Unveiling the Sophistication: Understanding Retail Investors' Trading Behavior in the U.S. Options Market

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May 17, 2024

Abstract

This paper examines dynamics and implications of retail trading in U.S. options markets, addressing prevalent limitations and misconceptions in existing literature across four key areas: flawed proxy data, missteps in profit/loss calculations, pitfalls in assumptions about market dynamics, and potential biases from limited data. Our analysis challenges the assumption that retail investors primarily engage in simple long options trading, highlighting the prevalence of complex orders and risk hedging techniques, and showcases retail traders' sophistication and risk management capabilities. Leveraging Cboe data related to retail platform trading and an expansive timeframe, our research provides valuable insights, addresses previous limitations, and contributes to a more informed discussion about retail options trading.

Keywords: Retail Trading, Options, Retail Investor Participation, Notional Value, Complex Orders, Market Dynamics, Market Markers, Price Improvement Mechanism

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Summary: Retail Options Trading - Debunking Misconceptions and Providing Valuable Insights

The ascent of retail investors in options markets has generated significant interest among a variety of stakeholders, including market participants, regulators, media and academics. Yet, prevalent narratives frequently hinge on flawed proxy data, missteps in profit/loss calculations, pitfalls in assumptions about market dynamics, and potential biases from limited data. This paper serves as an endeavor to rectify these issues, elucidating how bias can stem from misconceptions and flawed assumptions. It aspires to present a more comprehensive perspective on retail options trading, leveraging Cboe Options Exchange's trade data and conducting an extensive analysis of retail options trading dynamics.

In this paper, we conduct a critical evaluation of previous studies, shedding light on their shortcomings, which include overgeneralizations and incomplete analyses. Recent academic research has seen the adoption of proxies such as 'SLAN' data[2], 'customer' orders, or small-size 'customer' orders to represent retail trading activity. Our examination reveals that these methods have frequently yielded exaggerated or incomplete conclusions, including around the profitability and concentration levels of options trading. These flawed conclusions are based on the mistaken assumption that retail investors exclusively trade long single-leg options (involving premium payments) or long straddles during unusual and volatile market events, like earnings

[2] Referring to the OPRA code, "Single Leg Auction Non-ISO Transaction was the execution of an electronic order which was stopped at a price and traded in a two-sided auction mechanism that goes through an exposure period. Such auction mechanisms include and are not limited to price improvement, facilitation, or solicitation mechanism."

announcements. Another common misconception is the characterization of options trades as a 'zero-sum' game between market makers and retail investors, often incorrectly interpreted as wealth transfer. Furthermore, some existing literature tends to overgeneralize findings taken from a limited and extraordinary period, spanning from the onset of the Covid outbreak to the end of 2022, which coincided with a period of significant Fed fund rate hikes. Some researchers did not take into account that investors often adopt different trading strategies during such exceptional periods compared to normal times. These findings have the potential to unduly raise concerns about retail options trading.

Utilizing Cboe data focused on orders initiated by retail platform customers and executed on Cboe Options Exchange (C1), we observe a noteworthy presence of retail investors in the options market. Their participation has grown substantially from 18% to 31% between the fourth quarter of 2019 and the fourth quarter of 2023, underscoring their evolving role.[3]

In contrast to recent academic research on retail options trading, which frequently overlooks complex orders initiated by retail investors, our analysis of open positions in terms of notional value reveals that retail investors' complex orders accounted for 58% to 76% of retail open

[3] Orders sent to Cboe come through intermediaries. As such, Cboe cannot identify end-user investors. In this paper, we use orders with a customer designation submitted to the exchange from retail platforms to represent retail trades. Please note that the composition of investors that comprise the customer range is diverse and can include funds and other "professional" traders. Consequently, the notional value and volume of what we classify as retail trades in this paper may include some orders from professional individual traders and other participants who are not conventional retail investors. While this may introduce some noise into our analysis, it is still comprising a superior picture of retail trading activity and it does not diminish the insights gained from this study.

positions during the same period.[4] This challenges the prevailing assumption that retail investors exclusively maintain long positions. Our study unveils the versatility of retail investors' trading strategies.

We find that the net credit/debit[5] of simple orders from retail platforms is positive and increasing, while the net credit/debit of complex orders from retail platforms is negative and on the rise from the fourth quarter of 2019 to the fourth quarter of 2022. Additionally, our analysis of market maker order imbalance[6] in SPX options over a longer historical window shows a significant reduction since mid-2020. The monthly market maker order imbalance has decreased from -14% in December 2016 to -12% in May 2023. This finding challenges the notion that the recent growth of 0DTE SPX options has increased market maker order imbalance.

In our robustness analysis, we exclude SPX options from the sample. This analysis reveals that retail trades represent 32% to 40% of the non-SPX options traded on C1 from the fourth quarter of 2019 to the fourth quarter of 2023 in terms of notional value. These findings underscore the substantial role of retail investors in these markets.

[4] The numbers are derived from trade data on Cboe Options Exchange.
[5] The net credit/debit of an order is equivalent to the total premium of the order. In the case of complex orders, it is calculated as the premium of the long leg(s) minus the premium of the short leg(s). If the total net credit/debit is negative, it indicates a sell order where the trader collects the net credit. Conversely, if the total net credit/debit is positive, it represents a buy order where the trader pays the net debit.
[6] Market maker order imbalance is quantified by calculating the difference between market makers' buy positions and sell positions within the same trading day. We report the monthly average of market maker order imbalance in Table 7.

Among the non-SPX options traded by customers of retail platforms, complex orders continue to represent a significant portion, ranging from 34% to 60% of the notional value from the fourth quarter of 2019 to the end of 2023. When combined with our analysis of all symbols on C1, it becomes evident that using 'SLAN' data as a proxy for retail trades or conducting profit/loss calculations based on the assumption that retail investors exclusively engage in single-leg trading can lead to incorrect conclusions. Thus, existing literature relies on very incomplete data and cannot be credibly relied upon.

I. Introduction

A. Background

In recent years, the increased use of options by retail investors has garnered significant attention from various stakeholders, including academics, regulators, and market participants. The notional value[7] and trading volume by clientele group[8] demonstrate the significant presence of retail investors in the options market, emphasizing their evolving role as options traders (Figure 1a, Figure 1b). This increased participation has sparked numerous academic papers that seek to examine and understand retail options trading, but some of these papers are flawed. It is crucial to critically evaluate the prevailing narratives and address some of the flawed assumptions and

[7] The notional value of options contracts is determined by multiplying the size, strike price, and multiplier. For standard options, the multiplier is typically 100, representing 100 shares per contract.
[8] All option trades on Cboe Options Exchange are grouped into clientele groups, such as ‘customer’, ‘pro-customer’, ‘broker/dealer’, ‘firm’, and ‘market maker’.

opinions put forth in these studies to ensure options markets are not misunderstood or unnecessarily negatively impacted.

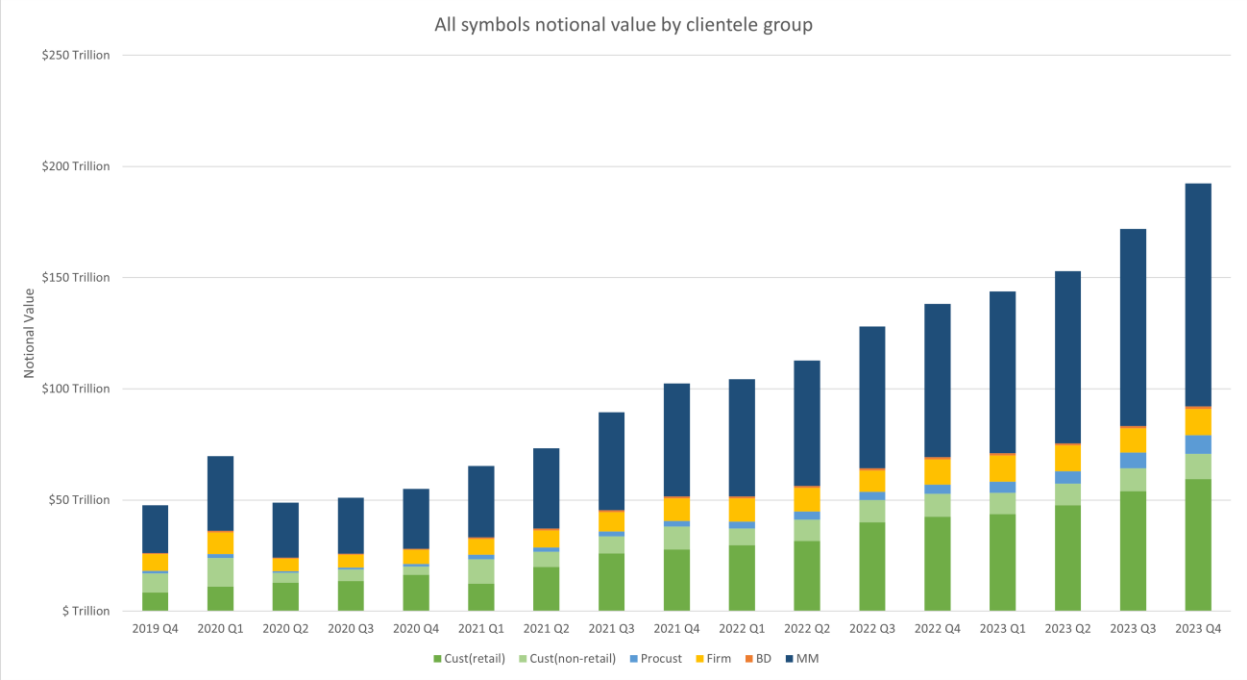

Figure 1a. Notional Value by Clientele Group (10/2019 - 12/2023)

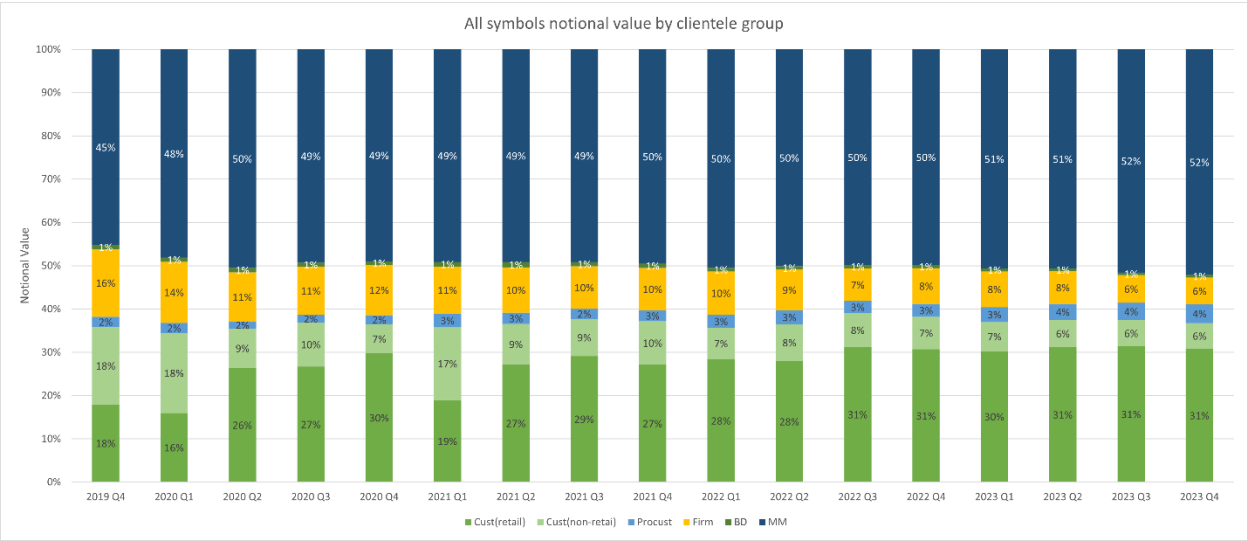

Figure 1b. Percentage of Notional Value by Clientele Group (10/2019 - 12/2023)

One prevailing misconception in certain academic papers is the overemphasis on short-term sample periods that fail to capture the full breadth of retail participation. Such limitations can lead to biased conclusions and prevent a comprehensive understanding of the long-term trends and dynamics in retail options trading. We can gain a more accurate picture of the evolving nature of retail investors' involvement in options markets by expanding the sample period to encompass a more accurate representation of today’s options markets.

Another point of contention lies in the assessment of retail investors' trading performance and profitability. Some studies rely solely on cumulative profit or loss as a measure of success, disregarding critical factors such as underlying market conditions, trading strategies and risk management techniques employed by retail investors. A more nuanced analysis is necessary to evaluate the overall effectiveness and impact of retail participation in options markets.

Furthermore, characterizing retail investors as novice traders who solely engage in simple, long options trades fails to capture the diversity and sophistication present in their trading activities. Retail investors employ various strategies, including complex options trades and risk hedging techniques, which contribute to a more multifaceted retail options trading landscape. Ignoring these aspects leads to an incomplete understanding of the motives, behaviors, and outcomes of retail investors' involvement in the options markets.

To address these shortcomings and provide a more accurate assessment, it is essential to conduct a thorough literature review and empirical analysis based on comprehensive datasets. By utilizing appropriate methodologies and considering a wider range of variables, we can offer valuable insights into the intricacies of retail options trading, debunk misconceptions, and contribute to a more informed discourse on the topic.

B. Our Statement

This paper is dedicated to conducting a rigorous analysis of retail options trading, with the aim of addressing the limitations observed in recent academic papers. By amalgamating our detailed trade and order data with broker-specific information for each order, and further extending our sample period, we aspire to conduct a thorough assessment of the behaviors exhibited by retail investors and a nuanced exploration of their trading strategies.

Using customer trades as a representation of retail investors' trades is a common practice in both academia and industry. However, it is important to note that the customer group analyzed in this paper, as classified by trade data with a “customer” flag, is more inclusive than datasets such as 'SLAN' and 'SLIM' OPRA. These alternative datasets may overlook complex orders, resulting in a limited perspective on retail options trading. To overcome this limitation and provide a more holistic analysis, this study incorporates trade data with customer flags, clientele group indications and retail platform indications. This approach enables us to capture a broader range of retail investor activity, including complex orders, leading to a more accurate representation of

retail participation in the options market. We elaborate on the difference between our approach and others in the literature review section.

This paper extends the sample period beyond the typical timeframe of previous studies, covering data from October 2019 to 2023. Beginning in October 2019, our sample captures significant market events, including the Covid-19 pandemic, meme stock frenzy, and rising inflation followed by a substantial increase in the Fed fund rate. These events may have caused structural shifts in equities and options markets, impacting retail investors' behavior. Notably, we chose October 2019 as our starting point due to the availability of retail broker information. Including data up to 2023 ensures a comprehensive analysis and mitigate against sample selection bias. Examining long-term trends provides deeper insights into retail investors' options trading patterns and the evolving landscape.

Cboe Options Exchange (C1) is the first and most prominent U.S. options exchange. C1 accounts for approximately 19% of the total daily volume and 45% of the daily notional value in the U.S. options market.[9] Among Cboe's four options exchanges, C1 represents 54% of the total daily volume and 84% of the daily notional value. For this paper, we focus on C1's trade data, which is largely representative of all Cboe exchanges and the broader U.S. options market. This concentration ensures consistency and efficiency in our analysis.

[9] As of June 2023.

Figure 1a and 1b provide insights into the notional value by clientele group, specifically distinguishing the difference between trades from retail platforms and trades from others within the broader "customer" category. It is evident that retail investors hold a significant presence in the options market. The absolute trading volume and notional value of retail trades have witnessed substantial growth, which has been characterized as a notable trend in retail trading. However, it is important to consider the overall trading volume and notional value across all market participants to avoid potential exaggeration of the rise in retail participation. Notably, retail participation has increased since the second quarter of 2020, accounting for 26% of the notional value traded on C1, compared to 16% in the first quarter of 2020. This trend continued with a slight increase to 31% in the fourth quarter of 2023. These figures demonstrate the evolving role of retail investors in the options market over the analyzed period.

Contrary to common assumptions in academic research, our analysis of options trade data from Q4 2019 to Q4 2023 on C1 reveals active participation by retail investors in complex options trading strategies, which often have capped downside risk. Figure 2a illustrates this, showing the proportion of simple and complex orders executed by retail investors on C1 during this period. The dataset covers all symbols traded on C1. Notably, our findings indicate that retail investors executed more than half of their orders on C1 as complex orders in terms of notional value, ranging from 57% to 77% between Q4 2019 and Q4 2023. This underscores the sophistication of retail investors in options trading, as complex strategies require higher broker permissions and a

deeper understanding of market dynamics.[10] Considering these complex orders is essential for a thorough and balanced analysis of retail investors' options trading activities, as focusing solely on single leg trades may yield a considerably incomplete picture of their behavior.

