

An Alternative Methodology for Measuring Expiration Day Price Effects at Friday's Close: The Expected Price Reversal— A Note

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INTRODUCTION

In response to concerns that the simultaneous expiration of index futures, futures options, and index options precipitate abnormal stock price movements in the "triple witching hour," the Chicago Mercantile Exchange, New York Stock Exchange (NYSE), and New York Futures Exchange have switched the settlement of their futures and futures options contracts to the open on expiration day from the close beginning with the June 1987 quarterly expiration.¹

Using transaction-by-transaction price data for individual NYSE stocks, Stoll and Whaley (1989) analyze volatility and price effects on quarterly expirations before and after June 1987. They find that return volatility is smaller at Friday's close in the post-June 1987 period than at Friday's close in the pre-June 1987 period. Based on the mean price reversal (REV), they conclude that price effects at Friday's close appear to have decreased slightly as a result of the switch to the open, but the decrease is small and not always readily observable.²

¹The triple witching hour refers to the last hour of trading on the third Fridays of March, June, September, and December, i.e., the quarterly expiration cycle for the S&P 500 futures.

²The magnitude of REV is equal to Monday's first half-hour return. The sign is based on price movements over the last half-hour on Friday versus the first half-hour on Monday. If prices move in the same direction, then $REV < 0$. If prices move in opposite directions, then $REV > 0$. The latter constitutes evidence of expiration day price effects. The magnitude of REV, which is an ex post measure of expiration day price effects, is affected by new information released from Friday's close to Monday's open.

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In this article, an alternative methodology is formulated to measure expiration day price effects, referred to as the expected price reversal (EPR). EPR is used to estimate price effects on the S&P 500 index at Friday's close for quarterly expirations pre/post-June 1987. EPR is the market's forecast of Monday's price reversal impounded in the settlement price for the next most distant futures contract.³ Expiration day price (EPR) effects cannot be measured directly; they can only be approximated. The EPR is used exclusively to approximate the magnitude of expiration day price effects at Friday's close. This procedure is not suited to measure expiration day effects at Friday's open.

THE EXPECTED PRICE REVERSAL

In the absence of transaction costs, the equilibrium relation between the S&P 500 futures price, F , and the S&P 500 spot price, S , is

$$F = S(1 + r - d) \quad (1)$$

where r is the riskless rate of interest for the period remaining until maturity of the futures contract and d is the dividend yield on the stocks in the index for the period remaining to maturity of the futures contract.

Let CF represent the settlement (15:15 C.S.T.) price for the next most distant S&P 500 futures contract. Let CS represent the closing (15:00 C.S.T.) price for the S&P 500 index. Both prices are observed on the third Friday of the contract month. If

$$CF = CS(1 + r - d) \quad (2)$$

then $EPR = 0$. In contrast, if

$$CF \neq CS(1 + r - d) \quad (3)$$

then let CSE represent the value of the S&P 500 index such that CF and CSE are in equilibrium, i.e.,

$$CF = CSE(1 + r - d) \quad (4)$$

Define the expected price reversal as

$$EPR = \ln(CS/CSE)100 \quad \text{if } (CS - S) > 0 \quad (5a)$$

and

$$EPR = \ln(CSE/CS)100 \quad \text{if } (CS - S) < 0 \quad (5b)$$

where S represents the value of the S&P 500 index at 14:00 C.S.T. This definition is consistent with the concept of a price reversal. A positive value for EPR indicates evidence of expiration day price effects. A negative value indicates a continuation, i.e., the absence of expiration day price effect.

EMPIRICAL RESULTS

Quarterly expiration day price effects at Friday's close for the S&P 500 index are estimated based on both EPR and REV. The data set covers the twenty-four quarterly expirations over the period June, 1984 through March, 1990. Results are reported separately for the pre-June, 1987 and post-June, 1987 periods. REV is based

³For the March expiration, the next most distant futures contract is the June contract.

on last hour Friday returns and on first half-hour Monday returns for the S&P 500 index. The empirical results are presented in Table I.

