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Role of Speculative Short Sales in Price Formation: The Case of the Weekend Effect

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ABSTRACT

We argue that short sellers affect prices in a significant and systematic manner. In particular, we contend that speculative short sales contribute to the weekend effect: The inability to trade over the weekend is likely to cause these short sellers to close their speculative positions on Fridays and reestablish new short positions on Mondays causing stock prices to rise on Fridays and fall on Mondays. We find evidence in support of this hypothesis based on a comparison of high short-interest stocks and low short-interest stocks, stocks with and without actively traded options, IPOs, zero short-interest stocks, and highly volatile stocks.

IN THIS PAPER, we empirically examine whether speculative short sales affect prices in a systematic manner. The focus is on the weekend effect that has remained an unexplained anomaly. Beginning with French (1980) and Gibbons and Hess (1981), there is much evidence in support of higher returns on Fridays and lower returns on Mondays. Keim and Stambaugh (1984) find that Friday returns are lower when there is Saturday trading. Ariel (1990) finds that a significantly larger number of stocks rises preholiday than postholiday. Empirical evidence related to more recent periods points to an insignificant weekend effect for large firms but continuance of the weekend effect for an equally weighted index as documented herein.[1]

Many potential explanations of the weekend effect have been proposed and investigated: measurement errors (Gibbons and Hess (1981) and Keim and Stambaugh (1984)); delay between trading and settlement in stocks (Dyl and Martin (1985) and Lakonishok and Levi (1982)); specialist related biases in prices (Keim and Stambaugh); timing of corporate releases after Friday's close (Damodaran (1989)); reduced institutional trading and greater individual trading on Mondays

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[1] Wang, Li, and Erickson (1997) find that the Monday return based on a value-weighted NYSE–AMEX index falls in magnitude from -0.13 percent during 1962 to 1972, to -0.10 percent during 1973 to 1982, to an insignificant -0.00 percent during 1983 to 1993.

(Lakonishok and Maberly (1990) and Chan, Leung, and Wang (2003)); daylight savings for two weekends a year (Kamstra, Kramer, and Levi (2000)); and so forth. These explanations have explained some part of the weekend effect. For example, Damodaran reports that the delay in corporate announcements can explain a small proportion (3.4 percent) of the weekend effect. Lakonishok and Levi find that the delay in settlement can explain about 17 percent of the weekend effect. Keim (1989) finds that the bid-ask bounce can account for 32 percent of the observed weekend effect but only for small stocks. On the whole, however, the weekend effect remains largely an unresolved issue.

We propose a new explanation for the weekend effect (defined as a Friday's return minus the following Monday's return). We argue that speculative short sellers are partly responsible for the weekend effect. As we explain more fully later, speculative short sales are naked positions that require close monitoring. Unlike a long position where the loss is limited to the value of holding, the downside risk of a speculative short position is theoretically unlimited. For that reason, "Pros warn that speculative short-selling, in which an investor simply sells a stock short hoping the price will fall, is one of the riskiest strategies going. … [I]t is not something a part-time investor should engage in".[2]

While close monitoring during trading hours can limit the potential loss of a short seller, nontrading hours introduce special risk as the short sellers are unable to trade. Thus, short sellers are averse to holding positions over non-market hours and would like to close positions at the end of the day and reopen them the next morning. On the other hand, the transaction costs of closing and opening a position make it expensive for the short sellers to trade too often. The weekend becomes a natural breakpoint, as it is a long period of nontrading. Thus, we believe that the inability to trade over the weekend tends to make many short sellers close their speculative positions at the end of the week and reopen them at the beginning of the following week leading to the weekend effect, where the stock prices rise on Fridays as short sellers cover their positions and fall on Mondays as short sellers reestablish new short positions.

The results are consistent with the above contention. Overall, we find that stocks that have higher relative short interest (short interest divided by the number of shares outstanding) have a significantly larger weekend effect than stocks with lower relative short interest. The introduction of put options in 1977 provides an interesting experiment for our hypothesis. We argue that speculative short sellers are more likely to prefer put options because of the high risk associated with speculative short positions. Thus, migration of speculative short sellers to the options market should coincide with a reduction in the weekend effect. Indeed, we find that the weekend effect weakens significantly after 1977 and disappears in the 1990s for stocks with actively traded options, but continues unabated for other stocks. In cross-sectional tests, we also find that stocks with higher put volume ratios (put volume divided by stock volume) have a significantly smaller weekend effect than stocks with low put volume ratios.

[2] *Business Week,* March 22, 1999, by Geoffrey Smith.

We test the hypothesis further with (i) initial public offerings that are likely to have a high proportion of speculative short sales, (ii) stocks with zero short interest, and (iii) highly volatile stocks that will be favored by speculative short sellers. In all cases, we find evidence consistent with the hypothesis that speculative short sales contribute to the weekend effect.

The paper contributes to the literature in two important ways. First, it helps us understand how short sellers behave and how their behavior affects formation of stock prices.[3] Second, the paper is able to provide a partial explanation for the weekend effect. Based on the results herein, short sales seem to account for a significant part of the weekend effect.

The rest of the paper is organized as follows. In Section I, short sales are discussed with the objective of distinguishing between speculative and nonspeculative short sales, and describing how speculative short sales may lead to a weekend effect. We describe the data, discuss measurement issues, and present sample characteristics in Section II. The results summarized above are presented in Section III, with a robustness check in Section IV. Section V concludes.

I. Short Sales and the Effect on Trading around Weekends

Short selling is the act of selling shares that you do not own with the expectation that you will be able to return the borrowed shares by buying them later at a lower price. Legal and institutional restrictions on short sales, along with the limited availability of shares to short sell, make it costly to short sell.