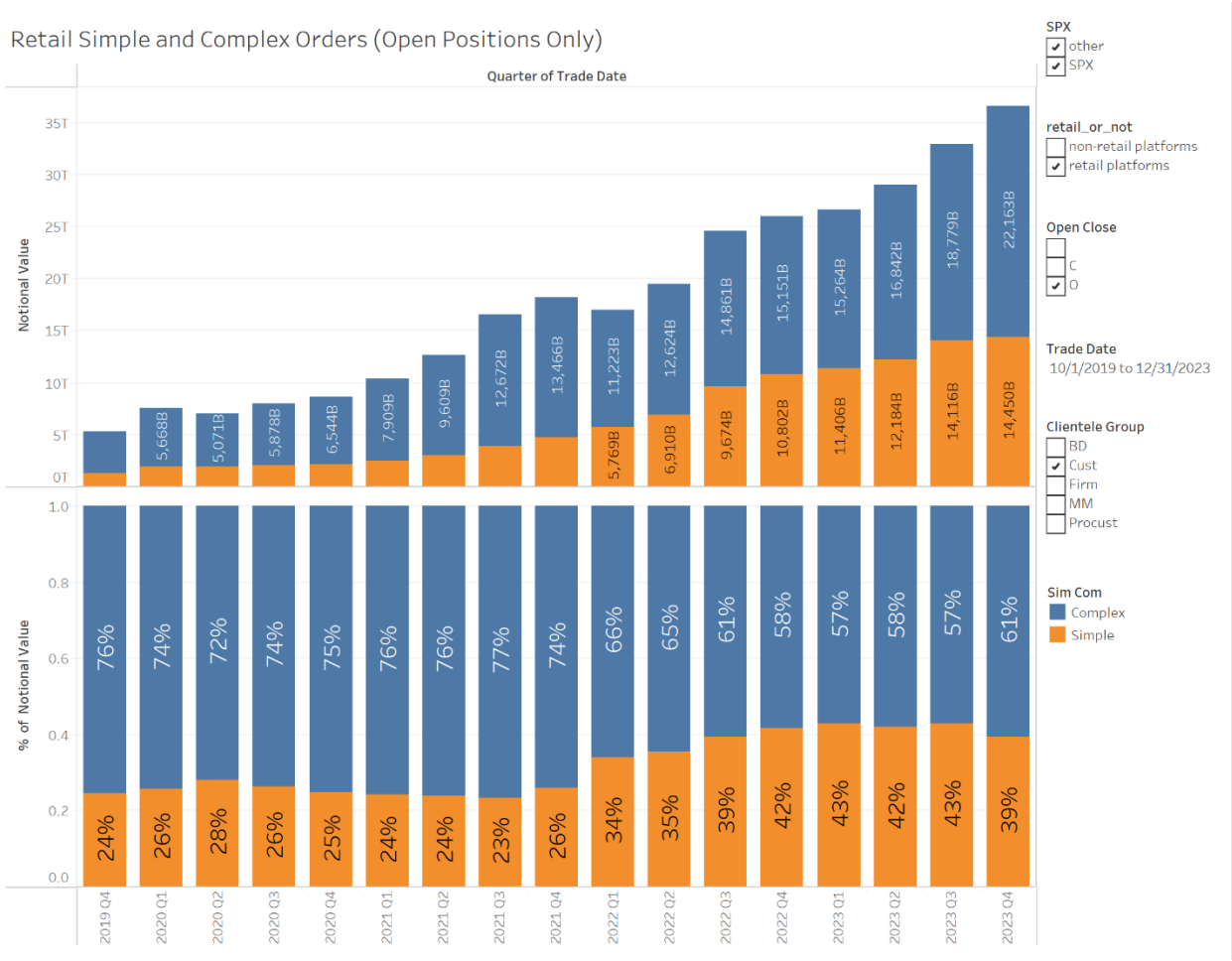

Figure 2a. Proportion of Notional Value for Simple and Complex Order Options Traded by Retail Investors, Open Positions Only (10/2019 - 12/2023)

[10] Brokers impose constraints on retail option traders through trading levels on margin-approved brokerage accounts, with higher levels granting access to more complex strategies. Each broker has its own level specifications and customer profiles that they use to determine their customers' trading levels. Taking one prominent retail broker as an example, retail investors at level two can trade long calls, puts, straddles, and strangles, while level three or above is required for more complex orders like iron condors.

Previous studies that assume most retail investors primarily engage in single leg options trades also make assumptions about retail investors' net long positions in options trading. These studies, exemplified by de Silva et al. (2023), conclude that retail investors' contrarian net long positions contribute to increased hedging difficulty and costs for market markers, resulting in higher option premiums compared to theoretical values. However, our analysis challenges this assumption by finding that while most single leg trades from retail investors are indeed long positions, the net positions of retail investors' complex orders are predominantly net short.[11] This observation, as depicted in Figures 3a and 3b, highlights the significance of considering the complexity of retail investors' trading strategies and their net positions in comprehending market dynamics and option premiums.

It's worth noting that Cboe cannot identify when a complex strategy is “legged-into” by an investor as in that instance, the orders comprising the strategy are submitted to the trade engine separately. Similarly, an investor selling a call on stock he/she owns to generate income would not necessarily be flagged as connected to another position/trade. Consequently, the universe of complex and outcome-driven trades is likely larger than what many data users, including Cboe, are able to identify.

[11] The net position is determined by calculating the difference between the total notional value of long calls and long puts and the total notional value of short calls and short puts. If the net position for a specific time period is positive, it is defined as net long. Conversely, if the net position is negative, it is defined as net short.

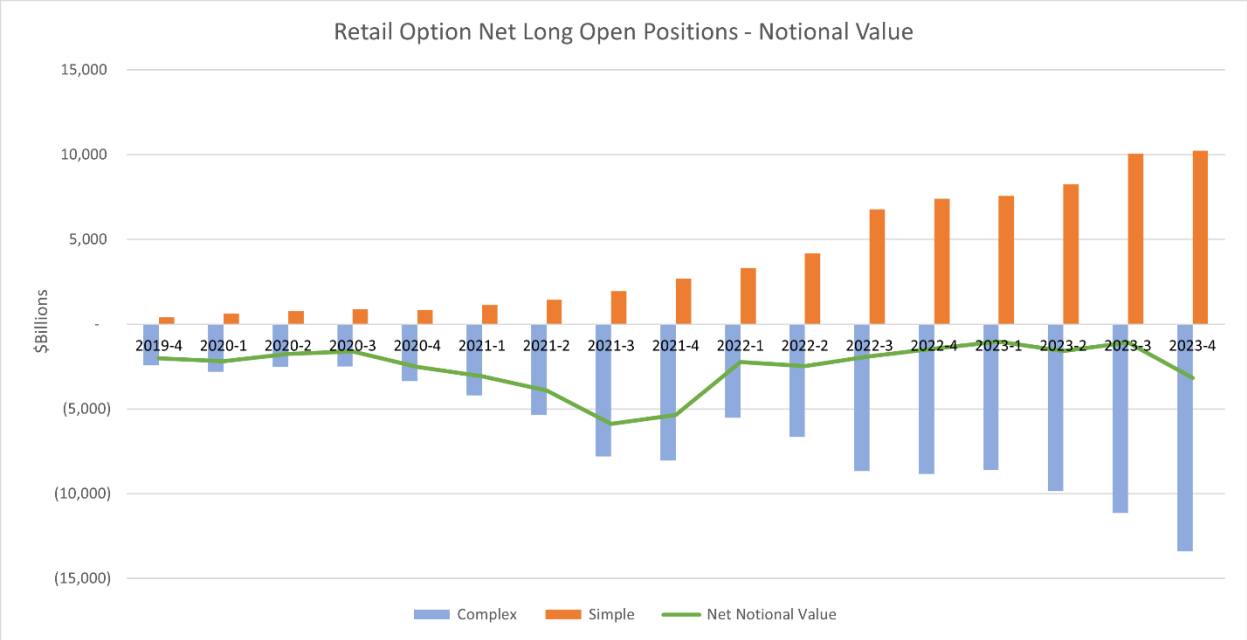

Figure 3a. Net Long Open Positions of Simple and Complex Order Options Traded from Retail Platforms in Notional Value (10/2019 - 12/2023)

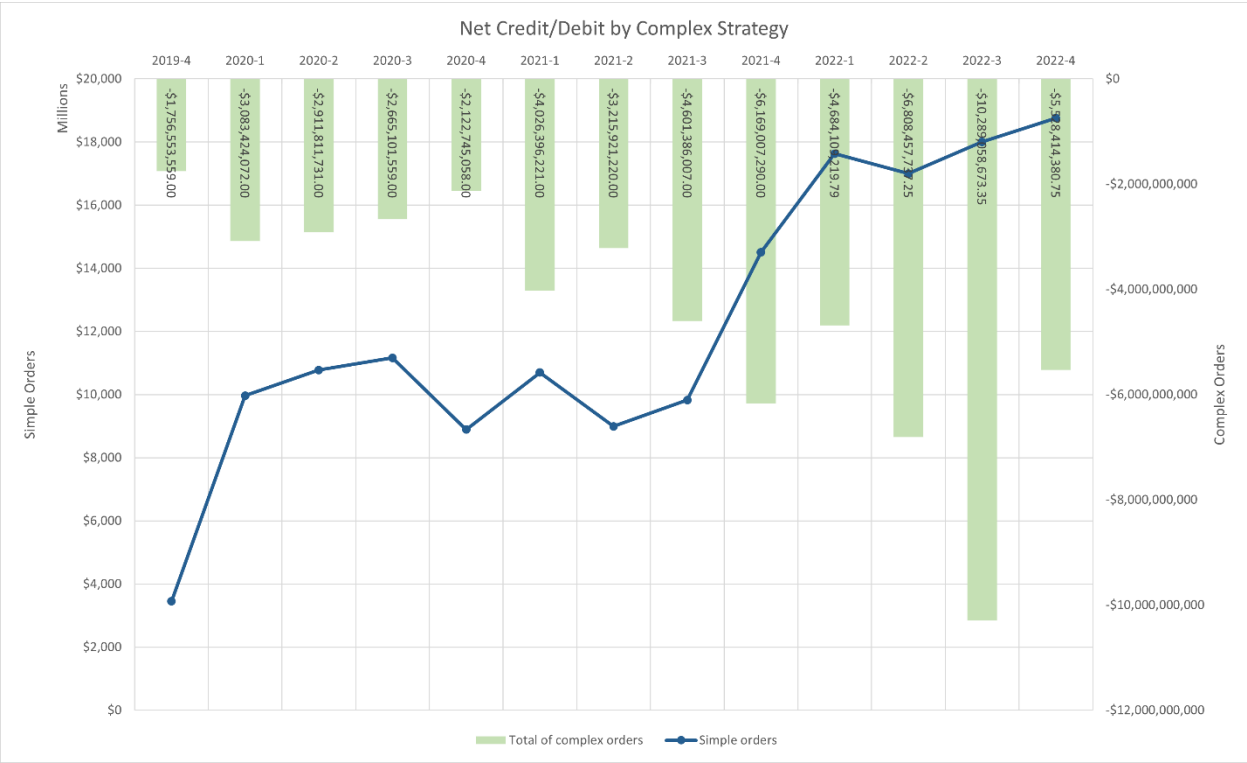

Figure 3b. Net credit/debit of Complex and Simple Orders from Retail Platforms (10/2019 - 12/2022)

Figure 3a summarizes the net long open positions of both simple and complex orders traded by customers on retail platforms in terms of notional value from Q4 2019 to the end of 2023. This measure is commonly used to indicate investors' aggregated exposure. According to our data, the aggregated net long open positions of retail investors have consistently been negative, indicating that retail investors' open positions are actually short, contrary to the prevailing academic research assumption. However, this measure alone does not provide insight into certain trading strategies, such as whether an investor is long or short a vertical spread, as the long and short positions in a vertical spread offset each other, resulting in a net long open position of zero. Therefore, we have developed an alternative measure to offer a more comprehensive overview, namely the net credit/debit measure shown in Figure 3b which is based on the premium of each order.

Figure 3b provides information on the net credit/debit of complex orders and simple orders executed by retail investors on C1. The figures represent the total notional values for each quarter from Q4 2019 to Q4 2022. The net credit/debit of complex orders reflects the overall net position based on payment (net debit) or collection (net credit) of premium resulting from complex options trading strategies employed by retail investors. A negative value indicates a net credit (more sell orders than buy orders), while a positive value indicates a net debit (more buy orders than sell orders). Similarly, the net credit/debit of simple orders represents the net position resulting from single leg options trading strategies.

The findings in Figure 3a and 3b challenge the conclusions of academic papers that use single leg trades to represent retail activity in the options market. While these papers suggest that retail investors hold net long positions, our analysis reveals a different picture. On an aggregated level, retail trades with complex strategies show a net short position, while retail trades involving simple orders exhibit a net long position. This disparity highlights the need for a more comprehensive analysis that considers the full range of trading strategies employed by retail investors. By solely focusing on single leg trades, previous studies may have overlooked the prevalence and impact of complex strategies, leading to an inaccurate portrayal of retail investors' positions in the options market.

To provide a more accurate and comprehensive understanding of retail trading behavior in options markets, this paper conducts a holistic study that analyzes trade data from C1, the largest U.S. options exchange, as well as retail trading strategy data obtained from major retail trading platforms. This approach allows us to overcome the limitations observed in previous academic studies, which will be discussed in the forthcoming literature review section. By leveraging robust and diverse datasets, we aim to offer valuable insights into the intricacies of retail options trading and shed light on the nuanced dynamics that shape how retail investors participate in the options market. Through this examination, we seek to contribute to the existing body of knowledge and offer a more precise understanding of retail investors' behaviors and their impact on options markets.

II. Literature Review

This study is motivated by the increasing interest in retail options trading in U.S. options markets from the public, particularly in academic circles. Offering in-depth insights into retail options trading is invaluable for all market participants as well as policymakers. However, it is critical to provide impartial perspective grounded in deep understanding of the structure and dynamics of the U.S. options markets. Leveraging our familiarity with U.S. options markets, we aim to address recurring limitations that have surfaced in recent academic research on retail options trading, focusing on four key areas: flawed proxy data, missteps in profit and loss calculations, pitfalls in assumptions about market dynamics, and potential biases arising from limited data.

A. Flawed Proxy Retail Trade Data

The ideal dataset for retail option trades would identify with precision every retail investor transaction. However, exchanges and other participants and observers who do not have direct relationships with retail investors must estimate based on data available to them. In previous research on retail options trading (e.g., Choy and Wei, 2012; de Silva, Smith, and So, 2023), datasets like Cboe's end-of-day open-close files have been used. These datasets group buy and sell volume when each clientele group opens or closes a position. The 'customer' group is often selected as a proxy for retail investors because 'customer' orders can often originate from retail investors. Researchers have attempted to mitigate the inclusion of non-retail trades (e.g., hedge funds) in the 'customer' data by focusing on contract sizes smaller than 10, aiming to create a hypothetically more accurate proxy for retail options trades. However, this approach may still

encompass trades initiated by non-retail customers because non-retail customers often fragment their larger trades into smaller orders. As a result, analyses of customer orders with contract sizes smaller than 10 may not exclusively or accurately represent retail investor activities, potentially introducing bias into the findings and conclusions based on these analyses.

Moreover, the open-close files do not provide trade-level data, thus lacking the granularity found within individual trades. Consequently, researchers have turned to more recent alternatives such as SLAN data, referring to OPRA's Single Leg Auction Non-ISO data, to serve as a proxy for retail options trade data (e.g., Ernst and Spatt, 2022; Bryzgalova, Pavlova, and Sikorskaya, 2023; Beckmeyer, Branger, and Gayda, March 2023[12]). To the best of our knowledge, Ernst and Spatt (2022) and Bryzgalova, Pavlova, and Sikorskaya (2023) were the first to utilize SLAN as a proxy for retail options trade-level data, followed by retail options trading studies. This choice was likely influenced by their assumption that the majority of retail investors engage in single-leg options trades, primarily as buyers, given the authors' lack of access to actual retail options trade-level data. Subsequently, this approach has been widely adopted by other academic papers investigating retail options trading (e.g., Beckmeyer, Branger, and Gayda, March 2023; Hendershott, Khan, and Riordan, 2022). In this literature review, we find it necessary to

[12] Here, we reference Beckmeyer, Branger, and Gayda's earlier version published in March 2023, which solely incorporates 'SLAN'/'SLIM' data. We note that Beckmeyer, Branger, and Gaya updated their paper in December 2023, to include 'MLAT' data, an abbreviation for Multi Leg Auction Trading data. In this latest iteration, they noted that retail investors predominantly favored multi-leg strategies when trading SPX 0DTE options in 2021 but shifted towards a predominance of single-leg strategies since mid-2022. They assert that toward the end of their sample period (September 2023) between 60% and 80% of the SPX 0DTE retail volume was in single-leg strategies. While it is appropriate to include muti-leg strategies, our findings illustrate that *more than 50%* of SPX 0DTE retail volume is comprised of multi-leg strategies. We will elaborate on the discrepancy in subsequent paragraphs.

acknowledge the limitations of using SLAN data as a proxy for retail options trade data as it can lead to biased observations.

