# The Information in Option Strike Price Introductions

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**Abstract**

I examine the information content of option strike price introductions. I find that stocks with options introduced above the prevailing maximum strike price outperform those with options introduced below the prevailing minimum strike price by up to 6% over the following 12 months. While this result is neither explained by stock-price momentum nor a variety of other documented stock and option variables, it is stronger for stocks with high informed trading intensity and high option-to-stock volume ratio. The results are consistent with informed investors with private information driving the introduction of new strike prices to enable cost-effective leverage.

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# 1 Introduction

One of the most important questions in finance is how private information is incorporated into asset prices. While private information is known to be gradually reflected in prices (Grossman and Stiglitz (1980)), a major challenge in understanding this process is that the information set of informed traders remains unobservable. Driven by economic incentives, informed traders seek to trade in markets where their informational advantage can be maximized. Specifically, informed traders might prefer to trade in the options market over the stock market because options provide cost-effective leverage (Black (1975)). As a result, informed trading in the options market may convey incremental information about the underlying stock, which is gradually incorporated into prices.

In this paper, I examine the information content of option strike price introductions on individual stocks. My results are consistent with option introductions at extreme strike prices containing long-term information about the underlying stock. Stocks with new options introduced above the prevailing maximum strike price over the past month outperform those with new options introduced below the prevailing minimum strike price by around 4% for the following 12 months (t-statistic 4.28), and up to 6% based on the magnitude of investor demand. The results suggest that informed traders with private information drive the introduction of deep out-of-the-money options to enable cost-effective leverage.

For example, let's say an investor has positive information about a stock. She could buy a stock that gives her a leverage of 1, or options that offer potentially more than ten times the leverage of stocks. But if she demands leverage higher than the existing options, then a new option with a strike price higher than the prevailing maximum strike price allows her to achieve higher leverage. I argue that option strike price introductions are likely to be driven by informed investors and thus contain information about the underlying stock.

To the best of my knowledge, this is the first paper to examine whether strike price introductions contain information about the underlying stock. The existing literature focused on how first-time option listings for stocks that did not have any options affect the underlying stock's price and volatility (Conrad (1989), Detemple and Jorion (1990), among others). However, this paper focuses on option strike price introductions for stocks that already have listed options, which is novel to the literature. I find an interesting channel for investor demand affecting the decision to introduce new options.

Options with new strike prices are introduced by option exchanges in response to significant price changes in the underlying stock or in response to investor demand. The rule books of major exchanges explicitly state that they respond to stock price changes or demand from institutional, corporate, or individual investors. The demand component driven by investors, rather than the mechanical component driven by price changes, is likely to contain information about the underlying stock. This paper first argues that the demand component of option introductions is sizable compared to the mechanical component. The results show that it is difficult to predict which stocks will have new options introduced in the next month using the stock and option variables in this month. The stock and option variables, including stock returns, stock volume, and option volume explain less than 10% of the variation in predicting the stocks with extreme option introductions in the cross-section. Although the regression might be misspecified, it includes the core variables that exchanges are likely to be considering if they mechanically introduce options in response to stock price changes.

This paper provides empirical evidence that option strike price introductions at the extreme contain information about the underlying stock. The results show that stocks with more options introduced above than below the prevailing range of strike prices over the past month outperform stocks with more options introduced below than above the prevailing range of strike prices by up to 6% in the next 12 months. The return spread does not reverse up to 24 months, consistent with information gradually incorporated into prices. The absence of a reversal suggests that temporary mispricing, hedging demand, or liquidity provision are less likely to be driving the results.

The option strategy that buys the newly introduced options exhibits positive and significant abnormal returns with larger magnitudes than the stock strategy. Particularly, the two option portfolios, both option portfolios that buys every call option introduced above the prevailing maximum strike price and buys every put option introduced below the prevailing minimum strike price, respectively, have significantly positive event time returns up to 12 months after portfolio formation. This is consistent with the new options providing cost-effective leverage to investors.

The return spread is not explained by standard risk factors or the stock and option variables that are proposed in the literature to predict future stock returns. The Fama and MacBeth (1973) regressions show that the option introduction variable has a coefficient of 0.10 (t-statistic 2.47), controlling for existing stock and option variables, including the option to volume ratio (Johnson and So (2012)), volatility surface (An et al. (2014)), volatility skew (Xing et al. (2010)), and volatility spread (Cremers and Weinbaum (2010)), that are known to predict stock returns. The coefficient translates into a 0.20% monthly return spread between stocks with options introduced above and below the prevailing range of strike prices for the next 12 months. In addition, a monthly long-short portfolio constructed using the option introduction variable that captures whether a stock had more options introduced above or below the prevailing range of strike prices exhibits a positive and significant alpha of 0.23% (t-statistic 2.06) against the Fama-French six-factor model plus the short-term reversal factor. The monthly alpha increases to 0.35% (t-statistic 2.64) using a measure that captures the magnitude of demand more accurately by counting the number of options introduced. In addition, sequential double-sorted portfolios show that the 1-month return and momentum do not explain the return spread. Based on anomaly return spreads from Chen and Zimmermann (2022) using top minus bottom decile sorts, the Sharpe ratio of the baseline portfolio with 12-month holding horizons is in the top 24% against the 180 value-weighted anomaly portfolios and the top 34% against the 213 anomaly portfolios using a 12-month holding horizon. At the daily level, stocks with more options introduced above than below (below than above) the prevailing range of strike prices are associated with positive (negative) daily returns but exhibit long-term drift over the next 12 months, consistent with the monthly results.

I present four pieces of evidence consistent with informed traders driving the option introductions.

First, the results show that the newly introduced options with high leverage are actively traded after they are introduced. When options are introduced, the call and put options are generally introduced at the same time for a given strike price. If informed traders drive the option introductions to enable cost-effective leverage, call options should be more actively traded than put options when strike prices are introduced above the prevailing maximum strike price, and vice versa. Consistent with this hypothesis, the results show that the open interest, which captures the number of contracts outstanding, of out-of-the-money call (put) options are higher than in-the-money put (call) options when options are introduced above (below) the prevailing range of strike prices.

Second, the results are stronger for stocks with high informed trading intensity. If option introductions are driven by informed trading, option introductions are expected to contain more information among stocks with stronger informed trading intensity. I use the informed trading intensity measure from Bogousslavsky et al. (2024) that captures the institutional trading volume of a given day based on 13F filings. Consistent with this argument, the results are stronger among stocks with high informed trading intensity than those with low informed trading intensity.

Third, the results are stronger for stocks with a high option-to-stock volume ratio. If informed traders trade in relatively liquid markets because they want to disguise their trades in high volume (Easley et al. (1998)), more informed trading is expected in the options market when the options market is relatively more liquid than the stock market. The results show that the return spread is larger for stocks with high option-to-stock volume ratio than for those with low option-to-stock volume ratio, supporting the above hypothesis.

Finally, the results show that analysts tend to under-project in magnitude the earnings of stocks that have options introduced at the extreme. If private information is driving option introductions, analysts may not fully incorporate the information contained in option strike price introductions in their earnings forecasts. Consistent with this point, the earnings forecast error spread between stocks with more options introduced above than below and stocks with more options introduced below than above the prevailing range of strike prices is positive and significant. This is consistent with analysts not fully incorporating information contained in option introductions.

The results show that option strike price introductions partially contain information about the volatility of the underlying stock. To empirically test whether volatility information is contained in option introductions, delta-hedged portfolios are constructed. Delta-hedged portfolios, option portfolios hedged by buying or selling stocks, are more sensitive to the volatility than the direction of the underlying stock price. If delta-hedged portfolios exhibit positive returns, it is likely that the returns are driven by information about the volatility of the underlying stock. Consistent with this hypothesis, the results show that delta-hedged portfolios have positive and significant returns in the first few months after portfolio formation.

The results show that option delistings, as opposed to option introductions, do not predict future stock returns, suggesting that they are less likely to have information about the underlying stock. The rule books of option exchanges state that options are delisted if they have 0 open interest and there are no requests from investors to maintain the option. This implies delistings have a demand component but it is more likely to be stale and less likely to be revealed through trades. Consistent with this notion, the results show that option delistings do not have significant predictability of future stock returns, unlike option introductions. Furthermore, option delistings might be associated with option introductions. For example, when an option strike price is introduced above the prevailing maximum strike price, an option strike price might be delisted below the prevailing minimum strike price. Using stock delistings without introductions on the other extreme, the return spread between delistings above and below the prevailing range of strike prices is closer to 0. This strengthens the argument that option introductions contain information about the underlying stock.

The results show that index option introductions, unlike individual stock option introductions, do not predict future index returns, implying that they are less likely to contain market-wide information about the underlying index. First, it is difficult to believe that informed traders have private information about market-wide movements. Second, the literature (Campbell and Thompson (2008), Welch and Goyal (2008), among others) shows that it is notoriously difficult to predict future market returns. Consistent with these priors, the time-series regressions of 1-month ahead index returns on index option introductions show that the coefficients are insignificant across major indexes. This is consistent with the notion that the information content of option introductions is likely to be related to individual stocks rather than market-wide indexes.

The results are robust to various specifications. The return spread between stocks with more options introduced above than below the prevailing range of strike prices is positive and significant, 12 months after portfolio formation across different subsets of stocks and subsets of options, as shown in the following:

The results are robust to whether the new options have short or long maturity. It is uncertain whether the informed traders are likely to use short-maturity options or long-maturity options to trade on their information. The short-maturity options require rolling over to other options which incurs trading costs due to bid-ask spreads. The long-maturity options do not require rolling over, but they are exposed to theta risk, where the option value goes down as time goes by. The results show that the return spread is positive and significant using both subset of options. It is likely that when options are introduced, they are introduced across different maturities, thus the option maturity does not significantly affect the results.

The information contained in option introductions is partially related to earnings announcements. If informed traders have information related to earnings announcements, the option introductions are expected to be clustered in earnings announcement months. To test whether information about the earnings announcement is contained in option introductions, the stocks are split into whether options are introduced in the same month as the earnings announcement or not. This jointly captures option introductions driven by information on forecasting earnings and information extracted from earnings reports. The results are stronger when options are introduced in earnings announcement months, though still within less than 20% of stocks. In addition, the predictability from option introductions for stocks in non-earnings months remains robust, implying that the information in option strike price introductions is not entirely related to earnings.