In spite of the relatively high cost of short selling, traders may like to short sell for nonspeculative and speculative reasons. Nonspeculative short selling consists of cases where the short sale is hedged with a long position in the same or related security. These include "arbitrage" activities due to several perceived or real mispricings such as index arbitrage, merger arbitrage, and pairs trading; short selling for tax postponement where an investor short sells the security that she or he owns towards the end of a taxable year so that capital gains are not realized during that taxable year; and short selling by put writers to hedge open positions.[4]

Speculative short sales occur when traders believe that a security is overpriced, and they may wish to take advantage from the expected drop in price by short selling that security. The inherent risk characteristics of a short position combined with institutional and market factors make the short position worthy of constant monitoring.[5] Further, conditions relating to borrowed shares change on a daily basis: The shares may be recalled by the lenders, forcing the short sellers to repurchase the stock prematurely to return it to the lender; the shares may

[3] Recognizing the importance of short sales, the SEC has proposed to amend the "uptick" rule to make it easier to sell short so that the cost associated with short selling is reduced. See Schroeder (2001) in *The Wall Street Journal* of October 3, 2001 on page A10.

[4] In addition, the put writer may buy a call option to fully hedge his or her exposure.

[5] Stock returns for unhedged short positions are theoretically unbounded from below. Other researchers (Asquith and Muelbroek (1996) and Dechow et al. (2001)) have also noted the higher risk in unhedged short positions.

be put on "special," meaning that the short seller has to pay greater compensation to the lender (see Geczy, Musto, and Reed (2002)); and the collateral is revised daily to ensure that the lender holds at least 102 percent of the value of shares lent. The short sellers may also be subject to "short squeeze."

To minimize the chance of large losses due to price increases, speculative short sellers watch their positions closely. While close monitoring during trading hours can limit the potential loss of a short seller, nontrading hours introduce special risk as the short sellers are unable to trade and are, therefore, unable to control losses that may occur due to a positive stock price move. Thus, short sellers are averse to holding a short position during nonmarket hours. However, the costs of closing and opening short positions discussed above make it expensive for the short sellers to trade too often. Since the weekend is a long period (65.5 hours for a regular weekend and 89.5 hours for a long weekend) of nontrading compared to the normal interday period (17.5 hours) of nontrading, short sellers may be less willing to hold open positions over the weekend. French and Roll (1986) find that the price volatility over nontrading hours is much smaller than during trading hours. Therefore, it can be argued that nontrading hours are probably less important than trading hours in terms of volatility. However, note that as short sellers can monitor prices during trading hours and take action, the volatility during trading hours is inconsequential, even desirable. On the other hand, even little volatility during nontrading hours can be devastating as the short sellers are unable to trade. Thus, we believe that the process of closing positions on Fridays and reopening short positions on Mondays is partly responsible for the weekend effect.

II. Data Sources and Sample Characteristics

Stock return and volume data are obtained from the daily and monthly files maintained by the Center for Research in Security Prices (CRSP). Daily returns for stocks listed on the New York Stock Exchange are available for the period from July 1962 to December 1999, whereas daily returns for stocks on the Nasdaq are available from December 1972.

Monthly short interest data are obtained directly from the NYSE and Nasdaq.[6] Members report outstanding short interest to NYSE and Nasdaq as of the settle-

[6] It might seem odd that we rely on *monthly* short interest data to explain the *weekend* effect. Note that the data frequency is of not much consequence because our tests rely on short interest data only to identify firms that have high (or low) levels of short interest. In some cases, we do not need short interest data at all (e.g., see our tests related to options). On the other hand, the *daily* short sales data available to some researchers are limited in period and in scope. Those data usually cover a limited period of about 12 months, that is much shorter than the 11 years (over 550 weekends) of data used herein. Further, the daily data are available from only one securities lender out of about five large securities lenders, and do not include any shares sold short from the brokerage firm's own stock or shares borrowed from other brokerage firms. The monthly short interest data are a direct measure of how many shares of a particular security are actually sold short irrespective of how or from where the security is borrowed.

ments that take place on the 15th of each month or the first business day prior to that date if it is a holiday. Since settlement takes three business days (five business days until June 7, 1995), the data actually represent short interest culminating with trading that has occurred three or five business days prior to the 15th day of the month. The data are available for Nasdaq securities from June 1988 to December 1999 and for NYSE from January 1988 to December 1999.[7]

The short-interest sample is matched with CRSP and limited to ordinary common shares. Mismatched data (14,671 firm-months) are excluded. Since exchanges do not usually report short interest for securities that have zero short interest for the current month and for the previous month, we assume that CRSP securities not found on the exchange-supplied short interest list have zero short interest. This results in an addition of 63,439 firm-months with zero short interest. Finally, we check for data entry errors. Prior month's short sales are reported in the current month for all months except for Nasdaq during June 1988 to December 1994. We verify that the prior month's short sales reported in the current month are within plus or minus one percent or 100 shares of the short interest reported during the prior month after adjusting for stock splits and stock dividends. If the difference is greater than $\pm$ one percent and more than 100 shares, then the short interest for the previous month is set to missing.[8] Some observations (11,176 firm-months) are set to missing as described above, but not dropped from the sample. Our final sample consists of 805,610 firm-months. The loss of data in the matching process is reasonable: 1.8 percent observations are dropped from the sample and an additional 1.3 percent firm-months are set to missing.

A. Sample Characteristics – The Weekend Effect

We define the "weekend effect" as Friday's return minus the following Monday's return for a security or a portfolio of securities.[9] This definition captures both the preweekend positive returns and the postweekend negative returns documented in the literature. Moreover, in the absence of seasonality in returns, firms should, on average, earn the same return on all trading days of the week when the previous calendar day is also a trading day. Since Mondays follow days that are closed for trading, the Monday return should reflect the return for more than one day, and, therefore, should be greater than the return on other days. Thus, the weekend effect should be negative for all securities. To be conservative and bias the results against us, we assume that the weekend effect should be zero.

[7] February 1990 and July 1990 data for Nasdaq stocks are not available with Nasdaq. We use the average short interest for January and March to estimate the February short interest, and the average short interest for June and August to estimate the July short interest.

[8] Our screens allow us to control for another data error. If a security has zero short interest, then that security is not usually included in the data provided by NYSE or Nasdaq. Thus, there is potential for confusion between a zero short interest observation and a truly missing observation. Verifying the prior month's short interest minimizes the chances of such an error.