The use of SLAN data in the analysis of retail options trading presents several significant challenges. First, SLAN data does not include complex orders, which, as illustrated in Figure 2a in the introduction, constitute a significant portion of retail trading. Indeed, retail use of complex orders ranges from 58% to 77% of the notional value traded on C1 between Q4 2019 and Q4 2023.[13] Omitting complex orders in studies of retail options trading results in a material portion of the complete picture being missed. Second, when using SLAN data, it remains challenging to entirely exclude trades initiated by non-retail traders, as the identities of traders are undisclosed, and non-retail investors also participate in single-leg trading. Moreover, SLAN data only include trades that occur within auction mechanisms, which, as reported by Hendershott, T., Khan, S., & Riordan, R. (2022), constitute just 23% of options volume for S&P 500 stocks. This implies that a substantial portion of retail options trading activity is not captured by auction mechanism orders alone and can be improperly captured by assuming all SLAN activity is retail.

In papers utilizing SLAN data, the analyses typically focus on all U.S. options across various underlying symbols, expirations, and strike prices. However, Beckmeyer, Branger, and Gayda (March 2023) narrow their focus exclusively to SPX options with the same expiration,

[13] This corresponds to 42% to 47% of the total volume as shown in Figure 2b in the Appendix. Looking only at SPX, complex orders constitute between 60% and 81% of retail SPX trading volume from Q4 2019 to the end of 2023.

specifically 0DTE (zero days to expiration) options. They surmise that 'SLIM' data, derived from SLAN data, outperforms the method of using small order sizes to identify retail trades in single equity options. Their analysis posits that SLAN/SLIM accounts for a very small portion of all SPX options, ranging from 2% to 4%[14], inadequately representing retail trading in SPX options.

As previously noted, omitting multi-leg strategies or complex orders in studies on retail option trading can introduce significant biases in findings and conclusions. In their December 2023 update, Beckmeyer, Branger, and Gayda attempted to include complex orders by including 'MLAT' trade data. As noted earlier, their updated analysis concluded that retail investors showed a preference for multi-leg strategies when trading SPX 0DTE options in 2021 but shifted their preference towards single-leg strategies since mid-2022, claiming that between 60% and 80% of retail volume became single leg. Thus, per their analysis, complex orders in their retail trading sample accounted for 20% to 40% since mid-2022. This predominance of single leg activity does not comport with our analysis.

Unlike Beckmeyer, Branger, and Gayda (December 2023), our analysis demonstrates that complex strategies still account for the majority of retail SPX 0DTE volume – more than 50% of retail SPX 0DTE volume up to Q1 2024 were identifiable complex strategies (notably customers can also execute single leg orders in order to create a complex strategy, so the percentage of

[14] However, in their latest version posted in December 2023, they acknowledge the importance of including multi-leg trades when studying SPX trading activity. Yet after incorporating 'MLAT' trades, they still find that "the share of retail trading in SPX options fluctuates from 2% to 4%". We question how the percentages could remain static after incorporating MLAT. Of course, our data demonstrates that multi-leg orders constitute a significant percentage of retail trading in SPX.

complex strategies utilized by retail is likely higher). This variance between our analysis and Beckmeyer, Branger, and Gayda (December 2023) is likely due to our more relevant data set. As discussed in this paper, we define retail orders as orders entered in the 'customer' range and submitted by retail platforms. The Beckmeyer, Branger, and Gayda (March and December 2023) data set likely includes considerable non-retail trading interest, which is a common issue when using the 'customer order' range without any other qualifiers as a proxy for retail trades. Further, single-leg auction (SLAN) and multi-leg auction trade (MLAT) do not include retail trades that did not go through an auction mechanism.

Our analysis reveals that non-retail 'customer' orders predominantly trade more simple orders than retail orders during our sample period, coinciding with Beckmeyer's sample period. Therefore, with multiple data limitations, Beckmeyer, Branger, and Gayda's sample likely overestimates the percentage of single-leg (simple) SPX 0DTE orders traded by retail investors. They do suggest that complex order trading (at least with respect to trading market volatility and jump risk) by retail investors is profitable. Yet, this important finding is not carried through to the rest of their analysis, which as noted earlier, appears to significantly underestimate the amount of retail SPX activity that is comprised of complex strategies.

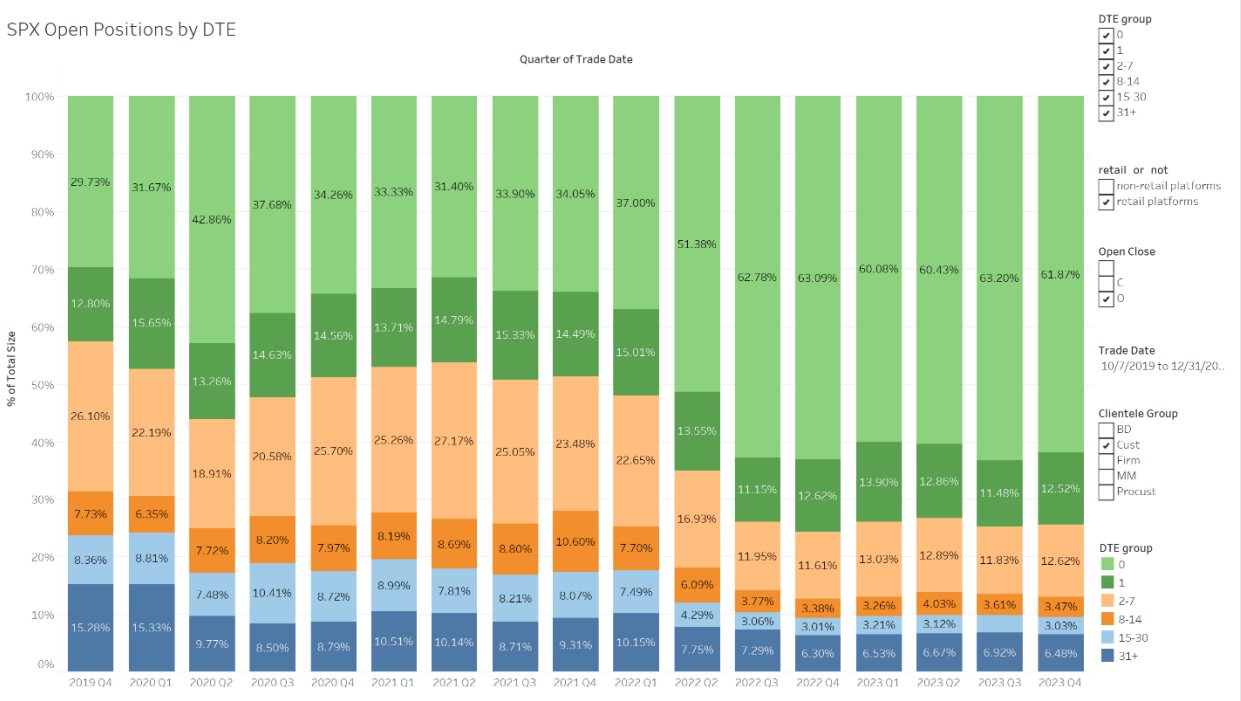

Figure 4: Retail Investors' Preference for SPX Options Days-to-Expiration in Open Positions by Volume (10/2019 -12/2023)

Studying retail options trading poses challenges due to the limited access to retail trading activities. However, researchers must remain mindful of the potential biases when using various datasets as proxies. Recent academic studies employing 'SLAN' data or 'customer' orders as proxies for retail trades have often drawn more extreme conclusions, such as exaggerated concentrations and substantial losses, based on the hypothesis that retail investors exclusively engage in long single-leg options (involving premium payments). These findings may unnecessarily raise concerns about retail options trading.

B. Profit and Loss Calculation Missteps

Let's begin by examining the simplest profit and loss (P&L) calculation method adopted in certain academic research, such as Ernst and Spatt (2022). This method assumes that retail

investors exclusively buy call options and calculate the change in call option premiums, claiming that the sum of these changes in call option premiums represents the profit and loss of aggregated retail options trading. Another paper, Hendershott, Khan, and Riordan (2022), although not explicitly emphasizing retail option trading, follows a similar approach by assuming retail investors exclusively hold long options positions (accepting retail investor long puts as well). They calculate the P&L of retail investors by multiplying the option closing price by the daily trading volume of each trader group and aggregating these values across the sample period. Both of these oversimplified P&L calculation approaches fail to account for the complexities inherent in retail option trading strategies and the broader dynamics of the options market, ultimately leading to flawed conclusions.

Our analysis reveals that retail investors trade both call and put options in nearly equal proportions, highlighting the incomplete picture presented by this P&L calculation method. Moreover, this method overlooks the substantial presence of complex orders, encompassing both buying and selling options, which comprise over half of retail trades in terms of notional value.

With further respect to the paper by Ernst and Spatt (2022), it's worth highlighting an example they use of a call option trade on Apple (AAPL) in the "Asset Returns and Broker Conflict of Interest" section. This example is discussed inaccurately, possibly due to typographical errors.[15] The calculation of the return on the call option trade is perplexing, and the lack of clarity

[15] Regarding Ernst and Spatt's paper on "Payment for Order Flow and Asset Choice" (May 31, 2022), I noticed an inconsistency on page 45. The mentioned call option with a February 2, 2021 expiration, $280 strike price, and $22.42 premium was not found listed on U.S. options exchanges. If listed, the premium would likely be higher, around $44, depending on the trade time.

regarding whether the example pertains to a call option expiring before or after the 3-month testing window hinders our ability to verify their option portfolio calculation.

Indeed, the comparison drawn between the profit and loss (P&L) of purchasing a call option versus acquiring 100 shares of the stock, as illustrated by Ernst and Spatt (2022), reveals a common misunderstanding around options trading on several fronts. First, as we've often emphasized, retail investors engage in both simple and complex orders, with call and put options representing just one facet of their trading strategies. Buying call options constitutes merely one of numerous option trading strategies adopted by retail investors, whereas purchasing stocks represents just one of the two stock trading strategies they pursue (assuming short selling as the other). Notably, C1's trade data indicates that the notional value of buying call options accounts for only about 18% of the total notional value in 2023.

Second, it's logical to assume that retail investors typically hold stocks for extended periods, often longer than a few weeks or months. However, in the options market, exemplified by C1, 94% of call options initiated by retail investors expire within a week (as shown in Figure 11). The scenario presented by Ernst and Spatt (2022), where retail investors purportedly hold both a call option and 100 shares for three months, is far removed from reality. Hence, if the P&L resulting from purchasing a call option and acquiring 100 shares is assumed to equate to the option price change and stock price change over a three-month period, the assertion of significant losses incurred diverges starkly from reality.

Third, the terminal value[16] of the payoff from owning 100 shares of stocks differs from that of owning a call option. Consequently, investors' risk preferences and the utility of buying a call option versus buying 100 shares vary. The profit and loss (P&L) of owning 100 shares of stocks decreases by one dollar for each one-dollar decrease in the current stock price. In contrast, the P&L of buying a call option does not decrease beyond the strike price when the current stock price falls below it, thus limiting the risk. To illustrate this point clearly, we have included a simple example in Figure 5. Consider an investor who purchases 100 shares of a stock at $50 and simultaneously buys an at-the-money call option with a strike price of $50 at a cost of $2. This figure represents the payoff at expiration for both transactions. The linear payoff of owning 100 shares of the stock is depicted by the green line in the graph, indicating that as the stock price increases, the profit also increases linearly. Conversely, we have the payoff of the call option, represented by the blue line in the graph, which illustrates the non-linear profit and loss profile.

[16] Here, terminal value refers to the value at the end of the holding period (expiration), contingent upon the underlying prices.

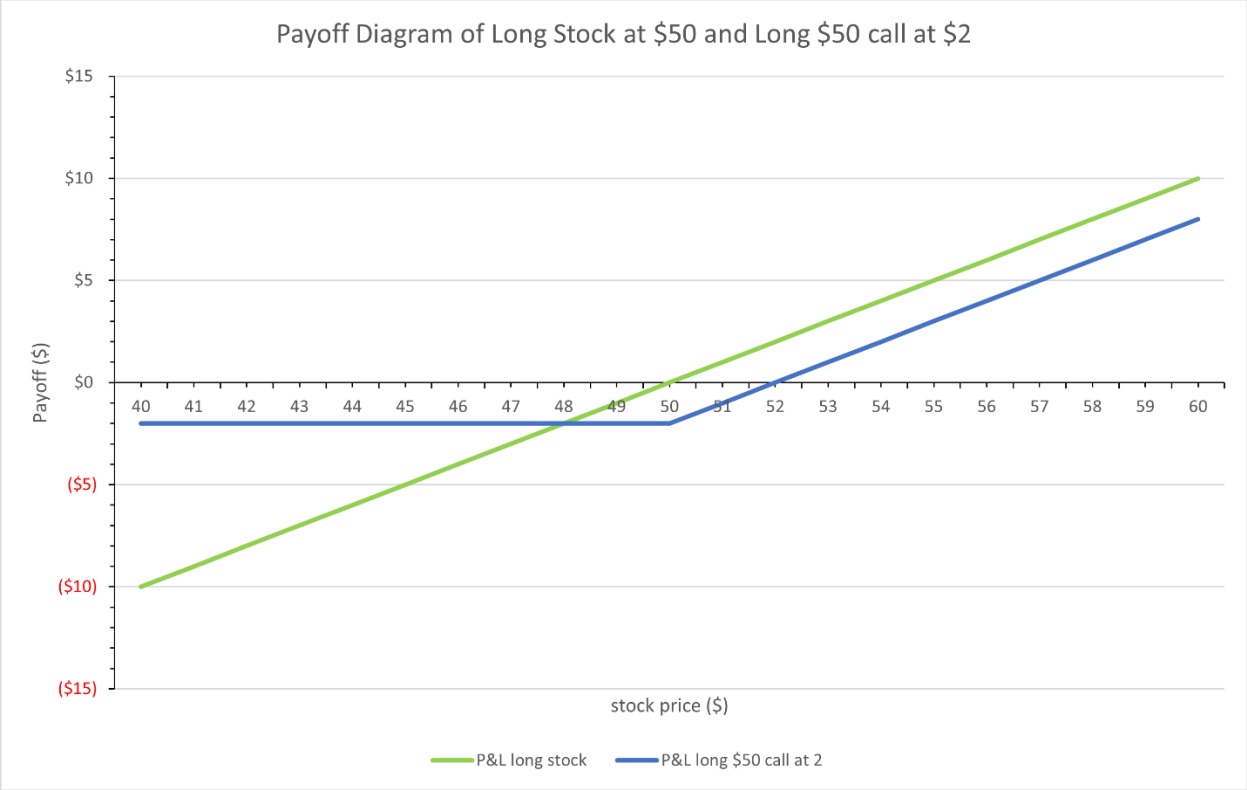

Figure 5. Payoff of Long Stock at $50 and Long $50 ATM call at $2

This example highlights the fundamentally different risk-reward profiles of these two strategies. When buying the stock, the return is a straightforward linear relationship with the stock's price movement. Conversely, buying the call option offers the potential for unlimited upside (as the stock price can rise significantly) along with limited downside risk (the maximum loss is confined to the premium paid for the option).

Furthermore, a critical component of options pricing that is overlooked in the Ernst and Spatt example is the concept of time value. This means that, even if the stock price remains unchanged over a 3-month period, the call option price will decline as it approaches expiration.

In summary, studies employing this straightforward approach for P&L calculations often contain an inherent flaw by comparing retail investors' equity P&L with the P&L of call options alone. This simplification overlooks the nuanced differences in risk preferences and utility functions between retail investors when trading options versus equities. By disregarding these crucial aspects, valuable insights into the diverse strategies and trading behaviors of retail investors are missed. As such, calculating P&L based on the assumption that retail investors exclusively buy call options does not accurately represent the reality of retail options trading.

Separate and more complex approaches to calculating profit and loss (P&L) in retail options trading expose further misconceptions and false assumptions. In certain research practices, there's a tendency to assume that retail investors exclusively adopt the costliest strategies for specific events, such as earnings announcements. This assumption can lead to conclusions suggesting that retail investors lack sophistication in comprehending potential profit and loss outcomes, possibly resulting in substantial losses. For instance, consider the study conducted by de Silva, Smith, and So (2023), where they presume that retail investors primarily use long straddles (buying both a call and a put option at the same strike price and maturity) before earnings announcement days.

