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The Information Content of Option Ratios

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Abstract
A broad stream of research shows that information flows into underlying stock prices through the options market. For instance, prior research shows that both the Put–Call Ratio (P/C) and the Option-to-Stock Volume Ratio (O/S) predict negative future stock returns. In this paper, we compare the level of information contained in these two commonly used option volume ratios. First, we find that P/C ratios contain more predictability about future stock returns at the daily level than O/S ratios. Second, in contrast to our first set of results, O/S ratios contain more predictability about future returns at the weekly and monthly levels than P/C ratios. In fact, our tests show that while P/C ratios contain predictability about future daily returns and, to some extent, future weekly returns, the return predictability in P/C ratios is fleeting. O/S ratios, on the other hand, significantly predict negative returns at all levels: daily, weekly, and monthly. While Pan and Poteshman (2006) show that

signed P/C ratios, which require proprietary data, have predictive power, we find that unsigned P/C ratios, which do not require proprietary data, also have predictive power.

Keywords

Put-Call Ratio, Option-to-Stock Volume Ratio, Informed trading, Return predictability

1. Introduction

The idea that the options market provides an additional avenue for informed investors to trade is well known. Black (1975) argues that, because of higher leverage opportunities and less downside risk, informed investors will prefer to trade options. Other theoretical research also discusses the possibility that informed investors will prefer to trade options as opposed to trading the underlying security (Diamond and Verrecchia, 1987, Easley et al., 1998, Danielsen and Sorescu, 2001). Several studies investigate the theoretical prediction that information will flow into security prices through the options market and find supportive evidence that some option trades contain information (DeTemple and Jorion, 1990, Figlewski and Webb, 1993, Kumar et al., 1998, Easley et al., 1998, Chan et al., 2002, Chakravarty et al., 2004, Cao et al., 2005, Battalio and Schultz, 2006, Roll et al., 2009, Roll et al., 2010, Hu, 2014).

In fairly recent studies, Pan and Poteshman, 2006, Roll et al., 2010, Johnson and So, 2012 examine two separate option ratios and show that these ratios predict future underlying stock returns. Specifically, using proprietary trade data obtained directly from the Chicago Board of Options Exchange, Pan and Poteshman (2006) calculate the Put–Call Ratio (P/C ratio hereafter) as buyer-initiated put volume scaled by total option (both put and call) volume. They show that daily P/C ratios are negatively related to next-day returns and argue that P/C ratios contain information about future spot prices. Pan and Poteshman (2006) also show that the information contained in P/C ratios is not explained by violations of market efficiency, but instead is driven by the trading on non-public information, suggesting that privately informed investors trade in the options market.

On the other hand, Johnson and So (2012) show, both theoretically and empirically, that the option-to-stock volume ratio (O/S ratio hereafter), which is the ratio of total option (both put and call) volume to total underlying share volume, contains return predictability.[3] Their models predict that high O/S ratios will lead to subsequent underperformance in the underlying security because informed bearish investors will trade some combination of options to avoid high equity borrowing costs (i.e. short-sale constraints). In addition, Johnson and So (2012, page 264) argue that examining the O/S ratio instead of Pan and Poteshman's (2006) P/C ratio allows researchers and investors the ability to determine the level of informed trading in the options market without the need for proprietary data to determine buyer-initiated put options. Consistent with their model predictions, Johnson and So (2012) show that weekly O/S ratios are negatively related to next-week returns suggesting that O/S ratios also contain information about future stock prices at the weekly level. In a related study, Roll et al. (2010) document that higher option volume-to-stock volume ratios during the pre-earnings announcement period predict post-earnings announcement returns and argue that O/S ratios contain important non-public information.

While both Pan and Poteshman, 2006, Johnson and So, 2012 present evidence that these two types of option ratios contain information, to our knowledge, research has not yet compared the level of information contained in these ratios. The main objective of this study is to extend this research by providing this comparison. In particular, we follow the empirical methods in Pan and Poteshman, 2006, Johnson and So, 2012 and compare the return predictability contained in both the P/C and O/S ratios at the daily, weekly, and monthly levels. Part of the motivation for Johnson and So (2012) to examine O/S ratios instead of P/C ratios is that the P/C ratios used in Pan and Poteshman (2006) require proprietary data that allows for the signing of option trades. However, in this study, we calculate P/C ratios using unsigned put volume relative to total option volume. In spite of this shortcoming, we find strong evidence supporting the idea that daily P/C ratios can predict negative next-day returns. Our tests also reveal that daily O/S ratios can predict negative next-day returns. These findings provide some important inferences. First, our finding that unsigned P/C ratios are negatively related to next-day returns suggests that determining buyer initiation of put volume is not required to capture all of the information contained in P/C ratios.[4] Second, our results showing that daily O/S ratios are negatively related to next-day returns indicate that the information contained in O/S ratios is not only captured at the weekly level, as in Johnson and So (2012), but also at the daily level. When comparing the negative relation between P/C ratios and next-day returns to the negative relation between O/S ratios and next-day returns, we find strong evidence that daily P/C ratios can predict negative returns significantly better than daily O/S ratios. In economic terms, the daily return predictability contained in P/C ratios is at least 40% greater than that of O/S ratios.

While our comparison of the information contained in both types of option ratios at the daily level is informative, a natural extension of our tests is to determine which option ratio contains more information about future stock prices at longer time intervals. The motivation behind these additional tests is based on findings in Pan and Poteshman (2006), which illustrates that the predictability contained in P/C ratios is relatively short lived. Our results indicate that even unsigned weekly P/C ratios are negatively related to next-week returns. However, the statistical significance of these weekly tests is markedly weaker than the statistical significance of our daily tests. Consistent with the findings in Johnson and So (2012), our tests further show that O/S ratios are negatively related to next-week returns. Moreover, our comparison of the predictive power of weekly O/S and P/C ratios indicates that the negative association between next-week returns and weekly O/S ratios is stronger than the negative association between next-week returns and weekly P/C ratios. In economic terms, the return predictability contained in weekly O/S ratios is, at times, more than 200% greater than the return predictability contained in weekly P/C ratios.

