Economic Perspectives—Volume 1, Number 1—Fall 1987—Pages 169–177

Anomalies
Seasonal Movements in Security Prices II: Weekend, Holiday, Turn of the Month, and Intraday Effects

Richard Thaler

"Discovery commences with the awareness of anomaly, i.e., with the recognition that nature has somehow violated the paradigm-induced expectations that govern normal science."

Thomas Kuhn

This feature will report successful searches for disconfirming evidence—economic anomalies. As suggested by Thomas Kuhn, an economic anomaly is a result inconsistent with the economics paradigm. Economics is distinguished from other social sciences by the belief that most (all?) behavior can be explained by assuming that agents have stable, well-defined preferences and make rational choices consistent with those preferences in markets that (eventually) clear. An empirical result is anomalous if it is difficult to "rationalize," or if implausible assumptions are necessary to explain it within the paradigm. Of course, "difficult" and "implausible" are judgements, and others might disagree with my assessment. Therefore, I invite readers to submit *brief* explanations (within the paradigm or otherwise) for any of the anomalies I report. To be considered for publication, however, proposed explanations must be falsifiable, at least in principle. A reader who claims that an alleged anomaly is actually the rational response to taxes should be willing to make some prediction based on that

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hypothesis; for example, the anomaly will not be observed in a country with no taxes, or for non-taxed agents, or in time periods before the relevant tax existed. Someone offering an explanation based on transactions costs might suggest an experimental test in which the transactions costs could be eliminated and should be willing to predict that the effect will disappear in that environment.

The future topics for this feature will come from as many fields of empirical economics as possible. Readers are invited to suggest topics by sending a note with some references to (or better yet copies of) the relevant research. My address is: Richard Thaler, c/o *Journal of Economic Perspectives*, Johnson Graduate School of Management, Malott Hall, Cornell University, Ithaca, NY 14853.

In the previous issue, I reviewed the peculiar behavior of security prices in January. Stock prices tend to rise in January, particularly the prices of small firms and firms whose stock price has declined substantially over the past few years. Also, risky stocks earn most of their risk premiums in January. This issue will conclude our survey of seasonal anomalies in security prices with a review of four additional effects: the behavior of prices over weekends, before holidays, at the turn of each month, and within the day.[1]

The Weekend Effect

Define the daily return (that is, price change plus dividends) for a particular day of the week as the return from the close of the previous trading day to the close of trading on that day. Using this definition, how should we expect Monday returns to compare to the returns for other weekdays? The most logical hypothesis—dubbed the "calendar time hypothesis" by French (1980)—is that prices should rise somewhat more on Mondays than on other days because the time between the close of trading on Friday and the close of trading on Monday is three days, rather than the normal one day between other trading days. Accordingly, Monday returns should be three times higher than other weekday returns. French offers an alternative, the "trading time hypothesis," which states that returns are generated only during active trading and implies that returns should be the same for every trading day. This hypothesis strikes me as unreasonable. Suppose, for example, trading were restricted to one day per week during the summer. Wouldn't we expect the return on those days to be equal to the normal *weekly* return? In any case, neither hypothesis is consistent with the data.

The first study of weekend effects in security markets appeared in the *Journal of Business* in 1931, written by a graduate student at Harvard named M. J. Fields. He was investigating the conventional Wall Street wisdom at the time that "the unwil-

[1]Timothy Taylor, our managing editor, has pointed out to me that calling these effects "seasonal" is a bit of a misnomer (especially the intraday effects), since they have little to do with seasons. However, I have been unable to come up with a better word. Any suggestions?

lingness of traders to carry their holdings over the uncertainties of a week-end leads to a liquidation of long accounts and a consequent decline of security prices on Saturday" (Fields, 1931, p. 415). Fields examined the pattern of the Dow Jones Industrial Average (DJIA) for the period 1915–1930 to see if the conventional wisdom was true. He compared the closing price of the DJIA for Saturday with the mean of the closing prices on the adjacent Friday and Monday. He found, in fact, that prices tended to rise on Saturdays. For the 717 weekends he studied, the Saturday price was more than \$.10 higher than the Friday–Monday mean 52 percent of the time, while it was lower only 36 percent of the time.