Before addressing common misconceptions regarding retail investors' long straddle positions, we present a comparative analysis covering normal trading days and earnings announcement weeks from Q4 2019 to Q4 2022. In 2022, among complex orders from retail platforms, long straddles

accounted for 0.2% during normal days and 0.6% during earnings announcement weeks. Although there was a slight increase in the notional value of long straddles during earnings weeks, we also observed increases in long and short call vertical spreads, generic debit strategies, and call butterflies, representing approximately 30%, 13%, and 4% respectively during earnings weeks for both long and short positions. Hence, apart from oversimplifying profit/loss calculations for retail investors' long straddle positions, the existing literature overlooks the broader context of retail trading activities during earnings announcement weeks. This oversight may lead to the misconception that retail investors employ less sophisticated and versatile strategies.

From a mathematical perspective, long positions on straddles can only yield profits when underlying stocks experience significant movements after earnings announcements. However, historical data indicates that stock prices tend to become more volatile leading up to earnings announcements due to various factors, such as investors anticipation of the announcements, speculating on their outcomes, or engaging in practices like "buy the rumor, sell the news." These trading activities in the equity market before earnings announcement days elevate volatility, subsequently driving up the premiums of options on those stocks.

Statistically, stock prices do tend to experience significant fluctuations immediately after earnings announcements. However, as mentioned earlier, options premiums and implied volatility of options are already elevated before earnings announcement days. Therefore, there is a possibility that the gains from call and put options in straddles due to the stock price swing may

not be sufficient to offset the losses caused by the reduction in implied volatility, which, in turn, leads to a decrease in options prices after earnings announcements. In such scenarios, options investors who close their positions after earnings announcements may incur losses, even if the stock price displays more volatility than on normal days.

Long straddle strategies are profitable when substantial price swings occur in a stock after its earnings announcement, referred to as earnings surprises. The determination of what constitutes a significant price swing for a profitable long straddle can be based on historical data or options trading resources. Importantly, buying a straddle should not be regarded as a simplistic retail strategy. Instead, it falls under the category of limited-risk options strategies, offering the potential for unlimited profits while risking only the premiums paid for the call and put options.

Finally, there are alternative options strategies often used during earnings announcements, including selling straddles and strangles. These strategies can yield profits when underlying prices display limited volatility and stay within the anticipated range by the options' expiration date. Another strategy to consider is selling iron condors, which provide a broader price range with a potentially lower return.

Taking all these factors into account, it becomes clear that options contracts are naturally more expensive before earnings announcement dates due to these complex market dynamics. Consequently, the conclusion that retail investors overpay for long straddles when trading around earnings announcements is dubious.

Taken collectively, the challenges of calculating aggregate profit and loss for retail options trading arise due to the lack of access to individual retail investors' trading activities. Researchers are forced to calculate these figures at an aggregated level – an approach with inherent limitations that can lead to errors. One common method used for this calculation, as seen in studies like de Silva, Smith, and So (2023) and Bryzgalova, Pavlova, and Sikorskaya (2023), is based on the method proposed by Barber, Lee, Liu, and Odean (2008). However, this method presents challenges when estimating holding period returns due to the absence of individual retail investor position data.

The formula used for calculating holding period returns in these studies is as follows:

$$r_{i,t,t+h} = \frac{Close\ midquote_{i,t+h}}{Average\ trade\ price_{i,t}^{SLAN}} - 1,$$

In this formula, *i* denotes the option contract*, t* denotes the day when the investor initiates the position, and *h* denotes the number of days the investor holds the position.

To obtain accurate aggregate retail investor performance, the calculation should be based on actual trade prices for both opening and closing positions, accounting for both long and short positions. In the case of a long position, the profit and loss should be calculated as the difference between the trade prices when opening and closing the option position. Moreover, the actual holding period must be considered to ensure precision. Consequently, the frequently used

method of calculating aggregate retail investor performance is likely to deviate considerably from the actual performance.

Here are the revised formulas for calculating holding period returns, considering long and short positions:

$$r_{i,t,t+h} = \frac{trade\ price_{i,t+h}}{trade\ price_{i,t}} - 1 \text{ if the investor longs an option}$$

$$r_{i,t,t+h} = 1 - \frac{trade\ price_{i,t+h}}{trade\ price_{i,t}} \text{ if the investor shorts an option}$$

It's important to note that even this revised method might not fully capture the actual benefit of retail investors' options trading, as some investors might hold positions in underlying assets, particularly when employing a combination of strategies like selling covered calls, buying protective puts, or using a 1x2 put ratio for hedging. These additional complexities further highlight the challenges in accurately assessing retail options trading performance at an aggregated level.

Another commonly encountered false narrative is the belief that trading operates as a zero-sum game, implying that one participant's gain inevitably translates into another participant's loss (e.g., de Silva, Smith, and So, 2023). However, it's crucial to recognize that options trading does not conform to this zero-sum paradigm as determining the profit and loss (P&L) of any group of traders requires a deeper understanding of their underlying positions and motivations.

Market makers, for instance, have a P&L structure that is unrelated to the changes in option prices during the holding period of retail investors. Their primary focus lies in providing liquidity and managing risks through continuous hedging. Their profitability is derived from intraday trading activities and the bid-ask spread, rather than relying solely on long-term shifts in option prices.

It's essential to avoid misconstruing market makers' revenue as a form of wealth transfer, as they must generate profits to cover operational expenses and sustain their businesses. Similarly, the losses incurred by retail investors should not be directly equated to the gains of market makers, as their trading strategies and objectives are fundamentally distinct. Retail investors' P&L is influenced by the fluctuations in option prices within a specific timeframe, whereas market makers engage in a multitude of trades to effectively manage their risk exposure, without holding positions over extended periods. Even if retail investors incur “losses” in their options trading due to rational decisions, such as purchasing protective puts on their underlying stock positions, it could ultimately benefit their overall financial well-being.

In addition to the various P&L calculation methods discussed earlier, some studies tend to attribute retail investors' losses in options trading to the disposition effect, as seen in de Silva, Smith, and So (2022). The disposition effect is a common trading psychology observed in various asset markets, highlighting investors' tendency to prematurely sell assets that have gained value while holding onto assets that are losing money, in the hope of reversing those losses. It's important to note that the disposition effect is a psychological phenomenon that can occur in

various financial markets, and its presence in options trading should not be viewed as a unique phenomenon. If this trading psychology is more pronounced in retail options trading, further analysis is needed to demonstrate that.

In conclusion, the examination of typical mistakes in comparing the profit and loss (P&L) of trading stocks and trading options reveals several critical misconceptions. These include the erroneous assumption of the utility of retail option trading, particularly when juxtaposed with stock trading. Additionally, the study of retail option trading concerning earnings announcements, the incorrect methodology employed for calculating aggregated P&L for retail options trading, and the misconception regarding wealth transfer between market makers and retail investors all contribute to significant misunderstandings in retail option trading dynamics. These misunderstandings impede the ability to meaningfully evaluate retail options trading and may misguide policymakers. Therefore, it is imperative to address these missteps and misconceptions to foster a clearer understanding of retail option trading and its implications for investors and policymakers alike.

C. Assumption Pitfalls and Misconceptions of Market Dynamics

There are several problematic assumptions within the realm of retail options trading that can distort the results, leading to a less comprehensive understanding of the market.

One common narrative is that retail investors overpay when trading options (e.g., de Silva, Smith, and So, 2022). That narrative is based on the following misconceptions: (1) Retail investors tend to trade options on stocks with more media coverage, and the media often focuses on highly volatile stocks during earnings announcements. This leads retail investors to buy more expensive option contracts due to the high volatility and resulting elevated option premiums. (2) Retail investors are typically net long contrarian option traders, which forces market makers to assume large exposures from their net short positions. To compensate for this increased risk exposure and higher hedging costs, market makers must adjust pricing accordingly. (3) According to the demand-based option pricing theory (Garleanu, Pedersen, and Poteshman 2009), which suggests that options prices can be influenced by demand, retail investors' demand for high EAV (Earnings Announcement Volatility) options drives up prices, leading them to overpay for these options

To look at the latter, the net long contrarian position exhibited by retail investors does not singularly force market makers to take large exposures and increase option premiums. Option pricing is influenced by multiple factors – including market supply and demand, volatility, expiration time, interest rates, and underlying asset price movements – and retail investors, along with other market participants, contribute to the overall supply and demand dynamics in the options market. Market makers and institutional investors also play a significant role in shaping options prices. Option pricing models consider a wide range of such variables and risk management strategies beyond just demand, as market makers actively manage their exposures and employ hedging strategies to mitigate risks. Consequently, the relationship between retail

investor activity and option premiums is complex and cannot be solely attributed to their net long positions.

Another misconception regarding the options market structure involves the understanding of price improvement mechanisms. For instance, in the paper by Ernst and Spatt, it is suggested that option trades exhibit low average prices, with the median trade receiving 3% price improvement. They also highlight that Price Improvement Mechanism (PIM) trades receive significant price improvement compared to the OPRA best bid or best ask, totaling over $2.4 billion. While this indeed underscores the advantageous nature of options trading, their analysis fails to consider the underlying factors contributing to observed price improvement in the U.S. options markets. Instead of acknowledging the pivotal role played by exchanges in implementing price improvement mechanisms for both U.S. equities and options markets, they attribute the larger price improvement in the options market solely to wider spreads. In contrast, these findings actually underscore the substantial contributions made by exchanges in facilitating price improvement for retail trades across both equities and options markets.

Another misunderstanding related to options market structure pertains to price improvement mechanisms in the options market. One such example of this is in the paper by Ernst and Spatt, which suggests that option trades have low average prices and that the median trade receives 3% price improvement. Interestingly, they also note that Price Improvement Mechanism (PIM) trades receive over $2.4 billion in price improvement compared to the OPRA best bid or best ask. Instead of recognizing the significant role that exchanges play in the price improvement

mechanisms of both U.S. equities and options markets, they attribute the larger price improvement in the options market solely to wider spreads. Contrary to their conclusion, these findings actually highlight the substantial contributions made by exchanges in facilitating price improvement for retail trades in both equities[17] and options markets.

Similarly, Bryzgalova, Pavlova, and Sikorskaya (2023) suggest that retail investors may be at a disadvantage in the U.S. options markets due to existing price improvement mechanisms. However, they cannot definitively confirm whether retail traders are negatively affected when their trades are routed to price improvement mechanisms. Therefore, they should refrain from drawing conclusions without concrete evidence to support their claims.

A third misconstrued research practice is the classification of buy and sell trades based on a comparison of trade prices to mid-quotes. This classification method is often used when explicit buy/sell information is not available in trade-level data. Trades with prices above the mid-quote are categorized as buy trades, while those with prices below the mid-quote are categorized as sell trades. However, a critical flaw arises when trade prices are equal to the mid-quote, making the validity of this classification approach questionable. For example, Beckmeyer et al. (2023) noted that a significant proportion of trades, both among retail (18%) and non-retail (16.9%) participants, occurred at the mid-quote, making it challenging to classify these trades as buys or

[17] Table 1 of Ernst and Spatt (2023) delves into the price improvement dynamics within the U.S. equities market. It unveils a notably negative coefficient between off-exchange share and improvement share, suggesting that during a specific timeframe, higher dollar volumes of off-exchange trading correlate with diminished price improvement for the respective stock.

sells. This substantial number of unclassified trades raises valid concerns about the reliability of their research findings.

The Beckmeyer et al. (2023) analysis of retail investors' P&L related to trading 0DTE options is severely hampered due to the unavailability of the investors' associated positions. It is imperative to underscore the undeniable reality that options trading outcomes are overwhelmingly dictated by underlying market movements, leaving investors susceptible to significant losses when the market moves against their strategies. Furthermore, the paper's comparison of retail investors' losses in 2022 to earlier years, without acknowledging the substantial disparities in underlying market conditions, including the unprecedented levels of volatility and uncertainty introduced by unforeseeable Federal Open Market Committee (FOMC) decisions on targeted federal funds, reflects a disregard for analytical rigor. In a bearish and highly volatile market environment, like the one experienced in 2022, it becomes increasingly probable for losses to ensue in both equities and options markets. Figure 6 illustrates the monthly rate of return from January 2021 to March 2024, showing large volatility in the stock market and big market downturns during that period. Thus, attributing the amplified average losses per day solely to the introduction of new S&P 500 Index options expirations betrays a fundamental flaw in reasoning and is a grossly misleading conclusion.

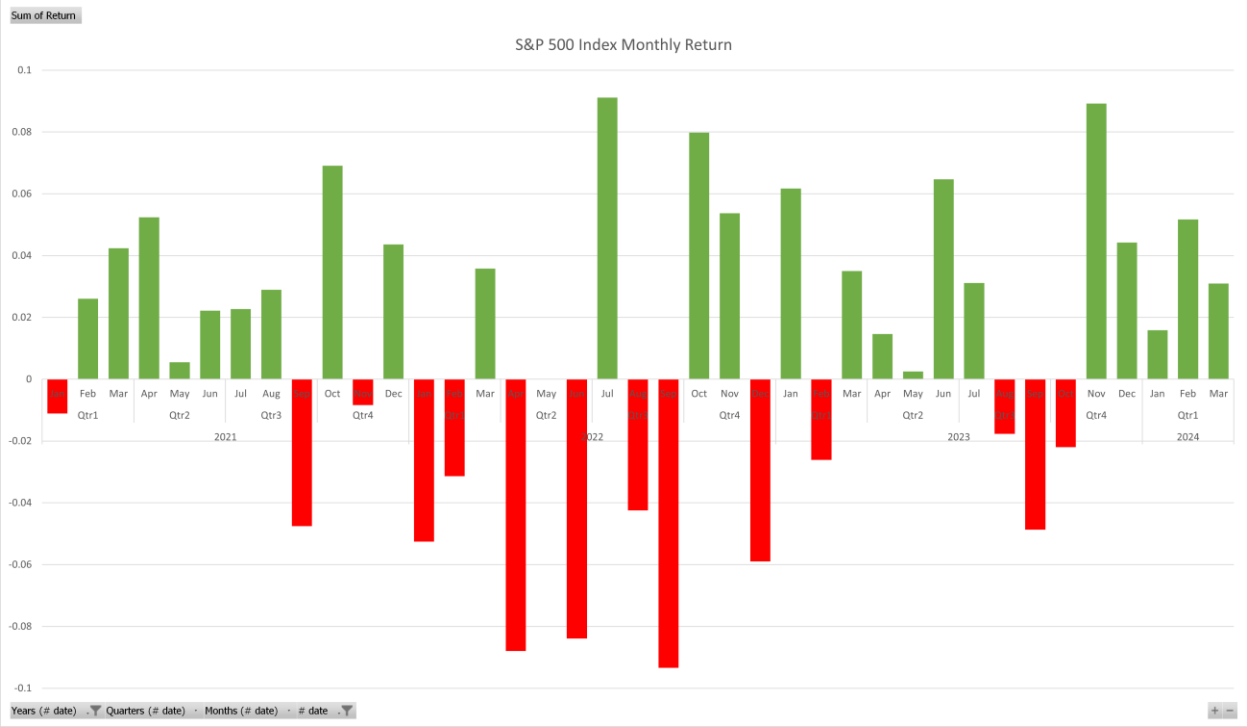

Figure 6. S&P 500 monthly rate of return including dividends (1/2021 - 3/2024)

D. Biased Perspectives Due to Limited Data

The confluence of a restricted sample period and exceptional events might skew views on retail options trading, necessitating a more balanced assessment.

The choice of sample period and granularity in a research paper is a crucial decision that researchers must make, often constrained by available resources. Having a limited time frame for a sample is not inherently problematic, but it can become an issue when researchers attempt to generalize their findings from outlier time periods to broader and longer spans of time. Such extrapolation can lead to concerns about the applicability and robustness of the results.

Furthermore, having access to sufficiently long historical data is essential for capturing the evolution of any market, including the U.S. options markets. Market dynamics, trading behaviors, and other factors can change over time, and without a comprehensive historical perspective, research findings may miss important developments and trends. Therefore, researchers should be mindful of the limitations imposed by their chosen sample period and granularity and consider how these factors may impact the validity and relevance of their findings.

The case of Ernst and Spatt's study on Payment for Order Flow and Asset Choice underscores the critical importance of recognizing these limitations when selecting a specific sample period for research. Their analysis was based on data spanning from November 4, 2019, to December 31, 2021, a period marked by significant market events, including the COVID-19 outbreak and the meme stock frenzy. While such a sample period can undoubtedly yield valuable insights into these specific events, it may not accurately reflect the broader conditions of the retail options trading landscape. This limited sample duration might fall short in providing a comprehensive understanding of the dynamics governing retail options trading. To enhance our comprehension of this domain, we extended the temporal scope of our analysis.[18]

Similarly, certain conclusions drawn by Beckmeyer et al. (2023) may exhibit biases resulting from their choice of a restricted sample period, primarily focusing on data from January 2021 to

[18] Our empirical analysis, which will be presented later in this paper, extends the sample period from October 2019 to March 2023, offering a comprehensive understanding of retail options trading.

