The Information in Option Strike Price Introductions

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Abstract

This paper shows that options market information slowly flows into the stock market through the introduction of new strike prices. Stocks with new options introduced above the prevailing maximum strike price outperform those with new options introduced below the prevailing minimum strike price by about 4% over the following 12 months. The results are not explained by standard risk factors, including short-term stock-price reversal and momentum. The results suggest informed investors with private information drive the introduction of new strike prices to enable cost-effective leverage.

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1 Introduction

How information flows across assets is one of the most important questions in finance. Specifically, options market information might slowly flow to stock prices. One possible mechanism is that informed traders might trade in options instead of stocks due to the cost-effective leverage of options (Black (1975), Easley et al. (1998)). In this paper, I propose a novel mechanism where the options market leads the stock market. I show that new strike price introductions for individual stock options contain long-term information about of the underlying stock. Empirical results suggest that strike price introductions are driven by informed investors with private information to enable cost-effective leverage.

To the best of my knowledge, this is the first paper to explore whether strike price introductions contain information about the underlying stock. The existing literature focused on whether first-time option introductions have any effect on individual stocks (Detemple and Jorion (1990), Conrad (1989), Skinner (1990)). In this paper, I focus on whether strike price introductions for stocks already with options are informative of the underlying stock.

To illustrate, the monthly stock return of Alpha Metallurgical Resources, Inc. (Ticker 'AMR') was 3.57% in January 2022, closing at $63.23 by the end of the month. At the same time, 10 new options were introduced with strike prices above the prevailing maximum strike price across all expiration dates. In February 2022, the stock went up by 49.9%. By the end of 2022, the stock was up more than 100% from its price at the beginning of the year. Were the strike prices introduced mechanically by the exchange? Or were the strike prices introduced in response to informed traders? In this paper, I explore whether the strike price introductions contain information about the underlying stock. I present evidence that the above example can be generalized in the cross-section of stocks, and that strike price introductions are driven by informed traders with private information.

The exchanges introduce new strike prices for individual stock options when the underlying stock prices move. If this is a mechanical process, strike price introductions should not contain any information about the underlying stock on top of the price change. However, empirical results suggest that new strike price introductions contain information about the underlying stock. I find that stocks with options introduced above the previous month's maximum strike price outperform those with options introduced below the previous month's minimum strike price by about 4.11% (t-statistic 4.28) over the next 12 months does not reverse. Figure 3 summarizes the main result. The cumulative return spread 12 months after portfolio formation using returns excess of the characteristic-based benchmark portfolios (Daniel et al. (1997)) remains positive and significant with returns of 2.23% (t-statistic 3.84).

I first introduce a simple model to show that option introductions above or below the prevailing strike prices are not accurately predicted by stock- or option-level variables. Variables related to past stock returns, stock volume, option volume, and other stock characteristics can explain less than 10% of the variance in option introductions. This implies that there is a significant discretionary portion in option introductions. This is consistent with the rule books of CBOE, NYSE, and NASDAQ, where they state new strike prices are introduced not only when the price moves significantly but in response to investor demand.

Next, I show that the return spread between stocks with options introduced above and below the prevailing strike prices are not driven by standard risk factors including short-term reversal and momentum. The return spread with 12 month holding horizons is not explained by the Fama-French 6-factor model (Fama and French (2018) plus the short-term reversal factor. In addition, the return spread is positive and significant 12 months after portfolio formation within stocks with high and low 1-month return and momentum.

The option introductions above and below the prevailing strike prices are not correlated or explained by existing option variables that predict stock returns including change in volatility surfaces (An et al. (2014)), option-to-stock volume ratio (Johnson and So (2012)), implied volatility spread (Cremers and Weinbaum (2010)), and SKEW (Xing et al. (2010)), among other measures. The correlation between the main variable that captures option introductions and existing option variables is less than 0.15 in absolute value. The Fama-MacBeth regressions show that option introductions above and below the prevailing strike prices have significant predictability of in the cross-section of expected stock returns for the next 12 months controlling for existing option variables.

I provide supporting evidence that informed investors with private information are driving the predictability of new exercise prices. First, I show that deep out-of-the-money call and put options have positive open interest after introduction, consistent with informed traders making use of the cost-effective leverage embedded in these options. Second, the results are stronger when informed trading intensity (ITI, Bogousslavsky et al. (2024)) is stronger, consistent with informed trading driving the results. Third, the predictability is stronger in stocks where its options are more liquid than the stock itself, consistent with Easley et al. (1998) that informed investors trade in in more liquid markets because it is easier to disguise their trades. Finally, earnings forecasts by analysts tend to underreact to stocks with new options introduced above the prevailing maximum strike price and below the prevailing minimum strike price, suggesting analysts are not aware of the private information gathered by informed investors and strike price introductions contain information on future cash flows.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 provides institutional details on how exchanges introduce new strike prices. Section 4 describes the data and variables used in the empirical analyses. Section 5 presents the empirical results. Section 6 concludes.

2 Literature Review

The existing literature primarily focuses on the impact of first-time option introductions on stocks that previously had no listed options. Theoretically, options are redundant assets that can be replicated with stocks and bonds in a frictionless market (Black and Scholes (1973)). However, markets are incomplete in the real world due to trading costs, short-sale constraints, and imperfect information (An et al. (2014)). Thus, option introductions may affect underlying stock prices. Several papers explore the consequences of introducing options to stocks for the first time. For example, Skinner (1989) shows that when options are first introduced to an underlying stock, stock volatility decreases, and stock volume increases. Conrad (1989) shows that stock prices permanently increase around the date of option introductions for those stocks without options. Detemple and Jorion (1990) find that option introductions are associated with increased stock price and decreased volatility, but these effects are weaker over time. Detemple and Selden (1991) theoretically shows that the underlying asset price increases when options are introduced. Also, Skinner (1990) documents that less information is contained in earnings announcements after options are introduced to a stock, consistent with more private information being produced. Adding to this literature, I explore the information content of new option introductions for stocks that already have options.

Many papers provide theoretical evidence that informed traders trade in the options market before trading in the the stock market. Black (1975) argue that informed investors might trade in the options market to exploit the leverage options provide. Back (1993) proposes a model that shows trading in options provides stronger signals than trading in stocks, and thus, options cannot be entirely hedged with stocks. Consistent with the literature, I show further evidence that informed traders tend to trade in the options market when they have private information.

The existing literature also provides empirical evidence of the options market leading the stock market. In particular, how option-to-stock volume ratio predicts stock returns is studied extensively in the literature. Easley et al. (1998) develop a model where buying a call or selling a put contains information about the underlying stock. Empirically, they show that call and put option volume might lead the underlying stock prices. Roll et al. (2010) explore the determinants of the option-to-stock volume ratio and provide evidence that it relates to trading costs, institutional holdings, and earnings announcement returns. Johnson and So (2012) show that option-to-stock volume negatively predicts future stock returns at the week-level (and reverse quickly after) because traders with negative information can trade on options more easily than short-selling the underlying stock. Hu (2014) decomposes stock imbalances into option-induced imbalances and option-independent imbalances, and shows that option-induced imbalances contain information on the underlying stock. More recently, Muravyev et al. (2022) argues that the predictability of stock returns from options volatility and volume is because they reflect stock borrowing fees. They argue option market-implied stock predictability is reduced significantly after controlling for stock borrowing fees.

In addition to the option-to-stock volume ratio, put-call ratios or measures related to volume, open interest, and implied volatility are also known to predict future stock returns. Pan and Poteshman (2006) show that put-call option volume ratios negatively predict future stock returns at the daily and weekly levels. Xing et al. (2010) documents that stock with steeper volatility smirks have low future expected returns without reversals, consistent with informed traders trading out-of-the-money put options. Cremers and Weinbaum (2010) provide evidence that based on put-call parity, weighted-average implied volatility differences between calls and puts predict future stock returns at the 1-week and 1-month level, which are not explained by short selling costs. Fodor et al. (2011) show that changes in call (put) open interest positively (negatively) predict future stock returns at the daily level. Jin et al. (2012) provide evidence that supports these results by showing that volatility smirks have stronger predictability before firm-specific information events. Muravyev et al. (2013) use put-call parity to estimate the disagreement between implied stock prices and actual stock prices, and find that option prices do not contain information on future returns of underlying stocks using 39 stocks. An et al. (2014) show that changes in call (put) option implied volatility positively (negatively) predict future stock returns for up to 6 months. Blau et al. (2014) show that put-call ratios predict stock returns at the daily level, whereas option-to-stock volume ratios predict stock returns at the weekly and monthly levels. Bergsma et al. (2020) show that volume- and open-interest-weighted average moneyness positively predicts future stock returns at the daily level. Kang et al. (2022) show that the put-to-call ratio of out-of-the-money options using daily volume and open interest negatively predicts future stock returns at the 1-month level but reverses quickly after. In the following sections, I control for variables (An et al. (2014), Fodor et al. (2011), Bergsma et al. (2020), Kang et al. (2022)) that use volume or open interest in the main tables.

In this paper, I provide suggestive evidence that informed investors with strong private information tend to request new strike prices, and this information is not immediately incorporated into the stock price. In addition, I provide about 12 months of predictability in the stock market, which is rare in the literature.

Recent papers have documented how mispricing affects stock or option prices. Goncalves-

Pinto et al. (2020) show that not only informed trading but price pressure in the stock market leads to temporary mispricing where options variables become informative. On the other hand, Eisdorfer et al. (2022) studies option mispricing where investors seem to underprice 5-week options compared to 4-week options due to inattention to maturities when rolling over monthly positions. The empirical results in this paper suggest that introducing new strike prices is less likely due to mispricing.

Finally, several studies have examined inventory risk faced by option market makers and their risk management. Muravyev (2016) provides evidence that option prices are affected more by market makers' inventory risk induced by order imbalances than asymmetric information. Hu et al. (2023) document evidence from the Korean Stock Exchange that option market makers manage risk by inventory management but rarely delta-hedge their positions, contrary to prior beliefs. Empirical results in this paper suggests the information in the introduction of new strike prices is most likely acquired by investors instead of option market makers because the CBOE rule book in the following section states that demand from market makers are not considered when introducing new strike prices.

3 Institutional Details

In this section, I explore how option exchanges introduce new strike prices for individual stock options. The following shows a common quote on how exchanges introduce additional exercise prices for individual options from the rule books of major option exchanges (CBOE, NYSE, and NASDAQ):

> "Additional series of options of the same class may be opened for trading on the Exchange when the Exchange deems it necessary to maintain an orderly market, to meet customer demand or when the market price of the underlying stock moves more than five strike prices from the initial exercise price or prices. The opening of a new series of options on the Exchange will not affect any other series of options of the same class previously opened." (Rule 4.5. Series of Option Contracts Open for Trading, CBOE

Rule Book)

Other statements related to adding series of options include the following:

> "The Exchange may also open additional strike prices of (Weekly, Monthly, Quarterly) Option Series that are more than 30% above or below the current price of the underlying index or security, provided that demonstrated customer interest exists for such series, as expressed by institutional, corporate, or individual customers or their brokers. Market-makers trading for their own account will not be considered when determining customer interest under this provision." (CBOE Rule Book)

The following statement explains how exchanges delist options:

> "When there is no open interest in a series, the Exchange may delist such series. Delisting shall be preceded by a notice to TPH organizations concerning the delisting." (Rule 4.4. Withdrawal of Approval of Underlying Securities, CBOE Rule Book)
>
> "...the Exchange will, on a monthly basis, review series that are outside a range of five strikes above and five strikes below the current price of the underlying ETF, and delist series with no open interest in both the put and the call series having a: (i) strike higher than the highest strike price with open interest in the put and/or call series for a given expiration month; and (ii) strike lower than the lowest strike price with open interest in the put and/or call series for a given expiration month." (CBOE Rule Book)
>
> "Notwithstanding the above referenced delisting policy, customer requests to add strikes and/or maintain strikes in Quarterly Options Series in ETF options in series eligible for delisting shall be granted." (CBOE Rule Book)

Based on the statements above, exchanges follow a passive process, but there seems to be a demand component in strike price introductions and delistings. The delistings seem to happen only when there is no open interest for an option. However, it is clear that new strike price introductions are partially driven by price changes. Plus, the demand component that drives option introductions is not based on market makers' demand, but investors' willingness to buy options. Overall, a demand component is implied by the rule book in the introduction of strike prices.

However, the exchanges do not specify the timing of the introductions after significant stock movements, how a significant stock movement is measured (in which time interval), or what an orderly market means. It is also unclear which price the exchange uses for calculating the 30% against the current price. Furthermore, the exchanges do not provide details on how they respond to demand.

The rules of introducing and delisting strike prices for an individual option do not have a clear standard due to the embedded demand component. If the demand component drives the introduction and delistings, it might contain information that predicts future stock returns. In this paper, I focus on introductions because delistings requires the options to have 0 open interest which is more passive.

4 Data and Variables

I use the Center for Research in Security Prices (CRSP) to get stock returns and characteristics from January 1996 to December 2023. I use end-of-the-month dates from OptionMetrics to get data on individual options and their corresponding strike prices from January 1996 to August 2023. Standard risk factors and the T-bill rate are obtained from Kenneth R. French's data library. I exclude stocks with prices less than $1 at the end of each month to mitigate microstructure concerns. I exclude options that do not have standard contract sizes (multiplier 100) at the end of each month to mitigate concerns related to stock splits. Options are required to have strike price information available in the OptionMetrics database at the end of each month. Stocks are required to have share code 10 and 11 and have at least one listed option available in the OptionMetrics database at the end of each month. This mitigates the effect of option introductions for stocks that did not have options at all. I use the characteristic-based benchmark portfolios from Daniel and Titman (1997) where I follow the replication code from Drechsler (2024). Following the literature, I use CRSP delisted returns for each stock after it is delisted, then set delisted returns to -35% for stocks delisted from NYSE and AMEX, and set delisted returns to -55% for stocks delisted from NASDAQ (Shumway

(1997), Shumway and Warther (1999), Chen and Zimmermann (2022)).

One advantage of using end-of-the-month dates to form monthly portfolios is that they are less likely to overlap with options expiration dates. Note that most options expire on the third Friday of the month, not only for index options but even for individual options, and most options are introduced on the first trading day after the third Friday of the month (see Figure B.1).

4.1 Main Variable: INTRO_q3 and INTRO_q5

INTRO_t captures the number of options introduced in month t either above the previous month's (month $t-1$) maximum strike price (with a positive sign) or below the previous month's (month $t-1$) minimum strike price (with a negative sign). I define two main variables with INTRO: INTRO_q3 and INTRO_q5, each representing three-way and five-way sorts.

INTRO_q3 equals 1 if INTRO is positive, equals -1 if INTRO is negative, and equals 0 otherwise. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks.

$$\begin{aligned} & = 1 \quad (INTRO_t > 0) \\ INTRO\_q3_t & = 0 \quad (INTRO_t = 0) \\ & = -1 \quad (INTRO_t < 0) \end{aligned} \tag{1}$$

Note that a given stock might have new options both above and below the prevailing strike prices in a given month. INTRO_t takes this into account by taking the difference of the number of options introduced above and the number of options introduced below. If more options are introduced above the prevailing strike prices than below, INTRO_t is positive, thus INTRO_q3=1. If there are equal number of options introduced both above and below the prevailing strike prices, INTRO_t is 0, thus INTRO_q3=0. On average, there are around 5.38 stocks per month across the entire sample period that have the same number of option introductions above and below the prevailing strike prices.

In additional tests, I sort stocks based on INTRO_q5 which is divided into five groups. I split INTRO_q3=1 into two groups based on the number of new options introduced above the previous month's maximum strike price: INTRO_q5=2 (above median introductions) and INTRO_q5=1 (below median introductions). Likewise, I split INTRO_q3=-1 into two groups based on the number of new options introduced below the previous month's minimum strike price: INTRO_q5=-1 (below median introductions), INTRO_q5=-2 (above median introductions). The purpose of splitting INTRO into five groups in addition to the of three groups is because INTRO captures the number of new options across all maturities and strike prices. If exchanges are responding to stronger demand from informed investors, they are likely to introduce new options across different maturities. Therefore, the five-way sort using INTRO_q5 captures different layers of demand. INTRO_q5 can be expressed as the following:

$$
\begin{aligned}
&= 2 \quad (INTRO_t > 0,\ \text{above median introductions}) \\
&= 1 \quad (INTRO_t > 0,\ \text{below median introductions}) \\
INTRO\_q5_t &= 0 \quad (INTRO_t = 0) \\
&= -1 \quad (INTRO_t < 0,\ \text{below median introductions}) \\
&= -2 \quad (INTRO_t < 0,\ \text{above median introductions})
\end{aligned}
\tag{2}
$$

Figure 1 shows a visual illustration of how INTRO is measured. Firm A's stock price in Figure 1 went from \$46 in February 2022 to \$56.2 in March 2022. The strike prices \$75 and \$80 were introduced above the prevailing maximum strike price of \$70. In this case, INTRO=2, because two strike prices were introduced above the prevailing maximum strike price. Also, INTRO_q3=1, because INTRO is positive.

Firm B's stock price in Figure 1 went from \$28.1 in February 2022 to \$28.8 in March 2022. The strike price $12.5 was introduced below the prevailing minimum strike price of $15. In this case, INTRO=-1, because one strike price was introduced below the prevailing minimum strike price. Also, INTRO_q3=-1 because INTRO is negative.

Figure 2 shows the number of stocks with options introduced above the prevailing maximum strike price and below the prevailing minimum strike price, respectively, each month. INTRO_q3=1 ('added above') represents a portfolio of stocks with new options introduced above the prevailing maximum strike price and INTRO_q3=-1 ('added below') represents a portfolio of stocks with new options introduced below the prevailing minimum strike price. Stocks are required to have at least one listed option before portfolio formation. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

On average, there are more stocks with INTRO_q3=1 than stocks with INTRO_q3=-1, potentially due to the following reasons: First, aggregate stock returns are correlated with strike price introductions. If market returns are positive there are more stocks with options introduced above the prevailing maximum strike price. If market returns are negative there are more stocks with options introduced below the prevailing minimum strike price. For example, the number of stocks with options introduced below the prevailing minimum strike price sharply increased during the 2008 Global Financial Crisis and during COVID in 2020. Second, strike prices are bounded below by 0 but not bounded above. When stock price is low and corresponding strike prices are already near 0, the number of options that can be introduced below the prevailing minimum strike price is limited.

I report the yearly average number of stocks for INTRO_q3=-1 and INTRO_q3=1 for each month in Table B.1.

In Figure B.1, I report the proportion of option introductions in days of the week for each month. Day 1 is Monday and day 5 is Friday. The options are included in the sample if INTRO_q3=-1 or 1. The sample period is 1996-2023. The figure shows that option introductions are mostly clustered on the first day of the fourth week, which is the first trading day after the third Friday.

However, the figure also shows that option introductions are not only clustered immediately after the third Friday but relatively spread out across all days of the month. In addition, a large proportion of introductions occur on the fourth day of the third week. These options have time to maturity of at least 8 days.

In the following section, I construct portfolios at the end of the month but use option introductions within any day of the month. This indirectly addresses microstructure or rebalancing issues of portfolio construction because most of the options are introduced at least one day or even weeks before portfolio formation.