[9] The weekend effect has been defined in various ways. For Keim and Stambaugh (1984), the Monday return is the weekend effect. For Rogalski (1984), it is the return from Friday close to Monday open. According to Lakonishok and Smidt (1988), the weekend effect refers to the negative return on Mondays and the positive return prior to a weekend.

Table I
The Weekend Effect

The sample consists of all ordinary common shares traded on NYSE, AMEX, or Nasdaq. The equally weighted and value-weighted index returns (in percent) are as reported by CRSP. Monday refers to the first trading day of the week, while Friday refers to the last trading day of the week. The weekend effect refers to the difference between a Friday's return and the following Monday's return. The *p*-values for testing whether the mean (median) is different from zero based on *t*-test (signed-rank test) are reported in parentheses.

	Equally weighted index return		Value-weighted index return		Number of days
Panel A: July 1962–1999	Mean	Median	Mean	Median	
Monday	− 0.093 (0.000)	− 0.024 (0.002)	− 0.054 (0.015)	− 0.017 (0.171)	1,956
Friday	0.245 (0.000)	0.285 (0.000)	0.108 (0.000)	0.123 (0.000)	1,956
Weekend Effect	0.338 (0.000)	0.299 (0.000)	0.162 (0.000)	0.186 (0.000)	1,956
Panel B: Subperiods					
July 1962–1972	0.310	0.281	0.255	0.266	548
Weekend effect	(0.000)	(0.000)	(0.000)	(0.000)	
1973–1989	0.388	0.336	0.209	0.186	887
Weekend effect	(0.000)	(0.000)	(0.000)	(0.000)	
1990–1999	0.282	0.261	− 0.017	0.003	521
Weekend effect	(0.000)	(0.000)	(0.714)	(0.980)	

However, as we report in Table I, there is evidence of a positive weekend effect, that is the Friday return is greater than the following Monday's return.[10] To focus in on the weekend effect, a Friday refers to the last trading day of the week whether it is actually a Thursday or a Friday. Similarly, a Monday refers to the first trading day of the week whether it is a Monday or a Tuesday.

Looking at Panel A of Table I, covering the period 1962 to 1999, we observe that the Monday return is always negative, except that the median for the value-weighted index is not statistically different from zero. On the other hand, the Friday return is always significantly positive. Consequently, the weekend effect exists for all weekends and is significantly positive: 0.34 percent for the equally weighted index and 0.16 percent for the value-weighted index.[11]

To examine the time trend in the weekend effect, we divide the entire period into three subperiods: 1962 to 1972, which has only NYSE/AMEX stocks and no

[10] As the weekend effect is expected to be negative due to Monday's larger expected return, the weekend effect is more positive and more anomalous than presented in the tables here.

[11] Differences are tested for statistical significance in two ways throughout the paper. Whenever returns can be paired, a paired *t*-test is used. Otherwise, the difference in means *t*-test is used.

option activity; 1973 to 1989, which reflects the addition of Nasdaq and higher option activity after 1978; and 1990 to 1999, which corresponds to a significantly higher level of option activity. The results are reported in Panel B of Table I. While the weekend effect for the equally weighted index continues unaffected through the three subperiods, the weekend effect for the value-weighted index weakens in the 1973 to 1989 period, and disappears in the 1990 to 1999 period. Later in the paper, we further explore the difference between the weekend effects of the two groups.

B. Sample Characteristics – Short Interest

For cross-sectional comparisons of short interest, it is necessary to standardize the absolute number of shares held short: A short interest of one million shares for General Electric is quite different from a short interest of one million shares for Black & Decker. We use "relative short interest" (RSI), the number of shares sold short divided by the number of common shares outstanding, as a measure of short interest. RSI is used in Asquith and Muelbroek (1996), DeChow et al. (2001), Desai et al. (2002), and much other recent research on short sales.

Sample characteristics relating to short interest reveal that the mean relative short interest has increased from 0.51 percent in 1988 to 1.62 percent in 1999 – a threefold increase (results not reported here). Compared to the RSI mean of 1.62 percent for 1999, the median is only 0.38 percent, suggesting the presence of a large number of firms with zero short interest. However, the fraction of firms with nonzero short interest has increased from 74 percent in 1988 to 92 percent in 1999. The increase in RSI and the increase in the fraction of firms with nonzero short interest underline the growing importance of short sales.[12]

Besides the time trend in RSI discussed above, we also find (although not reported herein) that large firms have higher relative short interest. This occurs for two reasons. First, large stocks have a greater breadth of holding, and, therefore, they have a greater availability of shares available to short sell (see Chen, Hong, and Stein (2001)). Second, investors rely on large firms for various kinds of arbitrage activity increasing relative short interest in large stocks. Third, large stocks have lower execution cost, as it is much less expensive to trade large stocks than small stocks.

III. Results

We present the results in three parts. First, we test the hypothesized relationship by investigating how the weekend effect varies with firms that have different levels of short interest but without explicitly recognizing the impact of options or the difference between speculative short sales and nonspeculative short sales. In

[12] The increase in relative short interest with time seems inconsistent with the assertion that speculative short sellers would migrate to the options market. However, the substitution of short sales by put options does not lead to a reduction in short sales because put writers, in turn, use short sales to hedge their exposure. In essence, everything else being equal, put options change a portion of speculative short sales into nonspeculative short sales.

the second part, we examine how the migration of speculative short sellers to the options market affects the weekend effect, both in a time series and a cross-sectional manner. In the third part, we identify stocks that allow us to distinguish between speculative and nonspeculative short sales. In particular, we consider initial public offerings soon after their initial issue and stocks that have zero short interest.

A. Relation between Relative Short Interest and the Weekend Effect

If a relation between RSI and the weekend effect exists, then we should find firms with high speculative short interest to have a more pronounced weekend effect. However, given data limitations, we cannot distinguish between speculative short interest and nonspeculative short interest. Therefore, our initial tests are based on the assumption that firms with a high level of short interest also have a relatively high level of speculative short interest. On the face of it, it might seem that exactly the opposite is true. For example, we know that large size stocks have higher RSI than small size stocks, yet larger stocks are likely to have more nonspeculative short sales. The proportion of nonspeculative short sales in large stocks is likely to increase in later years when speculative short sellers move to the options market. However, the problem with our assumption is less acute here, as we form RSI quartiles within each size decile, thereby mitigating the differences between large stocks and small stocks. Thus, we believe that the assumption that high (low) RSI stocks have higher (lower) speculative short interest is not unreasonable.