The next study of daily return patterns did not appear in the academic literature for four decades. Frank Cross (1973) studied the returns on the Standard and Poors index of 500 stocks (the S&P 500) over the period 1953 to 1970. He found that the index rose on 62 percent of the Fridays, but on only 39.5 percent of the Mondays. The mean return on Fridays was 0.12 percent, while the mean return on Mondays was −0.18 percent. As Cross says, "the probability that such a large difference would occur by chance is less than one in a million."

Kenneth French (1980) also used the S&P 500 index to study daily returns and obtained similar results. He studied the period 1953–1977 and found that the mean Monday return was negative for the full period (mean = −0.168 percent, $t = -6.8$) and also for every five year sub-period. The mean return was positive (as would be expected) for all other days of the week, with Wednesdays and Fridays having the highest returns. French then asked whether the negative returns on Mondays might be due to some unidentified "closed-market effect." If so, the expected return should be lower following holidays, as well as weekends. He found instead that average returns were higher than normal for Mondays, Wednesdays, Thursdays and Fridays after holidays. On Tuesdays following Monday holidays, returns were negative, perhaps a belated showing of the usual negative weekend returns. He interpreted these results as suggesting that there is something special about weekends, as opposed to general market closings.

The Cross and French studies both measured Monday returns as the difference between the closing price on Friday and the closing price on Monday. This leaves open whether prices fall during the day on Mondays or between Friday's close and Monday's opening. This issue was investigated by Richard Rogalski (1984). Rogalski obtained opening and closing prices for the DJIA for the period from October 1, 1974 to April 30, 1984 and for the S&P 500 for the period January 2, 1979 to April 30, 1984. He found that prices rose on Mondays from the opening to the close. The negative returns were all between the close of trading on Friday and the opening on Monday. Thus the Monday effect became the weekend effect.[2] He also found that weekends in January are different from other months. During January, weekend and

[2]Smirlock and Starks (1986) studied weekend effects for the DJIA over the period 1963–83. They found that the negative returns have shifted backward in time. In the 1963–68 period the negative returns occurred during Monday's trading. From 1968–74 the negative returns were concentrated in the opening hours of Monday trading. Since 1974 the losses have occurred between Friday close and Monday opening.

Monday returns are positive. Not surprisingly, in light of the results reported in the previous column, the January returns are also related to firm size. The smallest firms have the highest Monday returns (and the highest returns on all other days, for that matter).

If weekends are bad for stocks, what about other securities? Gibbons and Hess (1981) looked at the daily pattern of returns for treasury bills and found that Monday's return is significantly lower than other days. They also investigated several possible explanations of the weekend effect for stocks, the most plausible of which involves "settlement periods." Stocks purchased on one day need not be paid for until several business days later. The length of the settlement period has gradually increased over time. Apparently, the more computerized the process becomes, the longer it takes! From March 4, 1962 to February 10, 1968, the settlement period was four business days; since that time it has been five business days. For the former period, investors who sold stocks on Monday would receive payment in four days while those who sold on other days would not receive payment for six days. Since the negative Monday returns persist after 1968, the settlement effect cannot be a complete explanation, and Gibbons and Hess show that even before 1968 the differing settlement periods cannot explain the weekend effect.[3]

Odd empirical results such as the weekend effect generate legitimate worries about "data mining." After all, there are many ways to look at the data; if enough people spin the same tapes long enough, some significant results are bound to be found. Researchers have used two methods to see whether these anomalies may in fact be artifacts. One method is to study different time periods. In the case of the weekend effect, all the recent research can be thought of as replications of Fields's original study which covered 1915–1930. Cross and French used data starting in 1953 (a date chosen because that is when the New York Stock Exchange stopped trading on Saturdays). Since then, Keim and Stambaugh (1984) have confirmed that the weekend effect held for the S&P Composite Index for the period 1928–1982, and Lakonishok and Smidt (1987) studied the seasonal movements of the DJIA for the period 1897–1986 and again found consistent negative Monday returns, even for the previously unstudied 1897–1910 period.

Coursey and Dyl (1986) use a completely different approach to investigate the weekend effect. Using the methods of laboratory market experiments, they introduced trading interruptions and observed the resulting pattern of prices. In their experiments, subjects traded assets with uncertain values. For the first two trading "days" of each three-day "week," the assets had a lifetime of one day. For the third day, which was followed by a one-period non-trading "weekend," assets had two-day lifetimes. The results were consistent with the evidence in actual security markets. The prices on the days before trading interruptions were significantly higher (per unit of return) than on other days.

