Show Me the Money: Option Moneyness Concentration and Future Stock Returns

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Abstract

Informed traders often use options that are not in-the-money because these options offer higher potential gains for a smaller upfront cost. Since leverage is monotonically related to option moneyness (K/S), it follows that a higher concentration of trading in options of certain moneyness levels indicates more informed trading. Using a measure of stock-level dollar volume weighted average moneyness (AveMoney), we find that stock returns increase with AveMoney, suggesting more trading activity in options with higher leverage is a signal for future stock returns. The economic impact of AveMoney is strongest among stocks with high implied volatility, which reflects greater investor uncertainty and thus higher potential rewards for informed option traders. AveMoney also has greater predictive power as open interest increases. Our results hold at the portfolio level as well as cross-sectionally after controlling for liquidity and risk. When AveMoney is calculated with calls, a portfolio long high AveMoney stocks and short low AveMoney stocks yields a Fama-French five-factor alpha of 12% per year for all stocks and 33% per year using stocks with high implied volatility.

1. INTRODUCTION

Fischer Black (1975) was a proponent of the idea that traders with private information might prefer to transact in option markets. In a complete market, option prices should not convey any new information or contribute to price discovery of underlying assets (Black and Scholes, 1973; Merton, 1973).[1] However, in a market with asymmetric information, Easley, O'Hara, and Srinivas (1998) show theoretically that informed investors will choose to trade in options over stock in certain cases, specifically when options offer higher leverage. In this way, option volume can predict future stock returns. Subsequent studies suggest that informed traders select options with greater embedded leverage, specifically out-of-the-money (OTM) options. For instance, Ge, Lin, and Pearson (2016) assert that the embedded leverage of options – as measured by option moneyness – is an important channel for why option trading predicts stock returns.

If informed investors gravitate towards options with certain moneyness levels that offer greater leverage, then more relative trading activity in calls with higher K/S ratios would signal higher future stock returns, whereas such activity in puts with lower K/S ratios would predict lower future stock returns. In this paper, we develop a stock-level weighted average moneyness measure, *AveMoney*, and examine whether *AveMoney* predicts future stock returns. *AveMoney* captures the relative option trading activity in different moneyness categories for each stock and is calculated in three ways: for all options, calls only, and puts only. For example, as *AveMoney* constructed with calls increases, there is relatively more activity in calls that are further out-of-the-money. If informed bullish traders prefer OTM calls, then greater activity in OTM calls signals more positive future stock returns. Our results support this notion. We find that future

[1] Ansi and Ouda (2009) provide a review of this literature. Back (1993) explains how relaxing the assumption of symmetric information leads to options not being redundant securities. Ross (1976) was the first to suggest that

daily stock returns increase with *AveMoney*, suggesting informed option traders prefer options that offer higher leverage and such trading activity predicts next day stock returns. Our study suggests where the money is in options today indicates how to make money in stocks tomorrow.

Our paper complements prior studies on the role of option moneyness in informed options trading. Chakravarty, Gulen, and Mayhew (2004) find that option markets contribute about 17% to stock price discovery, [2] where OTM options have higher information share while at-the-money (ATM) options offer lower bid-ask spreads. Using a different sample, Anand and Chakravarty (2007) report that ATM options have the greatest information share as compared with OTM and in-the-money (ITM) options. Xing, Zhang, and Zhao (2010) suggest that the stock return predictability of the implied volatility smirk is related to informed traders' preference to trade in OTM puts to capitalize on negative news. Kehrle and Puhan (2015) develop an option market sidedness measure using the correlation between the change in open interest of OTM calls (puts) to ITM puts (calls) to proxy for informed trading on positive (negative) information. Their option market sidedness measure predicts future daily stock returns. Kang, Kim, and Lee (2018) report that an OTM put to OTM call trading volume ratio demonstrates monthly stock return predictability. Our study is distinct in that we do not only consider OTM options in isolation, but rather capture the entire continuum of option moneyness when constructing our average moneyness measure. We also incorporate option price information in *AveMoney* by weighting K/S by the midpoint of bid-ask prices as well as option volume.

Moreover, we investigate outcomes in which informed trading is most likely and examine whether *AveMoney* contains greater predictive power for stock returns. Specifically, stocks with

[2] In a more recent sample, Patel, Putnins, Michayluk, and Foley (2018) find 30% of new information is reflected in option prices before being transmitted to stock prices, and this percentage is even larger around information events.

higher implied volatility reflect greater investor uncertainty about future stock prices. This investor uncertainty may lead to a higher discount rate for such firms and thus investors who are informed about the true value of the underlying stock have higher potential gains. For instance, for an undervalued firm, informed investors can choose to buy stock or buy call options. Calls – particularly OTM calls – offer a larger potential reward due to embedded leverage. This gain is even larger with higher investor uncertainty as measured by implied volatility. Therefore, we expect *AveMoney* to show the greater stock return predictability as implied volatility increases. Consistent with this notion, we find evidence that the economic impact of *AveMoney* is strongest among stocks with high implied volatility.

Prior literature also suggests that changes in option open interest are related to future stock returns. Fodor, Krieger, and Doran (2011) find that large increases in put open interest are followed by lower equity returns, while call open interest increases precede relatively strong future returns. A positive change in open interest is associated with the opening of new option contracts. If investors are informed, it is reasonable to conjecture that they are more likely to open new contracts, rather than close existing contracts. Therefore, we expect that the opening of new option contracts is associated with more informed options trading. Supporting this idea, we find that the greatest increases in open interest are associated with the strongest stock return predictability for our average moneyness measure.

More broadly, our study is rooted in a rich strand of literature examining whether option markets lead stock markets. Early studies such as Manaster and Rendleman (1982) and Bhattacharya (1987) find that the options market leads the stock market in price discovery. However, several studies on option markets' contribution to stock price discovery find options play a limited role (Stephan and Whaley, 1990; Vijh, 1990; Chan, Chung, and Johnson, 1993;

Finucane, 1999; Chan, Chung, and Fong, 2002; Holowczak, Simaan, and Wu, 2006; Muravyev, Pearson and Broussard, 2013). Yet, other studies document evidence of significant stock return predictability using option volume measures, including put-call ratios, option-to-stock volume ratios, options order flow or order imbalances, and option volume itself (Pan and Poteshman, 2006; Roll, Schwartz, and Subrahmanyam, 2010; Johnson and So, 2012; Blau, Nguyen, and Whitby 2015; Hu, 2014; Ge, Lin and Pearson, 2016; Ryu and Yang 2018).[3] Another branch of this literature examines stock return predictability of option pricing measures. For instance, Diavatopoulos, Doran, and Peterson (2008), Bali and Hovakimian (2009), Kang, Kim, and Yoon (2010), Xing, Zhang, and Zhao (2010), Yan (2011), and An, Ang, Bali and Cakici (2014) explore the stock return predictability of option implied volatility, volatility spreads, and volatility smirks.[4] Cremers and Weinbaum (2010), Doran, Fodor, and Jiang (2013), and DeLisle et al. (2019) document how call-put implied volatility spreads predict future stock returns. Other studies investigate how option implied skewness and kurtosis affect option and stock returns (Bakshi, Kapadia and Madan, 2003; Rehman and Vilkov, 2012; Conrad, Ditmar, and Ghysels, 2013; Bali, Hu, and Murray, 2016; Stilger, Kostakis, and Poon, 2016).[5]

Our study contributes to this literature by examining the stock return predictability of a new measure derived from option trading activity across moneyness categories. The rest of the paper is as follows. Section 2 describes the data and variable definitions. Section 3 explains our methodology and reports results. Section 4 concludes.

