4 per share. This only resulted in the elimination of 11 firms. They assumed that returns are generated in transaction time and are given by the natural log of the price relative. An accrual return method was also examined but it failed to yield substantively different results so the simpler transaction return method was used. Additionally, the accrual return method resulted in serial correlation being introduced into the return series. Two periods were analyzed--126 trading days between September 1971 and February 1972 (946 firms) and 252 trading days during the year of 1981 (1138 firms).

Analysis of the returns suggest three distributions:

1. There is an opening distribution during the first 30 minutes of the trading day. There does not appear to be any departure from normality except when overnight returns are included in the 1971-72 time period.

2. There is an intraday distribution for the day excluding the opening 30 minutes, the last minute in the 1971-72 sample and the last 5 minutes in the later sample. This intraday distribution appears to be normal with a different mean and variance from the opening 30 minutes.

3. There is a closing distribution for the last minute in the early time period and the last 5 minutes in the later time period. The authors did not test these distributions for departures from normality.

The authors examined their market return series for evidence of serial correlation and found that correlations in the series were primarily induced by large overnight trades and infrequent trading. They also found that autocorrelation was greater in bull markets than in bear markets. Examining other characteristics of their sample, the authors reported a skewed price change-transaction volume relationship. Contrary to the relationship hypothesized by Epps (1975), the authors found that price increases were accompanied by smaller volumes than equivalent price decreases. The authors also found the larger the price change, the greater the time since the most recent transaction. This suggests that large price changes occur more often in thinly traded securities. Therefore, their price change-volume relationship may be the result of data aggregation and not necessarily evidence against the Epps hypothesis.

Harris (1986a) studied the daily and weekly patterns of 15 minute intradaily returns with the hope of shedding light upon the day-of-the-week effect. The analysis used transactions data for 296 trading days between December 1, 1981 and January 31, 1983. Data for days following holidays were excluded and no multiple day returns were included (e.g. the case of no trading on a day). In the case of only one trade in a day, no intraday trades were computed, but the transaction was used as open and close price for computing overnight returns. Returns were adjusted for splits and dividends using CRSP distribution adjustment factors.

Harris started by computing close to close returns for the data set. The results were similar to those in previous studies. The weekend return was negative while the weekday

returns were positive. An F-test failed to reject the equivalence of the daily returns, but it did reject the equivalence of the weekend return and the mean of the other four days. The author attributes the lack of significance of the former test to an insufficient length time series.

Daily close to close returns were examined for differences among market value groups. It was found that Fridays and Wednesdays had significant differences among market value portfolio returns. The Friday differences appeared to be associated with the small firm effect while the Wednesday differences had no apparent pattern.

In order to see when negative Monday returns accrue, Harris examined the Friday close to Monday open returns and the Monday open to close returns. He found that about half of the negative return accrues prior to Monday open and the other half during the day on Monday. This appears to contradict Oldfield and Rogalski's (1980), Rogalski's (1984) and Smirlock and Stark's (1985b) findings that negative weekend returns primarily accrue prior to the Monday open. When returns to portfolios formed on the basis of market value are computed, a logical explanation is revealed. For the high market value portfolios negative returns accrue prior to Monday's open and for low market value portfolios the negative returns accrue during the day on Monday. The earlier tests were made using indexes composed primarily of large firms.

Harris then computed 15 minute intradaily returns. An accrual return on an equally weighted portfolio was used. It was found that the first 45 minutes of Monday returns were significantly different than the first 45 minutes of returns for the rest of the week. A test of equivalence of the intradaily 15 minute returns for all weekday was rejected except when the first 45 minutes and the final 15 minutes of each trading day were removed. The final 15 minutes of the day exhibit significantly greater returns than the rest of the trading day, and the high returns appear to be primarily the result of the last transaction of the day. The magnitude of the returns during the first 45 minutes of the

day do not appear to be the result of the first trade of the day but appear to result from the first several trades of the day. A pattern was also noticed that prices rose between 12:30 and 1:30 and fell between 2:30 and 3:15.

Harris (1986b) attempts to characterize the end-of-day (EOD) phenomenon noticed by Harris (1986a) and Wood et.al. (1985). It was found in this study that the last transaction return is greater the closer the ultimate and penultimate transactions are to the close of the trading day. The increased mean returns do not appear to be the result of extreme values. The author rules out the possibilities that the high EOD returns are the result of transaction recording errors or out of sequence price records.

In order to test whether the final price is biased upward and hence corrected the next day, the author computes returns between the penultimate trade and the next day open and between the ultimate trade and the next day open. If the close price is biased upward, the return from the ultimate trade should be negative while the return from the penultimate trade should be near zero. The data fail to provide support for the upward biased EOD price hypothesis. However, given the way Garbade and Sekaran (1981) have shown opening prices are set, testing returns to the opening price may not be sufficient to detect a price correction.

Harris then attempted to find relationships between EOD returns and stock characteristics, trade characteristics and time classifications. First, the author calculated daily mean price changes for groups classified by firm size and stock price level. Mean prices were used because of the cross sectional correlation of daily stock price changes. Individually, both firm size and price level were significantly related to mean price change. When taken together, only price level was significant, with mean price changes inversely related to price level. If trading thinness is important in explaining high EOD returns, it could be possible that price level is a better proxy for thinness of trading than firm size.

McInish and Wood (1985) show that thin trading can mask day-of-the-week effects which are strongest for actively traded firms. They use average time from last trade to close as a measure of thinness of trading and compare the intraday, overnight and interday returns to portfolios formed on the basis of market value with the returns to portfolios formed on the basis of thinness of trading. The conventional wisdom has been that larger value firms are more actively traded so one would expect that the returns to the portfolios formed on the two different bases would be very close. The results showed that the day-of-the-week effect was much more pronounced for the most actively traded quintile of stocks than it was for the highest market value quintile of stocks.

Harris (1986b) tested for association between high EOD price changes and the specialist handling the issue, and no relationship was found. There was also no relationship between options listing or Pacific Stock Exchange listing (the Pacific Stock Exchange closes 30 minutes after the NYSE). The author examined the data for any evidence of seasonality. The only significant relationship found was a larger price change at the end of the month. The author had insufficient data to test for a January effect. In testing for a volume-EOD price change relationship, the author failed to find anything significant. The author did not disaggregate the data according to price level in testing for these relationship. It is possible that the use of the aggregated data failed to reveal any interactive effects that may be contained in the data.

Finally, Harris tested for changes in the frequency of transactions occurring at the ask price. He found that only about half of the price change was the result of increased ask price frequency, the other half being the result of movements in the equilibrium price. Harris also found that there was no increase of clustering at the end of the day.

## *Summary*

This chapter has presented a review of the literature that has relevance in the possible explanation of the end-of-day anomaly. The literature dealing with end-of-day prices movements directly is rather sparse, and only one, Harris (1986b), has attempted to explain the anomaly. His research, while failing to present an explanation other than an increase in buying at the end of the day, tested some of the traditional stock classifications that in the past have been important in explaining other anomalies, e.g. small firm effect and the Weekend effect. The limited nature of his dataset, ie. only fouteen months, did not allow an examination of the phenomenon over time. The present study will attempt, among other things, to determine if the anomoly persists over time and whether previously unnoticed patterns are exhibited.

# Chapter 3 Data and Methodology

## *Introduction*

The data and methodology to be used in this study will be presented in this chapter. There will be a discussion of the data, followed by a presentation of the calculation of intradaily returns. Finally, there will a discussion of the methodology for characterizing end-of-day price movements.

## *Data*

The data to be used for this research is that supplied by Francis Emory Fitch, Inc. It contains the symbol, time, date, volume and price of each transaction on the NYSE between September 1978 and August 1985. The data consists of approximately 60 million transaction records. The data as supplied has had erroneous records removed

and corrections applied. The data is from the same source as that used by most previous investigations employing intradaily data. It has been reported that the data is relatively free from errors. Harris (1986b) specifically tested for the end-of-day anomaly being the result of data errors. He failed to find evidence to suggest data errors being the cause of the reported end-of-day price movements. Additional screening will be done to remove large price changes that are not so identified. Also all transactions identified as "sold sale" will be removed as these transactions are out of time sequence.

The CRSP excess return tape will be used to identify days when firms returns were greater than or less than expected. Adjustments for splits and dividends when overnight returns are calculated will be made using CRSP daily price adjustment factors.

The enormity of the available data presents some analysis problems. In order to avoid these problems, sample statistics will be used to make inferences about the population. If the phenomenon is exhibited in the population at large, it should also be exhibited in a random sample from the population. Our dataset will consist of a random sample of 500 firms listed on the NYSE during the time period of September 1978 through August 1985. It was originally proposed to limit the sample to firms listed continuously during the 1978 to 1985 time period, but it was felt that this would bias the sample in favor of "survivors" with the possibility of valuable information being lost. Due to some unexpected data availability problems, eight firms from the original 500 firms sample had to be dropped resulting in a final sample of 492 firms. Appendix A presents the list of firms in the sample along with the time periods they were listed on the NYSE. As a consequence, on any one day the number of firms listed on the exchange from the sample is less than 500. Table 1 presents a summary of the number of firms listed daily.

**Table 1. Summary of Number of Firms Contained in Sample on a Daily Basis**

| Mean # of Firms Listed | Standard Deviation | Minimum Listed | Maximum Listed |
|---|---|---|---|
| 380.72 | 3.14152 | 373 | 389 |

# *Methodology*

## Calculation of intradaily returns

In this section the calculation of intradaily returns will be discussed. The main debate is whether an accrual return method such as that used by Harris (1986a) or a transaction return method as used by Wood, McInish and Ord (1985) and Harris (1986b) should be employed. The method selection will depend upon one's beliefs about the theoretical distribution underlying intradaily price movements. If price movements on an intraday level follow a diffusion process then an accrual return method would be appropriate. On the other hand if price changes follow a jump process then a transaction return method may be more appropriate.

The theoretical model presented and tested by Oldfield and Rogalski (1980) suggests that intradaily prices movements may be more accurately described by a jump process than a diffusion process. This also makes economic sense when the settlement process on the NYSE is considered. All trades made in a single day are settled at the same time five days later. This means that the opportunity cost of making a trade at the market open is the same as that of making a trade the same day just prior to the close. There is no economic reason for securities to appreciate during the day due to the time value of money.

Empirically, Wood, McInish and Ord (1985) found that using an accrual return method resulted in the introduction of serial correlation in the intradaily return stream. They examined both methods of return calculation and found that end-of-day price movements behaved similarly irrespective of which return calculation method was used.

Additionally, Harris (1986b) abandoned the use of accrual returns in his investigation of the end-of-day anomaly.

Given the above theoretical, empirical and economic arguments, intradaily returns used in this study will be calculated as follows:

$$r_t = \ln\left(\frac{p_t + d_t}{p_{t-1}}\right)$$

where: ln is the natural log function
$r_t$= the return in minute t
$p_t$= transaction price in minute t
$p_{t-1}$= transaction price in minute t-1
$d_t$= dividends paid since t-1

## Statistical Methodology

End-of-day transaction returns will be classified on the basis of several calendar time and security characteristics. Statistical testing of differences between the means of these classified group returns will be performed using an analysis of variance framework. The analysis of variance is a method for partitioning the total variance of a sample into the variance resulting from within group differences and the variance resulting from between group differences. The larger the variance between the classified groups is relative to the variance within the groups, then the greater the probability that not all of the underlying population groups means are equal. More precisely,

$$SS_t = \sum_{j=1}^{k} \sum_{i=1}^{n_j} (X_{ij} - M)^2$$

where: $SS_t$ = Total sums of squares
$k$ = Number of groups

$n_j$ = Number of observations in group $j$
$X_{ij}$ = The $i$th observation in group $j$
$M$ = Overall sample mean

$$SS_b = \sum_{j=1}^{k} n_j(M_j - M)^2$$

where: $SS_b$ = Sums of squares between groups
$M_j$ = Mean of group $j$

$$SS_w = \sum_{j=1}^{k} \sum_{i=1}^{n_j} (X_{ij} - M_j)^2$$

where: $SS_w$ = Sums of squares within groups

$$SS_t = SS_b + SS_w.$$

Given that the underlying populations are independent and normally distributed with common variance, then the test statistic

$$F = \frac{\dfrac{SS_b}{k-1}}{\dfrac{SS_w}{N-k}} = \frac{MS_b}{MS_w}$$

is distributed as an F statistic with $k - 1$ and $N - k$ degrees of freedom. The test statistic is quite robust with respect to violations of the assumptions of normality and common variance if large sample sizes and equal group sizes are used. The test statistic is sensitive to violations of the independence assumption, and daily stock returns have been shown to exhibit cross-sectional dependence. To minimize the impact of this dependence, daily classified group means will be used in the analysis of variance instead of individual security returns.

The analysis of variance procedure allows the rejection of the hypothesis that the means of two or more populations are equal. The procedure does not indicate between

which means significant differences exist. Tests making multiple comparisons between means must be made using a procedure that controls the Type I error rate--the probability that the null hypothesis will be rejected when it is not false. Kramer (1956) developed a procedure for making multiple comparisons that controls for Type I errors. The procedure is an extension of Tukey's "Honestly Significant Differences" (HSD) procedure because of its allowance for unequal group sizes. If group sizes are equal, the test is the same as Tukey's HSD procedure. The test statistic,

$$q = \frac{M_i - M_j}{\left[\frac{MS_w}{2}\left(\frac{1}{n_i} + \frac{1}{n_j}\right)\right]^{\frac{1}{2}}}$$

is distributed as the studentized range statistic where $k$ is the number of samples and $N - k$ is the number of degrees of freedom.

It will be desirable to test for independence between the time of day the final transaction occurs and the classification group. The statistical procedure to be used for this test will be the Chi-square test of independence for contingency tables. The test statistic is given by:

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

where: $r$ = Number of rows
$c$ = Number of columns
$O_{ij}$ = Observed frequency in cell $ij$
$E_{ij}$ = Expected frequency in cell $ij$

The statistic is distributed as Chi-squared with $(r - 1)(c - 1)$ degrees of freedom.

## Examination of the End-of-Day Anomaly

The proposed methodology for investigating and characterizing the end-of-day anomaly will be presented in this section. The first step in the analysis will be examination of the data sample to determine whether it exhibits the same characteristics as exhibited by Harris' dataset. Then, the relationship of firm performance to end-of-day price movements will be documented.

## Our sample contrasted with the results of Harris

The time period analyzed by Harris--December 1981 through January 1983--is a subset of the time period covered by our data. The analysis of our data will begin with tests for significant differences in mean final transaction returns for the different calendar and price level classifications examined by Harris. The results of our analysis will be compared to the results obtained by Harris. Additionally, the extended time period of our data will allow for examination of the mean final transaction returns over time. Since the end-of-day phenomenon has been noticed primarily in securities traded in the last five minutes of the trading day, the tests for significant differences in mean group returns will be performed using 1) all final transactions, 2) final transactions occurring prior to 3:56pm and 3) final transactions occurring at 3:56pm or later.

## Relationship of EOD returns to good days and bad days.

The possibility of a relationship between end-of-day price movements and whether the firm's stock experiences a good or bad day has yet to be investigated. There are several reasons why one might expect to find a relationship. First there is the role of the specialist and his/her need to maintain an inventory that is adequate enough to meet transitory imbalances between supply and demand. On days that a firm stock price is moving in one direction as the result of changing value, the specialist is faced with the task of easing the market price to its new equilibrium. In the process the specialist is expected participate in trades to prevent jumps in the security price. On days where the market price is increasing, the specialist's inventory is being depleted. Conversely, on days where to price is falling, the specialist's inventory is being increased. The specialist can remedy an out of balance inventory position by changing the bid/ask prices to induce buying or selling--which ever will change the inventory in the desired direction. The specialist's performance is evaluated on the basis of capital adequacy and ability to stabilize the market. This results in a higher expected cost of insufficient inventory than of excess inventory. Then on up days, the specialist is more likely to raise the bid price at the end of the trading day in order to replenish his/her inventory than to lower the ask price on a down day. This may account for the observance of a positive end-of-day effect.

A second possible reason to expect a relationship between pre-close price trends and end-of-day price movements is thinning of the limit order book as prices move away from a previous equilibrium value. As the limit order book gets thinner, smaller order sizes are needed to cause a change in the bid/ask prices. A thin limit order book combined with "market at the close" orders may result in large price movements at the end

of the trading day. If "market at the close" orders are primarily for buys, then this would explain why the end-of-day movements are primarily positive.

Finally, a third possible reason to expect a relationship between end-of-day price movements and type of day is the timing of information releases. Pattell and Wolfson (1982) present evidence in support of the hypothesis that firms tend to announce good news while the markets is open and bad news while the market is closed. Positive information releases resulting in upward movements in stock prices may also result in trading occurring late in the day in response to the information. Negative information releases resulting in downward movements in stock prices occur primarily when the market is closed and have little impact on trading near the close. If the timing of information releases is important, it would be expected that time of the last trade tends to be later on up days than on down days. This may explain why end-of-day price movements are primarily positive.

If end-of-day price movements are related to information flows in the market, then one would expect to find larger price movements on days when firms experience abnormal returns. To test for this possibility, firms will be ranked daily according to the magnitude of CRSP excess returns and placed into one of five portfolios based on the ranking. The daily mean returns to each portfolio will be examined for significant differences. A criticism of this approach is that CRSP excess returns are computed based on the daily closing price, and a large end-of-day price movement may determine into which excess return portfolio the security falls for the day. This would bias the results toward rejecting a null hypothesis of no relationship between end-of-day price movements and type of day.

A better test might be to classify a day as to being good or bad prior to the end of the day, and then test the null hypothesis of a relationship existing between type of day and end-of-day price movements. To test for this relationship securities will be

ranked according to the magnitude of the returns from the close of the previous day to the last transaction occurring prior to 3:55pm. Daily each security will be placed into one of five groups according to the magnitude of its 3:55pm return. The mean returns to the final transaction of the day will be tested for significant between group differences. Implicit in this analysis is an expectation of zero return between the previous day's close and 3:55pm. This would only happen if we expected no movement in the market or if there were no correlation between security movements and market movements. Neither of these situations is very realistic.

In order to deal with the problem that a security's expected return from one day's close to 3:55pm the following day is not realistically zero, some measure of an expected return for that time period must be made. Implicit in the CRSP excess return is an expected return to the security at 4:00pm. This expected return will be used as a measure of the 3:55pm expected return, and a 3:55pm excess return will be calculated as the difference between the realized 3:55pm return and the expected 3:55pm return. The securities will be ranked daily on the basis of this excess return measure and placed into one of five portfolios daily according to their ranking. The mean final transaction returns of each 3:55pm excess return group will be tested for significant between group differences.

# Chapter 4 Results

## *Introduction*

The results of the analysis of the data will be presented in this chapter. There will first be a discussion of patterns in the data and the persistence of these patterns over time. This will be followed by a presentation of the results from examining the relationship between returns to end-of-day transactions and two measures of daily firm performance. Finally, there will be a presentation of results from the analysis of price changes classified as reversals or continuations.

## *Patterns in the Data*

In this section the results of the analysis of differences in returns to the final transaction during different time periods is presented. Due to the possibility of corre-

lation between individual securities during any trading day, group means were calculated for each trading day. These group means were used in the analysis of variance procedures. The F statistics and P-values presented are from the analysis of variance tests of differences between the group means. The Tukey-Kramer procedure for making multiple comparisons was used to identify which time period group means, if any, were different. This procedure controls for Type I errors so we can say that we are 95% confident that the differences noted are true for the population. Three different comparisons of differences in the final transaction returns were made. The first comparison tested for differences between all final transactions regardless of the time of the final transaction. The second comparison was between all final transactions occurring prior to 3:56pm, and the third comparison was between all final transactions occurring at 3:56pm or later. All results, except for those in Table 3, are expressed in terms of percentages. The results in Table 3 are expressed in cents. This is to facilitate comparisons with the Harris study since most of his results are expressed in cents.

Table 2 and Table 3 present the results of tests for differences in end-of-day price movements between different time periods. First, the grand means for all time periods are presented. It can be seen that on average, the final price change and return for all time periods were positive. If the means of the returns and the price changes were assumed to be normally distributed, then the Student's T Test could be used to test whether the means were significantly different from zero. The T statistics for all final price changes and returns were 8.89 and 10.51, respectively. When the final transaction was classified as before or after 3:56pm, the mean price change and mean return were negative prior to 3:56pm with respective T statistics of -8.40 and -6.40. The mean price change and mean return after 3:56pm were positive with T statistics of 33.64 and 34.73.