[3] Lakonishok and Levi (1982) also investigate the settlement effect issue, taking into consideration the time it takes checks to clear. They too find that settlement periods cannot explain the observed pattern of prices.

Holiday Effects

In French's investigation of weekend effects he looked at the price behavior after holidays and found nothing special happening. However, in another early study, Fields (1934) found that the DJIA showed a high proportion of advances the day *before* holidays. In this case it took over 50 years for Fields to be resurrected from obscurity by Robert Ariel (1985). Ariel looked at the returns on the 160 days that preceded holidays during the period 1963–1982. For an equal-weighted index of stocks he found that the mean return on the preholidays was .529 percent, compared to .056 percent on other days, a ratio of greater than 9 to 1. For a value-weighted index the preholiday returns average .365 percent compared to .026 percent on other days, a ratio of greater than 14 to 1. The differences are both statistically and economically significant. Again, these results were replicated for the 90-year DJIA series by Lakonishok and Smidt (1987). They obtained an average preholiday return of .219 percent, compared to the normal daily rate of return of .0094 percent, a ratio of greater than 23 to 1. The size of these numbers is highlighted by the following amazing fact: over the last 90 years, 51 percent of the capital gains in the DJIA have occurred on the approximately ten preholidays per year.

Turn of the Month Effects

Ariel (1987) has also examined the pattern of returns within months. For the period 1963–1981 he divided months into two parts, the first part starting with the last day of the prior month. He then compared the cumulative returns for the two periods using both equal-weighted and value-weighted indexes. Again the results are quite startling. The return for the latter half of the month is *negative*. All the returns for the period occur in the first part of the month! This result has been replicated and sharpened by Lakonishok and Smidt. Using their 90-year series for the Dow, they find that the returns for the four days around the turn of the month, starting with the last day of the prior month, is .473 percent. (The average return for a four-day period is .0612 percent.) Also, the turn-of-the-month four-day return is greater than the average total monthly return which is .35 percent. In other words, aside from the four days around the turn of every month, the DJIA falls!

Intraday Effects

The most recent contribution to the analysis of seasonal price movements was made possible by the existence of the Francis Emory Fitch tape, which provides a time-ordered record of every common stock transaction (all 15 million!) made on the NYSE for the fourteen months between December 1, 1981, and January 31, 1983.

Lawrence Harris (1986a) used this tape to investigate intraday price movements. He computed rates of return for every fifteen minute period the market was open. He found that the weekend effect spills over into the first 45 minutes of trading on Monday, with prices falling during this period. On all other days, prices rise sharply during the first 45 minutes. Also, returns are high near the very end of the day, particularly on the last trade of the day. Furthermore, the day-end price changes are greatest when the final transaction is within the last five minutes of trading. Harris (1986b) investigated and rejected the possibility that this odd result can be attributed to errors in the data or price manipulations by specialists. One fact which argues against these hypotheses is that opening price changes tend to be positive, whereas if the price increases at the end of the day were artifacts, one would expect the subsequent opening changes to be negative. One of the most intriguing aspects of the end-of-the-day results is that similar patterns have been observed in experimental markets. For example, Forsythe, Palfrey, and Plott (1982, 1984) and Plott and Sunder (1982) found positive price blips just before trading closed in their experimental asset markets. This was originally thought to be an experimental markets anomaly, but it appears to be present on the NYSE as well.

Commentary

There is a striking pattern to the results described in this and the previous column. Abnormal price returns occur around the turn of the year, the turn of the month, the turn of the week, the turn of the day, and before holidays. Why? Most of the reasonable, or even not so reasonable, explanations have been tested and rejected. Certainly it is safe to say that no one would have predicted any of these results in 1975, when the efficient market hypothesis was thought by most financial economists to be a well-established fact. While the effects are not large enough for traders with any significant transactions costs to exploit, they remain a genuine puzzle. Investors who plan to trade anyway could alter the timing of their trading to take advantage of the predictable price changes. What new explanations are promising? It is hard to imagine any single factor that can explain all of these effects. However, several kinds of factors seem worth investigating.