[3] Han, Kim and Byun (2017) predict that option trading could be motivated by information about future stock prices (directional information) and/or information about future stock volatility (volatility information). They find option volume's stock return predictability depends on the shape of the volatility smirk. Similarly, Chen and Wang (2017) document that changes in implied volatility of put options are driven by volatility-motivated demand and directional trading.

[4] In addition, Baltussen, Van Bekkum, and Van der Grient (2018) examine the volatility of implied volatility.

[5] Diavatopoulos et al. (2012) report that option implied skew and kurtosis predicts stock returns around earnings announcements.

2. DATA AND VARIABLE DEFINITIONS

2.1 Data

Our sample period is January 2006 through December 2017. Daily option data is from OptionMetrics and includes bid and ask quotes, open interest, trading volume, strike prices, exercise dates, and implied volatilities for all U.S. exchange traded options. To be included in the sample, options must have positive volume, positive open interest, midpoint price of at least $.25, and between 10 and 60 days to expiration. We merge options data with daily stock returns from the Center for Research in Security Prices (CRSP) database.

2.2 Variable Definitions

We construct stock-level dollar volume-weighted *Average Moneyness* (*AveMoney*) as average moneyness (K/S) of all options for the firm day with weights calculated as the product of volume and midpoint price. *AveMoney* is calculated daily with three variations: using all options (*AveMoney*), calls only (*Call AveMoney*), and puts only (*Put AveMoney*). Return is the daily stock return of the day following the *AveMoney* calculation. *IV* is the prior day's open interest-weighted implied volatility and *Skew* is the prior day's open interest-weighted option skewness. Our control variables include firm size, prior month's return, momentum, turnover, and illiquidity. *Ln(ME)* is the natural logarithm of the market capitalization on the prior day. *LRet* is the prior month's stock return. *Momentum* is the cumulative monthly stock return for months $t-13$ to $t-2$. *Turnover* is stock turnover of the prior month. Illiquidity is the absolute value of the return divided by the dollar trading volume (Amihud, 2002) averaged over trading days $t-22$ to $t-1$ prior to *AveMoney* measurement.

2.3 Descriptive Statistics

We report the descriptive statistics for the entire sample in Table 1 Panel A. As expected, mean *AveMoney* is close to one, suggesting average strike price is very close to stock price after weighting by dollar volume. Mean *Call AveMoney* is slightly lower than the overall average, while mean *Put AveMoney* is slightly lower. The firms represented in our sample are large with an average market capitalization of $19 billion.

<< Table 1 >>

Next, we divide the sample into quintiles by *AveMoney* in Panel B. For each *AveMoney* quintile, means and standard deviations of variables are presented. *AveMoney* increases monotonically from 0.948 in the Low *AveMoney* quintile to 1.038 in the High *AveMoney* quintile. *Call AveMoney* also increases monotonically, while *Put AveMoney* is U-shaped. *IV* is also U-shaped across *AveMoney* quintiles. In later tests, we will sort stocks into quintiles by *AveMoney*, *Call AveMoney*, *Put AveMoney*, and *IV*.

3. EMPIRICAL RESULTS

3.1 Portfolio Sorts with Raw Portfolio Returns

3.1.1 Single Sorts

We consider *AveMoney* using all options, call options only, and put options only, separately. If there is more dollar volume in options that further out-of-the-money, it means there is more activity in calls with higher K/S (greater *AveMoney*) and in puts with lower K/S (lower *AveMoney*). These options are likely to have higher leverage, which informed traders prefer to use (Easley, O'Hara, and Srinivas 1998). Informed call traders bet on higher stock prices, while informed put traders bet on lower stock prices. Thus, we expect stock returns to increase as *AveMoney* increases.

<< Table 2 >>

Table 2 presents mean returns after sorting firms into quintiles daily based on *AveMoney* where higher (lower) *AveMoney* can be interpreted as a higher average strike price for options traded on the day when weighting by midpoint price. When calculating *AveMoney* using all options, there is a monotonic relationship between *AveMoney* quintile and future daily stock return, where the Low *AveMoney* portfolio daily return is 1.2 basis points (bps) and the High *AveMoney* portfolio return is 4.4 bps. The High-Low portfolio difference is a statistically significant 3.2 bps (t = 4.40). When *AveMoney* is calculated using only call options, an even stronger monotonic relationship between *Call AveMoney* and daily stock returns exists, where the low *AveMoney* portfolio daily return is 0.6 bps and the high *AveMoney* portfolio daily return in 6.1 bps. The High-Low *Call AveMoney* portfolio difference is 5.4 bps (t = 7.44). This result is consistent with informed traders choosing calls with higher leverage to bet on future stock price increases. When *Put AveMoney* is calculated using only puts, the High-Low portfolio difference is not statistically significant for daily returns which could be due to relatively high levels of hedging in deep OTM puts. Also, the results for puts are difficult to interpret because there is a non-monotonic relationship. Returns increase initially with *Put AveMoney* increases, then decrease from the fourth to fifth quintile. Overall, it appears the significant High-Low portfolio difference for *AveMoney* using all options is driven by the strong results for calls. This suggests more dollar volume in call options with higher strike prices (more likely to be OTM calls with higher leverage) predicts higher future daily stock returns.

3.1.2 Double Sorts

Next, we explore whether a stock's weighted average implied volatility (*IV*) affects the relationship between *AveMoney* and returns. Stocks with higher implied volatilities reflect greater investor uncertainty about future price. With higher risk, there is higher potential reward for informed option traders. Therefore, stocks with high *IV* and high *Call AveMoney* or low *Put AveMoney* represent riskier stocks with heavy leverage use by option traders. To examine the importance of *IV* for our Table 2 results, we form double-sorted quintile portfolios based on *AveMoney* and *IV* for calls and puts separately using dependent sorts. If stocks with high *IV* represent high potential profit opportunities for informed traders, we expect the positive High-Low *AveMoney* portfolio difference to become larger in magnitude as *IV* increases.