To test the relation between RSI and the weekend effect, we evaluate the difference in the weekend effect for the highest RSI quartile and the weekend effect for the lowest RSI quartile. The following model is specified:

$$\begin{aligned} Ret_{it} =& \beta 1 M\_D_{it} + \beta_2 Tu\_D_{it} + \beta_3 W\_D_{it} + \beta_4 Th\_D_{it} + \beta_5 F\_D_{it} + \beta_6 M\_D_{it} \times H_{it} \\ &+ \beta_7 Tu\_D_{it} \times H_{it} + \beta_8 W\_D_{it} \times H_{it} + \beta_9 Th\_D_{it} \times H_{it} + \beta_{10} F\_D_{it} \times H_{it} + \varepsilon_{itt} \end{aligned} \tag{1}$$

where the dependent variable is the mean daily return for the high and low RSI quartile portfolios, M_D, Tu_D, W_D, Th_D, and F_D are dummies for weekdays, H is a dummy that is set to one for the high relative short interest quartile, and zero otherwise every month, and i refers to the high RSI or low RSI portfolio. The coefficients $\beta_1 - \beta_5$ represent the mean weekday returns for the low RSI sample, whereas the sum of same day coefficients ($\beta_1+\beta_6$, $\beta_2+\beta_7$, etc.) represent the weekday returns for the high RSI sample. Our prediction is that β_6 will be negative and β_{10} will be positive.

As discussed in Section II.B, we know that there is a continuous and significant increase in relative short interest from 1988 to 1999. Therefore, it is better to estimate regressions in a Fama–MacBeth (1973) framework annually, and then report the summary results of the regression coefficients. Size deciles are constructed on each short interest date followed by RSI quartiles within each size

decile. The returns are computed for the period following the construction of RSI quartiles. The average coefficients for the period July 1988 to December 1999 are reported in Table II.[13]

It is interesting to look at the day-of-the-week pattern in returns. The coefficients in Table II imply that the Monday return is the smallest among all weekdays and the Friday return is the largest, leading to the weekend effect. In particular, low RSI firms have a weekend effect of 0.267 percent $(0.246 - (-0.021))$. The high RSI firms have a weekend effect of 0.39 percent $(0.288 - (-0.101))$ with statistically and economically significant returns on both Mondays and Fridays. As predicted, the regression shows that the coefficient on M_D × H (β_6) is significantly negative. That is, high RSI firms have a Monday return that is 0.08 percent smaller than the Monday return for low RSI firms. Although β_{10} is positive, indicating that the Friday return is larger for high RSI firms than for low RSI firms, the difference is not statistically significant. Overall, the weekend effect for high RSI firms is significantly larger by 0.12 percent than for low RSI firms.[14] The results suggest that approximately 30 percent (0.12/0.39) of the weekend effect is due to the difference in short interest, assuming all else constant. It is important to note that the results are not driven by small size firms. The lowest RSI quartile and highest RSI quartile are drawn from each size decile. Thus, both subsamples have an equal number of small and large firms and any size-related characteristics should not affect the two subsamples differently.

B. Options as a Substitute for Short Sales

Until now, we have ignored the effect of options on short sales, although an investor with negative information can either short sell or buy put options.[15] Presented with a choice between short sales and put options, some speculative short sellers are likely to prefer put options, because speculative short sellers have a short horizon and their positions are risky.[16] [Diamond and Verrecchia (1987) also note that options can reduce the cost of short sales. The substitution

[13] Results for a pooled regression are similar to the results from Fama–MacBeth regressions for all the regressions in the paper.

[14] It should be noted here that the monthly RSI is correlated with a mean of 0.52 and a median of 0.62. The autocorrelation implies that monthly observations used in the Fama–MacBeth regressions are not independent. Therefore, we rerun the regressions annually using annual data to form the low and high RSI portfolios. The results are similar to those reported in Table II.

[15] Writing a call option is another strategy to take advantage of an expected drop in stock price. However, buying a put option is superior due to the chance of a larger profit and lower risk. Figlewski and Webb (1993) make a similar observation.

[16] Using a daily short interest database, Reed (2001) reports summary statistics for the length of security loans. He finds that the 25th percentile, median, and 75th percentile lengths are one day, three days, and nine days. By contrast, the Merger Fund, which specializes in merger arbitrage, reports an annual portfolio turnover of a little less than 400 percent, implying an average holding period of three months. Thus, speculative short sellers are likely to have a horizon of only a few days compared with a horizon of several months for nonspeculative short sellers.

Table II

Regression Results of High and Low RSI Quartiles

The short interest sample is divided into size deciles according to their market capitalization as of the date of short interest each month during July 1988 to December 1999. Each size decile is then subdivided into four quartiles based on the relative short interest (RSI) for individual stocks in that month. For the period following size and RSI computations, we obtain the average return for each trading day for the high and low RSI quartiles. The table reports Fama–MacBeth regression results for the low RSI and high RSI quartiles. The regression model is

$$Ret_{it} = \beta_1 M\_D_{it} + \beta_2 Tu\_D_{it} + \beta_3 W\_D_{it} + \beta_4 Th\_D_{it} + \beta_5 F\_D_{it} + \beta_6 M\_D_{it} \times H_{it} + \beta_7 Tu\_D_{it} \times H_{it} + \beta_8 W\_D_{it} \times H_{it} + \beta_9 Th\_D_{it} \times H_{it} + \beta_{10} F\_D_{it} \times H_{it} + \varepsilon_{itt} \quad (1')$$

where M_D, Tu_D, W_D, Th_D, and F_D are dummies for weekdays, H is a dummy that is set to one for the high relative short interest quartile, and zero otherwise.