1. Price movements may be related to customs that influence the flow of funds in and out of the market. For example, pension funds and mutual funds may receive payments (and make corresponding changes in their portfolios) at dates that coincide with calendar changes because firms and individuals customarily make such payments at regular intervals. At the individual level, Ritter (1987) found that the price movements of small firms near the turn of the year seem to be related to buying and selling by private individuals (who, compared to institutions, own a greater share of small firms than large firms). Specifically, the ratio of buy orders to sell orders for the noninstitutional customers of Merrill Lynch are high in early January and low in late December. In other words, individuals as a group are selling in December and buying

in January. Also, the variation in the buy-sell ratio explains 46 percent of the annual variation in the abnormal small firm January returns (defined as the returns to the smallest decile of NYSE stocks minus the returns on the largest decile). Similar studies of the habits of institutional investors would be very worthwhile.

2. Another reason why institutional investors may make seasonally related changes in their portfolios is the practice quaintly referred to as "window dressing." The claim on Wall Street is that investment managers clean up their portfolios before reporting dates, to get rid of embarrassing holdings. Since the reporting dates presumably coincide with natural calendar dates, such actions may be related to some of the seasonal price movements, particularly the year-end and month-end effects.

3. A different type of explanation of seasonal price movements is that they are related to the systematic timing of the arrival of good and bad news. This hypothesis seems most plausible for the weekend effect, if the announcement of bad news is systematically postponed until after the close of trading on Friday. Several of the authors cited above mention this hypothesis, though it has not been seriously investigated.

These hypotheses all can explain why there might be patterns of buying and selling that coincide with calendar time. Of course, they are not consistent with the efficient market hypothesis since that hypothesis assumes that there is an infinitely elastic supply of arbitragers and traders ready to buy or sell whenever prices vary from their intrinsic values. However, there is reason to believe that the supply and demand elasticities of arbitragers is finite. For example, articles published nearly simultaneously by Shleifer (1986) and by Harris and Gurel (1986) found that in recent years when stocks are added to the S&P 500 index, their prices rise immediately by almost 3 percent. The authors argue convincingly that there is no information about quality embedded in the announcement that a stock has been added to the index. Rather, they attribute the price appreciation to the increased demand for the stocks by index funds, mutual funds that attempt to mimic the S&P index. Consistent with this explanation, the effect is more pronounced in the last few years as index funds have become an important segment of the institutional investment community. Also, Harris and Gurel found that the price increase is temporary; the price increases are dissipated within three weeks. Once the possibility of downward sloping demand curves for stocks is conceded, then many possible explanations of anomalous price behavior can no longer be dismissed out of hand.

The three explanations described above are based on institutional considerations. One argument against these hypotheses is that some of the effects have been observed in experimental markets in which the relevant institutional features are missing. There are no cash inflows, no portfolios to be window dressed, and no news announcements in the experimental markets studied. Thus, Coursey and Dyl (1986) suggest that the weekend effect might be explained by psychological factors, such as a preference for compound gambles over simple gambles. Other behavioral explanations might incorporate variations in the mood of the market participants (good moods on Fridays and before holidays, bad moods on Mondays, and so on). It is well known, for example, that suicides occur more frequently on Monday than on any other day.

What conclusions can be drawn from the seasonal anomaly literature at this time? Marc Reinganum (1984, p. 839), one of the participants in this field, interprets the results as a challenge to theorists: "What then do the anomalies mean? They mean that the theories of capital asset pricing (at least as they pertain to equity markets) have been toppled. They mean that the most interesting insights into the pricing behavior of stocks are being discovered by tedious and painstakingly thorough examination of data. They mean that, in the constant ebb and flow between theory and empirics, empirics currently holds the upper hand." I don't agree. The ball is still in the empiricists' court. The clues that will allow us to understand these puzzles must come from additional econometric and experimental investigations. Only then can the formal modelers try to put the pieces together conceptually. The challenge, then, is really to all economists to try to understand why the seasonal price movements occur, and how they can persist for at least 90 years, and for at least 50 years after their existence has been published.

■ *This column was prepared with the expert assistance of Charles Lee, and with the helpful advice of Josef Lakonishok and Seymour Smidt.*

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