Similar to our tests at the daily and weekly levels, in our final set of tests, we focus on the relation between this month's option ratios and next-month returns. We find a significant negative relation between monthly O/S ratios and next month's risk-adjusted returns. These results support the idea that the information contained in weekly O/S ratio documented in Johnson and So (2012) also extends to the monthly level. However, we do not find a significant relation between monthly P/C ratios and next-month returns. In light of the findings both in Pan and Poteshman (2006) and in our tests at the daily and weekly levels, this insignificant relation suggests that the return predictability contained in P/C ratios is fleeting. That is, the information about future stock prices contained in P/C ratios, while greater than the information contained in O/S ratios at the daily level, decreases through time. When examining monthly data, we find that there is virtually no return predictability contained in P/C ratios. Statistical tests show that, as expected, the negative relation between next-month returns and current O/S ratios is significantly greater than the relation between next-month returns and current P/C ratios. This difference is both economically and statistically significant. In unreported robustness tests, we find that the conclusions that we are able to draw are similar when we examine various time periods and options with varying lengths to expiration.

Our results showing that P/C ratios are better than O/S ratios at predicting short-term returns but worse at predicting longer-term returns have important implications. First, when examining the information content of various option ratios, future research must account for the fleeting nature of the information contained in P/C ratios relative to O/S ratios. Second, to the extent that investors use various option ratios as buy or sell signals, our results provide an important caveat when looking at the strength of the signal across longer time horizons. Third, while the return predictability of P/C ratios decreases when examining longer time horizons, our results still show that even unsigned P/C ratios contain information about future returns over shorter time horizons. Likewise, our fourth finding implies that the negative relation between weekly O/S ratios and next-week returns shown in Johnson and So (2012) is robust to daily and monthly time periods.

The remainder of the paper is organized as follows. Section 2 describes the data used in the analysis. Section 3 discusses the methods used in the study and reports the results from our empirical tests. Finally, Section 4 offers some concluding remarks.

2. Data description

The data used in this analysis come from several sources. From OptionMetrics, we gather daily option volume. The daily option volume is partitioned into both call option volume and put option volume. From the Center for Research on Securities Prices (CRSP), we gather daily trade volume, prices, market capitalization, bid-ask spreads, and returns (holding period returns including dividend). We exclude financial firms (SIC between 6000 and 6999) and utility firms (SIC between 4900 and 4959). Our sample begins in 1996 (beginning of OptionMetrics data) and ends in 2012. After merging the OptionMetrics data to the CRSP data, we are left with 5459 stocks, or 1955 unique stocks per year.[5]

Because the time horizon of returns is important in our analysis, we aggregate the daily measures of call option volume, put option volume, volume, prices, and returns to the weekly (from Monday to Monday) and the monthly (from the first day of the month to the first day of the next month) levels, respectively. We restrict to firm-days with at least one call and one put contract traded to reduce measurement problems associated with illiquid option markets. Similarly, we include only firm-weeks with at least 25 call and 25 put contracts traded as in Johnson and So (2012) and we keep only firm-months with at least 50 call and 50 put contracts traded. The daily data consist of 4,411,927 stock-day observations, the weekly data contain 1,066,392 stock-week observations, and the monthly data consist of 304,181 stock-month observations.

The O/S ratio (multiplied by 100) is defined as the total option volume divided by the total stock volume over the same time period. The P/C ratio is defined as the total put volume divided by the total options volume (puts and calls) over the same time period. We calculate each ratio at the daily, weekly, and monthly levels. While both ratios include total option volume, the correlation coefficient between the two is insignificant at the daily level. At the weekly and monthly levels, the correlation coefficient is 0.0056 and 0.0355, respectively, and is significant at the 0.01 level (not tabulated).

Table 1 presents statistics that describe the three samples. Panel A reports the results for the daily sample, while Panels B and C present the summary statistics for the weekly and monthly samples, respectively. In Panel A, we find that the average stock has a P/C ratio of 0.39, an O/S ratio of 0.14, and a daily option volume of 3299 contracts. The average firm size is 14.57 (median 14.45) where size equals the natural logarithm of market capitalization. The stock price averages $33.40 while daily volume averages 2.2 million shares. Finally, the average stock has a daily return of 0.06% with the average bid-ask spread of $0.11, where bid-ask spread is the difference between the closing ask price and the closing bid price reported from CRSP.[6]

Table 1. Summary statistics.

	Mean	**Median**	**Stand. Dev.**	**Min**	**Max**
	[1]	**[2]**	**[3]**	**[4]**	**[5]**
Panel A. Daily Data					
P/C	0.39	0.35	0.26	0.00	1.00
O/S * 100	0.14	0.06	21.42	0.00	34329.40
OptVol	3299.42	372.00	21290.19	2.00	6165738.00
Size	14.57	14.45	1.56	7.32	20.30
Price	33.40	27.00	29.57	1.01	768.05
Volume	2.21	0.78	5.86	0.00	995.82
Spread	0.11	0.03	0.26	0.00	172.48

Return	0.06	0.00	3.99	-83.80	625.93
Panel B. Weekly Data					
P/C	0.37	0.35	0.21	0.00	1.00
O/S * 100	0.11	0.06	0.21	0.00	29.71
OptVol	13681.94	1635.00	68371.90	50.00	6605465.00
Size	14.43	14.30	1.55	7.32	20.30
Price	31.86	25.56	28.47	−104.72	767.65
Volume	9.45	3.33	24.57	0.00	2227.92
Spread	0.11	0.03	0.29	0.00	99.00
Return	0.26	0.07	8.36	-84.85	689.72
Panel C. Monthly Data					
P/C	0.36	0.34	0.19	0.00	1.00
O/S * 100	0.09	0.05	0.14	0.00	7.42
OptVol	47572.75	4791.00	230606.96	100.00	20792620.00
Size	14.20	14.06	1.55	7.37	20.26
Price	29.70	23.66	26.88	−92.88	760.82
Volume	340.44	113.95	918.86	0.06	59733.52
Spread	0.12	0.03	0.58	0.00	172.48
Return	1.02	0.56	16.96	−98.13	1349.51

Descriptive statistics are reported for varying time horizons. Statistics for daily, weekly, and monthly data are reported in Panels A, B, and C, respectively. P/C is the put volume scaled by total option (both put and call) volume. O/S is the ratio of total option (both put and call) volume to total underlying share volume. OptVol is total put and call volume. Size is calculated as log of market capitalization at the end of the period. Volume is the underlying share trading volume. Spread is the difference between the closing ask price and the closing bid price. Return is raw holding period returns with dividend.