5 Empirical Results

5.1 Predictive Model of Strike Price Introductions

In this section, I introduce a model that predicts option introductions above and below the prevailing strike prices. I explore whether option introductions in the next month are explained by stock and option variables in this month to estimate the size of the discretionary component of strike price introductions. If option introductions are explained by variables such as past returns and volume, then it implies that the discretionary component is small and options are introduced passively. However, if option introductions are not entirely explained by stock or option variables, then it implies that the discretionary component is large and options are not introduced passively and may contain information on the underlying stock. In the model, the adjusted-R^2 captures the discretionary component of option introductions.

Two models are introduced: one that predicts new option introductions above the prevailing maximum strike price and one that predicts below the prevailing minimum strike price. The dependent variable equals 1 if INTRO_q3=1 and 0 otherwise for the former model and the dependent variable equals 1 if INTRO_q3=-1 and 0 otherwise for the latter model.

As shown in Appendix B, option introductions are spread out across different days of the month. For a given stock, there might be multiple introductions in a given month. Thus, the model only considers stocks either without any option introductions with option introductions above or below the prevailing strike prices on the first trading day after the 3rd Friday of a given month. This mitigates any econometric issues when using past 10-day returns immediately before option introductions. All stocks will have 10-day returns aligned on the same period for each month.

For both of the models, stock variables are included: 10-day return, 1-month return, 11-month return skipping the most recent month, 10-day volume, 1-month volume, 1-month change in volume, market cap, price level, idiosyncratic volatility, and turnover. Also, option variables are included: 10-day option volume, 1-month option volume, and change in 1-month option volume.

The two models that predict new option introductions are expressed as follows:

$$\begin{aligned} added\_above_{i,t} \sim\ & ret\_10d_{i,t} + ret\_1M_{i,t-1} + MOM_{i,t-1} \\ & + volume\_10d_{i,d} + volume_{i,t-1} + \Delta volume_{i,t-1} \\ & + option\_volume\_10d_{i,t} + option\_volume_{i,t-1} + \Delta option\_volume_{i,t-1} \\ & + mcap_{i,t-1} + price_{i,t-1} + IVOL_{i,t-1} + turnover_{i,t-1} + e_{i,t}, \end{aligned} \tag{3}$$

$$\begin{aligned} added\_below_{i,t} \sim\ & ret\_10d_{i,t} + ret\_1M_{i,t-1} + MOM_{i,t-1} \\ & + volume\_10d_{i,d} + volume_{i,t-1} + \Delta volume_{i,t-1} \\ & + option\_volume\_10d_{i,t} + option\_volume_{i,t-1} + \Delta option\_volume_{i,t-1} \\ & + mcap_{i,t-1} + price_{i,t-1} + IVOL_{i,t-1} + turnover_{i,t-1} + e_{i,t}, \end{aligned} \tag{4}$$

The $added\_above_{i,t}$ equals 1 if new options are introduced above the prevailing maximum strike price for stock i in month t and 0 otherwise. The $added\_below_{i,t}$ equals 1 if new options are introduced above the prevailing minimum strike price for stock i in month t and 0 otherwise.

The $ret\_10d_{i,t}$ is the past 10-day average daily return of stock i in month t before the option is introduced above or below the prevailing strike prices. The $ret\_1M_{i,t-1}$ is the 1-month return of stock i in month $t-1$, $MOM_{i,t-1}$ is the 11-month return skipping the most recent month for stock i in month $t-1$.

The $volume\_10d_{i,d}$ is the past 10-day average daily volume (in millions) of stock i in month t before the option is introduced above or below the prevailing strike prices. The $volume_{i,t-1}$ is the monthly volume (in billions) for stock i in month $t-1$, $\Delta volume_{i,t-1}$ is the 1-month change in monthly volume (in billions) for stock i from month $t-2$ to month $t-1$.

The $option\_volume\_10d_{i,t}$ is the past 10-day average option volume (in millions) of stock i in month t before the option is introduced above or below the prevailing strike prices. The $option\_volume_{i,t-1}$ is the aggregate volume across all options (in millions) of stock i in month $t-1$, $\Delta option\_volume_{i,t-1}$ is the change in option volume (in millions) of stock i from month $t-2$ to month $t-1$.

The $mcap_{i,t-1}$ is the market capitalization (in millions) of stock i at the end of month $t-1$, $price_{i,t-1}$ (in thousands) is the price of stock i at the end of month $t-1$, $IVOL_{i,t-1}$ is the idiosyncratic volatility of stock i calculated as the standard deviation of daily returns in month $t-1$, and $turnover_{i,t-1}$ is the turnover (in millions) of stock i calculated as the monthly volume divided by shares outstanding in month $t-1$, and $e_{i,t}$ is the error term.

To fit the model, I conduct Fama and MacBeth (1973) regressions to capture the cross-sectional predictability of stock and option variables. Each month, the indicator variables are regressed on stock and option characteristics in the cross-section. Then, the average coefficients of each cross-sectional regression is reported with their corresponding t-statistics across the time-series.

Table 1 shows Fama and MacBeth (1973) regressions of indicator variables for strike price introductions on stock and option characteristics following equation 3 and 4. First of all, the monthly average adjusted R^2 for each model is 8.2% and 4.1%, respectively. This reveals that new option introductions above the prevailing maximum strike price and below the prevailing minimum strike price are not explained by basic stock and option characteristics. The results imply a significant discretionary component in both extremes of option introductions.

As expected, positive 10-day and 1-month returns significantly predict new options above the prevailing maximum strike price whereas negative 10-day and 1-month returns significantly predict new options below the prevailing minimum strike price. This is consistent with the fact that exchanges introduce new options when there are large movements in stock prices in the short-term. The coefficient of 0.34 for $ret\_1M_{i,t-1}$ in the first set of regressions shows that a 10% return is associated with a 3.4%P increase in the probability of options introduced above the strike price. Also, momentum in the stock price significantly predicts new option introduction in the same direction as the 1-month return. Higher momentum increases the change of an option being introduced above the prevailing maximum strike price.

The level of past month's stock volume is negatively associated with option introductions both above the prevailing maximum strike price and below the prevailing minimum strike price. This is consistent with Easley et al. (1998) that informed traders tend to trade in the options market as opposed to the stock market when the stock's liquidity is low. If new options introduced by informed traders, then low stock liquidity might be associated with more option introductions both above the maximum and below the prevailing minimum strike price. However, in the 10 days leading up to the option introduction, higher volume is positively correlated with option introductions both above and below the prevailing strike price.

The change in stock volume seems to positively predict chances of option introductions on both sides. This is consistent with exchanges introducing more options in both extremes when the underlying stock becomes more active which could eventually lead to more option volume. In addition, the turnover is negatively associated with options added above the prevailing maximum strike price and positively associated with options added below the prevailing minimum strike price. This is difficult to reconcile with volume having a negative coefficient.

The level of option volume 10 days leading up to the option introduction has a negative coefficient for both options added above and below. This is against the argument that new options are introduced above and below the prevailing strike prices due to option volume spillovers. In addition, the changes in option volume has a negative coefficient for options added above and positive coefficient for options added below. On the other hand, the level of option volume in the past month seems to have a negative coefficient though the coefficient is insignificant for options added below. This mixed result implies that option introductions are less likely due to significant increases in option volume.

The market cap has a negative coefficient for in both regressions implying that exchanges are less likely to introduce options with extreme strike prices for larger firms than smaller firms. This may be due to the fact that exchanges have already a wide range of options for larger firms than smaller firms. Also, the overall volatility might be smaller in larger firms. The stock price level positively predicts option introductions in both extremes, which implies options are more likely to be introduced when prices are high given a fixed strike price interval.

The idiosyncratic volatility negatively predicts new option introductions both above the maximum and below the prevailing minimum strike price. This result is contrary to the expectation that exchanges introduce new options in both extremes when the stock price is more volatile. It might be due to the fact that larger and less volatile firms have lower volatility but the potential option volume after option introduction is larger than small and volatile firms because overall option volume is high.

5.2 Summary Statistics

In this section, I report average characteristics for the sample of stocks with options and for the portfolio sorts based on INTRO_q3. This is because the sample may have characteristics that differ from those of the entire CRSP dataset which serves as the foundation of most asset pricing studies.

Table 2 shows summary statistics of stocks with listed options and average characteristics of the stocks with options introduced above the prevailing maximum strike price and below the prevailing minimum strike price, respectively. The 'n_firms' denotes the average number of firms in each month for the sample period. The average monthly market cap of 10th, 25th, 50th, 75th, and 90th quantile of stocks within stocks with options, all stocks, and NYSE stocks are reported in millions of dollars.

Table 2a shows that stocks with options have on average 2,341 stocks per month. The median market cap of stocks with options is 1,291 million that is above the median market cap of all stocks and below the market cap of NYSE stocks. The sample of stocks with listed options tend to have larger market cap than the sample of all stocks because the exchanges consider the stock's market cap and liquidity when they decide to list options for a given stock.

Table 2b shows average characteristics of the stocks with options introduced above the prevailing maximum strike price and below the prevailing minimum strike price, respectively. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. The 'Avg. N of stocks' reports the average number of stocks for each INTRO_q3=-1, 0, and 1 in each month. The 'ret_mean' reports the average 1-month return. The 'ret_11_lag1_mean' reports the average 11-month return skipping the most recent month. The 'mcap_mean' reports the average market capitalization in millions of dollars. The 'beme' reports the average log book-to-market ratio. The 'ret_ivol_mean' reports the average idiosyncratic volatility estimated by the standard deviation of 1-month daily returns. The '1 - (-1)' is the difference between '1' and '-1' and corresponding t-statistics are reported without clustering.

I first average the monthly average values of each portfolio with INTRO_q3=-1, 0, 1, and the spread ('1 - (-1)'). Then, I take the average and t-statistic across the months in the sample period.

The portfolio with INTRO_q3=1 tends to have significantly higher 1-month returns, higher momentum returns, larger market cap, larger book-to-market ratio, and smaller idiosyncratic volatility than the portfolio with INTRO_q3=-1. To mitigate concerns that stock characteristics are driving the results, I control for these variables in section 5.

5.3 Single-sorted Portfolio Returns

In this section, I test whether new options introduced above the maximum or below the prevailing minimum strike price for individual stock options contain any information about the underlying stock. We would not expect any predictability if new strike prices were passively introduced by the exchanges.

The main result of this paper can be summarized by Figure 3. The portfolio with INTRO_q3=1 significantly outperforms the portfolio with INTRO_q3=-1 up to 12 months after portfolio formation. The return difference does not reverse even after 12 months. Contrary to the conventional wisdom that exchanges passively introduce new strike prices, the results imply that strike price introductions at the extreme might contain information about the underlying stock.

Table 3 shows the actual numbers of 3. It shows the event time cumulative returns K months after portfolio formation up to 24 months using three groups of INTRO_q3. The event at Month=0 is when the options were introduced. At the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. For INTRO_q3=1 and INTRO_q3=-1, the market return is subtracted. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. The corresponding t-statistics for the '1 - (-1)' are also reported. 'Long-short' uses raw returns whereas 'DGTW (1997)' uses returns excess of characteristic-based benchmark portfolio (Daniel et al. (1997)). Characteristic-based benchmark portfolios are formed using five sorts of market cap, book-to-market, and momentum, respectively, to get a total of 125 portfolios. The market cap sort uses NYSE breakpoints, the book-to-market sort uses book-to-market excess of the Fama-French 48 industry average book-to-market, and momentum sort uses the past 11 month returns skipping the most recent month.

The results show around a 4.11% (t-statistic 4.28) cumulative return spread between the portfolio with INTRO_q3=1 and INTRO_q3=-1, 12 months after portfolio formation. Both the portfolio with INTRO_q3=1 and INTRO_q3=-1 are significantly contributing to the returns, although the magnitude is stronger for INTRO_q3=-1. When using excess returns of the characteristic-based benchmark portfolios, the cumulative returns are reduced to 2.23% (t-statistic 3.84) but remain statistically significant.

To explore whether the number of new options introduced above or below matters, I split the stocks into five groups: INTRO_q5=-2, -1, 0, 1, 2. Table 4 shows the event time cumulative returns K months after portfolio formation up to 24 months using five groups of INTRO_q5. The event at Month=0 is when the options were introduced. The portfolio of stocks with new options introduced above the prevailing maximum strike price are split into two groups based on the number of new options: INTRO_q5=2 (above median) and INTRO_q5=1 (below median). The portfolio of stocks with new options introduced below the prevailing minimum strike price are split into two groups based on the number of new options: INTRO_q5=-1 (below median), INTRO_q5=-2 (above median). INTRO_q5=0 represents the rest of the stocks. For INTRO_q5=-2, -1, 1, 2 the market return is subtracted. The '2 - (-2)' is the difference between INTRO_q5=2 and INTRO_q5=-2 and its corresponding t-statistics are reported. 'Long-short' uses raw returns whereas 'DGTW (1997)' uses returns excess of the characteristic-based benchmark portfolio (Daniel et al. (1997)).

The results show statistically significant cumulative return spreads of 6.40% (t-statistic 5.18) 12 months after portfolio formation. When using excess returns of the characteristic-based benchmark portfolios, the cumulative returns are reduced to 2.76% (t-statistic 3.53) but remain statistically significant.

The above results imply that strike price introductions might have information about the underlying stock. When a new option is introduced above the previous month's maximum strike price, it is a positive signal for the underlying stock. On the other hand, when a new option is introduced below the previous month's minimum strike price, it is a negative signal for the underlying stock. The fact that there is any return spread is surprising if we believe exchanges are passively introducing new options.

5.4 Time-series Regressions

In this section, I construct monthly portfolios and explore their risk exposures to the Fama-French 6-factors. I use 1-month holding periods for each of the INTRO_q3=-1, 0, and 1 portfolios, INTRO_q5=-2, -1, 0, 1, and 2 portfolios, the spread ('1 - (-1)') between INTRO_q3=1 and INTRO_q3=-1, and the spread ('2 - (-2)') between INTRO_q5=2 and INTRO_q5=-2.

Table 5 shows monthly regressions of portfolio returns using 12 month holding horizons on Fama and French (2018) 6-factor returns plus the short-term reversal factor. For the upper half of the table, at the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. All portfolios are formed using 12 different portfolios formed in the past 12 months, each held for 12 months. Returns excess of the 1-month T-bill rate ('excess') and alphas of FF6 and FF6+STREV are reported with corresponding t-statistics. The coefficients and t-statistics are reported for each variable for the regression on FF6+STREV. Stocks are required to have at least one listed option before portfolio formation.

The results show that the spread ('1 - (-1)') between INTRO_q3=1 and INTRO_q3=-1 exhibit significant alpha of 0.23% (t-statistic 2.06) against the 6-factor model plus the short-term reversal. The portfolio positively loads on momentum with a coefficient of 0.43 (t-statistic 18.37) and negatively loads on short-term reversal with a coefficient of -0.13 (t-statistic -4.23).

For the bottom half of the table, the portfolio of stocks with new options introduced above the prevailing maximum strike price are split into two groups based on the number of new options: INTRO_q5=2 (above median) and INTRO_q5=1 (below median). The portfolio of stocks with new options introduced below the prevailing minimum strike price are split into two groups based on the number of new options: INTRO_q5=-1 (below median), INTRO_q5=-2 (above median). INTRO_q5=0 represents the rest of the stocks. The '2 - (-2)' is the difference between INTRO_q5=2 and INTRO_q5=-2. All portfolios are formed using 12 different portfolios formed in the past 12 months, each held for 12 months.

The results show that the spread ('2 - (-2)') between INTRO_q5=2 and INTRO_q5=-2 exhibit significant alpha of 0.35% (t-statistic 2.64) against the 6-factor model plus the short-term reversal. The portfolio positively loads on momentum with a coefficient of 0.53 (t-statistic 19.13) and negatively loads on short-term reversal with a coefficient of -0.16 (t-statistic -4.50).

Overall, the two different spread portfolios formed on three-way sorts and five-way sorts are not entirely explained by the 6-factor model and short-term reversal.

5.5 Correlation with Existing Variables

In this section, I study whether INTRO_q3 is correlated with existing variables in the literature that predict stock returns.

Table 6 shows the correlation between INTRO_q3 (and INTRO_q5) with existing variables in the literature. Stock-level variables from stock characteristics include: 1-month return ('ret'), 1-month idiosyncratic volatility ('ret_ivol'), and 11-month return skipping the most recent month ('ret_11_lag1'). Stock-level variables from option characteristics include: 1-month change in call volatility surface (ΔCVOL, An et al. (2014)), 1-month change in put volatility surface (ΔPVOL, An et al. (2014)), 1-month option-to-stock volume ratio (volume_option_to_stock, Johnson and So (2012)), 1-month average implied volatility spread ('vol_spread_vw_mean', Cremers and Weinbaum (2010)), 1-month average SKEW (SKEW_mean, Xing et al. (2010)), 1-month percentage change in call-put open interest ratio (OI_C_P_ratio_1M_diff_pct, Fodor et al. (2011)), out-of-the-money put-call open interest ratio (OTMPC_oi, Kang et al. (2022)), out-of-the-money put-call volume ratio (OTMPC_volume, Kang et al. (2022)), open interest-weighted average moneyness (avg_money_oi, Bergsma et al. (2020)), volume-weighted average moneyness (avg_money_volume, Bergsma et al. (2020)). Details on the variable construction are presented in Appendix A.

The INTRO_q3 is correlated with 1-month return and momentum with coefficients of 0.25 and 0.16, respectively. However, Table 3, Table B.2, and Table 5 shows that 1-month return and momentum do not explain the main results. The correlation between INTRO_q3 and other existing variables are lower than 0.15 in absolute value. These results suggest INTRO_q3 is unlikely to be proxying existing variables in the literature.

The above list of option measures includes a subset of the variables in the literature. However, I include the variables that most likely capture the open interest or volume spillovers that lead to new strike price introductions. For example, the out-of-the-money put-call volume ratio (Kang et al. (2022)) directly captures how much volume the out-of-the-money call options had over the past month relative to out-of-the-money put options. The low correlation between INTRO_q3 and variables related to volume and open interest mitigates the concern that new strike price introductions merely capture open interest or volume spillovers.

5.6 Fama-MacBeth Regressions

In this section, I explore whether INTRO_q3 explains the cross-section of expected stock returns controlling for stock- and option-related variables proposed in the literature. This mitigates the concern that the low correlation between INTRO_q3 and existing variables does not always indicate independence in explaining the cross-section of expected stock returns.