February 2023. It's crucial to note that retail participation has been on the rise since around March 2020. The authors of the paper assert that option market makers consistently held net-short positions in 0DTE options throughout 2021 and until May 2022, with similar patterns noted in options with different maturities. This aligns with J.P. Morgan's commentary, which suggests that market makers' substantial negative order imbalance contributes to negative Gamma exposure, potentially amplifying intraday market swings.

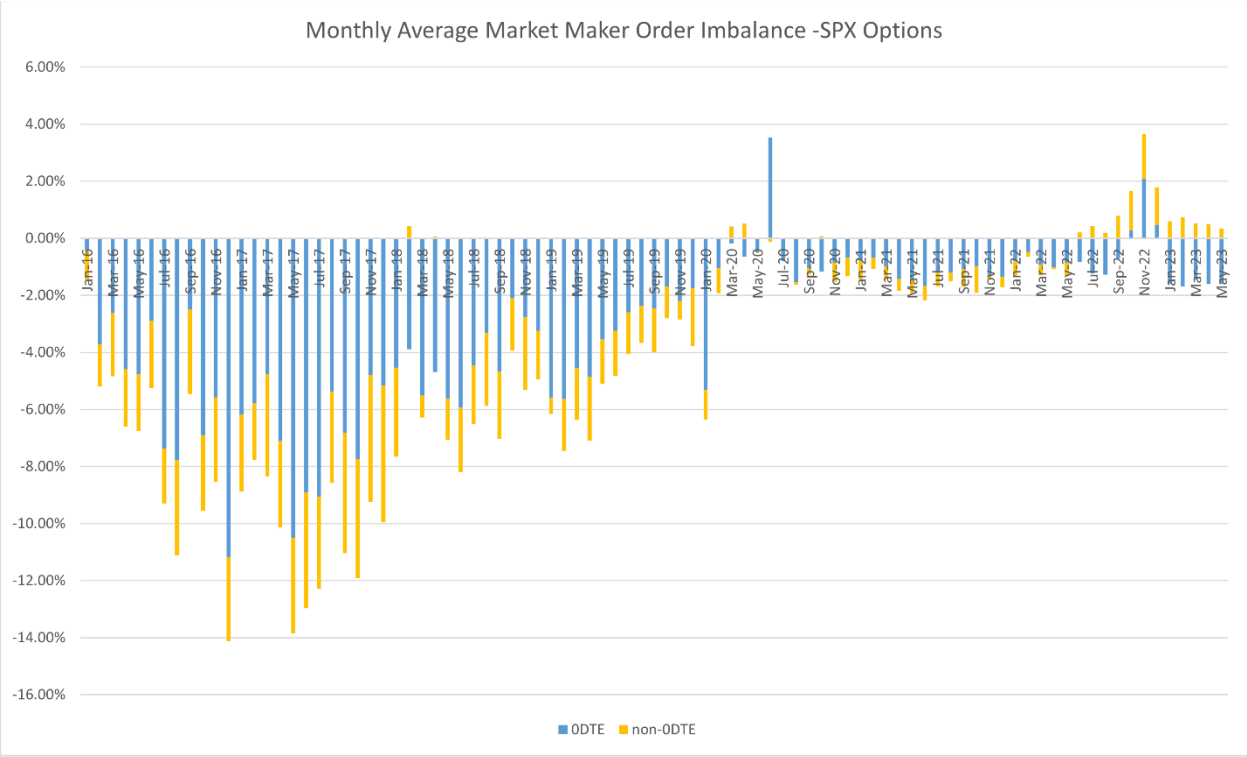

Figure 7. Market Makers' Monthly Average Order Imbalance (1/2016 - 5/2023)

However, our analysis, as depicted in Figure 7 using Cboe's open close files, reveals that net short positions, starting from March 2020, are notably smaller when compared to previous periods. This suggests that the actual picture might run counter to the conclusions presented in the paper. In fact, it is plausible that retail participation plays a role in mitigating market makers' order imbalance within the options markets.

Therefore, recognizing the significance of the chosen sample period in research, it is crucial to acknowledge that the paper's findings may be influenced by the confined time frame, potentially introducing bias. Conducting a more comprehensive analysis that encompasses the pre-surge era of retail participation, becomes essential for an accurate assessment of the impact of retail involvement on market makers' order imbalance. Furthermore, research findings stemming from a limited time frame that includes exceptional events such as market collapses or frenzies may offer limited applicability to normal market conditions. The unique circumstances during such periods may not faithfully represent the typical behavior of retail investors in the U.S. options markets.

In addition to concerns about sample period extrapolation, the transparency of data poses another noteworthy issue. Table 1 illustrates how different datasets can yield distinct impressions, as seen in the percentage of Days to Expiration (DTE) traded. For instance, Ernst and Spatt (2023) rely on anonymous trade data in their "Asset Returns and Broker Conflict of Interest" section, raising questions about the generalizability and representativeness of their findings. The lack of clarity regarding how the sample accurately reflects the broader population of retail traders in the options market diminishes the validity and applicability of the conclusions drawn in this section. Furthermore, Bryzgalova, Pavlova, and Sikorskaya (2023) employ the non-Alternative Trading System (ATS) equity trading volume share of the “big three” as a proxy for internalized option trading volume. However, this proxy may not precisely mirror the actual volume of internalized

options trades. The absence of specific internalization data for option trades constrains the robustness of these conclusions.

E. Summary and Suggestions

In light of our discussion on the limitations of certain research regarding retail options trading, we wish to summarize our key points and offer insights into the importance of research in the U.S. options market, along with recommendations for future studies.

First, claims that retail investors systematically overpay for options during earnings announcement trading is unwarranted. While options, like other goods, adhere to the principles of supply and demand, there are other factors at play which govern fair prices. It is important to acknowledge that options provide opportunities for investors to benefit, regardless of underlying price movements, by employing suitable trading strategies. Excessive demand from retail investors alone cannot significantly deviate options prices from their theoretical values. Given this, the increased options trading by retail investors ahead of earnings announcements indicates their understanding of how to leverage the advantages offered by options compared to equities. This suggests that retail investors have a grasp of the potential benefits and strategies associated with trading options and highlights their ability to navigate the options market effectively.

Moving forward, holistic research should utilize extensive historical datasets to delve into market makers' potential exposure imbalances during normal weeks and earnings announcement weeks.

This would yield deeper insights into market makers' net short exposure and the intricate dynamics between market makers, retail investors, and option pricing.

Regarding the assumption of retail investors' positions being exclusively long or long call options, evidence does not support the notion that long-position option investors systematically overpay during earnings announcements. Options pricing is multifaceted, influenced by various factors. Thus, the conclusions regarding P&L and wealth transfer between retail investors and market makers require refinement through further research.

Furthermore, it is important to address another common mistake often made in comparing the returns of holding equities and buying calls, a simplistic comparison that fails to account for the nature of option contracts and their expiration mechanics. Even if the underlying stock has a zero return at the end of the sample period, the majority of options will either expire worthless or at lower prices due to the decay of time value. Specifically, out-of-the-money and at-the-money options at the time of the trade will be worthless at expiration, while in-the-money options will only be worth their intrinsic value when the return of the underlying stock is zero.

For this reason, fully understanding the nature of option pricing and the concept of time decay is fundamental to trading options. The narrative that retail investors who buy options lack this understanding or are simply naïve is incorrect. Retail investors who buy calls may be expressing an opinion on potential price movements, while retail investors who buy puts often aim to protect their underlying positions. When retail investors purchase puts and those puts expire worthless

or at lower prices, they are not necessarily losing propositions. Instead, retail investors buy puts to safeguard their underlying stock positions, similar to homeowners purchasing insurance for their homes. Just as we would not criticize someone for purchasing homeowner's insurance as diminishing their wealth when nothing happens to their home during the insurance policy period, it is unfair and inappropriate to claim that buying puts depletes retail investors' wealth or to suggest that this construct should discourage retail investors from trading options.

In conclusion, our examination of retail options trading research has uncovered several critical concerns that warrant attention. Proxy data, exemplified by the use of 'SLAN' data, raises questions about the scope, accuracy and representativeness of findings, impacting the validity of conclusions drawn from such data. Additionally, misconceptions surrounding the calculation of retail investors' options profits and losses can result in inaccurate performance assessments. Assumptions and misconceptions about market dynamics within the retail options trading sphere can further distort results, hindering a comprehensive understanding of the market. Moreover, the confluence of a restricted sample period and exceptional events may introduce bias into perspectives on retail options trading, emphasizing the need for a more balanced and encompassing assessment. Researchers should be mindful of these concerns to ensure the rigor and reliability of their analyses in this complex and evolving market.

III. Empirical Analysis - Retail Option Trading

Our empirical analysis uses trade data from C1, spanning from October 2019 to March 2023. While some sub-datasets include data before 2020, others commence from the beginning of

2020. To ensure a more inclusive view and account for structural changes due to the COVID-19 pandemic starting in March 2020, we incorporate pre-pandemic data. It's essential to highlight that excluding pre-pandemic data in studies on retail trading may lead to overgeneralized conclusions. Our focus is on retail option trading, identifying orders from retail platforms submitted to C1. This data is available from October 2019, marking the beginning of our study.

As discussed in the literature review section, utilizing 'customer' orders, even when focusing solely on contract sizes smaller than 10, as a proxy for retail trades cannot entirely prevent the inclusion of non-retail trades in the sample. This is because 'customer' orders may originate from both retail investors and non-retail professional users who sometimes break down their larger trades into smaller orders. In our approach, we mitigate these limitations by only including customer orders that originated from retail platforms, significantly reducing the inclusion of non-retail trades. While there may be a small limitation regarding certain platforms, which could include professional traders, we believe our sample better represents retail options trading compared to studies using OPRA's 'SLAN' and 'SLIM' data or the general customer category in option trade data.

A. Retail's Participation in the U.S. Options Market

In the introduction section, Figures 1a and 1b provide insights into the total notional value traded on C1, illustrating the market volume and growth in the options market. These figures reveal a persistent upward trend in the U.S. options market since 2020, with market makers consistently holding approximately half of the market share, increasing from 45% in 2019 Q4 to 52% in 2023

Q4. Notably, there has been an uptick in retail investor participation since Q2 2020, coinciding with the outbreak of the pandemic.

Figure 8 provides an overview of contract size distribution based on the clientele group (excluding market makers) from January 2020 to December 2023, distinguishing between trades conducted on retail platforms and those conducted elsewhere. In the lower part of the chart, the number of trades on retail platforms is grouped into categories, including 1, 2-10, 11-50, 51-100, and 100+. The data reveals that retail investors predominantly engage in trading 1-10 contracts at a time. This finding is significant as it challenges the focus of some studies on retail options trading, which often concentrate on one-contract trades, thereby overlooking a substantial portion of retail investors' trading activities. In contrast, other clientele groups, such as customer orders traded outside of our defined retail platform list, pro-customer, broker-dealers (BD), and firms, engage in fewer small-contract size trades. Their trading activities are characterized by larger contract sizes, indicating a different pattern compared to retail investors.

Figure 8. Contract Size Distribution by Clientele Group (1/2020 - 12/2023)

Figure 2 in the introduction section illustrates that retail investors consistently trade more complex orders than simple orders in terms of notional value. Despite the proportion of simple orders increasing from 24% in Q4 2019 to 39% in Q4 2023, it is clear that focusing solely on single orders by using OPRA's SLAN and SLIM data leads to a significant underestimation of the overall retail options trading activities. Studies that solely examine simple orders in retail option trading and overlook the prevalence and significance of complex orders, which require higher account requirements and demonstrate the sophistication of retail investors, mislead readers by excluding a major portion of retail trading activity and underestimating the sophistication and risk management abilities of retail investors.

Furthermore, it is important to acknowledge that the actual trading strategies employed by retail investors may involve even more complex scenarios than our analysis captures. The nature of the trade data mechanism poses certain limitations in accurately identifying and categorizing complex orders. For example, if an option investor opens one leg of a trade at a different time than the other leg, our analysis can only identify these as two separate simple orders with different time stamps. As a result, we group them as simple orders, potentially leading to an underestimation of the proportion of complex strategies in open positions.

B. Retail Trading Strategies

Given the significant prevalence of complex orders among retail trades in terms of notional value and the limited focus of previous studies on these strategies, our analysis aims to provide a detailed examination of complex retail orders. We categorize retail trades based on commonly used option trading strategies and present the percentage of total notional value and the net credit/debit associated with each strategy in Figure 9 and Figure 10, respectively. By doing so, we offer a thorough understanding of the trading strategies adopted by retail investors from October 2019 to December 2023, shedding light on the net positions and profitability of these strategies.

Figure 9 illustrates the proportion of the notional value of open positions for each strategy traded by retail investors during the sample period. Put vertical spread is the strategy most used by retail investors, followed by call vertical spread.

Figure 10 reveals an important trend observed among retail investors, as they have consistently collected net credits from selling complex orders. Our dataset shows a significant increase in net credits obtained by retail investors over time. Starting at $1.7 billion in Q4 2019, the net credits reached a peak of $10.3 billion in Q3 2022 and remained notably high at $5.5 billion in Q4 2022. This trend demonstrates retail investors' ability to generate income through the strategic implementation of shorting complex strategies.

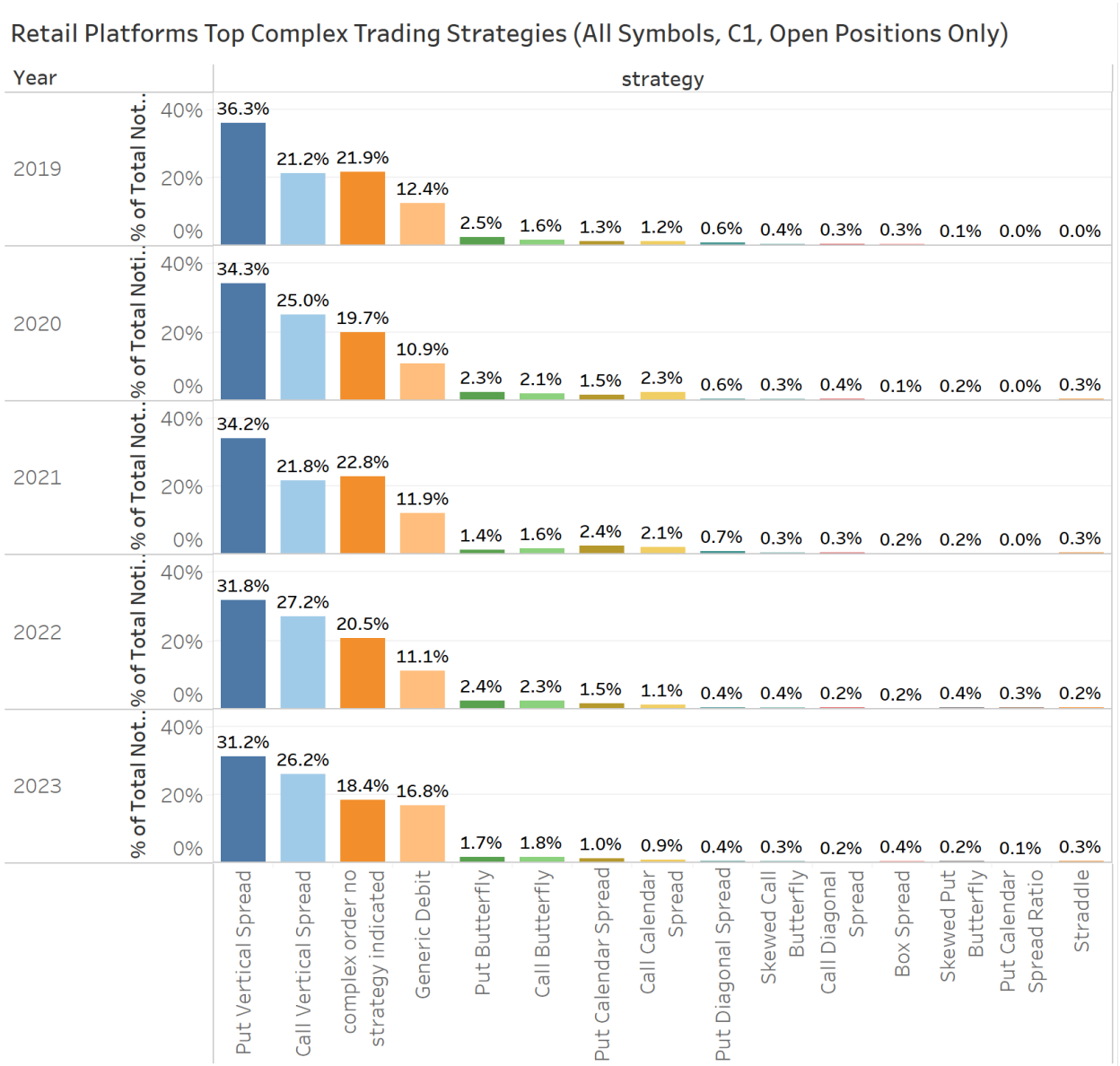

Figure 9. Breakdown of retail complex orders (10/2019 –12/2023)