When the returns and price changes on the final transaction were broken out by year, it could be seen that the returns and price changes have not remained constant over

**Table 2. Mean Returns on the Final Transaction of the Trading Day for Different Time Periods**

| | ALL FINAL TRANSACTIONS | | TIME OF FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| TIME PERIOD | Average Return | N | Average Return | N | Average Return | N |
| ALL DAYS | 0.0288 | 1763 | -0.0201 | 1767 | 0.1174 | 1763 |
| TIME PERIOD | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0098$^{dc}$ | 251 | -0.0283$^{bc}$ | 251 | 0.0918$^{dc}$ | 251 |
| 9/01/79-8/31/80 | -0.0000$^{d}$ | 252 | -0.0422$^{c}$ | 252 | 0.0853$^{d}$ | 252 |
| 9/01/80-8/31/81 | 0.0173$^{dc}$ | 249 | -0.0299$^{bc}$ | 252 | 0.1178$^{bdc}$ | 249 |
| 9/01/81-8/31/82 | 0.0040$^{dc}$ | 251 | -0.0434$^{c}$ | 252 | 0.1254$^{bac}$ | 251 |
| 9/01/82-8/31/83 | 0.0327$^{bc}$ | 254 | -0.0058$^{ba}$ | 254 | 0.1038$^{dc}$ | 254 |
| 9/01/83-8/31/84 | 0.0577$^{ba}$ | 254 | -0.0078$^{ba}$ | 254 | 0.1415$^{ba}$ | 254 |
| 9/01/84-8/31/85 | 0.0795$^{a}$ | 252 | 0.0164$^{a}$ | 252 | 0.1561$^{a}$ | 252 |
| Test for Differences Between Time Periods | F(6,1756) = 18.00 P-value = 0.0001 | | F(6,1760) = 7.09 P-value = 0.0001 | | F(6,1756) = 8.60 P-value = 0.0001 | |
| TIME PERIOD | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-11/30/81 | 0.0103$^{b}$ | 814 | -0.0332$^{b}$ | 818 | 0.1034$^{b}$ | 814 |
| 12/01/81- 1/31/83 | 0.0137$^{b}$ | 295 | -0.0292$^{b}$ | 295 | 0.1137$^{b}$ | 295 |
| 2/01/83- 8/31/85 | 0.0586$^{a}$ | 654 | 0.0003$^{a}$ | 654 | 0.1365$^{a}$ | 654 |
| Test for Differences Between Time Periods | F(2,1760) = 36.39 P-value = 0.0001 | | F(2,1764) = 12.73 P-value = 0.0001 | | F(2,1760) = 10.04 P-value = 0.0001 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 2 (cont).** **Mean Returns on the Final Transaction of the Trading Day for Different Time Periods**

| | ALL FINAL TRANSACTIONS | | TIME OF FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| TIME PERIOD | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0112[b] | 337 | -0.0349[b] | 338 | 0.0968[b] | 337 |
| TUESDAY | 0.0236[b] | 359 | -0.0240[b] | 360 | 0.1110[b] | 359 |
| WEDNESDAY | 0.0253[b] | 360 | -0.0238[b] | 362 | 0.1139[b] | 360 |
| THURSDAY | 0.0264[b] | 354 | -0.0253[b] | 354 | 0.1205[ba] | 354 |
| FRIDAY | 0.0569[a] | 353 | 0.0069[a] | 353 | 0.1441[a] | 353 |
| Test for Differences Between Time Periods | F(4,1758) = 7.69 P-value = 0.0001 | | F(4,1762) = 5.07 P-value = 0.0005 | | F(4,1758) = 5.22 P-value = 0.0003 | |
| TIME PERIOD | Average Return | N | Average Return | N | Average Return | N |
| JANUARY | 0.0282[a] | 149 | -0.0241[a] | 149 | 0.1192[ba] | 149 |
| FEBRUARY | 0.0195[a] | 133 | -0.0341[a] | 133 | 0.1145[ba] | 133 |
| MARCH | 0.0137[a] | 152 | -0.0385[a] | 154 | 0.1077[ba] | 152 |
| APRIL | 0.0371[a] | 143 | -0.0067[a] | 144 | 0.1162[ba] | 143 |
| MAY | 0.0192[a] | 148 | -0.0264[a] | 148 | 0.1028[b] | 148 |
| JUNE | 0.0257[a] | 148 | -0.0174[a] | 148 | 0.0984[b] | 148 |
| JULY | 0.0369[a] | 149 | -0.0115[a] | 149 | 0.1245[ba] | 149 |
| AUGUST | 0.0332[a] | 155 | -0.0104[a] | 155 | 0.1222[ba] | 155 |
| SEPTEMBER | 0.0214[a] | 141 | -0.0237[a] | 142 | 0.1099[ba] | 141 |
| OCTOBER | 0.0191[a] | 155 | -0.0319[a] | 155 | 0.1127[ba] | 155 |
| NOVEMBER | 0.0451[a] | 143 | 0.0031[a] | 143 | 0.1214[ba] | 143 |
| DECEMBER | 0.0466[a] | 147 | -0.0193[a] | 147 | 0.1591[a] | 147 |
| Test for Differences Between Time Periods | F(11,1751) = 1.32 P-value = 0.2086 | | F(11,1755) = 1.25 P-value = 0.2487 | | F(11,1751) = 1.73 P-value = 0.0616 | |
| TIME PERIOD | Average Return | N | Average Return | N | Average Return | N |
| 1st Half of Month | 0.0330[a] | 752 | -0.0152[a] | 755 | 0.1193[a] | 752 |
| 2nd Half of Month | 0.0271[a] | 753 | -0.0248[a] | 754 | 0.1199[a] | 753 |
| Test for Differences Between Time Periods | F(1,1503) = 0.97 P-value = 0.3253 | | F(1,1507) = 1.96 P-value = 0.1613 | | F(1,1503) = 0.01 P-value = 0.929 | |

**Note:** **Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 3. Mean Price Changes on the Final Transaction of the Trading Day for Different Time Periods**

| | ALL FINAL TRANSACTIONS | | TIME OF FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| TIME PERIOD | Average Price Change | N | Average Price Change | N | Average Price Change | N |
| ALL DAYS | 0.4355 | 1763 | -0.4359 | 1767 | 2.0081 | 1763 |
| TIME PERIOD | Average Price Change | N | Average Price Change | N | Average Price Change | N |
| 9/01/78-8/31/79 | $0.2211^{dc}$ | 251 | $-0.5276^{ba}$ | 251 | $1.8180^{a}$ | 251 |
| 9/01/79-8/31/80 | $0.0781^{dc}$ | 252 | $-0.7218^{b}$ | 252 | $1.6931^{a}$ | 252 |
| 9/01/80-8/31/81 | $0.3295^{bdc}$ | 249 | $-0.6000^{b}$ | 252 | $2.2920^{a}$ | 249 |
| 9/01/81-8/31/82 | $0.0363^{d}$ | 251 | $-0.6982^{b}$ | 252 | $1.9131^{a}$ | 251 |
| 9/01/82-8/31/83 | $0.5757^{bac}$ | 254 | $-0.1711^{ba}$ | 254 | $1.9641^{a}$ | 254 |
| 9/01/83-8/31/84 | $0.8202^{ba}$ | 254 | $-0.3249^{ba}$ | 254 | $2.2851^{a}$ | 254 |
| 9/01/84-8/31/85 | $0.9798^{a}$ | 252 | $-0.0110^{a}$ | 252 | $2.0920^{a}$ | 252 |
| Test for Differences Between Time Periods | F(6,1756) = 8.23 P-value = 0.0001 | | F(6,1760) = 4.01 P-value = 0.0005 | | F(6,1756) = 2.08 P-value = 0.0526 | |
| TIME PERIOD | Average Price Change | N | Average Price Change | N | Average Price Change | N |
| 9/01/78-11/30/81 | $0.2190^{b}$ | 814 | $-0.6015^{b}$ | 818 | $1.9551^{a}$ | 814 |
| 12/01/81- 1/31/83 | $0.1872^{b}$ | 295 | $-0.5647^{b}$ | 295 | $1.9131^{a}$ | 295 |
| 2/01/83- 8/31/85 | $0.8170^{a}$ | 654 | $-0.1706^{a}$ | 654 | $2.1170^{a}$ | 654 |
| Test for Differences Between Time Periods | F(2,1760) = 18.26 P-value = 0.0001 | | F(2,1764) = 7.78 P-value = 0.0004 | | F(2,1760) = 1.01 P-value = 0.3643 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 3 (cont.). Mean Price Changes on the Final Transaction of the Trading Day for Different Time Periods**

| | ALL FINAL TRANSACTIONS | | TIME OF FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| TIME PERIOD | Average Price Change | N | Average Price Change | N | Average Price Change | N |
| MONDAY | 0.2075[b] | 337 | -0.6549[b] | 338 | 1.8096[b] | 337 |
| TUESDAY | 0.2441[b] | 359 | -0.6134[b] | 360 | 1.8506[b] | 359 |
| WEDNESDAY | 0.4335[b] | 360 | -0.4129[ba] | 362 | 1.9789[ba] | 360 |
| THURSDAY | 0.4128[b] | 354 | -0.4744[ba] | 354 | 2.0105[ba] | 354 |
| FRIDAY | 0.8726[a] | 353 | -0.0302[a] | 353 | 2.3853[a] | 353 |
| Test for Differences Between Time Periods | F(4,1758) = 5.87 P-value = 0.0001 | | F(4,1762) = 4.58 P-value = 0.0011 | | F(4,1758) = 2.91 P-value = 0.0206 | |
| TIME PERIOD | Average Price Change | N | Average Price Change | N | Average Price Change | N |
| JANUARY | 0.4521[a] | 149 | -0.5670[a] | 149 | 2.2420[a] | 149 |
| FEBRUARY | 0.3556[a] | 133 | -0.6026[a] | 133 | 2.0257[a] | 133 |
| MARCH | 0.2394[a] | 152 | -0.6796[a] | 154 | 1.8811[a] | 152 |
| APRIL | 0.6733[a] | 143 | -0.0895[a] | 144 | 2.1446[a] | 143 |
| MAY | 0.2913[a] | 148 | -0.4987[a] | 148 | 1.7468[a] | 148 |
| JUNE | 0.3869[a] | 148 | -0.4534[a] | 148 | 1.8068[a] | 148 |
| JULY | 0.7339[a] | 149 | -0.1523[a] | 149 | 2.1753[a] | 149 |
| AUGUST | 0.4176[a] | 155 | -0.2719[a] | 155 | 1.8384[a] | 155 |
| SEPTEMBER | 0.1592[a] | 141 | -0.7334[a] | 142 | 1.8957[a] | 141 |
| OCTOBER | 0.2718[a] | 155 | -0.6773[a] | 155 | 1.9896[a] | 155 |
| NOVEMBER | 0.6920[a] | 143 | -0.0763[a] | 143 | 2.0828[a] | 143 |
| DECEMBER | 0.5612[a] | 147 | -0.4237[a] | 147 | 2.2839[a] | 147 |
| Test for Differences Between Time Periods | F(11,1751) = 1.25 P-value = 0.2462 | | F(11,1755) = 1.72 P-value = 0.0633 | | F(11,1751) = 0.75 P-value = 0.6916 | |
| TIME PERIOD | Average Price Change | N | Average Price Change | N | Average Price Change | N |
| 1st Half of Month | 0.5681[a] | 752 | -0.3254[a] | 755 | 2.1640[a] | 752 |
| 2nd Half of Month | 0.3868[a] | 753 | -0.5046[a] | 754 | 1.9774[a] | 753 |
| Test for Differences Between Time Periods | F(1,1503) = 2.90 P-value = 0.0886 | | F(1,1507) = 2.55 P-value = 0.1102 | | F(1,1503) = 2.07 P-value = 0.1508 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

time. Table 2 shows that for all three classifications of final transactions significant differences existed between group means for each year. It appeared that the return to all final transactions had been increasing from year to year. The Tukey-Kramer Multiple Comparisons Procedure (TKMCP) shows that the average return on the final transaction in 8485 (this refers to year 9/01/84-8/31/85) was significantly greater than the average return in years 7879 through 8283. The average return in year 8384 was significantly greater than the average returns in years 7879 through 8182. When the average returns to transactions occurring before 3:56pm and after 3:56pm were examined separately, it could be seen that the average return was increasing for both before and after 3:56pm final transactions. Examining differences in price changes between years in Table 3 reveals that while significant differences did exist, they were not as strong nor as systematic as the differences in returns. The average price change in 8485 was found to be greater than the average changes in years 7879 through 8182, and the average price change in year 8182 was found to be less than those in years 8283 through 8485. When the final transaction was classified as to time of occurrence it was found that no significant differences existed between average price changes in different years on final transaction occurring after 3:56pm.

Comparing the differences in average returns and price changes for different years makes comparisons with Harris' results difficult because the time period of his study did not match up with the annual time periods we have examined so far. Therefore, differences in the mean returns and price changes for the pre-Harris time period (9/01/78-11/30/81), the Harris time period (12/01/81-1/31/83) and the post-Harris time period (2/01/83-8/31/85) were also examined. The analysis of variance procedure revealed significant differences between average time period returns for all final transactions and for both before and after 3:56pm transactions. The TKMCP found no significant differences between the Harris and the pre-Harris time periods, but significant

differences were found between the post-Harris time period and each of the other time periods. Mean returns were found to be greater in the post-Harris time period. This result is in line with the results found in the test for differences between years. The results of the analysis using mean price changes instead of average returns were similar except that no significant differences were found between time periods for transactions occurring after 3:56pm.

Contrasting the results from our sample with those of Harris' "population" shows that for all final transactions, our sample had an average price change of .1872 cents while the "population" had an average price change of .573 cents. The standard error for our mean price change was .1280 cents. Assuming a normally distributed mean price change, then a 95% confidence interval about our sample mean fails to capture Harris' "population" means. Our sample had an average price decline of .5647 cents if the final transaction occurred before 3:56 compared with a "population" price decline of .270 cents. Here again if we assume normality of the mean price changes, we find that a 95% confidence interval about our sample mean constructed using the mean's standard error of .1385 cents fails to capture the "population" mean. After 3:56 final transactions had means appreciations of 1.9131 cents for our sample and 1.724 cents for the "population". The standard error for our mean was .1545 cents resulting in a 95% confidence that does capture Harris' "population" mean. The only comparison of final transaction returns that can be made is the average return for all final transaction which was 0.0137% for our sample and 0.049% for the "population". The 95% confidence interval captures the "population" mean using the sample mean's standard error of 0.0873%.

The discrepancy between the statistics of our sample and the statistics of the population is disturbing. The present study was intitially begun with a sample size of 100 firms--not a subset of the present sample--and the differences between Harris' results and the statistics for our sample were first noticed there. We have tried to reconcile the dif-

ferences but have not been able to come up with an explanation. There are several possibilities that may explain the differences. First, we filtered our data for transcription errors that would be manifest as large magnitude returns. Harris made no mention of running his data through a similar filter. Possibly transacription errors are responsible for the discrepancies. Second, Harris (1986a) eliminated from his sample days following holidays, but he made no mention of eliminating those days in Harris (1986b). If days following holidays were eliminated in the second study, possibly a systematic relationship between end-of-day returns and days after holidays is responsible for the differences. Elimination of days following holidays from our sample failed to reconcile the differences. We are confident that the results of the present study are accurate, and leave it to Harris to explain his results and reexamine his calculations.

The second pages of Table 2 and Table 3 show the results from comparisons of mean returns and mean price changes to the final transaction and whether a relationship existed between magnitude of return or price change and several documented time anomalies. Analysis of variance was used to test for differences of return and price changes for different days of the week, months of the year, and times of the month. The time of the month classification was that used by Ariel (1987) where the last one and the first eight trading days of the month comprised the first half of the month group. The second half of the month contained the tenth trading day from the end of the month through the next to last trading day of the month. The results reveal that the only significant differences found were between weekdays. Significant differences were found for all final transactions, transactions occurring prior to 3:56pm and transactions occurring after 3:56pm for both returns and price changes. The TKMCP suggests that the reason for the differences found was that Friday's final transaction return was greater than the final transaction returns on the other days of the week. This was initially surprising in light of Harris' failure to find any differences in weekday final transaction returns.

Analysis of differences in weekday returns for each of the pre-Harris, Harris, and post-Harris time periods (results shown in Appendix B) revealed that significant differences between mean weekday returns on transactions occurring in the last five minutes existed for both the pre- and post-Harris time periods, but not during the Harris time period.

Table 4 presents results of tests of differences between mean final transaction returns in different years for each day of the week. The results show that significant differences existed between years for every day of the week. Except for Tuesdays, the TKMCP suggested that the return to the final transaction was getting larger over time for every day of the week. The TKMCP, which controls for Type I errors was not powerful enough to detect individual differences between mean returns on Tuesdays. Classification of returns by time of final trade revealed no annual differences for Tuesdays for both pre 3:56pm and post 3:56pm transaction groups. Wednesdays exhibited no significant differences between years for pre 3:56pm final transactions, and Thursdays exhibited no significant differences for post 3:56 transactions. All other days and classifications revealed significant differences with the TKMCP showing a general trend of increasing mean returns over time, particularly in the last year. Table 2 and Table 3 also showed that means final transaction returns were increasing over time.

A puzzling difference between Table 2 and Table 3 is the fact that no significant differences in mean price changes were found for post 3:56pm transactions, while significant differences in mean returns were found. This might suggest that the yearly differences in mean returns may primarily be the result of yearly differences in mean returns to low priced securities. In order to test this hypothesis, firms were grouped each day by the price level of the last transaction of the day. Mean returns to the final transaction for each group were computed each day, and analysis of variance was used to test for differences between price level group means. Table 5 presents results of tests for security price level differences in mean return to the final transaction.

**Table 4. Test for Yearly Differences in Returns to the Final Transaction for Different Weekdays**

WEEKDAY = MONDAY

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0035$^{ba}$ | 47 | -0.0251$^{ba}$ | 47 | 0.0741$^{a}$ | 47 |
| 9/01/79-8/31/80 | -0.0269$^{b}$ | 49 | -0.0721$^{b}$ | 49 | 0.0694$^{a}$ | 49 |
| 9/01/80-8/31/81 | -0.0201$^{b}$ | 49 | -0.0682$^{ba}$ | 50 | 0.0826$^{a}$ | 49 |
| 9/01/81-8/31/82 | -0.0296$^{b}$ | 48 | -0.0671$^{ba}$ | 48 | 0.0693$^{a}$ | 48 |
| 9/01/82-8/31/83 | 0.0187$^{ba}$ | 48 | -0.0120$^{ba}$ | 48 | 0.0743$^{a}$ | 48 |
| 9/01/83-8/31/84 | 0.0581$^{a}$ | 47 | -0.0138$^{ba}$ | 47 | 0.1514$^{a}$ | 47 |
| 9/01/84-8/31/85 | 0.0756$^{a}$ | 49 | 0.0160$^{a}$ | 49 | 0.1568$^{a}$ | 49 |
| Test for Differences Between Years | F(6,330) = 5.97 P-value = 0.0001 | | F(6,331) = 2.94 P-value = 0.0083 | | F(6,330) = 3.02 P-value = 0.0069 | |

WEEKDAY = TUESDAY

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0013$^{a}$ | 52 | -0.0434$^{a}$ | 52 | 0.0886$^{a}$ | 52 |
| 9/01/79-8/31/80 | -0.0001$^{a}$ | 50 | -0.0406$^{a}$ | 50 | 0.0850$^{a}$ | 50 |
| 9/01/80-8/31/81 | 0.0026$^{a}$ | 50 | -0.0473$^{a}$ | 51 | 0.1138$^{a}$ | 50 |
| 9/01/81-8/31/82 | 0.0257$^{a}$ | 53 | -0.0068$^{a}$ | 53 | 0.1082$^{a}$ | 53 |
| 9/01/82-8/31/83 | 0.0349$^{a}$ | 52 | -0.0147$^{a}$ | 52 | 0.1250$^{a}$ | 52 |
| 9/01/83-8/31/84 | 0.0425$^{a}$ | 52 | -0.0199$^{a}$ | 52 | 0.1270$^{a}$ | 52 |
| 9/01/84-8/31/85 | 0.0605$^{a}$ | 50 | 0.0046$^{a}$ | 50 | 0.1291$^{a}$ | 50 |
| Test for Differences Between Years | F(6,352) = 2.32 P-value = 0.0328 | | F(6,353) = 1.15 P-value = 0.3327 | | F(6,352) = 0.92 P-value = 0.4809 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 4 (cont).** **Test for Yearly Differences in Returns to the Final Transaction for Different Weekdays**

WEEKDAY = WEDNESDAY

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0051$^{bac}$ | 51 | -0.0306$^{a}$ | 51 | 0.0833$^{ba}$ | 51 |
| 9/01/79-8/31/80 | -0.0039$^{bc}$ | 52 | -0.0365$^{a}$ | 52 | 0.0660$^{b}$ | 52 |
| 9/01/80-8/31/81 | 0.0414$^{bac}$ | 51 | 0.0002$^{a}$ | 52 | 0.1255$^{ba}$ | 51 |
| 9/01/81-8/31/82 | -0.0248$^{c}$ | 50 | -0.0744$^{a}$ | 51 | 0.1056$^{ba}$ | 50 |
| 9/01/82-8/31/83 | 0.0323$^{bac}$ | 53 | -0.0130$^{a}$ | 53 | 0.1168$^{ba}$ | 53 |
| 9/01/83-8/31/84 | 0.0531$^{ba}$ | 51 | -0.0119$^{a}$ | 51 | 0.1379$^{ba}$ | 51 |
| 9/01/84-8/31/85 | 0.0722$^{a}$ | 52 | -0.0014$^{a}$ | 52 | 0.1619$^{a}$ | 52 |
| Test for Differences Between Years | F(6,353) = 4.12 P-value = 0.0005 | | F(6,355) = 1.88 P-value = 0.0838 | | F(6,353) = 2.67 P-value = 0.0150 | |

WEEKDAY = THURSDAY

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0114$^{bc}$ | 50 | -0.0291$^{ba}$ | 50 | 0.0989$^{a}$ | 50 |
| 9/01/79-8/31/80 | -0.0100$^{c}$ | 51 | -0.0661$^{b}$ | 51 | 0.0926$^{a}$ | 51 |
| 9/01/80-8/31/81 | 0.0127$^{bc}$ | 49 | -0.0415$^{ba}$ | 49 | 0.1245$^{a}$ | 49 |
| 9/01/81-8/31/82 | 0.0084$^{bc}$ | 51 | -0.0511$^{ba}$ | 51 | 0.1623$^{a}$ | 51 |
| 9/01/82-8/31/83 | 0.0309$^{bac}$ | 51 | -0.0108$^{ba}$ | 51 | 0.1049$^{a}$ | 51 |
| 9/01/83-8/31/84 | 0.0587$^{ba}$ | 52 | 0.0096$^{a}$ | 52 | 0.1203$^{a}$ | 52 |
| 9/01/84-8/31/85 | 0.0719$^{a}$ | 50 | 0.0113$^{a}$ | 50 | 0.1399$^{a}$ | 50 |
| Test for Differences Between Years | F(6,347) = 4.60 P-value = 0.0002 | | F(6,347) = 3.04 P-value = 0.0065 | | F(6,347) = 1.73 P-value = 0.1130 | |

**Note:** **Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 4 (cont).** **Test for Yearly Differences in Returns to the Final Transaction for Different Weekdays**

WEEKDAY = FRIDAY

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0302$^{b}$ | 51 | -0.0128$^{ba}$ | 51 | 0.1127$^{bc}$ | 51 |
| 9/01/79-8/31/80 | 0.0407$^{b}$ | 50 | 0.0038$^{ba}$ | 50 | 0.1138$^{bc}$ | 50 |
| 9/01/80-8/31/81 | 0.0489$^{b}$ | 50 | 0.0064$^{ba}$ | 50 | 0.1417$^{bac}$ | 50 |
| 9/01/81-8/31/82 | 0.0383$^{b}$ | 49 | -0.0194$^{b}$ | 49 | 0.1809$^{ba}$ | 49 |
| 9/01/82-8/31/83 | 0.0461$^{b}$ | 50 | 0.0220$^{ba}$ | 50 | 0.0950$^{c}$ | 50 |
| 9/01/83-8/31/84 | 0.0761$^{ba}$ | 52 | -0.0038$^{ba}$ | 52 | 0.1720$^{ba}$ | 52 |
| 9/01/84-8/31/85 | 0.1165$^{a}$ | 51 | 0.0514$^{a}$ | 51 | 0.1919$^{a}$ | 51 |
| Test for Differences Between Years | F(6,346) = 4.31 P-value = 0.0003 | | F(6,346) = 2.16 P-value = 0.0461 | | F(6,346) = 4.47 P-value = 0.0002 | |

**Note:** **Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 5. Test for Security Price Level Differences in Returns to the Final Transaction of the Trading Day**

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| PRICE LEVEL | Average Return | N | Average Return | N | Average Return | N |
| < $10 | 0.1032[a] | 1767 | -0.0277[a] | 1767 | 0.3751[a] | 1762 |
| $10-$20 | 0.0262[b] | 1767 | -0.0213[a] | 1767 | 0.1342[b] | 1763 |
| $20-$30 | 0.0147[b] | 1767 | -0.0210[a] | 1767 | 0.0869[c] | 1763 |
| $30-$50 | 0.0159[b] | 1767 | -0.0130[a] | 1767 | 0.0594[dc] | 1763 |
| > $50 | 0.0132[b] | 1767 | -0.0034[a] | 1767 | 0.0256[d] | 1763 |
| Test for Differences Between Price Levels | F(4,8830) = 46.21 P-value = 0.0001 | | F(4,8830) = 1.99 P-value = 0.0935 | | F(4,8809) = 168.47 P-value = 0.0001 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 6. Frequencies of Final Transactions at Different Price Levels**

| PRICE LEVEL | ALL FINAL TRANSACTIONS | FINAL TRANSACTION BEFORE 3:56 PM | FINAL TRANSACTION AFTER 3:56 PM |
|---|---|---|---|
| < $10 | 84950 | 59652 | 25298 |
| $10-$20 | 183991 | 127846 | 56145 |
| $20-$30 | 159966 | 107350 | 52616 |
| $30-$50 | 145846 | 86286 | 59560 |
| > $50 | 50349 | 21436 | 28913 |

Test for independence of price level and time of final transaction:

Chi-square = 16048.05
P-value < 0.0001

When considering all final transactions together, significant differences exist between price levels. The TKMCP showed that the average return to securities below $10 was significantly greater than the mean returns of the other four price level groups. Classifying transactions by time of occurrence revealed that the differences found in all final transactions are primarily the result of differences in mean returns to final transactions occurring after 3:56pm. These mean returns increased from a low of .0256% for the greater than $50 price group to a high of .3751% for the less than $10 price group. Table 6 presents frequencies of final transactions for the different price level groups. A test for independence of price level and time of final transaction was performed. The Chi-squared test statistic and p-value are presented. The result of the test showed a lack of independence between price level and frequencies of before and after 3:56pm final transactions. Intuitively, we would expect to find a relationship to exist. If lower priced securities are more thinly traded, then we would expect a lower frequency of post 3:56pm final transactions for the low price levels. The relationship found to exist is as would be expected. The over $50 price group had 57.4% of its final transactions occurring after 3:56pm, while the under $10 price group had only 29.8% of its transactions occurring after 3:56pm.