Table 7 shows Fama and MacBeth (1973) regressions of 1-month and 12-month returns, respectively, on INTRO_q3 and stock characteristics. Each month, future 1-month (or future 12-month average return) are regressed on INTRO_q3 and characteristics in the cross-section. Then, the average coefficients of each cross-sectional regression is reported with their corresponding t-statistics across the time-series. When using 12-month returns as the dependent variable, t-statistics are calculated using Newey and West (1987) standard errors with 12 lags. Stock-level variables from stock characteristics include: 1-month return ('ret'), 1-month idiosyncratic volatility ('ret_ivol'), and 11-month return skipping the most recent month ('ret_11_lag1'). Stock-level variables from option characteristics include: 1-month change in call volatility surface (ΔCVOL, An et al. (2014)), 1-month change in put volatility surface (ΔPVOL, An et al. (2014)), 1-month option-to-stock volume ratio (volume_option_to_stock, Johnson and So (2012)), 1-month average implied volatility spread ('vol_spread_vw_mean', Cremers and Weinbaum (2010)), 1-month average SKEW (SKEW_mean, Xing et al. (2010)), 1-month percentage change in call-put open interest ratio (OI_C_P_ratio_1M_diff_pct, Fodor et al. (2011)), out-of-the-money put-call open interest ratio (OTMPC_oi, Kang et al. (2022)), out-of-the-money put-call volume ratio (OTMPC_volume, Kang et al. (2022)), open interest-weighted average moneyness (avg_money_oi, Bergsma et al. (2020)), volume-weighted average moneyness (avg_money_volume, Bergsma et al. (2020)). Details on the variable construction are presented in Appendix A. Variables that are not in percentage changes are standardized by subtracting its cross-sectional average and dividing by its cross-sectional standard deviation. If variables are not available for a given stock, 0 is assigned to preserve the sample size.

The advantage of conducting Fama-MacBeth regressions is that I can control for multiple variables proposed in the literature. In addition, the magnitude of the predictability is easily interpretable in terms of average spread per month. On the other hand, Fama-MacBeth regressions tend to overstate the effect of smaller stocks because the estimation equally weights each stock. Thus, the results shown in Fama-MacBeth regressions do not necessarily match Table 3 where I use value-weighted portfolios. The average adjusted-R^2's are reported for each specification to show how much the cross-section of future stock returns can be explained by the independent variables.

Table 7 shows that when future 1-month return is the dependent variable, INTRO_q3 does not significantly explain the cross-section of stock returns, although the coefficient is positive. This is partially due to the fact that the predictability of INTRO_q3 is mainly for long-term future returns.

Consistent with INTRO_q3's long-term predictability, when future 12-month average return is the dependent variable, INTRO_q3 significantly explains the cross-section of stock returns with a coefficient of 0.10 (t-statistic 2.39), even after controlling for stock- and option-level variables. The INTRO_q3 has the largest coefficient among all variables in the regression. The magnitude of 0.10 can be translated into 0.20% (0.10×2) return spread per month on average for the next 12 months between INTRO_q3=1 and INTRO_q3=-1.

5.7 Double-sorted Portfolio Returns

In this section, I aim to separate the passive and informational parts of strike price introductions. According to the institutional details, the exchanges introduce strike prices whenever there is a large change in the underlying stock price. To proxy large changes in stock prices, I use past 1-month returns and past 11-month returns skipping the most recent month (momentum). The past

1-month returns and momentum returns are natural candidates.

Since option introductions above the prevailing maximum strike price are significantly correlated with past 1-month returns and momentum, there may not be sufficient number of stocks in a portfolio that independently sorts past 1-month returns and INTRO_q3. For example, when 1-month returns are high, only a limited number of stocks might have options introduced below the prevailing minimum strike price. To mitigate this concern, I sequentially double-sort the portfolios. In other words, within INTRO_q3=1, I split the stocks into two groups by their past 1-month return. This ensures that the double-sorted portfolios have sufficient number of stocks each month.

Table 8 shows event time portfolio returns K month after portfolio formation of double sorted portfolios sorted by INTRO_q3 and past 1-month return. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the median past 1-month return: low and high. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high past 1-month return groups, respectively.

Within the INTRO_q3=-1 group, the low 1-month return portfolio seems to have larger negative returns than the high 1-month return portfolio. Within the INTRO_q3=1 group, the high 1-month return portfolio seems to have larger positive returns than the low 1-month return portfolio. These results suggest that 1-month return seems to be contributing to the new options on both extremes. However, the '1 - (-1)' portfolio within the low 1-month return sort and the '1 - (-1)' portfolio within the high 1-month return sort both have significantly positive returns 12 months after portfolio formation. This confirms that 1-month return is not entirely driving the spread between stocks with options introduced above the prevailing maximum strike price and stocks with options introduced below the prevailing minimum strike price.

Table 9 shows event time portfolio returns K month after portfolio formation of double sorted portfolios sorted by INTRO_q3 and momentum. The return patterns are similar to the 1-month return sort from Table 8. Thus, 1-month returns or momentum do not entirely explain the spread

('1 - (-1)') between INTRO_q3=1 and INTRO_q3=-1.

Table 10 shows event time portfolio returns K month after portfolio formation of double sorted portfolios sorted by INTRO_q3 and idiosyncratic volatility (IVOL) measured by the standard deviation of returns in the portfolio formation month. The event time return spread between INTRO_q3=1 and INTRO_q3=-1 is significant in both high IVOL and low IVOL subsets. But the return spread is much larger in the stocks with high IVOL, mostly driven by INTRO_q3=-1.

In Appendix B, I show independently double-sorted portfolio returns based on stock characteristics such as maximum cumulative returns, market cap, and book-to-market. The results suggest that the above stock characteristics do not explain the spread ('1 - (-1)') between INTRO_q3=1 and INTRO_q3=-1.

The results are reported in Table B.2. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on their characteristic: cumulative maximum 1M return (max), market cap (mcap), and book-to-market ratio (B/M). Then, within the five groups, stocks are sorted by INTRO_q3=-1, 0, and 1. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high momentum groups, respectively.

I use maximum cumulative returns to capture the highest price in a given month. For example, there could be stocks with the same price at the beginning and at the end of the month, but with extremely high prices in between. The exchanges might be introducing new strike prices in response to the highest price even when the past 1-month return is 0 for a given month. So I measure the maximum cumulative return to capture any significant price changes in a given month.

5.8 Evidence of Informed Trading

In this section, I provide suggestive empirical evidence that the return spread between stocks with options introduced above and below the prevailing strike price is driven by informed trading. I present four pieces of evidence that informed investors with private information are driving the option introductions and return predictability using the following tests: open interest after option introduction, informed trading intensity, option to stock volume ratio, and earnings forecast errors.

5.8.1 Open Interest after Option Introductions

In this section, I explore whether the new options introduced above the previous month's maximum strike price or below the previous month's minimum strike price are actually traded after introduction. If informed traders are requesting the exchange to introduce new strike prices, we should expect positive open interest after those options are introduced.

To compare open interest across different stocks, I scale open interest by the stock's shares outstanding. This provides a standard measure of open interest. Table 11 shows open interest scaled by shares outstanding K months after option introduction. The event at Month=0 is when the options were introduced. First, scaled open interest is equal-weighted at the stock-month level across all call and put options, respectively. Second, the average scaled open interest is value-weighted each month across the stocks. Finally, this is averaged across all months in the sample period for INTRO_q3=1 and INTRO_q3=-1, respectively.

For INTRO_q3=-1, where new options are introduced below the previous month's minimum strike price, the call option open interest of 0.19% is significantly smaller than the put option open interest of 0.29% (t-statistic -4.76). The call-put difference in open interest is negative not only in the month the option was introduced but throughout the 12 months after portfolio formation.

On the other hand, for INTRO_q3=1, where new options are introduced above the previous month's maximum strike price, the call option open interest of 0.37% is significantly larger than the put option open interest 0.06% (t-statistic 16.28). The call-put difference in open interest is positive not only in the month the options are introduced but throughout the 12 months after portfolio formation.

These results suggest that indeed informed investors seem to trade more call options than put options when new options are introduced above the prevailing maximum strike price, and trade more put options than call options when new options are introduced below the prevailing minimum strike price. This supports the hypothesis that informed investors might be requesting the exchange to introduce new strike prices to trade those options.

5.8.2 Informed Trading Intensity

In this section, I examine whether informed trading intensity is associated with the return spread between INTRO_q3=1 and -1. The return spread is expected to be larger when informed trading intensity is high if the return spread is driven by informed trading.

I use the informed trading intensity (ITI) measure from Bogousslavsky et al. (2024) where they construct a daily measure that captures the trading intensity of informed investors trained on Schedule 13D filings. I average the daily ITI measure in each month to construct a monthly ITI measure. The sample period of ITI data is from January 1996 to July 2019.

Table 12 shows event time portfolio returns K month after portfolio formation of double sorted portfolios sorted by INTRO_q3 and past ITI. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the median of past month's daily average ITI: low and high. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high past ITI groups, respectively.

Within the INTRO_q3=-1 group, the high ITI portfolio seems to have more negative returns than the low ITI portfolio. Within the INTRO_q3=1 group, the high ITI portfolio seems to have similar returns with the low ITI portfolio. Furthermore, the '1 - (-1)' portfolio within the low ITI sort and the '1 - (-1)' portfolio within the high ITI sort both have significantly positive returns 12 months after portfolio formation. However, the '1 - (-1)' portfolio within the high ITI sort have higher returns than the the '1 - (-1)' portfolio within the low ITI sort. More informed trading is associated with larger spreads in the '1 - (-1)' portfolio. This supports the argument that informed trading is driving the return spread between stocks with new options above the prevailing maximum strike price and stocks with new options below the prevailing minimum strike price.

5.8.3 Option to Stock Volume Ratio

In this section, I study whether informed trading in the options market is more likely when it is more liquid than the stock market. One of the main predictions of the model by Easley et al. (1998) is that informed traders trade in the options market if the stock market is less liquid than the options market. This is because informed traders can hide their positions and pool with the uninformed traders. If the return spread between stocks with options introduced above and below the prevailing strike prices is driven by informed traders, then the spread should be more pronounced when options market is relatively more liquid than the stock market.

To empirically test this prediction, I use the option to stock volume ratio (O/S ratio) following Johnson and So (2012). More details on the replication process is shown in Appendix A. The main prediction is that informed traders are likely to trade in the options market instead of the stock market for the stocks with high option to stock volume ratio, which proxies for relative liquidity between the options and stock market.

Table 13 shows event time portfolio returns K months after portfolio formation of double sorted portfolios sorted by INTRO_q3 and past option-to-stock volume (O/S ratio, Johnson and So (2012)). The event at Month=0 is when the options were introduced. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the median of past month's O/S ratio: low and high. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high past O/S ratio groups, respectively.

Table 13 shows that when INTRO_q3=-1 the stocks with high O/S have larger negative returns than the stocks with low O/S ratio. In addition, when INTRO_q3=1 the stocks with high O/S ratio have larger positive returns for the first 11 months than the stocks with low O/S ratio. This shows that within each INTRO_q3=-1 and 1 group, the event time returns tend to be larger when the O/S ratio is high, at least within the 11 months after portfolio formation.

The spread between the '1' and '-1' portfolio among the stocks with high O/S ratio is much higher than the stocks with low O/S ratio. This result is consistent with the model of Easley et al. (1998) where informed investors trading in the options market instead of the stock market when the options market is relatively more liquid than the stock market. Thus, the result suggests that the return spread between stocks with option introductions above and below the prevailing strike prices is driven by informed traders.

5.8.4 Earnings Forecast Errors

In this section, I explore whether analysts incorporate potential information contained in strike price introductions. Analysts are information producers where they aim to incorporate all available information about the target firm (Givoly and Lakonishok (1979), among others). However, if analysts have limited attention, the new option introductions above the prevailing maximum strike price and below the prevailing minimum strike price might not be immediately impounded in the price of the firm. Therefore, I test whether analysts underreact to the information contained in strike price introductions.

Table 14 shows the earnings forecast errors for the portfolios sorted by INTRO_q3. The average earnings forecast errors are reported in percentages along with corresponding t-statistics for portfolios of INTRO_q3=1, INTRO_q3=-1, and the spread ('1 - (-1)') using stocks that have annual earnings announcements within 30, 90, 180, and 365 days after portfolio formation. Earnings forecast errors are defined as $(ActualEPS_{t+\tau}$ - $ForecastedEPS_{t-1})/Price_{t-1}$ for each stock where portfolios are formed from the beginning of month t. A positive (negative) forecast error is consistent with analysts underreacting to positive (negative) information. The actual EPS forecasts are from the next annual earnings announcement in some month (τ = 0,1,2,...,11) after portfolio formation. The EPS forecasts are from the latest median estimate as of the portfolio formation month $t-1$. The stock-level earnings forecast errors are value-weighted up to the portfolio level, then averaged across the sample period. The earnings forecast errors are winsorized at the 1% and 99% level in each month.

Table 14 shows that the spread portfolio ('1 - (-1)') using INTRO_q3 has an earnings forecast error of 0.46% (t-statistic 0.28) using stocks with annual earnings announcements within 30 days after portfolio formation, but has an earnings forecast error of 2.59% (t-statistic 3.92) using stocks with annual earnings announcements within 365 days after portfolio formation. This is consistent with Table 3 where the return spread of INTRO_q3=1 and INTRO_q3=-1 is pronounced in the long-term rather than the short-term. The results imply that the spread portfolio can be partially explained by analysts underreacting to potential long-term information contained in new option introductions.

In addition, the spread portfolio ('2 - (-2)') using INTRO_q5 has an earnings forecast error of -0.05% (t-statistic -0.04) using stocks with annual earnings announcements within 30 days after portfolio formation. The earnings forecast error becomes 4.39% (t-statistic 2.65) using stocks with annual earnings announcements within 365 days after portfolio formation.

The fact that most of the earnings forecast errors are driven by portfolio with INTRO_q3=-1 than INTRO_q3=1 in Table 14 is consistent with Table 3 because the magnitude of the returns are stronger for portfolio with INTRO_q3=-1 than INTRO_q3=1.

5.9 Option delistings

In this section, I examine whether option delistings instead of option introductions contain information about the underlying stock. It is unclear ex-ante whether the delistings contain information about the underlying stock. However, the exchanges state in the rule book that they delist options with no open interest but also respond to customer request to maintain those options. There seems to be a demand component for delistings but the information is likely to be stale. Then, it is likely that delistings are more mechanical than introductions. If an option was delisted, the option had zero open interest and there was no request to maintain it. Thus, I test whether option delistings, which are more likely to be mechanical than option introductions, contain information about the underlying stock.

For this section, I introduce a variable that represents stocks with option delistings above and below the current strike prices. DELIST_q3 equals 1 if a given stock had options delisted above the current strike prices, equals -1 if a given stock had options delisted below the current strike prices, and equals 0 otherwise. In other words, DELIST_q3=1 represents a portfolio of stocks with options delisted above the current maximum strike price, DELIST_q3=-1 represents a portfolio of stocks with options delisted below the current minimum strike price, and DELIST_q3=0 represents the rest of the stocks.

Table 15 shows event time portfolio returns K months after portfolio formation sorted by DELIST_q3 and INTRO_q3. The event at Month=0 is when the options were delisted or introduced. At the end of each month, stocks are divided into three groups: DELIST_q3=-1, 0, and 1. DELIST_q3=1 represents a portfolio of stocks with options delisted in month t above the prevailing maximum strike price at the end of month t, DELIST_q3=-1 represents a portfolio of stocks with options delisted in month t below the prevailing minimum strike price at the end of month t, and DELIST_q3=0 represents the rest of the stocks. The '1d - (-1d)' is the difference between DELIST_q3=1 and DELIST_q3=-1. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. DELIST_q3=1 would predict negative returns and DELIST_q3=-1 would predict positive returns if option delistings contain information on the underlying stock.

Table 15 shows that DELIST_q3 does not have predictability on the stocks. The stocks sorted by DELIST_q3 have a return spread of -1.04% (t-statistic -1.43) 12 months after portfolio formation. This confirms that option delistings do not predict stock returns. Option delistings are more likely to be mechanical whereas option introductions are more likely to be informational.

The small negative return might be due to the fact that delistings can be correlated with introductions. When an option is introduced above the prevailing strike price there could be an option delisted below the prevailing strike price at the same time. I test whether option delistings without option introductions on the other extreme have return spreads more closer to 0. Table 15 shows that the return spread of DELIST_q3=1 and DELIST_q3=-1 excluding the stocks where the INTRO_q3=-1 and INTRO_q3=1, respectively, is -0.44% (t-statistic -0.58) 12 months after portfolio formation. The return spread is even closer to 0 than using all delisted options.

5.10 Robustness Tests

In this section, I conduct robustness tests by splitting the sample in the cross-section with stock and option characteristics. Table 16 shows the event time cumulative return spread between INTRO_q3=1 and INTRO_q3=-1 12 months after portfolio formation split by the following stock and option characteristics. Across all specifications, the return spread between stocks with options above and below the prevailing strike prices seem to be significant and positive 12 months after portfolio formation.

5.10.1 Day of the Month of Option Introduction

In this section, I examine whether the introduction dates of the new options have different levels of predictability. As shown in Appendix B, a significant proportion of options are introduced on the first trading day after the third Friday (considering holidays), where most options expire. If options are introduced immediately after the third Friday, it is more likely to be driven by the exchange because they need to fill in the expired options. If options are introduced on other days, it is more likely to be driven by demand or price changes because it is unexpected. Therefore, new options that are introduced immediately after the third Friday are expected to have weaker predictability than those introduced immediately after the third Friday.

Table 16 shows cumulative event time return spread between INTRO_q3=1 and INTRO_q3=-1 12 months after portfolio formation split by the day of the month of option introduction. The event time return spread between stocks with new options introduced above and below the prevailing strike prices is slightly larger when using options that are introduced not immediately after the third Friday. This is consistent with the prediction that unexpected option introductions contain more information on the underlying stock than expected option introductions. The results support the argument that informed traders are likely to drive option introductions.

Table B.3 shows the above result in more detail.

5.10.2 Option Maturity Analysis

In this section, I explore whether the maturity of the options that are introduced above the prevailing maximum strike price or below the prevailing minimum strike price are relevant. On the one hand, if informed investors have long-run information on a given stock, they would want to buy long-term options to exploit their information. On the other hand, even when informed investors have long-run information on a given stock, they would want to buy short-term options and rollover over time, because options lose value over time. I choose 100 days to split the options into two samples because it is close to the median option maturity (98 days) at the time of introduction for the entire sample.

Table 16 shows cumulative event time return spread between INTRO_q3=1 and INTRO_q3=-1 12 months after portfolio formation split by using new options with less than 100 days to maturity at the time of the introduction and with more than or equal to 100 days to maturity at the time of the introduction, respectively. In both cases, the cumulative returns are positive and significant. The cumulative returns at 12 months after portfolio formation are 3.73% (t-statistic 3.64) and 4.66% (t-statistic 4.44), respectively. The difference in return does not seem to be large. The stocks introduced with longer maturity options exhibit larger spreads than those with shorter maturity options, supporting that informed investors might be buying long-run options to exploit their long-run information.

This could be due to the fact that when options are introduced, different maturities are introduced at the same time. Alternatively, both of the theories introduced above may be driving the results: investors either buy long-term options or rollover short-term options. Either way, the results point to information content in strike price introductions.

Table B.4 shows the above result in more detail.

5.10.3 Earnings Announcements

In this section, I investigate whether earnings announcement months or days to earnings announcements affect the spread between INTRO_q3=1 and -1. I use quarterly earnings announcement months.