M_D	Tu_D	W_D	Th_D	F_D	$M\_D \times H$	$Tu\_D \times H$	$W\_D \times H$	$Th\_D \times H$	$F\_D \times H$	Average Adjusted R-square
Regression of Low RSI and High RSI Quartiles										
− 0.021	0.068	0.156	0.129	0.246	− 0.080	− 0.077	0.022	0.025	0.042	0.089
(0.446)	(0.026)	(0.000)	(0.008)	(0.000)	(0.012)	(0.004)	(0.522)	(0.478)	(0.108)	

of short sales by options is also apparent in Senchak and Starks (1993), who find that the announcement effect of unexpected short interest changes is smaller for optioned stocks than for nonoptioned stocks.] The put options allow the short sellers to reduce their risk (because their loss is limited to the put premium) and increase leverage. Though the option premium is an additional cost component, the time value of the option is not onerous, since speculative short sellers are likely to have a relatively short time horizon. On the other hand, hedged short sellers have little risk and longer holding periods, making options undesirable for such strategies. For example, the one billion dollar Merger Fund typically has less than five percent of its deals hedged using put options. The remaining deals are hedged by selling shares short. It appears that the migration to the options market is selective: Speculative short sellers are more likely to rely on put options than other short sellers.

The substitution of short sales by put options introduces two new traders: (a) put buyers (instead of short sellers) and (b) put writers. Since the risk of put buyers is limited to put value and not unlimited as with short sales, the need for constant monitoring is much reduced. On the other hand, put writers usually hedge their position by short selling the underlying stock, possibly coupled with a call option (see footnote 4). So, they are not exposed to as much risk and have less need to trade around the weekend. Since both put buyers and put writers have a reduced need to trade around the weekend than short sellers, we expect the weekend effect to weaken with the introduction of actively traded options.

Based on the above argument, we now examine the impact of put options on the weekend effect, first as a time series test and later as a pair of cross-sectional tests. Put options were first introduced in July 1977 at the Chicago Board Options Exchange. Thus, 1978 was the first full year when put options were available. Options can have high bid-ask spreads especially for options that do not have high volume. Thus, migration to the options market is more likely to occur for stocks with actively traded options. Since we do not have option volume data by stock for the entire 1962 to 1999 period, we use stock trading volume as a proxy for option trading volume. To test the adequacy of using stock trading volume as a proxy for option trading volume, we regress put option volume on stock volume for March 1998 to December 1999, for which we have individual put option volume data available. The correlation coefficient is 0.7. Further, on average, 80 stocks out of the 100 highest stock volume stocks appear among the 100 highest put option volume stocks. Therefore, stock volume seems a reasonable proxy for option volume.[17]

To perform the time-series test, we compare the weekend effect for the 100 most actively traded stocks with the weekend effect for 100 less active stocks. We pick the 100 most active stocks at the end of each year based on the average monthly volume for that year. Similarly, we pick 100 stocks that are less actively traded.

[17] Since Nasdaq volume measures are more likely to overstate the true volume, we multiply the Nasdaq volume by 0.50 to make it comparable to NYSE volume. This correction has been suggested in Atkins and Dyl (1997) and by Ed Dyl in personal correspondence.

These are stocks that rank from 1,901 to 2,000 by volume each year.[18] We compare the weekend effect in the following year for the two groups.

The Monday return, the Friday return, and the weekend effect for the two samples are reported in Table III. In the case of the 100 most active stocks, the weekend effect is 0.41 percent, which is significant and large during 1963 to 1977 when no put options existed. However, the effect seems to drop off during 1978 to 1987 and 1988 to 1999 after the introduction of options. On the other hand, the weekend effect continues unabated for the less active stocks throughout the entire sample period: 0.25 percent during 1963 to 1977, 0.42 percent during 1978 to 1987, and finally, 0.37 percent during 1988 to 1999. As the more active stocks are likely to have an active market for options, the result is consistent with the assertion that the replacement of short sales by put options by speculative short sellers caused the weekend effect to weaken as the put holders have a smaller tendency to trade than short sellers. However, continuance of the weekend effect for the less active stocks suggests that the weakening of the weekend effect for the more active stocks cannot be attributed to reasons related to the passage of time.

However, it is possible that arbitrageurs caused the weekend effect to subside for high volume stocks (that are also the ones with put options) but not for other stocks. To test this possibility and to further refine the impact of options on the weekend effect, we use two cross-sectional tests. The first cross-sectional test relates the weekend effect to the availability of options while explicitly controlling for volume, as given by equation (2). The dependent variable is the weekend return, and the independent variables are stock volume (*Vol*), a dummy (*OptD*) that is set to one if the stock has listed options, and an interaction term between stock volume and the option dummy:

$$WkEndRet_{it} = a + \beta_1 Vol_{it} + \beta_2 OptD_{it} + \beta_3 OptD_{it} \times Vol_{it} + \varepsilon_{it} \qquad (2)$$

The results, reported as Panel A in Table IV, reveal that stocks with listed options have a weekend effect that is 0.16 percent smaller than stocks that do not have listed options after controlling for volume. This result is consistent with the hypothesis that short sellers use options when available in preference to short selling, possibly causing the weekend effect to dissipate. The coefficient on volume is positive, although statistically not different from zero. The positive coefficient on volume implies that an increase in volume would lead to an *increase* in the weekend effect. Thus, the reduction in the weekend effect is unlikely to occur due to higher stock volume.

The second cross-sectional test relies on stock level data relating to put volume. As argued earlier, put options are more likely to be used by speculative short sellers than by nonspeculative short sellers. Therefore, stocks with a higher volume of put options relative to their daily stock trading volume (called put volume ratio) should have a less visible weekend effect than stocks with low put volume ratios. Monthly put volume data for individual stocks are available from

[18] Choosing stocks with a volume rank of 2,001 to 2,100 seems less ad hoc. However, in the early 1960s, there are fewer than 2,100 stocks (but more than 2,000 stocks) on CRSP, making that choice slightly less desirable. The results, in any case, are almost identical.