In an effort to shed light on whether the increases in the return to the final transaction of the seven year time period was the result of all price level securities, differences in mean returns to the final transaction over time were examined for each price group. The results of the analysis are presented in Table 7. When considering all final transactions, all price groups exhibited significant differences between years. The TKMCP failed to reveal any time related trends of the $30-$50 and the greater then $50 price groups, but showed that the average returns tended to increase for the other price groups, particularly in the last three years. When final returns were classified by occurrence before or after 3:56pm, significant differences between years were found only in the

**Table 7. Test for Yearly Differences in Returns to the Final Transaction of the Trading Day for Different Security Price Levels**

PRICE LEVEL = < $10

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0032[b] | 251 | -0.0524[ba] | 251 | 0.1358[c] | 251 |
| 9/01/79-8/31/80 | -0.0155[b] | 252 | -0.1031[b] | 252 | 0.2290[c] | 252 |
| 9/01/80-8/31/81 | 0.0560[b] | 252 | -0.0494[ba] | 252 | 0.3574[bc] | 249 |
| 9/01/81-8/31/82 | 0.0057[b] | 252 | -0.1076[b] | 252 | 0.3298[bc] | 250 |
| 9/01/82-8/31/83 | 0.1003[b] | 254 | 0.0067[ba] | 254 | 0.3710[bc] | 254 |
| 9/01/83-8/31/84 | 0.2453[a] | 254 | 0.0263[ba] | 254 | 0.5484[ba] | 254 |
| 9/01/84-8/31/85 | 0.3258[a] | 252 | 0.0851[a] | 252 | 0.6514[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 19.56 P-value = 0.0001 | | F(6,1760) = 3.99 P-value = 0.0006 | | F(6,1755) = 8.62 P-value = 0.0001 | |

PRICE LEVEL = $10-$20

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0111[bc] | 251 | -0.0281[bac] | 251 | 0.1149[ba] | 251 |
| 9/01/79-8/31/80 | -0.0015[c] | 252 | -0.0357[bc] | 252 | 0.0924[b] | 252 |
| 9/01/80-8/31/81 | 0.0158[bc] | 252 | -0.0310[bc] | 252 | 0.1508[a] | 249 |
| 9/01/81-8/31/82 | -0.0003[c] | 252 | -0.0462[c] | 252 | 0.1404[ba] | 251 |
| 9/01/82-8/31/83 | 0.0368[ba] | 254 | -0.0135[bac] | 254 | 0.1354[ba] | 254 |
| 9/01/83-8/31/84 | 0.0577[a] | 254 | -0.0048[ba] | 254 | 0.1534[a] | 254 |
| 9/01/84-8/31/85 | 0.0636[a] | 252 | 0.0100[a] | 252 | 0.1519[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 10.36 P-value = 0.0001 | | F(6,1760) = 4.25 P-value = 0.0003 | | F(6,1756) = 3.54 P-value = 0.0017 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 7 (cont).** **Test for Yearly Differences in Returns to the Final Transaction of the Trading Day for Different Security Price Levels**

PRICE LEVEL = $20-$30

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0091[ba] | 251 | -0.0210[a] | 251 | 0.0777[a] | 251 |
| 9/01/79-8/31/80 | 0.0020[b] | 252 | -0.0282[a] | 252 | 0.0673[a] | 252 |
| 9/01/80-8/31/81 | 0.0023[b] | 252 | -0.0389[a] | 252 | 0.1030[a] | 249 |
| 9/01/81-8/31/82 | 0.0087[ba] | 252 | -0.0215[a] | 252 | 0.0946[a] | 251 |
| 9/01/82-8/31/83 | 0.0201[ba] | 254 | -0.0103[a] | 254 | 0.0848[a] | 254 |
| 9/01/83-8/31/84 | 0.0280[ba] | 254 | -0.0170[a] | 254 | 0.0958[a] | 254 |
| 9/01/84-8/31/85 | 0.0329[a] | 252 | -0.0099[a] | 252 | 0.0850[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 3.17 P-value = 0.0042 | | F(6,1760) = 1.71 P-value = 0.1151 | | F(6,1756) = 1.69 P-value = 0.1195 | |

PRICE LEVEL = $30-$50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0119[a] | 251 | -0.0216[a] | 251 | 0.0696[a] | 251 |
| 9/01/79-8/31/80 | 0.0090[a] | 252 | -0.0214[a] | 252 | 0.0526[a] | 252 |
| 9/01/80-8/31/81 | 0.0100[a] | 252 | -0.0184[a] | 252 | 0.0627[a] | 249 |
| 9/01/81-8/31/82 | 0.0080[a] | 252 | -0.0159[a] | 252 | 0.0540[a] | 251 |
| 9/01/82-8/31/83 | 0.0214[a] | 254 | -0.0021[a] | 254 | 0.0612[a] | 254 |
| 9/01/83-8/31/84 | 0.0237[a] | 254 | -0.0123[a] | 254 | 0.0645[a] | 254 |
| 9/01/84-8/31/85 | 0.0276[a] | 252 | 0.0004[a] | 252 | 0.0510[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 2.23 P-value = 0.0378 | | F(6,1760) = 1.93 P-value = 0.0726 | | F(6,1756) = 1.08 P-value = 0.3726 | |

**Note:** **Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 7 (cont).** **Test for Yearly Differences in Returns to the Final Transaction of the Trading Day for Different Security Price Levels**

PRICE LEVEL = > $50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0195[a] | 251 | 0.0024[a] | 251 | 0.0325[a] | 251 |
| 9/01/79-8/31/80 | 0.0086[ba] | 252 | -0.0160[a] | 252 | 0.0292[a] | 252 |
| 9/01/80-8/31/81 | 0.0233[a] | 252 | 0.0087[a] | 252 | 0.0353[a] | 249 |
| 9/01/81-8/31/82 | -0.0038[b] | 252 | -0.0191[a] | 252 | 0.0118[a] | 251 |
| 9/01/82-8/31/83 | 0.0132[ba] | 254 | 0.0050[a] | 254 | 0.0217[a] | 254 |
| 9/01/83-8/31/84 | 0.0136[ba] | 254 | -0.0063[a] | 254 | 0.0232[a] | 254 |
| 9/01/84-8/31/85 | 0.0184[a] | 252 | 0.0016[a] | 252 | 0.0255[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 3.05 P-value = 0.0057 | | F(6,1760) = 1.49 P-value = 0.1778 | | F(6,1756) = 1.76 P-value = 0.1027 | |

**Note:** **Within columns, group means with same superscript letter are not significantly different at the .05 level.**

two lower price level groups. The differences were most dramatic for the less than $10 price group where the mean return to final transactions occurring after 3:56pm increased from .1358% in 7879 to .6514% in 8485. Taken together, these results suggest that the increases in final transaction returns over time were primarily the results of increases in final transaction returns to low priced securities.

In order to determine what role, if any, security price level played in day of the week differences, an analysis of day of the week final transaction returns differences was made for each security price level. It can be seen in Table 8 that no significant differences in weekday final transaction returns were found for the two highest price level groups. For the other three price level groups, all final, pre 3:56pm and post 3:56pm transactions were found to exhibit significant weekday differences in the final transaction return. The only exception was the pre 3:56pm transactions for the less than $10 price group. The weekday effect appeared to be the strongest for the $10-$20 price group. The TKMCP showed that for all significant differences detected, Friday's final trade return was in the highest mean return grouping. As in the case of the annual differences, the weekday differences in mean final transaction returns can be primarily attributed to the lower priced securities.

In summary, the returns to the final transaction appear to be increasing over time, and this increase appears to be primarily the result of increases in the returns to transactions occurring after 3:56pm in low priced securities. Additionally, weekday patterns that have heretofore gone unnoticed have been documented. Again the patterns appear to be associated with price level of the securities.

**Table 8. Test for Weekday Differences in Returns to the Final Transaction of the Trading Day for Different Security Price Levels**

PRICE LEVEL = < $10

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0510[b] | 338 | -0.0503[a] | 338 | 0.2487[b] | 337 |
| TUESDAY | 0.0960[ba] | 360 | -0.0480[a] | 360 | 0.4229[ba] | 358 |
| WEDNESDAY | 0.0873[b] | 362 | -0.0419[a] | 362 | 0.3561[ba] | 360 |
| THURSDAY | 0.0897[b] | 354 | -0.0449[a] | 354 | 0.3668[ba] | 354 |
| FRIDAY | 0.1903[a] | 353 | 0.0466[a] | 353 | 0.4749[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 3.94 P-value = 0.0035 | | F(4,1762) = 1.92 P-value = 0.1049 | | F(4,1757) = 2.65 P-value = 0.0321 | |

PRICE LEVEL = $10-$20

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0037[b] | 338 | -0.0425[b] | 338 | 0.1152[b] | 337 |
| TUESDAY | 0.0222[b] | 360 | -0.0188[ba] | 360 | 0.1170[b] | 359 |
| WEDNESDAY | 0.0230[b] | 362 | -0.0258[b] | 362 | 0.1337[ba] | 360 |
| THURSDAY | 0.0244[b] | 354 | -0.0285[b] | 354 | 0.1459[ba] | 354 |
| FRIDAY | 0.0569[a] | 353 | 0.0083[a] | 353 | 0.1586[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 7.22 P-value = 0.0001 | | F(4,1762) = 5.43 P-value = 0.0002 | | F(4,1758) = 3.27 P-value = 0.0111 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 8 (cont).** **Test for Weekday Differences in Returns to the Final Transaction of the Trading Day for Different Security Price Levels**

PRICE LEVEL = $20-$30

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0050[b] | 338 | -0.0305[b] | 338 | 0.0800[ba] | 337 |
| TUESDAY | 0.0003[b] | 360 | -0.0346[b] | 360 | 0.0737[b] | 359 |
| WEDNESDAY | 0.0156[ba] | 362 | -0.0178[ba] | 362 | 0.0831[ba] | 360 |
| THURSDAY | 0.0194[ba] | 354 | -0.0175[ba] | 354 | 0.0911[ba] | 354 |
| FRIDAY | 0.0332[a] | 353 | -0.0047[a] | 353 | 0.1064[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 4.83 P-value = 0.0007 | | F(4,1762) = 3.22 P-value = 0.0121 | | F(4,1758) = 2.60 P-value = 0.0346 | |

PRICE LEVEL = $30-$50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0159[a] | 338 | -0.0102[a] | 338 | 0.0572[a] | 337 |
| TUESDAY | 0.0092[a] | 360 | -0.0189[a] | 360 | 0.0539[a] | 359 |
| WEDNESDAY | 0.0179[a] | 362 | -0.0135[a] | 362 | 0.0634[a] | 360 |
| THURSDAY | 0.0130[a] | 354 | -0.0132[a] | 354 | 0.0549[a] | 354 |
| FRIDAY | 0.0239[a] | 353 | -0.0091[a] | 353 | 0.0673[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 1.48 P-value = 0.2065 | | F(4,1762) = 0.49 P-value = 0.7413 | | F(4,1758) = 1.05 P-value = 0.3777 | |

**Note:** **Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 8 (cont).** **Test for Weekday Differences in Returns to the Final Transaction of the Trading Day for Different Security Price Levels**

PRICE LEVEL = > $50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0078[a] | 338 | -0.0131[a] | 338 | 0.0227[a] | 337 |
| TUESDAY | 0.0143[a] | 360 | -0.0066[a] | 360 | 0.0286[a] | 359 |
| WEDNESDAY | 0.0103[a] | 362 | -0.0048[a] | 362 | 0.0195[a] | 360 |
| THURSDAY | 0.0136[a] | 354 | -0.0012[a] | 354 | 0.0275[a] | 354 |
| FRIDAY | 0.0201[a] | 353 | 0.0084[a] | 353 | 0.0296[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 1.12 P-value = 0.3455 | | F(4,1762) = 1.12 P-value = 0.3476 | | F(4,1758) = 0.75 P-value = 0.5561 | |

**Note:** **Within columns, group means with same superscript letter are not significantly different at the .05 level.**

## *Good Day -- Bad Day Effects*

The observation that the final transaction return has been persistently positive is puzzling to say the least. The association of low priced securities with larger end of day returns suggests that there may be different forces causing transactions to occur in securities of different price levels. If it is true that high priced securities are typically more liquid than low priced securities, then information may be the primary force driving trading in low level securities. A larger proportion of transactions in high price securities, as compared to low price securities, may be occurring solely for liquidity reasons without any change in the intrinsic value of the securities. This is a possible explanation for why we might observe larger price movements on low priced securities, but it has failed to explain why the price movements are typically positive if the final transaction occurs late in the day. Pattell and Wolfson (1982) offer a possible explanation. The positive returns late in the day may be the result of a pattern of good news typically being released while the market is open and bad news being released while the market is closed. This raises the question of whether the return to the final transaction is different on good days than it is on bad days. In this section we will examine the relationship between type of day and return to the final transaction.

CRSP excess returns were used to measure the performance of each security in the sample each trading day. Then for each day the security performances were ranked and placed into one of five groups according to magnitude of excess return. The daily mean final transaction returns for each group were computed and an analysis of variance was performed to test for differences between the group means. The results for the procedure are presented in Table 9. For all final transactions the mean returns range from -0.3051% for the lowest excess return quintile to 0.3734% for the highest excess return

**Table 9. Test for CRSP Excess Return Quintile Differences in the Final Transaction Return**

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| EXCESS RETURN QUINTILE | Average Return | N | Average Return | N | Average Return | N |
| LOWEST | -0.3051[e] | 1766 | -0.3977[e] | 1766 | -0.1490[e] | 1762 |
| 2 | -0.0757[d] | 1766 | -0.1285[d] | 1766 | 0.0266[d] | 1762 |
| 3 | 0.0272[c] | 1766 | -0.0195[c] | 1766 | 0.1216[c] | 1762 |
| 4 | 0.1292[b] | 1766 | 0.1098[b] | 1766 | 0.1716[b] | 1762 |
| HIGHEST | 0.3664[a] | 1766 | 0.3722[a] | 1766 | 0.3734[a] | 1762 |
| Test for Differences Between Quintiles | F(4,8825) = 3081.28 P-value = 0.0001 | | F(4,8825) = 2418.21 P-value = 0.0001 | | F(4,8805) = 891.55 P-value = 0.0001 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

quintile. The TKMCP reveals that significant differences exist between each of the individual group means. When the returns are classified as to before or after 3:56pm, another interesting pattern emerges. While both the before and after 3:56pm final transaction returns increase monotonically with increasing excess return quintile, the magnitude of the differences between the before and the after 3:56pm returns decreases. The before and after 3:56pm final transaction returns are not statistically different at the 5% level for the highest excess return quintile.

Table 10 presents the frequencies of transactions occurring before and after 3:56pm for each excess return quintile. It would be expected that on days with information flows into the market, a higher proportion of final transactions would take place after 3:56pm. If excess returns do provide a measure of information flows about particular securities, then we would expect the highest and lowest excess return quintiles to exhibit the highest proportions of trades after 3:56pm. The Chi-squared test for independence of excess return quintile and time of final transaction does allow rejection of the null hypothesis of independence. The highest excess return quintile has the largest proportion of transactions after 3:56pm followed, in order of decreasing proportion, by the lowest, 4th, 2nd, and 3rd quintiles. Almost 41% of the final trades in the highest quintile take place after 3:56pm. Compare this with 35.8% for the lowest quintile and 33.1% for the 3rd quintile, and the Pattell and Wolfson (1985) hypothesis of different timing of good and bad news releases appears to have some merit.

A test of yearly differences in the return to the final transaction was performed for each excess return quintile. The results of the analysis are presented in Table 11. The analysis revealed significant differences between final transaction returns in each year for all excess return quintiles except for the 4th quintile. The final transaction returns exhibited a trend of getting more positive over the seven year time period for the lowest through the third quintiles, with the pattern appearing to be strongest for the lowest

**Table 10. Frequencies of Final Transactions for Different CRSP Excess Return Quintiles**

| EXCESS RETURN QUINTILE | ALL FINAL TRANSACTIONS | FINAL TRANSACTION | |
|---|---|---|---|
| | | BEFORE 3:56 PM | AFTER 3:56 PM |
| LOWEST | 120358 | 77287 | 43071 |
| 2 | 121040 | 80181 | 40859 |
| 3 | 121102 | 80999 | 40103 |
| 4 | 121084 | 78142 | 42942 |
| HIGHEST | 120003 | 70947 | 49056 |

Test for independence of excess return level and time of final transaction:

Chi-square = 1952.74
P-value < 0.0001

**Table 11. Test for Yearly Differences in Returns to the Final Transaction for Different CRSP Excess Return Quintiles**

EXCESS RETURN QUINTILE = LOWEST

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.3543$^{dc}$ | 250 | -0.4156$^{bc}$ | 250 | -0.2313$^{d}$ | 250 |
| 9/01/79-8/31/80 | -0.3811$^{de}$ | 252 | -0.4557$^{dc}$ | 252 | -0.2423$^{d}$ | 252 |
| 9/01/80-8/31/81 | -0.3104$^{bc}$ | 252 | -0.3981$^{bac}$ | 252 | -0.1357$^{bc}$ | 249 |
| 9/01/81-8/31/82 | -0.4184$^{e}$ | 252 | -0.5046$^{d}$ | 252 | -0.2078$^{dc}$ | 251 |
| 9/01/82-8/31/83 | -0.2588$^{ba}$ | 254 | -0.3428$^{ba}$ | 254 | -0.1169$^{ba}$ | 254 |
| 9/01/83-8/31/84 | -0.2048$^{a}$ | 254 | -0.3330$^{a}$ | 254 | -0.0474$^{a}$ | 254 |
| 9/01/84-8/31/85 | -0.2096$^{a}$ | 252 | -0.3349$^{a}$ | 252 | -0.0635$^{ba}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 35.79 P-value = 0.0001 | | F(6,1759) = 12.08 P-value = 0.0001 | | F(6,1755) = 15.11 P-value = 0.0001 | |

EXCESS RETURN QUINTILE = 2

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.1064$^{d}$ | 250 | -0.1453$^{bc}$ | 250 | -0.0176$^{c}$ | 250 |
| 9/01/79-8/31/80 | -0.1128$^{d}$ | 252 | -0.1565$^{bc}$ | 252 | -0.0209$^{c}$ | 252 |
| 9/01/80-8/31/81 | -0.0925$^{dc}$ | 252 | -0.1506$^{bc}$ | 252 | 0.0390$^{ba}$ | 249 |
| 9/01/81-8/31/82 | -0.1048$^{d}$ | 252 | -0.1594$^{c}$ | 252 | 0.0344$^{ba}$ | 251 |
| 9/01/82-8/31/83 | -0.0623$^{bc}$ | 254 | -0.1070$^{ba}$ | 254 | 0.0180$^{bc}$ | 254 |
| 9/01/83-8/31/84 | -0.0403$^{ba}$ | 254 | -0.1122$^{bac}$ | 254 | 0.0627$^{ba}$ | 254 |
| 9/01/84-8/31/85 | -0.0117$^{a}$ | 252 | -0.0692$^{a}$ | 252 | 0.0700$^{a}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 17.48 P-value = 0.0001 | | F(6,1759) = 7.57 P-value = 0.0001 | | F(6,1755) = 8.44 P-value = 0.0001 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 11 (cont). Test for Yearly Differences in Returns to the Final Transaction for Different CRSP Excess Return Quintiles**

EXCESS RETURN QUINTILE = 3

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0079$^{dc}$ | 250 | -0.0260$^{ba}$ | 250 | 0.0902$^{c}$ | 250 |
| 9/01/79-8/31/80 | 0.0034$^{dc}$ | 252 | -0.0328$^{ba}$ | 252 | 0.0883$^{c}$ | 252 |
| 9/01/80-8/31/81 | 0.0093$^{dc}$ | 252 | -0.0300$^{ba}$ | 252 | 0.1055$^{bc}$ | 249 |
| 9/01/81-8/31/82 | -0.0184$^{d}$ | 252 | -0.0593$^{b}$ | 252 | 0.1046$^{bc}$ | 251 |
| 9/01/82-8/31/83 | 0.0292$^{bc}$ | 254 | 0.0067$^{a}$ | 254 | 0.0821$^{c}$ | 254 |
| 9/01/83-8/31/84 | 0.0606$^{ba}$ | 254 | -0.0070$^{a}$ | 254 | 0.1628$^{ba}$ | 254 |
| 9/01/84-8/31/85 | 0.0982$^{a}$ | 252 | 0.0112$^{a}$ | 252 | 0.2173$^{a}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 15.61 P-value = 0.0001 | | F(6,1759) = 4.16 P-value = 0.0004 | | F(6,1755) = 9.50 P-value = 0.0001 | |

EXCESS RETURN QUINTILE = 4

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.1271$^{a}$ | 250 | 0.1031$^{a}$ | 250 | 0.1789$^{a}$ | 250 |
| 9/01/79-8/31/80 | 0.1241$^{a}$ | 252 | 0.1048$^{a}$ | 252 | 0.1684$^{a}$ | 252 |
| 9/01/80-8/31/81 | 0.1386$^{a}$ | 252 | 0.1217$^{a}$ | 252 | 0.1832$^{a}$ | 249 |
| 9/01/81-8/31/82 | 0.1250$^{a}$ | 252 | 0.1073$^{a}$ | 252 | 0.1847$^{a}$ | 251 |
| 9/01/82-8/31/83 | 0.1261$^{a}$ | 254 | 0.1167$^{a}$ | 254 | 0.1527$^{a}$ | 254 |
| 9/01/83-8/31/84 | 0.1204$^{a}$ | 254 | 0.0949$^{a}$ | 254 | 0.1563$^{a}$ | 254 |
| 9/01/84-8/31/85 | 0.1429$^{a}$ | 252 | 0.1204$^{a}$ | 252 | 0.1776$^{a}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 0.75 P-value = 0.6100 | | F(6,1759) = 0.61 P-value = 0.7249 | | F(6,1755) = 1.12 P-value = 0.3472 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 11 (cont). Test for Yearly Differences in Returns to the Final Transaction for Different CRSP Excess Return Quintiles**

EXCESS RETURN QUINTILE = HIGHEST

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.3727$^{ba}$ | 250 | 0.3662$^{ba}$ | 250 | 0.3833$^{ba}$ | 250 |
| 9/01/79-8/31/80 | 0.3664$^{b}$ | 252 | 0.3728$^{ba}$ | 252 | 0.3663$^{b}$ | 252 |
| 9/01/80-8/31/81 | 0.3360$^{b}$ | 252 | 0.3366$^{b}$ | 252 | 0.3480$^{b}$ | 249 |
| 9/01/81-8/31/82 | 0.4294$^{a}$ | 252 | 0.4252$^{a}$ | 252 | 0.4609$^{a}$ | 251 |
| 9/01/82-8/31/83 | 0.3274$^{b}$ | 254 | 0.3264$^{b}$ | 254 | 0.3462$^{b}$ | 254 |
| 9/01/83-8/31/84 | 0.3501$^{b}$ | 254 | 0.3576$^{ba}$ | 254 | 0.3442$^{b}$ | 254 |
| 9/01/84-8/31/85 | 0.3836$^{ba}$ | 252 | 0.4207$^{a}$ | 252 | 0.3652$^{b}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 6.25 P-value = 0.0001 | | F(6,1759) = 4.46 P-value = 0.0002 | | F(6,1755) = 3.94 P-value = 0.0007 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

quintile and weakest for the 3rd quintile. The significant differences found between years for the highest quintile do not appear to exhibit any trend over the time period.