The results are robust to using stocks with high or low borrowing fees. The results might be driven by put option demand for stocks with high borrowing fees (Johnson and So (2012)). Also, Muravyev et al. (2022) show that stock borrowing fees explain a significant portion of stock returns by predicted by options market information. However, using borrowing fee estimates from the procedure introduced in Muravyev et al. (2022), I find that the results are robust to using subsets of easy-to-borrow stocks and hard-to-borrow stocks, respectively.

The results are robust in different subperiods. Bondarenko and Muravyev (2022) show that the ability of options market signals to predict stock returns substantially deteriorated after October 2009 due to a massive crackdown on insider options trading. To address this concern, I split the sample into two subperiods: before and after October 2009. I find that the results are robust in both sample periods. This is consistent with option introductions likely containing private information, not illegal insider information.

The results are robust to different event study specifications: using Newey and West (1987) standard errors with twelve lags, using control firms as the reference portfolio instead of the market portfolio, and using stocks without overlapping signals in the past 12 months. The main implication of the results is consistent across all three specifications.

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 7 concludes.

## 2 Related Literature

The existing literature primarily focused 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 first-time stock option introductions. Skinner (1989) shows that when options are first introduced to an underlying stock, its volatility decreases and volume increases. Conrad (1989) shows that stock prices permanently increase around the date of first-time option introductions. Detemple and Jorion (1990) find that option introductions are associated with increased stock price and decreased volatility, but these effects weakened 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 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 evidence of a new channel through which informed traders 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. Easley et al. (1998) develop a model where buying a call or selling a put contains information about the underlying stock. 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 option volatility and volume predict future stock returns because they reflect stock borrowing fees. 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 this paper, I provide suggestive evidence that informed investors with strong private information drive the introduction of options with new strike prices at the extreme.

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. This suggests 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. The results in this paper suggest the information in the introduction of new strike prices is most likely acquired by investors instead of option market makers.

# 3 Institutional Details

In this section, I explore how option exchanges introduce new strike prices for individual stock options. The following are rules on how exchanges introduce additional exercise prices for individual options stated almost identically across 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. New strike prices can be introduced or not be delisted in response to demand. It is clear that new strike price introductions are not only driven by price changes but by demand from investors. The demand component that drives option introductions is not based on market makers' demand but investors' willingness to buy options. This partially rules out an alternative explanation that hedging demand might be driving option introductions. On the other hand, the delistings seem to happen only when there is no open interest for an option. Overall, a demand component is implied in the introduction of strike prices by the rule books across major exchanges.

Note that 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. If informed investors demand extreme strike prices that lead to new strike price introductions, it might contain information that predicts future stock returns. Delistings, however, are less likely to be driven by demand because the necessary condition is 0 open interest. In this paper, I show that strike price introductions contain information on the underlying stock whereas delistings do not.

# 4 Data and Variables

## 4.1 Data

I use the Center for Research in Security Prices (CRSP) to get stock returns and characteristics from January 1996 to December 2023. I use OptionMetrics to get data on individual stock options and their corresponding strike prices from January 1996 to August 2023. I use return data up to December 2023 but use options data up to August 2023. Standard risk factors and the T-bill rate are obtained from Kenneth R. French's data library. I use the I/B/E/S Summary History dataset for quarterly and yearly earnings forecasts and the corresponding earnings announcement dates.

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)).

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. Note that all options are American options where option holders can exercise the option at any point in time before expiration.

## 4.2 Main Variable: INTRO_q3 and INTRO_q5

For each stock at the end of month $t$, INTRO_t is defined as the number of options introduced in month $t$ that have strike prices above the highest strike price available at the end of month $t-1$, minus the number of options introduced below the lowest strike price available at the end of month $t-1$. I define two main variables with INTRO_t: INTRO_q3 and INTRO_q5, each representing three-way and five-way sorts.

INTRO_q3 equals 1, 0, -1 if INTRO_t is positive, 0, negative, respectively. If INTRO_q3 is positive, the stock had more options introduced above than below the prevailing range of strike prices (at the end of the previous month) in a given month. This definition takes into account the stocks with options introduced both above and below the prevailing strike prices by taking the difference. 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. Figure B.1 shows a visual illustration of how INTRO and INTRO_q3_t are measured.

$$
\begin{aligned}
& = 1 \quad (\text{INTRO\_t} > 0) \\
\text{INTRO\_q3\_t} & = 0 \quad (\text{INTRO\_t} = 0) \\
& = -1 \quad (\text{INTRO\_t} < 0)
\end{aligned}
\tag{1}
$$

To capture the magnitude of demand more accurately, I further sort stocks based on INTRO_q5 that divides stocks into five groups. If exchanges are responding to stronger demand from informed investors, they are likely to introduce more options across different maturities and across different strike prices. Then, the INTRO variable, which takes into account the number of new options introduced, might capture the level of demand from investors more accurately. Based on this hypothesis, I split INTRO_q3=1 into two groups based on the median value of INTRO: 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 median value of INTRO: INTRO_q5=-1 (below median introductions), INTRO_q5=-2 (above median introductions). INTRO_q5 can be expressed as the following:

$$\begin{aligned} &= 2 \quad (\text{INTRO\_t} > 0,\ \text{above median}) \\ &= 1 \quad (\text{INTRO\_t} > 0,\ \text{below median}) \\ \text{INTRO\_q5\_t} &= 0 \quad (\text{INTRO\_t} = 0) \\ &= -1 \quad (\text{INTRO\_t} < 0,\ \text{below median}) \\ &= -2 \quad (\text{INTRO\_t} < 0,\ \text{above median}) \end{aligned} \tag{2}$$

Figure 1 shows the number of stocks with positive INTRO (INTRO_q3=1) and negative INTRO (INTRO_q3=-1), respectively, in each month (The yearly average number of stocks for INTRO_q3=-1 and INTRO_q3=1 is shown in Table B.2). 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 positively correlated with strike price introductions. If market returns are positive, there more stocks with positive returns on average that mechanically affect the number of options introduced above the prevailing maximum strike price, and vice versa. For example, there were a significant number of stocks with options introduced below the prevailing minimum strike price during market declines: Global Financial Crisis in 2008 and COVID in 2020. Second, strike prices are bounded below by 0 but not bounded above. When the 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.

# 5 Empirical Results

## 5.1 Predictive Regression of Strike Price Introductions

In this section, I use cross-sectional regressions that predict option introductions above and below the prevailing strike prices. I explore whether stocks with option introductions in the next month are predictable 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 by the exchange. However, if option introductions are not entirely explained by stock or option variables, then it implies that there is a discretionary component and options are not only introduced passively but in response to demand. In the regression, the adjusted-$R^2$ is likely to capture the lower bound of the mechanical component in option introductions.

I run two separate Fama and MacBeth (1973) regressions to capture the cross-sectional predictability of stock and option variables in predicting the stocks with extreme option introductions: one that predicts stocks with new option introductions above the prevailing maximum strike price and below the prevailing minimum strike price, respectively. The dependent variable equals 1 if INTRO_q3=1 and 0 otherwise for the former regression and it equals 1 if INTRO_q3=-1 and 0 otherwise for the latter regression.

To mitigate any econometric concerns using past returns before option introductions, the regressions are run on a subset of stocks that have extreme option introductions on the first trading day after the 3rd Friday of each month. This ensures that all stocks will have the same introduction date for each month. Then, 10-day returns immediately before the introduction will be aligned with the same period for each month.

For both regressions, I include the stock and option variables that are likely to be related to the mechanical component of option introductions. The stock variables include: 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. The option variables include: 10-day option volume, 1-month option volume, and change in 1-month option volume.

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

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

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

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 (indicator for INTRO_q3=1). 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 (indicator for INTRO_q3=-1).

The $ret\_10d_{i,t}$ is the past 10-day average daily return of stock $i$ in month $t$ before the option introduction date. 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 introduction date. 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. The $const$ is the constant.

The indicator variables are regressed on stock and option characteristics in the cross-section each month. Then, the average coefficients of each cross-sectional regression are reported with their corresponding t-statistics across the time-series in parentheses.

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. The monthly average adjusted $R^2$ for each regression is 8.2% and 4.1%, respectively. This is consistent with option introductions at the extreme not fully explained by stock and option characteristics that might be related to the mechanical factors of option introductions. The results imply a significant discretionary component in both extremes of option introductions. Although the model might be misspecified, it includes variables that the exchanges are likely to be using for mechanical option introductions.

Consistent with exchanges introducing new options when there are large movements in stock prices, the 10-day and 1-month returns leading up to the option introduction positively predict new options being introduced at the extreme. 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.

The level of past month's stock volume is negatively associated with option introductions both above and below the prevailing range of strike prices. 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 stock volume is positively correlated with option introductions both above and below the prevailing strike price. Also, 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 trading. 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 inconsistent with the argument that new options might be introduced due to option volume spillovers. Furthermore, the changes in option volume have a negative coefficient for options added above and a 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 to be due to significant increases in option volume.

The market cap has a negative coefficient 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. 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 argument that exchanges introduce new options in both extremes when the stock price is more volatile.

## 5.2 Summary Statistics

In this section, I report average characteristics for the sample of stocks with options and for the portfolios sorted by INTRO_q3. Note that the sample of stocks with listed options 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. There are on average a total of 2,341 stocks with listed options per month and the median market cap is 1,291 million dollars which is above the median market cap using all stocks. The sample of stocks with listed options tend to have larger market cap than the sample of all stocks most likely because the exchanges consider the stock's market cap and liquidity when they decide to list options for a given stock. For the portfolio sorts, there are on average 157 stocks for INTRO_q3=-1 and 294 stocks for INTRO_q3=1.

If stocks are classified into portfolios that have stocks with options above or below the prevailing strike prices, double-counting the stocks with options introduced at both ends, there are on average 166 stocks for 'below' (stocks with new options introduced below the prevailing minimum strike price) and 299 stocks for 'above' (stocks with new options introduced above the prevailing maximum strike price). Table B.1 shows the results using uni-directional signals by allowing stocks to be in both 'below' and 'above' portfolios. The results are not sensitive to the construction of INTRO_q3, which might force the stock to fit into the signal.