Price effects in the post-June 1987 period are smaller at Friday's close than at Friday's close in the pre-June 1987 period based on the mean value for EPR. How-

Table I
MEASURING QUARTERLY EXPIRATION DAY EFFECTS.
WHAT HAS CHANGED?: PRE/POST-JUNE, 1987

	Last Hour S&P Returns (T)	Expected Price Reversal (EPR)	Price Reversal (REV)
A. Pre-June 1987 (Old Expiration Procedures)			
06/15/84	-0.502	0.235	-0.148
09/21/84	-1.272	0.464	0.193
12/21/84	0.284	-0.560	-0.284
03/15/85	-0.981	0.447	0.283
06/21/85	0.949	1.082	0.889
09/20/85	-0.586	0.258	1.391
12/20/85	-0.076	-0.256	-0.465
03/21/86	-1.104	0.231	0.632
06/20/86	1.092	0.827	0.786
09/19/86	0.522	0.241	-0.344
12/19/86	1.513	1.087	0.405
03/20/87	0.471	0.487	0.121
Mean	0.026%	0.378%	0.288%
Variance	0.850	0.234	0.315
B. Post-June 1987 (New Expiration Procedures)			
06/19/87	0.267	0.267	-0.332
09/18/87	-0.330	0.361	0.781
12/18/87	0.322	0.745	-0.421
03/18/88	0.314	-0.166	0.867
06/17/88	0.708	0.263	0.704
09/16/88	0.545	0.507	0.415
12/16/88	0.261	0.315	0.141
03/17/89	0.185	0.322	0.585
06/16/89	0.243	0.196	0.090
09/15/89	0.689	0.049	-0.003
12/15/89	0.682	0.094	-0.140
03/16/90	0.284	0.079	0.528
Mean	0.347%	0.253%	0.268%
Variance	0.082	0.054	0.192
<i>t</i>	1.15	-0.81	-0.10
<i>F</i>	10.24*	4.28**	1.63

*,**Significant at the 0.01 and 0.05 level, respectively. T = third Friday of the contract month. T + 1 = Monday following third Friday. The *t*-statistic is testing the hypothesis of equal means between expiration procedures. The *F*-statistic is testing the hypothesis of equal variances.

ever, the decline (0.378% to 0.253%) is not statistically significant at a meaningful level. Similar results (0.288% to 0.268%) are reported in Table I based on the mean value for REV.

A significant reduction in the variance (0.234 to 0.054) of price effects is observed in the post-June, 1987 period based on EPR. The reduction in the variance (0.315 to 0.193) of price effects based on REV is not significant at a meaningful level. This does not imply that this reduction is necessarily "a good thing." The reduction in variance of estimated price effects may simply imply that price effects are more certain for the post-June, 1987 period. However, this reduction is consistent with the observation that last hour S&P 500 index return volatility (0.850 to 0.083) is significantly reduced in the post-June, 1987 period.

As a measure of price effects around the open in the post-June, 1987 period, returns from Thursday's close to Friday's open (non-trading period) are calculated for the next most distant futures contract. The price reversal in the futures market based on Friday's close is calculated also. These results are compared with those calculated for the pre-June, 1987 period. The mean nontrading period return differential between expiration procedures is equal to 0.3019% ($t = 1.77$, $p < 0.10$). As expected, the variance of nontrading period returns and the mean price reversal are both larger in the post-June, 1987 period. Statistically, however, the results are not distinguishable at a meaningful level. Price effects at Friday's open appear to have increased slightly in the post-June, 1987 period.

CONCLUSIONS

An alternative methodology, the expected price reversal, is used to measure quarterly expiration day price effects at Friday's close on the S&P 500 index. Results are compared for the pre-June, 1987 and post-June, 1987 periods. Based on the mean value for EPR, it appears that the change in expiration procedures has resulted in a slight decrease in price effects at Friday's close for the S&P 500 index. Based on the variance of EPR, the volatility of price effects is significantly reduced in the post-June, 1987 period. In contrast, the volatility of price effects based on REV is not significantly different at a meaningful level pre/post-June, 1987.

Although the results are in general agreement with those reported by Stoll and Whaley (1989), the expected price reversal indicates that the reduction in price effects post-June, 1987 is greater than suggested by methods based on REV.

Bibliography

- Stoll, H., and Whaley, R. (1989): "Expiration-Day Effects: What Has Changed?" Working paper, Vanderbilt University.

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