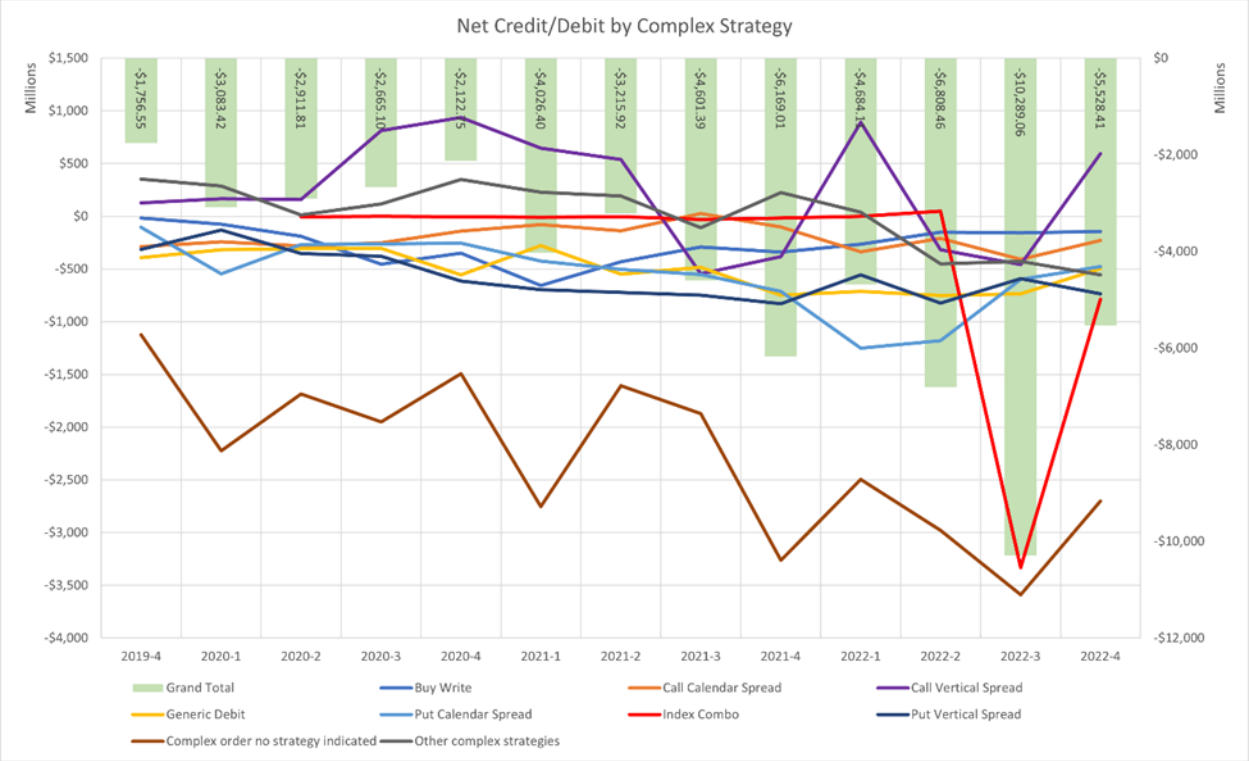

Figure 10. Net Credit/Debit by Complex Strategy (10/2019-12/2022)

Examining the net credit/debit data, we identify several commonly used complex strategies among retail investors, including put calendar spread, put vertical spread, call calendar spread, and generic debit. However, it is important to note that our dataset does not allow us to calculate the actual profit and loss of retail investors, as we lack information about the timing and trade prices when these positions are closed. Nevertheless, the data provides strong evidence that retail investors actively engage in more sophisticated strategies, challenging the notion that they solely focus on buying single leg call and put options.

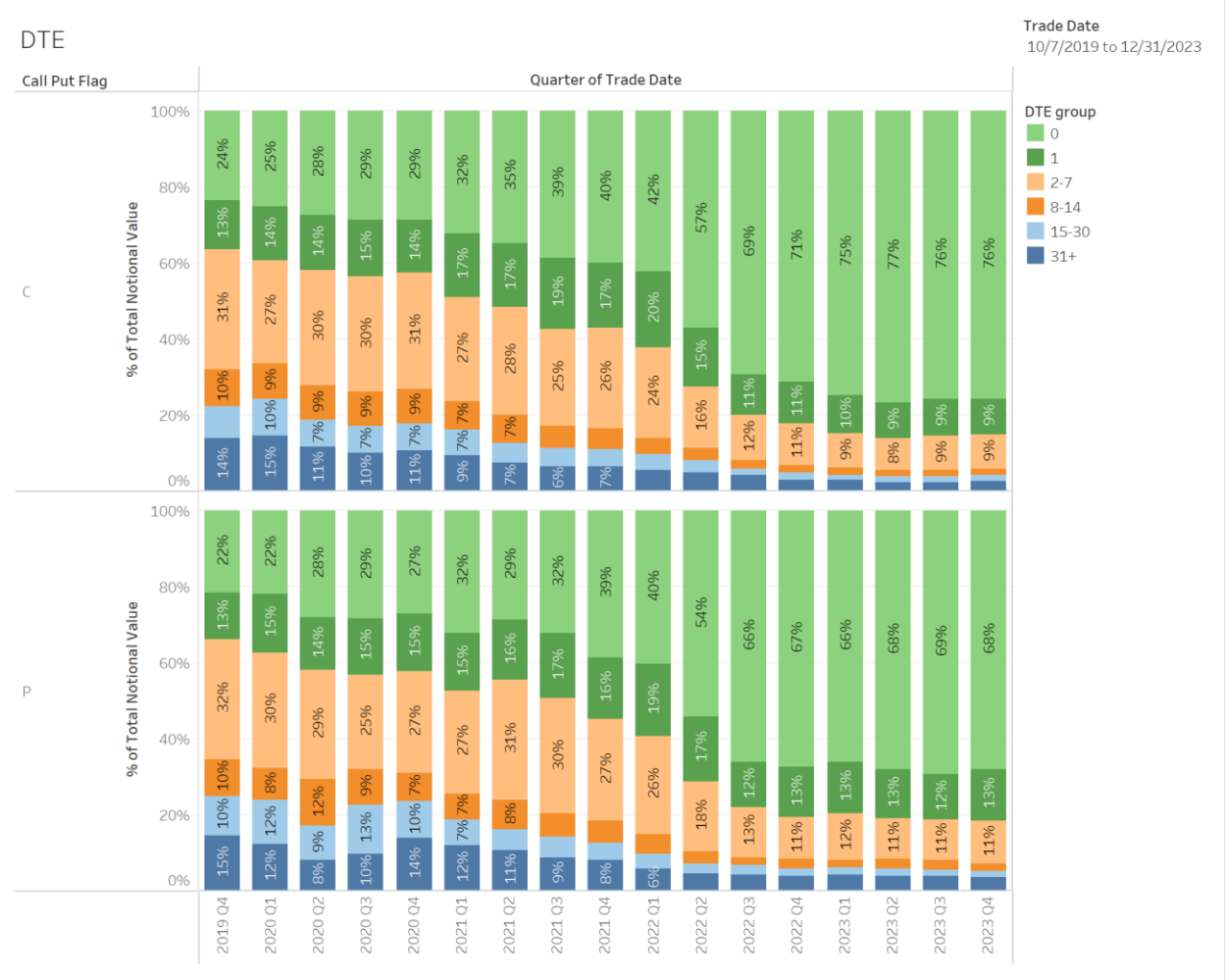

Figure 11. Retail Investors' Preference for Days-to-expiration in Notional Value (10/2019 – 12/2023)

We also analyzed retail investors' preference for days-to-expiration (DTE) and moneyness. Since complex strategies can involve different DTEs and moneyness within the same order, such as calendar spreads and vertical spreads, we focus solely on simple orders from retail platforms. Our analysis reveals a growing demand for short-term options, both for call options and put options. In Q4 2019, option contracts with a DTE of one week or less (i.e., DTE=0, 1, or 2-7) accounted for less than 70% of retail notional value. Today, they represent more than 90% of retail notional value.

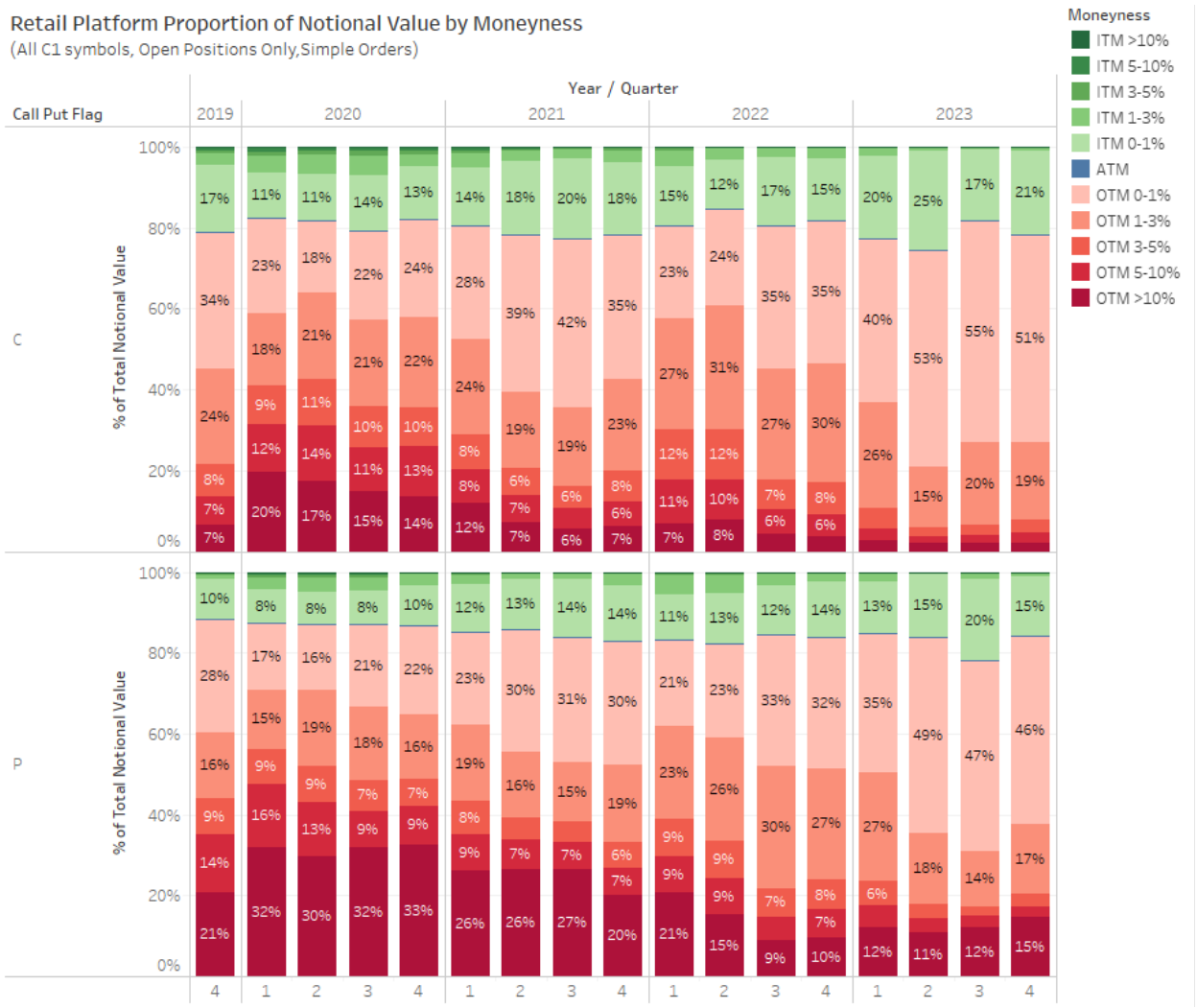

Figure 12. Retail Investors' Preference for Moneyness (10/2019 – 12/2023)

Regarding moneyness, our analysis reveals that retail investors demonstrate a preference for out-of-the-money (OTM) options, specifically those with OTM < 3% for both calls and puts. This suggests a propensity among retail investors to trade options with a higher likelihood of expiring worthless but offering significant returns if the underlying asset's price moves favorably. Those OTM options boast high liquidity and narrow bid-ask spreads. Notably, options with OTM<1% have experienced significant growth in 2023. These options closely track underlying assets but are less expensive than ITM<1% options. Conversely, there has been a decline in the proportion

of deep OTM calls and puts (OTM >10%) traded by retail investors, particularly for call options. This shift in trading patterns may reflect retail investors' risk preferences and sentiments toward the underlying markets.

IV. Robustness Analysis – Sensitivity Testing without SPX Options

In this section, we explore retail investors' options trading activities excluding SPX options, which are solely traded on C1 and constitute a significant portion of options trades on the exchange. To ensure the robustness of our analysis, we conduct an examination to determine if excluding SPX options from our sample affects our conclusions. Since Q1 2022, SPX options have accounted for over 20% of open positions and approximately 80%-90% of open positions on C1, as shown in Figure 13a and Figure 14a. Additionally, they have represented over 25% of total volume and more than 82% of total notional value of retail options trades on C1 during the same period, as depicted in Figure 13b and Figure 14b. Traders often utilize spreads when trading SPX options, possibly due to their high notional value and representation of a diversified market index. However, traders dealing with single leg non-index options contracts may consider factors such as assignment and settlement. For example, shorting cash-secured puts involves anticipating potential assignment, while going long on call (put) options may involve the intention to buy (sell) the underlying assets. Traders who prefer assignment and physical settlement may gravitate toward options on individual stocks or ETFs rather than indices, potentially influencing their trading preferences towards complex orders. Therefore, our analysis focuses on dissecting retail options trading of non-SPX options, which may reveal slightly different preferences compared to our previous findings.

A. Unraveling Retail Option Trading Beyond Our Major Proprietary Product

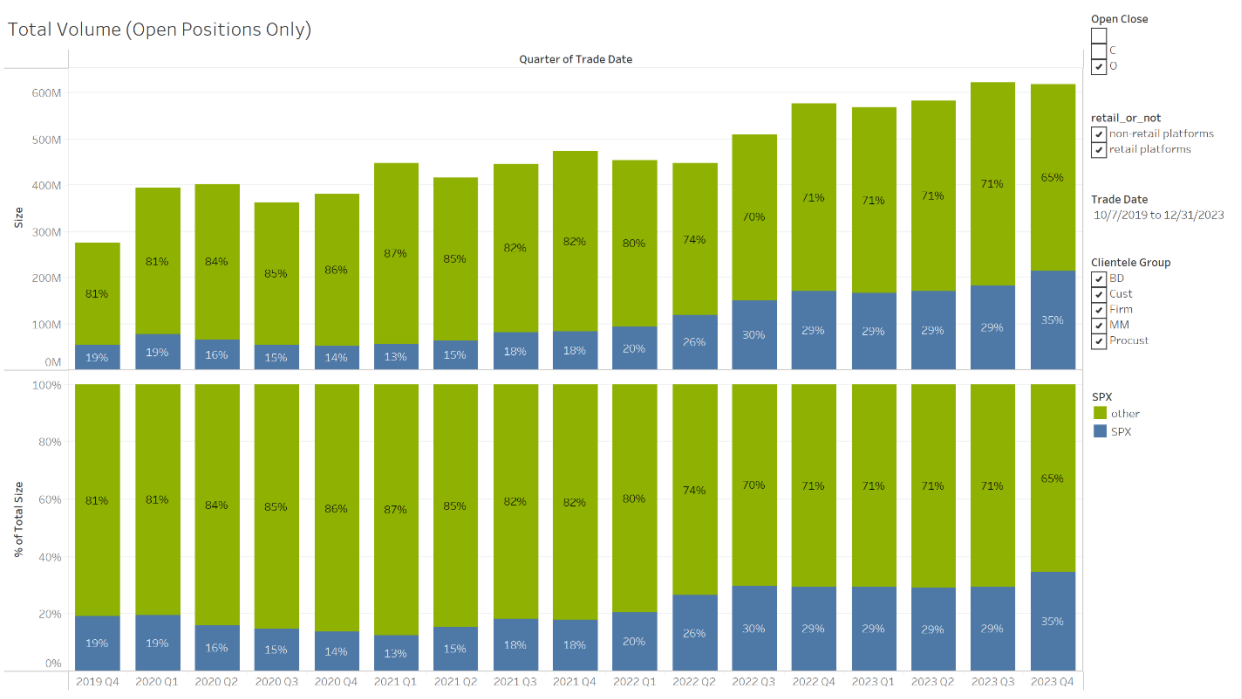

Figure 13a. Total Volume of Open Positions on Cboe Options Exchange (10/2019 – 12/2023)

Before delving solely into non-SPX options, we conducted a comparative analysis of retail investors' trading concentration between SPX options and other options, considering all market participants on C1. Our examination, depicted in Figure 13a and 13b, shows that retail traders using retail platforms exhibit a notable preference for SPX options in comparison to the overall C1 market. Between Q1 2019 and Q4 2023, SPX options comprised 19%-35% of the total volume traded on C1 by all market participants, while options represented 15%-44% of the total volume in retail trades. Notably, retail investors have increasingly shown a preference for trading SPX options since Q2 2021, a trend reflected in the broader market since Q1 2022. This shift suggests a growing sophistication among retail investors, who recognize the benefits of SPX options—cash-settled index contracts offering exposure to a diversified market portfolio. It may

also indicate a desire among retail investors to construct well-diversified portfolios.