Table 2b reports the monthly average characteristics of portfolios sorted into INTRO_q3=-1, 0, 1, and the spread ('1 - (-1)'). 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.

## 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 information about the underlying stock. We would not expect any predictability if new strike prices were mechanically introduced by the exchanges.

The main result of this paper can be summarized by Figure 2. 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. This is consistent with strike price introductions at the extreme ends contain information about the underlying stock.

Table 3 shows the event time cumulative returns K months after portfolio formation up to 24 months for portfolios sorted by INTRO_q3 which corresponds to Figure 2. The cumulative event time return spread 12 months after portfolio formation between the portfolio with INTRO_q3=1 and INTRO_q3=-1 is 4.11% (t-statistic 4.28). Both portfolios with

INTRO_q3=1 and INTRO_q3=-1 are 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 captures the magnitude of investor demand, 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 results show statistically significant cumulative return spreads of 5.85% (t-statistic 4.95) 12 months after portfolio formation. When using excess returns of the characteristic-based benchmark portfolios, the cumulative returns are reduced to 2.99% (t-statistic 3.86) but remain statistically significant.

If the stock strategy has a significantly positive cumulative return spread, an options strategy that buys the new options should also have significant cumulative return spreads. Table 5 shows event time cumulative option strategy returns K months after portfolio formation up to 12 months. An option strategy is formed by buying new put options for INTRO_q3=-1 and new call options for INTRO_q3=1. Both sides of the strategy exhibits positive and significant abnormal returns up to 12 months after portfolio formation with larger magnitudes than the stock strategy.

The above results show that option strike price introductions predict future stock and option returns. The fact that there is a return spread is surprising, if the prior is that exchanges passively introduce new options.

Some might be concerned that the return spread is insignificant in the first few months. The delayed stock price response might be consistent with private information being incorporated through future news (Grossman and Stiglitz (1980)). For example, private information might be revealed through future earnings announcements. I find evidence supporting this channel in Section 5.7 and Section 6.4. But this does not entirely explain the delayed price response.

I also show that using daily event time returns for stocks with INTRO_q3=-1 and 1 does not significantly change results. Table B.3 shows that option strike price introductions affect the underlying stock price on the day of the introduction and the first day after the introduction. Undocumented tests show that even after the short-term reaction, there is a delayed response in the long-run.

## 5.4 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. Details on constructing the option variables 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. The correlation between INTRO_q3 and other existing variables are smaller than 0.15 in absolute values. These results suggest INTRO_q3 is unlikely to be proxying existing variables in the literature.

## 5.5 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. I run Fama and MacBeth (1973) regressions to control for multiple variables proposed in the literature at the same time. In addition, the magnitude of the predictability is easily interpretable in terms of average spread per month. However, 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.

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. 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.

However, 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 2.47) after controlling for stock- and option-level variables. This is consistent with INTRO_q3's long-term predictability. The INTRO_q3 has the largest coefficient among all variables in the regression. The magnitude of 0.10 can be translated into 0.20% ($0.10 \times 2$) return spread per month on average for the next 12 months between INTRO_q3=1 and INTRO_q3=-1.

Some might argue that the above list of stock and option measures includes a subset of the variables in the literature. However, I include the variables that are most likely affecting option strike price introductions. For example, the out-of-the-money put-call volume ratio (Kang et al. (2022)) captures how much volume the out-of-the-money call options had over the past month relative to out-of-the-money put options, which relates to the open interest or volume spillovers that may lead to new strike price introductions. The results show that this is unlikely the case.

## 5.6 Time-series Regressions

In this section, I construct monthly portfolios and explore their risk exposures to the Fama-French six-factors. The portfolios 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, are formed using 12 different portfolios formed in the past 12 months, each held for 12 months, to be consistent with the long-run predictability.

Table 8 shows time-series regressions of monthly portfolio returns using 12 month holding horizons on Fama and French (2018) six-factor returns plus the short-term reversal factor return.

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. The '1 - (-1)' is the difference between INTRO_q3=1 and INTRO_q3=-1. 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 six-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 lower half of the table, at the end of each month, stocks are divided into five groups: INTRO_q3=-2, -1, 0, 1, and 2. The '2 - (-2)' is the difference between INTRO_q5=2 and INTRO_q5=-2. 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 six-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 six-factor model plus short-term reversal.

The magnitude of the above spreads are nontrivial. Figure B.2 shows that based on anomaly return spreads from Chen and Zimmermann (2022) using top minus bottom decile sorts, the Sharpe ratio of the baseline portfolio with 12-month holding horizons is in the top 24% against the 180 value-weighted anomaly portfolios and the top 34% against the 213 anomaly portfolios using a 12-month holding horizon.

## 5.7 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.

### 5.7.1 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 option-level open interest by multiplying open interest by its contingent contracts (100 stocks per contract) and by dividing the stock's shares outstanding. Table 9 shows the average open interest scaled by shares outstanding K months after option introduction.

For 'options added below', where new options are introduced below the previous month's minimum strike price, the scaled call option open interest of 1.89% is significantly smaller than the put option open interest of 2.93% (the difference is -1.04%P with a t-statistic of -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 'options added above', where new options are introduced above the previous month's maximum strike price, the call option open interest of 3.66% is significantly larger than the put option open interest 0.61% (the difference is 3.06%P with a t-statistic of 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 more call options are traded than put options when new options are introduced above the prevailing maximum strike price, and more put options are traded than call options when new options are introduced below the prevailing minimum strike price. This supports the hypothesis that informed investors might be trading the newly added out-of-the-money options, which have higher leverage, after they are introduced.

In the Appendix, Table B.4 shows the new out-of-the-money puts and calls offer around 11% and 17% more leverage than those offered before. However, the bid-ask spread of new out-of-the-money puts and calls are 57.1% and 39.1%, respectively, which are significantly larger than those offered before. These results are consistent with informed traders benefiting from option introductions that enables cost-effective leverage but option market makers being aware of informed trading in newly introduced options.

### 5.7.2 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 10 shows event time portfolio returns K month after portfolio formation of portfolios double sorted by INTRO_q3 and past ITI. 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.

### 5.7.3 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 under high volume 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 11 shows event time portfolio returns K months after portfolio formation of portfolios double sorted by INTRO_q3 and past option-to-stock volume (O/S ratio, Johnson and So (2012)). It 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. 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.

#### 5.7.4 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 learn all available information about the target firm (Givoly and Lakonishok (1979), among others). However, if analysts have limited attention, the information from new option introductions above the prevailing maximum strike price and below the prevailing minimum strike price might not be immediately incorporated into the stock price. Therefore, I test whether analysts underreact to the information contained in strike price introductions.

Table 12 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 ($\tau$ = 0,1,2,...,11) after portfolio formation.

Table 12 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 similar results consistent with analyst underreaction.

The fact that most of the earnings forecast errors are driven by portfolio with INTRO_q3=-1 than INTRO_q3=1 in Table 12 is consistent with Table 3 where the magnitude of the returns are stronger for portfolio with INTRO_q3=-1 than INTRO_q3=1.

# 6 Additional Tests

## 6.1 Information on Volatility

In this section, I explore whether the information in option introductions are related to volatility. A delta-hedged option strategy captures the volatility of the underlying stock more than the direction of the underlying stock price. The positive abnormal returns of a delta-hedged option strategy implies information related to volatility. Thus, it is consistent with option introductions containing information about volatility. On the other hand, if the delta-hedged option strategy does not exhibit positive abnormal returns, then it is consistent with option introductions containing information about the direction of the underlying stock rather than its volatility.

To construct the delta-hedged option portfolio, I use call options for options introduced above the prevailing maximum strike price and put options for options introduced below the prevailing minimum strike price. This ensures using out-of-the-money options with high leverage that are newly introduced. The details of constructing the delta-hedge option portfolio is elaborated in Appendix A.

Table 13 shows delta-hedged option returns K (1 to 12) months after portfolio formation. It shows that delta-hedged put and call options both have positive and significant returns of 16.93% (t-statistic 6.94) and 8.26% (t-statistic 3.57) in the first month after portfolio formation. This result is consistent with option introductions containing information about the future volatility of the underlying stock, on top of directional information.

## 6.2 Option delistings

In this section, I examine whether option delistings as opposed to option introductions contain information about the underlying stock. It is unclear ex-ante whether the delistings contain information about the underlying stock. However, the rule books of the option exchanges state 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 driven by mechanical factors than by demand, contain information about the underlying stock.

To test this hypothesis, I introduce DELIST_q3 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 14 shows event time portfolio returns K months after portfolio formation sorted by DELIST_q3 and INTRO_q3, respectively. It 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 1.44) 12 months after portfolio formation. This is consistent with option delistings not predicting stock returns. Thus, option delistings are more likely to be driven by mechanical factors whereas option introductions are more likely to be investor demand.

The small positive return of 1.04%, 12 months after portfolio formation, 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. Table 14 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, consistent with delistings less likely to be driven by investor demand.

## 6.3 Index Options

In this section, I explore whether option introductions in index options contain information about the underlying index. The literature shows that predicting 1-month market returns is notoriously difficult (Welch and Goyal (2008), Campbell and Thompson (2008), among others), implying that it is unlikely that informed traders have private information about market-wide movements compared to individual stocks. If option introductions contain information about the future movements of underlying index, they should predict future index returns. To test this hypothesis, I regress future 1-month index returns on INTRO_q3 and INTRO variables for each index in the time-series, following Pan and Poteshman (2006).

I consider the following indexes: Dow Jones Industrial Average, NASDAQ 100, S&P 500, S&P 100, S&P Midcap 400, S&P Smallcap 600, Russell 2000, and AMEX, based on their data availability in OptionMetrics. If option introductions contain information, INTRO_q3 or INTRO should exhibit positive and significant coefficients.

Table 15 shows the results of time-series regressions of future 1-month index returns on current month's INTRO_q3 and INTRO for each corresponding index. The first and second set of results show that INTRO_q3 and INTRO, which incorporates the number of options, do not predict future index returns. All coefficients are insignificant at the 10% level. These results are consistent with index option introductions not containing information about the future movement of the index, and implies that individual stock option introductions contain information specific to the stock.