Panels B and C show that the weekly and monthly P/C and O/S ratios for the average stock have similar statistics to those in Panel A. The mean P/C ratio is between 0.36 and 0.37 (median 0.34–0.35) while mean O/S ratio is between 0.09 and 0.11 (median 0.05–0.06), similar to Johnson and So's (2012, page 269) sample. In addition, the average stock has a weekly option volume of 13,682 and stock trading volume of more than 9 million shares while the monthly data are 47,573 option contracts and approximately 340 million shares. The average stock has a weekly return of 0.26% and a monthly return of 1.02%.

There are a few noteworthy implications from Table 1. First, the P/C and O/S ratios are not normally distributed but instead are heavily right skewed, which is consistent with Johnson and So's (2012, page 269) sample. Therefore, in our later tests, we rank P/C and O/S ratios into quintiles and use the ranking indicator instead of the actual value. Second, although the median O/S ratios are consistent among different frequency levels, the mean value is highest at the daily level and lowest at the monthly level. This is most likely because the daily data is more volatile; there are some days with abnormal trading activity on both stock and/or options. Aggregating into longer frequency reduces that volatility. The skewness of the O/S ratio is almost 1500 at daily level but is only 28 at weekly level and 9 at monthly level. We also note that when we examine firm characteristics for each quintile of option ratios, we find that firm characteristics, including the number of call options, the number of put options, volume, firm sizes, and prices, decrease monotonically across increasing O/S quintiles. These observations are qualitatively similar to the weekly sample in Johnson and So (2012, page 269). However, a clear pattern of changes in firm characteristics is not observed when we sort stocks by P/C ratio because the P/C ratio includes option volume in both the numerator and the denominator.

3. Empirical results

3.1. Univariate analysis

To better understand the varying information content of option ratios, we follow both Pan and Poteshman, 2006, Johnson and So, 2012 and examine the relation between both O/S and P/C ratios and next-period stock returns. Table 2 focuses on daily data while Table 3, Table 4 examine weekly and monthly data, respectively. For each frequency, we begin by sorting stocks into quintiles based on the respective option ratio. We then examine the stock's average next-period return across varying quintiles. We use CRSP raw returns as well as Fama–French 3-Factor risk-adjusted returns and Fama–French-Carhart 4-Factor risk-adjusted returns. The risk-adjusted returns in our analysis are the residuals of the estimated 3-Factor and 4-Factor models for each stock at the daily, weekly, and monthly levels.

Table 2. Univariate tests – relation between option ratios and next day returns.

	Raw *returns*$_{t+1}$	**3-Factor risk-adjusted returns$_{t+1}$**	**4-Factor risk-adjusted returns$_{t+1}$**
	[1]	**[2]**	**[3]**
Panel A. Daily Data – Sorting by O/S Ratio on Day t			
Q1 (low)	0.1219 [4.73]	0.0281 [2.35]	0.0277 [2.39]
Q2	0.0862 [3.24]	−0.0092 [−0.77]	−0.0093 [−0.81]
Q3	0.07 [2.61]	−0.023 [−1.94]	−0.0221 [−1.91]
Q4	0.0588 [2.20]	−0.0353 [−2.95]	−0.0345 [−2.93]
Q5 (high)	0.0314 [1.24]	−0.0672 [−5.68]	−0.0659 [−5.63]
Q5 − Q1	−0.0905*** [−10.08]	−0.0953*** [−12.11]	−0.0936*** [−12.04]
Panel B. Daily Data – Sorting by P/C Ratios on Day t			
Q1 (low)	0.1272 [4.75]	0.0277 [2.33]	0.0274 [2.35]
Q2	0.0971 [3.59]	0.0003 [0.03]	−0.0002 [−0.02]
Q3	0.0746 [2.78]	−0.0188 [−1.57]	−0.0173 [−1.48]
Q4	0.0462 [1.79]	−0.0468 [−3.97]	−0.0458 [−3.98]
Q5 (high)	0.0235 [0.95]	−0.0691 [−5.88]	−0.0684 [−6.00]
Q5 − Q1	−0.1038*** [−13.37]	−0.0967*** [−13.59]	−0.0958*** [−13.55]
Panel C. Daily Data – Difference-in-Differences (O/S vs. P/C)			
Diff-in-Diff	0.0014 [0.13]	0.0021 [0.20]	0.0132 [1.11]

Stocks are sorted into quintiles based on option ratios calculated at the daily level. Panel A reports results for O/S ratios. Panel B reports results for P/C ratios. The average next-day returns for stocks in each quintile are reported in Columns [1]–[5]. We report next-day raw returns and two measures of risk-adjusted returns. Raw return is daily return with dividend from CRSP. Risk-adjusted returns are defined as the residual of the Fama–French 3-Factor model (3-Factor risk-adjusted returns$_{t+1}$) or the residual of the Fama–French-Carhart 4-Factor model (4-Factor risk-adjusted returns$_{t+1}$). We note that Q1 is the quintile of stocks with the lowest option ratio while Q5 is the quintile of stocks with the highest option ratio. Panel C reports results from difference-in-differences tests. Returns from the high and low quintiles for O/S ratios are subtracted from returns from high and low quintiles for P/C ratios. We report corresponding *t*-statistics in brackets.

* Denoting statistical significance at the 0.10 level.

** Denoting statistical significance at the 0.05 level.

***Denoting statistical significance at the 0.01 level.

Table 3. Univariate tests – relation between option ratios and next week returns.