First, if informed traders have information related to earnings announcements, the option introductions is expected to be clustered in earnings announcement months. However, I find that the option introductions are not clustered in earnings announcement months. Recall that are 157 and 294 stocks on average with INTRO_q3=-1 and INTRO_q3=1, respectively (Table 2b). The average number of stocks that have INTRO_q3=-1 and INTRO_q3=1 in the same month of the quarterly earnings announcement dates are only 26 and 45 stocks, respectively. This shows that option introductions are unlikely to be related to information about the quarterly earnings announcement in the same month. But empirical results show that these stocks contain information about future quarterly earnings announcements. Table 16 shows cumulative event time return spread between INTRO_q3=1 and INTRO_q3=-1 12 months after portfolio formation grows up to 8.24% (t-statistic 3.30). Although there are a small number of stocks with option introductions in quarterly earnings announcement months, the option introductions are highly informative of future stock returns. For stocks with INTRO_q3=-1 or 1 not in the same month of quarterly earnings announcements, the return spread of 3.99% (t-statistic 3.95) 12 months after portfolio formation is comparable to the baseline result of 4.11% (4.28).

Second, if the return spread of INTRO_q3=1 and INTRO_q3=-1 is driven by the information in future earnings announcements, the informed traders might want to realize their positions in the near future than the far future. Then, option introductions that happen shortly before future earnings announcements should have larger return spreads than when they happen long before future earnings announcements. I split the stocks into whether it has an earnings announcement within or beyond 45 days from the end of the portfolio formation month. I choose 45 days to equally split the stocks because the interval of each quarterly earnings announcement is around 90 days.

Table 16 shows cumulative event time return spread between INTRO_q3=1 and INTRO_q3=-1 12 months after portfolio formation split by whether the next quarterly earnings announcement is within or beyond 45 days from the end of the portfolio formation month. In both cases, the return spread 12 months after portfolio formation is similar. This at least shows that option introductions do not necessarily contain information about the next quarterly earnings announcement.

Table B.5 shows the above results in more detail.

5.10.4 Stock Borrowing Fees

In this section, I test whether the return spread is explained by stock borrowing fees. Muravyev et al. (2022) show that stock borrowing fees explain a significant portion of stock returns by predicted by options market information. Muravyev et al. (2022) introduce how to accurately estimate stock borrowing fees from implied volatility surfaces of OptionMetrics. Accordingly, stock borrowing fees are estimated with 30-day implied volatility surfaces using delta of 0.50 for calls and -0.50 for puts. This measures the expected borrowing fee over the next 30 days. Formally, the borrowing fees for each stock in each month are calculated as follows:

$$\frac{-(\sigma_C - \sigma_P)}{\sqrt{2\pi(T-t)}}$$

where σ_C (σ_P) is the implied volatility surface of the call (put) options, $T-t$ is the time to maturity that determines the horizon of the expected borrowing fee.

Table 16 shows cumulative event time return spread between INTRO_q3=1 and INTRO_q3=-1 12 months after portfolio formation of double sorted portfolios sorted by INTRO_q3 and estimated borrowing fees (Muravyev et al. (2022)). The event at Month=0 is when the options were introduced. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the whether each stock's estimated borrowing fees are larger than 1%. Stocks with borrowing fees smaller than or equal to 1% (larger than 1%) are classified as easy-to-borrow stocks (hard-to-borrow stocks). Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high borrowing fee groups, respectively.

The results show that even within the stocks that are easy-to-borrow, the return spread between stocks with options introduced above and below the prevailing strike prices are positive and significant. The return spread 12 months after portfolio formation is 4.34% (t-statistic 4.17) for easy-to-borrow stocks and 4.32% (t-statistic 3.66) for hard-to-borrow stocks. This shows evidence that borrowing fees are not likely to be driving the return spread.

Table B.6 shows the above result in more detail.

5.10.5 Subperiod Analysis

In this section, I explore whether the returns are consistent across different subperiods. There has been several research showing that the ability of options market signals to predict stock returns substantially deteriorated after 2008-2009. Bondarenko and Muravyev (2022) show that the predictability of option variables on future stock returns deteriorates after October 2009, after a massive crackdown on insider trading through options.

To address the above issue, I split the portfolio formation months into two subperiods: February 1997 to September 2008 and October 2009 to August 2023. Table 16 cumulative event time return spread between INTRO_q3=1 and INTRO_q3=-1 12 months after portfolio formation in two subperiods based on the portfolio formation month. The results show that the cumulative return spread 12 months after portfolio formation are positive and significant in both sample periods. This implies that the results are less likely due to insider trading in options.

Table B.7 shows the above result in more detail.

6 Conclusion

I propose a novel mechanism where the options market leads the stock market. Exchanges introduce new strike prices for individual stock options not only in response to price changes but to customer demand. If the introductions were passively carried out by the exchanges, no information should be contained in the introductions in addition to the price changes themselves. However, I find that stocks with options introduced above the prevailing maximum strike price outperform those with options introduced below the prevailing minimum strike price for at least 12 months. This result is not explained by standard risk factors including momentum and short-term reversal. I provide suggestive evidence that informed investors with private information are requesting the exchanges to introduce new strike prices for individual stocks so that they increase their leverage at a low cost using deep out-of-the-money options.

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Table 1: Determinants of Strike Price Introductions

This table shows Fama and MacBeth (1973) regressions of indicator variables for strike price introductions on stock and option characteristics following equation 3 and 4. The definition of variables are presented in Section 5.1 for variable definitions. The average adjusted-R^2's ('Avg. Adj. R^2'), average number of stocks ('Avg. N. stocks'), and the number of months ('Months') used are reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. The sample period is 1996-2023.

	Dependent Variable	
variables	$added\_above_t$	$added\_below_t$
$ret\_10d_{i,t}$	0.50	-0.25
	(25.50)	(-21.23)
$ret\_1M_{i,t-1}$	0.34	-0.16
	(25.00)	(-19.54)
$MOM_{i,t-1}$	0.04	-0.01
	(18.74)	(-7.08)
$volume\_10d_{i,t}$	0.01	0.01
	(9.09)	(10.24)
$volume_{i,t-1}$	-51.85	-75.11
	(-10.00)	(-10.43)
$\Delta volume_{i,t-1}$	36.29	29.79
	(8.95)	(8.55)
$option\_volume\_10d_{i,t}$	-0.96	-1.95
	(-3.48)	(-6.85)
$option\_volume_{i,t-1}$	0.05	0.13
	(2.92)	(7.57)
$\Delta option\_volume_{i,t-1}$	-0.06	-0.01
	(-3.81)	(-1.02)
$mcap_{i,t-1}$	-0.35	-0.23
	(-11.68)	(-10.64)
$price_{i,t-1}$	0.41	0.10
	(11.67)	(4.53)
$IVOL_{i,t-1}$	-0.27	-0.33
	(-5.30)	(-5.99)
$turnover_{i,t-1}$	-2.66	3.16
	(-9.04)	(10.31)
$Intercept_{i,t}$	0.07	0.04
	(21.54)	(11.72)
Avg. Adj. R^2	8.1%	4.0%
Avg. N. Stocks	2,172	2,172
Months	330	330

Table 2: Stock Characteristics

This table shows summary statistics of stocks with listed options and average characteristics of the stocks with options introduced above the prevailing maximum strike price and below the prevailing minimum strike price, respectively. The 'n_firms' denotes the average number of firms in each month for the sample period. The average monthly market cap of 10th, 25th, 50th, 75th, and 90th quantile of stocks within stocks with options, all stocks, and NYSE stocks are reported in millions of dollars. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. The 'Avg. N of stocks' reports the average number of stocks for each INTRO_q3=-1, 0, and 1 in each month. The 'ret_mean' reports the average 1-month return. The 'ret_11_lag1_mean' reports the average 11-month return skipping the most recent month. The 'mcap_mean' reports the average market capitalization in millions of dollars. The 'beme' reports the average log book-to-market ratio. The 'ret_ivol_mean' reports the average idiosyncratic volatility estimated by the standard deviation of 1-month daily returns. The '1 - (-1)' is the difference between '1' and '-1' and corresponding t-statistics are reported without clustering. Returns are reported in percentages. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

(a) Sample Summary Statistics

		mcap (MM)				
sample	n_firms	Q10	Q25	Q50	Q75	Q90
stocks with options	2,341	179	436	1,291	4,094	14,080
all stocks	4,835	29	94	404	1,828	7,197
NYSE stocks	1,393	248	697	2,079	6,536	20,731

(b) Portfolio Sorts

	INTRO_q3				
variables	-1	0	1	1 - (-1)	t-stat
Avg. N of stocks	157	1,893	294	-	-
ret_mean (%)	-7.44	0.58	9.21	16.64	(42.92)
ret_11_lag1_mean (%)	6.12	12.12	50.29	44.17	(27.79)
mcap_mean (MM)	4,761	7,426	10,039	5,278	(11.67)
beme_log_mean	-1.09	-0.93	-1.00	0.09	(4.66)
ret_ivol_mean (%)	3.25	2.62	2.67	-0.58	(-11.79)

Table 3: Event Time Returns for INTRO_q3=-1, 1, and spread

This table shows the event time cumulative returns K months after portfolio formation up to 24 months using three groups of INTRO_q3. The event at Month=0 is when the options were introduced. At the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. For INTRO_q3=1 and INTRO_q3=-1, the market return is subtracted. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. The corresponding t-statistics for the '1 - (-1)' are also reported. 'Long-short' uses raw returns whereas 'DGTW (1997)' uses returns excess of the characteristic-based benchmark portfolio (Daniel et al. (1997)). Characteristic-based benchmark portfolios are formed using five sorts of market cap, book-to-market, and momentum, respectively, to get a total of 125 portfolios. The market cap sort uses NYSE breakpoints, the book-to-market sort uses book-to-market excess of the Fama-French 48 industry average book-to-market, and momentum sort uses the past 11 month returns skipping the most recent month. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	INTRO_q3				Long-short		DGTW (1997)	
Month	-1	t-stat	1	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	-0.29	(-1.49)	0.12	(0.85)	0.41	(1.43)	0.08	(0.43)
2	-0.44	(-1.68)	0.26	(1.34)	0.69	(1.82)	0.12	(0.52)
3	-1.03	(-3.45)	0.26	(1.10)	1.29	(2.92)	0.33	(1.18)
4	-1.17	(-3.42)	0.36	(1.22)	1.53	(2.92)	0.44	(1.27)
5	-1.48	(-3.84)	0.46	(1.38)	1.94	(3.27)	0.74	(1.98)
6	-1.71	(-3.93)	0.71	(2.00)	2.41	(3.84)	0.99	(2.43)
7	-2.14	(-4.25)	0.84	(2.20)	2.97	(4.26)	1.42	(3.27)
8	-2.34	(-4.22)	0.98	(2.47)	3.31	(4.44)	1.76	(3.82)
9	-2.68	(-4.52)	1.09	(2.54)	3.77	(4.68)	2.07	(4.15)
10	-2.74	(-4.40)	1.20	(2.67)	3.95	(4.72)	2.17	(4.16)
11	-2.72	(-4.14)	1.37	(2.90)	4.09	(4.62)	2.23	(4.07)
12	-2.84	(-4.03)	1.28	(2.51)	4.11	(4.28)	2.23	(3.84)
13	-3.08	(-4.27)	1.25	(2.35)	4.33	(4.38)	2.34	(3.94)
14	-3.07	(-4.14)	1.35	(2.48)	4.42	(4.38)	2.40	(3.88)
15	-3.12	(-4.15)	1.41	(2.60)	4.54	(4.44)	2.64	(4.17)
16	-3.09	(-4.04)	1.51	(2.79)	4.60	(4.46)	2.68	(4.23)
17	-3.12	(-4.03)	1.57	(2.78)	4.68	(4.43)	2.71	(4.13)
18	-3.24	(-4.06)	1.65	(2.78)	4.89	(4.41)	2.85	(4.18)
19	-3.45	(-4.18)	1.76	(2.86)	5.22	(4.49)	3.05	(4.34)
20	-3.25	(-3.92)	1.79	(2.88)	5.04	(4.33)	2.85	(3.93)
21	-3.05	(-3.62)	1.79	(2.89)	4.84	(4.18)	2.58	(3.47)
22	-3.22	(-3.79)	1.75	(2.80)	4.97	(4.27)	2.47	(3.27)
23	-3.19	(-3.73)	1.78	(2.72)	4.97	(4.15)	2.49	(3.19)
24	-2.86	(-3.22)	1.67	(2.48)	4.53	(3.71)	2.19	(2.69)

Table 4: Event Time Returns for INTRO_q5=-2, -1, 1, 2, and spread

This table shows the event time cumulative returns K months after portfolio formation up to 24 months using five groups of INTRO_q5. The event at Month=0 is when the options were introduced. The portfolio of stocks with new options introduced above the prevailing maximum strike price are split into two groups based on the number of new options: INTRO_q5=2 (above median) and INTRO_q5=1 (below median). The portfolio of stocks with new options introduced below the prevailing minimum strike price are split into two groups based on the number of new options: INTRO_q5=-1 (below median), INTRO_q5=-2 (above median). INTRO_q5=0 represents the rest of the stocks. For INTRO_q5=-2, -1, 1, 2 the market return is subtracted. The '2 - (-2)' is the difference between INTRO_q5=2 and INTRO_q5=-2 and its corresponding t-statistics are reported. 'Long-short' uses raw returns whereas 'DGTW (1997)' uses returns excess of the characteristic-based benchmark portfolio (Daniel et al. (1997)). Characteristic-based benchmark portfolios are formed using five sorts of market cap, book-to-market, and momentum, respectively, to get a total of 125 portfolios. The market cap sort uses NYSE breakpoints, the book-to-market sort uses book-to-market excess of the Fama-French 48 industry average book-to-market, and momentum sort uses the past 11 month returns skipping the most recent month. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	INTRO_q5								Long-short		DGTW (1997)	
Month	-2	t-stat	-1	t-stat	1	t-stat	2	t-stat	2 - (-2)	t-stat	2 - (-2)	t-stat
1	-0.07	(-0.27)	-0.33	(-1.57)	0.07	(0.54)	0.23	(1.25)	0.31	(0.88)	-0.04	(-0.16)
2	-0.36	(-1.09)	-0.38	(-1.35)	0.17	(0.91)	0.34	(1.24)	0.71	(1.48)	0.07	(0.22)
3	-1.16	(-2.88)	-0.80	(-2.45)	0.14	(0.58)	0.37	(1.07)	1.55	(2.62)	0.42	(1.01)
4	-1.61	(-3.57)	-0.65	(-1.71)	0.08	(0.29)	0.60	(1.56)	2.22	(3.38)	0.72	(1.51)
5	-2.28	(-4.38)	-0.83	(-1.94)	0.22	(0.64)	0.65	(1.50)	2.95	(3.94)	1.24	(2.36)
6	-2.61	(-4.41)	-0.92	(-1.94)	0.31	(0.86)	1.14	(2.46)	3.78	(4.69)	1.73	(3.08)
7	-3.22	(-4.87)	-1.11	(-2.04)	0.30	(0.81)	1.21	(2.25)	4.46	(4.96)	2.19	(3.51)
8	-3.40	(-4.76)	-1.36	(-2.27)	0.39	(1.00)	1.38	(2.40)	4.81	(5.02)	2.52	(3.78)
9	-3.81	(-5.06)	-1.58	(-2.44)	0.45	(1.09)	1.60	(2.58)	5.43	(5.30)	2.94	(4.24)
10	-3.89	(-4.91)	-1.60	(-2.39)	0.61	(1.42)	1.67	(2.64)	5.59	(5.32)	2.85	(3.99)
11	-3.64	(-4.25)	-1.67	(-2.37)	0.77	(1.70)	1.88	(2.80)	5.55	(4.93)	2.83	(3.77)
12	-4.01	(-4.49)	-1.62	(-2.16)	0.83	(1.71)	1.80	(2.58)	5.85	(4.95)	2.99	(3.86)
13	-4.07	(-4.43)	-1.96	(-2.57)	1.00	(1.97)	1.65	(2.26)	5.76	(4.74)	2.94	(3.73)
14	-4.29	(-4.47)	-1.76	(-2.23)	1.14	(2.16)	1.79	(2.40)	6.11	(4.93)	3.13	(3.81)
15	-4.14	(-4.33)	-1.97	(-2.39)	1.14	(2.12)	1.87	(2.49)	6.04	(4.85)	3.12	(3.69)
16	-3.96	(-3.97)	-2.01	(-2.42)	1.23	(2.20)	1.88	(2.47)	5.87	(4.54)	2.91	(3.37)
17	-4.01	(-3.91)	-2.10	(-2.44)	1.27	(2.23)	2.08	(2.59)	6.12	(4.53)	3.05	(3.31)
18	-4.18	(-3.91)	-2.10	(-2.37)	1.47	(2.49)	2.01	(2.40)	6.22	(4.38)	3.11	(3.25)
19	-4.29	(-3.89)	-2.24	(-2.49)	1.52	(2.45)	2.07	(2.39)	6.38	(4.35)	3.20	(3.21)
20	-4.27	(-3.77)	-1.99	(-2.18)	1.49	(2.39)	2.30	(2.64)	6.59	(4.39)	3.14	(3.07)
21	-4.08	(-3.52)	-1.92	(-2.10)	1.48	(2.40)	2.36	(2.63)	6.46	(4.30)	2.84	(2.66)
22	-4.37	(-3.74)	-1.94	(-2.06)	1.28	(2.03)	2.46	(2.72)	6.86	(4.51)	3.04	(2.81)
23	-4.04	(-3.45)	-2.13	(-2.23)	1.22	(1.88)	2.51	(2.64)	6.58	(4.20)	2.88	(2.53)
24	-3.82	(-3.20)	-1.85	(-1.87)	1.01	(1.51)	2.43	(2.48)	6.29	(3.90)	2.67	(2.27)

Table 5: Time-series Regressions

This table shows monthly regressions of portfolio returns using 12 month holding horizons on Fama and French (2018) 6-factor returns plus the short-term reversal factor. For the upper half of the table, at the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. For the bottom half of the table, the portfolio of stocks with new options introduced above the prevailing maximum strike price are split into two groups based on the number of new options: INTRO_q5=2 (above median) and INTRO_q5=1 (below median). The portfolio of stocks with new options introduced below the prevailing minimum strike price are split into two groups based on the number of new options: INTRO_q5=-1 (below median), INTRO_q5=-2 (above median). INTRO_q5=0 represents the rest of the stocks. The '2 - (-2)' is the difference between INTRO_q5=2 and INTRO_q5=-2. All portfolios are formed using 12 different portfolios formed in the past 12 months, each held for 12 months. Returns excess of the 1-month T-bill rate ('excess') and alphas of FF6 and FF6+STREV are reported with corresponding t-statistics. The coefficients and t-statistics are reported for each variable for the regression on FF6+STREV. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

INTRO_q3=-1, 0, 1										
INTRO_q3	excess	FF6	FF6+STREV	Mkt_RF	SMB	HML	RMW	CMA	MOM	STREV
-1	0.44	-0.17	-0.19	0.99	0.11	0.02	-0.01	-0.02	-0.21	0.09
	(1.49)	(-2.28)	(-2.57)	(54.37)	(4.46)	(0.79)	(-0.26)	(-0.41)	(-13.39)	(4.20)
0	0.66	-0.02	-0.02	0.99	-0.05	0.03	0.05	0.03	-0.04	0.01
	(2.61)	(-1.13)	(-1.28)	(265.82)	(-8.88)	(5.04)	(7.37)	(2.84)	(-12.64)	(2.58)
1	0.77	0.03	0.04	1.05	0.03	-0.05	-0.02	-0.09	0.22	-0.05
	(2.91)	(0.51)	(0.66)	(67.14)	(1.21)	(-2.04)	(-0.58)	(-2.39)	(16.99)	(-2.60)
1 - (-1)	0.33	0.20	0.23	0.06	-0.09	-0.08	-0.01	-0.07	0.43	-0.13
	(1.95)	(1.78)	(2.06)	(2.00)	(-2.25)	(-1.67)	(-0.15)	(-1.08)	(18.37)	(-4.23)