The results of an examination of weekday differences in final transaction returns for each excess return quintile is presented in Table 12. For the lowest and 4th excess return quintiles no significant differences were found in final transaction returns occurring prior to 3:56pm, but significant differences were found for all final transactions and final transactions occurring after 3:56pm. The TKMCP revealed that for all final transactions in the lowest quintile Friday's final transaction return was significantly greater than Monday's final return, and in the 4th quintile Friday's final returns was significantly greater than both Monday's and Tuesday's final returns. For final trades occurring after 3:56pm both Thurday's and Friday's final return exceeded Monday's final return in the lowest quintile and Friday's return exceeded Monday's, Tuesday's and Wednesday's final returns in the 4th quintile. In the 2nd excess return quintile, significant differences were detected for all final trades and both time classified trade groups. The TKMCP failed to detect significant day of the week differences for the after 3:56pm final transactions, but the TKMCP did find that Friday's final return was significantly greater than Monday's, Tuesday's and Wednesday's final returns for the all final and pre 3:56pm transaction groups. In the highest quintile Friday's return was found to be greater than Monday's return for final trades occurring prior to 3:56pm, and for all final transactions Friday's final return was found to be greater than Monday's, Tuesday's and Thursday's final trade returns. No significant differences were found for the 3rd excess return quintile.

It appears that a relationship does exist between CRSP excess returns and the return to the final transaction of the trading day. Greater final transaction returns are associated with greater excess returns. It also appears that the time related variations in

**Table 12. Test for Weekday Differences in Returns to the Final Transaction for Different CRSP Excess Return Quintiles**

EXCESS RETURN QUINTILE = LOWEST

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.3290[b] | 338 | -0.4015[a] | 338 | -0.2044[b] | 337 |
| TUESDAY | -0.3049[ba] | 360 | -0.3974[a] | 360 | -0.1499[ba] | 359 |
| WEDNESDAY | -0.3184[ba] | 362 | -0.4175[a] | 362 | -0.1469[ba] | 360 |
| THURSDAY | -0.3015[ba] | 354 | -0.4102[a] | 354 | -0.1225[a] | 354 |
| FRIDAY | -0.2725[a] | 352 | -0.3612[a] | 352 | -0.1238[a] | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 2.86 P-value = 0.0223 | | F(4,1761) = 1.77 P-value = 0.1318 | | F(4,1757) = 3.44 P-value = 0.0082 | |

EXCESS RETURN QUINTILE = 2

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0954[b] | 338 | -0.1532[b] | 338 | 0.0158[a] | 337 |
| TUESDAY | -0.0838[b] | 360 | -0.1350[b] | 360 | 0.0190[a] | 359 |
| WEDNESDAY | -0.0846[b] | 362 | -0.1384[b] | 362 | 0.0135[a] | 360 |
| THURSDAY | -0.0692[ba] | 354 | -0.1226[ba] | 354 | 0.0318[a] | 354 |
| FRIDAY | -0.0460[a] | 352 | -0.0940[a] | 352 | 0.0528[a] | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 5.64 P-value = 0.0002 | | F(4,1761) = 4.54 P-value = 0.0012 | | F(4,1757) = 2.38 P-value = 0.0495 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 12 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different CRSP Excess Return Quintiles**

EXCESS RETURN QUINTILE = 3

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0252[a] | 338 | -0.0216[a] | 338 | 0.1227[a] | 337 |
| TUESDAY | 0.0237[a] | 360 | -0.0273[a] | 360 | 0.1292[a] | 359 |
| WEDNESDAY | 0.0257[a] | 362 | -0.0266[a] | 362 | 0.1270[a] | 360 |
| THURSDAY | 0.0249[a] | 354 | -0.0190[a] | 354 | 0.1128[a] | 354 |
| FRIDAY | 0.0367[a] | 352 | -0.0029[a] | 352 | 0.1162[a] | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 0.38 P-value = 0.8265 | | F(4,1761) = 0.92 P-value = 0.4540 | | F(4,1757) = 0.25 P-value = 0.9088 | |

EXCESS RETURN QUINTILE = 4

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.1181[b] | 338 | 0.1029[a] | 338 | 0.1541[b] | 337 |
| TUESDAY | 0.1162[b] | 360 | 0.1016[a] | 360 | 0.1506[b] | 359 |
| WEDNESDAY | 0.1308[ba] | 362 | 0.1160[a] | 362 | 0.1687[b] | 360 |
| THURSDAY | 0.1278[ba] | 354 | 0.1068[a] | 354 | 0.1733[ba] | 354 |
| FRIDAY | 0.1528[a] | 352 | 0.1217[a] | 352 | 0.2111[a] | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 3.25 P-value = 0.0114 | | F(4,1761) = 0.64 P-value = 0.6314 | | F(4,1757) = 5.51 P-value = 0.0002 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 12 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different CRSP Excess Return Quintiles**

EXCESS RETURN QUINTILE = HIGHEST

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.3375[b] | 338 | 0.3321[b] | 338 | 0.3611[a] | 337 |
| TUESDAY | 0.3622[b] | 360 | 0.3750[ba] | 360 | 0.3658[a] | 359 |
| WEDNESDAY | 0.3713[ba] | 362 | 0.3887[ba] | 362 | 0.3574[a] | 360 |
| THURSDAY | 0.3511[b] | 354 | 0.3530[ba] | 354 | 0.3659[a] | 354 |
| FRIDAY | 0.4089[a] | 352 | 0.4100[a] | 352 | 0.4167[a] | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 5.33 P-value = 0.0003 | | F(4,1761) = 3.84 P-value = 0.0041 | | F(4,1757) = 1.94 P-value = 0.1007 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

the final trade returns, i.e. yearly and day of the week, may be associated with excess returns.

One troubling point must be addressed before drawing any conclusions about the CRSP excess return and the returns to the final transaction. It has been documented that the final transaction is typically positive, particularly in the last five minutes of the trading day. Could it be that trades in the final five minutes heavily influence the magnitude of the CRSP excess return? To investigate this possibility, securities were ranked according to the magnitude of return from the previous day's close to the latest trade occurring prior to 3:55pm. Quintile groups were formed on the basis of this ranking and group returns to the final transaction were computed. The results presented in Table 13 are quite dramatic. For all final transactions and for final transactions occurring prior the 3:56pm, the relationship is what would be expected. The returns to the final transaction increase monotonically from lowest return quintile to highest return quintile. The after 3:56pm results are counter intuitive with the returns to the final transaction decreasing monotonically from the lowest quintile to the highest quintile. These results might be explained by the bid/ask structure of security prices. When a transaction price is reported, it is not reported whether that transaction was at the bid price or the ask price. Logically, the proportion of transactions used in computing the 3:55pm return taking place at the bid price decreases from the lowest quintile to the highest quintile. If the majority of transactions in the last five minutes are buys, as would be suggested by the evidence so far, then buys in the low return quintiles would be reversals as prices changed from bid to ask and would exhibit themselves as positive returns. In the high return quintiles the predominance of buys would result in mostly no price changes and continuation price changes that would be manifest as positive returns.

Table 14 presents the frequencies of final transaction taking place before and after 3:56pm for each of the return quintiles. The proportions of transactions taking place

**Table 13. Test for 3:55pm Return Quintile Differences in the Final Transaction Return**

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| RETURN QUINTILE | Average Return | N | Average Return | N | Average Return | N |
| LOWEST | -0.1798[e] | 1766 | -0.4804[e] | 1766 | 0.3300[a] | 1762 |
| 2 | -0.0687[d] | 1766 | -0.1701[d] | 1766 | 0.1227[b] | 1762 |
| 3 | 0.0128[c] | 1766 | -0.0161[c] | 1766 | 0.0725[c] | 1762 |
| 4 | 0.1010[b] | 1766 | 0.1350[b] | 1766 | 0.0305[d] | 1762 |
| HIGHEST | 0.2742[a] | 1766 | 0.4359[a] | 1766 | 0.0041[e] | 1762 |
| Test for Differences Between Quintiles | F(4,8825) = 1414.89 P-value = 0.0001 | | F(4,8825) = 3359.35 P-value = 0.0001 | | F(4,8805) = 390.06 P-value = 0.0001 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 14. Frequencies of Final Transactions for Different 3:55pm Return Quintiles**

| RETURN QUINTILE | ALL FINAL TRANSACTIONS | FINAL TRANSACTION BEFORE 3:56 PM | FINAL TRANSACTION AFTER 3:56 PM |
|---|---|---|---|
| LOWEST | 120641 | 75440 | 45201 |
| 2 | 119162 | 77630 | 41532 |
| 3 | 126237 | 84459 | 41778 |
| 4 | 120133 | 78593 | 41540 |
| HIGHEST | 120056 | 73776 | 46280 |

Test for independence of return level and time of final transaction:

Chi-square = 1064.98
P-value < 0.0001

after 3:56pm was as would be expected. The highest and lowest quintiles had the greatest proportions--38.6% and 37.5%, respectively--of after 3:56pm final trades. The next most frequently post 3:56pm traded quintiles were the 2nd and 4th with respective proportions of 34.9% and 34.6%. The 3rd quintile had 33.1% of its final transactions take place after 3:56pm. The disparity between the highest quintile frequencies and the other quintile frequencies found for the CRSP excess returns did not appear to exist for the 3:55 return quintiles. This would suggest that post 3:56pm trades did indeed impact CRSP excess returns.

The results of test for yearly differences in final transaction returns for each of the 3:55 return quintiles are presented in Table 15. Significant differences between years existed for all final transaction groups in all quintiles except for post 3:56pm transactions in the 3rd quintile. For the lowest and the 2nd quintiles, the results suggested that the returns to the final transaction had been increasing over the period for every time classification except post 3:56pm transactions in the 2nd quintile. Return quintile 3 also appeared to exhibit patterns of increasing returns to the all final and pre 3:56pm final transaction returns over time. While significant differences were found between years for all final transactions in the 4th return quintile, the TKMCP failed to detect between which years the significant differences exist. In this quintile pre 3:56pm final trade returns appeared to be decreasing over time, while the post 3:56pm returns appeared to be increasing over time. Finally, in the highest return quintile all final transaction returns and pre 3:56pm final transaction returns showed a tendency to decrease over the time period while the post 3:56pm final transaction returns appeared to increase slightly over the period.

Each return quintile was tested for weekday differences in final transaction returns, the results of which are presented in Table 16. For after 3:56pm final transaction returns, significant differences were found only in the lowest return quintile where Friday's final

**Table 15. Test for Yearly Differences in Returns to the Final Transaction for Different 3:55pm Return Quintiles**

RETURN QUINTILE = LOWEST

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.2679$^{dc}$ | 250 | -0.5342$^{cb}$ | 250 | 0.2984$^{ba}$ | 250 |
| 9/01/79-8/31/80 | -0.2968$^{d}$ | 252 | -0.5779$^{cd}$ | 252 | 0.2741$^{b}$ | 252 |
| 9/01/80-8/31/81 | -0.2282$^{c}$ | 252 | -0.4971$^{cb}$ | 252 | 0.2959$^{b}$ | 249 |
| 9/01/81-8/31/82 | -0.3238$^{d}$ | 252 | -0.6279$^{d}$ | 252 | 0.3358$^{ba}$ | 251 |
| 9/01/82-8/31/83 | -0.1577$^{b}$ | 254 | -0.4493$^{b}$ | 254 | 0.3382$^{ba}$ | 254 |
| 9/01/83-8/31/84 | -0.0175$^{a}$ | 254 | -0.3547$^{a}$ | 254 | 0.3706$^{ba}$ | 254 |
| 9/01/84-8/31/85 | 0.0309$^{a}$ | 252 | -0.3237$^{a}$ | 252 | 0.3956$^{a}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 78.93 P-value = 0.0001 | | F(6,1759) = 29.72 P-value = 0.0001 | | F(6,1755) = 3.38 P-value = 0.0025 | |

RETURN QUINTILE = 2

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0929$^{cb}$ | 250 | -0.1938$^{b}$ | 250 | 0.1183$^{bac}$ | 250 |
| 9/01/79-8/31/80 | -0.1076$^{c}$ | 252 | -0.2016$^{b}$ | 252 | 0.0890$^{c}$ | 252 |
| 9/01/80-8/31/81 | -0.0934$^{cb}$ | 252 | -0.1931$^{b}$ | 252 | 0.1220$^{bac}$ | 249 |
| 9/01/81-8/31/82 | -0.1146$^{c}$ | 252 | -0.2198$^{b}$ | 252 | 0.1605$^{a}$ | 251 |
| 9/01/82-8/31/83 | -0.0608$^{b}$ | 254 | -0.1472$^{a}$ | 254 | 0.1016$^{bc}$ | 254 |
| 9/01/83-8/31/84 | -0.0105$^{a}$ | 254 | -0.1205$^{a}$ | 254 | 0.1411$^{ba}$ | 254 |
| 9/01/84-8/31/85 | -0.0019$^{a}$ | 252 | -0.1157$^{a}$ | 252 | 0.1264$^{bac}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 32.23 P-value = 0.0001 | | F(6,1759) = 17.86 P-value = 0.0001 | | F(6,1755) = 4.24 P-value = 0.0003 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 15 (cont). Test for Yearly Differences in Returns to the Final Transaction for Different 3:55pm Return Quintiles**

RETURN QUINTILE = 3

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0038$^{bc}$ | 250 | -0.0344$^{b}$ | 250 | 0.0701$^{a}$ | 250 |
| 9/01/79-8/31/80 | -0.0088$^{c}$ | 252 | -0.0365$^{b}$ | 252 | 0.0588$^{a}$ | 252 |
| 9/01/80-8/31/81 | 0.0043$^{bc}$ | 252 | -0.0306$^{ba}$ | 252 | 0.0901$^{a}$ | 249 |
| 9/01/81-8/31/82 | -0.0099$^{c}$ | 252 | -0.0335$^{b}$ | 252 | 0.0560$^{a}$ | 251 |
| 9/01/82-8/31/83 | 0.0263$^{bac}$ | 254 | 0.0148$^{a}$ | 254 | 0.0489$^{a}$ | 254 |
| 9/01/83-8/31/84 | 0.0317$^{ba}$ | 254 | -0.0076$^{ba}$ | 254 | 0.0902$^{a}$ | 254 |
| 9/01/84-8/31/85 | 0.0490$^{a}$ | 252 | 0.0144$^{a}$ | 252 | 0.0938$^{a}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 6.27 P-value = 0.0001 | | F(6,1759) = 4.24 P-value = 0.0003 | | F(6,1755) = 1.84 P-value = 0.0884 | |

RETURN QUINTILE = 4

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.1068$^{a}$ | 250 | 0.1547$^{a}$ | 250 | -0.0264$^{b}$ | 250 |
| 9/01/79-8/31/80 | 0.1124$^{a}$ | 252 | 0.1531$^{a}$ | 252 | 0.0211$^{ba}$ | 252 |
| 9/01/80-8/31/81 | 0.1036$^{a}$ | 252 | 0.1392$^{bac}$ | 252 | 0.0257$^{ba}$ | 249 |
| 9/01/81-8/31/82 | 0.1087$^{a}$ | 252 | 0.1435$^{ba}$ | 252 | 0.0176$^{ba}$ | 251 |
| 9/01/82-8/31/83 | 0.1146$^{a}$ | 254 | 0.1581$^{a}$ | 254 | 0.0467$^{ba}$ | 254 |
| 9/01/83-8/31/84 | 0.0829$^{a}$ | 254 | 0.0956$^{c}$ | 254 | 0.0713$^{a}$ | 254 |
| 9/01/84-8/31/85 | 0.0782$^{a}$ | 252 | 0.1010$^{bc}$ | 252 | 0.0563$^{a}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 2.54 P-value = 0.0188 | | F(6,1759) = 5.48 P-value = 0.0001 | | F(6,1755) = 3.16 P-value = 0.0044 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 15 (cont). Test for Yearly Differences in Returns to the Final Transaction for Different 3:55pm Return Quintiles**

RETURN QUINTILE = HIGHEST

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.3062$^{ba}$ | 250 | 0.4761$^{bac}$ | 250 | -0.0285$^{b}$ | 250 |
| 9/01/79-8/31/80 | 0.3004$^{b}$ | 252 | 0.4782$^{ba}$ | 252 | -0.0309$^{b}$ | 252 |
| 9/01/80-8/31/81 | 0.2907$^{bc}$ | 252 | 0.4400$^{bac}$ | 252 | 0.0206$^{ba}$ | 249 |
| 9/01/81-8/31/82 | 0.3570$^{a}$ | 252 | 0.5130$^{a}$ | 252 | -0.0070$^{b}$ | 251 |
| 9/01/82-8/31/83 | 0.2369$^{dc}$ | 254 | 0.4087$^{bdc}$ | 254 | -0.0147$^{b}$ | 254 |
| 9/01/83-8/31/84 | 0.1936$^{d}$ | 254 | 0.3405$^{d}$ | 254 | 0.0041$^{b}$ | 254 |
| 9/01/84-8/31/85 | 0.2360$^{dc}$ | 252 | 0.3961$^{dc}$ | 252 | 0.0855$^{a}$ | 252 |
| Test for Differences Between Years | F(6,1759) = 17.54 P-value = 0.0001 | | F(6,1759) = 9.11 P-value = 0.0001 | | F(6,1755) = 5.48 P-value = 0.0001 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 16. Test for Weekday Differences in Returns to the Final Transaction for Different 3:55pm Return Quintiles**

RETURN QUINTILE = LOWEST

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.2054$^{b}$ | 338 | -0.4849$^{a}$ | 338 | 0.2944$^{b}$ | 337 |
| TUESDAY | -0.1689$^{ba}$ | 360 | -0.4644$^{a}$ | 360 | 0.3415$^{ba}$ | 359 |
| WEDNESDAY | -0.2033$^{b}$ | 362 | -0.4993$^{a}$ | 362 | 0.3071$^{ba}$ | 360 |
| THURSDAY | -0.1784$^{ba}$ | 354 | -0.4899$^{a}$ | 354 | 0.3290$^{ba}$ | 354 |
| FRIDAY | -0.1438$^{a}$ | 352 | -0.4637$^{a}$ | 352 | 0.3765$^{a}$ | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 2.96 P-value = 0.0189 | | F(4,1761) = 0.76 P-value = 0.5508 | | F(4,1757) = 2.52 P-value = 0.0393 | |

RETURN QUINTILE = 2

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0850$^{b}$ | 338 | -0.1849$^{b}$ | 338 | 0.1124$^{a}$ | 337 |
| TUESDAY | -0.0749$^{b}$ | 360 | -0.1757$^{ba}$ | 360 | 0.1159$^{a}$ | 359 |
| WEDNESDAY | -0.0706$^{ba}$ | 362 | -0.1703$^{ba}$ | 362 | 0.1173$^{a}$ | 360 |
| THURSDAY | -0.0693$^{ba}$ | 354 | -0.1704$^{ba}$ | 354 | 0.1226$^{a}$ | 354 |
| FRIDAY | -0.0444$^{a}$ | 352 | -0.1497$^{a}$ | 352 | 0.1450$^{a}$ | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 4.29 P-value = 0.0019 | | F(4,1761) = 2.23 P-value = 0.0637 | | F(4,1757) = 1.75 P-value = 0.1358 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 16 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different 3:55pm Return Quintiles**

RETURN QUINTILE = 3

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0054[a] | 338 | -0.0190[a] | 338 | 0.0517[a] | 337 |
| TUESDAY | 0.0042[a] | 360 | -0.0212[a] | 360 | 0.0582[a] | 359 |
| WEDNESDAY | 0.0101[a] | 362 | -0.0230[a] | 362 | 0.0765[a] | 360 |
| THURSDAY | 0.0126[a] | 354 | -0.0189[a] | 354 | 0.0820[a] | 354 |
| FRIDAY | 0.0314[a] | 352 | 0.0017[a] | 352 | 0.0935[a] | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 1.95 P-value = 0.1000 | | F(4,1761) = 1.12 P-value = 0.3461 | | F(4,1757) = 2.14 P-value = 0.0732 | |

RETURN QUINTILE = 4

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0817[b] | 338 | 0.1140[b] | 338 | 0.0148[a] | 337 |
| TUESDAY | 0.0918[b] | 360 | 0.1265[ba] | 360 | 0.0308[a] | 359 |
| WEDNESDAY | 0.0973[b] | 362 | 0.1346[ba] | 362 | 0.0079[a] | 360 |
| THURSDAY | 0.1047[ba] | 354 | 0.1371[ba] | 354 | 0.0351[a] | 354 |
| FRIDAY | 0.1291[a] | 352 | 0.1621[a] | 352 | 0.0636[a] | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 5.35 P-value = 0.0003 | | F(4,1761) = 3.46 P-value = 0.0079 | | F(4,1757) = 2.02 P-value = 0.0888 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 16 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different 3:55pm Return Quintiles**

RETURN QUINTILE = HIGHEST

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.2574[b] | 338 | 0.4028[b] | 338 | -0.0095[a] | 337 |
| TUESDAY | 0.2584[b] | 360 | 0.4210[ba] | 360 | -0.0101[a] | 359 |
| WEDNESDAY | 0.2923[ba] | 362 | 0.4572[ba] | 362 | 0.0239[a] | 360 |
| THURSDAY | 0.2597[ba] | 354 | 0.4167[ba] | 354 | 0.0051[a] | 354 |
| FRIDAY | 0.3026[a] | 352 | 0.4804[a] | 352 | 0.0105[a] | 352 |
| Test for Differences Between Weekdays | F(4,1761) = 3.61 P-value = 0.0062 | | F(4,1761) = 3.68 P-value = 0.0055 | | F(4,1757) = 0.96 P-value = 0.4258 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

return was significantly greater than Monday's final return. Pre 3:56pm final return differences were found for the 4th and the highest return quintiles where the TKMCP showed Friday's returns to be greater than Monday' returns. For all final transactions significant weekday differences were found for all quintiles except the 3rd. In the lowest quintile Friday's final transaction return was found to be significantly greater than both Monday's and Wednesday's final returns. Friday's return was found to be greater than Monday's and Tuesday's returns in the 2nd and the highest quintiles, and in the 4th quintile Friday's returns was found to be greater than Monday's, Tuesday's and Wednesday's final transaction returns.

In this section we have examined the relationship between final transaction returns and two measures of daily firm performance--the CRSP excess return and the return to the latest transaction prior to 3:55pm. It could be argued that the failure to correct for systematic movements of the security price with movements in the market when computing the 3:55pm return may be responsible for the differences in results between the performance measures. When a correction was made for the market movements and a 3:55pm excess return was computed, the results were qualitatively the same as those given by the 3:55pm return. One of the interesting results from this examination of good days and bad days was the impact the final transaction appeared to have on the excess return.