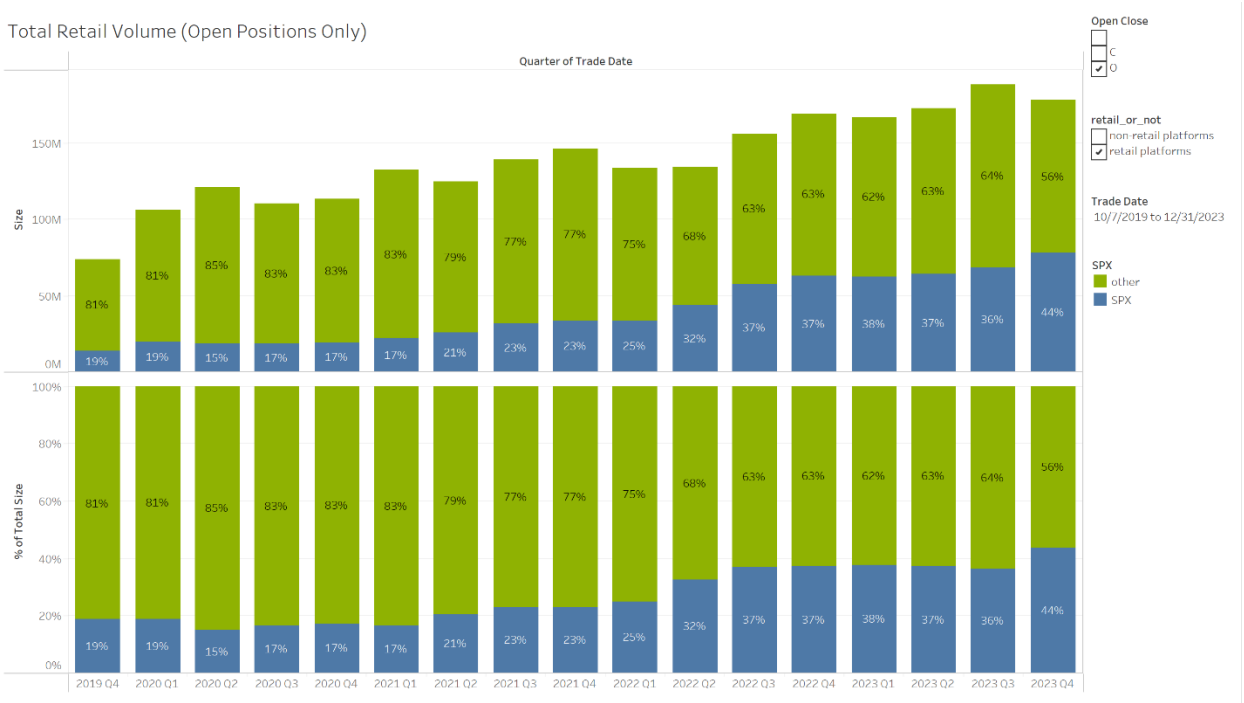

Figure 13b. Total Volume of Open Positions from Retail Platforms traded on Cboe Options Exchange (10/2019 – 12/2023)

When exploring options traders' financial exposure, the notional value emerges as a more fitting measure than volume, as it represents the total dollar value of the underlying asset that the options contract controls. In this case, SPX options significantly outweigh other options (refer to Figure 14a and 14b), reinforcing the relevance of our analyses, which includes SPX options, presented in previous sections as the main focus of this paper. However, to gain a comprehensive understanding of all retail investors, it is worthwhile to delve into the non-SPX options space separately from all retail trades on C1.

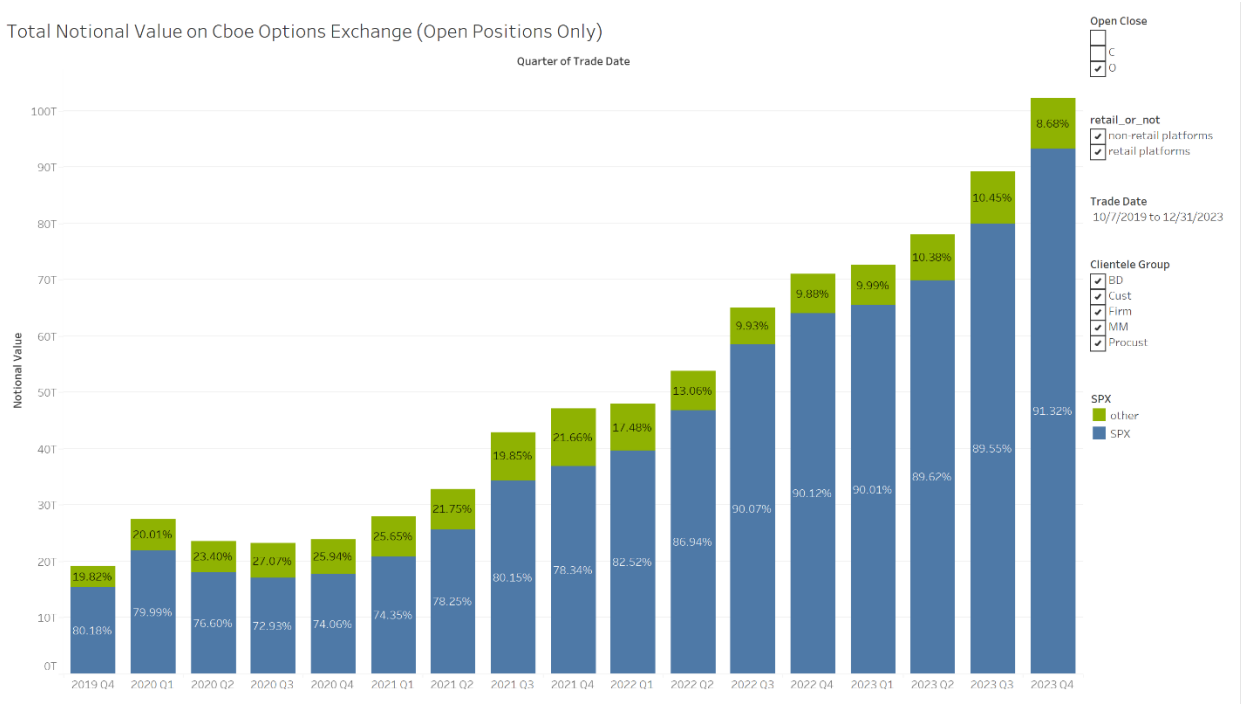

Figure 14a. Total Notional Value of Open Positions on Cboe Options Exchange (10/2019 –12/2023)

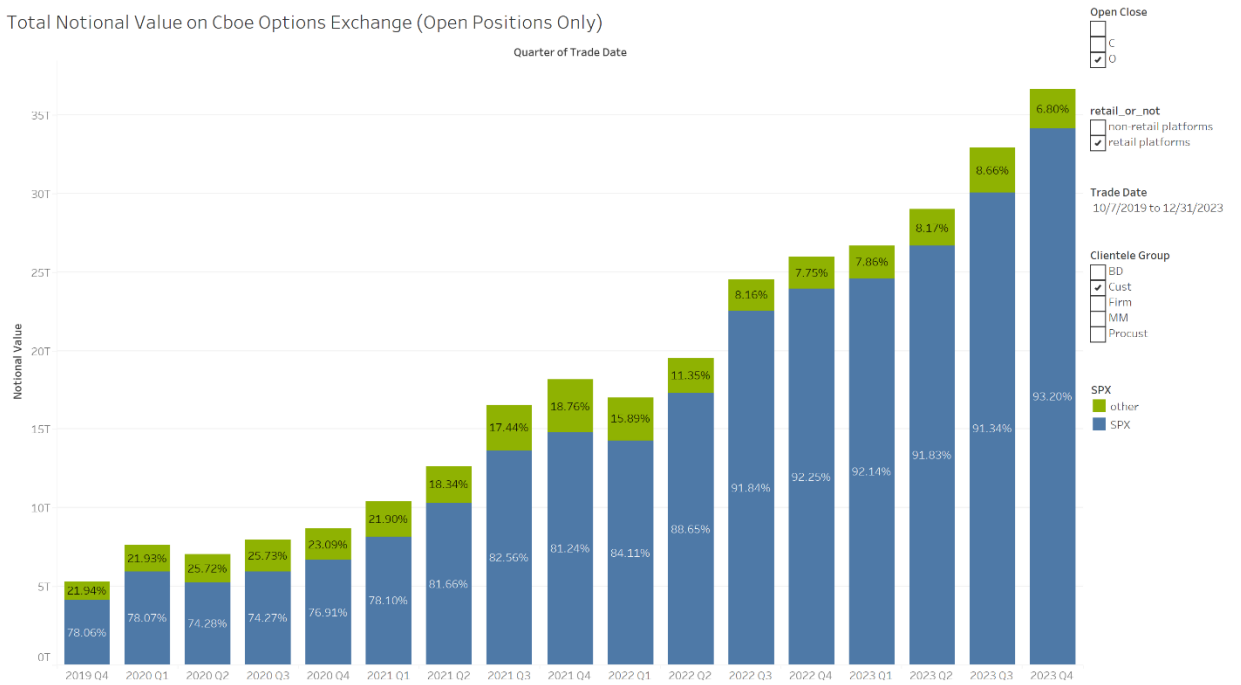

Figure 14b. Total Notional Value of Open Positions from Retail Platforms on Cboe Options Exchange (10/2019– 12/2023)

Figures 15a and 15b display the breakdown of notional value traded by various clientele groups, with retail trades being a part of the 'CUST' group. These charts reveal that the overall market's trades of non-SPX options peaked in Q4 2021, aligning with the proportion of retail trades during the same period. Comparing these two charts with Figure 1a and 1b, it becomes evident that the overall market and retail investors' preference for options on single stocks diminished, while the preference for options on SPX continued to grow after Q4 2021. Importantly, the portion of retail trades in non-SPX options closely resembles that in all options on C1, accounting for approximately 37% during the sample period. These observations suggest that retail participation remained relatively consistent in both non-SPX and SPX options.

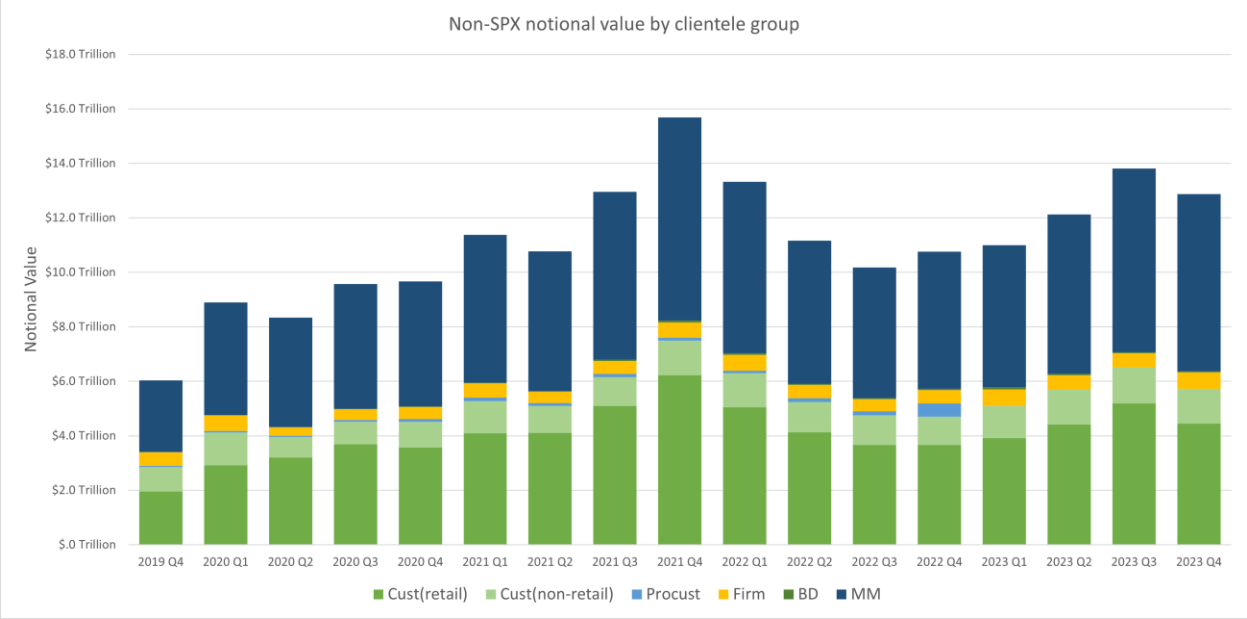

Figure 15a. Notional Value on C1 by Clientele Group, Excluding SPX Options (10/2019 – 12/2023)

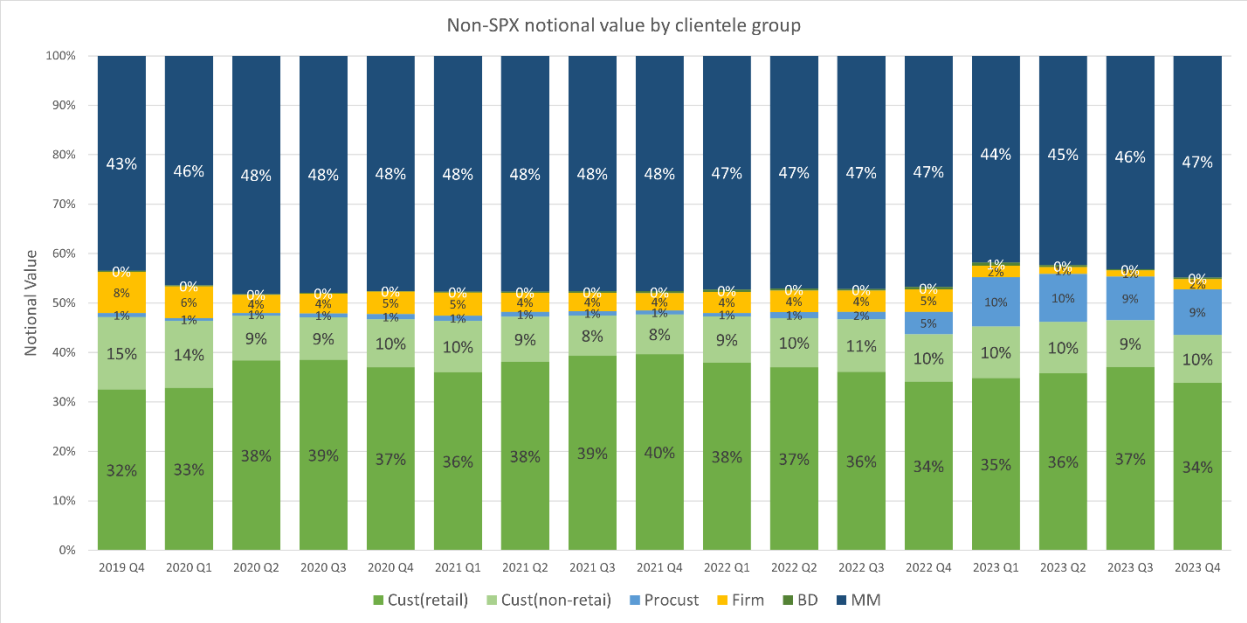

Figure 15b. Percentage of Notional Value on C1 by Clientele Group, Excluding SPX Options (10/2019 – 12/2023)

Figure 16a depicts the proportion of simple and complex retail orders, measured by notional value in non-SPX options, showcasing some variance from the broader options market, as anticipated at the outset of this section. Among retail trades of non-SPX options, the percentage of simple orders has exhibited an upward trend, rising from 44% to 51% between Q4 2019 and Q4 2023, indicating a more pronounced shift compared to when SPX options are included. It's noteworthy that while complex retail orders of non-SPX options comprise less than half of retail trades in terms of notional value, excluding them would overlook a massive portion of retail trading activity. Moreover, given the significance of SPX options in retail options trading, studies focused solely on single-leg options offer a limited perspective of retail options activity.