Table III

Option Activity and the Weekend Effect

One hundred most active stocks are selected each year based on average monthly volume among all stocks that have at least seven months of nonmissing trading volume during the year. Similarly, 100 stocks that rank from 1,901 to 2,000 by volume each year are selected as the less actively traded stocks. We then obtain average return for each trading day for the two samples for the following year. The mean and median for these average daily returns (in percent) for the two samples are reported. The *p*-values are reported in parentheses.

		More Active Stocks			Less Active Stocks			
		Monday Return	Friday Return	Weekend Effect	Monday Return	Friday Return	Weekend Effect	No. of Weeks
	Mean	−0.225	0.182	0.407	−0.020	0.227	0.247	
		(0.000)	(0.000)	(0.000)	(0.506)	(0.000)	(0.000)	731
		−0.175	0.155	0.363	−0.011	0.201	0.231	
1963–1977	Median	(0.000)	(0.000)	(0.000)	(0.404)	(0.000)	(0.000)	
		−0.141	0.122	0.262	−0.134	0.283	0.417	522
	Mean	(0.030)	(0.004)	(0.000)	(0.006)	(0.000)	(0.000)	
		−0.034	0.034	0.189	−0.049	0.276	0.345	
1978–1987	Median	(0.125)	(0.011)	(0.000)	(0.043)	(0.000)	(0.000)	
		0.114	0.079	−0.035	−0.127	0.247	0.374	
	Mean	(0.017)	(0.056)	(0.542)	(0.002)	(0.000)	(0.000)	625
		0.134	0.098	−0.041	−0.085	0.247	0.364	
1988–1999	Median	(0.001)	(0.004)	(0.987)	(0.004)	(0.000)	(0.000)	
		−0.089	0.131	0.220	−0.087	0.249	0.337	
	Mean	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	1,878
		−0.027	0.099	0.201	−0.040	0.233	0.299	
Overall	Median	(0.062)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	

Table IV

Regression Results for Option Activity and the Weekend Effect

The following regression model is estimated in which the dependent variable is the weekend return, and the independent variables are stock volume, a dummy that is set to one if the stock has listed options, and an interaction term between stock volume and the option dummy. Fama–Macbeth regressions are estimated from 1974 (the first complete year with listed options) to 1999. Current year weekend returns and prior year volumes are used in the regressions. The results are reported as Panel A. The regression model is:

$$WkEndRet_{it} = \alpha + \beta_1 Vol_{it} + \beta_2 OptD_{it} + \beta_3 OptD_{it} \times Vol_{it} + \varepsilon_{it} \quad (2')$$

The results in Panel B are from equation (3′), where the put volume ratio (put option volume divided by stock volume) has been added as another independent variable. We report results for three regressions with different cutoffs for put volume. If put volume is less than the cutoff, then the put volume ratio is set to zero. Stock volume is measured in millions of shares per day. *P*-values are reported in parentheses.

$$WkEndRet_i = \alpha + \beta_1 Vol_i + \beta_2 OptD_i + \beta_3 OptD_{it} \times Vol_i + \beta_4 PutRatio_i + \varepsilon_i \quad (3')$$

Panel A: Option Listings and the Weekend Effect

Intercept	*Vol*	*OptD*	*OptD* × *Vol*	Adj. R^2
0.371	0.025	− 0.155	− 0.051	
(0.000)	(0.106)	(0.000)	(0.016)	0.005

Panel B: Put Volume Ratios and the Weekend Effect

Cutoff *Put Vol*	Intercept	*Vol*	*OptD*	*OptD* × *Vol*	*PutRatio*	Adj. R^2
50 contracts per day	0.476	0.233	− 0.073	− 0.252	− 2.999	0.003
	(0.000)	(0.250)	(0.013)	(0.218)	(0.025)	
100 contracts per day	0.476	0.233	− 0.076	− 0.245	− 3.736	0.003
	(0.000)	(0.250)	(0.009)	(0.231)	(0.009)	
500 contracts per day	0.476	0.233	− 0.086	− 0.239	− 5.113	0.003
	(0.000)	(0.250)	(0.003)	(0.243)	(0.013)	

the Chicago Board Options Exchange for the period March 1998 to December 1999. Prior period data are not available from the Chicago Board Options Exchange. Equation (3) is estimated for all stocks for which put option volume is available:

$$WkEndRet_i = \alpha + \beta_1 Vol_i + \beta_2 OptD_i + \beta_3 OptD_{it} \times Vol_i + \beta_4 PutRatio_i + \varepsilon_i \quad (3)$$

Average daily volume, average weekend return, and average put volume ratio are estimated for each stock over the entire 22-month period. The absolute level of put option volume is important for transaction costs related to option trading. If the option trading volume is low, then the trading costs for options may be higher, and traders may be reluctant to substitute short sales with put options. Therefore, we use different minimum levels of put volume for computation of put ratios: 50, 100, and 500 put option contracts per day.

The results, in Panel B of Table IV reveal that stock volume does not have a significant impact on the weekend effect. However, not surprisingly and as hypothesized, stocks with listed options have a significantly smaller weekend effect, as do stocks with higher put volume ratio. The option dummy accounts for approximately 0.08 percent of the weekend effect. On average, stocks with the most actively traded put options (500 contracts per day) account for an additional 0.28 percent (-5.113×0.055) of the weekend effect reducing the unexplained weekend effect from 0.48 percent to 0.12 percent.[19] Option trading for stocks with less actively traded put options (50 contracts per day) accounts for a smaller 0.10 percent of the weekend effect in addition to the 0.07 percent explained by the option listing dummy. These results are consistent with the observation that stocks with actively traded put options have a significantly smaller weekend effect.

It seems reasonable to conclude from the time-series and cross-sectional tests above that speculative short sellers contribute to the weekend effect, and that the weekend effect becomes smaller probably due to the migration of speculative short sellers to the options market.