## *Reversals and Continuations on the Final Trade*

Any price change can be classified as a continuation or a reversal conditioned upon the most recent price change. If two consecutive price changes are in the same direction,

i.e. both positive or both negative, then the second price change is classified as a continuation. Conversely, if two price changes are in opposite direction, i.e. one positive and one negative or vice versa, then the second price change is classified a reversal. In the transaction data reversal price changes are typically movements from the bid to ask price or from the ask to bid price. Reversals generally do not represent a change in the value of the security, and returns from the reversal process compensate the Specialist for his/her services. Continuations on the other hand do represent changes in the value of the security and returns on continuation are the result of appreciation or depreciation of the security. In this section results of examining the returns to final transactions when classified as reversals or continuations will presented. The final trade of the day can fall into one of four categories. It can be 1) a reversal, 2) a continuation, 3) no change, or 4) a change of unknown type if no previous price change occurred in the day.

Table 17 presents the results of a test of differences in mean return to the final transaction for continuations, reversals and unclassified price changes. Significant differences were detected for all final transactions and for final transactions occurring prior to 3:56pm. The TKMCP revealed that the mean return on reversals was greater than the mean return on continuations. Table 18 presents the frequencies of the different price change types on the final transaction. It can be seen that a greater proportion of post 3:56pm (60.3%) than pre 3:56pm (58.0%) transactions were price changes. If unclassified price changes are ignored, the proportion of reversal price changes increased from 34.2% before 3:56pm to 38.2% after 3:56pm, while the proportion of continuations increased from 19.3% to 20.7%.

Table 19 contains the results of tests for yearly differences in final transaction returns for each final price change type. The results show that significant differences existed between years for reversal price changes for all final transactions and for both before and after 3:56pm final transactions. The TKMCP shows that for post 3:56pm

**Table 17. Test for Reversal and Continuation Differences in the Final Transaction Return**

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| TYPE OF PRICE CHANGE | Average Return | N | Average Return | N | Average Return | N |
| REVERSAL | 0.0793[a] | 1767 | -0.0136[a] | 1767 | 0.2223[a] | 1763 |
| CONTINUATION | 0.0200[b] | 1767 | -0.0623[b] | 1767 | 0.1412[a] | 1763 |
| UNKNOWN | -0.0052[b] | 1767 | -0.0338[b a] | 1767 | 0.1416[a] | 1715 |
| Test for Differences Between Types | F(2,5298) = 24.11 P-value = 0.0001 | | F(2,5298) = 6.03 P-value = 0.0024 | | F(2,5238) = 2.99 P-value = 0.0506 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 18. Frequencies of Final Transactions for Different Price Change Types**

| PRICE CHANGE | ALL FINAL TRANSACTIONS | FINAL TRANSACTION BEFORE 3:56 PM | FINAL TRANSACTION AFTER 3:56 PM |
|---|---|---|---|
| REVERSAL | 206608 | 124417 | 82191 |
| NO CHANGE | 257550 | 169130 | 88420 |
| CONTINUATION | 114775 | 70157 | 44618 |
| UNKNOWN | 46169 | 38866 | 7303 |

Test for independence of type and time of final transaction:

Chi-square = 10173.64
P-value < 0.0001

**Table 19. Test for Yearly Differences in Returns to the Final Transaction for Reversals and Continuations**

PRICE CHANGE = REVERSAL

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0505[b] | 251 | -0.0301[b] | 251 | 0.1935[dc] | 251 |
| 9/01/79-8/31/80 | 0.0349[b] | 252 | -0.0536[b] | 252 | 0.1830[dc] | 252 |
| 9/01/80-8/31/81 | 0.0677[b] | 252 | -0.0104[b] | 252 | 0.2155[bdc] | 249 |
| 9/01/81-8/31/82 | 0.0412[b] | 252 | -0.0491[b] | 252 | 0.2348[bac] | 251 |
| 9/01/82-8/31/83 | 0.0546[b] | 254 | -0.0104[b] | 254 | 0.1649[d] | 254 |
| 9/01/83-8/31/84 | 0.1310[a] | 254 | 0.0026[ba] | 254 | 0.2675[ba] | 254 |
| 9/01/84-8/31/85 | 0.1748[a] | 252 | 0.0552[a] | 252 | 0.2971[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 22.69 P-value = 0.0001 | | F(6,1760) = 6.23 P-value = 0.0001 | | F(6,1756) = 10.11 P-value = 0.0001 | |

PRICE CHANGE = CONTINUATION

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0192[bc] | 251 | -0.0732[a] | 251 | 0.0851[b] | 251 |
| 9/01/79-8/31/80 | -0.0260[c] | 252 | -0.0876[a] | 252 | 0.0755[b] | 252 |
| 9/01/80-8/31/81 | -0.0050[bc] | 252 | -0.0815[a] | 252 | 0.1368[ba] | 249 |
| 9/01/81-8/31/82 | -0.0123[bc] | 252 | -0.0745[a] | 252 | 0.1152[ba] | 251 |
| 9/01/82-8/31/83 | 0.0621[ba] | 254 | -0.0220[a] | 254 | 0.1926[a] | 254 |
| 9/01/83-8/31/84 | 0.0520[bac] | 254 | -0.0631[a] | 254 | 0.1768[ba] | 254 |
| 9/01/84-8/31/85 | 0.0874[a] | 252 | -0.0346[a] | 252 | 0.2053[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 5.32 P-value = 0.0001 | | F(6,1760) = 1.26 P-value = 0.2726 | | F(6,1756) = 4.32 P-value = 0.0002 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 19 (cont). Test for Yearly Differences in Returns to the Final Transaction for Reversals and Continuations**

PRICE CHANGE = UNKNOWN

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0263[ba] | 251 | -0.0444[a] | 251 | 0.0744[a] | 248 |
| 9/01/79-8/31/80 | -0.0536[ba] | 252 | -0.0678[a] | 252 | 0.0166[a] | 246 |
| 9/01/80-8/31/81 | -0.0606[b] | 252 | -0.0940[a] | 252 | 0.2084[a] | 239 |
| 9/01/81-8/31/82 | -0.0639[b] | 252 | -0.1100[a] | 252 | 0.3623[a] | 244 |
| 9/01/82-8/31/83 | 0.0163[ba] | 254 | 0.0261[a] | 254 | -0.1041[a] | 237 |
| 9/01/83-8/31/84 | 0.0677[ba] | 254 | 0.0129[a] | 254 | 0.1853[a] | 252 |
| 9/01/84-8/31/85 | 0.0831[a] | 252 | 0.0398[a] | 252 | 0.2414[a] | 249 |
| Test for Differences Between Years | F(6,1760) = 3.48 P-value = 0.0020 | | F(6,1760) = 2.67 P-value = 0.0139 | | F(6,1708) = 1.59 P-value = 0.1466 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

transactions, returns were increasing over the time period except for a dip in 8283. For the pre 3:56pm final trades, the only significant difference found was that the return in 8485 was greater than all other years except 8384. Years 8384 and 8485 were found to be significantly greater than the other years for the all final transactions group.

The continuations price change type results showed significant differences between years for all final transactions and the post 3:56pm final trades time classification. For each of these groups, mean returns appeared to be increasing over the time period. The TKMCP found that the 8283 and 8485 mean returns were greater than the 7879 and 7980 mean returns. For all final transactions it was found that the return in year 8485 was greater than the mean returns in years 7879 through 8182, and the mean return in 8283 was greater than the mean return in 7980.

When unclassified price changes were considered, significant differences were found in the pre 3:56pm time category and the all final transaction category. The TKMCP was not sensitive enough to detect any differences in the pre 3:56pm time category, but it was found that the 8485 mean return for all final transactions was greater than the mean returns in years 8081 and 8182.

The results of tests for differences in final transaction return on different days of the week for different price change types are presented in Table 20. The only significant results for the reversal group were for all final transactions where it was found that Friday's return was significantly greater than the returns on Monday and Tuesday. When continuations were examined, significant differences between days of the week where found for all final transactions and both pre and post 3:56pm final transactions. For the post 3:56pm group, the TKMCP revealed that Friday's mean return was greater than the mean returns on the other four days. The pre 3:56pm return on Friday was significantly greater than Monday's pre 3:56pm mean final transaction return, and for all final transactions Friday's final return was greater than the mean return on every other day

**Table 20. Test for Weekday Differences in Returns to the Final Transaction for Reversals and Continuations**

PRICE CHANGE = REVERSAL

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0628[b] | 338 | -0.0228[a] | 338 | 0.2046[a] | 337 |
| TUESDAY | 0.0658[b] | 360 | -0.0226[a] | 360 | 0.2053[a] | 359 |
| WEDNESDAY | 0.0746[ba] | 362 | -0.0255[a] | 362 | 0.2264[a] | 360 |
| THURSDAY | 0.0822[ba] | 354 | -0.0141[a] | 354 | 0.2271[a] | 354 |
| FRIDAY | 0.1107[a] | 353 | 0.0168[a] | 353 | 0.2477[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 3.89 P-value = 0.0037 | | F(4,1762) = 1.95 P-value = 0.0996 | | F(4,1758) = 1.94 P-value = 0.1005 | |

PRICE CHANGE = CONTINUATION

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0228[b] | 338 | -0.1009[b] | 338 | 0.1025[b] | 337 |
| TUESDAY | 0.0157[b] | 360 | -0.0638[ba] | 360 | 0.1326[b] | 359 |
| WEDNESDAY | 0.0170[ba] | 362 | -0.0468[ba] | 362 | 0.1147[b] | 360 |
| THURSDAY | 0.0066[b] | 354 | -0.0818[ba] | 354 | 0.1325[b] | 354 |
| FRIDAY | 0.0816[a] | 353 | -0.0202[a] | 353 | 0.2226[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 5.05 P-value = 0.0005 | | F(4,1762) = 2.76 P-value = 0.0265 | | F(4,1758) = 4.98 P-value = 0.0005 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 20 (cont). Test for Weekday Differences in Returns to the Final Transaction for Reversals and Continuations**

PRICE CHANGE = UNKNOWN

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0781[b] | 338 | -0.0934[b] | 338 | -0.0616[a] | 325 |
| TUESDAY | -0.0017[ba] | 360 | -0.0378[ba] | 360 | 0.1666[a] | 352 |
| WEDNESDAY | -0.0107[ba] | 362 | -0.0526[ba] | 362 | 0.1853[a] | 347 |
| THURSDAY | -0.0006[ba] | 354 | -0.0408[ba] | 354 | 0.2529[a] | 345 |
| FRIDAY | 0.0619[a] | 353 | 0.0539[a] | 353 | 0.1523[a] | 346 |
| Test for Differences Between Weekdays | F(4,1762) = 3.07 P-value = 0.0157 | | F(4,1762) = 2.95 P-value = 0.0193 | | F(4,1710) = 1.26 P-value = 0.2838 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

except for Wednesday. Unclassified price changes exhibited significant differences between weekdays for all final transactions and pre 3:56pm final transactions. In each case Friday's mean return was found to be greater than Monday's mean return.

When final transactions were classified as to the type of price change, i.e. reversal, continuation, no change or unknown, many of the patterns previously documented persisted. The results indicated that a higher proportion of final transactions occurring in the last five minutes of the day were price changes, and this increase in the number of price changes was due primarily to an increase in the number of reversals. It was also observed that the final transaction returns have been increasing over time, particularly in the past few years, and the mean Friday return tended to be higher than the mean returns on other days of the week. The final analysis performed in this dissertation was an examination of different price level securities to determine whether the patterns documented earlier were persistent across price change types or whether they are the results of only reversals or only continuations. Unclassified price changes were also examined for the sake of completeness.

Table 21 through Table 24 present the price level analysis for final transactions that are reversal price changes. In Table 21 it can be seen that significant differences existed between the mean return to the final transaction at different price levels for all final transactions and post 3:56pm final transactions. It appears that the differences found for all final transactions were primarily the results of transactions occurring after 3:56pm. The TKMCP shows that the mean returns decreased from 0.83% for securities under $10 to 0.03% for securities greater than $50. Table 22 presents the frequencies of final trades occurring before and after 3:56pm for each of the price level groups. These results are most meaningful when compared to the results in Table 6. It can be seen from Table 6 that 29.8% of all final transactions in the lowest price group took place after 3:56pm, and it can be seen from Table 22 that 37.1% of all final transactions which were reversals

**Table 21. Test for Security Price Level Differences in Returns to the Final Transaction for Reversals**

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| PRICE LEVEL | Average Return | N | Average Return | N | Average Return | N |
| < $10 | 0.3064[a] | 1767 | -0.0205[a] | 1767 | 0.8319[a] | 1747 |
| $10-$20 | 0.0759[b] | 1767 | -0.0162[a] | 1767 | 0.2478[b] | 1763 |
| $20-$30 | 0.0422[cb] | 1767 | -0.0164[a] | 1767 | 0.1422[c] | 1762 |
| $30-$50 | 0.0359[cb] | 1767 | -0.0081[a] | 1767 | 0.0939[dc] | 1763 |
| > $50 | 0.0205[c] | 1766 | -0.0038[a] | 1695 | 0.0337[d] | 1743 |
| Test for Differences Between Price Levels | F(4,8829) = 85.06 P-value = 0.0001 | | F(4,8758) = 0.15 P-value = 0.9621 | | F(4,8773) = 243.46 P-value = 0.0001 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 22. Frequencies of Final Transactions at Different Price Levels if the Final Price Change is a Reversal**

| PRICE LEVEL | ALL FINAL TRANSACTIONS | FINAL TRANSACTION BEFORE 3:56 PM | FINAL TRANSACTION AFTER 3:56 PM |
|---|---|---|---|
| < $10 | 24451 | 15375 | 9076 |
| $10-$20 | 59391 | 38457 | 20934 |
| $20-$30 | 54583 | 34944 | 19639 |
| $30-$50 | 50691 | 28608 | 22083 |
| > $50 | 17492 | 7033 | 10459 |

Test for independence of price level and time of final transaction:

Chi-square = 4138.03
P-value < 0.0001

took place after 3:56pm. In fact, the proportion of post 3:56pm reversal final transactions exceeded the proportion of post 3:56pm final transactions of all change types in every price level group. The difference in proportion does decrease as price level increases.

Tests of differences in mean returns to reversal final trades during different years were performed for each price level group. These results are presented in Table 23. The most significant results were found at the lowest price level where the mean return to post 3:56pm reversal final transactions increased from 0.50% in 7879 to 1.33% in 8485. The pre 3:56pm final transactions and all final transactions also had significant differences between years, but an increasing trend was not as apparent as in the post 3:56pm groups. In the $10 to $20 price range significant differences were found for the pre 3:56pm and all final transactions groups with a trend of increasing means over the years. All final transactions in the $20 to $30 price range had significant differences between years with a trend of increasing means over the time period. The only other significant differences were in the over $50 price range for pre 3:56pm final transactions. No trend was apparent. Table 24 contains the results from tests of differences between the final transaction return on days of the week. The only significant differences found were for all final transactions in the $20 to $30 price range where Friday's final return was greater than Tuesday's final return.

As was mentioned earlier, reversal price changes are typically movements between the bid and ask prices of a security. The returns that have been documented are paid to the Specialist in compensation for his/her services of providing liquidity. The returns that accrue to investors for buying and selling securities are the result of changes in the equilibrium value of the security. Movements of this value are manifest as continuation price changes. In the absence of transaction costs other than the bid/ask spread, the

**Table 23. Test for Yearly Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Reversal**

PRICE LEVEL = < $10

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.1363[b] | 251 | -0.0305[ba] | 251 | 0.4956[b] | 249 |
| 9/01/79-8/31/80 | 0.0775[b] | 252 | -0.1535[ba] | 252 | 0.5458[b] | 250 |
| 9/01/80-8/31/81 | 0.2721[b] | 252 | 0.0147[ba] | 252 | 0.8805[ba] | 247 |
| 9/01/81-8/31/82 | 0.0995[b] | 252 | -0.1738[b] | 252 | 0.6846[b] | 245 |
| 9/01/82-8/31/83 | 0.1310[b] | 254 | -0.1157[ba] | 254 | 0.6856[b] | 251 |
| 9/01/83-8/31/84 | 0.6129[a] | 254 | 0.0687[ba] | 254 | 1.1905[a] | 253 |
| 9/01/84-8/31/85 | 0.8136[a] | 252 | 0.2465[a] | 252 | 1.3294[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 16.65 P-value = 0.0001 | | F(6,1760) = 2.30 P-value = 0.0322 | | F(6,1740) = 7.57 P-value = 0.0001 | |

PRICE LEVEL = $10-$20

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0547[dc] | 251 | -0.0292[ba] | 251 | 0.2278[a] | 251 |
| 9/01/79-8/31/80 | 0.0252[d] | 252 | -0.0594[b] | 252 | 0.2032[a] | 252 |
| 9/01/80-8/31/81 | 0.0676[bdc] | 252 | -0.0218[ba] | 252 | 0.2801[a] | 249 |
| 9/01/81-8/31/82 | 0.0282[dc] | 252 | -0.0661[b] | 252 | 0.2462[a] | 251 |
| 9/01/82-8/31/83 | 0.0886[bac] | 254 | -0.0026[ba] | 254 | 0.2479[a] | 254 |
| 9/01/83-8/31/84 | 0.1265[ba] | 254 | 0.0249[a] | 254 | 0.2662[a] | 254 |
| 9/01/84-8/31/85 | 0.1397[a] | 252 | 0.0404[a] | 252 | 0.2630[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 8.91 P-value = 0.0001 | | F(6,1760) = 4.24 P-value = 0.0003 | | F(6,1756) = 1.14 P-value = 0.3353 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 23 (cont). Test for Yearly Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Reversal**

PRICE LEVEL = $20-$30

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0363[ba] | 251 | -0.0223[a] | 251 | 0.1569[a] | 251 |
| 9/01/79-8/31/80 | 0.0135[b] | 252 | -0.0415[a] | 252 | 0.1123[a] | 252 |
| 9/01/80-8/31/81 | 0.0380[ba] | 252 | -0.0211[a] | 252 | 0.1522[a] | 249 |
| 9/01/81-8/31/82 | 0.0411[ba] | 252 | -0.0057[a] | 252 | 0.1597[a] | 250 |
| 9/01/82-8/31/83 | 0.0410[ba] | 254 | 0.0001[a] | 254 | 0.1112[a] | 254 |
| 9/01/83-8/31/84 | 0.0616[a] | 254 | -0.0111[a] | 254 | 0.1581[a] | 254 |
| 9/01/84-8/31/85 | 0.0641[a] | 252 | -0.0131[a] | 252 | 0.1458[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 2.42 P-value = 0.0248 | | F(6,1760) = 0.99 P-value = 0.4330 | | F(6,1755) = 1.41 P-value = 0.2070 | |

PRICE LEVEL = $30-$50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0241[a] | 251 | -0.0287[a] | 251 | 0.1021[a] | 251 |
| 9/01/79-8/31/80 | 0.0343[a] | 252 | -0.0170[a] | 252 | 0.0994[a] | 252 |
| 9/01/80-8/31/81 | 0.0347[a] | 252 | -0.0028[a] | 252 | 0.1033[a] | 249 |
| 9/01/81-8/31/82 | 0.0278[a] | 252 | -0.0065[a] | 252 | 0.0772[a] | 251 |
| 9/01/82-8/31/83 | 0.0321[a] | 254 | 0.0005[a] | 254 | 0.0835[a] | 254 |
| 9/01/83-8/31/84 | 0.0496[a] | 254 | -0.0139[a] | 254 | 0.1138[a] | 254 |
| 9/01/84-8/31/85 | 0.0487[a] | 252 | 0.0116[a] | 252 | 0.0783[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 1.46 P-value = 0.1877 | | F(6,1760) = 1.42 P-value = 0.2047 | | F(6,1756) = 1.40 P-value = 0.2095 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 23 (cont).** **Test for Yearly Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Reversal**

PRICE LEVEL = > $50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0198[a] | 251 | -0.0542[b] | 227 | 0.0500[a] | 248 |
| 9/01/79-8/31/80 | 0.0098[a] | 252 | -0.0062[ba] | 245 | 0.0323[a] | 248 |
| 9/01/80-8/31/81 | 0.0437[a] | 252 | 0.0410[a] | 252 | 0.0455[a] | 249 |
| 9/01/81-8/31/82 | 0.0067[a] | 251 | -0.0079[ba] | 235 | 0.0137[a] | 239 |
| 9/01/82-8/31/83 | 0.0125[a] | 254 | -0.0065[ba] | 253 | 0.0194[a] | 253 |
| 9/01/83-8/31/84 | 0.0215[a] | 254 | 0.0032[ba] | 239 | 0.0333[a] | 254 |
| 9/01/84-8/31/85 | 0.0296[a] | 252 | -0.0010[ba] | 244 | 0.0414[a] | 252 |
| Test for Differences Between Years | F(6,1759) = 2.06 P-value = 0.0551 | | F(6,1688) = 2.78 P-value = 0.0107 | | F(6,1736) = 1.39 P-value = 0.2168 | |

**Note:** **Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 24. Test for Weekday Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Reversal**

PRICE LEVEL = < $10

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.2345[a] | 338 | -0.0493[a] | 338 | 0.8158[a] | 333 |
| TUESDAY | 0.2490[a] | 360 | -0.1013[a] | 360 | 0.7894[a] | 356 |
| WEDNESDAY | 0.3033[a] | 362 | -0.0654[a] | 362 | 0.8146[a] | 355 |
| THURSDAY | 0.3018[a] | 354 | -0.0331[a] | 354 | 0.8008[a] | 352 |
| FRIDAY | 0.4414[a] | 353 | 0.1480[a] | 353 | 0.9390[a] | 351 |
| Test for Differences Between Weekdays | F(4,1762) = 1.74 P-value = 0.1385 | | F(4,1762) = 1.40 P-value = 0.2307 | | F(4,1742) = 0.37 P-value = 0.8281 | |

PRICE LEVEL = $10-$20

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0553[b] | 338 | -0.0280[a] | 338 | 0.2185[a] | 337 |
| TUESDAY | 0.0692[ba] | 360 | -0.0049[a] | 360 | 0.2135[a] | 359 |
| WEDNESDAY | 0.0690[ba] | 362 | -0.0376[a] | 362 | 0.2721[a] | 360 |
| THURSDAY | 0.0782[ba] | 354 | -0.0284[a] | 354 | 0.2709[a] | 354 |
| FRIDAY | 0.1071[a] | 353 | 0.0179[a] | 353 | 0.2624[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 2.22 P-value = 0.0642 | | F(4,1762) = 1.87 P-value = 0.1134 | | F(4,1758) = 2.03 P-value = 0.0882 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 24 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Reversal**

PRICE LEVEL = $20-$30

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0425[ba] | 338 | -0.0109[a] | 338 | 0.1340[a] | 337 |
| TUESDAY | 0.0198[b] | 360 | -0.0417[a] | 360 | 0.1241[a] | 359 |
| WEDNESDAY | 0.0377[ba] | 362 | -0.0225[a] | 362 | 0.1459[a] | 360 |
| THURSDAY | 0.0536[ba] | 354 | -0.0015[a] | 354 | 0.1454[a] | 353 |
| FRIDAY | 0.0582[a] | 353 | -0.0044[a] | 353 | 0.1618[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 2.69 P-value = 0.0298 | | F(4,1762) = 2.03 P-value = 0.0880 | | F(4,1757) = 0.87 P-value = 0.4837 | |

PRICE LEVEL = $30-$50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0409[a] | 338 | 0.0070[a] | 338 | 0.0839[a] | 337 |
| TUESDAY | 0.0333[a] | 360 | -0.0106[a] | 360 | 0.0865[a] | 359 |
| WEDNESDAY | 0.0402[a] | 362 | -0.0070[a] | 362 | 0.1023[a] | 360 |
| THURSDAY | 0.0281[a] | 354 | -0.0137[a] | 354 | 0.0952[a] | 354 |
| FRIDAY | 0.0373[a] | 353 | -0.0155[a] | 353 | 0.1014[a] | 353 |
| Test for Differences Between Weekdays | F(4,1762) = 0.60 P-value = 0.6658 | | F(4,1762) = 0.90 P-value = 0.4615 | | F(4,1758) = 0.68 P-value = 0.6051 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 24 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Reversal**

PRICE LEVEL = > $50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0161[a] | 338 | -0.0153[a] | 328 | 0.0280[a] | 333 |
| TUESDAY | 0.0226[a] | 359 | -0.0107[a] | 348 | 0.0366[a] | 352 |
| WEDNESDAY | 0.0241[a] | 362 | 0.0108[a] | 345 | 0.0334[a] | 357 |
| THURSDAY | 0.0174[a] | 354 | -0.0126[a] | 337 | 0.0391[a] | 352 |
| FRIDAY | 0.0220[a] | 353 | 0.0084[a] | 337 | 0.0313[a] | 349 |
| Test for Differences Between Weekdays | F(4,1761) = 0.21 P-value = 0.9320 | | F(4,1690) = 0.79 P-value = 0.5322 | | F(4,1738) = 0.21 P-value = 0.9352 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

mean return for continuation price changes must exceed the mean return for reversal price changes in order for a profit to be made on these final transaction price changes.