## 6.4 Robustness Tests

In this section, I conduct robustness tests by splitting the sample in the cross-section with stock and option characteristics.

### 6.4.1 Day of the Month of Option Introduction

Table B.9 shows the cumulative event time return spread between INTRO_q3=1 and -1, 12 months after portfolio formation is robust to using options with different introduction days within a month. The options are split into two groups: options introduced on the first trading day after the third Friday and other days. As shown in Figure B.3, option introductions are spread throughout the days of the month but 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 mechanical because exchanges need to fill in the expired options and set the range of strike prices. For other days, it is more likely to be driven by demand or price changes because they are unexpected. The cumulative event time return spread is slightly smaller when using options that are introduced immediately after the third Friday. This is consistent with the prediction that unexpected option introductions are likely to contain more information on the underlying stock than expected option introductions. Table B.10 shows the above result in more detail.

### 6.4.2 Option Maturities

Table B.9 shows the cumulative event time return spread between INTRO_q3=1 and -1, 12 months after portfolio formation is robust to using options with different maturities split into two groups: less than 100 days and more or equal to 100 days (the median maturity is 98 days for new options). 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. 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 roll over, because options lose value over time. It is difficult to identify whether informed traders are likely to trade short- or long-maturity options because the difference between the two return spreads is not large. This could also be partially due to the fact that when options are introduced, different maturities are introduced at the same time. But the slightly higher returns using long-maturity options likely suggests long-run information.

### 6.4.3 Earnings Announcements

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

First, I find that option introductions are not clustered in earnings announcement months. There are on average 157 and 294 stocks with INTRO_q3=-1 and 1, respectively (Table 2b), but only 26 and 45 stocks INTRO_q3=-1 and 1, respectively, that have options introduced in the same month of the underlying stock's quarterly earnings announcement. This shows that option introductions are less likely to be related to information about the quarterly earnings announcement in the same month.

However, Table B.9 shows that option introductions are likely to be explained by information about future quarterly earnings announcements. The cumulative event time return spread between INTRO_q3=1 and -1, 12 months after portfolio formation, is 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. But even for stocks with INTRO_q3=-1 or 1 that are not in the same month of quarterly earnings announcements, the return spread of 3.99% (t-statistic 3.95) 12 months after portfolio formation, comparable to the baseline result of 4.11% (4.28).

Second, Table B.9 shows that option introductions are not strongly associated with information on the closest earnings announcement. The cumulative event time return spread between INTRO_q3=1 and -1, 12 months after portfolio formation, is positive and significant whether or not the stock with extreme option introductions has a quarterly earnings announcement within 45 days or after. In both cases, the return spread 12 months after portfolio formation is similar. Table B.12 shows the above results in more detail.

### 6.4.4 Stock Borrowing Fees

Table B.9 shows that the return spread from option introductions are not explained by stock borrowing fees. The cumulative event time return spread between INTRO_q3=1 and INTRO_q3=-1, 12 months after portfolio formation, is positive and significant whether or not stocks have estimated borrowing fees above or below 1% (Muravyev et al. (2022)).

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 (borrowing fees higher than 1%). This is consistent with option introductions less likely to be related to short-selling constraints. The stock borrowing fees are estimated following Muravyev et al. (2022) and the details are elaborated in Appendix A. Table B.13 shows the above result in more detail.

### 6.4.5 Subperiod Analysis

Table B.9 shows that the cumulative event time return spread between INTRO_q3=1 and -1, 12 months after portfolio formation, is positive and significant in both of the two subperiods. Based on Bondarenko and Muravyev (2022), where they show that the predictability of option variables on future stock returns deteriorates after October 2009, following a massive crackdown on insider trading through options, I split the portfolio formation months into two periods: February 1997 to September 2009 and October 2009 to August 2023. This implies that the results are less likely due to illegal insider trading in options. Table B.14 shows the above result in more detail.

### 6.4.6 Event Study Specifications

Table B.15 shows that the results are robust to different specifications of event studies.

First, the results are robust to using Newey and West (1987) standard errors with twelve lags for event time cumulative returns. This mitigates the concern that the auto-correlation in cumulative returns for each event is driving the results because returns are overlapping.

Second, the results are robust to using control firms with matched characteristics as the benchmark portfolio. Barber and Lyon (1997) and Lyon et al. (1999) show that using abnormal returns against matched firms by size and book-to-market is effective in event studies. The control firm is selected as the following: First, among firms with options, firms within the target firm's market cap range of 70% to 130% are selected. Then, the firm that has the closest book-to-market value as the target firm is selected as the control firm.

Finally, the results are robust even after removing stocks that have multiple option introductions in the past 12 months. One of the major concerns in event studies that analyze long-run abnormal returns is overlapping periods of return calculation of the same stock (Lyon et al. (1999)). For example, if a given firm has multiple option introductions in the past 12 months, the next 12-month cumulative returns after each option introduction are not independent events because the returns share overlapping months. To address this concern, I repeat the event time analysis using a subsample of stocks with INTRO_q=1 (=-1) that did not experience any option introductions above (below) the prevailing maximum (minimum) strike price in the past 12 months, following Lyon et al. (1999).

All three specifications have positive and significant spreads 12 months after portfolio formation. The results are robust to different types of event time specifications.

#### 6.4.7 Double-sorted Portfolio Returns

Table B.5, Table B.6, and Table B.7 show the cumulative event time return spread between INTRO_q3=1 and -1, 12 months after portfolio formation, is robust to double-sorting portfolios by past 1-month return, momentum, and idiosyncratic volatility. These variables are likely to be used by exchanges when they introduce options in response to price changes. A caveat is that option introductions might be correlated with the above variables. 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 ensure there are sufficient number of stocks in each portfolio, I sequentially sort the portfolios first by INTRO_q3 then by the above variables. The results show that the return spread is not explained by past 1-month return, momentum, and idiosyncratic volatility.

Table B.8 shows the cumulative event time return spread between INTRO_q3=1 and -1, 12 months after portfolio formation, is robust to double-sorting portfolios by stock characteristics: maximum cumulative returns, market cap, and book-to-market. The results suggest that the above stock characteristics do not explain the spread between INTRO_q3=1 and INTRO_q3=-1.

# 7 Conclusion

I examine the information content of option introductions with new strike prices. Exchanges introduce options with new strike prices for individual stock options not only in response to price changes but to investor demand. If the strike price introductions were passively carried out by the exchanges, no information should be contained in the strike price introductions in addition to the price changes themselves. However, stocks with options introduced above the prevailing maximum strike price outperform those with options introduced below the prevailing minimum strike price by up to 6% over the following 12 months. While this result is neither explained by stock-price momentum nor a variety of other documented stock and option variables, it is stronger for stocks with high informed trading intensity and high option-to-stock volume ratio, consistent with informed traders disguising their trades in high volume. The new out-of-the-money options with higher leverage are actively traded after introduction. This suggests that informed investors with private information drive the introduction of new strike prices to enable cost-effective leverage.

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Table 1: Determinants of Strike Price Introductions

This table shows Fama and MacBeth (1973) regressions of indicator variables for option introductions with strike prices above or below the prevailing strike prices on stock and option characteristics following equation 3 and 4. The definition of variables are presented in Section 5.1. 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. T-statistics are reported in parentheses. 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) |
| $const$ | 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 and below the prevailing range of strike prices, 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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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_1M_mean' reports the average 1-month return. The 'ret_MOM_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_log_mean' 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_1M_mean (%) | -7.44 | 0.58 | 9.21 | 16.64 | (42.92) |
| ret_MOM_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 (in %) K months after portfolio formation up to 24 months using three groups of INTRO_q3. The event at Month=0 is the month when the options are 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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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 (in %) K months after portfolio formation up to 24 months using five groups of INTRO_q5. The event at Month=0 is the month when the options are 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: Event Time Option Strategy Returns for INTRO_q3=-1, 1

This table shows event time cumulative option strategy returns (in %) K months after portfolio formation up to 12 months. At the end of each month $t$, the returns for new put options for INTRO_q3=-1 and new call options for INTRO_q3=1 are calculated. The monthly returns are equally weighted at the stock-month level, then value-weighted by the underlying stock's market cap at each month. The options are held from the end of the month $t$, where they were introduced, until the end of the month $T-1$, just before the expiration month $T$. Stocks are required to have at least one listed option before portfolio formation. The option returns are calculated using an effective spread of 50% and are winsorized at the 1% and 99% level each month. At the end of each month $t$, options are required to have expiration dates beyond the end of month $t+1$. Stocks with prices less than $1 are excluded. The sample period is 1996-2023.

| | INTRO_q3 | | | |
|---|---|---|---|---|
| | buy put option | | buy call option | |
| Month | -1 | t-stat | 1 | t-stat |
| 1 | 9.19 | (0.61) | -0.94 | (-0.46) |
| 2 | 14.51 | (0.93) | 7.48 | (2.13) |
| 3 | 22.98 | (1.46) | 13.92 | (3.47) |
| 4 | 31.39 | (1.98) | 21.43 | (4.10) |
| 5 | 41.08 | (2.53) | 26.49 | (4.56) |
| 6 | 54.52 | (3.16) | 35.74 | (5.04) |
| 7 | 63.95 | (3.56) | 40.38 | (5.36) |
| 8 | 70.69 | (3.72) | 41.64 | (5.24) |
| 9 | 71.00 | (3.70) | 46.86 | (5.48) |
| 10 | 72.94 | (3.73) | 47.48 | (5.48) |
| 11 | 75.25 | (3.80) | 48.40 | (5.45) |
| 12 | 79.58 | (3.84) | 48.39 | (5.33) |