<< Table 3 >>

Table 3 presents double sort results using *AveMoney* and *IV* for all options, calls, and puts in Panels A, B, and C, respectively. In Panel A, for *AveMoney* calculated using all options, the High-Low AveMoney differences are positive and significant across all but one *IV* quintile. Furthermore, across IV quintiles, the High-Low *AveMoney* differences increase from 1.6 bps (t = 2.49) to 5.2 bps (t = 2.13) in the High quintile. The only deviation from the monotonic increase across IV quintiles is in the fourth quintile, where the High-Low *AveMoney* return difference is insignificant. In Panel B, where *AveMoney* is from calls only, there is a strictly monotonic relationship between High-Low *Call AveMoney* differences and *IV*. The lowest *IV* quintile's High-Low *Call AveMoney* portfolio difference is insignificant, but all other *IV* quintiles demonstrate positive High-Low *Call AveMoney* return differences. Notably, the difference for the high *IV* quintile is 14 bps (t = 5.61), which is both statistically and economically significant. The results for *AveMoney* from puts (Panel C) show insignificant High-Low *Put AveMoney* return differences for all but the low *IV* quintile, where the difference is 1.4 bps (t = 2.18).

Overall, the evidence in Table 3 points to *AveMoney* having more power to predict future stock returns when implied volatility is high. These results support the notion that weighted moneyness is most informative for future returns within high *IV* firms.

3.1.3 Open Interest Change

We next examine if an increase in the opening of new option contracts is associated with more informed options trading and thus greater stock return predictability. Open interest is the number of option contracts outstanding for a firm at the end of a given day. Change in open interest (*OI CHG*) is the change in the number of option contracts outstanding relative to the prior day. Higher *OI CHG* represents opening of more new option contracts. It is likely that increases in informed trading will be associated with an increase in the opening of option contracts. Therefore, we expect stocks with higher *OI CHG* to exhibit a stronger relationship between *AveMoney* and next day stock returns. In Table 4, we sort firms into *AveMoney* quintiles daily and then further into *OI CHG* quintiles. We use call options to calculate *AveMoney* and *OI CHG* in Panel A, and put options in Panel B.

<< Table 4 >>

Panel A of Table 4 demonstrates that High-Low *Call AveMoney* differences are statistically significant across all *Call OI CHG* quintiles. Although the pattern is not strictly monotonic, the High-Low differences increase from 0.034 (t = 2.34) in the Low *Call OI CHG* quintile to 0.056 (t = 3.46) in the High *Call OI CHG* quintile. Also, within *Call AveMoney* quintiles, next day portfolio returns tend to increase from the Low *Call OI CHG* quintile to the High *Call OI CHG* quintile. In Panel B of Table 4, however, there is no consistent relationship between *Put OI CHG*, *Put AveMoney*, and next day stock returns.

The patterns in Table 4 are consistent with more informed trading when there is more activity in calls that are further out-of-the-money and at the same time an increase in the opening of new call contracts.

3.1.4 Robustness

In this subsection, we test the robustness of our results by sorting by option skewness instead of implied volatility, and examine whether our prior findings hold at the monthly level.

In Table 5, we conduct dependent double sorts by *Skew* and *AveMoney* using calls in Panel A and puts in Panel B. In Panel A, the High-Low *Call AveMoney* differences are positive and significant in three out of five quintiles. In Panel B, the High-Low *Put AveMoney* differences are positive and significant in one quintile. Given that our main results are strongest for calls and the results hold after sorting on skewness, it is unlikely our results are driven by skewness.

<< Table 5 >>

In Table 6, we repeat the *IV* and *AveMoney* double sort analysis of Table 3 at the monthly level. Specifically, we replicate Panels B and C of Table 3 using monthly stock returns instead of daily stock returns. We calculate *AveMoney* on the last day of the month and examine *AveMoney* portfolios returns for the next month. Panel A of Table 6 reports the results using calls only, while Panel B does so for puts. There is lack of significance for all but the high *IV* quintiles for calls and puts. In the high *IV* quintile, the High-Low *AveMoney* difference is positive and significant for calls (0.877, t = 2.75), while it is negative and significant for puts (–1.065, t = –3.37). The call monthly results are consistent with daily results, but put results are puzzling given the relationship is the opposite of what we would expect. It is notable that the result could be driven by a large drop in monthly returns for portfolio in the high *IV* and high *Put AveMoney* quintiles. We acknowledge that either traders hedging with puts or selling puts may affect our findings at longer horizons. Setting aside the puzzling put findings in Panel B, the evidence in Panel A supports the notion that *AveMoney* derived from call options has significant monthly stock portfolio return predictability for stocks with high implied volatility.

<< Table 6 >>

3.2 Portfolio Sorts with Fama-French Five-Factor Alphas

In order to test whether the relationship between *AveMoney*, *IV*, and stock returns holds after adjusting for risk, we regress portfolio returns on the Fama-French five-factor risk model (Fama and French, 2015) and examine portfolio alphas.

First, we verify that our findings in our single sorts hold when controlling for risk factors included in the five-factor model. Table 7 reports the results of regressing the equally-weighted portfolio returns on the five factors. Panel A presents the results using *Call AveMoney* calculated with calls only. The portfolio alphas monotonically increase from –3 bps per day (p-value<0.01) to 2 bps per day (p-value<0.10). Thus, a portfolio long high *Call AveMoney* stocks and short low *Call AveMoney* stocks would yield a five-factor alpha of 5 bps per day (p-value<0.01), or 12% per year (based on a 250 trading-day year). This finding confirms the stock return predictability of *AveMoney* after accounting for risk. However, we acknowledge that daily rebalancing of this long-short portfolio would generate transaction costs that would subsume the portfolio's alpha. As for puts, the High-Low long-short portfolio would yield an alpha of an insignificant 0.5 bps. Therefore, although we confirm portfolio sorts by *AveMoney* demonstrate predictability in risk-adjusted stock returns, the economic magnitude is quite small.

<< Table 7 >>

Yet, our prior results suggest the economic impact of *AveMoney* is stronger among stocks with high IV. For that reason, we test next whether High-Low *AveMoney* long-short portfolio alphas have greater economic significance as *IV* increases. We double sort by *AveMoney* quintiles and then within each *AveMoney* quintile, into *IV* quintiles. Table 8 reports the results for *AveMoney* calculated using calls (Panel A) and puts (Panel B).

<< Table 8 >>

Similar to our raw portfolio returns results in Table 3, there is a monotonic increase in Panel A of Table 8 in High-Low *Call AveMoney* differences from the low *IV* quintile to the high *IV* quintile, where all but the lowest *IV* quintile are positive and significant. It is noteworthy that the High-Low *Call AveMoney* difference is 13.1 bps (t = 3.86) for the high *IV* quintile. This evidence suggests that a portfolio strategy that is long high *Call AveMoney* stocks and short low *Call AveMoney* stocks will generate an alpha of about 33% over a 250 trading day year. Again, transactions costs for a daily rebalanced portfolio will be substantial. Yet, in untabulated results, we find that even a monthly rebalanced portfolio is significantly profitable.[6] Panel B reports the results for puts. Similar to our prior findings, the High-Low *Put AveMoney* portfolio differences are largely insignificant, where the only *IV* quintile demonstrating statistical significance is the low *IV* quintile. These results suggest that *AveMoney*'s daily stock return predictability is magnified by implied volatility even after controlling for risk using the Fama-French five-factor model.

3.3 Fama-MacBeth Regressions

[6] Nevertheless, it is notable that the predictability is coming from negative portfolio returns in the low *AveMoney* portfolio, rather than from positive returns from the high *AveMoney* portfolio.