Table 25 contains the results of tests for differences between price level group final transaction returns if the final trade was a continuation price change. Significant differences were found for all final trades and for both pre and post 3:56pm final trades. If the final transaction was a continuation occurring after 3:56pm then the mean final trade return of 0.57% for securities less than $10 in price was significantly greater than the mean final trade return for all other price level group securities. If the final trade was a continuation occurring prior to 3:56pm then the mean return of -0.18% for securities less than $10 was significantly less than the mean return to securities in price level groups exceeding $20. When all final continuation transactions were considered together, then the mean return of 0.13% for the $10 or less securities was found to be significantly greater than the mean returns for securities in the $10 to $50 price level groups.

The frequencies of final transactions occurring before and after 3:56pm are presented in Table 26. Contrasting these results with those in Table 6, the most noticeable difference is the proportion of trades occurring after 3:56pm in the less than $10 price group. If the final trade was a continuation, then it was found that 38.4% of the final transactions took place after 3:56pm. This is compared with 29.8% of all final transactions taking place after 3:56pm in this price range. For the other price ranges a larger proportion of continuations, as compared to all trades, took place in the last five minutes, but the differences were not nearly as pronounced as in the case of the $10 or less security price group.

Table 27 shows how returns to continuation final transactions have been changing over time. Significant differences between years were detected in both the $10 or less and the $10 to $20 price groups for all final transactions and post 3:56pm final transactions. For the $10 or less post 3:56pm trades, the mean return of 1.67% for the year 8283 was

**Table 25. Test for Security Price Level Differences in Returns to the Final Transaction for Continuations**

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| PRICE LEVEL | Average Return | N | Average Return | N | Average Return | N |
| < $10 | 0.1269[a] | 1721 | -0.1759[b] | 1578 | 0.5681[a] | 1375 |
| $10-$20 | 0.0162[b] | 1767 | -0.0817[ba] | 1767 | 0.2131[b] | 1747 |
| $20-$30 | 0.0114[b] | 1767 | -0.0532[a] | 1766 | 0.1368[b] | 1753 |
| $30-$50 | 0.0131[b] | 1767 | -0.0419[a] | 1765 | 0.0868[b] | 1757 |
| > $50 | 0.0245[ba] | 1762 | -0.0041[a] | 1608 | 0.0422[b] | 1714 |
| Test for Differences Between Price Levels | F(4,8779) = 3.44 P-value = 0.0081 | | F(4,8479) = 6.55 P-value = 0.0001 | | F(4,8341) = 19.68 P-value = 0.0001 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 26. Frequencies of Final Transactions at Different Price Levels if the Final Price Change is a Continuation**

| PRICE LEVEL | ALL FINAL TRANSACTIONS | FINAL TRANSACTION BEFORE 3:56 PM | FINAL TRANSACTION AFTER 3:56 PM |
|---|---|---|---|
| < $10 | 7565 | 4660 | 2905 |
| $10-$20 | 28565 | 19189 | 9376 |
| $20-$30 | 32167 | 21264 | 10903 |
| $30-$50 | 33132 | 19556 | 13576 |
| > $50 | 13346 | 5488 | 7858 |

Test for independence of price level and time of final transaction:

Chi-square = 3085.71
P-value < 0.0001

**Table 27. Test for Yearly Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Continuation**

PRICE LEVEL = < $10

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.1983$^{c}$ | 248 | -0.3130$^{a}$ | 240 | 0.0078$^{b}$ | 203 |
| 9/01/79-8/31/80 | -0.1071$^{bc}$ | 250 | -0.2792$^{a}$ | 242 | 0.2755$^{b}$ | 200 |
| 9/01/80-8/31/81 | -0.0530$^{bac}$ | 250 | -0.2552$^{a}$ | 235 | 0.3164$^{b}$ | 190 |
| 9/01/81-8/31/82 | -0.0683$^{bc}$ | 249 | -0.1023$^{a}$ | 241 | 0.1917$^{b}$ | 182 |
| 9/01/82-8/31/83 | 0.5020$^{ba}$ | 241 | -0.1190$^{a}$ | 220 | 1.6683$^{a}$ | 170 |
| 9/01/83-8/31/84 | 0.2608$^{bac}$ | 238 | -0.1355$^{a}$ | 195 | 0.5690$^{ba}$ | 203 |
| 9/01/84-8/31/85 | 0.5778$^{a}$ | 245 | 0.0113$^{a}$ | 205 | 1.0150$^{ba}$ | 227 |
| Test for Differences Between Years | F(6,1714) = 4.12 P-value = 0.0004 | | F(6,1571) = 0.61 P-value = 0.7188 | | F(6,1368) = 3.27 P-value = 0.0034 | |

PRICE LEVEL = $10-$20

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0077$^{ba}$ | 251 | -0.0784$^{a}$ | 251 | 0.1538$^{ba}$ | 250 |
| 9/01/79-8/31/80 | -0.0492$^{b}$ | 252 | -0.0951$^{a}$ | 252 | 0.0808$^{b}$ | 251 |
| 9/01/80-8/31/81 | -0.0090$^{ba}$ | 252 | -0.1020$^{a}$ | 252 | 0.2482$^{a}$ | 246 |
| 9/01/81-8/31/82 | -0.0226$^{ba}$ | 252 | -0.1145$^{a}$ | 252 | 0.2475$^{a}$ | 246 |
| 9/01/82-8/31/83 | 0.0434$^{ba}$ | 254 | -0.0614$^{a}$ | 254 | 0.2175$^{ba}$ | 252 |
| 9/01/83-8/31/84 | 0.0695$^{a}$ | 254 | -0.0863$^{a}$ | 254 | 0.2727$^{a}$ | 253 |
| 9/01/84-8/31/85 | 0.0885$^{a}$ | 252 | -0.0344$^{a}$ | 252 | 0.2726$^{a}$ | 249 |
| Test for Differences Between Years | F(6,1760) = 3.40 P-value = 0.0024 | | F(6,1760) = 0.73 P-value = 0.6292 | | F(6,1740) = 3.36 P-value = 0.0027 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 27 (cont). Test for Yearly Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Continuation**

PRICE LEVEL = $20-$30

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0026[a] | 251 | -0.0389[a] | 251 | 0.1041[a] | 251 |
| 9/01/79-8/31/80 | -0.0176[a] | 252 | -0.0713[a] | 252 | 0.0865[a] | 251 |
| 9/01/80-8/31/81 | -0.0085[a] | 252 | -0.0842[a] | 252 | 0.1519[a] | 248 |
| 9/01/81-8/31/82 | -0.0120[a] | 252 | -0.0635[a] | 252 | 0.1408[a] | 250 |
| 9/01/82-8/31/83 | 0.0398[a] | 254 | -0.0206[a] | 254 | 0.1710[a] | 253 |
| 9/01/83-8/31/84 | 0.0314[a] | 254 | -0.0654[a] | 254 | 0.1685[a] | 252 |
| 9/01/84-8/31/85 | 0.0487[a] | 252 | -0.0284[a] | 251 | 0.1342[a] | 248 |
| Test for Differences Between Years | F(6,1760) = 1.96 P-value = 0.0682 | | F(6,1759) = 1.17 P-value = 0.3212 | | F(6,1746) = 1.37 P-value = 0.2246 | |

PRICE LEVEL = $30-$50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0089[a] | 251 | -0.0534[a] | 251 | 0.0981[a] | 251 |
| 9/01/79-8/31/80 | -0.0124[a] | 252 | -0.0630[a] | 252 | 0.0685[a] | 252 |
| 9/01/80-8/31/81 | -0.0104[a] | 252 | -0.0561[a] | 252 | 0.0713[a] | 249 |
| 9/01/81-8/31/82 | -0.0013[a] | 252 | -0.0447[a] | 252 | 0.0550[a] | 247 |
| 9/01/82-8/31/83 | 0.0438[a] | 254 | 0.0021[a] | 254 | 0.1107[a] | 253 |
| 9/01/83-8/31/84 | 0.0221[a] | 254 | -0.0514[a] | 254 | 0.1004[a] | 253 |
| 9/01/84-8/31/85 | 0.0408[a] | 252 | -0.0271[a] | 250 | 0.1026[a] | 252 |
| Test for Differences Between Years | F(6,1760) = 2.46 P-value = 0.0228 | | F(6,1758) = 1.72 P-value = 0.1135 | | F(6,1750) = 1.29 P-value = 0.2588 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 27 (cont). Test for Yearly Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Continuation**

PRICE LEVEL = > $50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0329[a] | 250 | 0.0579[a] | 200 | 0.0264[a] | 236 |
| 9/01/79-8/31/80 | 0.0216[a] | 251 | -0.0203[ba] | 243 | 0.0495[a] | 247 |
| 9/01/80-8/31/81 | 0.0302[a] | 252 | -0.0051[ba] | 251 | 0.0723[a] | 248 |
| 9/01/81-8/31/82 | 0.0062[a] | 250 | -0.0331[b] | 218 | 0.0263[a] | 230 |
| 9/01/82-8/31/83 | 0.0342[a] | 254 | 0.0125[ba] | 248 | 0.0449[a] | 254 |
| 9/01/83-8/31/84 | 0.0169[a] | 254 | -0.0421[b] | 226 | 0.0343[a] | 251 |
| 9/01/84-8/31/85 | 0.0296[a] | 251 | 0.0078[ba] | 222 | 0.0397[a] | 248 |
| Test for Differences Between Years | F(6,1755) = 0.66 P-value = 0.6846 | | F(6,1601) = 2.32 P-value = 0.0309 | | F(6,1707) = 1.23 P-value = 0.2886 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

found to be significantly greater than the mean returns in years 7879 through 8182. All final transaction mean returns in this price group showed an increasing trend from a low of -0.20% in 7879 to a high of 0.58% in 8485. The post 3:56pm final trades in the $10 to $20 price range had a low mean return of 0.08% which differed significantly from the mean returns in years 8081 through 8485, exclusive of 8283. A trend was not apparent. Mean returns did appear to be increasing for all final transactions in this price range where the 7980 mean return of -0.05% was significantly less than the mean 8384 and 8485 returns of 0.07% and 0.09%, respectively. Significant differences were found in the $30 to $50 price group for all final transactions, but the TKMCP was not sensitive enough to distinguish the differences. Significant differences were also found in the over $50 price range for pre 3:56pm final transactions which exhibited a general tendency to decrease over the time period from a high mean return of 0.06% in 7879 to lows of -0.03% and -0.04% in years 8182 and 8384, respectively.

The results of examining weekday effects on mean final transaction returns for continuations are presented in Table 28. The strongest effects appear to be in the $10 to $20 price level group. The mean Friday return of 0.35% for post 3:56pm transactions was significantly greater than the mean returns on Mondays through Wednesdays. The pre 3:56pm Friday mean return was greater than the pre 3:56pm mean return on Monday, and for all final transactions in this price group, Friday's mean return was significantly greater than the mean returns on Monday and Tuesday. In the $10 or less price group, the only significant differences found were that for all final transactions, Friday's mean return of 0.38% was greater then Monday's mean return of -0.19%. Significant differences were found in the $20 to $30 price level group for all final transactions and for both pre and post 3:56pm transactions. For the pre 3:56pm group Friday's mean return of -0.01% was found to be greater than Monday's mean returns of -0.08%. The post 3:56pm mean return of 0.18% on Friday was significantly greater than the 0.09%

**Table 28. Test for Weekday Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Continuation**

PRICE LEVEL = < $10

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.1908[b] | 329 | -0.3179[a] | 303 | 0.2026[a] | 262 |
| TUESDAY | 0.3083[ba] | 346 | -0.0654[a] | 320 | 0.9818[a] | 280 |
| WEDNESDAY | 0.1774[ba] | 353 | -0.0667[a] | 323 | 0.3952[a] | 289 |
| THURSDAY | -0.0519[ba] | 348 | -0.4038[a] | 317 | 0.3668[a] | 274 |
| FRIDAY | 0.3767[a] | 345 | -0.0342[a] | 315 | 0.8834[a] | 270 |
| Test for Differences Between Weekdays | F(4,1716) = 3.31 P-value = 0.0104 | | F(4,1573) = 1.88 P-value = 0.1122 | | F(4,1370) = 1.70 P-value = 0.1467 | |

PRICE LEVEL = $10-$20

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0484[b] | 338 | -0.1391[b] | 338 | 0.1519[b] | 334 |
| TUESDAY | -0.0082[b] | 360 | -0.0956[ba] | 360 | 0.1515[b] | 357 |
| WEDNESDAY | 0.0155[ba] | 362 | -0.0634[ba] | 362 | 0.1856[b] | 355 |
| THURSDAY | 0.0166[ba] | 354 | -0.0880[ba] | 354 | 0.2290[ba] | 352 |
| FRIDAY | 0.1032[a] | 353 | -0.0250[a] | 353 | 0.3468[a] | 349 |
| Test for Differences Between Weekdays | F(4,1762) = 5.51 P-value = 0.0002 | | F(4,1762) = 2.45 P-value = 0.0447 | | F(4,1742) = 6.07 P-value = 0.0001 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 28 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Continuation**

PRICE LEVEL = $20-$30

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0133[b] | 338 | -0.0802[b] | 338 | 0.1253[ba] | 335 |
| TUESDAY | -0.0176[b] | 360 | -0.0705[ba] | 360 | 0.0909[b] | 357 |
| WEDNESDAY | 0.0158[ba] | 362 | -0.0424[ba] | 362 | 0.1302[ba] | 356 |
| THURSDAY | 0.0116[ba] | 354 | -0.0667[ba] | 354 | 0.1502[ba] | 354 |
| FRIDAY | 0.0599[a] | 353 | -0.0071[a] | 352 | 0.1875[a] | 351 |
| Test for Differences Between Weekdays | F(4,1762) = 3.44 P-value = 0.0083 | | F(4,1761) = 2.46 P-value = 0.0436 | | F(4,1748) = 2.41 P-value = 0.0473 | |

PRICE LEVEL = $30-$50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0144[a] | 338 | -0.0325[a] | 338 | 0.0927[ba] | 337 |
| TUESDAY | -0.0080[a] | 360 | -0.0697[a] | 360 | 0.0722[ba] | 356 |
| WEDNESDAY | 0.0143[a] | 362 | -0.0482[a] | 362 | 0.0995[ba] | 360 |
| THURSDAY | 0.0077[a] | 354 | -0.0306[a] | 354 | 0.0485[b] | 352 |
| FRIDAY | 0.0376[a] | 353 | -0.0273[a] | 351 | 0.1212[a] | 352 |
| Test for Differences Between Weekdays | F(4,1762) = 1.73 P-value = 0.1415 | | F(4,1760) = 1.48 P-value = 0.2066 | | F(4,1752) = 3.08 P-value = 0.0154 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 28 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Continuation**

PRICE LEVEL = > $50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0272[a] | 338 | 0.0077[a] | 312 | 0.0429[a] | 327 |
| TUESDAY | 0.0186[a] | 359 | -0.0220[a] | 323 | 0.0441[a] | 347 |
| WEDNESDAY | 0.0098[a] | 360 | -0.0244[a] | 324 | 0.0237[a] | 350 |
| THURSDAY | 0.0244[a] | 353 | 0.0065[a] | 324 | 0.0384[a] | 344 |
| FRIDAY | 0.0433[a] | 352 | 0.0123[a] | 325 | 0.0620[a] | 346 |
| Test for Differences Between Weekdays | F(4,1757) = 1.37 P-value = 0.2433 | | F(4,1603) = 0.97 P-value = 0.4205 | | F(4,1709) = 1.29 P-value = 0.2720 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

mean return on Tuesday. When all final continuation transactions in this price range were considered Friday's return of 0.06% was significantly greater then the mean returns on Monday and Tuesday of -0.01% and -0.02%, respectively. Significant differences were found in the $30 to $50 price level group for post 3:56pm final transactions where Friday's mean return of 0.12% was greater then Thursday's mean return of 0.05%.

The results of tests for price level differences in returns to final transactions for unclassified price changes are given in Table 29. Significant differences were found for post 3:56pm final trades where the mean return of 0.41% for $10 and less securities was greater than the mean returns in the greater than $20 price groups. Table 30 presents the frequencies of trades occurring before and after 3:56pm. Compared to the frequencies reported in Table 6, the proportion of unclassified price changes occurring after 3:56pm was less than the proportion of all trades occurring after 3:56pm for every price level. This was not surprising since the later in the day a price change occurs, the less likely that it could not be classified. A smaller proportion of all trades occurring after 3:56pm were unclassified when compared to the proportion of all trades occurring prior to 3:56pm which were unclassified.

Tests for annual differences in final transaction returns for unclassified price changes reveal no significant differences for any price level group. These results are presented in Table 31. When weekday differences in mean final trade returns were analyzed, significant differences were found for all final transactions and pre 3:56pm transactions in the $10 to $20 and the $20 to $30 price ranges. In each case, Friday's return was at least as great or greater than the final return on the other four days of the week. The weekday results are presented in Table 32.

In conclusion the observed end of day effect was not solely the result of the reversal process nor was it solely the results of the changes of the intrinsic value of the securities. It appeared that the reversal process may have had a larger impact on the end-of-day

**Table 29. Test for Security Price Level Differences in Returns to the to the Final Transaction for Unknown Price Change Types**

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| PRICE LEVEL | Average Return | N | Average Return | N | Average Return | N |
| < $10 | 0.0412[a] | 1741 | -0.0427[a] | 1695 | 0.4121[a] | 1006 |
| $10-$20 | -0.0178[a] | 1763 | -0.0372[a] | 1754 | 0.1067[ba] | 1189 |
| $20-$30 | -0.0354[a] | 1748 | -0.0548[a] | 1717 | 0.0640[b] | 1005 |
| $30-$50 | 0.0127[a] | 1708 | -0.0073[a] | 1635 | 0.0789[b] | 898 |
| > $50 | 0.0127[a] | 1151 | -0.0053[a] | 870 | 0.0389[b] | 527 |
| Test for Differences Between Price Levels | F(4,8106) = 1.07 P-value = 0.3711 | | F(4,7666) = 0.54 P-value = 0.7067 | | F(4,4620) = 4.00 P-value = 0.0030 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 30. Frequencies of Final Transactions at Different Price Levels if the Final Price Change Type is Unknown**

| PRICE LEVEL | ALL FINAL TRANSACTIONS | FINAL TRANSACTION BEFORE 3:56 PM | FINAL TRANSACTION AFTER 3:56 PM |
|---|---|---|---|
| < $10 | 9776 | 8204 | 1572 |
| $10-$20 | 16912 | 14811 | 2101 |
| $20-$30 | 10584 | 9058 | 1526 |
| $30-$50 | 6977 | 5547 | 1430 |
| > $50 | 1920 | 1246 | 674 |

Test for independence of price level and time of final transaction:

Chi-square = 813.44
P-value < 0.0001

**Table 31. Test for Yearly Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Unknown**

PRICE LEVEL = < $10

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0503[a] | 249 | -0.0724[a] | 247 | 0.2368[a] | 164 |
| 9/01/79-8/31/80 | -0.1888[a] | 252 | -0.2301[a] | 252 | -0.0302[a] | 164 |
| 9/01/80-8/31/81 | -0.1042[a] | 252 | -0.1843[a] | 252 | 0.6806[a] | 145 |
| 9/01/81-8/31/82 | -0.0650[a] | 252 | -0.2117[a] | 252 | 0.8160[a] | 147 |
| 9/01/82-8/31/83 | 0.1007[a] | 248 | 0.1389[a] | 241 | -0.4852[a] | 98 |
| 9/01/83-8/31/84 | 0.3485[a] | 242 | 0.1827[a] | 219 | 0.7461[a] | 136 |
| 9/01/84-8/31/85 | 0.2644[a] | 246 | 0.1282[a] | 232 | 0.7114[a] | 152 |
| Test for Differences Between Years | F(6,1734) = 1.72 P-value = 0.1123 | | F(6,1688) = 1.71 P-value = 0.1151 | | F(6,999) = 1.25 P-value = 0.2775 | |

PRICE LEVEL = $10-$20

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0321[a] | 251 | -0.0450[a] | 251 | 0.1061[a] | 202 |
| 9/01/79-8/31/80 | -0.0254[a] | 252 | -0.0385[a] | 252 | 0.0959[a] | 178 |
| 9/01/80-8/31/81 | -0.0474[a] | 252 | -0.0470[a] | 252 | 0.0420[a] | 147 |
| 9/01/81-8/31/82 | -0.0611[a] | 252 | -0.0774[a] | 252 | 0.1133[a] | 179 |
| 9/01/82-8/31/83 | -0.0210[a] | 253 | -0.0239[a] | 252 | -0.0327[a] | 109 |
| 9/01/83-8/31/84 | 0.0366[a] | 252 | -0.0055[a] | 249 | 0.1643[a] | 189 |
| 9/01/84-8/31/85 | 0.0260[a] | 251 | -0.0224[a] | 246 | 0.1857[a] | 185 |
| Test for Differences Between Years | F(6,1756) = 1.03 P-value = 0.4047 | | F(6,1747) = 0.30 P-value = 0.9361 | | F(6,1182) = 0.77 P-value = 0.5914 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 31 (cont). Test for Yearly Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Unknown**

PRICE LEVEL = $20-$30

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | -0.0510[a] | 249 | -0.0655[a] | 249 | -0.0069[a] | 142 |
| 9/01/79-8/31/80 | 0.0058[a] | 250 | 0.0039[a] | 248 | 0.0258[a] | 128 |
| 9/01/80-8/31/81 | -0.0800[a] | 251 | -0.1102[a] | 249 | 0.0475[a] | 135 |
| 9/01/81-8/31/82 | -0.0497[a] | 252 | -0.0722[a] | 252 | 0.1937[a] | 148 |
| 9/01/82-8/31/83 | -0.0597[a] | 252 | -0.0881[a] | 250 | 0.0750[a] | 118 |
| 9/01/83-8/31/84 | -0.0127[a] | 253 | -0.0398[a] | 247 | 0.0619[a] | 175 |
| 9/01/84-8/31/85 | 0.0013[a] | 241 | -0.0059[a] | 222 | 0.0455[a] | 159 |
| Test for Differences Between Years | F(6,1741) = 1.39 P-value = 0.2151 | | F(6,1710) = 1.77 P-value = 0.1023 | | F(6,998) = 1.23 P-value = 0.2858 | |