	Raw returns$_{t+1}$	**3-Factor risk-adjusted returns$_{t+1}$**	**4-Factor risk-adjusted returns$_{t+1}$**
	[1]	**[2]**	**[3]**
Panel A. Weekly Data – Sorting by O/S Ratio on Week t			
Q1 (low)	0.473 [3.83]	0.0475 [0.42]	0.0442 [0.40]
Q2	0.3732	−0.0691 [−0.64]	−0.0674 [−0.64]
Q3	0.2988 [2.35]	−0.123 [−1.12]	−0.1191 [−1.11]
Q4	0.2029 [1.61]	−0.2308 [−2.07]	−0.2242 [−2.04]
Q5 (high)	0.1346 [1.13]	−0.3323 [−3.02]	−0.322 [−2.95]
Q5 − Q1	−0.3385*** [−7.04]	−0.3798*** [−9.89]	−0.3663*** [−9.73]
Panel B. Weekly Data – Sorting by P/C Ratios on Week t			
Q1 (low)	0.4095 [3.14]	−0.0357 [−0.34]	−0.0395 [−0.38]
Q2	0.317 [2.49]	−0.1306 [−1.20]	−0.1251 [−1.17]
Q3	0.2704 [2.17]	−0.1565 [−1.40]	−0.1512 [−1.38]
Q4	0.2548 [2.14]	−0.1917 [−1.71]	−0.1843 [−1.66]
Q5 (high)	0.2283 [1.96]	−0.1965 [−1.75]	−0.1924 [−1.75]
Q5 − Q1	−0.1812*** [−4.37]	−0.1607*** [−4.49]	−0.1529*** [−4.31]
Panel C. Weekly Data – Difference-in-Differences (O/S vs. P/C)			
Diff-in-Diff	−0.1573** [−2.48]	−0.2190*** [−4.17]	−0.2133*** [−4.12]

Stocks are sorted into quintiles based on option ratios calculated at the weekly level. Panel A reports results for O/S ratios. Panel B reports results for P/C ratios. The average next-week returns for stocks in each quintile are reported in Columns [1]–[5]. We report next-week raw returns and two measures of risk-adjusted returns. Raw return is cumulative daily return from Monday to the next Monday. Panel C reports results from difference-in-differences tests. Returns from the high and low quintiles for O/S ratios are subtracted from returns from high and low quintiles for P/C ratios. We report corresponding *t*-statistics in brackets.

* Denoting statistical significance at the 0.10 level.

**Denoting statistical significance at the 0.05 level.

***Denoting statistical significance at the 0.01 level.

Table 4. Univariate tests – relation between option ratios and next-month returns.

	Raw returns$_{t+1}$	**3-Factor risk-adjusted returns$_{t+1}$**	**4-Factor risk-adjusted returns$_{t+1}$**
	[1]	**[2]**	**[3]**
Panel A. Monthly Data – Sorting by O/S Ratio on Month t			
Q1 (low)	1.7864 [3.41]	−0.1224 [−0.14]	−0.1624 [−0.19]
Q2	1.2087 [2.36]	−0.4751 [−0.57]	−0.4594 [−0.56]
Q3	1.0946 [2.10]	−0.579 [−0.68]	−0.5685 [−0.68]
Q4	0.8081 [1.54]	−0.745 [−0.86]	−0.7021 [−0.82]
Q5 (high)	0.5434 [1.07]	−1.2057 [−1.37]	−1.1747 [−1.35]
Q5–Q1	−1.2430*** [−4.85]	−1.0832*** [−5.58]	−1.0123*** [−5.86]
Panel B. Monthly Data – Sorting by P/C Ratios on Month t			

Q1 (low)	1.4393 [2.61]	−0.3133 [−0.38]	−0.327 [−0.41]
Q2	0.9826 [1.83]	−0.7504 [−0.90]	−0.7128 [−0.86]
Q3	1.0213 [2.02]	−0.6115 [−0.70]	−0.5984 [−0.70]
Q4	0.9664 [1.95]	−0.7316 [−0.82]	−0.7126 [−0.81]
Q5 (high)	1.0029 [2.06]	−0.7332 [−0.83]	−0.7296 [−0.85]
Q5 – Q1	−0.4364** [−2.11]	−0.4199** [−2.40]	−0.4025** [−2.39]
Panel C. Monthly Data – Difference-in-Differences (O/S vs. P/C)			
Diff-in-Diff	−0.6633** [−2.54]	−0.6098** [−2.53]	−0.8066** [−2.45]

Stocks are sorted into quintiles based on option ratios calculated at the monthly level. Panel A reports results for O/S ratios. Panel B reports results for P/C Ratios. The average next-month returns for stocks in each quintile are reported in Columns [1]–[5]. We report next-month raw returns and two measures of risk-adjusted returns. We note that Q1 is the quintile of stocks with the lowest option ratio while Q5 is the quintile of stocks with the highest option ratio. Panel C reports results from difference-in-differences tests. Returns from the high and low quintiles for O/S ratios are subtracted from returns from high and low quintiles for P/C ratios. We report corresponding *t*-statistics in brackets.

* Denoting statistical significance at the 0.10 level.

**Denoting statistical significance at the 0.05 level.

***Denoting statistical significance at the 0.01 level.

3.1.1. Daily univariate tests

Panel A of Table 2 reports the results for the O/S ratio. We sort stocks into quintiles based on the daily O/S ratio where Q1 is the quintile of stocks with the lowest daily O/S ratio and Q5 is the quintile of stocks with the highest daily O/S ratio. We find that both raw and risk-adjusted next-day returns decrease monotonically across increasing O/S quintiles with the return difference between extreme quintiles being negative and statistically significant. In particular, column [1] reports that the average next-day raw return for stocks in the quintile with the lowest O/S ratio (Q1) is 0.1219%. Next-day raw returns for stocks in the quintile with the highest O/S ratio (Q5) average 0.0314%. The return difference between the high and low quintiles is −0.0905%, which is significant at the 0.01 level (*t*-statistic = −10.08). A similar pattern can be seen when examining the 3-Factor and 4-Factor risk-adjusted returns in columns [3] and [5]. In economic terms, the average raw return in the quintile with the lowest O/S ratios is nearly three times as high as the average raw return in the quintile with the highest O/S ratios. When focusing on the risk-adjusted returns in Panel A, we find that the average return in the quintile with the smallest O/S ratio is nearly 2.5 times higher than the average return in the quintile with the largest O/S ratios. These results suggest that the negative relation between daily O/S ratios and next-day returns is not only statistically significant, but the magnitude of the relation is also economically meaningful. We note, however, that these high-minus-low quintile returns do not account for transaction costs. In unreported tests, we find that median bid-ask spreads (as a percentage of stock price) during our entire sample represent 7–11 basis points. Given that the return differences between high and low quintiles in Table 2 Panel A are approximately 10 basis points across columns, a long-short strategy at the daily level might not be profitable. In contrast, during the more modern era (i.e. post-decimalization period), median bid-ask spreads decrease by nearly 50%, suggesting 4–6 basis points net of transaction costs for the high-minus-low quintiles. Overall, these findings are consistent with the idea that higher O/S ratios are a bearish indicator of future stock return performance at the daily level.