INTRO_q5=-2, -1, 0, 1, 2										
INTRO_q5	excess	FF6	FF6+STREV	Mkt_RF	SMB	HML	RMW	CMA	MOM	STREV
-2	0.36	-0.25	-0.27	1.02	0.22	-0.01	-0.03	-0.06	-0.26	0.10
	(1.10)	(-2.79)	(-3.10)	(46.67)	(7.24)	(-0.41)	(-0.81)	(-1.19)	(-14.18)	(4.22)
-1	0.54	-0.10	-0.11	0.98	0.10	0.10	0.00	0.02	-0.17	0.06
	(1.87)	(-1.16)	(-1.33)	(47.40)	(3.41)	(3.05)	(0.12)	(0.34)	(-9.93)	(2.73)
0	0.66	-0.02	-0.02	0.99	-0.05	0.03	0.05	0.03	-0.04	0.01
	(2.61)	(-1.13)	(-1.28)	(265.82)	(-8.88)	(5.04)	(7.37)	(2.84)	(-12.64)	(2.58)
1	0.73	0.00	0.00	0.98	0.01	0.03	0.09	-0.03	0.17	-0.03
	(3.05)	(-0.06)	(0.03)	(66.77)	(0.29)	(1.09)	(3.29)	(-0.96)	(13.35)	(-1.63)
2	0.81	0.06	0.07	1.10	0.09	-0.08	-0.10	-0.16	0.27	-0.06
	(2.74)	(0.69)	(0.84)	(50.57)	(2.93)	(-2.21)	(-2.48)	(-3.04)	(14.42)	(-2.51)
2 - (-2)	0.45	0.31	0.35	0.08	-0.13	-0.06	-0.06	-0.10	0.53	-0.16
	(2.22)	(2.31)	(2.64)	(2.44)	(-2.90)	(-1.20)	(-1.11)	(-1.23)	(19.13)	(-4.50)

Table 6: Correlation of INTRO_q3 with Existing Variables

This table shows the correlation between INTRO_q3 with existing variables in the literature. Stock-level variables from stock characteristics include: 1-month return ('ret'), 1-month idiosyncratic volatility ('ret_ivol'), and 11-month return skipping the most recent month ('ret_11_lag1'). Stock-level variables from option characteristics include: 1-month change in call volatility surface (ΔCVOL, An et al. (2014)), 1-month change in put volatility surface (ΔPVOL, An et al. (2014)), 1-month option-to-stock volume ratio (volume_option_to_stock, Johnson and So (2012)), 1-month average implied volatility spread ('vol_spread_vw_mean', Cremers and Weinbaum (2010)), 1-month average SKEW (SKEW_mean, Xing et al. (2010)), 1-month percentage change in call-put open interest ratio (OI_C_P_ratio_1M_diff_pct, Fodor et al. (2011)), out-of-the-money put-call open interest ratio (OTMPC_oi, Kang et al. (2022)), out-of-the-money put-call volume ratio (OTMPC_volume, Kang et al. (2022)), open interest-weighted average moneyness (avg_money_oi, Bergsma et al. (2020)), volume-weighted average moneyness (avg_money_volume, Bergsma et al. (2020)). Details on the variable construction are presented in Appendix A. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. The sample period is 1996-2023.

variables	INTRO_q3	INTRO_q5
ret	0.25	0.27
ret_ivol	-0.08	-0.07
ret_11_lag1	0.16	0.17
ΔCVOL	-0.04	-0.04
ΔPVOL	-0.04	-0.04
volume_option_to_stock	0.03	0.03
vol_spread_vw_mean	-0.06	-0.06
SKEW_mean	-0.01	-0.02
OI_C_P_ratio_1M_diff_pct	0.00	0.00
OTMPC_volume	0.10	0.10
OTMPC_oi	0.07	0.08
avg_money_volume	-0.09	-0.09
avg_money_oi	-0.13	-0.14

Table 7: Fama-MacBeth Regressions

This table shows Fama and MacBeth (1973) regressions of 1-month and 12-month returns, respectively, on INTRO_q3 and stock characteristics. Each month, future 1-month (or future 12-month average return) are regressed on INTRO_q3 and characteristics in the cross-section. Then, the average coefficients of each cross-sectional regression is reported with their corresponding t-statistics across the time-series. When using 12-month returns as the dependent variable, t-statistics are calculated using Newey and West (1987) standard errors with 12 lags. Stock-level variables from stock characteristics include: 1-month return ('ret'), 1-month idiosyncratic volatility ('ret_ivol'), and 11-month return skipping the most recent month ('ret_11_lag1'). Stock-level variables from option characteristics include: 1-month change in call volatility surface (ΔCVOL, An et al. (2014)), 1-month change in put volatility surface (ΔPVOL, An et al. (2014)), 1-month option-to-stock volume ratio (volume_option_to_stock, Johnson and So (2012)), 1-month average implied volatility spread ('vol_spread_vw_mean', Cremers and Weinbaum (2010)), 1-month average SKEW (SKEW_mean, Xing et al. (2010)), 1-month percentage change in call-put open interest ratio (OI_C_P_ratio_1M_diff_pct, Fodor et al. (2011)), out-of-the-money put-call open interest ratio (OTMPC_oi, Kang et al. (2022)), out-of-the-money put-call volume ratio (OTMPC_volume, Kang et al. (2022)), open interest-weighted average moneyness (avg_money_oi, Bergsma et al. (2020)), volume-weighted average moneyness (avg_money_volume, Bergsma et al. (2020)). Details on the variable construction are presented in Appendix A. Variables that are not in percentage changes are standardized by subtracting its cross-sectional average and dividing by its cross-sectional standard deviation. If variables are not available for a given stock, 0 is assigned to preserve the sample size. The average adjusted-R^2's ('Avg. Adj. R^2'), average number of stocks ('Avg. N. stocks'), and the number of months ('Months') used are reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. The sample period is 1996-2023.

variables	Stocks with options					
		ret 1M			ret 12M	
INTRO_q3	0.18	0.05	0.02	0.12	0.11	0.10
	(1.16)	(0.54)	(0.30)	(1.68)	(2.53)	(2.39)
ret_z		-0.22	-0.21		-0.02	-0.01
		(-2.72)	(-2.76)		(-0.47)	(-0.37)
mcap_log		-0.06	-0.06		-0.02	-0.02
		(-1.26)	(-1.19)		(-0.35)	(-0.28)
beme_log		0.06	0.06		0.09	0.09
		(0.83)	(0.76)		(0.61)	(0.61)
ret_11_lag1_z		0.15	0.15		-0.08	-0.07
		(1.51)	(1.60)		(-0.85)	(-0.84)
ret_ivol_z		-0.29	-0.28		-0.05	-0.06
		(-2.70)	(-2.77)		(-0.40)	(-0.50)
ΔCVOL_z			0.19			0.01
			(5.44)			(1.88)
ΔPVOL_z			-0.22			-0.02
			(-6.71)			(-3.25)
volume_option_to_stock_z			-0.12			-0.03
			(-3.36)			(-1.10)
vol_spread_vw_mean_z			0.07			0.08
			(1.87)			(2.45)
SKEW_mean_z			-0.02			-0.03
			(-0.80)			(-1.31)
OI_C_P_ratio_1M_diff_pct			0.03			0.01
			(2.10)			(1.54)
OTMPC_oi_z			-0.02			-0.01
			(-0.66)			(-1.10)
OTMPC_volume_z			-0.02			0.04
			(-0.60)			(1.93)
avg_money_oi_z			-0.14			-0.02
			(-1.68)			(-0.53)
avg_money_volume_z			0.14			0.03
			(1.83)			(1.01)
(Intercept)	0.85	1.78	1.70	0.92	1.70	1.24
	(2.38)	(2.03)	(1.97)	(1.79)	(1.97)	(0.92)
Avg. Adj. R^2	0.5%	5.8%	6.5%	0.3%	6.6%	7.4%
Avg. N. stocks	2190	2190	2190	2055	2055	2055
Months	330	330	330	323	323	323

Table 8: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by 1-month Return

This table shows event time portfolio returns K months after portfolio formation of double sorted portfolios sorted by INTRO_q3 and past 1-month return. The event at Month=0 is when the options were introduced. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the median past 1-month return: low and high. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high past 1-month return groups, respectively. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	INTRO_q3=-1				INTRO_q3=1				spread			
	low ret 1M		high ret 1M		low ret 1M		high ret 1M		low ret 1M		high ret 1M	
Month	-1	t-stat	-1	t-stat	1	t-stat	1	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	-0.30	(-0.98)	-0.35	(-1.89)	0.15	(1.03)	0.12	(0.54)	0.45	(1.18)	0.47	(1.48)
2	-0.88	(-2.27)	-0.20	(-0.72)	0.02	(0.10)	0.56	(1.86)	0.90	(1.85)	0.77	(1.64)
3	-1.70	(-3.67)	-0.64	(-1.94)	0.16	(0.59)	0.42	(1.13)	1.87	(3.16)	1.06	(1.95)
4	-1.96	(-3.57)	-0.69	(-1.88)	0.33	(0.96)	0.42	(0.94)	2.29	(3.30)	1.10	(1.75)
5	-2.68	(-4.35)	-0.98	(-2.49)	0.56	(1.55)	0.37	(0.75)	3.24	(4.16)	1.34	(1.94)
6	-3.27	(-4.65)	-1.03	(-2.42)	0.67	(1.80)	0.81	(1.55)	3.93	(4.64)	1.84	(2.50)
7	-3.94	(-5.09)	-1.33	(-2.73)	0.73	(1.84)	1.03	(1.84)	4.67	(5.07)	2.36	(2.96)
8	-4.23	(-5.17)	-1.55	(-2.82)	0.70	(1.68)	1.25	(2.07)	4.93	(5.11)	2.80	(3.23)
9	-4.60	(-5.36)	-1.87	(-3.11)	0.85	(1.98)	1.47	(2.20)	5.45	(5.47)	3.33	(3.47)
10	-4.81	(-5.23)	-1.91	(-3.01)	1.04	(2.25)	1.49	(2.22)	5.85	(5.60)	3.41	(3.48)
11	-5.05	(-5.07)	-1.83	(-2.70)	1.01	(2.03)	1.88	(2.68)	6.06	(5.24)	3.70	(3.61)
12	-5.40	(-5.09)	-1.72	(-2.39)	0.84	(1.59)	1.93	(2.59)	6.24	(5.00)	3.65	(3.31)
13	-5.25	(-4.71)	-2.03	(-2.76)	1.05	(1.88)	1.60	(2.09)	6.31	(4.84)	3.63	(3.17)
14	-5.08	(-4.33)	-2.09	(-2.78)	1.27	(2.23)	1.71	(2.21)	6.35	(4.70)	3.81	(3.27)
15	-5.06	(-4.09)	-2.13	(-2.77)	1.15	(1.97)	1.98	(2.40)	6.21	(4.38)	4.11	(3.40)
16	-5.31	(-4.37)	-1.98	(-2.47)	1.33	(2.17)	1.89	(2.30)	6.64	(4.76)	3.86	(3.16)
17	-5.40	(-4.20)	-2.02	(-2.46)	1.45	(2.32)	1.84	(2.15)	6.84	(4.69)	3.85	(3.06)
18	-5.61	(-4.28)	-2.13	(-2.55)	1.49	(2.25)	1.95	(2.21)	7.10	(4.72)	4.07	(3.15)
19	-5.83	(-4.29)	-2.17	(-2.53)	1.58	(2.32)	2.09	(2.33)	7.42	(4.69)	4.26	(3.22)
20	-5.56	(-4.10)	-1.93	(-2.25)	1.52	(2.22)	2.23	(2.44)	7.08	(4.50)	4.16	(3.09)
21	-5.45	(-3.87)	-1.63	(-1.90)	1.49	(2.20)	2.25	(2.40)	6.95	(4.30)	3.89	(2.87)
22	-5.75	(-3.96)	-1.62	(-1.85)	1.49	(2.14)	2.16	(2.27)	7.24	(4.36)	3.78	(2.78)
23	-5.72	(-3.89)	-1.61	(-1.80)	1.50	(2.09)	2.22	(2.28)	7.22	(4.27)	3.83	(2.78)
24	-5.46	(-3.71)	-1.27	(-1.35)	1.31	(1.80)	2.27	(2.26)	6.77	(3.98)	3.55	(2.50)

Table 9: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by Momentum

This table shows event time portfolio returns K months after portfolio formation of double sorted portfolios sorted by INTRO_q3 and momentum. The event at Month=0 is when the options were introduced. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the median past 11-month return skipping the most recent month (momentum): low and high. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high momentum groups, respectively. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	INTRO_q3=-1				INTRO_q3=1				spread			
	low MOM		high MOM		low MOM		high MOM		low MOM		high MOM	
Month	-1	t-stat	-1	t-stat	1	t-stat	1	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	-0.44	(-1.46)	-0.09	(-0.48)	-0.10	(-0.76)	0.28	(1.31)	0.34	(0.95)	0.38	(1.18)
2	-0.89	(-2.18)	0.04	(0.15)	-0.12	(-0.65)	0.46	(1.47)	0.77	(1.58)	0.42	(0.96)
3	-1.65	(-3.40)	-0.31	(-0.95)	-0.16	(-0.66)	0.43	(1.12)	1.49	(2.60)	0.74	(1.38)
4	-1.77	(-3.19)	-0.22	(-0.61)	-0.28	(-0.90)	0.67	(1.42)	1.49	(2.23)	0.89	(1.43)
5	-2.72	(-4.26)	-0.22	(-0.56)	-0.32	(-0.92)	0.77	(1.44)	2.40	(3.15)	0.99	(1.39)
6	-2.84	(-4.07)	-0.51	(-1.12)	-0.28	(-0.79)	1.06	(1.77)	2.55	(3.16)	1.57	(2.01)
7	-3.32	(-4.15)	-0.77	(-1.49)	-0.22	(-0.60)	1.25	(1.98)	3.10	(3.39)	2.02	(2.39)
8	-3.53	(-4.05)	-0.81	(-1.44)	-0.05	(-0.13)	1.37	(2.07)	3.48	(3.51)	2.17	(2.40)
9	-4.11	(-4.56)	-0.79	(-1.26)	-0.02	(-0.05)	1.60	(2.34)	4.09	(3.93)	2.39	(2.46)
10	-4.26	(-4.51)	-0.66	(-1.01)	0.03	(0.07)	1.73	(2.43)	4.30	(3.96)	2.39	(2.39)
11	-4.09	(-4.11)	-0.60	(-0.87)	0.16	(0.32)	1.89	(2.49)	4.25	(3.64)	2.49	(2.37)
12	-3.95	(-3.83)	-0.74	(-1.00)	0.04	(0.07)	1.78	(2.26)	3.98	(3.25)	2.51	(2.25)
13	-3.93	(-3.68)	-0.97	(-1.28)	0.01	(0.02)	1.77	(2.21)	3.95	(3.13)	2.74	(2.38)
14	-3.83	(-3.44)	-0.94	(-1.22)	0.13	(0.23)	1.90	(2.34)	3.96	(3.01)	2.85	(2.41)
15	-3.83	(-3.37)	-1.00	(-1.24)	0.20	(0.34)	2.05	(2.49)	4.03	(2.98)	3.04	(2.51)
16	-3.66	(-3.12)	-0.95	(-1.18)	0.28	(0.46)	2.17	(2.66)	3.95	(2.82)	3.11	(2.57)
17	-3.40	(-2.79)	-1.17	(-1.45)	0.39	(0.63)	2.30	(2.73)	3.79	(2.64)	3.46	(2.77)
18	-3.28	(-2.60)	-1.30	(-1.56)	0.59	(0.91)	2.27	(2.57)	3.87	(2.62)	3.57	(2.70)
19	-3.18	(-2.48)	-1.41	(-1.66)	0.85	(1.25)	2.36	(2.65)	4.03	(2.65)	3.77	(2.76)
20	-2.79	(-2.12)	-1.35	(-1.59)	0.88	(1.30)	2.45	(2.67)	3.67	(2.39)	3.81	(2.74)
21	-2.38	(-1.83)	-1.28	(-1.48)	0.93	(1.37)	2.48	(2.65)	3.31	(2.20)	3.75	(2.70)
22	-2.48	(-1.84)	-1.49	(-1.71)	0.87	(1.26)	2.44	(2.56)	3.35	(2.16)	3.93	(2.81)
23	-2.29	(-1.69)	-1.35	(-1.53)	1.02	(1.44)	2.40	(2.41)	3.31	(2.12)	3.74	(2.60)
24	-2.10	(-1.53)	-0.91	(-0.99)	0.95	(1.26)	2.30	(2.27)	3.04	(1.91)	3.21	(2.19)

Table 10: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by IVOL

This table shows event time portfolio returns K months after portfolio formation of double sorted portfolios sorted by INTRO_q3 and idiosyncratic volatility (IVOL). The event at Month=0 is when the options were introduced. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the median IVOL in the past month: low and high. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high IVOL groups, respectively. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	INTRO_q3=-1				INTRO_q3=1				spread			
	low IVOL		high IVOL		low IVOL		high IVOL		low IVOL		high IVOL	
Month	-1	t-stat	-1	t-stat	1	t-stat	1	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	-0.05	(-0.24)	-0.88	(-2.41)	0.05	(0.36)	0.35	(1.29)	0.10	(0.35)	1.24	(2.80)
2	-0.14	(-0.55)	-1.44	(-2.72)	0.24	(1.19)	0.53	(1.36)	0.38	(1.02)	1.97	(3.15)
3	-0.52	(-1.72)	-2.69	(-4.37)	0.29	(1.31)	0.47	(0.86)	0.81	(1.99)	3.16	(4.00)
4	-0.40	(-1.11)	-3.46	(-5.24)	0.44	(1.64)	0.62	(0.97)	0.84	(1.72)	4.09	(4.55)
5	-0.56	(-1.38)	-4.62	(-6.22)	0.56	(1.85)	0.88	(1.20)	1.13	(2.02)	5.49	(5.42)
6	-0.62	(-1.35)	-5.38	(-6.49)	0.71	(2.15)	1.67	(2.12)	1.33	(2.21)	7.05	(6.69)
7	-1.06	(-2.09)	-5.82	(-6.24)	0.77	(2.14)	2.04	(2.42)	1.83	(2.73)	7.87	(6.93)
8	-1.21	(-2.17)	-5.95	(-5.86)	0.92	(2.42)	2.23	(2.56)	2.13	(2.94)	8.18	(7.02)
9	-1.42	(-2.36)	-6.83	(-6.29)	0.99	(2.34)	2.42	(2.61)	2.40	(3.08)	9.25	(7.33)
10	-1.33	(-2.12)	-7.14	(-6.32)	1.15	(2.59)	2.35	(2.46)	2.48	(3.03)	9.49	(7.40)
11	-1.24	(-1.90)	-7.22	(-5.85)	1.31	(2.77)	2.53	(2.53)	2.55	(2.94)	9.75	(7.07)
12	-1.34	(-1.92)	-7.21	(-5.53)	1.24	(2.49)	2.47	(2.36)	2.58	(2.76)	9.69	(6.67)
13	-1.72	(-2.38)	-6.94	(-5.04)	1.22	(2.35)	2.44	(2.19)	2.94	(3.04)	9.38	(6.27)
14	-1.75	(-2.30)	-6.94	(-4.86)	1.30	(2.42)	2.65	(2.33)	3.05	(3.04)	9.58	(6.24)
15	-1.70	(-2.17)	-7.12	(-4.77)	1.30	(2.36)	3.08	(2.64)	3.01	(2.91)	10.19	(6.64)
16	-1.55	(-1.95)	-7.43	(-4.94)	1.46	(2.62)	2.98	(2.56)	3.01	(2.88)	10.42	(6.66)
17	-1.68	(-2.11)	-7.29	(-4.61)	1.52	(2.63)	3.14	(2.63)	3.19	(3.00)	10.43	(6.42)
18	-1.80	(-2.20)	-7.35	(-4.62)	1.65	(2.73)	3.07	(2.55)	3.45	(3.08)	10.42	(6.25)
19	-2.14	(-2.52)	-6.82	(-4.16)	1.81	(2.92)	2.99	(2.46)	3.95	(3.37)	9.81	(5.72)
20	-1.91	(-2.26)	-6.99	(-4.13)	1.75	(2.78)	3.35	(2.69)	3.66	(3.12)	10.33	(5.86)
21	-1.70	(-1.98)	-6.84	(-3.95)	1.74	(2.81)	3.31	(2.58)	3.44	(2.94)	10.15	(5.70)
22	-1.91	(-2.22)	-6.73	(-3.76)	1.69	(2.68)	3.25	(2.51)	3.60	(3.08)	9.98	(5.42)
23	-1.94	(-2.20)	-6.53	(-3.61)	1.76	(2.69)	3.11	(2.36)	3.70	(3.08)	9.64	(5.06)
24	-1.48	(-1.60)	-6.36	(-3.51)	1.64	(2.42)	2.97	(2.23)	3.11	(2.50)	9.33	(4.84)

Table 11: Event Time Open Interest of New Options

This table shows open interest scaled by shares outstanding K months after option introduction. The event at Month=0 is when the options were introduced. First, scaled open interest is equal-weighted at the stock-month level across all call and put options, respectively. Second, the average scaled open interest is value-weighted each month across the stocks. Finally, this is averaged across all months in the sample period for INTRO_q3=1 and INTRO_q3=-1, respectively. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. The sample period is 1996-2023.