PRICE LEVEL = $30-$50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0210[a] | 250 | 0.0139[a] | 244 | 0.0272[b] | 122 |
| 9/01/79-8/31/80 | 0.0476[a] | 241 | 0.0157[a] | 227 | 0.0636[ba] | 119 |
| 9/01/80-8/31/81 | -0.0006[a] | 244 | -0.0106[a] | 243 | 0.0556[b] | 107 |
| 9/01/81-8/31/82 | -0.0057[a] | 237 | -0.0398[a] | 231 | 0.2394[a] | 79 |
| 9/01/82-8/31/83 | -0.0168[a] | 246 | -0.0426[a] | 235 | 0.1088[ba] | 108 |
| 9/01/83-8/31/84 | 0.0332[a] | 250 | 0.0367[a] | 236 | 0.0528[b] | 183 |
| 9/01/84-8/31/85 | 0.0092[a] | 240 | -0.0263[a] | 219 | 0.0763[ba] | 180 |
| Test for Differences Between Years | F(6,1701) = 0.59 P-value = 0.7378 | | F(6,1628) = 0.79 P-value = 0.5770 | | F(6,891) = 2.03 P-value = 0.0595 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 31 (cont). Test for Yearly Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Unknown**

PRICE LEVEL = > $50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| YEAR | Average Return | N | Average Return | N | Average Return | N |
| 9/01/78-8/31/79 | 0.0290[a] | 127 | -0.0319[ba] | 80 | 0.0743[a] | 62 |
| 9/01/79-8/31/80 | -0.0163[a] | 159 | -0.0271[ba] | 133 | 0.0403[a] | 51 |
| 9/01/80-8/31/81 | 0.0281[a] | 206 | 0.0103[ba] | 183 | 0.0545[a] | 70 |
| 9/01/81-8/31/82 | -0.0778[a] | 117 | -0.1365[b] | 92 | 0.1475[a] | 34 |
| 9/01/82-8/31/83 | -0.0011[a] | 169 | -0.0234[ba] | 140 | 0.0263[a] | 63 |
| 9/01/83-8/31/84 | 0.0411[a] | 186 | 0.0060[ba] | 115 | 0.0280[a] | 133 |
| 9/01/84-8/31/85 | 0.0504[a] | 187 | 0.1168[a] | 127 | -0.0033[a] | 114 |
| Test for Differences Between Years | F(6,1144) = 1.04 P-value = 0.4004 | | F(6,863) = 1.59 P-value = 0.1473 | | F(6,520) = 1.29 P-value = 0.2623 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 32. Test for Weekday Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Unknown**

PRICE LEVEL = < $10

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.1222[a] | 333 | -0.0339[a] | 323 | -0.3414[a] | 198 |
| TUESDAY | -0.0348[a] | 356 | -0.1773[a] | 341 | 0.7106[a] | 191 |
| WEDNESDAY | 0.0518[a] | 354 | -0.1195[a] | 345 | 0.5000[a] | 204 |
| THURSDAY | 0.1082[a] | 348 | 0.0077[a] | 340 | 0.7326[a] | 203 |
| FRIDAY | 0.1964[a] | 350 | 0.1086[a] | 346 | 0.4559[a] | 210 |
| Test for Differences Between Weekdays | F(4,1736) = 0.91 P-value = 0.4590 | | F(4,1690) = 0.92 P-value = 0.4498 | | F(4,1001) = 1.60 P-value = 0.1732 | |

PRICE LEVEL = $10-$20

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.1025[b] | 338 | -0.1392[b] | 334 | 0.1442[a] | 215 |
| TUESDAY | 0.0262[a] | 360 | 0.0206[a] | 359 | 0.0839[a] | 231 |
| WEDNESDAY | -0.0346[ba] | 362 | -0.0515[ba] | 360 | 0.1147[a] | 252 |
| THURSDAY | -0.0461[ba] | 350 | -0.0761[ba] | 350 | 0.0782[a] | 244 |
| FRIDAY | 0.0637[a] | 353 | 0.0542[a] | 351 | 0.1151[a] | 247 |
| Test for Differences Between Weekdays | F(4,1758) = 4.57 P-value = 0.0011 | | F(4,1749) = 4.72 P-value = 0.0009 | | F(4,1184) = 0.17 P-value = 0.9553 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 32 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Unknown**

PRICE LEVEL = $20-$30

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.1048[b] | 333 | -0.1348[b] | 327 | 0.0108[a] | 177 |
| TUESDAY | -0.0563[ba] | 356 | -0.0800[ba] | 349 | 0.0533[a] | 192 |
| WEDNESDAY | -0.0148[ba] | 360 | -0.0228[a] | 354 | 0.0774[a] | 191 |
| THURSDAY | -0.0274[ba] | 350 | -0.0525[ba] | 343 | 0.0546[a] | 219 |
| FRIDAY | 0.0231[a] | 349 | 0.0114[a] | 344 | 0.1125[a] | 226 |
| Test for Differences Between Weekdays | F(4,1743) = 4.00 P-value = 0.0031 | | F(4,1712) = 4.31 P-value = 0.0018 | | F(4,1000) = 0.58 P-value = 0.6740 | |

PRICE LEVEL = $30-$50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0258[a] | 322 | -0.0365[a] | 314 | 0.0864[a] | 161 |
| TUESDAY | 0.0264[a] | 348 | 0.0056[a] | 326 | 0.0433[a] | 187 |
| WEDNESDAY | 0.0030[a] | 350 | -0.0079[a] | 336 | 0.0582[a] | 187 |
| THURSDAY | 0.0146[a] | 345 | -0.0229[a] | 333 | 0.1130[a] | 182 |
| FRIDAY | 0.0427[a] | 343 | 0.0246[a] | 326 | 0.0963[a] | 181 |
| Test for Differences Between Weekdays | F(4,1703) = 1.04 P-value = 0.3856 | | F(4,1630) = 0.67 P-value = 0.6135 | | F(4,893) = 0.67 P-value = 0.6138 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table 32 (cont). Test for Weekday Differences in Returns to the Final Transaction for Different Security Price Levels - Price Change Type: Unknown**

PRICE LEVEL = > $50

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0451[a] | 227 | -0.0686[a] | 168 | -0.0109[a] | 103 |
| TUESDAY | 0.0633[a] | 239 | 0.0268[a] | 177 | 0.0702[a] | 114 |
| WEDNESDAY | 0.0071[a] | 222 | -0.0002[a] | 179 | 0.0243[a] | 88 |
| THURSDAY | 0.0218[a] | 234 | 0.0241[a] | 186 | 0.0332[a] | 103 |
| FRIDAY | 0.0135[a] | 229 | -0.0141[a] | 160 | 0.0677[a] | 119 |
| Test for Differences Between Weekdays | F(4,1146) = 1.34 P-value = 0.2539 | | F(4,865) = 0.66 P-value = 0.6187 | | F(4,522) = 1.30 P-value = 0.2699 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

anomaly first because the mean reversal returns appeared to be larger than the mean continuation returns, and second because the proportion of reversals in the final five minutes was almost twice the proportion of continuations. Both continuations and reversals displayed similar patterns with regard to weekday and year. It was noticed that the weekday effect may have been stronger for the continuations while the yearly effect appeared to be stronger for reversals.

# Chapter 5 Summary and Conclusions

This study has examined end-of-day transaction returns for a random sample of firms listed on the NYSE during the time period of September 1978 through August 1985. The results presented in Chapter four may be briefly summarized as follows:

1. The end-of-day phenomenon was found to persist over the seven year time period, and the results indicate that the phenomenon is getting stronger over time.
2. The final transaction returns do exhibit weekday difference's with Friday's mean return being at least as great or greater than the mean returns on the other days of the week.
3. The price level differences first noted by Harris also persist over time with low price securities exhibiting increasing returns over the time period. Low price securities also exhibited the strongest weekday return differences.
4. A relationship was found to exist between CRSP excess return level (good day/bad day) and the final transaction returns, and classification of good day/bad day prior to 3:55pm provided evidence that the final return may have a large impact on the CRSP excess return.

5. Reversals are more frequent than continuations on the final trade, particularly after 3:56pm, and the mean return to reversals is greater than the mean return to continuations. This difference is solely the result of differences in returns to reversals and continuations for securities in the less than $10 price level.
6. The mean returns to continuations are not great enough to overcome the cost of the bid/ask spread implying that there are no profit opportunities to trading on the final transaction after 3:56pm.

## *Directions for Future Research*

This study has raised a number of interesting questions that are beyond its scope and hence are potential topics of further research. Some of the major topics are as follows:

1. Is there any relationship between price level and trading thinness? Are the price level differences found in this study just a proxy for thinness of trading differences.
2. The final trade of the day appeared to have an major impact on the CRSP excess return, particularly if the final trade was a reversal. What are the impacts of the bid/ask spread on CRSP excess returns and, what impact does the excess return/end-of-day relationship have on other studies that utilize the CRSP excess returns to measure daily security performance?
3. Is it possible that the end-of-day phenomenon is not necessarily the result of increased buying at the close, but the result of increased selling leading up to the close, possibly the result of day traders liquidating their inventories?

4. Are the significant increases in the mean end-of-day returns noted in the last two years related to increases in programmed trading strategies or related to market index instruments trading?
5. Is it possible to identify a subgroup of securities which may be primarily responsible for the end-of-day anomaly, or is the phenomenon pervasive across firms.

# Appendix A Listing of Firms used in Study

| Name | Start Date | End Date |
|---|---|---|
| A M C A INTL LTD | 831206 | 850831 |
| A V X CORP | 790612 | 850831 |
| ACME ELEC CORP | 820115 | 850831 |
| ADVEST GROUP INC | 821118 | 850831 |
| CENTRAL AGUIRRE SUGAR CO | 780901 | 781208 |
| AILEEN INC | 780901 | 850831 |
| ALBANY INTL CORP | 780901 | 830803 |
| ALBERTSONS INC | 780901 | 850831 |
| ALEXANDERS INC | 780901 | 850831 |
| ALLEN ELEC & EQUIP CO | 780901 | 850831 |
| ALLIED CHEM CORP | 810428 | 850831 |
| ALLIED STORES CORP | 780901 | 850831 |
| AMALGAMATED SUGAR CO | 780901 | 821103 |
| AMERICAN AGRONOMICS CORP | 810323 | 850831 |
| AMERICAN BLDG MAINTENANCE INDS | 780901 | 850831 |
| AMERICAN BUSINESS PRODS INC | 801208 | 850831 |
| AMERICAN DISTILLING CO | 780901 | 800808 |
| AMERICAN ELEC PWR INC | 780901 | 850831 |
| AMERICAN EXPRESS CO | 780901 | 850831 |
| AMERICAN FAMILY CORP | 780901 | 850831 |
| AMERICAN INTL GROUP INC | 841010 | 850831 |
| AMERICAN RADIATOR & STD SAN CORP | 780901 | 850831 |
| AMERICUS TR FOR AT&T COM SHS | 831221 | 850831 |
| AMERICUS TR FOR AT&T COM SHS | 831221 | 850831 |
| AMIC CORP | 780901 | 790214 |
| AMSOUTH BANCORPORATION | 810520 | 810630 |
| AMERICAN SUGAR REFNG CO | 780901 | 840208 |
| AMSTED INDS INC | 780901 | 850831 |
| ANACOMP INC | 820426 | 850831 |
| ANDERSON GREENWOOD & CO | 820217 | 850831 |
| ANGELICA CORP | 780901 | 850831 |
| ANHEUSER BUSCH COS INC | 800418 | 850831 |
| ANIXTER BROS INC | 780901 | 850831 |
| WESTCOAST TRANSMISSION LTD | 780901 | 850831 |
| WESTERN AIR LINES INC | 780901 | 850831 |

| Name | Start Date | End Date |
|---|---|---|
| ANTA CORP | 811110 | 850411 |
| ANTHEM ELECTRS INC | 841205 | 850831 |
| APACHE PETE INC | 810224 | 850831 |
| APPLIED MAGNETICS CORP | 780901 | 850831 |
| ARCTIC ENTERPRISES INC | 780901 | 810304 |
| ARKANSAS BEST CORP | 780901 | 850831 |
| ARLEN RLTY & DEV CORP | 780901 | 850831 |
| ARMSTRONG RUBR CO | 780901 | 850831 |
| ASHLAND OIL & REFNG CO | 780901 | 850831 |
| AVIALL INC | 841031 | 850831 |
| AVON PRODS INC | 780901 | 850831 |
| B M C INDS INC | 830504 | 850831 |
| BALLY MFG CORP | 780901 | 850831 |
| BANK CALIF N A SAN FRANCISCO | 780901 | 840618 |
| VIRGINIA COMWLTH BANCSHARES | 780901 | 850831 |
| BANKERS TR N Y CORP | 780901 | 850831 |
| BARNETT BANKS FLA INC | 791217 | 850831 |
| BAY ST GAS CO | 780901 | 850831 |
| BECKMAN INSTRS INC | 780901 | 820304 |
| BEECH AIRCRAFT CORP | 780901 | 800208 |
| BENDIX CORP | 780901 | 830131 |
| BENEQUITY HLDGS | 850618 | 850831 |
| BEST PRODS INC | 780901 | 850831 |
| BLACK HILLS PWR & LT CO | 800709 | 850831 |
| BOEING CO | 780901 | 850831 |
| BOSTON EDISON CO | 780901 | 850831 |
| BRAUN C F & CO | 780901 | 800130 |
| BRIGGS & STRATTON CORP | 780901 | 850831 |
| BRISTOL MYERS CO | 780901 | 850831 |
| BRITISH TELECOMMUNICATIONS PLC | 841203 | 850620 |
| BROWN CO | 780901 | 801028 |
| BULOVA WATCH INC | 780901 | 790321 |
| BUNDY CORP | 780901 | 850831 |
| BUNKER HILL INCOME SECS INC | 780901 | 850831 |
| BURLINGTON NORTHN INC | 780901 | 850831 |
| BUTTES GAS & OIL CO | 851118 | 850831 |
| COLUMBIA BROADCASTING SYS INC | 780901 | 850831 |
| CONTINENTAL COPPER & STL INDS | 780901 | 850831 |
| C S X CORP | 801113 | 850831 |
| C T S CORP | 780901 | 850831 |
| C 3 INC | 830222 | 850831 |
| CANAL RANDOLPH CORP | 780901 | 850306 |
| CANNON MLS CO | 790215 | 820216 |
| CAPITAL CITIES BROADCASTING CORP | 780901 | 850831 |
| CAPITAL HLDG CORP DEL | 780901 | 850831 |
| CANADIAN BREWERIES LTD | 780901 | 850831 |
| CAROLINA FGHT CARRIERS CORP | 780901 | 850831 |
| CAROLINA PWR & LT CO | 780901 | 850831 |

| Name | Start Date | End Date |
|---|---|---|
| CARPENTER STL CO | 780901 | 850831 |
| CARSON PIRIE SCOTT & CO DEL | 780901 | 850831 |
| CASCADE NAT GAS CORP | 780901 | 850831 |
| CECO CORP | 780901 | 850831 |
| CENTRAL LA ELEC INC | 780901 | 830617 |
| CENERGY CORP | 841015 | 850831 |
| CENTRAL & SOUTH WEST CORP | 780901 | 850831 |
| CENTRAL ME PWR CO | 780901 | 850831 |
| CHEMED CORP | 820629 | 850831 |
| CHESAPEAKE & OHIO RY CO | 780901 | 801031 |
| CHICAGO PNEUMATIC TOOL CO | 780901 | 850831 |
| CHOCK FULL O NUTS CORP | 780901 | 850831 |
| CHRIS CRAFT INDS INC | 780901 | 850831 |
| CHROMALLOY CORP | 780901 | 850831 |
| CINCINNATI MLG MACH CO | 780901 | 850831 |
| CLARK EQUIP CO | 780901 | 850831 |
| CLUB MED INC | 840925 | 850831 |
| CLUETT PEABODY & CO INC | 780901 | 850831 |
| COACHMEN INDS INC | 780901 | 850831 |
| COCA COLA BOTTLING CO N Y INC | 780901 | 810827 |
| COLE NATL CORP | 780901 | 840917 |
| COLUMBIA GAS SYS INC | 780901 | 850831 |
| COLUMBIA PICTURES CORP | 780901 | 820621 |
| COMBUSTION ENGR INC | 780901 | 850831 |
| COMBUSTION EQUIP ASSOC INC | 780901 | 801103 |
| NEW ENGLAND GAS & ELEC ASSN | 730912 | 810508 |
| COMMUNICATIONS SATELLITE CORP | 780901 | 850831 |
| CONNECTICUT GEN MTG & RLTY INVTS | 780901 | 810818 |
| CONTINENTAL OIL CO | 780901 | 810930 |
| GIANNINI CONTROLS CORP | 780901 | 850831 |
| CONSUMERS PWR CO | 780901 | 850831 |
| CONTINENTAL CORP | 780901 | 850831 |
| CONTINENTAL CAN INC | 780901 | 841101 |
| CONTINENTAL ILL CORP | 780901 | 850831 |
| CONTINENTAL ILL PPTYS | 780901 | 790712 |
| CONTROL DATA CORP MINN | 780901 | 850831 |
| AMERICAN SNUFF CO | 780901 | 850831 |
| COMPUTING & SOFTWARE INC | 780901 | 850831 |
| CRAIG CORP | 780901 | 850831 |
| CROWN CORK & SEAL INC | 780901 | 850831 |
| CRUM & FORSTER | 780901 | 830111 |
| CULLINANE DATABASE SYS INC | 820427 | 850831 |
| CUNNINGHAM DRUG STORES INC | 780901 | 810220 |
| UNIVERSAL CYCLOPS STL CORP | 780901 | 850831 |
| DAMON ENGR INC | 780901 | 850831 |
| DAN RIVER MLS INC | 780901 | 830524 |
| DE LUXE CHECK PRINTERS INC | 800425 | 850831 |
| DENNISON MFG CO | 780901 | 850831 |

| Name | Start Date | End Date |
|---|---|---|
| DENNYS RESTAURANTS INC | 780901 | 850125 |
| DENTISTS SUPPLY CO NY | 780901 | 821223 |
| DE SOTO CHEM COATINGS INC | 780901 | 850831 |
| DIAMOND NATL CORP | 780901 | 821202 |
| DIAMOND SHAMROCK OFFSHORE PTNR | 850829 | 850831 |
| DIGITAL EQUIP CORP | 780901 | 850831 |
| DILLINGHAM CORP | 780901 | 830317 |
| DONALDSON LUFKIN & JENRETTE INC | 780901 | 850116 |
| DORR OLIVER INC | 780901 | 790531 |
| DOW JONES & CO INC | 780901 | 850831 |
| DYCO PETE CORP | 810123 | 850831 |
| DYNAMICS CORP AMER | 780901 | 850831 |
| EDGERTON GERMES & GRIER INC | 780901 | 850831 |
| EAGLE PICHER CO | 780901 | 850831 |
| EASTERN AIR LINES INC. | 780901 | 850831 |
| EASTMAN KODAK CO | 780901 | 850831 |
| EATON MFG CO | 780901 | 850831 |
| EDISON BROS STORES INC | 680102 | 790928 |
| EDWARDS A G & SONS INC | 780901 | 850831 |
| ELCOR CHEM CORP | 780901 | 850831 |
| ELECTROSPACE SYS INC | 840828 | 850831 |
| ELIXIR INDS | 780901 | 820223 |
| ALABAMA GAS CORP | 850718 | 850831 |
| ENERGY EXCHANGE CORP | 821111 | 850831 |
| ENGELHARD CORP | 810527 | 850831 |
| ENVIROTECH CORP | 780901 | 820302 |
| EQUIMARK CORP | 780901 | 850831 |
| EQUITABLE LIFE MTG & RLTY INVS | 780901 | 830105 |
| ERBAMONT N V | 830621 | 850831 |
| ESTERLINE CORP | 780901 | 850831 |
| ETHYL CORP | 780901 | 850831 |
| EVANS PRODS CO | 780901 | 850831 |
| EX CELL O CORP | 780901 | 850831 |
| FLORIDA PWR & LT CO | 780901 | 850831 |
| FABRI CTRS AMER INC | 780901 | 850831 |
| FAIRCHILD STRATOS CORP | 780901 | 850831 |
| FANSTEEL METALLURGICAL CORP | 840309 | 850831 |
| FAR WEST FINL CORP | 780901 | 850831 |
| FEDERAL MOGUL BOWER BEARINGS INC | 780901 | 850831 |
| FEDERATED DEPT STORES INC | 780901 | 850831 |
| FIDELITY FINL CORP | 780901 | 820412 |
| FINANCIAL CORP SANTA BARBARA | 780901 | 850831 |
| FIRST BOSTON INC | 830506 | 850831 |
| FIRST CHICAGO CORP | 780901 | 850831 |
| FIRST CITY BANCORPORATION TEX | 780901 | 850831 |
| FIRST NATIONWIDE FINL CORP | 850411 | 850831 |
| FIRST VA BANKSHARES CORP | 780901 | 850831 |
| FLORIDA EAST COAST RY CO | 780901 | 850831 |

| Name | Start Date | End Date |
|---|---|---|
| GENERAL RESH CORP | 810915 | 850831 |
| FOOTE CONE & BELDING INC | 780901 | 850831 |
| FOSTER WHEELER CORP | 780901 | 850831 |
| FOXBORO CO | 780901 | 850831 |
| FREEPORT MCMORAN ENERGY PARTNER | 850419 | 850831 |
| FREEPORT MCMORAN OIL & GAS RTY | 831012 | 850831 |
| NATCO CORP | 780901 | 850831 |
| GENERAL AMERN TRANSN CORP | 780901 | 850831 |
| GEOPHYSICS CORP AMER | 780901 | 850831 |
| GENERAL TEL & ELECTRS CORP | 780901 | 850831 |
| GATEWAY INDS INC DEL | 780901 | 810413 |
| GEARHART OWEN INDS INC | 780901 | 850831 |
| GENERAL BANCSHARES CORP | 780901 | 850831 |
| GENERAL MTRS CORP | 780901 | 850831 |
| GENERAL PORTLAND CEM CO | 780901 | 811123 |
| GENERAL REFRACTORIES CO | 780901 | 850831 |
| GENERAL RY SIGNAL CO | 780901 | 850831 |
| GIDDINGS & LEWIS INC | 780901 | 820802 |
| GOODRICH B F CO | 780901 | 850831 |
| GOODYEAR TIRE & RUBR CO | 780901 | 850831 |
| GOULD NATL BATTERIES INC | 780901 | 850831 |
| GREEN MOUNTAIN PWR CORP | 820127 | 850831 |
| GREEN TREE ACCEPTANCE INC | 850628 | 850831 |
| GRUBB AND ELLIS CO | 830414 | 850831 |
| GUARDIAN INDS CORP | 780901 | 850221 |
| GULF OIL CORP | 780901 | 840615 |
| GULF STS UTILS CO | 680102 | 790917 |
| GULFSTREAM AEROSPACE CORP | 830419 | 850816 |
| HALLIBURTON CO | 780901 | 850831 |
| HANCOCK JOHN INVS INC | 780901 | 850831 |
| HANDY & HARMAN | 780901 | 850831 |
| HARCOURT BRACE & WORLD INC | 780901 | 850831 |
| HARRIS GRAPHICS CORP | 841010 | 850831 |
| HARSCO CORP | 780901 | 850831 |
| HARTE HANKS NEWSPAPERS INC | 780901 | 840911 |
| HAZLETON LABS CORP | 821215 | 850831 |
| GREAT WEST HOSPS INC | 850422 | 850831 |
| HEILEMAN G BREWING INC | 780901 | 850831 |
| HEILIG MEYERS CO | 830609 | 850831 |
| HELMERICH & PAYNE INC | 780901 | 850831 |
| HERCULES POWDER CO | 780901 | 850831 |
| HERITAGE COMMUNICATIONS INC | 820519 | 850831 |
| HI SHEAR CORP | 791207 | 850831 |
| HOMESTAKE MNG CO | 780901 | 850831 |
| HOMESTEAD FINL CORP | 840125 | 850831 |
| MINNEAPOLIS HONEYWELL REGULATOR | 780901 | 850831 |
| HORIZON BANCORP | 800523 | 850831 |
| HOSPITAL CORP AMER | 701120 | 801031 |