Panel B of Table 2 reports the results for the P/C ratio. Again, both raw and risk-adjusted next-day returns decrease monotonically across increasing P/C ratio quintiles with the return difference between extreme quintiles being negative and statistically significant. Column [1] shows that raw returns for stocks in the quintile with the lowest P/C ratios are 0.1272% (*t*-statistic = 4.75), while raw returns in the quintile of stocks with the largest P/C ratios are 0.0235% (*t*-statistic = 0.95). The difference in returns between the high and low quintiles is −0.1038% and statistically significant (*t*-statistic = −13.37). In economic terms, the returns in the lowest quintile are more than 5.7 times larger than the returns in the highest quintile. Both 3-Factor and 4-Factor risk-adjusted returns show a similar pattern with the return differences between the high and low quintiles of −0.0967% and −0.0958%, respectively. Similar to the findings in Panel A that examine the O/S ratios, these findings indicate that P/C ratios also contains negative information about future stock performance. We again note that the high-minus-low strategy is more profitable after the decimalization because bid-ask spreads decrease.[7]

To compare the relative level of information contained in these two option ratios, we examine whether the return differences between extreme quintiles are statistically different for O/S and P/C ratios using a difference-in-differences tests. Results are reported in Panel C of Table 2. Columns [1], [3], and [5] show that the difference-in-differences is not significant, suggesting that the negative relation between option ratios and next-day risk-adjusted returns for O/S ratios is not stronger than P/C ratios. These findings are in contrast to the assertion by Johnson and So (2012, page 263) that only signed P/C ratios, which are only available through proprietary datasets, are informative. At least at the daily level, our evidence suggests that unsigned P/C ratios appear to be as good as O/S ratios at predicting negative future returns.

3.1.2. Weekly univariate tests

Since Pan and Poteshman, 2006, Johnson and So, 2012 use different time horizons, we next focus our analysis at the weekly level.[8] Results for our weekly return analysis are reported in Table 3. Consistent with the results in Panels A and B of Table 2, we find that both average raw returns (column [1]) and risk-adjusted returns (columns [3] and [5]) decrease monotonically across increasing quintiles. As before, Q1 consists of stocks in the lowest option ratio quintile and Q5 consists of stocks in the highest option ratio quintile. Further, the monotonic negative relation between option ratios and next-week returns hold for both O/S ratios (Panel A) and P/C ratios (Panel B). In addition to the monotonically decreasing returns, the differences between extreme quintiles are negative and significant at the 0.05 level in column [1] and at the 0.01 level in columns [3] and [5]. These differences range from −0.3385% to −0.3798% for O/S ratio sorts and from −0.1573% to −0.2190% for P/C ratio sorts. Column [5] suggests that, in economic terms, stocks in the lowest O/S ratio quintile have returns that are nearly twice as high as the returns for stocks in the highest O/S ratio quintile. Similarly, stocks in the lowest P/C ratio quintile have returns that are 3.2 times higher than stocks in the highest P/C ratio quintile. These results again suggest that both the O/S ratio and P/C ratio are informative in predicting future stock returns.

However, in contrast to our findings at the daily level, when we compare the relative information content between O/S ratios and P/C ratios at the weekly level, we find that P/C ratios are less powerful than O/S ratios in predicting future returns; all the estimates of the difference-in-differences tests are negative and significant at the 0.01 level (Panel C). For instance, the 4-Factor adjusted-return difference-in-differences estimate in column [5] is −0.2133% (*t*-statistic = −4.12). This result suggests that the difference in returns between extreme O/S ratio quintiles is more than twice as negative as the difference in returns between extreme P/C ratio quintiles. Similar conclusions can be drawn when examining raw returns and 3-Factor risk-adjusted returns. Given that bid-ask spreads are between 7 and 12 basis points, these findings suggest that after accounting for transaction costs, high-minus-low returns are approximately 22–31 basis points in Panel A and 8–11 basis points in Panel B. In sum, the results in Table 3 suggest that even at the weekly level, unsigned P/C ratios have some predictive power with respect to future returns. However, weekly O/S ratios seem to have greater predictive power than weekly P/C ratios.

3.1.3. Monthly Univariate Tests

In our last set of univariate tests, we analyze the relative information content of the P/C and O/S ratios using monthly data and report the results in Table 4. Panel A shows that, when quintiles are sorted based on O/S ratios, returns still monotonically decrease across increasing quintiles. Further, the return differences between the high and low quintiles, −1.2430%, −1.0832% and −1.0123% for raw returns, 3-Factor risk-adjusted returns, and 4-Factor risk-adjusted returns, are significant at the 0.01 level. In addition, these differences between extreme quintiles are economically significant as stocks in the lowest O/S quintile have returns that are twice as large as returns for stocks in the largest O/S quintile. However, in Panel B, when quintiles are sorted based on P/C ratios, we do not find significant differences between extreme P/C quintiles. As before, Panel C reports the differences in differences and provides some evidence that the predictive power of monthly O/S ratios is greater than the predictive power of monthly P/C ratios. Another implication from Table 4 is that, at the monthly level, unsigned P/C ratios have a difficult time predicting future returns.

In general, the results from our univariate analysis suggest that, to some extent, both unsigned P/C ratios and O/S ratios predict negative future stock returns. Indeed the evidence suggests that P/C ratios contain more predictability about future stock returns at the daily level than O/S ratios. However, the return predictability in P/C ratios is fleeting. At the weekly level, P/C ratios still contain predictability about future daily returns but the magnitude of the predictability is less than half of that contained in O/S ratios. The fleeting nature of the information content in P/C ratios can also be seen at the monthly level. While O/S ratios still contain predictability about future returns, the information in P/C ratio disappears at this longer time horizon. The fleeting return predictability contained in P/C ratios could be due to the fact that the ratio is only made up of option volume, which by design only measures short-term contracts.