	INTRO_q3=-1				INTRO_q3=1			
Month	call	put	call-put	t-stat	call	put	call-put	t-stat
0	0.19	0.29	-0.10	(-4.76)	0.37	0.06	0.31	(16.28)
1	0.26	0.39	-0.14	(-6.39)	0.70	0.15	0.55	(20.24)
2	0.20	0.37	-0.17	(-9.34)	0.69	0.15	0.54	(19.16)
3	0.21	0.40	-0.19	(-10.39)	0.75	0.18	0.57	(19.10)
4	0.21	0.42	-0.21	(-10.77)	0.77	0.21	0.56	(19.17)
5	0.21	0.41	-0.21	(-10.04)	0.74	0.22	0.52	(18.53)
6	0.19	0.41	-0.21	(-9.51)	0.69	0.23	0.47	(17.07)
7	0.17	0.36	-0.19	(-9.16)	0.61	0.20	0.41	(12.07)
8	0.08	0.24	-0.16	(-8.36)	0.49	0.15	0.34	(10.92)
9	0.09	0.25	-0.16	(-8.16)	0.48	0.15	0.32	(11.47)
10	0.08	0.23	-0.15	(-8.33)	0.46	0.16	0.30	(11.99)
11	0.08	0.22	-0.14	(-8.41)	0.45	0.16	0.28	(13.92)
12	0.08	0.22	-0.14	(-8.42)	0.43	0.17	0.26	(14.20)

Table 12: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by ITI

This table shows event time portfolio returns K months after portfolio formation of double sorted portfolios sorted by INTRO_q3 and past informed trading intensity (ITI, Bogousslavsky et al. (2024)). The event at Month=0 is when the options were introduced. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the median of past month's daily average ITI: low and high. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high past ITI groups, respectively. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2019.

	INTRO_q3=-1				INTRO_q3=1				spread			
	low ITI		high ITI		low ITI		high ITI		low ITI		high ITI	
Month	-1	t-stat	-1	t-stat	1	t-stat	1	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	-0.21	(-0.93)	-0.10	(-0.42)	0.21	(1.17)	0.12	(0.73)	0.42	(1.28)	0.22	(0.65)
2	0.02	(0.06)	-0.33	(-1.02)	0.32	(1.23)	0.19	(0.89)	0.30	(0.67)	0.52	(1.17)
3	-0.26	(-0.74)	-0.81	(-2.09)	0.41	(1.41)	0.14	(0.45)	0.68	(1.39)	0.94	(1.73)
4	-0.12	(-0.29)	-1.24	(-2.90)	0.56	(1.69)	0.19	(0.48)	0.68	(1.19)	1.43	(2.23)
5	-0.28	(-0.55)	-1.93	(-4.03)	0.70	(1.88)	0.27	(0.58)	0.98	(1.44)	2.20	(2.94)
6	-0.41	(-0.74)	-2.16	(-3.98)	0.88	(2.18)	0.65	(1.40)	1.29	(1.77)	2.81	(3.65)
7	-0.67	(-1.15)	-2.70	(-4.30)	0.94	(2.04)	0.85	(1.88)	1.61	(2.05)	3.55	(4.34)
8	-0.74	(-1.19)	-2.80	(-4.06)	1.09	(2.22)	1.05	(2.30)	1.83	(2.16)	3.85	(4.41)
9	-0.81	(-1.19)	-3.14	(-4.27)	1.20	(2.29)	1.16	(2.33)	2.01	(2.20)	4.30	(4.57)
10	-0.76	(-1.03)	-3.15	(-4.21)	1.33	(2.46)	1.17	(2.26)	2.09	(2.18)	4.33	(4.50)
11	-0.55	(-0.70)	-3.19	(-4.11)	1.43	(2.61)	1.35	(2.45)	1.98	(1.98)	4.55	(4.43)
12	-0.59	(-0.72)	-3.36	(-4.03)	1.47	(2.59)	1.10	(1.86)	2.06	(1.93)	4.46	(4.03)
13	-0.73	(-0.86)	-3.72	(-4.24)	1.55	(2.58)	1.04	(1.75)	2.28	(2.03)	4.76	(4.18)
14	-0.68	(-0.75)	-3.66	(-4.09)	1.70	(2.73)	1.05	(1.70)	2.38	(2.00)	4.71	(4.04)
15	-0.54	(-0.57)	-4.01	(-4.46)	1.81	(2.89)	1.07	(1.79)	2.35	(1.92)	5.08	(4.40)
16	-0.51	(-0.54)	-3.88	(-4.20)	1.95	(3.11)	1.10	(1.82)	2.46	(2.02)	4.98	(4.20)
17	-0.35	(-0.36)	-4.02	(-4.22)	1.93	(2.99)	1.25	(1.98)	2.28	(1.84)	5.26	(4.25)
18	-0.50	(-0.51)	-4.16	(-4.23)	1.87	(2.74)	1.43	(2.17)	2.38	(1.85)	5.59	(4.35)
19	-0.60	(-0.60)	-4.15	(-4.09)	1.82	(2.57)	1.59	(2.37)	2.42	(1.83)	5.74	(4.36)
20	-0.50	(-0.50)	-3.92	(-3.78)	1.81	(2.64)	1.68	(2.47)	2.32	(1.75)	5.59	(4.16)
21	-0.31	(-0.30)	-3.67	(-3.49)	1.69	(2.52)	1.74	(2.49)	2.01	(1.52)	5.41	(4.00)
22	-0.31	(-0.30)	-3.91	(-3.66)	1.85	(2.71)	1.49	(2.08)	2.16	(1.62)	5.40	(3.88)
23	-0.35	(-0.33)	-3.82	(-3.59)	1.97	(2.81)	1.26	(1.66)	2.32	(1.70)	5.09	(3.55)
24	0.12	(0.11)	-3.71	(-3.41)	1.92	(2.63)	1.13	(1.47)	1.81	(1.26)	4.84	(3.36)

Table 13: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by O/S ratio

This table shows event time portfolio returns K months after portfolio formation of double sorted portfolios sorted by INTRO_q3 and past option-to-stock volume (O/S ratio, Johnson and So (2012)). The event at Month=0 is when the options were introduced. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the median of past month's O/S ratio: low and high. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high past O/S ratio groups, respectively. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	INTRO_q3=-1				INTRO_q3=1				spread			
	low O/S		high O/S		low O/S		high O/S		low O/S		high O/S	
Month	-1	t-stat	-1	t-stat	1	t-stat	1	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	0.18	(0.79)	-0.44	(-1.72)	0.00	(-0.03)	0.21	(1.22)	-0.11	(-0.32)	0.41	(0.90)
2	0.27	(0.89)	-0.54	(-1.58)	0.14	(0.66)	0.37	(1.56)	0.19	(0.44)	1.37	(2.28)
3	-0.22	(-0.62)	-1.28	(-3.09)	0.32	(1.09)	0.39	(1.42)	0.83	(1.50)	1.95	(2.60)
4	-0.13	(-0.33)	-1.67	(-3.56)	0.33	(0.89)	0.55	(1.62)	0.84	(1.44)	2.14	(2.47)
5	-0.66	(-1.50)	-1.99	(-3.85)	0.39	(0.95)	0.68	(1.73)	1.15	(1.83)	2.09	(2.17)
6	-0.70	(-1.41)	-2.21	(-3.76)	0.67	(1.55)	0.94	(2.21)	0.89	(1.26)	2.68	(2.59)
7	-1.01	(-1.84)	-2.79	(-4.08)	0.62	(1.50)	1.16	(2.49)	1.31	(1.69)	3.46	(3.02)
8	-1.06	(-1.80)	-3.02	(-4.08)	0.92	(2.16)	1.27	(2.61)	1.62	(1.93)	3.92	(3.14)
9	-1.43	(-2.21)	-3.45	(-4.45)	0.90	(1.98)	1.41	(2.67)	2.24	(2.31)	4.68	(3.57)
10	-1.68	(-2.42)	-3.39	(-4.17)	1.15	(2.48)	1.44	(2.56)	3.18	(3.12)	4.75	(3.45)
11	-1.60	(-2.13)	-3.46	(-3.97)	1.33	(2.78)	1.60	(2.69)	3.03	(2.72)	5.39	(3.67)
12	-1.51	(-1.88)	-3.71	(-3.99)	1.50	(2.92)	1.39	(2.20)	3.26	(2.77)	5.56	(3.66)
13	-1.60	(-1.86)	-3.93	(-4.11)	1.63	(3.07)	1.30	(1.96)	3.55	(2.97)	5.56	(3.53)
14	-1.38	(-1.54)	-3.93	(-4.01)	1.68	(3.04)	1.46	(2.15)	3.59	(2.94)	5.74	(3.65)
15	-1.17	(-1.22)	-4.15	(-4.13)	1.77	(3.33)	1.48	(2.15)	3.57	(2.89)	5.66	(3.52)
16	-1.20	(-1.31)	-4.22	(-4.06)	1.86	(3.35)	1.58	(2.29)	3.87	(3.20)	6.34	(3.88)
17	-1.02	(-1.04)	-4.20	(-4.06)	1.94	(3.39)	1.59	(2.20)	4.26	(3.41)	6.60	(3.98)
18	-1.02	(-1.03)	-4.44	(-4.16)	2.07	(3.50)	1.62	(2.11)	4.34	(3.36)	7.06	(4.07)
19	-1.00	(-0.95)	-4.76	(-4.38)	2.12	(3.45)	1.76	(2.23)	4.51	(3.21)	7.33	(4.10)
20	-0.97	(-0.91)	-4.47	(-4.09)	2.22	(3.58)	1.74	(2.16)	4.53	(3.25)	7.18	(3.93)
21	-0.44	(-0.38)	-4.33	(-3.93)	2.19	(3.46)	1.76	(2.16)	4.34	(3.05)	7.27	(3.90)
22	-0.48	(-0.41)	-4.67	(-4.10)	2.06	(3.17)	1.74	(2.11)	5.05	(3.53)	7.67	(4.02)
23	-0.44	(-0.38)	-4.72	(-4.06)	1.99	(3.03)	1.81	(2.12)	5.45	(3.73)	8.09	(3.99)
24	-0.44	(-0.36)	-4.34	(-3.60)	1.88	(2.82)	1.66	(1.89)	5.23	(3.38)	7.42	(3.60)

Table 14: Earnings Forecast Errors

This table shows the earnings forecast errors for the portfolios sorted by INTRO_q3. At the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. The average earnings forecast errors are reported in percentages along with corresponding t-statistics for portfolios of INTRO_q3=1, INTRO_q3=-1, and the spread ('1 - (-1)') using stocks that have annual earnings announcements within 30, 90, 180, and 365 days after portfolio formation. Earnings forecast errors are defined as $(ActualEPS_{t+\tau}$ - $ForecastedEPS_{t-1})/Price_{t-1}$ for each stock where portfolios are formed from the beginning of month t. A positive (negative) forecast error is consistent with analysts underreacting to positive (negative) information. The actual EPS forecasts are from the next annual earnings announcement in some month (τ = 0,1,2,...,11) after portfolio formation. The EPS forecasts are from the latest median estimate as of the portfolio formation month $t-1$. The stock-level earnings forecast errors are value-weighted up to the portfolio level, then averaged across the sample period. The earnings forecast errors are winsorized at the 1% and 99% level in each month. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. The sample period is 1996-2023.

	INTRO_q3			INTRO_q5		
Days	-1	1	1 - (-1)	-2	2	2 - (-2)
30	-1.47	-1.01	0.46	-0.11	-0.16	-0.05
	(-0.98)	(-1.42)	(0.28)	(-0.44)	(-0.13)	(-0.04)
90	-1.80	-0.05	1.75	-0.35	0.06	0.41
	(-1.40)	(-0.78)	(1.36)	(-0.87)	(0.27)	(0.88)
180	-1.01	-0.04	0.97	-1.43	-0.07	1.36
	(-4.89)	(-0.65)	(4.56)	(-4.01)	(-0.56)	(3.75)
365	-2.59	0.00	2.59	-4.39	0.00	4.39
	(-3.94)	(0.04)	(3.92)	(-2.65)	(0.03)	(2.65)

Table 15: Event Time Returns for DELIST_q3=-1, 1

This table shows event time portfolio returns K months after portfolio formation sorted by DELIST_q3 and INTRO_q3. The event at Month=0 is when the options were delisted or introduced. At the end of each month, stocks are divided into three groups: DELIST_q3=-1, 0, and 1. DELIST_q3=1 represents a portfolio of stocks with options delisted above the prevailing maximum strike price, DELIST_q3=-1 represents a portfolio of stocks with options delisted below the prevailing minimum strike price, and DELIST_q3=0 represents the rest of the stocks. The '1d - (-1d)' is the difference between DELIST_q3=1 and DELIST_q3=-1. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. The corresponding t-statistics for the '1d - (-1d)' and '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	baseline		delist		delist w/o intro	
Month	1 - (-1)	t-stat	1d - (-1d)	t-stat	1d - (-1d)	t-stat
1	0.41	(1.43)	0.08	(0.43)	0.09	(0.43)
2	0.69	(1.82)	-0.03	(-0.12)	-0.05	(-0.16)
3	1.29	(2.92)	-0.29	(-0.86)	-0.24	(-0.71)
4	1.53	(2.92)	-0.37	(-0.94)	-0.29	(-0.71)
5	1.94	(3.27)	-0.35	(-0.78)	-0.05	(-0.11)
6	2.41	(3.84)	-0.62	(-1.33)	-0.13	(-0.27)
7	2.97	(4.26)	-0.69	(-1.35)	-0.05	(-0.10)
8	3.31	(4.44)	-0.82	(-1.47)	-0.19	(-0.33)
9	3.77	(4.68)	-0.98	(-1.64)	-0.40	(-0.63)
10	3.95	(4.72)	-1.01	(-1.62)	-0.59	(-0.89)
11	4.09	(4.62)	-0.78	(-1.14)	-0.24	(-0.33)
12	4.11	(4.28)	-1.04	(-1.43)	-0.44	(-0.58)
13	4.33	(4.38)	-1.14	(-1.50)	-0.54	(-0.67)
14	4.42	(4.38)	-1.08	(-1.37)	-0.46	(-0.55)
15	4.54	(4.44)	-1.26	(-1.56)	-0.69	(-0.77)
16	4.60	(4.46)	-1.46	(-1.72)	-1.07	(-1.16)
17	4.68	(4.43)	-1.72	(-2.00)	-1.36	(-1.45)
18	4.89	(4.41)	-2.15	(-2.45)	-1.80	(-1.90)
19	5.22	(4.49)	-2.13	(-2.37)	-1.87	(-1.90)
20	5.04	(4.33)	-2.09	(-2.30)	-1.80	(-1.81)
21	4.84	(4.18)	-2.10	(-2.27)	-1.80	(-1.76)
22	4.97	(4.27)	-2.10	(-2.22)	-1.65	(-1.58)
23	4.97	(4.15)	-1.55	(-1.63)	-1.05	(-1.00)
24	4.53	(3.71)	-1.32	(-1.34)	-0.90	(-0.84)

Table 16: Robustness Tests

This table shows cumulative event time return spread between INTRO_q3=1 and INTRO_q3=-1 12 months after portfolio formation split by stock and option characteristics. At the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. Each specification uses stock or option characteristics to split the sample in the cross-section. Details of each specification are presented in Section 5.10. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. The '1 - (-1)' is the cumulative event time return spread between INTRO_q3=1 and INTRO_q3=-1 12 months after portfolio formation. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	Month 12	
Variables	1 - (-1)	t-stat
Day of the month of option introduction		
After 3rd Friday	4.27	(3.38)
All other days	5.29	(4.98)
Maturity		
less than 100 days	3.73	(3.64)
more than or equal to 100 days	4.66	(4.44)
Introductions in earnings or non-earnings months		
Earnings month	8.24	(3.30)
Non-earnings month	3.99	(3.95)
Days to next earnings announcement		
less than or equal to 45 days	3.96	(2.93)
more than 45 days	4.21	(3.50)
Estimated Borrowing fees		
Easy-to-borrow stocks (fee <= 1%)	4.34	(4.17)
Hard-to-borrow stocks (fee > 1%)	4.32	(3.66)
Subperiod analysis		
1996-2009	4.15	(2.80)
2009-2023	4.07	(3.36)

Firm A

	2022-02-28	2022-03-31
Stock Price	46	56.2

INTRO_q3 = 1

Strike price	Strike price
	80
	75
70	70
65	65
60	60
...	...