Last, we investigate the effect of *AveMoney* on stock returns and test what role *IV* plays in this relationship in a full multivariate regression setting, after controlling for a wide array of variables. We conduct cross-sectional tests with daily Fama-MacBeth regressions (Fama and MacBeth, 1973) using our entire sample of all stocks with options data available. The complete specification is:

$$R = \alpha + \beta_1 AveMoney + \beta_2 (AveMoney \times IV) + \beta_3 IV + \beta_4 Skew + \beta_5 ln(ME) + \beta_7 LRet + \beta_8 Momentum + \beta_9 Turnover + \beta_{10} Illiquidity + \varepsilon \quad (1)$$

where *R* is the return on stock *i* in day *t*. Subscripts *i* and *t* are omitted from equation (1) for brevity. In subsequent models, *AveMoney* is replaced by *Call AveMoney* or *Put AveMoney*.

Table 9 reports the results. Model 1 uses equation (1) without the *AveMoney* × *IV* interaction term. The *AveMoney* coefficient is positive in sign but insignificant. Using the full equation (1) specification in Model 2, both the *AveMoney* and *AveMoney* × *IV* coefficients are insignificant. Models 3 and 4 use *Call AveMoney* and *Call AveMoney* × *IV* terms in the place of *AveMoney* and *AveMoney* × *IV*. In Model 3, the *Call AveMoney* coefficient estimate is 1.475 and highly significant (t = 2.80). In Model 4, the *Call AveMoney* × *IV* coefficient is 6.075 and marginally significant (t = 1.94), while the *Call AveMoney* coefficient is insignificant. Models 5 and 6, however, indicate that *Put AveMoney* and *Put AveMoney* × *IV* are insignificant. When both *Call AveMoney* and *Put AveMoney* are included in Model 7, *Call AveMoney* is positive and significant (1.398, t = 2.66), while *Put AveMoney* is insignificant. When the *Call AveMoney* × *IV* and *Put AveMoney* × *IV* interaction terms are included in Model 8, the *Call AveMoney* × *IV* coefficient is 5.379 (t = 1.77) and the *Call AveMoney*, *Put AveMoney*, and *Put AveMoney* × *IV* coefficients are insignificant.[7]

<< Table 9 >>

These findings indicate that when *Call AveMoney* increases, next day stock returns are higher. This result suggests more option activity in calls that are further out-of-the-money predicts higher next day stock returns. Also, the greater a stock's average implied volatility, the stronger this positive relationship between *Call AveMoney* and future stock returns. In sum, the regression evidence is consistent with our findings at the portfolio level. Namely, *AveMoney* calculated using calls has significant predictive power for future stock returns and such predictability is greater when stocks have more volatility.

4. CONCLUSION

Informed traders often use options that are not in-the-money because these options offer higher potential gains for a smaller upfront cost. Thus, option moneyness should be related to informed option trading. Based on this idea, we construct a measure of stock-level dollar volume weighted average moneyness (*AveMoney*) which captures the relative option trading activity as K/S increases. We find that stock returns increase with *AveMoney*, suggesting informed option traders prefer to use options that offer higher leverage. Our results are strongest when *AveMoney* is calculated using call options only, probably because puts are often used for hedging while calls are used for speculating on future stock price movements.

[7] As for the control variables, skewness enters with a negative sign (Conrad, Dittmar, and Ghysels 2013), size has a negative coefficient, and turnover has a negative impact on stock returns.

Moreover, stocks with higher option implied volatilities reflect greater investor uncertainty about future prices and offer higher potential reward for informed option traders. In support of this assertion, we find evidence that the economic impact of *AveMoney* is strongest among stocks with high implied volatility. Also, the stock return predictability of *AveMoney* is stronger when there have been large increases in open interest, which supporting the idea that the opening of new option contracts is associated with more informed options trading.

Our findings hold at the portfolio level as well as cross-sectionally while remaining robust to liquidity and risk controls. Using call options to calculate *AveMoney*, a portfolio long high *AveMoney* stocks and short low *AveMoney* stocks yields a Fama-French five-factor alpha of 12% per year for all stocks and 33% per year among stocks with high implied volatility. Overall, our study demonstrates that relative trading activity in options of different moneyness levels can signal the direction of future stock returns.

REFERENCES

An, B., Ang, A., Bali, T., & Cakici, N. (2014). The joint cross section of stocks and options. *Journal of Finance*, 69, 2279-2337

Anand, A., & Chakravarty, S. (2007). Stealth trading in options markets, *Journal of Financial and Quantitative Analysis*, 42, 167.

Ansi, A., & Ben Ouda, O. (2009). How option markets affect price discovery on the spot markets: A survey of the empirical literature and synthesis. *International Journal of Business and Management*, 4, 155–169.

Back, K. (1993). Asymmetric information and options. *Review of Financial Studies*, 6, 435-472.

Bakshi, G., Kapadia, N., & Madan, D. (2003). Stock return characteristics, skew laws, and differential pricing of individual equity options. *Review of Financial Studies*, 16, 101-143.

Bali, T., & Hovakimian, A. (2009). Volatility spreads and expected stock returns. *Management Science*, 55, 1797-1812.

Bali, T.G., Hu, J., & Murray, S. (2016). Option implied volatility, skewness, and kurtosis and the cross-section of expected stock returns. Georgetown University, Singapore Management University, and Georgia State University: Working paper.

Baltussen, G., Van Bekkum, S., & Van der Grient, B. (2018). Unknown unknowns: Uncertainty about risk and stock returns. *Journal of Financial and Quantitative Analysis*, 53, 1615-1651.

Bhattacharya, M. (1987). Price changes of related securities: The case of call options and stocks. *Journal of Financial and Quantitative Analysis*, 22, 1-15.

Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy*, 81, 637-654.

Black, F. (1975). Fact and fantasy in the use of options. *Financial Analysts Journal*, 31, 36-41.

Blau, B.M., Nguyen, N., & Whitby, R.J. (2014). The information content of option ratios. *Journal of Banking & Finance*, 43, 179–187.

Chakravarty, S., Gulen, H., & Mayhew, S., (2004). Informed trading in stock and option markets. *Journal of Finance*, 59, 1235-1257.

Chan, K., Chung, P., & Johnson, H. (1993). Why option prices lag stock prices: A trading-based explanation. *Journal of Finance*, 48, 1957-1967.

Chan, K., Chung, Y. P., & Fong, W. M. (2002). The informational role of stock and option volume. *Review of Financial Studies*, 14, 1049-1075.

Chen, C., & Wang, S. (2017). Net buying pressure and option informed trading. *Journal of Futures Markets*, 37, 238-259.

Conrad, J., Dittmar, R. F., & Ghysels, E. (2013). Ex ante skewness and expected stock returns. *Journal of Finance*, 68, 85-124.

Cremers, M., & Weinbaum, D. (2010). Deviations from put-call parity and stock return predictability. *Journal of Financial and Quantitative Analysis*, 45, 335–367.