3.2. Multivariate analysis – A Fama–MacBeth approach

We recognize the need to control for other factors that might influence the relation between option ratios and future returns. Thus, in this section, we examine the predictability of unsigned P/C ratios and O/S ratios in a multivariate setting. In particular, we estimate the following equation using Fama–Macbeth regressions for our pooled samples at the daily, weekly, and monthly levels.(1)

$$returns_{i,t+1}=\beta_0+\beta_1 P/C(Q5)_{i,t}+\beta_2 O/S(Q5)_{i,t}+\beta_3 Turnover_{i,t}+\beta_4 Spread_{i,t}+\beta_5 Return_{i,t-5,t-1}+\varepsilon_{i,t+1}$$

The dependent variable is the 4-Factor risk-adjusted return. We note that tests using raw returns and 3-Factor risk-adjusted returns produce qualitatively similar results. Our two main explanatory variables of interest are $P/C(Q5)_{i,t}$ and $O/S(Q5)_{i,t}$ which are binary variables that equal one if stock *i*'s P/C ratio or O/S ratio is, respectively, in the top quintile in time *t* and zero otherwise. We use indicator variables following Johnson and So (2012).[9] Further, we include as additional independent variables: share turnover ($Turnover_{i,t}$), bid-ask spreads ($Spread_{i,t}$), and cumulative returns during the prior five periods ($Return_{i,t-5,t-1}$). Similar control variables are included in Pan and Poteshman (2006). Panels A, B, and C of Table 5 report the results at the daily, weekly, and monthly levels, respectively, with the corresponding Newey–West standard error-adjusted *t*-statistics in brackets.

Table 5. Multivariate tests – Fama–MacBeth regressions.

	[1]	**[2]**	**[3]**	**[4]**	**[5]**
Panel A. Regression Results at the daily level (t = days)					
Intercept	−0.0227 [−1.27]	0.0026 [0.14]	−0.0242 [−1.36]	−0.0024 [−0.13]	0.0073 [0.40]
$P/C(Q5)_{i,t}$	−0.0654*** [−15.29]	−0.0700*** [−16.40]			−0.0676*** [−15.82]

$O/S(Q5)_{i,t}$			−0.0445*** [−8.51]	−0.0350*** [−7.18]	−0.0313*** [−6.40]
$Turnover_{i,t}$		0.0118*** [5.72]		0.0125*** [6.12]	0.0124*** [6.09]
$Spread_{i,t}$		−0.6795*** [−20.05]		−0.6834*** [−20.04]	−0.6797*** [−19.95]
$Return_{i,t-5,t-1}$		−0.0089*** [−16.00]		−0.0087*** [−15.71]	−0.0089*** [−15.99]
Adjusted R^2	0.0201	0.973	0.0945	1.0253	1.0441
$O/S(Q5)_{i,t}P/C(Q5)_{i,t}$					0.0364*** [5.28]
Panel B. Regression Results at the weekly level (t = weeks)					
Intercept	−0.1004 [−0.49]	0.0877 [0.42]	−0.0633 [−0.31]	0.0987 [0.47]	0.1105 [0.53]
$P/C(Q5)_{i,t}$	−0.0602** [−2.12]	−0.0601** [−2.23]			−0.0558** [−2.07]
$O/S(Q5)_{i,t}$			−0.2437*** [−8.95]	−0.1581*** [−6.15]	−0.1589*** [−6.17]
$Turnover_{i,t}$		−0.0058** [−2.40]		−0.0051** [−2.13]	−0.0053** [−2.23]
$Spread_{i,t}$		−3.0692*** [−11.45]		−2.9948*** [−11.34]	−2.9944*** [−11.30]
$Return_{i,t-5,t-1}$		−0.0092*** [−7.24]		−0.0089*** [−7.03]	−0.0090*** [−7.15]
Adjusted R^2	0.0606	1.0475	0.087	1.0564	1.1053
$O/S(Q5)_{i,t} - P/C(Q5)_{i,t}$					−0.1031** [−2.47]
Panel C. Regression Results at the monthly level (t = months)					
Intercept	−0.2349 [−0.14]	0.2628 [0.16]	−0.0996 [−0.06]	0.3091 [0.19]	0.3247 [0.20]
$P/C(Q5)_{i,t}$	−0.1252 [−1.08]	−0.089 [−0.86]			−0.0805 [−0.78]
$O/S(Q5)_{i,t}$			−0.7787*** [−5.27]	−0.4527*** [−3.10]	−0.4626*** [−3.19]
$Turnover_{i,t}$		−0.3773 [−1.03]		−0.2882 [−0.79]	−0.2962 [−0.82]
$Spread_{i,t}$		−9.8276*** [−5.65]		−9.8866*** [−5.59]	−9.8274*** [−5.57]
$Return_{i,t-5,t-1}$		−0.0209*** [−5.16]		−0.0207*** [−5.07]	−0.0208*** [−5.11]
Adjusted R^2	0.0979	1.6072	0.1197	1.6254	1.7036
$O/S(Q5)_{i,t} - P/C(Q5)_{i,t}$					−0.3821** [−2.06]

The table reports the results from following equation using Fama–MacBeth with pooled stock-time observations.

(1)

$$returns_{i,t+1} = \beta_0 + \beta_1 P/C(Q5)_{i,t} + \beta_2 O/S(Q5)_{i,t} + \beta_3 Turnover_{i,t} + \beta_4 Spread_{i,t} + \beta_5 Return_{i,t-5,t-1} + \varepsilon_{i,t+1}$$

The dependent variable is the Fama–French-Carhart 4-Factor risk-adjusted return for stock *i* during time *t* + 1. We note that tests using raw returns and Fama–French 3-Factor risk-adjusted returns produce qualitatively similar results. Our two main explanatory variables of interest are $P/C(Q5)_{i,t}$ and $O/S(Q5)_{i,t}$ which are binary variables that equal one if stock *i*'s P/C ratio or O/S ratio are, respectively, in the top quintile on time *t* and zero otherwise. We include as additional independent variables share turnover ($Turnover_{i,t}$), bid-ask spreads ($Spread_{i,t}$), and cumulative returns during the prior five periods ($Return_{i,t-5,t-1}$). Panels A, B, and C show the results at the daily, weekly, and monthly levels, respectively. That is, in Panel A *t* equals one day while in Panel B *t* represents one week and in Panel C *t* is equal to one month. We report corresponding *t*-statistics using Newey–West standard errors in brackets.

* Denoting statistical significance at the 0.10 level.

**Denoting statistical significance at the 0.05 level.

***Denoting statistical significance at the 0.01 level.

3.2.1. Daily multivariate tests

Panel A presents the results from estimating Eq. (1) at the daily level. In column [1], we run a simple regression where the only independent variable is $P/C(Q5)_{i,t}$. Column [2] includes the control variables into column [1]. Columns [3] and [4] present the results from similar analyses with regards to $O/S(Q5)_{i,t}$. Finally, in column [5] we conduct the comparison of the estimates for $P/C(Q5)_{i,t}$ and $O/S(Q5)_{i,t}$ by including them both in the model.