Firm B

	2022-02-28	2022-03-31
Stock Price	28.1	28.8

INTRO_q3 = -1

Strike price	Strike price
...	...
22.5	22.5
20	20
17.5	17.5
15	15
	12.5

Figure 1: Examples of Strike Price Introductions

This figure shows two firms with different values of INTRO_q3. For Firm A, strike prices were introduced above the prevailing maximum strike price. For Firm B, strike price were introduced below the prevailing minimum strike price. Both examples are from the end of February 2022 to the end of March 2022. Each firm's stock prices and INTRO_q3 variable are shown in the figure.

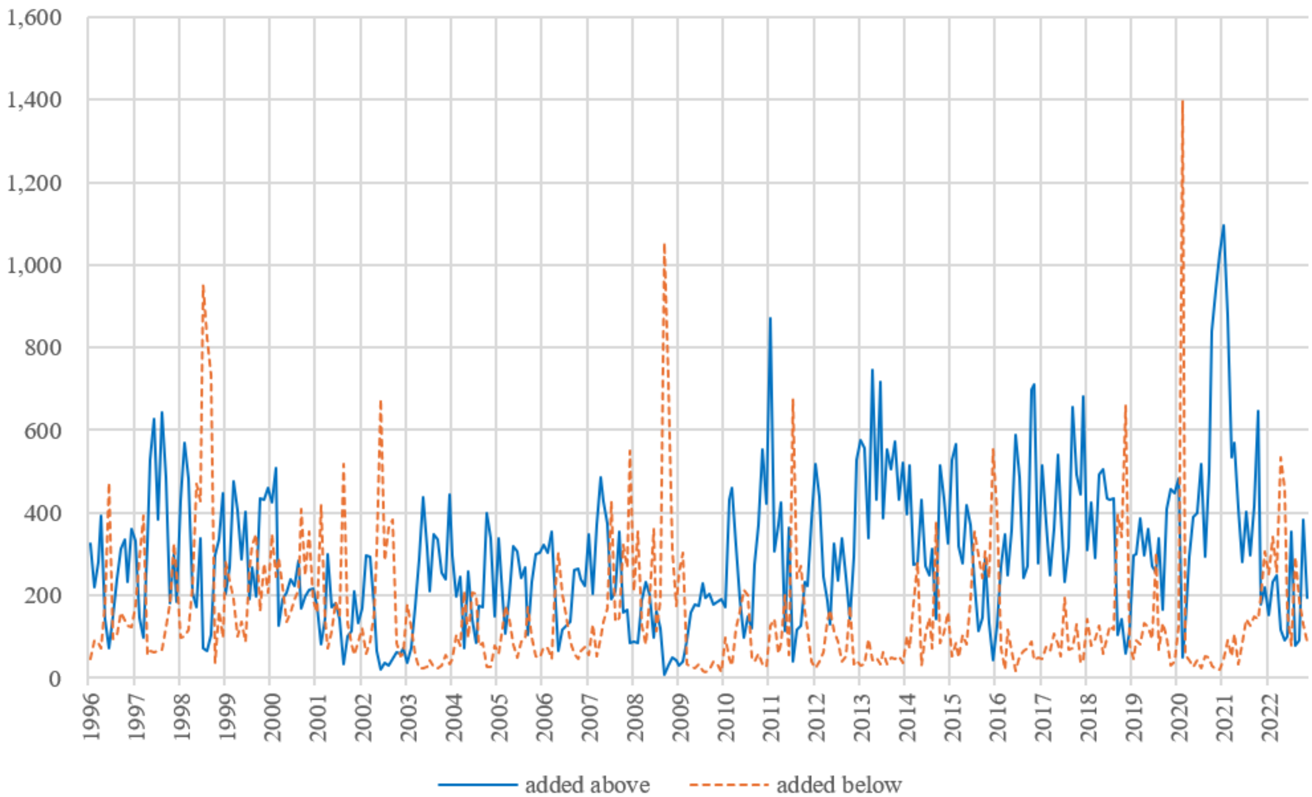

Figure 2: Number of Stocks

This figure shows the number of stocks with options introduced above the prevailing maximum strike price and below the prevailing minimum strike price, respectively, each month. INTRO_q3=1 ('added above') represents a portfolio of stocks with new options introduced above the prevailing maximum strike price and INTRO_q3=-1 ('added below') represents a portfolio of stocks with new options introduced below the prevailing minimum strike price. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

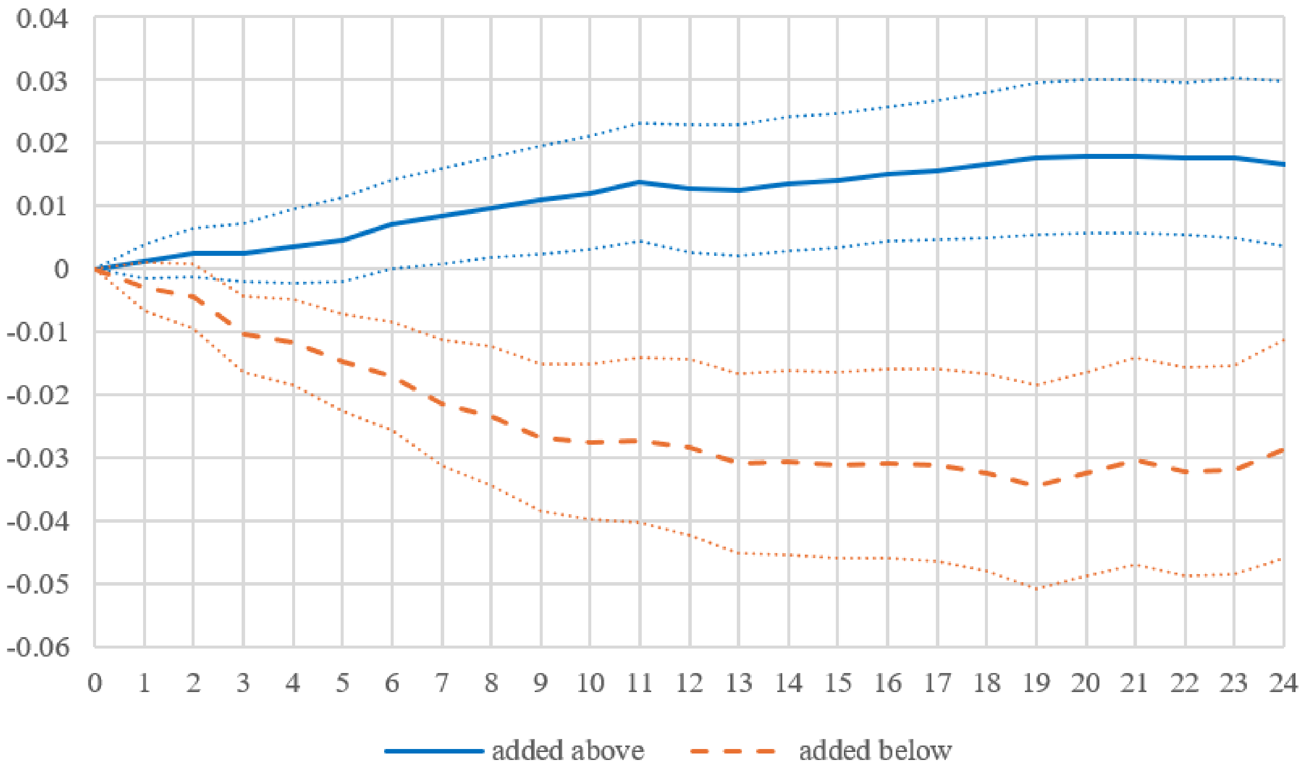

Figure 3: Returns After Portfolio Formation

This figure shows the event time cumulative returns K months after portfolio formation up to 24 months for INTRO_q3=1 and INTRO_q3=-1. INTRO_q3=1 ('added above') represents a portfolio of stocks with new options introduced above the prevailing maximum strike price and INTRO_q3=-1 ('added below') represents a portfolio of stocks with new options introduced below the prevailing minimum strike price. The solid lines represent cumulative returns after portfolio formation. The dotted lines represent 95% confidence levels of the cumulative returns. Stocks are required to have at least one listed option before portfolio formation. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. Stocks with prices less than $1 are excluded. The sample period is 1996-2023.

Appendix A Option Variables

A.1 1-month Change in Call and Put Volatility Surface (An et al. (2014))

Following An et al. (2014), (implied) volatility surfaces are from retrieved from OptionMetrics. OptionMetrics computes call and put volatility surfaces separately from options with different strikes and maturities using a smoothing algorithm. OptionMetrics provides data on constant maturity volatility surfaces. I follow An et al. (2014) and retrieve volatility surfaces for call and put options with absolute delta of 0.5 and a constant maturity of 30 days. The ΔCVOL (ΔPVOL) is the 1-month change in call (put) volatility surface for each stock.

An et al. (2014) shows ΔCVOL (ΔPVOL) positively (negatively) predicts monthly stock returns for up to 6 months. Note that the original paper uses equal-weighted returns for the ΔCVOL and ΔPVOL portfolios. This pause value-weighted portfolios.

A.2 1-month Implied Volatility Spread (Cremers and Weinbaum (2010))

For each stock-day, I calculate the implied volatility spread between a given call and put option with the same strike price and same expiration date. Then, I weight the implied volatility spread by the sum of the open interest of the given call and put option to get a stock-day measure of the implied volatility spread. Finally, I average the implied volatility spread of each stock across each month to get a stock-month measure. I consider options with best bids greater than 0, implied volatility between 0% and 200%, and positive open interest.

Note that Cremers and Weinbaum (2010) calculates the weekly implied volatility spreads to predict future weekly returns. Cremers and Weinbaum (2010) reports predictability for up to 4 weeks with the weekly implied volatility spreads. In this paper, I use monthly implied volatility spreads.

A.3 1-month SKEW (Xing et al. (2010))

For each option-day, I calculate its moneyness as the stock price divided by the strike price. Then, for each stock-day, I get the at-the-money call option where its moneyness is closest to 1 given that its moneyness lies between 0.95 and 1.05. Also, I get the out-of-the-money put option where its moneyness is closest to 0.95 given that its moneyness is less than equal to 0.95. Finally, for each day, I calculate the SKEW measure as the out-of-the-money put option's implied volatility minus the at-the-money call option's implied volatility. The monthly SKEW measure takes the average of the daily SKEW for each stock for a given month.

Note that Xing et al. (2010) calculates the weekly SKEW (average of daily SKEW) to predict weekly returns. Xing et al. (2010) reports predictability for up to 24 weeks with the weekly SKEW measure. In this paper, I use monthly SKEW.

A.4 1-month Option-to-stock Volume Ratio (Johnson and So (2012))

At the end of each month, I replicate the option-to-stock volume ratio by taking ratio of total option volume across maturities from 10 to 60 days to total stock volume over the past month for simplicity and monthly comparability. Johnson and So (2012) uses a weekly measure using firms with at least 25 call and put contracts traded, and aggregating option volume across maturities expiring in the 30 days after the option is traded.

Note that Johnson and So (2012) shows return predictability at the weekly level. But the replicated monthly measure has significant predictability in the Fama-MacBeth regressions in Table 7.

A.5 Average Moneyness weighted by Volume and Open Interest (Bergsma et al. (2020))

Following Bergsma et al. (2020)), I replicate volume- and open interest-weighted average moneyness of a stock as the following:

$$avg\_money\_volume = \sum_i \frac{K_i}{S} \times \frac{MP_i \times Vol_i}{TotalVol}$$

$$TotalVol = \sum_j MP_j \times Vol_j$$

$$avg\_money\_oi = \sum_i \frac{K_i}{S} \times \frac{MP_i \times OI_i}{TotalOI}$$

$$TotalOI = \sum_j MP_j \times OI_j$$

where K_i is the strike price of option i, S is the stock price, MP_i is the midpoint option price, Vol_i is the volume of option i, OI_i is the open interest of option i, $TotalVol$ and $TotalOI$ is the total volume and open interest, respectively.

Note that Bergsma et al. (2020) documents stock return predictability at the daily level using equal-weighted returns.

A.6 1-month Percentage Change in Call and Put Option Open Interest (Fodor et al. (2011))

Following Fodor et al. (2011), at the end of each month, I replicate the percentage changes of open interest for call and put options using all options with days to expiration between 30 and 365 days and with open interest of at least 50 (call and put options combined). I use the monthly changes in call-put open interest ratio as the main measure in my tests.

Note that Fodor et al. (2011) constructs a weekly measure and uses options with days to expiration between 30 and 365 at the initial measurement day, and drops options with less than 50 open interest for either call or put options.

A.7 1-month Out-of-the-money Put-Call Volume and Open Interest Ratio (Kang et al. (2022))

Following Kang et al. (2022), I replicate the out-of-the-money put-call ratio with volume and open interest as the following:

$$OTMPC\_vol_{i,t} = \frac{\text{Sum of OTM trading volume of puts}}{\text{Sum of OTM trading volume of all options}}$$

$$OTMPC\_oi_{i,t} = \frac{\text{Sum of } \Delta_{+}\text{OTM open interest of puts}}{\text{Sum of } \Delta_{+}\text{OTM open interest of all options}}$$

The $OTMPC\_vol$ is calculated using trading volume of puts and calls which is straightforward. The $OTMPC\_oi$ requires more details on the construction. Δ_{+}OTM open interest is the sum of positive changes in open interest for each option, when the option was out-of-the-money during the month. Then, it is aggregated across all options to obtain a stock-level measure.

Note that Kang et al. (2022) constructs a monthly measure as above and documents stock return predictability at the month-level.

Appendix B Figures and Tables

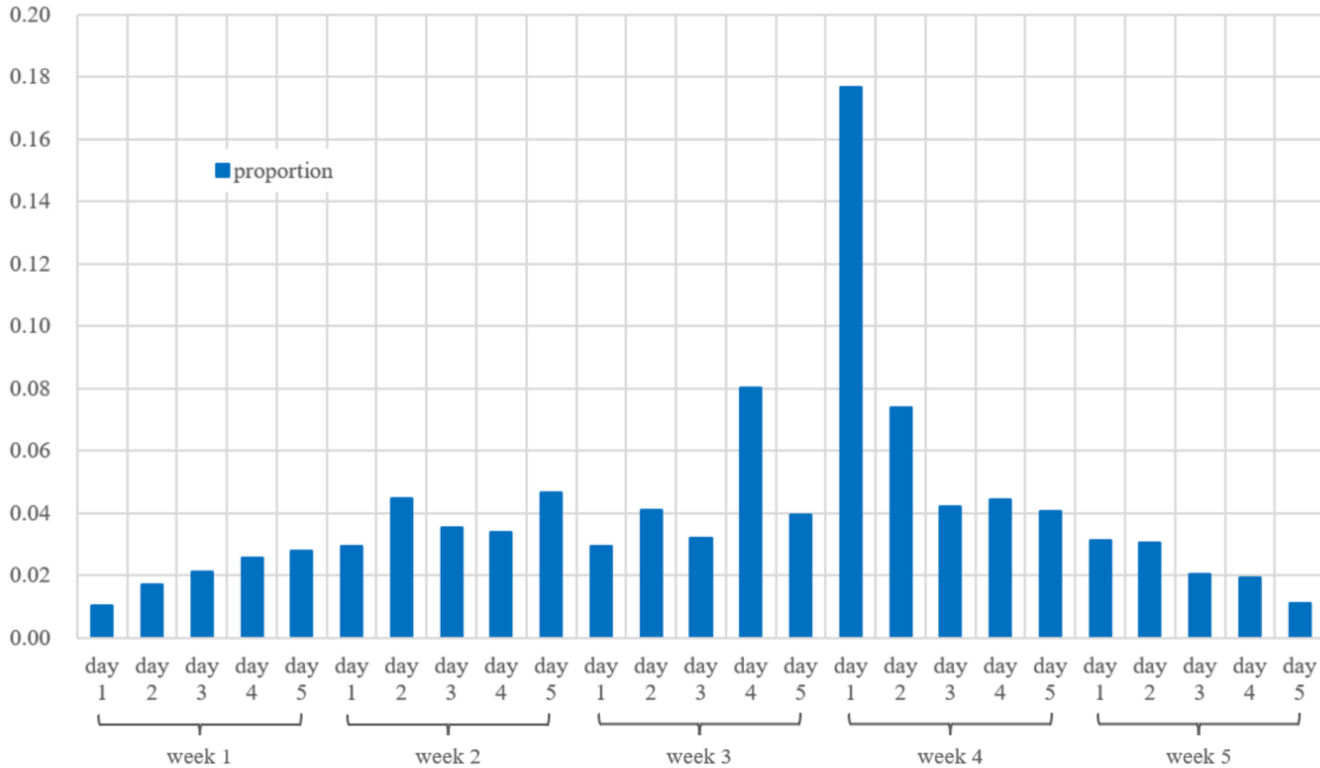

Figure B.1: Proportion of Option Introductions in Days of the Week for each Month

This graph shows the proportion of option introductions in days of the week for each month. Day 1 is Monday and day 5 is Friday. The option are included in the sample if INTRO_q3=-1 or 1. The sample period is 1996-2023.

Table B.1: Average Number of Stocks

This table shows the number of stocks with options introduced above the prevailing maximum strike price and below the prevailing minimum strike price, respectively. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. The average number of stocks in each month where INTRO_q3 is -1, 0, and 1 is reported for each year. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. The sample period is 1996-2023.