C. Initial Public Offerings and Zero Short-Interest Stocks

Now, we consider special stocks that permit different tests of the hypothesis. Unlike a typical CRSP firm, an initial public offering (IPO) is a better vehicle for investigating the weekend effect for several reasons. First, nonspeculative short selling is less likely to occur in IPOs: IPOs are usually not part of an index (no index arbitrage), not likely to be takeover candidates (no merger arbitrage), investors are unlikely to have accumulated capital gains (no shorting against the box), and other types of nonspeculative short sellers will avoid IPOs due to their inherent volatility. Thus, the level of RSI in an IPO is a close approximation of speculative short interest. Second, options are unlikely to be available on IPOs, meaning that short sellers cannot use put options instead of short selling. Third, IPOs are popular among short sellers according to Geczy et al. (2002).

Since IPO shares are not actually issued to the buyers until 3 to 4 days after the IPO date, short selling cannot begin until that time. In addition, syndicate members are allowed to lend their shares 30 days after the IPO. Therefore, we consider the IPO weekend effect over weeks two to four (6th trading day to 20th trading day after listing) when it is most difficult to borrow shares of IPOs and most activity is presumably speculative in nature.

Initial public offerings are identified from CRSP based on their day of listing. For every short interest date, we classify the IPOs into RSI quartiles depending on the reported short interest and the number of shares outstanding as of that date. We estimate equation (1) with average weekday IPO returns for high and low RSI quartiles. Fama–MacBeth regression results are reported in Panel A of Table V. The Friday return is significantly higher by 0.37 percent for the highest RSI quartile than the Friday return for the lowest RSI quartile. The Monday returns for the low and high RSI quartiles are not statistically significant. Overall, the weekend effect is

[19] The mean put ratio for nonzero put ratio firms is 0.055.

TableV

Weekend Effect for Initial Public Offerings and Zero Short Interest Stocks

The weekend effect is reported for all Initial Public Offerings (IPOs) on NYSE, AMEX, and Nasdaq during 1988 to 1999. Stock returns for these IPOs are considered from the 6th trading day to the 20th trading day after listing. Weekday IPO returns for 1988 to 1999 are used to estimate annual Fama–MacBeth regressions for model: (1′), below. The results are reported in Panel A. Zero short-interest stocks are stocks where the reported short interest is zero for six consecutive months. To contrast these stocks with high short-interest stocks, we include a matched sample of firms that are in the same size decile but with the highest RSI in the same month. Panel B reports Fama–Macbeth regression results jointly for the high RSI and zero RSI samples. The regression model is specified as equation (1′) in Table II. The *p*-values are reported below in parentheses.

$$Ret_{it} = \beta_1 M\_D_{it} + \beta_2 Tu\_D_{it} + \beta_3 W\_D_{it} + \beta_4 Th\_D_{it} + \beta_5 F\_D_{it} + \beta_6 M\_D_{it} \times H_{it} + \beta_7 Tu\_D_{it} \times H_{it} + \beta_8 W\_D_{it} \times H_{it} + \beta_9 Th\_D_{it} \times H_{it} + \beta_{10} F\_D_{it} \times H_{it} + \varepsilon_{itt} \quad (1')$$

where *M_D*, *Tu_D*, *W_D*, *Th_D*, and *F_D* are dummies for weekdays, *H* is a dummy that is set to one for the high relative short interest quartile, and zero otherwise.

M_D	*Tu_D*	*W_D*	*Th_D*	*F_D*	*M_D* × *H*	*Tu_D* × *H*	*W_D* × *H*	*Th_D* × *H*	*F_D* × *H*	Average Adjusted *R*-squared
Panel A: Regression of High RSI and Low RSI Quartile IPOs–1989–1999										
− 0.083	− 0.058	0.032	0.203	0.040	− 0.100	0.186	0.069	0.052	0.367	0.009
(0.205)	(0.585)	(0.797)	(0.016)	(0.775)	(0.494)	(0.327)	(0.595)	(0.565)	(0.015)	
Panel B: Regression of High RSI and Zero RSI Portfolios—1988–1999										
− 0.038	0.061	0.166	0.156	0.283	− 0.104	− 0.097	0.012	0.073	0.079	0.090
(0.232)	(0.079)	(0.001)	(0.010)	(0.000)	(0.022)	(0.078)	(0.736)	(0.158)	(0.014)	

0.47 percent for the high RSI quartile compared with 0.12 percent for the low RSI quartile, accounting for almost three-quarters of the weekend effect.

A different approach to testing the impact of short sales on the weekend effect is to select stocks that are reported to have zero short interest. If the weekend effect is at least partly caused by short sellers, then stocks with zero short interest should experience a smaller weekend effect, as the short sellers do not have to close their positions on Fridays or reopen them on Mondays.

Since we use monthly short sale data for analysis, we assume that a stock has zero short interest for all weekends during a month if that stock has zero short interest in the three months prior and three months following the relevant month. As earlier, on each short interest date, we form portfolios of stocks with zero RSI. At the same time, we construct another portfolio consisting of firms in the *same size decile* as the zero RSI stock but with the highest RSI. Our sample consists of 41,737 firm-months with zero short interest and the same number of firm-months with the highest RSI but in the same size decile. Fama–Macbeth regressions are estimated and reported as Panel B in Table V.

The results suggest that zero short interest stocks exhibit no statistically significant Monday return, but the Friday return is 0.28 percent, which is statistically and economically greater than zero. Overall, the weekend effect for the zero short-interest portfolio is 0.32 percent. For a size-matched sample of the highest RSI portfolio, we find that both the Monday return is significantly more negative than the zero short-interest sample and the Friday return is also significantly more positive than the zero short-interest sample. Overall, the highest RSI portfolio has a significantly larger weekend effect of 0.51 percent. The difference of 0.18 percent in the weekend effect indicates that short sales contribute more than one-third of the weekend effect in this sample.[20] The nonzero weekend effect for the zero short-interest sample implies that short sales cannot be the whole story for the weekend effect *unless* the zero RSI sample contains missing observations that have been incorrectly classified as zero RSI firm-months.

We find that high relative short-interest IPOs have a stronger weekend effect than low relative short-interest IPOs. Similarly, when we compare the weekend effect for stocks that have zero short interest with that of high relative short-interest stocks, we find that stocks with high relative short interest have a significantly larger weekend effect than zero short-interest stocks. All of the results herein seem to support the notion that speculative short sellers contribute to the weekend effect.