| Name | Start Date | End Date |
|---|---|---|
| HOUSTON NAT GAS CORP | 780901 | 850716 |
| HUBBARD REAL EST INVTS | 780901 | 850831 |
| HUGHES TOOL CO | 780901 | 850831 |
| HYDRAULIC CO | 801219 | 850831 |
| IDEAL CEM CO | 780901 | 850831 |
| IDEAL TOY CORP | 780901 | 820817 |
| INTERNATIONAL NICKEL CO CDA LTD | 780901 | 850831 |
| INLAND CONTAINER CORP | 780901 | 781114 |
| STANDARD & POORS INTERCAPITAL | 780901 | 850831 |
| INTERNATIONAL SHOE CO | 780901 | 850831 |
| INTERLAKE IRON CORP | 780901 | 850831 |
| INTERNATIONAL FLAVORS & FRAG | 780901 | 850831 |
| INTERNATIONAL HARVESTER CO | 780901 | 850831 |
| INTERNATIONAL MINERALS & CHEM | 780901 | 850831 |
| INTERNATIONAL PAPER CO | 780901 | 850831 |
| IOWA ELEC LT & PWR CO | 780901 | 850831 |
| IOWA ILL GAS & ELEC CO | 780901 | 850831 |
| INDIANAPOLIS PWR & LT CO | 780901 | 850831 |
| IPCO HOSP SUPPLY CORP | 780901 | 850831 |
| CHARTER N Y CORP | 791017 | 850831 |
| JAMES FRED S & CO INC | 780901 | 821201 |
| JAMESWAY CORP | 780901 | 850831 |
| JANTZEN INC | 780901 | 800117 |
| JAPAN FD INC | 780901 | 850831 |
| JEWEL TEA INC | 780901 | 841116 |
| JOHNSON & JOHNSON | 780901 | 850831 |
| JOHNSON E F CO | 780901 | 821130 |
| KAISER STEEL CORP | 780901 | 840229 |
| KANEB PIPE LINE CO | 780901 | 850831 |
| KANSAS CITY SOUTHN RY CO | 780901 | 850831 |
| KANSAS GAS & ELEC CO | 780901 | 850831 |
| KANSAS PWR & LT CO | 780901 | 850831 |
| KEENE CORP | 780901 | 810430 |
| KELLWOOD CO | 780901 | 850831 |
| C I RLTY INVS | 790831 | 810731 |
| KOEHRING CO | 780901 | 800905 |
| KOPPERS INC | 780901 | 850831 |
| KUBOTA LTD | 780901 | 850831 |
| KUHLMAN CORP | 780901 | 850831 |
| KYSOR INDL CORP DEL | 780901 | 850831 |
| L & N HSG CORP | 820429 | 850831 |
| L L & E RTY TR | 830706 | 850831 |
| LIBERTY LN CORP | 780901 | 850831 |
| LAFARGE CORP | 831123 | 850831 |
| LAMSON & SESSIONS CO | 780901 | 850831 |
| LEE ENTERPRISES INC | 780901 | 850831 |
| LEHIGH VALLEY INDS INC | 780901 | 850831 |
| LESLIE FAY INC | 780901 | 820428 |

| Name | Start Date | End Date |
|---|---|---|
| LIBERTY CORP S C | 780901 | 850831 |
| LINCOLN NATL CORP IND | 780901 | 850831 |
| LITTON INDS INC | 780901 | 850831 |
| LOMAS & NETTLETON FINL CORP | 780901 | 850831 |
| LOMAS & NETTLETON MTG INVS | 780901 | 850831 |
| LONGS DRUG STORES INC | 780901 | 850831 |
| LOWENSTEIN M & SONS INC | 780901 | 850831 |
| LUBYS CAFETERIAS INC | 820222 | 850831 |
| MICROWAVE ASSOC INC | 780901 | 850831 |
| METRO GOLDWYN MAYER FILM CO | 800617 | 850831 |
| MAC ANDREWS & FORBES CO | 780901 | 800418 |
| MAC DONALD E F CO | 780901 | 811028 |
| MANHATTAN LIFE CORP | 790102 | 821230 |
| MANUFACTURERS HANOVER CORP | 780901 | 850831 |
| JOHNS MANVILLE CORP | 811102 | 850831 |
| SUPERSCOPE INC | 731107 | 840621 |
| MARK CTLS CORP | 780901 | 850831 |
| MARSH & MC LENNAN INC | 780901 | 850831 |
| MASSMUTUAL MTG & RLTY INVS | 780901 | 850625 |
| MASSMUTUAL CORPORATE INVS INC | 780901 | 850831 |
| MATSUSHITA ELEC INDL LTD | 780901 | 850831 |
| MATTEL INC | 780901 | 850831 |
| MAY DEPT STORES CO | 780901 | 850831 |
| MAYER OSCAR & CO INC DEL | 780901 | 810505 |
| MAYS J W INC | 780901 | 820205 |
| MAYTAG CO | 780901 | 850831 |
| MC DONALDS CORP | 780901 | 850831 |
| MC GRAW HILL PUBG INC | 780901 | 850831 |
| MC LEAN INDS INC NEW | 831025 | 850831 |
| MC MORAN EXPL CO | 781113 | 810407 |
| MELLON NATL CORP | 810710 | 850831 |
| METROMEDIA INC | 780901 | 840621 |
| MIDLAND ROSS CORP | 780901 | 850831 |
| MILLER WOHL INC | 780901 | 840626 |
| MOHAWK DATA SCIENCES CORP | 780901 | 850831 |
| MOHAWK RUBR CO | 780901 | 840119 |
| MONARCH MACH TOOL CO | 780901 | 850831 |
| MORAN ENERGY INC | 801201 | 840320 |
| MYERS L E GROUP CO | 840725 | 850831 |
| MYERS L E CO | 780901 | 840629 |
| NAPLES FED SVGS & LN ASSN FLA | 800215 | 850831 |
| N B I INC | 811102 | 850831 |
| NATIONAL DETROIT CORP | 780901 | 850831 |
| NATIONAL VULCANIZED FIBRE CO | 780901 | 850831 |
| NATIONAL CAN CORP | 780901 | 850501 |
| NATIONAL CONVENIENCE STORES | 810501 | 850831 |
| NATIONAL MED CARE INC | 780901 | 841220 |
| NATIONAL MINE SVC CO | 780901 | 850831 |

| Name | Start Date | End Date |
|---|---|---|
| NEPTUNE METER CO | 780901 | 790103 |
| NEW YORK ST ELEC & GAS CORP | 780901 | 850831 |
| NEWELL COS INC | 790628 | 850831 |
| NEWHALL RES | 830329 | 850831 |
| NICOLET INSTR CORP | 820630 | 850831 |
| NORTHERN ILL GAS CO | 780901 | 850831 |
| NOBLE AFFILIATES INC | 800610 | 850831 |
| NORFOLK SOUTHERN CORP | 820625 | 850831 |
| NORTHERN CALIF SVGS & LN ASSN | 780901 | 820730 |
| NORTHROP CORP | 780901 | 850831 |
| NORTHWEST PIPELINE CORP | 780901 | 790206 |
| NORTHWEST BANCORPORATION | 780901 | 850831 |
| OKLAHOMA CEM CO | 780901 | 810424 |
| OGDEN CORP | 780901 | 850831 |
| ORANGE-CO INC | 780901 | 850831 |
| OUTBOARD MARINE CORP | 780901 | 850831 |
| OVERNITE TRANSN CO | 780901 | 850831 |
| OWENS CORNING FIBERGLAS CORP | 780901 | 850831 |
| OXFORD MFG INC | 780901 | 850831 |
| P H H GROUP INC | 781218 | 850831 |
| PACIFIC LTG CORP | 780901 | 850831 |
| PACIFIC LMBR CO | 780901 | 850831 |
| PACIFIC NORTHWEST BELL TEL CO | 780901 | 801222 |
| PACIFIC SCIENTIFIC CO | 791129 | 850831 |
| PACIFIC TIN CONS CORP | 780901 | 850831 |
| PALM BEACH CO | 780901 | 850831 |
| PAMIDA INC | 780901 | 810115 |
| PANTRY PRIDE INC | 830218 | 850831 |
| PAPERCRAFT CORP | 780901 | 850831 |
| PARGAS INC | 780901 | 831202 |
| PARK ELECTROCHEMICAL CORP | 840425 | 850831 |
| PAY N PAK STORES INC | 830502 | 850831 |
| PAYLESS CASHWAYS INC | 810917 | 850831 |
| PENNSYLVANIA RR CO | 780901 | 781024 |
| PENN CENT CORP | 781114 | 850831 |
| PENNSALT CHEMS CORP | 780901 | 850831 |
| SOUTH PENN OIL CO | 780901 | 850831 |
| PEOPLES DRUG STORES INC | 780901 | 840409 |
| PERRY DRUG STORES INC | 830413 | 850831 |
| PERTEC CORP | 780901 | 791211 |
| PHILADELPHIA SUBN CORP | 780901 | 850831 |
| PIEDMONT AVIATION INC | 780925 | 850831 |
| PIONEER NAT GAS CO | 780901 | 850831 |
| PLESSEY LTD | 780901 | 850831 |
| PNEUMO DYNAMICS CORP | 780901 | 841018 |
| PUBLIC SVC CO N H | 780901 | 850831 |
| PUERTO RICAN CEM INC | 780901 | 850831 |
| PUROLATOR INC | 780403 | 840425 |

| Name | Start Date | End Date |
|---|---|---|
| BURNS R L CORP | 771213 | 811215 |
| MICHIGAN SEAMLESS TUBE CO | 780901 | 850831 |
| R P C ENERGY SVCS INC | 840702 | 850831 |
| RADICE CORP | 850228 | 850831 |
| RALSTON PURINA CO | 780901 | 850831 |
| REALTY REFUND TR | 780901 | 850831 |
| REECE CORP | 780901 | 850831 |
| REGAL INTL INC | 820601 | 850831 |
| LEASCO DATA PROCESSING EQUIP | 780901 | 820108 |
| REPUBLIC NATL BK N Y | 800819 | 850831 |
| REPUBLIC STL CORP | 780901 | 840629 |
| RESEARCH COTTRELL INC | 810311 | 850831 |
| RESERVE OIL & GAS CO | 780901 | 800123 |
| REXHAM CORP | 780901 | 850831 |
| CHAIN BELT CO | 780901 | 850831 |
| REYNOLDS METALS CO | 780901 | 850831 |
| ROCHESTER TEL CORP | 780901 | 850831 |
| ROLLINS COMMUNICATIONS INC | 840702 | 850831 |
| ROLLINS ENVIRONMENTAL SVCS INC | 820803 | 850831 |
| RORER WILLIAM H INC | 780901 | 850831 |
| NEW YORK & HONDURAS ROSARIO MNG | 780901 | 800410 |
| ROYAL DUTCH PETE CO | 780901 | 850831 |
| RYDER SYS INC | 780901 | 850831 |
| SANTA ANITA RLTY ENTERPRISES | 810521 | 850831 |
| WELCH SCIENTIFIC CO | 780901 | 850831 |
| SAVIN BUSINESS MACHS CORP | 780901 | 850831 |
| SAXON PAPER CORP | 780901 | 820428 |
| SCHLUMBERGER LTD | 780901 | 850831 |
| SCOTT & FETZER CO | 780901 | 850831 |
| SCOTT PAPER CO | 780901 | 850831 |
| SEA CONTAINERS LTD | 840330 | 850831 |
| SEALED AIR CORP | 790531 | 850831 |
| SEDCO INC | 780901 | 841224 |
| SHAPELL INDS INC | 780901 | 840718 |
| C B W L HAYDEN STONE INC | 780901 | 810629 |
| SHELL OIL CO | 780901 | 850607 |
| SHELL TRANS & TRADING LTD | 780901 | 850831 |
| SHERWIN WILLIAMS CO | 780901 | 850831 |
| SHOWBOAT INC | 840530 | 850831 |
| SIGNAL OIL & GAS CO | 780901 | 850831 |
| SKIL CORP | 780901 | 790323 |
| SKYLINE HOMES INC | 780901 | 850831 |
| ALPHA PORTLAND CEM CO | 850503 | 850831 |
| SNYDER OIL PARTNERS | 850618 | 850831 |
| SONY CORP | 780901 | 850831 |
| SOO LINE RR CO | 780901 | 850831 |
| ATICO MTG INVS | 780901 | 820825 |
| SOUTHDOWN INC | 780901 | 850831 |

| Name | Start Date | End Date |
|---|---|---|
| SOUTHERN NEW ENGLAND TEL CO | 780901 | 850831 |
| SOUTHLAND CORP | 780901 | 850831 |
| SPARTON CORP | 780901 | 850831 |
| SPRINGS MLS INC | 780901 | 850831 |
| SQUARE D CO | 780901 | 850831 |
| STANDARD OIL CO OHIO | 780901 | 850831 |
| STANDARD INTL CORP | 780901 | 850831 |
| STANDARD FINL CORP | 681022 | 781023 |
| STERLING DRUG INC | 780901 | 850831 |
| STEVENS J P & CO INC | 780901 | 850831 |
| GREEN SHOE MFG CO | 780901 | 850831 |
| SUN ELEC CORP | 780901 | 850831 |
| SUNSHINE MNG CO | 780901 | 850831 |
| T G I FRIDAYS INC | 831208 | 850831 |
| THOMPSON RAMO WOOLDRIDGE INC | 780901 | 850831 |
| TAPPAN CO | 780901 | 791203 |
| TECHNICOLOR INC | 780901 | 830124 |
| TELEDYNE INC | 780901 | 850831 |
| TELEPROMPTER CORP | 780901 | 810818 |
| TELEX CORP | 780901 | 850831 |
| TEMPLE INLAND INC | 840127 | 850831 |
| INTEX OIL CO | 780901 | 850831 |
| TEXAS GULF SULPHUR CO | 780901 | 810925 |
| TEXFI INDS INC | 780901 | 850831 |
| TI CARO INC | 800603 | 840504 |
| ELECTRONIC MEMORIES & MAGNETICS | 850530 | 850831 |
| TONKA CORP | 780901 | 850831 |
| TOSCO CORP | 800130 | 850831 |
| TOWLE MFG CO | 801218 | 850831 |
| TRANE CO | 780901 | 840224 |
| TRANSCANADA PIPELINES LTD | 850530 | 850831 |
| TRANSCO EXPL PARTNERS | 830715 | 850831 |
| UNITED STS FGHT CO | 780901 | 850831 |
| TRI-SOUTH MTG INVS | 780901 | 850415 |
| TRIANGLE PAC FOREST PRODS CORP | 780901 | 850831 |
| TRICENTROL LTD | 800715 | 850831 |
| TUCSON GAS & ELEC CO | 690521 | 790509 |
| TWENTIETH CENTY FOX FILM CORP | 780901 | 810611 |
| UNIVERSITY COMPUTING CO | 780227 | 840521 |
| U R S SYS CORP | 840306 | 850831 |
| INTERSTATE UNIFORM SVCS CORP | 840116 | 850831 |
| UNILEVER LTD | 780901 | 850831 |
| UNION CARBIDE CORP | 780901 | 850831 |
| UNION COMM CORP | 780901 | 830330 |
| UTD CABLE TELEVISION | 811007 | 850831 |
| UNITED FINL CORP CALIF | 780901 | 800104 |
| UNITED STS HOME & DEV CORP | 780901 | 850831 |
| UNITED STS INDS INC | 780901 | 840718 |

| Name | Start Date | End Date |
|---|---|---|
| UNITED STS LEASING CORP | 780901 | 850831 |
| UNITED STS STL CORP | 780901 | 850831 |
| UNITED STS TOB CO | 780901 | 850831 |
| UNITED STOCKYARDS CORP | 850211 | 850404 |
| UNITED AIRCRAFT CORP | 780901 | 850831 |
| V W R UTD CORP | 780901 | 850831 |
| UNIVERSAL LEAF TOB INC | 780901 | 850831 |
| MISSOURI PUB SVC CO | 850502 | 850831 |
| VANITY FAIR MLS INC | 780901 | 850831 |
| VARCO INTL INC | 810629 | 850831 |
| VARIAN ASSOC | 780901 | 850831 |
| VEECO INSTRS INC | 781201 | 850831 |
| VIACOM INTL INC | 780901 | 850831 |
| VORNADO INC | 780901 | 850831 |
| WESTERN UN INTL INC | 780901 | 791120 |
| WACHOVIA CORP | 780901 | 850831 |
| WACHOVIA RLTY INVTS | 780901 | 820318 |
| WACKENHUT CORP | 801230 | 850831 |
| WALGREEN CO | 780901 | 850831 |
| WALKER HIRAM GOODERHAM & WORTS | 780901 | 800409 |
| WARNER BROS CO | 780901 | 850831 |
| WASHINGTON STL CORP | 780901 | 790327 |
| WEINGARTEN RLTY INC | 850816 | 850831 |
| WEIS MKTS INC | 780901 | 850831 |
| WENDYS INTL INC | 810527 | 850831 |

# Appendix B Weekday Difference Results around Harris Time period

**Table B1. Test for Weekday Mean Return Differences before, during and after the Harris Time Period**

TIME PERIOD = 9/01/78-11/30/81

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0108[b] | 157 | -0.0514[b] | 158 | 0.0798[b] | 157 |
| TUESDAY | -0.0000[b] | 165 | -0.0449[b] | 166 | 0.0975[ba] | 165 |
| WEDNESDAY | 0.0154[ba] | 166 | -0.0220[ba] | 168 | 0.0976[ba] | 166 |
| THURSDAY | 0.0040[b] | 162 | -0.0484[b] | 162 | 0.1118[ba] | 162 |
| FRIDAY | 0.0421[a] | 164 | -0.0002[a] | 164 | 0.1297[a] | 164 |
| Test for Differences Between Weekdays | F(4,809) = 5.15 P-value = 0.0004 | | F(4,813) = 4.77 P-value = 0.0008 | | F(4,809) = 2.87 P-value = 0.0223 | |

TIME PERIOD = 12/01/81- 1/31/83

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | -0.0201[b] | 57 | -0.0595[a] | 57 | 0.0699[a] | 57 |
| TUESDAY | 0.0570[a] | 61 | 0.0215[a] | 61 | 0.1347[a] | 61 |
| WEDNESDAY | -0.0202[b] | 60 | -0.0683[a] | 60 | 0.0927[a] | 60 |
| THURSDAY | 0.0198[ba] | 60 | -0.0304[a] | 60 | 0.1386[a] | 60 |
| FRIDAY | 0.0305[ba] | 57 | -0.0109[a] | 57 | 0.1308[a] | 57 |
| Test for Differences Between Weekdays | F(4,290) = 3.05 P-value = 0.0175 | | F(4,290) = 2.50 P-value = 0.0431 | | F(4,290) = 1.46 P-value = 0.2137 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table B1 (cont). Test for Weekday Mean Return Differences before, during and after the Harris Time Period**

TIME PERIOD = 2/01/83-8/31/85

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Return | N | Average Return | N | Average Return | N |
| MONDAY | 0.0537[b] | 123 | -0.0022[ba] | 123 | 0.1309[ba] | 123 |
| TUESDAY | 0.0376[b] | 133 | -0.0187[b] | 133 | 0.1169[b] | 133 |
| WEDNESDAY | 0.0579[ba] | 134 | -0.0061[ba] | 134 | 0.1436[ba] | 134 |
| THURSDAY | 0.0567[b] | 132 | 0.0054[ba] | 132 | 0.1230[b] | 132 |
| FRIDAY | 0.0868[a] | 132 | 0.0234[a] | 132 | 0.1677[a] | 132 |
| Test for Differences Between Weekdays | F(4,649) = 5.47 P-value = 0.0002 | | F(4,649) = 2.96 P-value = 0.0192 | | F(4,649) = 4.36 P-value = 0.0017 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table B2. Test for Weekday Mean Price Change Differences before, during and after the Harris Time Period**

TIME PERIOD = 9/01/78-11/30/81

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Price Change | N | Average Price Change | N | Average Price Change | N |
| MONDAY | -0.0296[b] | 157 | -0.8074[b] | 158 | 1.6455[a] | 157 |
| TUESDAY | 0.0490[ba] | 165 | -0.7886[ba] | 166 | 1.8467[a] | 165 |
| WEDNESDAY | 0.2998[ba] | 166 | -0.4679[ba] | 168 | 1.9640[a] | 166 |
| THURSDAY | 0.0691[ba] | 162 | -0.8689[b] | 162 | 1.9844[a] | 162 |
| FRIDAY | 0.6941[a] | 164 | -0.0866[a] | 164 | 2.3228[a] | 164 |
| Test for Differences Between Weekdays | F(4,809) = 2.81 P-value = 0.0245 | | F(4,813) = 3.14 P-value = 0.0141 | | F(4,809) = 1.28 P-value = 0.2771 | |

TIME PERIOD = 12/01/81- 1/31/83

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | FINAL TRANSACTION AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Price Change | N | Average Price Change | N | Average Price Change | N |
| MONDAY | -0.1013[a] | 57 | -0.9128[a] | 57 | 1.8442[a] | 57 |
| TUESDAY | 0.4002[a] | 61 | -0.3193[a] | 61 | 1.9787[a] | 61 |
| WEDNESDAY | -0.1758[a] | 60 | -0.8360[a] | 60 | 1.4659[a] | 60 |
| THURSDAY | 0.4263[a] | 60 | -0.4285[a] | 60 | 2.3001[a] | 60 |
| FRIDAY | 0.3785[a] | 57 | -0.3371[a] | 57 | 1.9753[a] | 57 |
| Test for Differences Between Weekdays | F(4,290) = 1.08 P-value = 0.3649 | | F(4,290) = 0.84 P-value = 0.5004 | | F(4,290) = 0.77 P-value = 0.5431 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

**Table B2 (cont). Test for Weekday Mean Price Change Differences before, during and after the Harris Time Period**

TIME PERIOD = 2/01/83-8/31/85

| | ALL FINAL TRANSACTIONS | | FINAL TRANSACTION BEFORE 3:56 PM | | AFTER 3:56 PM | |
|---|---|---|---|---|---|---|
| WEEKDAY | Average Price Change | N | Average Price Change | N | Average Price Change | N |
| MONDAY | 0.6533[b] | 123 | -0.3396[ba] | 123 | 2.0030[ba] | 123 |
| TUESDAY | 0.4146[b] | 133 | -0.5295[b] | 133 | 1.7968[b] | 133 |
| WEDNESDAY | 0.8720[ba] | 134 | -0.1545[ba] | 134 | 2.2270[ba] | 134 |
| THURSDAY | 0.8285[ba] | 132 | -0.0112[ba] | 132 | 1.9108[b] | 132 |
| FRIDAY | 1.3078[a] | 132 | 0.1725[a] | 132 | 2.6401[a] | 132 |
| Test for Differences Between Weekdays | F(4,649) = 5.36 P-value = 0.0003 | | F(4,649) = 3.25 P-value = 0.0119 | | F(4,649) = 3.55 P-value = 0.0071 | |

**Note: Within columns, group means with same superscript letter are not significantly different at the .05 level.**

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