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_1M'), 1-month idiosyncratic volatility ('ret_ivol'), 11-month return skipping the most recent month ('ret_MOM'), log market cap ('mcap_log'), log book-to-market ratio ('beme_log'), profitability ('profitability'), and investment ('investment'). 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 ('O/S ratio', Johnson and So (2012)), 1-month average implied volatility spread ('volatility_spread', Cremers and Weinbaum (2010)), 1-month average implied volatility skew ('volatility_skew', Xing et al. (2010)), 1-month percentage change in call-put open interest ratio ('Δcall_put_open_interest', Fodor et al. (2011)), out-of-the-money put-call open interest ratio ('OTM_put_call_OI', Kang et al. (2022)), out-of-the-money put-call volume ratio ('OTM_put_call_volume', Kang et al. (2022)), open interest-weighted average moneyness ('avg_moneyness_OI', Bergsma et al. (2020)), volume-weighted average moneyness ('avg_moneyness_volume', Bergsma et al. (2020)). Details on constructing the option variables 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_1M | 0.25 | 0.27 |
| ret_ivol | -0.08 | -0.07 |
| ret_MOM | 0.16 | 0.17 |
| mcap_log | 0.10 | 0.10 |
| beme_log | 0.01 | 0.00 |
| profitability | 0.00 | 0.00 |
| investment | 0.00 | 0.00 |
| volatility_spread | -0.06 | -0.06 |
| volatility_skew | -0.01 | -0.02 |
| ΔCVOL | -0.04 | -0.04 |
| ΔPVOL | -0.04 | -0.04 |
| avg_moneyness_volume | -0.09 | -0.09 |
| avg_moneyness_OI | -0.13 | -0.14 |
| O/S ratio | 0.03 | 0.03 |
| Δcall_put_open_interest | 0.00 | 0.00 |
| OTM_put_call_volume | 0.10 | 0.10 |
| OTM_put_call_OI | 0.07 | 0.08 |

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_1M'), log market cap ('mcap_log'), log book-to-market ratio ('beme_log'), 11-month return skipping the most recent month ('ret_MOM'), 1-month idiosyncratic volatility ('ret_ivol'), profitability ('profitability'), and investment ('investment'). 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 ('O/S ratio', Johnson and So (2012)), 1-month average implied volatility spread ('volatility_spread', Cremers and Weinbaum (2010)), 1-month average implied volatility skew ('volatility_skew', Xing et al. (2010)), 1-month percentage change in call-put open interest ratio ('Δcall_put_open_interest', Fodor et al. (2011)), out-of-the-money put-call open interest ratio ('OTM_put_call_OI', Kang et al. (2022)), out-of-the-money put-call volume ratio ('OTM_put_call_volume', Kang et al. (2022)), open interest-weighted average moneyness ('avg_moneyness_OI', Bergsma et al. (2020)), volume-weighted average moneyness ('avg_moneyness_volume', Bergsma et al. (2020)). Details on constructing the option variables 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.

| | Stocks with options | | | | | |
|---|---|---|---|---|---|---|
| variables | | ret 1M | | | ret 12M | |
| INTRO_q3 | 0.18 | 0.05 | 0.03 | 0.12 | 0.11 | 0.10 |
| | (1.16) | (0.53) | (0.31) | (1.67) | (2.59) | (2.47) |
| ret_1M | | -0.23 | -0.22 | | -0.02 | -0.02 |
| | | (-2.79) | (-2.83) | | (-0.52) | (-0.42) |
| mcap_log | | -0.06 | -0.06 | | -0.03 | -0.02 |
| | | (-1.32) | (-1.25) | | (-0.39) | (-0.32) |
| beme_log | | 0.06 | 0.06 | | 0.09 | 0.09 |
| | | (0.78) | (0.74) | | (0.57) | (0.58) |
| ret_MOM | | 0.15 | 0.15 | | -0.08 | -0.07 |
| | | (1.49) | (1.59) | | (-0.88) | (-0.87) |
| ret_ivol | | -0.27 | -0.27 | | -0.05 | -0.05 |
| | | (-2.60) | (-2.69) | | (-0.34) | (-0.44) |
| profitability | | 0.08 | 0.08 | | 0.06 | 0.06 |
| | | (2.40) | (2.38) | | (1.48) | (1.53) |
| investment | | -0.07 | -0.06 | | -0.08 | -0.08 |
| | | (-2.10) | (-1.95) | | (-3.93) | (-3.85) |
| ΔCVOL | | | 0.19 | | | 0.01 |
| | | | (5.48) | | | (1.90) |
| ΔPVOL | | | -0.22 | | | -0.02 |
| | | | (-6.74) | | | (-3.44) |
| O/S ratio | | | -0.11 | | | -0.03 |
| | | | (-3.31) | | | (-1.02) |
| volatility_spread | | | 0.07 | | | 0.08 |
| | | | (1.97) | | | (2.52) |
| volatility_skew | | | -0.02 | | | -0.03 |
| | | | (-0.81) | | | (-1.33) |
| Δcall_put_open_interest | | | 0.03 | | | 0.01 |
| | | | (2.03) | | | (1.47) |
| OTM_put_call_OI | | | -0.02 | | | -0.01 |
| | | | (-0.73) | | | (-1.14) |
| OTM_put_call_volume | | | -0.02 | | | 0.03 |
| | | | (-0.66) | | | (1.82) |
| avg_moneyness_OI | | | -0.14 | | | -0.02 |
| | | | (-1.67) | | | (-0.52) |
| avg_moneyness_volume | | | 0.14 | | | 0.03 |
| | | | (1.85) | | | (1.01) |
| const | 0.85 | 1.83 | 1.75 | 0.92 | 1.37 | 1.29 |
| | (2.38) | (2.09) | (2.02) | (1.79) | (0.99) | (0.95) |
| Avg. Adj. $R^2$ | 0.5% | 6.0% | 6.7% | 0.3% | 7.0% | 7.7% |
| Avg. N. stocks | 2190 | 2190 | 2190 | 2055 | 2055 | 2055 |
| Months | 330 | 330 | 330 | 323 | 323 | 323 |

Table 8: Time-series Regressions

This table shows monthly regressions of portfolio returns using 12 month holding horizons on Fama and French (2018) six-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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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 9: Event Time Open Interest of Introduced Options

This table shows the open interest scaled by shares outstanding K months after option introduction. The scaled open interest captures the percentage of stocks contingent to the option contract to the number of shares outstanding for each stock. The event at Month=0 is the month when the options are introduced. For each stock-month, scaled open interest is added up at the stock-month level across all call and put options, respectively, and across stocks with options added above and below the prevailing strike prices, respectively, in four groups (call, put, above, below). Then, the sum of scaled open interest is value-weighted across the four groups. Finally, the value-weighted sum of scaled open interest is average across all months in the sample period across the four groups. T-statistics are reported in parentheses. 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.

| | options added below | | | | options added above | | | |
|---|---|---|---|---|---|---|---|---|
| Month | call | put | call-put | t-stat | call | put | call-put | t-stat |
| 0 | 1.89 | 2.93 | -1.04 | (-4.76) | 3.66 | 0.61 | 3.06 | (16.28) |
| 1 | 2.56 | 3.94 | -1.38 | (-6.39) | 7.00 | 1.47 | 5.54 | (20.24) |
| 2 | 1.95 | 3.67 | -1.71 | (-9.34) | 6.92 | 1.49 | 5.43 | (19.16) |
| 3 | 2.06 | 3.99 | -1.93 | (-10.39) | 7.54 | 1.81 | 5.73 | (19.10) |
| 4 | 2.14 | 4.24 | -2.10 | (-10.77) | 7.66 | 2.07 | 5.58 | (19.17) |
| 5 | 2.05 | 4.11 | -2.05 | (-10.04) | 7.40 | 2.18 | 5.22 | (18.53) |
| 6 | 1.94 | 4.08 | -2.14 | (-9.51) | 6.93 | 2.26 | 4.68 | (17.07) |
| 7 | 1.67 | 3.57 | -1.90 | (-9.16) | 6.14 | 2.01 | 4.13 | (12.07) |
| 8 | 0.84 | 2.45 | -1.60 | (-8.36) | 4.90 | 1.52 | 3.39 | (10.92) |
| 9 | 0.91 | 2.47 | -1.56 | (-8.16) | 4.79 | 1.54 | 3.25 | (11.47) |
| 10 | 0.81 | 2.34 | -1.53 | (-8.33) | 4.65 | 1.61 | 3.04 | (11.99) |
| 11 | 0.78 | 2.21 | -1.43 | (-8.41) | 4.45 | 1.63 | 2.82 | (13.92) |
| 12 | 0.82 | 2.18 | -1.37 | (-8.42) | 4.32 | 1.70 | 2.62 | (14.20) |

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

This table shows event time portfolio returns (in %) K months after portfolio formation of portfolios double sorted by INTRO_q3 and past informed trading intensity (ITI, Bogousslavsky et al. (2024)). The event at Month=0 is the month when the options are 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 11: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by O/S ratio

This table shows event time portfolio returns (in %) K months after portfolio formation of portfolios double sorted by INTRO_q3 and past option-to-stock volume (O/S ratio, Johnson and So (2012)). The event at Month=0 is the month when the options are 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 12: 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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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 ($\tau$ = 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. T-statistics are reported in parentheses. 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 13: Event Time Delta-hedged Option Returns for INTRO_q3=-1, 1

This table shows event time cumulative delta-hedged option returns (in %) K months after portfolio formation up to 12 months. At the end of each month $t$, delta-hedged returns of new put options for INTRO_q3=-1 and new call options for INTRO_q3=1 are calculated. The monthly returns are equally weighted at the stock-month level, then value-weighted by the underlying stock's market cap at each month. The options are held from the end of the month $t$, where they were introduced, until the end of the month $T-1$, just before the expiration month $T$. Stocks are required to have at least one listed option before portfolio formation. The option returns are calculated from bid-ask midpoint option prices and are winsorized at the 1% and 99% level each month. At the end of each month $t$, options are required to have expiration dates beyond the end of month $t+1$. Stocks with prices less than $1 are excluded. The sample period is 1996-2023.