We find that the estimates for $P/C(Q5)_{i,t}$ and $O/S(Q5)_{i,t}$, are negative and significant across specifications. For example, from column [2], $P/C(Q5)_{i,t}$ estimate is −0.0700 (*t*-statistic = −16.40), suggesting that stocks in the highest P/C ratio quintile have next-day risk-adjusted returns that are seven basis points (or 17.75% annually) lower than the stocks that are not in the highest P/C ratio quintile. This suggest that the estimate for $P/C(Q5)_{i,t}$ is not only statistically significant, but also economically meaningful. Similarly, in column [4], we find that the estimate for $O/S(Q5)_{i,t}$ is −0.0350 (*t*-statistic = −7.18). This negative estimate suggests that stocks in the highest O/S ratio quintile underperform stocks that are not in the highest O/S ratio quintile by 4.45 basis points (or 8.75% annually) on the following day.

Furthermore, when comparing of the estimates for $P/C(Q5)_{i,t}$ and $O/S(Q5)_{i,t}$ by including them both in the model (column [5]), we find that the difference is 0.0364 (*t*-statistic = 5.28) suggesting that the negative relation between $P/C(Q5)_{i,t}$ and next-day risk-adjusted returns is significantly stronger than the negative relation between $O/S(Q5)_{i,t}$ and next-day risk-adjusted returns. In economic terms, the estimate for $P/C(Q5)_{i,t}$ is more than twice as large (in absolute value) as the estimate for $O/S(Q5)_{i,t}$. The coefficients on the control variables are similar in sign and magnitude to those in previous columns and are similar in sign to those in Pan and Poteshman (2006) with the exception of the estimate for $Spread_{i,t}$.

Before moving on to the next section we recognize the need to discuss a few of the implications from our findings. First, our finding that the $P/C(Q5)_{i,t}$ results in statistical and economic underperformance provides an important inference. Results in Pan and Poteshman (2006) suggest that P/C ratios that are calculated using buyer-initiated put-option volume in the numerator contain predictive ability about future returns. Our results, which use P/C ratios with unsigned put-option volume in the numerator, also present evidence consistent with the idea that daily P/C ratios contain information about next-day returns. We are able to confirm that *unsigned* P/C ratios contain information about future returns at the daily level in a multivariate setting. A second notable implication from our tests is that daily O/S ratios also contain information about future daily returns that is statistically and economically meaningful. While Johnson and So (2012) show that weekly O/S ratios contain information about future returns, our findings suggest that the information contained in O/S ratios is also observable at the daily level. Finally, our results also suggest that P/C ratios contain more predictive power than O/S ratios at the daily level.

3.2.2. Weekly multivariate tests

In Panel B we replicate our daily multivariate analysis using weekly data. As before, we focus on $P/C(Q5)_{i,t}$ and $O/S(Q5)_{i,t}$ separately in columns [1] through [4] of Panel B. Our findings are qualitatively similar to those in the full model (column [5]). So, for brevity, we only discuss our findings in column [5]. Similar to our daily tests in the previous subsection, our two variables of interest both produce negative estimates. In economic terms, the estimate for $P/C(Q5)_{i,t}$ suggests that stocks with the highest P/C ratios underperform stocks with the lowest P/C ratios by 5.58 basis points (or approximately 2.8% annually). The economic significance of the estimate for $P/C(Q5)_{i,t}$ is marginal at best. The estimate for $O/S(Q5)_{i,t}$ suggests that stocks with the highest O/S ratios underperform stocks with the lowest O/S ratios by 15.89 basis points (or approximately 7.9% annually). In terms of control variables, we find that all control variables produce negative estimates that are reliably different from zero.

When comparing the estimates for $P/C(Q5)_{i,t}$ to the estimates for $O/S(Q5)_{i,t}$, we find that the difference between the estimates is −0.1031 (*t*-statistic = −2.47). This difference suggests that the underperformance of stocks in the highest O/S ratios is approximately three times greater than the underperformance of stocks in the highest P/C ratios. Given our findings in Panel A, these results are peculiar and indicate that while P/C ratios contain more information about future stock returns than O/S ratios at the daily level, this does not hold at the weekly level. Instead, weekly O/S ratios are more informative than weekly P/C ratios.

3.2.3. Monthly multivariate tests

Finally, Panel C reports the results from estimating Eq. (1) at the monthly level. Again, column [5] reports the results from estimating the full model. Several results are noteworthy. First, we do not find that $P/C(Q5)_{i,t}$ produces an estimate that is reliably different from zero. This result is contrary to our findings in Panels A and B. Specifically, this result suggests that while stocks with the highest daily and weekly P/C ratios underperform other stocks, stocks with the highest monthly P/C ratios do not underperform other stocks that do not have the highest monthly P/C ratios. Second, we still find that the $O/S(Q5)_{i,t}$ produces a negative estimate that is statistically different from zero (estimate = −0.4626, *t*-statistic = −3.19). In economic terms, this estimate indicates that stocks with the highest monthly O/S ratios underperform other stocks by 46 basis points, or approximately 5.5% in annual terms. Third, we still find that the difference between the estimates for $P/C(Q5)_{i,t}$ and $O/S(Q5)_{i,t}$ is negative and statistically significant (difference = −0.3821, *t*-statistic = −2.06). This result suggests that the return predictability contained in monthly O/S ratios is stronger than the return predictability contained in monthly P/C ratios. With regard to controls, the coefficient on turnover is no longer significant but bid-ask spreads and lagged cumulative monthly returns are still negatively related to next-month returns.

3.2.4. Robustness tests

In this section, we discuss three additional sets of unreported robustness tests. First, following Johnson and So (2012) we estimate the following equation using pooled samples and Fama–MacBeth regressions at the daily, weekly and monthly levels.