DeLisle, R. J., Diavatopoulos, D., Fodor, A., & Kassa, H. (2019). Variation in option implied volatility spread and future stock returns. Utah State University, Seattle University, Ohio University, and Miami University: Working paper.

Diavatopoulos, D., Doran, J., & Peterson, D. R. (2008). The information content in implied idiosyncratic volatility and the cross-section of stock returns: Evidence from the option markets. *Journal of Futures Markets* 28, 1013-1039.

Diavatopoulos, D., Doran, J., Fodor, A., & Peterson, D.R. (2012). The information content of implied skewness and kurtosis changes prior to earnings announcements for stock and option returns. *Journal of Banking and Finance*, 36, 786-802.

Doran, J.S., Fodor, A., & Jiang, D. (2013). Call-put implied volatility spreads and option returns. *Review of Asset Pricing Studies*, 3, 258-290.

Easley, D., O'Hara, M., & Srinivas. P., (1998). Option volume and stock prices: Evidence on where informed traders trade. *Journal of Finance*, 53, 431-465.

Fama, E. F., & French, K. R., (2015). A five-factor asset pricing model. *Journal of Financial Economics* 116, 1-22.

Fama, E.F., & MacBeth, J. (1973). Risk, return, and equilibrium: empirical tests. *Journal of Political Economy* 71, 607-636.

Finucane, T.J., (1999). A new measure of the direction and timing of information flow between markets. *Journal of Financial Markets*, 2, 135-151.

Fodor, A. Krieger, K., & Doran, J. (2011), Do option open-interest changes foreshadow future equity returns? *Financial Markets and Portfolio Management*, 25, 265-280.

Ge, L., Lin, T.C., & Pearson, N.D., (2016). Why does the option to stock volume ratio predict stock returns? *Journal of Financial Economics*, 120, 601-622.

Han, J., Kim, D.-H., & Byun, S.-J. (2017). Informed Trading in the Options Market and Stock Return Predictability. *Journal of Futures Markets*, 37, 1053-1093.

Holowczak, R., Simaan, Y., & Wu, L. (2006). Price discovery in the U.S. stock and stock options markets: A portfolio approach. *Review of Derivatives Research*, 9, 37–65.

Hu, J. (2014). Does option trading convey stock price information? *Journal of Financial Economics* 111, 625-645.

Johnson, T.L., & So, E.C. (2012). The option to stock volume ratio and future returns. *Journal of Financial Economics*, 106, 262-286.

Kang, B. J., Kim, T. S., & Yoon, S. J., (2010). Information content of volatility spreads. *Journal of Futures Markets*, 30, 533-558.

Kang, C. M., Kim, D., & Lee, G. (2018). Informed trading of out-of-the-money options and market efficiency. UNSW, University of Wisconsin-Milwaukee, and NH Finance Research Institute: Working paper.

Kehrle, K, & Puhan, T., (2012). The information content of option demand. University of Mannheim: Working paper.

Manaster, S., & Rendleman, R. (1982). Option prices as predictors of equilibrium stock prices. *Journal of Finance*, 37, 1043-1057.

Merton, R.C., (1973). The relationship between put and call option prices: Comment, *Journal of Finance*, 31, 369-381.

Muravyev, D., Pearson, N. D., & Broussard, J. P. (2013). Is there price discovery in equity options? *Journal of Financial Economics* 107, 259-283.

Pan, J., & Poteshman, A. (2006). The information in option volume for stock prices. *Review of Financial Studies*, 19, 871-908.

Patel, V., Putnins, T.J., & Michayluk, D., Foley, S. (2018). Price discovery in stock and options markets. University of Technology Sydney, Stockholm School of Economics in Riga, and University of Sydney: Working paper.

Rehman, Z., & Vilkov, G. (2012). Risk-neutral skewness: Return predictability and its sources. BlackRock and Goethe University: Working Paper.

Roll, R., Schwartz, E., & Subrahmanyam, A. (2010). O/S: The relative trading activity in options and stock. *Journal of Financial Economics*, 96, 1-17.

Ross, S. A. (1976). Options and efficiency. *Quarterly Journal of Economics*, 90, 75-89.

Ryu, D., & Yang, H. (2018). The directional information content of options volumes. *Journal of Futures Markets*, 38, 1533–1548.

Stephan, A. J., & Whaley. E. R., (1990). Intraday price changes and trading volume relations in the stock and stock option markets. *Journal of Finance*, 45, 191-220.

Stilger, P. S., Kostakis, A., & Poon, S.-H. (2016). What does risk-neutral skewness tell us about future stock returns? *Management Science*, 63, 1814–1834.

Vijh, A. (1990). Liquidity of the CBOE equity options. *Journal of Finance*, 45, 1157-1179.

Xing, Y., Zhang, X., & Zhao, R. (2010). What does individual option volatility smirks tell us about future equity returns? *Journal of Financial and Quantitative Analysis* 45, 641–662.

Yan, S. (2011). Jump risk, stock returns, and slope of implied volatility smile. *Journal of Financial Economics* 99, 216-233.

Table 1: Descriptive Statistics

Table 1 reports descriptive statistics for our sample in its entirety and sorted into quintiles by *AveMoney*. *AveMoney* is stock-level dollar volume-weighted Average Moneyness, defined as average strike-to-stock price (K/S) of a stock's underlying options, with the weights determined by the product of option contracts traded times midpoint prices. *AveMoney* is calculated using all options, using calls only, and using puts only. Panel A reports for the entire sample and Panel B for the sample divided into quintiles by *AveMoney*. Return is the daily stock return of the next day following the *AveMoney* calculation. *IV* is the prior day's open interest-weighted implied volatility. *Skew* is the prior day's open interest-weighted option skewness. *ME* is the natural logarithm of the market capitalization on the prior day (reported in billions). *LRet* is the prior month's stock return. *Momentum* is the cumulative monthly stock return for months $t-13$ to $t-2$. *Turnover* is stock turnover of the prior month. *Illiquidity* is Amihud's (2002) illiquidity measure (multiplied by 10^6) of the prior month. The sample period is from January 2006 to December 2017.