| | INTRO_q3 | | | |
|---|---|---|---|---|
| | buy put option | | buy call option | |
| Month | -1 | t-stat | 1 | t-stat |
| 1 | 16.93 | (6.94) | 8.26 | (3.57) |
| 2 | 23.44 | (7.34) | 8.67 | (3.10) |
| 3 | 24.89 | (6.83) | 8.25 | (2.82) |
| 4 | 26.68 | (7.19) | 6.09 | (1.76) |
| 5 | 29.21 | (6.63) | 4.84 | (1.36) |
| 6 | 30.09 | (6.48) | 3.60 | (0.95) |
| 7 | 31.49 | (6.52) | 1.03 | (0.26) |
| 8 | 30.94 | (6.57) | -1.19 | (-0.30) |
| 9 | 31.27 | (6.14) | -1.93 | (-0.48) |
| 10 | 30.16 | (6.01) | -3.55 | (-0.85) |
| 11 | 29.81 | (5.38) | -5.75 | (-1.37) |
| 12 | 27.71 | (5.52) | -7.33 | (-1.72) |

Table 14: Event Time Returns for DELIST_q3=-1, 1

This table shows event time portfolio returns (in %) 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) | 0.06 | (0.10) |
| 8 | 3.31 | (4.44) | 0.82 | (1.48) | 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 | (1.44) | 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) | 0.47 | (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) | 1.81 | (1.90) |
| 19 | 5.22 | (4.49) | 2.13 | (2.37) | 1.87 | (1.90) |
| 20 | 5.04 | (4.33) | 2.09 | (2.30) | 1.81 | (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 | (1.35) | 0.90 | (0.84) |

Table 15: Index Options

This table shows the results of time-series regressions of future 1-month index returns on current month's INTRO_q3 and INTRO for each corresponding index. The following indexes are considered: Dow Jones Industrial Average (1997-10 to 2023-08), NASDAQ 100 (1996-01 to 2023-08), S&P 500 (1996-01 to 2023-08), S&P 100 (1996-01 to 2023-08), S&P Midcap 400 (1996-01 to 2012-05), S&P Smallcap 600 (1996-01 to 2012-02), Russell 2000 (1996-01 to 2023-08), and AMEX (1996-01 to 2008-10). The ticker, coefficient estimate, t-statistic, $R^2$ (in %), and the number of months are reported. The number of months varies based on the data availability from OptionMetrics for each index. The sample period is 1996-2023.

| | | INTRO_q3 | | | INTRO | | | |
|---|---|---|---|---|---|---|---|---|
| index | ticker | estimate | t-stat | $R^2$ | estimate | t-stat | $R^2$ | N |
| Dow Jones | DJX | -0.258 | -0.31 | 0.03 | 0.001 | 0.11 | 0.00 | 310 |
| NASDAQ 100 | NDX | 0.820 | 1.05 | 0.34 | -0.001 | -0.10 | 0.00 | 331 |
| S&P 500 | SPX | -0.096 | -0.15 | 0.01 | -0.013 | -0.81 | 0.20 | 331 |
| S&P 100 | OEX | -0.735 | -1.48 | 0.66 | -0.001 | -0.05 | 0.00 | 331 |
| S&P Midcap 400 | MID | -0.246 | -0.30 | 0.05 | 0.023 | 1.28 | 0.84 | 197 |
| S&P Smallcap 600 | SML | -0.331 | -0.47 | 0.12 | 0.049 | 1.55 | 1.23 | 194 |
| Russell 2000 | RUT | -0.215 | -0.31 | 0.03 | 0.009 | 0.77 | 0.18 | 331 |
| AMEX | XMI | 0.417 | 0.50 | 0.17 | 0.019 | 0.69 | 0.32 | 154 |

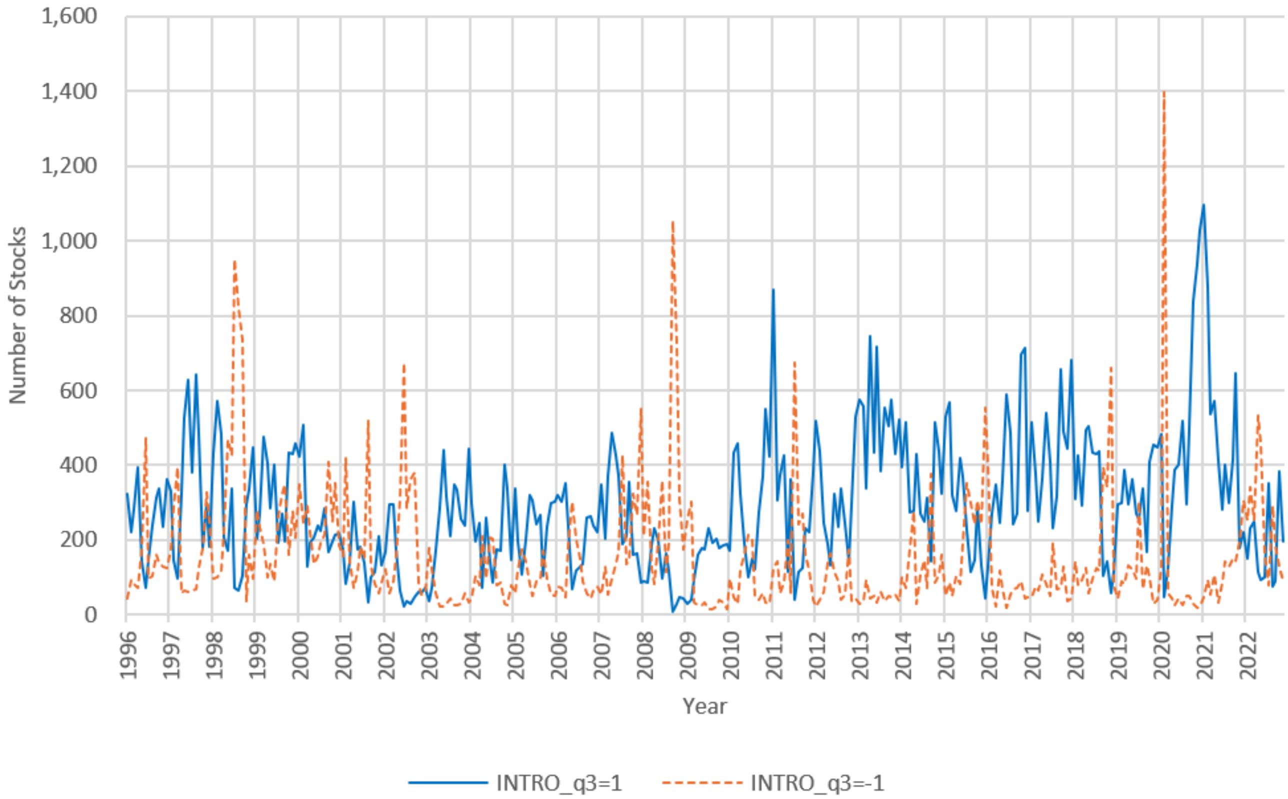


Figure 1: Number of Stocks with Extreme Option Introductions

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 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price and INTRO_q3=-1 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.

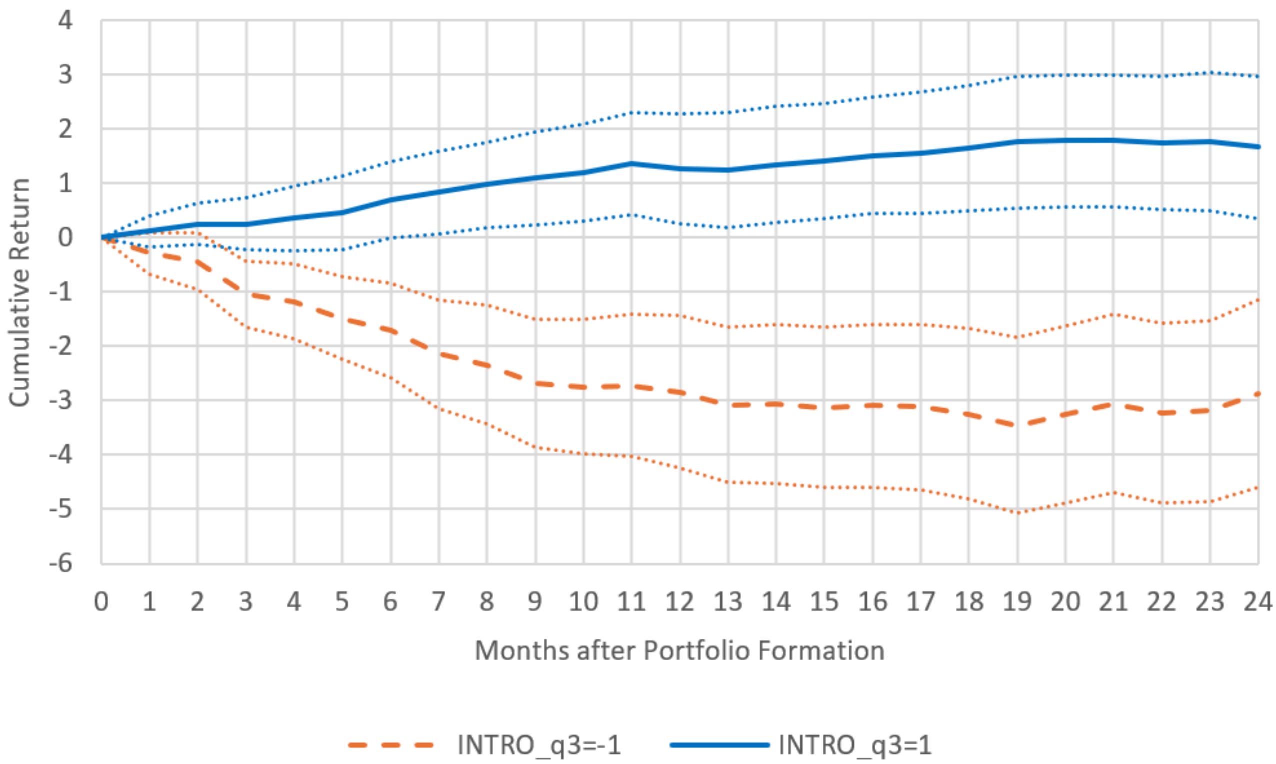


Figure 2: Portfolio Returns After Portfolio Formation

This figure shows the event time cumulative returns (in %) K months after portfolio formation up to 24 months for INTRO_q3=1 and INTRO_q3=-1. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price and INTRO_q3=-1 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.