		INTRO_q3		
	year	-1	0	1
1	1996	143	1,369	246
2	1997	161	1,532	367
3	1998	366	1,656	271
4	1999	209	1,790	334
5	2000	252	1,587	270
6	2001	185	1,605	156
7	2002	222	1,605	115
8	2003	56	1,517	232
9	2004	100	1,578	235
10	2005	101	1,711	230
11	2006	112	1,797	228
12	2007	168	1,790	292
13	2008	356	1,763	112
14	2009	81	1,964	142
15	2010	89	1,885	278
16	2011	181	1,896	301
17	2012	81	2,043	290
18	2013	48	1,940	529
19	2014	133	2,124	361
20	2015	181	2,155	310
21	2016	131	2,195	366
22	2017	81	2,133	405
23	2018	190	2,038	359
24	2019	107	2,112	304
25	2020	159	1,935	439
26	2021	100	2,308	561
27	2022	257	2,647	188
28	2023	130	2,530	294
	Avg.	157	1,893	294

Table B.2: Event Time Double-sorted Returns for INTRO_q3=-1, 1

This table shows event time portfolio returns K months after portfolio formation. The event at Month=0 is when the options were introduced. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on their characteristic: cumulative maximum 1M return (max), market cap (mcap), and book-to-market ratio (B/M). Then, within the five groups, stocks are sorted by INTRO_q3=-1, 0, and 1. Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high momentum groups, respectively. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	double-sorted portfolio returns											
	max				mcap				B/M			
	low		high		low		high		low		high	
Month	1 - (-1)	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	0.28	(0.90)	0.68	(1.92)	0.37	(0.98)	0.40	(1.39)	0.38	(1.09)	0.35	(1.18)
2	0.39	(0.96)	1.15	(2.38)	0.60	(1.20)	0.67	(1.73)	0.57	(1.29)	0.61	(1.45)
3	0.98	(2.09)	1.82	(3.10)	1.42	(2.56)	1.23	(2.69)	1.09	(2.18)	1.08	(2.07)
4	1.01	(1.81)	2.10	(3.06)	1.78	(2.90)	1.45	(2.66)	1.32	(2.27)	1.26	(2.10)
5	1.68	(2.67)	2.43	(3.12)	2.41	(3.51)	1.85	(3.01)	1.79	(2.70)	1.49	(2.25)
6	1.89	(2.77)	3.36	(4.05)	2.88	(3.94)	2.31	(3.56)	2.34	(3.18)	1.70	(2.49)
7	2.54	(3.27)	3.89	(4.26)	3.05	(3.74)	2.92	(4.06)	2.75	(3.29)	2.34	(3.13)
8	2.74	(3.31)	4.37	(4.42)	3.37	(3.88)	3.26	(4.25)	3.01	(3.41)	2.75	(3.43)
9	3.03	(3.49)	5.06	(4.65)	3.99	(4.19)	3.70	(4.48)	3.50	(3.77)	2.98	(3.42)
10	3.41	(3.83)	4.88	(4.32)	4.25	(4.19)	3.85	(4.51)	3.79	(3.85)	2.85	(3.20)
11	3.71	(3.76)	5.07	(4.40)	4.47	(4.15)	3.99	(4.40)	3.84	(3.69)	3.06	(3.23)
12	3.81	(3.60)	5.12	(4.18)	4.52	(3.93)	4.02	(4.09)	3.98	(3.63)	2.88	(2.83)
13	4.14	(3.73)	4.86	(3.88)	4.38	(3.64)	4.26	(4.21)	4.26	(3.78)	2.65	(2.52)
14	4.02	(3.56)	5.10	(3.95)	4.35	(3.50)	4.36	(4.21)	4.45	(3.89)	2.58	(2.32)
15	4.12	(3.54)	5.48	(4.12)	4.66	(3.69)	4.46	(4.25)	4.72	(4.00)	2.68	(2.38)
16	4.19	(3.55)	5.58	(4.15)	4.75	(3.77)	4.50	(4.25)	4.92	(4.09)	2.50	(2.17)
17	4.17	(3.45)	5.77	(4.15)	4.93	(3.80)	4.58	(4.21)	5.22	(4.21)	2.44	(2.04)
18	4.64	(3.67)	5.82	(4.05)	4.76	(3.61)	4.83	(4.22)	5.38	(4.08)	2.82	(2.30)
19	4.87	(3.73)	5.81	(3.89)	4.63	(3.34)	5.18	(4.33)	6.05	(4.44)	2.48	(1.93)
20	4.65	(3.51)	5.84	(3.87)	4.51	(3.20)	5.00	(4.15)	6.12	(4.44)	2.15	(1.63)
21	4.59	(3.49)	5.56	(3.64)	4.32	(2.96)	4.79	(4.01)	5.72	(4.20)	2.00	(1.50)
22	4.72	(3.52)	5.46	(3.53)	4.56	(3.11)	4.89	(4.06)	5.89	(4.25)	1.95	(1.45)
23	4.86	(3.55)	5.20	(3.32)	4.48	(2.98)	4.86	(3.95)	5.92	(4.19)	1.74	(1.27)
24	4.35	(3.11)	4.88	(3.04)	4.15	(2.75)	4.41	(3.51)	5.74	(3.96)	1.34	(0.96)

Table B.3: Event Time Returns for INTRO_q3=-1, 1 split by Day of the Month of Option Introduction

This table shows event time portfolio returns K months after portfolio formation split by the day of the month of option introduction. The event at Month=0 is when the options were introduced. At the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. For 'After 3rd Friday', new options introduced on the first trading day after the 3rd Friday are considered. For 'All other days', new options introduced on all other days are considered. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

			Introductions			
	baseline		After 3rd Friday		All other days	
Month	1 - (-1)	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	0.41	(1.43)	0.50	(1.39)	0.56	(1.86)
2	0.69	(1.82)	0.13	(0.22)	0.94	(2.32)
3	1.29	(2.92)	1.54	(1.95)	1.64	(3.44)
4	1.53	(2.92)	1.99	(2.27)	1.85	(3.31)
5	1.94	(3.27)	2.67	(2.60)	2.50	(3.94)
6	2.41	(3.84)	2.83	(2.63)	3.06	(4.51)
7	2.97	(4.26)	3.66	(3.13)	3.81	(4.97)
8	3.31	(4.44)	4.16	(3.49)	4.14	(5.00)
9	3.77	(4.68)	4.12	(3.51)	4.68	(5.24)
10	3.95	(4.72)	4.03	(3.73)	4.90	(5.24)
11	4.09	(4.62)	4.42	(3.79)	5.03	(5.12)
12	4.11	(4.28)	4.27	(3.38)	5.29	(4.98)
13	4.33	(4.38)	4.81	(3.62)	5.47	(5.00)
14	4.42	(4.38)	4.49	(3.32)	5.60	(4.97)
15	4.54	(4.44)	4.49	(3.27)	5.70	(4.99)
16	4.60	(4.46)	4.41	(3.07)	5.86	(5.06)
17	4.68	(4.43)	4.41	(3.08)	5.98	(5.06)
18	4.89	(4.41)	4.33	(2.89)	6.30	(5.08)
19	5.22	(4.49)	4.24	(2.79)	6.63	(5.17)
20	5.04	(4.33)	3.79	(2.45)	6.57	(5.06)
21	4.84	(4.18)	3.83	(2.42)	6.27	(4.82)
22	4.97	(4.27)	4.04	(2.50)	6.46	(4.91)
23	4.97	(4.15)	4.13	(2.49)	6.33	(4.68)
24	4.53	(3.71)	3.96	(2.38)	5.91	(4.25)

Table B.4: Event Time Returns for INTRO_q3=-1, 1 Split by Maturity

This table shows event time portfolio returns K months after portfolio formation split by option maturity at the time of option introduction. The event at Month=0 is when the options were introduced. At the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. For ‘maturity < 100’, new options with less than 100 days to maturity at the time of the introduction are considered. For ‘maturity ≥ 100’, new options with more than or equal to 100 days to maturity at the time of the introduction are considered. The ‘1 - (-1)’ is the difference between INTRO_q3=1 and INTRO_q3=-1. The corresponding t-statistics for the ‘1 - (-1)’ are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	baseline		maturity < 100		maturity ≥ 100	
Month	1 - (-1)	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	0.41	(1.43)	0.24	(0.73)	0.36	(1.22)
2	0.69	(1.82)	0.62	(1.37)	0.63	(1.62)
3	1.29	(2.92)	1.22	(2.30)	1.31	(2.82)
4	1.53	(2.92)	1.68	(2.77)	1.54	(2.81)
5	1.94	(3.27)	1.95	(2.94)	2.09	(3.30)
6	2.41	(3.84)	2.59	(3.74)	2.53	(3.76)
7	2.97	(4.26)	2.99	(3.95)	3.20	(4.24)
8	3.31	(4.44)	3.42	(4.19)	3.58	(4.39)
9	3.77	(4.68)	3.80	(4.32)	4.18	(4.77)
10	3.95	(4.72)	3.85	(4.24)	4.53	(4.95)
11	4.09	(4.62)	3.90	(4.02)	4.69	(4.80)
12	4.11	(4.28)	3.73	(3.64)	4.66	(4.44)
13	4.33	(4.38)	3.69	(3.52)	4.83	(4.47)
14	4.42	(4.38)	3.52	(3.29)	5.10	(4.57)
15	4.54	(4.44)	3.55	(3.20)	5.20	(4.65)
16	4.60	(4.46)	3.47	(3.07)	5.29	(4.67)
17	4.68	(4.43)	3.73	(3.21)	5.20	(4.45)
18	4.89	(4.41)	3.79	(3.19)	5.51	(4.48)
19	5.22	(4.49)	3.97	(3.17)	5.88	(4.62)
20	5.04	(4.33)	3.86	(3.02)	5.72	(4.50)
21	4.84	(4.18)	3.59	(2.79)	5.57	(4.39)
22	4.97	(4.27)	3.66	(2.82)	5.70	(4.42)
23	4.97	(4.15)	3.61	(2.68)	5.64	(4.25)
24	4.53	(3.71)	3.35	(2.44)	5.17	(3.78)

Table B.5: Event Time Returns for INTRO_q3=-1, 1 Split by Earnings Month

This table shows event time portfolio returns K months after portfolio formation split by whether option introductions and quarterly earnings announcements are in the same month or not and by the days to the next quarterly earnings announcement. The event at Month=0 is when the options were introduced. At the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. For 'INTRO in earnings month', stocks with INTRO_q3=1 or -1 in the same month of its quarterly earnings announcement are used. For 'INTRO in non-earnings month', stocks with INTRO_q3=1 or -1 in months without a quarterly earnings announcement are considered. For 'days to earnings ≤ 45' ('days to earnings > 45'), stocks with quarterly earnings announcements scheduled within 45 days (more than 45 days) from the last day of the portfolio formation month are considered. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	INTRO in earnings month		INTRO in non-earnings month		days to earnings ≤ 45		days to earnings > 45	
Month	1 - (-1)	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	0.40	(0.65)	0.34	(1.14)	0.39	(0.97)	0.84	(2.66)
2	1.70	(2.10)	0.65	(1.56)	0.81	(1.55)	1.26	(2.63)
3	4.88	(2.99)	1.16	(2.40)	1.94	(3.14)	1.61	(3.00)
4	4.91	(3.03)	1.26	(2.14)	2.02	(2.79)	2.19	(3.59)
5	5.69	(3.28)	1.69	(2.51)	2.71	(3.38)	2.63	(3.55)
6	6.19	(3.21)	2.37	(3.41)	2.73	(3.06)	2.53	(3.28)
7	6.11	(3.01)	2.98	(4.00)	3.54	(3.62)	2.80	(3.26)
8	7.20	(3.38)	3.34	(4.14)	3.93	(3.70)	3.29	(3.48)
9	6.21	(2.87)	3.98	(4.53)	4.12	(3.51)	3.95	(3.84)
10	6.75	(2.90)	4.11	(4.63)	4.11	(3.38)	4.25	(3.86)
11	8.01	(3.21)	4.09	(4.34)	4.44	(3.49)	4.28	(3.81)
12	8.24	(3.30)	3.99	(3.95)	3.96	(2.93)	4.21	(3.50)
13	7.77	(2.88)	4.25	(4.08)	4.42	(3.14)	4.33	(3.37)
14	6.79	(2.55)	4.41	(4.15)	5.16	(3.54)	4.44	(3.25)
15	6.78	(2.39)	4.51	(4.20)	5.59	(3.82)	4.52	(3.23)
16	6.95	(2.38)	4.43	(4.08)	5.16	(3.51)	4.98	(3.37)
17	6.41	(2.14)	4.51	(4.06)	5.27	(3.51)	5.46	(3.54)
18	7.31	(2.40)	4.70	(4.08)	4.81	(3.14)	5.68	(3.62)
19	6.69	(2.18)	4.95	(4.12)	4.66	(2.95)	5.78	(3.62)
20	6.41	(2.09)	4.74	(3.91)	4.77	(2.94)	5.49	(3.62)
21	7.53	(2.41)	4.39	(3.62)	4.49	(2.76)	5.62	(3.66)
22	7.11	(2.21)	4.46	(3.64)	4.25	(2.56)	5.66	(3.59)
23	6.22	(1.90)	4.38	(3.48)	4.51	(2.68)	5.31	(3.37)
24	5.36	(1.57)	3.95	(3.06)	4.18	(2.37)	5.02	(3.14)

Table B.6: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by Estimated Borrowing Fees

This table shows event time portfolio returns K months after portfolio formation of double sorted portfolios sorted by INTRO_q3 and estimated borrowing fees (Muravyev et al. (2022)). The event at Month=0 is when the options were introduced. At the end of each month, stocks are sorted into three groups by INTRO_q3=-1, 0, and 1. Then, within groups INTRO_q3=1 and INTRO_q3=-1, stocks are sorted into two groups based on the whether each stock's estimated borrowing fees are larger than 1%. Stocks with borrowing fees smaller than or equal to 1% (larger than 1%) are classified as easy-to-borrow stocks (hard-to-borrow stocks). Finally, the '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1 within the low and high borrowing fee groups, respectively. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	INTRO_q3=-1				INTRO_q3=1				spread			
	easy-to-borrow		hard-to-borrow		easy-to-borrow		hard-to-borrow		easy-to-borrow		hard-to-borrow	
Month	-1	t-stat	-1	t-stat	1	t-stat	1	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	-0.16	(-0.75)	-0.66	(-2.44)	0.10	(0.51)	-0.03	(-0.19)	0.26	(0.78)	0.63	(1.86)
2	-0.30	(-1.07)	-0.69	(-1.98)	0.29	(1.41)	0.07	(0.28)	0.59	(1.48)	0.76	(1.63)
3	-0.73	(-2.17)	-1.47	(-3.56)	0.27	(0.95)	-0.04	(-0.12)	1.00	(2.01)	1.43	(2.63)
4	-0.82	(-2.06)	-1.82	(-3.94)	0.43	(1.19)	-0.02	(-0.04)	1.24	(2.08)	1.80	(2.83)
5	-1.10	(-2.55)	-2.39	(-4.42)	0.82	(2.35)	-0.19	(-0.43)	1.92	(3.04)	2.20	(3.01)
6	-1.50	(-3.12)	-2.75	(-4.50)	1.20	(2.85)	-0.12	(-0.23)	2.70	(3.86)	2.64	(3.32)
7	-1.91	(-3.53)	-3.36	(-4.92)	1.39	(3.18)	0.05	(0.09)	3.30	(4.36)	3.41	(3.95)
8	-2.07	(-3.56)	-3.77	(-5.06)	1.70	(3.63)	-0.01	(-0.01)	3.77	(4.73)	3.76	(4.05)
9	-2.38	(-3.83)	-4.16	(-5.02)	1.83	(3.40)	-0.12	(-0.21)	4.21	(4.80)	4.04	(4.00)
10	-2.14	(-3.32)	-4.55	(-5.11)	1.95	(3.51)	-0.09	(-0.14)	4.09	(4.55)	4.47	(4.17)
11	-2.14	(-3.06)	-4.62	(-5.01)	2.07	(3.46)	-0.06	(-0.11)	4.20	(4.27)	4.55	(4.16)
12	-2.37	(-3.19)	-4.63	(-4.66)	1.97	(3.26)	-0.31	(-0.48)	4.34	(4.17)	4.32	(3.66)
13	-2.72	(-3.53)	-4.62	(-4.67)	2.02	(3.26)	-0.22	(-0.33)	4.74	(4.42)	4.39	(3.64)
14	-2.83	(-3.53)	-4.51	(-4.40)	2.19	(3.44)	-0.30	(-0.42)	5.02	(4.53)	4.21	(3.39)
15	-2.70	(-3.30)	-4.81	(-4.61)	2.13	(3.22)	-0.30	(-0.43)	4.84	(4.23)	4.51	(3.61)
16	-2.54	(-3.01)	-5.19	(-4.98)	2.24	(3.18)	-0.26	(-0.35)	4.78	(4.04)	4.93	(3.92)
17	-2.71	(-3.17)	-4.94	(-4.61)	2.25	(3.09)	-0.26	(-0.35)	4.97	(4.07)	4.68	(3.65)
18	-2.65	(-2.98)	-5.02	(-4.55)	2.36	(3.07)	-0.29	(-0.38)	5.02	(3.90)	4.73	(3.56)
19	-2.95	(-3.16)	-4.98	(-4.36)	2.60	(3.29)	-0.55	(-0.72)	5.55	(4.11)	4.43	(3.23)
20	-2.52	(-2.69)	-4.93	(-4.24)	2.64	(3.39)	-0.61	(-0.82)	5.16	(3.83)	4.32	(3.13)
21	-2.34	(-2.46)	-4.80	(-4.08)	2.72	(3.31)	-0.65	(-0.87)	5.06	(3.68)	4.14	(2.99)
22	-2.32	(-2.39)	-5.19	(-4.21)	2.71	(3.41)	-0.76	(-1.01)	5.03	(3.68)	4.42	(3.08)
23	-2.11	(-2.21)	-5.39	(-4.28)	2.73	(3.33)	-0.94	(-1.23)	4.85	(3.52)	4.45	(3.00)
24	-1.66	(-1.70)	-5.44	(-4.19)	2.66	(3.04)	-0.95	(-1.23)	4.33	(3.06)	4.48	(2.92)

Table B.7: Subperiod Analysis

This table shows the event time cumulative returns K months after portfolio formation up to 24 months using three groups of INTRO_q3 in two subperiods based on the portfolio formation month: February 1996 to September 2009 and October 2009 to August 2023. Pre- and post-October 2009 is chosen to see whether results are weakened after a massive crackdown against insider trading in 2009 following Bondarenko and Muravyev (2022). The event at Month=0 is when the options were introduced. At the end of each month, stocks are divided into three groups: INTRO_q3=-1, 0, and 1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and INTRO_q3=0 represents the rest of the stocks. For INTRO_q3=1 and INTRO_q3=-1, the market return is subtracted. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. The corresponding t-statistics for the '1 - (-1)' are also reported. Stocks are required to have at least one listed option before portfolio formation. Stocks with prices less than $1 are excluded. All portfolios are value-weighted by the market cap of each stock at the end of the formation period. The sample period is 1996-2023.

	baseline 1996-2023		1996-2009		2009-2023	
Month	1 - (-1)	t-stat	1 - (-1)	t-stat	1 - (-1)	t-stat
1	0.51	(1.73)	0.60	(1.28)	0.42	(1.18)
2	0.85	(2.18)	0.54	(0.87)	1.16	(2.42)
3	1.44	(3.19)	1.25	(1.79)	1.63	(2.80)
4	1.72	(3.23)	1.72	(2.10)	1.72	(2.50)
5	2.15	(3.58)	2.59	(2.79)	1.71	(2.24)
6	2.66	(4.20)	3.17	(3.25)	2.16	(2.66)
7	3.28	(4.68)	3.87	(3.66)	2.70	(2.93)
8	3.65	(4.84)	4.28	(3.82)	3.03	(2.99)
9	4.06	(5.00)	4.54	(3.73)	3.58	(3.32)
10	4.22	(5.01)	4.47	(3.59)	3.96	(3.49)
11	4.39	(4.89)	4.50	(3.39)	4.28	(3.54)
12	4.40	(4.53)	4.36	(2.92)	4.44	(3.59)
13	4.62	(4.63)	4.68	(3.00)	4.56	(3.70)
14	4.78	(4.68)	4.74	(2.94)	4.82	(3.89)
15	4.89	(4.73)	4.98	(3.07)	4.79	(3.78)
16	4.94	(4.75)	4.56	(2.79)	5.34	(4.22)
17	4.99	(4.70)	4.36	(2.61)	5.65	(4.38)
18	5.21	(4.68)	4.38	(2.51)	6.09	(4.49)
19	5.55	(4.77)	4.79	(2.64)	6.38	(4.45)
20	5.40	(4.62)	4.52	(2.50)	6.34	(4.37)
21	5.21	(4.48)	4.10	(2.31)	6.43	(4.36)
22	5.37	(4.58)	3.98	(2.23)	6.88	(4.64)
23	5.32	(4.43)	3.74	(2.08)	7.06	(4.54)
24	4.82	(3.92)	3.35	(1.82)	6.45	(4.05)