Panel A: Summary Statistics

Variable	N	Mean	Median	Std Dev	1st Pctl	5th Pctl	95th Pctl	99th Pctl
AveMoney	119,396	0.998	0.995	0.079	0.836	0.915	1.081	1.245
Call AveMoney	119,396	0.988	0.993	0.057	0.802	0.894	1.063	1.123
Put AveMoney	119,396	1.009	0.996	0.097	0.867	0.924	1.125	1.353
IV	119,396	0.395	0.349	0.208	0.126	0.166	0.776	1.126
Skew	119,396	0.080	0.072	0.061	-0.048	0.007	0.178	0.278
ME	119,396	18.968	6.215	40.861	0.183	0.530	77.094	204.690
LRet	119,396	0.015	0.012	0.121	-0.278	-0.159	0.196	0.367
Momentum	119,396	0.213	0.125	0.671	-0.684	-0.460	1.126	2.473
Turnover	119,396	6.772	2.580	36.613	0.440	0.801	19.700	87.294
Illiquidity	119,396	0.157	0.024	2.015	0.000	0.001	0.496	1.615

Panel B: Summary Statistics by AveMoney Quintile

	Low AveMoney Quintile		AveMoney Quintile 2		AveMoney Quintile 3		AveMoney Quintile 4		High AveMoney Quintile	
Variable	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
AveMoney	0.948	0.100	0.990	0.060	1.002	0.056	1.013	0.060	1.038	0.081
Call AveMoney	0.912	0.060	0.973	0.015	0.993	0.012	1.011	0.013	1.051	0.041
Put AveMoney	1.014	0.118	1.008	0.088	1.006	0.077	1.008	0.086	1.012	0.109
IV	0.437	0.216	0.358	0.175	0.343	0.175	0.365	0.182	0.472	0.252
Skew	0.087	0.068	0.084	0.056	0.082	0.053	0.077	0.055	0.068	0.069
ME	18.159	43.552	27.254	54.918	24.451	44.987	17.197	31.620	7.753	13.465
LRet	0.028	0.139	0.016	0.107	0.012	0.106	0.010	0.110	0.009	0.139
Momentum	0.260	0.856	0.207	0.573	0.190	0.572	0.196	0.589	0.214	0.720
Turnover	7.575	55.261	6.243	30.484	6.407	21.993	5.876	17.971	7.763	43.797
Illiquidity	0.256	3.826	0.094	0.624	0.093	1.551	0.101	0.630	0.239	1.579

Table 2: Single Sorts on AveMoney

This table presents the one-day raw returns for equal-weighted portfolios sorted into quintiles by *AveMoney*. Firms are sorted each day into quintiles based on *AveMoney* where *AveMoney* is calculated using all options, call options only, and put options. *AveMoney* is stock-level dollar *Volume-Weighted Average Moneyness* defined as average strike-to-stock price (K/S) of a stock's underlying options, with the weights determined by the product of option contracts traded times midpoint prices. High-Low portfolio return differences are presented for each *AveMoney* specification. Portfolio returns are reported in percent. *t*-statistics are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% level of significance respectively using a two-tailed test. The sample period is from January 2006 to December 2017.

	All	Call	Put
Low AveMoney Quintile	0.012	0.006	0.012
AveMoney Quintile 2	0.021	0.022	0.036
AveMoney Quintile 3	0.035	0.027	0.037
AveMoney Quintile 4	0.040	0.035	0.046
High AveMoney Quintile	0.044	0.061	0.021
High-Low	0.032***	0.054***	0.009
	(4.40)	(7.44)	(1.17)

Table 3: Double Sorts on AveMoney and IV

This table presents the one-day raw returns for equal-weighted portfolios double sorted into quintiles by *AveMoney* and within each quintile, further into quintiles by *IV*. First, firms are sorted each day into *AveMoney* quintiles where *AveMoney* is calculated using all options, call options only, and put options only in Panels A, B, and C, respectively. *AveMoney* is stock-level dollar *Volume-Weighted Average Moneyness* defined as average strike-to-stock price (K/S) of a stock's underlying options, with the weights determined by the product of option contracts traded times midpoint prices. Then, within each *AveMoney* quintile, firms are further sorted into quintiles by *IV*. *IV* is the prior day's open interest-weighted implied volatility. High-Low portfolio return differences across *IV* quintiles are presented. Portfolio returns are reported in percent. *t*-statistics are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% level of significance respectively using a two-tailed test. The sample period is from January 2006 to December 2017.

Panel A: All Options AveMoney and IV

	Low IV Quintile	IV Quintile 2	IV Quintile 3	IV Quintile 4	High IV Quintile
Low AveMoney Quintile	0.021	0.029	0.014	0.030	-0.024
AveMoney Quintile 2	0.028	0.037	0.016	0.032	-0.005
AveMoney Quintile 3	0.025	0.031	0.036	0.056	0.000
AveMoney Quintile 4	0.037	0.039	0.042	0.057	0.057
High AveMoney Quintile	0.037	0.046	0.048	0.043	0.028
High-Low	0.016**	0.017**	0.034***	0.014	0.052**
	(2.49)	(1.97)	(3.06)	(0.99)	(2.13)

Panel B: Call AveMoney and IV

	Low IV Quintile	IV Quintile 2	IV Quintile 3	IV Quintile 4	High IV Quintile
Low Call AveMoney Quintile	0.026	0.023	0.019	0.030	-0.030
Call AveMoney Quintile 2	0.028	0.033	0.011	0.016	-0.021
Call AveMoney Quintile 3	0.024	0.038	0.032	0.040	-0.007
Call AveMoney Quintile 4	0.036	0.037	0.039	0.061	0.004
High Call AveMoney Quintile	0.035	0.050	0.056	0.071	0.110
High-Low	0.009	0.026***	0.038***	0.041***	0.140***
	(1.33)	(3.01)	(3.41)	(2.92)	(5.61)

Panel C: Put AveMoney and IV

	Low IV Quintile	IV Quintile 2	IV Quintile 3	IV Quintile 4	High IV Quintile
Low Put AveMoney Quintile	0.022	0.029	0.017	0.032	-0.012
Put AveMoney Quintile 2	0.028	0.037	0.032	0.055	0.009
Put AveMoney Quintile 3	0.034	0.036	0.044	0.055	0.025
Put AveMoney Quintile 4	0.030	0.043	0.040	0.052	0.030
High Put AveMoney Quintile	0.036	0.036	0.023	0.023	0.003
High-Low	0.014**	0.008	0.006	-0.009	0.015
	(2.18)	(0.86)	(0.51)	(-0.64)	(0.60)

Table 4: Open Interest Change

This table presents the one-day raw returns for equal-weighted portfolios double sorted into quintiles by *AveMoney* and within each quintile, further into quintiles by *IV*. First, firms are sorted each day into *AveMoney* quintiles where *AveMoney* is calculated using call options only, and put options only in Panels A and B respectively. *AveMoney* is stock-level dollar *Volume-Weighted Average Moneyness* defined as average strike-to-stock price (K/S) of a stock's underlying options, with the weights determined by the product of option contracts traded times midpoint prices. Then, within each *AveMoney* quintile, firms are further sorted into quintiles by *IV*. *IV* is the prior day's open interest-weighted implied volatility. High-Low portfolio return differences across *IV* quintiles are presented. Portfolio returns are reported in percent. *t*-statistics are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% level of significance respectively using a two-tailed test. The sample period is from January 2006 to December 2017.