# Internet Appendix

## 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 Implied Volatility 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 implied volatility 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 implied volatility skew measure takes the average of the daily implied volatility skew for each stock for a given month.

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

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

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

$$avg\_moneyness\_OI = \sum_i \frac{K_i}{S} \times \frac{MP_i \times OI_i}{TotalOI}$$

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

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:

$$OTM\_put\_call\_volume_{i,t} = \frac{\text{Sum of OTM trading volume of puts}}{\text{Sum of OTM trading volume of all options}}$$

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

The *OTM_put_call_volume* is calculated using trading volume of puts and calls which is straightforward. The *OTM_put_call_OI* requires more details on the construction. $\Delta_+$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.

## A.8 Delta-hedged option portfolios

I compute monthly delta-hedged returns in 6.1 for each option following Frazzini and Pedersen (2022). At the end of each month $t$, I construct a delta-hedged position for each option introduced starting with \$1 worth of options. The portfolio value $V$ is iteratively calculated by equation 5, starting from $V_0 = 1$. The portfolio value $V$ is given by

$$V_t = V_{t-1} + x(F_t - F_{t-1}) - x\Delta_{t-1}R_t^S S_{t-1} + R_t^f(V_{t-1} - xF_{t-1} + x\Delta_{t-1}S_{t-1}), \tag{5}$$

where $F$ is the option price, $S$ is the stock price, $x$ is the number of option contracts ($x = 1/F_0$), $\Delta$ is the option delta, $R_t^S$ is the monthly stock return, and $R_t^f$ is the monthly risk free rate. The delta-hedged portfolios are rebalanced monthly using updated delta, unlike Frazzini and Pedersen (2022) where they use daily rebalanced portfolios. The monthly return of the delta-hedged portfolio at the end of month $t$ is given by $V_t - V_{t-1}$ ($V_1 - V_0 = V_1 - 1$ for the first month). The option price and option delta is given by OptionMetrics where they use the Cox et al. (1979) model to calculate delta for American options.

The monthly delta-hedged portfolio returns for each option is equally weighted across each stock-month and INTRO_q3 (=1 or -1). This is equivalent to investors equally buying all out-of-the-money options that were newly introduced. Then, stock-month delta-hedged portfolio returns are value-weighted by the underlying stock's market capitalization to form event time portfolios up to 12 months after portfolio formation.

## A.9 Stock borrowing fees (Muravyev et al. (2022))

Muravyev et al. (2022) show that stock borrowing fees explain a significant portion of stock returns 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 $\sigma_C$ ($\sigma_P$) 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.

# Appendix B Figures and Tables

Firm A's stock price in Figure B.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, since two strike prices were introduced above the prevailing maximum strike price. Also, INTRO_q3=1, since INTRO is positive. On the other hand, Firm B's stock price 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, since one strike price was introduced below the prevailing minimum strike price. Also, INTRO_q3=-1 because INTRO is negative.

| | Firm A | | Firm B | |
|---|---|---|---|---|
| | 2022-02-28 | 2022-03-31 | 2022-02-28 | 2022-03-31 |
| Stock Price | 46 | 56.2 | 28.1 | 28.8 |
| | INTRO_q3 = 1 | | INTRO_q3 = -1 | |
| | Strike price | Strike price | Strike price | Strike price |
| | | **80** | ... | ... |
| | | **75** | 22.5 | 22.5 |
| | 70 | 70 | 20 | 20 |
| | 65 | 65 | 17.5 | 17.5 |
| | 60 | 60 | 15 | 15 |
| | ... | ... | | **12.5** |

Figure B.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.

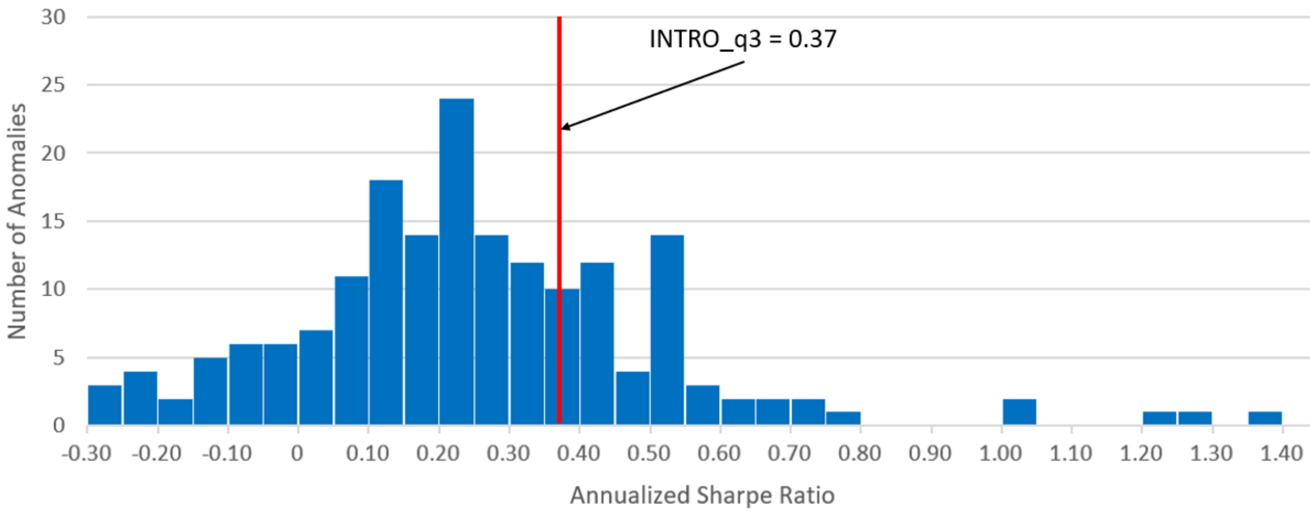


Figure B.2: Annualized Sharpe Ratio of Stock Anomalies

This figure shows the annualized Sharpe ratio of 180 stock anomalies from Chen and Zimmermann (2022) that use value-weighted long-short decile portfolios. INTRO_q3 shows the Sharpe ratio of the return spread between stocks with options introduced above and below the prevailing strike prices. The sample period is March 1996 to December 2023.

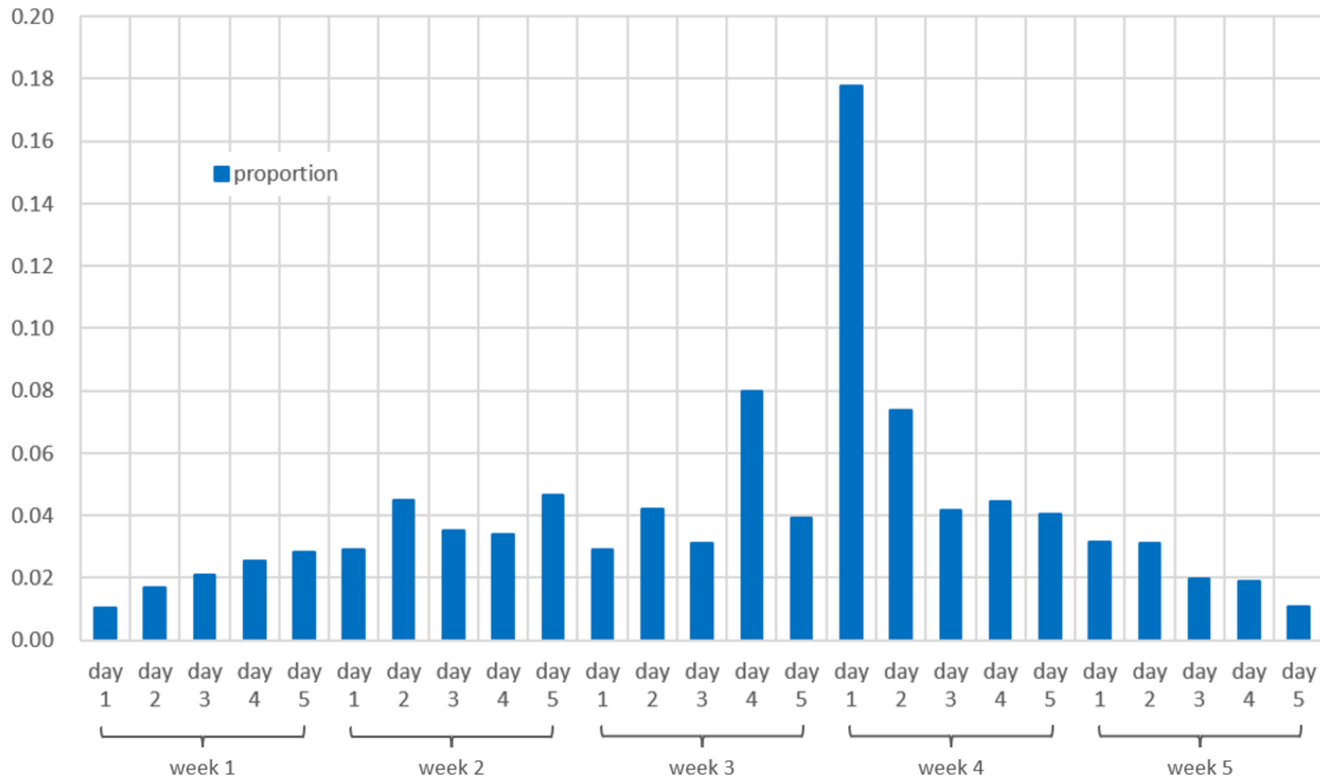


Figure B.3: Proportion of Option Introductions in Days of the Week for each Month

This figure 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: Event Time Returns for Above, Below, and Spread

This table shows the event time cumulative returns (in %) K months after portfolio formation up to 24 months using three groups of stocks based on option introductions. The event at Month=0 is the month when the options are introduced. At the end of each month, stocks are divided into three groups: options introduced above or below the prevailing range of strike prices, or options not introduced at all. The 'above' represents a portfolio of stocks with new options introduced above the prevailing maximum strike price, the 'below' represents a portfolio of stocks with new options introduced below the prevailing minimum strike price, and 'none' represents the rest of the stocks. For 'above' and 'below', the market return is subtracted. Note that a given stock is allowed to be in the 'above' and 'below' portfolio at the same time. The 'a - b' is the difference between 'above' and 'below'. The corresponding t-statistics for the 'a - b' 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.