IV. Robustness Test – Volatile Stocks

In the previous section, we presented a variety of tests for evaluating the relation between the weekend effect and speculative short sales. We did not call any of them robustness tests because each of them provides an estimate of the contribu-

[20] The size matching seems reasonable as the average weekly returns (obtained by compounding weekday returns) for the zero short interest sample (0.63 percent) and the size-matched portfolio (0.59 percent) are comparable.

tion of speculative short sales to the weekend effect. The robustness test presented here does not explicitly provide such an estimate. Instead, it considers the implication of the hypothesized relation.

The volatility of stocks becomes relevant to speculative short sellers in two ways. First, speculative short sellers will likely shun stocks with low volatility because those stocks are likely to constantly earn the expected return, which is nonnegative. On the other hand, highly volatile stocks are likely to provide more profitable opportunities. Thus, the fraction of speculative short sales is likely to be higher for more volatile stocks than for less volatile stocks. Second, if speculative short sellers are inclined to close their positions over the weekend, then there is a greater probability that they will close the more volatile positions than the less volatile positions. Taking both of the expectations together, we expect that more volatile stocks will have a greater weekend effect than the less volatile stocks.

We evaluate the relation between standard deviation and the weekend effect as follows. Each year, we calculate the standard deviation for all ordinary common stocks provided they have data for more than 200 trading days. As standard deviation is likely to vary by firm size, we form size deciles based on market capitalization at the middle of the year (i.e., as of June 30 each year). Within each size decile, the stocks are divided into quartiles by standard deviation. The daily mean standard deviation for each quartile is reported as the first row in Table VI. The last column shows that the difference of 3.5 percent in the standard deviations of the low and high standard deviation quartiles is statistically significant.

We compute the weekend effect for these stocks provided at least 40 nonmissing weekend returns are available. The returns, reported in Table VI, are obtained for the same year for which the standard deviation is calculated, as we expect the relation to be contemporaneous. The Friday return is greater for the highest standard deviation quartile by a significant 0.324 percent than for the lowest standard deviation quartile. At the same time, the Monday return is lower for the highest standard deviation quartile by a significant -0.184 percent than for the lowest standard deviation quartile. Similarly, the weekend effect for the highest standard deviation quartile is significantly greater at 0.62 percent than that for the lowest standard deviation quartile at 0.11 percent, and the difference of 0.51 percent is also statistically significant. These results are consistent with the expectation that speculative short sellers are more likely to close open positions in more volatile stocks over the weekend leading to a larger weekend effect for those stocks than for less volatile stocks.

Some observers may argue that volatile returns will translate into a larger weekend effect without the impact of short sales. We do not believe such a systematic relation exists. In any case, to allay those concerns, we divide the weekend effect by the standard deviation and report the standardized weekend effect as the last row in Table VI. The standardized weekend effect is still significantly larger for the highest standard deviation quartile than for the lowest standard deviation quartile. Regression results (not reported) confirm the panel results in Table VI. These results provide further evidence that support the assertion that trading patterns of speculative short sellers contribute to the weekend effect.

TableVI

Weekend Effect by Standard Deviation Quartiles

For each year from 1963 to 1999, we divide all NYSE/Nasdaq/AMEX stocks into size deciles based on their market capitalization as at June, end of the current year. Within each size decile, we subdivide stocks into quartiles based on their standard deviation for stocks with over 200 days of return data. Friday return, Monday return, and the weekend effect are reported below for each standard deviation quartile. The *p*-values are in parentheses.

	Std. Qtl. 1	Std. Qtl. 2	Std. Qtl. 3	Std. Qtl. 4	Std. Qtl. 4–Std. Qtl. 1
Daily standard	0.017	0.026	0.034	0.051	0.035
deviation	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Friday return	0.107	0.188	0.262	0.432	0.324
(in percent)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Monday return	− 0.006	− 0.061	− 0.129	− 0.190	− 0.184
(in percent)	(0.701)	(0.012)	(0.000)	(0.000)	(0.000)
Weekend effect	0.113	0.249	0.391	0.622	0.508
(in percent)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Standardized	0.067	0.099	0.119	0.135	0.068
weekend effect	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

V. Summary and Concluding Remarks

Although observers acknowledge the role of short sales in setting proper stock prices, an understanding of how and whether short sales actually affect prices in the short term is lacking. We use the weekend effect as the test case to examine the hypothesis that speculative short sellers systematically influence prices. Our hypothesis is based on the contention that speculative short sellers are unwilling or less likely to hold their positions over long nontrading periods, typically the weekend. Therefore, they buy to cover on Fridays and reopen their positions on Mondays, causing Friday returns to be larger than Monday returns.

We find evidence consistent with this hypothesis. Stocks with high levels of relative short interest have significantly higher weekend effect than similar sized stocks with a low level of relative short interest. We explore this result further in different ways. The introduction of options provides a natural experiment. We reason that speculative short sellers are more likely to use put options than short sales. Thus, if speculative short sellers contribute to the weekend effect, then the availability of put options should reduce the weekend effect. We find that the weekend effect has fallen for stocks that have actively traded options but not for other stocks.

The initial public offerings provide a sample that consists largely of speculative short interest. Within IPOs, we find a significantly higher weekend effect for high relative short interest firms than for low relative short interest firms. When we compare zero short interest firms with firms that have a high relative short interest, again we find that firms with higher relative short interest have a greater weekend effect. Finally, the more volatile stocks have a greater weekend effect consistent with the hypothesis that short sellers are more likely to close open positions for more volatile stocks than for less volatile stocks over the weekend.

Point estimates suggest that trading patterns of short sellers can explain a significant part of the weekend effect. The evidence is also consistent with related seasonalities such as high preholiday returns (Ariel (1990)), lower Friday returns with Saturday trading (Keim and Stambaugh (1984)), the negative return from Friday close to Monday open (Rogalski (1984)), and similar patterns in nonequity markets (Gibbons and Hess (1981)). The impact of short sellers on stock prices documented in this paper indicates that a further understanding of the role of short sellers (because they are so different from other market participants) may enable us to more fully comprehend the process of price discovery.

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