Panel A: Call AveMoney and Call OI Change

	Low Call OI CHG Quintile	Call OI CHG Quintile 2	Call OI CHG Quintile 3	Call OI CHG Quintile 4	High Call OI CHG Quintile
Low Call AveMoney Quintile	-0.002	0.010	0.003	0.018	0.020
Call AveMoney Quintile 2	0.014	0.027	0.013	0.001	0.037
Call AveMoney Quintile 3	0.015	0.016	0.005	0.038	0.041
Call AveMoney Quintile 4	0.032	0.028	0.031	0.037	0.034
High Call AveMoney Quintile	0.032	0.042	0.052	0.062	0.076
High-Low	0.034**	0.032**	0.049***	0.045***	0.056***
	(2.34)	(2.19)	(3.26)	(2.76)	(3.46)

Panel B: Put AveMoney and Put OI Change

	Low Put OI CHG Quintile	Put OI CHG Quintile 2	Put OI CHG Quintile 3	Put OI CHG Quintile 4	High Put OI CHG Quintile
Low Put AveMoney Quintile	0.023	0.017	0.002	-0.005	0.009
Put AveMoney Quintile 2	0.051	0.034	0.038	0.023	0.018
Put AveMoney Quintile 3	0.038	0.028	0.029	0.028	0.039
Put AveMoney Quintile 4	0.044	0.049	0.046	0.030	0.044
High Put AveMoney Quintile	0.048	0.015	0.028	0.008	-0.004
High-Low	0.025*	-0.002	0.026*	0.012	-0.013
	(1.72)	(-0.10)	(1.69)	(0.76)	(-0.79)

Table 5: Skewness

This table explores the robustness of our results by testing whether skewness explains the relationship between *AveMoney* and stock returns. In Panel A, firms are sorted each day into *AveMoney* quintiles, and within each *AveMoney* quintile, firms are further sorted into quintiles by *Skew*. *AveMoney* is stock-level dollar *Volume-Weighted Average Moneyness* defined as average strike-to-stock price (K/S) of a stock's underlying options, with the weights determined by the product of option contracts traded times midpoint prices. *Skew* is the prior day's open interest-weighted option skewness. High-Low portfolio return differences across *Skew* quintiles are presented. Portfolio returns are reported in percent. *t*-statistics are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% level of significance respectively using a two-tailed test. The sample period is from January 2006 to December 2017.

Panel A: Call AveMoney and Skew					
	Low Skew Quintile	Skew Quintile 2	Skew Quintile 3	Skew Quintile 4	High Skew Quintile
Low Call AveMoney Quintile	0.052	0.026	0.010	0.005	-0.026
Call AveMoney Quintile 2	0.048	0.037	0.015	0.006	-0.017
Call AveMoney Quintile 3	0.078	0.045	0.023	0.014	-0.012
Call AveMoney Quintile 4	0.076	0.054	0.024	0.021	-0.011
High Call AveMoney Quintile	0.114	0.065	0.033	0.013	-0.016
High-Low	0.062***	0.040***	0.022*	0.008	0.010
	(3.55)	(3.01)	(1.76)	(0.60)	(0.63)

Panel B: Put AveMoney and Skew					
	Low Skew Quintile	Skew Quintile 2	Skew Quintile 3	Skew Quintile 4	High Skew Quintile
Low Put AveMoney Quintile	0.070	0.029	0.004	-0.007	-0.025
Put AveMoney Quintile 2	0.080	0.047	0.017	0.018	-0.011
Put AveMoney Quintile 3	0.074	0.044	0.026	0.020	0.005
Put AveMoney Quintile 4	0.083	0.063	0.024	0.027	-0.003
High Put AveMoney Quintile	0.060	0.043	0.034	0.000	-0.049
High-Low	-0.010	0.014	0.031**	0.006	-0.024
	(-0.55)	(1.04)	(2.42)	(0.49)	(-1.45)

Table 6: Monthly Returns

This table further investigates our findings by examining whether the relationship between *AveMoney* and returns holds at the monthly level. *AveMoney* is stock-level dollar *Volume-Weighted Average Moneyness* defined as average strike-to-stock price (K/S) of a stock's underlying options, with the weights determined by the product of option contracts traded times midpoint prices. We replicate Panel A of Table 3 using monthly stock returns instead of daily stock returns. We calculate *AveMoney* on the last day of the month and examine *AveMoney* portfolio returns for the next month. We double sort by *AveMoney* and *IV* as in Table 3. *IV* is the prior day's open interest-weighted implied volatility. High-Low portfolio return differences across *IV* quintiles. Portfolio returns are reported in percent. *t*-statistics are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% level of significance respectively using a two-tailed test. The sample period is from January 2006 to December 2017.

Panel A: One Month Return using Call AveMoney

	Low IV Quintile	IV Quintile 2	IV Quintile 3	IV Quintile 4	High IV Quintile
Low Call AveMoney Quintile	0.687	0.770	0.708	0.781	-0.403
Call AveMoney Quintile 2	0.736	0.631	0.710	0.596	-0.072
Call AveMoney Quintile 3	0.718	0.716	0.432	0.530	0.014
Call AveMoney Quintile 4	0.835	0.780	0.897	0.518	0.296
High Call AveMoney Quintile	0.816	0.851	0.735	0.586	0.474
High-Low	0.129	0.081	0.027	-0.195	0.877***
	(1.42)	(0.66)	(0.18)	(-1.01)	(2.75)

Panel B: One Month Return using Put AveMoney

	Low IV Quintile	IV Quintile 2	IV Quintile 3	IV Quintile 4	High IV Quintile
Low Put AveMoney Quintile	0.753	0.772	0.687	0.666	0.292
Put AveMoney Quintile 2	0.723	0.582	0.826	0.620	0.498
Put AveMoney Quintile 3	0.790	0.790	0.698	0.496	0.202
Put AveMoney Quintile 4	0.791	0.745	0.665	0.793	0.089
High Put AveMoney Quintile	0.735	0.858	0.606	0.433	-0.773
High-Low	-0.018	0.086	-0.081	-0.234	-1.065***
	(-0.20)	(0.70)	(0.54)	(-1.21)	(-3.37)

Table 7: Fama-French Alphas with Single Sorts

This table reports the Fama-French five-factor alphas (Fama and French 2015) along with five-factor model parameters for stocks sorted into *AveMoney* quintile portfolios. *AveMoney* is stock-level dollar *Volume-Weighted Average Moneyness* defined as average strike-to-stock price (K/S) of a stock's underlying options, with the weights determined by the product of option contracts traded times midpoint prices. *MKTRF* is the realization of the market risk premium. *SMB* is the return on a portfolio of small stocks minus the return on a portfolio of big stocks. *HML* is the return on a portfolio of high book-to-market (value) minus low book-to-market (growth) stocks. *RMW* is the difference between the returns on portfolios of stocks with robust and weak profitability. *CMA* is the difference between the returns on portfolios of the stocks of low and high investment firms (i.e. conservative and aggressive firms, respectively). Panel A presents the results for *AveMoney* calculated using calls, while Panel B does so for *AveMoney* calculated using puts. *, **, and *** indicate 10%, 5%, and 1% level of significance respectively using a two-tailed test. The sample period is from January 2006 to December 2017.