| | Option introduction | | | | Long-short | | DGTW (1997) | |
|---|---|---|---|---|---|---|---|---|
| Month | below | t-stat | above | t-stat | a - b | t-stat | a - b | t-stat |
| 1 | -0.25 | (-1.37) | 0.12 | (0.88) | 0.38 | (1.38) | 0.09 | (0.48) |
| 2 | -0.43 | (-1.74) | 0.27 | (1.45) | 0.71 | (1.92) | 0.17 | (0.74) |
| 3 | -1.04 | (-3.59) | 0.28 | (1.22) | 1.32 | (3.11) | 0.37 | (1.38) |
| 4 | -1.19 | (-3.62) | 0.43 | (1.57) | 1.62 | (3.28) | 0.53 | (1.66) |
| 5 | -1.52 | (-4.08) | 0.54 | (1.72) | 2.06 | (3.64) | 0.81 | (2.32) |
| 6 | -1.73 | (-4.11) | 0.83 | (2.53) | 2.56 | (4.31) | 1.11 | (3.01) |
| 7 | -2.17 | (-4.46) | 0.95 | (2.64) | 3.12 | (4.70) | 1.55 | (3.83) |
| 8 | -2.36 | (-4.40) | 1.07 | (2.77) | 3.42 | (4.76) | 1.83 | (4.18) |
| 9 | -2.66 | (-4.65) | 1.22 | (2.98) | 3.89 | (5.07) | 2.15 | (4.61) |
| 10 | -2.79 | (-4.64) | 1.30 | (2.99) | 4.08 | (5.12) | 2.27 | (4.68) |
| 11 | -2.75 | (-4.30) | 1.46 | (3.18) | 4.20 | (4.93) | 2.37 | (4.63) |
| 12 | -2.85 | (-4.18) | 1.41 | (2.90) | 4.26 | (4.64) | 2.38 | (4.45) |
| 13 | -3.11 | (-4.45) | 1.39 | (2.78) | 4.50 | (4.78) | 2.49 | (4.60) |
| 14 | -3.12 | (-4.37) | 1.46 | (2.85) | 4.58 | (4.77) | 2.54 | (4.49) |
| 15 | -3.18 | (-4.39) | 1.50 | (2.89) | 4.68 | (4.80) | 2.75 | (4.72) |
| 16 | -3.17 | (-4.29) | 1.60 | (3.09) | 4.77 | (4.83) | 2.83 | (4.79) |
| 17 | -3.15 | (-4.25) | 1.64 | (3.03) | 4.78 | (4.75) | 2.81 | (4.64) |
| 18 | -3.28 | (-4.28) | 1.67 | (2.91) | 4.95 | (4.67) | 2.92 | (4.61) |
| 19 | -3.52 | (-4.37) | 1.76 | (2.97) | 5.28 | (4.73) | 3.13 | (4.74) |
| 20 | -3.28 | (-4.09) | 1.79 | (3.00) | 5.07 | (4.55) | 2.90 | (4.28) |
| 21 | -3.06 | (-3.80) | 1.81 | (3.03) | 4.87 | (4.43) | 2.64 | (3.82) |
| 22 | -3.27 | (-4.00) | 1.80 | (3.02) | 5.07 | (4.59) | 2.63 | (3.78) |
| 23 | -3.22 | (-3.87) | 1.82 | (2.89) | 5.03 | (4.40) | 2.62 | (3.61) |
| 24 | -2.82 | (-3.29) | 1.73 | (2.69) | 4.55 | (3.91) | 2.30 | (3.07) |

Table B.2: 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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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.3: Daily Event Time Returns for INTRO_q3=-1, 1

This table shows event time returns (in %) K (=-1,0,1,2,3) days before and after option introductions for INTRO_q3=-1 and 1. The event at Day=0 is the day when the options are 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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, and INTRO_q3=0 represents the rest of the stocks. For INTRO_q3=1 and INTRO_q3=-1, the market return is subtracted. Stocks with INTRO_q3=1 and INTRO_q3=-1 are value-weighted by their market cap at the end of each event day. Then, the portfolio returns averaged across each day 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.

| | INTRO_q3 | | | |
|---|---|---|---|---|
| Day | -1 | t-stat | 1 | t-stat |
| -1 | -1.99 | (-29.25) | 1.55 | (21.40) |
| 0 | -0.65 | (-11.95) | 0.33 | (8.19) |
| 1 | 0.07 | (2.05) | -0.03 | (-1.64) |
| 2 | -0.04 | (-1.35) | -0.01 | (-0.63) |
| 3 | 0.00 | (-0.08) | -0.01 | (-0.65) |

Table B.4: Leverage Ratio and Bid-Ask Spread for New Options

This table shows the leverage ratio and bid-ask spread of new out-of-the-money call options for INTRO_q3=1 and new out-of-the-money put options for INTRO_q3=-1. The call (put) option with the highest strike price that is introduced above the prevailing maximum (below the prevailing minimum) strike price in month $t$ is matched to the call (put) option with the maximum strike price in month $t-1$ and with the same expiration date. The leverage of each option is calculated as the delta times the underlying stock price divided by the option price given by the bid-ask midpoint. The leverage ratio is the ratio of new option leverage and old option leverage. The bid-ask spread is calculated as the best offer minus the best bid divided by the bid-ask midpoint. The variables are equally weighted across stock-months and value-weighted by the underlying stock's market cap across each month. Options are required to have days to maturity between 50 and 365 days, positive open interest, and non-zero best bid price. Around 47 and 105 options for INTRO_q3=-1 and 1, respectively, are analyzed per month on average. The sample period is 1996-2023.

| variable | new OTM put | new OTM call |
|---|---|---|
| leverage (new) | 5.5 | 9.7 |
| leverage (old) | 5.0 | 8.4 |
| leverage ratio (new/old) | 1.11 | 1.17 |
| bid-ask spread (%, new) | 57.1 | 39.1 |
| bid-ask spread (%, old) | 30.1 | 21.4 |

Table B.5: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by 1-month Return

This table shows event time portfolio returns (in %) K months after portfolio formation of portfolios double sorted by INTRO_q3 and past 1-month return. The event at Month=0 is the month when the options are 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 B.6: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by Momentum

This table shows event time portfolio returns (in %) K months after portfolio formation of portfolios double sorted by INTRO_q3 and momentum. The event at Month=0 is the month when the options are 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 B.7: Event Time Returns for INTRO_q3=-1, 1 Double-sorted by IVOL

This table shows event time portfolio returns (in %) K months after portfolio formation of portfolios double sorted by INTRO_q3 and idiosyncratic volatility (IVOL). The event at Month=0 is the month when the options are 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 B.8: Event Time Double-sorted Returns for INTRO_q3=-1, 1

This table shows event time portfolio returns (in %) K months after portfolio formation. The event at Month=0 is the month when the options are 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.9: Robustness Tests

This table shows cumulative event time return spread (in %) between INTRO_q3=1 and -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 6.4. INTRO_q3=1 represents a portfolio of stocks with new options introduced above the prevailing maximum strike price (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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 -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.

| Variables | Month 12<br>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) |
| | | |
| Option 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) |

Table B.10: Event Time Returns for INTRO_q3=-1, 1 split by Day of the Month of Option Introduction

This table shows event time portfolio returns (in %) K months after portfolio formation split by the day of the month of option introduction. The event at Month=0 is the month when the options are 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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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.11: Event Time Returns for INTRO_q3=-1, 1 Split by Maturity

This table shows event time portfolio returns (in %) K months after portfolio formation split by option maturity at the time of option introduction. The event at Month=0 is the month when the options are 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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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.12: Event Time Returns for INTRO_q3=-1, 1 Split by Earnings Month

This table shows event time portfolio returns (in %) 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 the month when the options are 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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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.13: 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 portfolios double sorted by INTRO_q3 and estimated borrowing fees (Muravyev et al. (2022)). The event at Month=0 is the month when the options are 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.14: Subperiod Analysis

This table shows the event time cumulative returns (in %) 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 the month when the options are 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 (at the end of the previous month) over the past month, INTRO_q3=-1 represents a portfolio of stocks with new options introduced below the prevailing minimum strike price (at the end of the previous month) over the past month, 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) |

Table B.15: Event Time Returns with Different Specifications

This table shows the event time cumulative returns (in %) of the spread between INTRO_q3=1 and INTRO_q3=-1 using three different specifications: using Newey and West (1987) standard errors with twelve lags, using control firms as the benchmark portfolio instead of the market return, and using stocks with INTRO_q=1 (=-1) without option introductions above (below) the prevailing maximum (minimum) strike price in the past 12 months. The control firm is selected as the firm with the closest book-to-market value as the target firm, within the firms with 70% to 130% market cap of the target firm. 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.

| | Newey-West | | Control firms | | No overlap | |
|---|---|---|---|---|---|---|
| Month | spread | t-stat | spread | t-stat | spread | t-stat |
| 1 | 0.41 | (1.64) | 0.11 | (0.42) | 0.27 | (0.80) |
| 2 | 0.69 | (1.66) | 0.31 | (0.81) | 0.33 | (0.73) |
| 3 | 1.29 | (2.28) | 0.43 | (1.00) | 0.94 | (1.69) |
| 4 | 1.53 | (2.08) | 0.61 | (1.18) | 1.04 | (1.53) |
| 5 | 1.94 | (2.10) | 1.05 | (1.79) | 0.98 | (1.40) |
| 6 | 2.41 | (2.24) | 1.24 | (2.00) | 1.39 | (2.00) |
| 7 | 2.97 | (2.48) | 1.69 | (2.46) | 2.08 | (2.66) |
| 8 | 3.31 | (2.46) | 1.91 | (2.60) | 2.19 | (2.64) |
| 9 | 3.77 | (2.49) | 2.02 | (2.59) | 2.70 | (2.77) |
| 10 | 3.95 | (2.51) | 2.05 | (2.53) | 2.94 | (2.92) |
| 11 | 4.09 | (2.47) | 1.99 | (2.35) | 3.21 | (3.03) |
| 12 | 4.11 | (2.17) | 1.77 | (1.99) | 3.53 | (3.03) |