(2)

$$returns_{i,t+1} = \beta_0 + \beta_1 \Delta P/C(Q5)_{i,t} + \beta_2 \Delta O/S(Q5)_{i,t} + \beta_3 Turnover_{i,t} + \beta_4 Spread_{i,t} + \beta_5 Return_{i,t-5,t-1} + \varepsilon_{i,t+1}$$

The variables are the same as those in Eq. (1) with the exception of $\Delta P/C(Q5)_{i,t}$ and $\Delta O/S(Q5)_{i,t}$. $\Delta P/C(Q5)_{i,t}$ and $\Delta O/S(Q5)_{i,t}$ are binary variables that equals one if stock *i*'s standardized $\Delta P/C$ or $\Delta O/S$ ratio is respectively in the top quintile on day *t* and zero otherwise, where standardized $\Delta P/C$ and $\Delta O/S$ are defined following Johnson and So (2012). We find that our results in Table 5 are robust at all data levels. In particular, at the daily level, both $\Delta P/C(Q5)_{i,t}$ and $\Delta O/S(Q5)_{i,t}$ produce estimates that are negative and significant. Further, the difference between these estimates is 0.0516 and statistically significant at the 0.01 level. At the weekly level, we do not find that the estimate for $\Delta P/C(Q5)_{i,t}$ is reliably different from zero. However, the estimate for $\Delta O/S(Q5)_{i,t}$ is both negative and significant. In addition, tests for the difference between these estimates show that the estimate for $\Delta O/S(Q5)_{i,t}$ is statistically larger (in absolute value) than the estimate for $\Delta P/C(Q5)_{i,t}$ (*t*-statistic = −3.52). Finally at the monthly level, the results are qualitatively similar to those in Panel C of Table 5.

In the second set of robustness tests, we examine options ratios at different expirations. The rationale is that option implied volatility is forward looking. Therefore, the return predictability of option ratios may be influenced by the time to expiration. After dividing option contracts into three categories based on the time to expiration – less than 30 days, between 30 and 90 days, and more than 90 days – we replicate our tests in Table 5 for each category. In general, we are able to provide similar conclusions from these unreported tests to the conclusions that we have drawn in Table 5. However, we note that there is weak evidence that P/C ratios with expirations between 30 and 90 days contain return predictability at the monthly level that is statistically significant at the 0.10 level. Other than this exception, results from these tests again indicate that P/C ratios predict negative returns better than O/S ratios at the daily level. However, for those options with less than 30 days until expiration and more than 90 days until expiration, the return predictability contained in O/S ratios is stronger than the predictability contained in P/S ratios at the weekly and monthly levels.

Finally, we study the information content of options ratios for sub-periods. Specifically, we partition the data into three sub-periods (1996–2000, 2001–2007, and 2008–2012). In the latter two sub-periods, we find results that are similar to those in Table 5. However, we note that in the first sub-period (1996–2000), we find that P/C ratios contained information about future returns at the daily, weekly, and monthly levels. Further, the information content in P/C ratios was greater than the information content in O/S ratios at each of these frequencies during this sub-period. Therefore, we are only able to conclude that our results are robust to the more modern time periods. Perhaps a fruitful avenue for future research might be to examine the information contained in P/C ratios historically. For the most part, our results seem to hold when controlling for different measures of option ratios, time-to-expiration, and varying time periods.

4. Conclusion

Prior research provides evidence that options trading activity contains information about future stock prices. In this study, we compare the information content of two option ratios – the put-call ratio and the option volume-to-stock volume ratio – that have been shown to predict future stock returns. The results from this comparison, which have interesting implications, can be summarized as follows. First, we find that P/C ratios can predict significant negative returns at the daily and weekly levels, but do not appear to be associated with future returns at the monthly level. Second, we find that O/S ratios significantly predict negative returns at all levels—daily, weekly, and monthly. Third, P/C ratios contain greater predictive power than O/S ratios when analyzing daily data. Fourth, the return predictability contained in P/C ratios is fleeting as we find that O/S ratios predict negative returns better than P/C ratios at both weekly and monthly levels.

These findings have important implications for both investors who might use these option ratios as buy/sell signals and future research that might examine the information contained in these ratios. In addition to these findings, the results in our study also provide some other implications. First, while Pan and Poteshman (2006) show that P/C ratios calculated using proprietary data on the trade initiation predict future returns, our tests show that more traditionally available options data that does not allow researchers to identify buyer or seller initiated trades is still informative with regard to future stock performance. We note, however, that the return predictability contained in Pan and Poteshman's (2006) P/C ratios is stronger in magnitude than the return predictability contained in the P/C ratios in our study. Second, although Johnson and So (2012) find that O/S ratios contain information about future returns at the weekly level, our results suggest that the information content of O/S ratios also exists at the daily and monthly levels.

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[3]Johnson and So (2012) argue (page 263) that O/S ratios predict negative returns because, in the presence of short-sale constraints, informed investors, who could otherwise short the stock by borrowing shares, can now trade some combination of options. Therefore, information that was once constrained can now flow into stock prices through the trading of options. This argument is similar to that of prior theoretical studies with regards to the presence of high equity borrowing costs (Diamond and Verrecchia, 1987, Danielsen and Sorescu, 2001).

[4]This result, while indirectly related to our research question, provides an important contribution to the literature as future studies may be able to ascertain some of the information contain in P/C ratios using the traditionally available options data as opposed to proprietary options data.

[5]Johnson and So's (2012) weekly sample includes 1660 unique firms per year, which is slightly smaller than our sample. However, we do not restrict our sample as much as they do. For example, we do not require that each observation have a minimum of six months of past weekly option and equity volumes. In addition, our sample includes the most recent two years that have more stocks per year than other years.

[6]We note the importance of using bid-ask spreads as a control variable throughout our analysis as spreads have been shown to represent an approximation for transaction costs. While most studies have had to use intraday transactions data to estimate spreads, recently CRSP has made closing bid-ask spreads available. However, research by Roll and Subrahmanyam, 2010, Chung and Zhang, 2014 show that using daily CRSP closing spreads is a very close approximation of intraday spreads.

[7]For instance, high-minus-low returns are approximately 4–6 basis points per day net of transaction costs during the post-decimalization period.

[8]Fodor et al. (2011) find predictability in equity returns at the weekly level for both changes in call and put open-interest levels as well as changes in the call-to-put open interest ratio.

[9]We also use indicator variables rather than continuous variables to make it easier to interpret the economic magnitude of the differences between the coefficients on the option ratios. In particular, if the distribution of the two option ratios differs, then making inferences about the magnitude of the coefficients using actual values may result in biased conclusions.