Panel A: Call AveMoney

	Low Call AveMoney Quintile	Call AveMoney Quintile 2	Call AveMoney Quintile 3	Call AveMoney Quintile 4	High Call AveMoney Quintile	High-Low
Intercept	-0.028***	-0.014**	-0.010*	-0.005	0.019*	0.047***
MKT	1.065***	1.049***	1.089***	1.151***	1.254***	0.189***
SMB	0.464***	0.271***	0.215***	0.252***	0.432***	-0.032
HML	0.113***	0.005	-0.013	-0.011	-0.019	-0.132***
RMW	-0.243***	-0.060***	-0.036**	-0.124***	-0.432***	-0.189***
CMA	-0.227***	-0.109***	-0.142***	-0.223***	-0.471***	-0.244***

Panel B: Put AveMoney

	Low Put AveMoney Quintile	Put AveMoney Quintile 2	Put AveMoney Quintile 3	Put AveMoney Quintile 4	High Put AveMoney Quintile	High-Low
Intercept	-0.024***	-0.002	-0.001	0.007	-0.019	0.005
MKT	1.098***	1.060***	1.080***	1.137***	1.233***	0.135***
SMB	0.491***	0.259***	0.182***	0.249***	0.454***	-0.037
HML	0.000	-0.016	-0.011	-0.016	0.119***	0.119***
RMW	-0.252***	-0.041**	-0.029*	-0.138***	-0.434***	-0.182***
CMA	-0.312***	-0.105***	-0.120***	-0.197***	-0.439***	-0.128***

Table 8: Fama-French Alphas with Double Sorts

This table reports the Fama-French five-factor alphas (Fama and French 2015) for stocks double sorted into *AveMoney* quintile portfolios, followed by *IV* quintile portfolios. *AveMoney* is stock-level dollar *Volume-Weighted Average Moneyness* defined as average strike-to-stock price (K/S) of a stock's underlying options, with the weights determined by the product of option contracts traded times midpoint prices. *IV* is the prior day's open interest-weighted implied volatility. Panel A presents the results for *AveMoney* calculated using calls, while Panel B does so for *AveMoney* calculated using puts. High-Low portfolio differences and associated *t*-statistics are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% level of significance respectively using a two-tailed test. The sample period is from January 2006 to December 2017.

Panel A: Call AveMoney

	Low IV Quintile	IV Quintile 2	IV Quintile 3	IV Quintile 4	High IV Quintile
Low Call AveMoney Quintile	-0.001	-0.010*	-0.020**	-0.012	-0.061***
Call AveMoney Quintile 2	0.001	-0.003	-0.030***	-0.028**	-0.061***
Call AveMoney Quintile 3	-0.005	0.001	-0.011	-0.005	-0.051**
Call AveMoney Quintile 4	0.009**	-0.001	-0.004	0.014	-0.039*
High Call AveMoney Quintile	0.005	0.012*	0.014	0.024*	0.070
High-Low	0.006	0.023***	0.034***	0.036**	0.131***
	(0.23)	(2.60)	(3.08)	(1.98)	(3.86)

Panel B: Put AveMoney

	Low IV Quintile	IV Quintile 2	IV Quintile 3	IV Quintile 4	High IV Quintile
Low Put AveMoney Quintile	-0.005	-0.005	-0.023***	-0.012	-0.046**
Put AveMoney Quintile 2	0.001	-0.001	-0.011	0.009	-0.036*
Put AveMoney Quintile 3	0.005	-0.001	0.002	0.009	-0.017
Put AveMoney Quintile 4	0.002	0.006	-0.001	0.005	-0.007
High Put AveMoney Quintile	0.007	0.000	-0.018*	-0.019	-0.038
High-Low	0.011*	0.005	0.006	-0.007	0.008
	(1.67)	(1.26)	(0.53)	(0.62)	(1.23)

Table 9: Fama-MacBeth Regressions

This table uses daily Fama-MacBeth regressions to test the impact of AveMoney on next day stock returns and whether IV plays a significant role in this relationship. The key independent variables are *AveMoney*, *Call AveMoney*, *Put AveMoney*, and each of these three variables' interaction with *IV*. *AveMoney* is stock-level dollar *Volume-Weighted Average Moneyness* defined as average strike-to-stock price (K/S) of a stock's underlying options, with the weights determined by the product of option contracts traded times midpoint prices. *Call AveMoney* is *AveMoney* calculated using call options only and *Put AveMoney* as *AveMoney* calculated using put options only. *IV* is the prior day's open interest-weighted implied volatility. All control variables are defined in Table 1. *t*-statistics are reported in parentheses.*, **, and *** indicate 10%, 5%, and 1% level of significance respectively using a two-tailed test. The sample period is from January 2006 to December 2017.

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AveMoney	0.458	-0.837						
	(1.01)	(-0.67)						
AveMoney × IV		1.847						
		(0.79)						
Call AveMoney			1.475***	-2.348			1.398***	-1.984
			(2.80)	(-1.57)			(2.66)	(-1.38)
Call AveMoney × IV				6.075*				5.379*
				(1.94)				(1.77)
Put AveMoney					-0.281	0.315	-0.233	0.357
					(-0.69)	(0.28)	(-0.57)	(0.34)
Put AveMoney × IV						-1.002		-1.002
						(-0.47)		(-0.48)
IV	-0.497	-2.406	-0.563	-6.846**	-0.485	0.413	-0.576	-5.188
	(-1.08)	(-0.98)	(-1.24)	(-2.15)	(-1.05)	(0.18)	(-1.26)	(-1.38)
Skew	-0.678***	-0.686***	-0.665***	-0.671***	-0.688***	-0.694***	-0.668***	-0.680***
	(-9.86)	(-9.89)	(-9.70)	(-9.92)	(-9.96)	(-10.01)	(-9.76)	(-10.00)
ln(ME)	-0.039	-0.047*	-0.037	-0.053**	-0.041	-0.045*	-0.038	-0.055**
	(-1.53)	(-1.84)	(-1.43)	(-2.13)	(-1.59)	(-1.79)	(-1.48)	(-2.24)
LRet	0.450	0.399	0.453	0.456	0.436	0.417	0.458	0.428
	(0.79)	(0.70)	(0.80)	(0.81)	(0.77)	(0.73)	(0.81)	(0.77)
Momentum	-0.088	-0.099	-0.084	-0.102	-0.079	-0.072	-0.084	-0.092
	(-0.53)	(-0.60)	(-0.51)	(-0.63)	(-0.48)	(-0.44)	(-0.51)	(-0.57)
Turnover	-0.456**	-0.497**	-0.437**	-0.474**	-0.448**	-0.440**	-0.430**	-0.459**
	(-2.09)	(-2.29)	(-2.01)	(-2.19)	(-2.05)	(-2.04)	(-1.99)	(-2.17)
Illiquidity	-0.251*	-0.281*	-0.243	-0.278*	-0.241	-0.255*	-0.237	-0.291*
	(-1.66)	(-1.86)	(-1.60)	(-1.84)	(-1.59)	(-1.69)	(-1.56)	(-1.94)
Intercept	0.105	0.248*	-0.001	0.415***	0.182***	0.134	0.033	0.349*
	(1.62)	(1.85)	(-0.02)	(2.68)	(3.13)	(1.07)	(0.38)	(1.88)
Adj-R^2	8.69%	9.19%	8.64%	9.28%	8.75%	9.28%	8.95%	10.06%