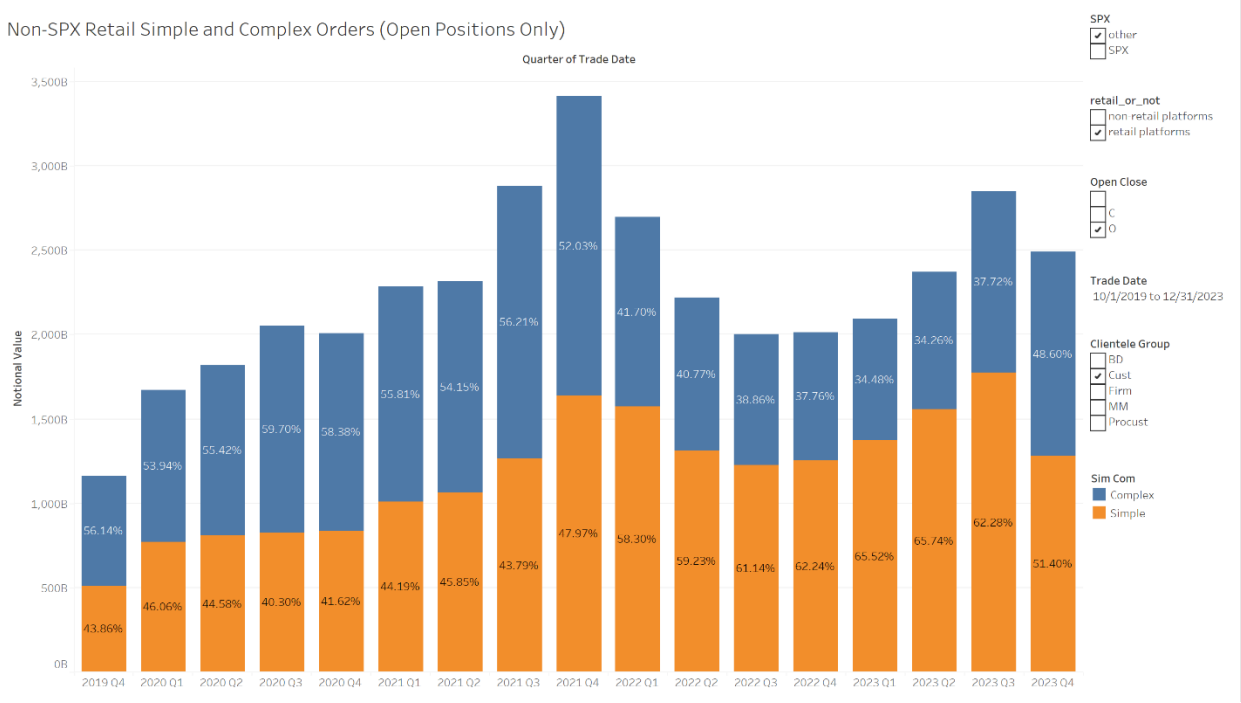

Figure 16a. Notional Value of Retail Simple and Complex orders on C1, Excluding SPX Options (10/2019 – 12/2023)

B. Common Retail Trading Strategy in Non-SPX Options

a. Simple Orders in Non-SPX options

Examining the breakdown of retail trading strategy in non-SPX options within the broader context is crucial, given that more than half of the notional value of retail orders comprises simple orders. As depicted in Figure 17a, buy orders dominate among retail investors opening positions of simple orders in non-SPX options. The combined long positions of call and put options (illustrated by the green bars) have risen from 75% to 85% between Q4 2019 and Q4 2023. This trend underscores that while the volume of simple orders traded in non-SPX options is increasing, the majority of those orders are buy orders, indicative of limited-risk trades where the maximum loss is confined to the premium paid by retail investors at the time of purchase. It's

noteworthy that the increase primarily stems from the growth in long put options, often utilized to hedge downside risks.

Figure 17a. Breakdown of Retail Simple Orders in Notional Value, Excluding SPX Options (10/2019 – 12/2023)

b. Complex Orders in Non-SPX options

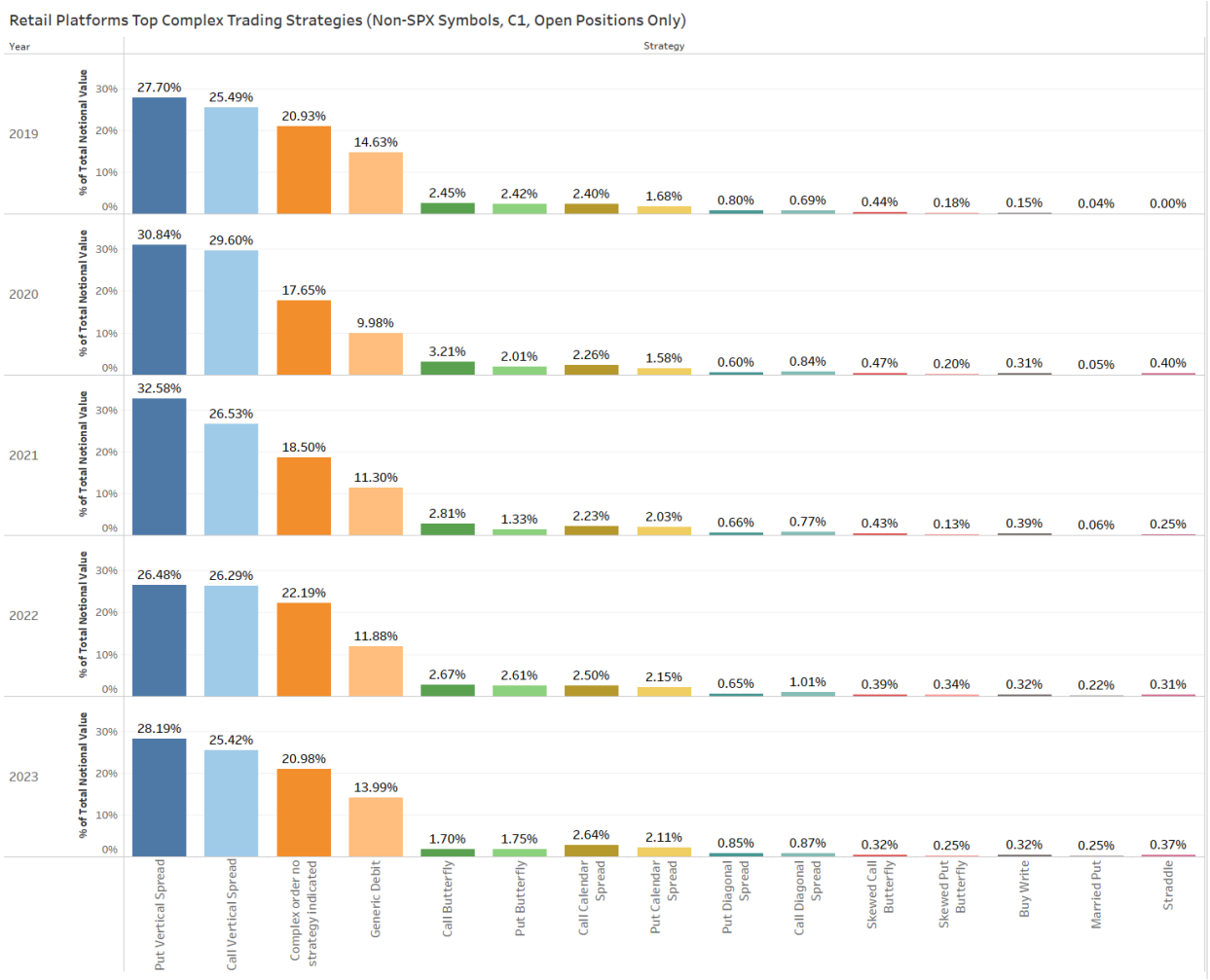

Figure 18a. Common Retail Complex Trading Strategy in Non-SPX Options, ranked by Notional Value (10/2019 – 12/2023)

The proportion of complex non-SPX retail orders has declined slightly from 56% to 49% from Q4 2019 to Q4 2023, as shown in Figure 16a. However, these strategies continue to hold significance in non-SPX retail options trading. Therefore, we present a summary of statistics regarding various complex trading strategies employed by retail investors when trading non-SPX options. When comparing Figure 18a to Figure 9, it becomes evident that put vertical spreads and call vertical spreads are the most commonly used complex trading strategies for non-SPX options. These strategies also dominate our analysis when we include SPX options. Put vertical

spreads are employed in approximately 28% of non-SPX options retail trades (Figure 18a), compared to 34% in all options retail trades (Figure 9). Remarkably, all these complex strategies are designed with limited losses in mind.

This sensitivity test reaffirms our earlier findings presented in the preceding chapters. First, it confirms that retail investors began trading more SPX options in Q2 2021. Over the years, retail investors have increasingly favored simple orders in non-SPX options, resulting in simple orders exceeding half of the notional value of non-SPX options since 2022. Although complex orders still constitute the majority of retail option trades in all options, the vast majority of simple non-SPX retail orders are buy orders, indicating a focus on limited losses. Particularly, put vertical spreads and call vertical spreads remain the most common complex strategies used by retail investors, accounting for over half of the complex trades. Overall, retail investors' preferences for options that are based on a well-diversified market portfolio, such as SPX options, have grown, and the majority of their trades – whether in strictly non-SPX options or across all options – are centered on limited losses. These insights reflect caution and highlight the evolving and sophisticated nature of retail options traders.

V. Conclusion

In this paper, we critically examined and analyzed retail trading in options markets with the aim of providing a comprehensive understanding of the dynamics, behaviors, and implications of retail investor participation in options trading, while addressing the limitations and flaws observed in existing literature.

Throughout our analysis, we identified several key findings and discussed their implications. We highlighted the importance of considering extended sample periods to capture the full breadth of retail participation in options markets. By expanding the sample period beyond short-term snapshots, we gained a more accurate and comprehensive understanding of the evolving trends and dynamics in retail options trading.

We also challenged prevailing assumptions and misconceptions about retail investors' performance and trading strategies. Contrary to the popular belief that retail investors solely engage in simple, long options trades, our analysis revealed the prevalence of complex orders and risk hedging techniques among retail investors. This finding underscores the need for a more nuanced analysis that considers the diversity and sophistication present in retail trading activities.

By incorporating diverse datasets, considering a wider range of variables, and challenging prevailing assumptions, we have contributed to a more informed discourse on the topic.

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Appendix

I. Description of Our Retail Options Trading Data

We based our analysis on options orders traded on Cboe Options Exchange (C1) that were identified as originating from major retail trading platforms and categorized as 'customer' orders. It's important to note that some customers of these retail trading platforms may also be professional investors who engage in frequent trading with substantial positions, making trading their primary source of income. Additionally, there could be a minimal number of orders from hedge funds and institutional investors, whose investment objectives often differ from those of retail investors. Unfortunately, we were unable to distinguish and exclude these orders from our sample.

II. Definition of Simple Orders and Complex Orders

Simple Order

Simple orders include four different types: buy calls, sell calls, buy puts, or sell puts.

Complex Order

A complex order is an order for two or more different options series "legs" sent to the exchange as a single order. The order, if filled, is guaranteed to execute within a net price and ratio, unlike sending two or more individual orders. Complex orders on C1 Exchange may include an equity leg. However, in this study, we excluded any volume from equity leg in a complex order.

Complex Strategy

- Put Vertical Spread

A long (short) put vertical spread consists of one long (short) put with a higher strike price and one short (long) put with a lower strike price. Both puts have the same underlying stock and the same expiration date. A long put spread is established for a net cost and profits as the underlying stock declines in price. A short put spread is established for a net credit and profits from either a rising stock price or from time erosion or from both.

- Call Vertical Spread

A long (short) call vertical spread consists of one long (short) call with a lower strike price and one short (long) call with a higher strike price. Both calls have the same underlying stock and the same expiration date. A long call spread is established for a net cost and profits as the underlying stock rises in price. A short call spread is established for a net credit and profits from either a rising stock price or from time erosion or from both.

- Call Butterfly

A long (short) butterfly spread with calls is a three-part strategy that is created by buying (selling) one call at a lower strike price, selling (buying) two calls with a higher strike price and buying (selling) one call with an even higher strike price. All calls have the same expiration date, and the strike prices are equidistant.

- Put Butterfly

A long (short) butterfly spread with puts is a three-part strategy that is created by buying (selling) one put at a higher strike price, selling (buying) two puts with a lower strike price and buying (selling) one put with an even lower strike price. All puts have the same expiration date, and the strike prices are equidistant.

- Call Calendar Spread

A long (short) calendar spread with calls is created by buying (selling) one “longer-term” call and selling (buying) one “shorter-term” call with the same strike price.

- Put Calendar Spread

A long (short) calendar spread with puts is created by buying (selling) one “longer-term” put and selling (buying) one “shorter-term” put with the same strike price.

- Call Diagonal Spread

A long (short) call diagonal spread is created by buying (selling) one “longer-term” call with a lower strike price and selling (buying) one “shorter-term” call with a higher strike price.

- Put Diagonal Spread

A long (short) put diagonal spread is created by buying (selling) one “longer-term” put with a higher strike price and selling (buying) one “shorter-term” put with a lower strike price.

- Skewed Call Butterfly

A skewed call butterfly is a three-part strategy involving four calls. If there are four strike prices, A, B, C and D, with A being the lowest, a short (long) skewed call butterfly is created by selling (buying) one call at strike A, buying (selling) two calls at strike B, skipping strike C and selling (buying) one call at strike D. All calls have the same expiration date, and the four strike prices are equidistant.

- Skewed Put Butterfly

A skewed put butterfly is a three-part strategy involving four puts. If there are four strike prices, A, B, C and D, with D being the highest, a long (short) skewed put butterfly is created by buying (selling) one put at strike D, selling (buying) two puts at strike C, skipping strike B and buying

(selling) one put at strike A. All puts have the same expiration date, and the four strike prices are equidistant.

- Buy Write

A buy write, which is also known as a covered call, is a 2-part strategy in which stock is purchased and calls are sold on a share-for-share basis

- Married Put

A married put, or protective put position is created by buying (or owning) stock and buying put options on a share-for-share basis.

- Straddle

A long straddle consists of one long call and one long put. Both options have the same underlying stock, the same strike price and the same expiration date. A short straddle involves selling a call and put with the same strike price.

- Box Spread

A box spread is a 4-part strategy that is created by buying a bull call vertical spread together with the corresponding bear put vertical spread, with both spreads having the same strike price and expiration dates.

- Generic Debit

Generic debit consists of a union of debit strategies except for other listed debit strategies.

- Conversion

Conversion strategy is a 3-leg strategy including an equity leg. It consists of buying a put and writes a covered call with identical strike prices and expiration dates.

- Complex order no strategy indicated

All other complex strategies that are not listed above.

III. Additional Charts

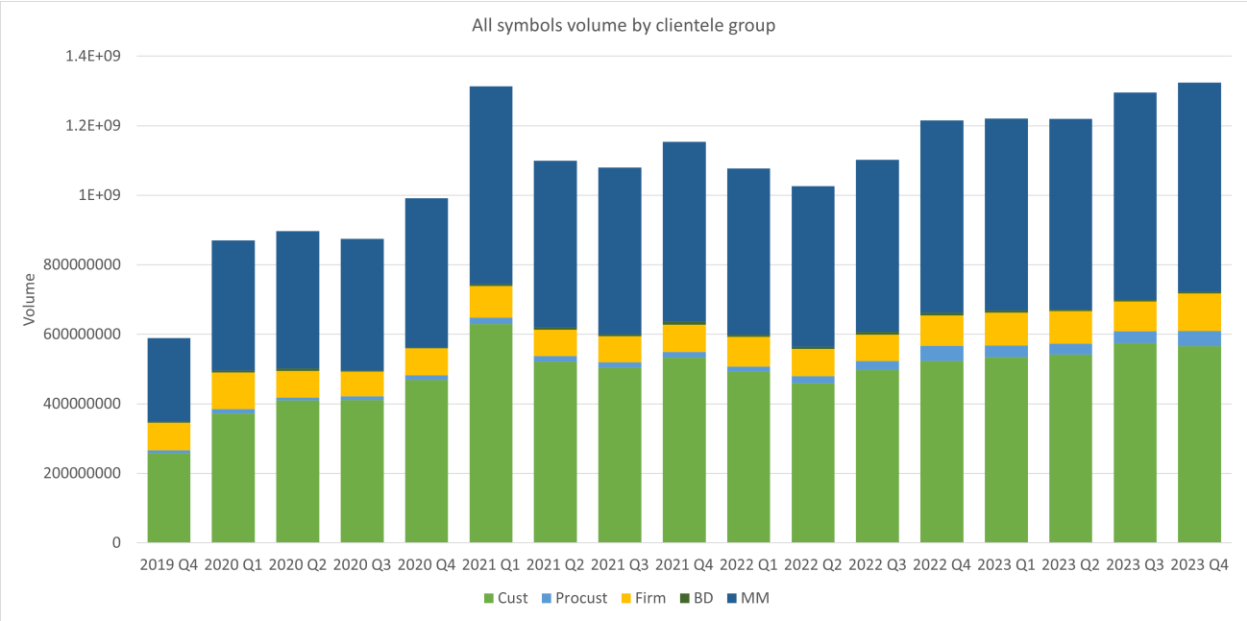

Figure 1c. Trading Volume by Clientele Group

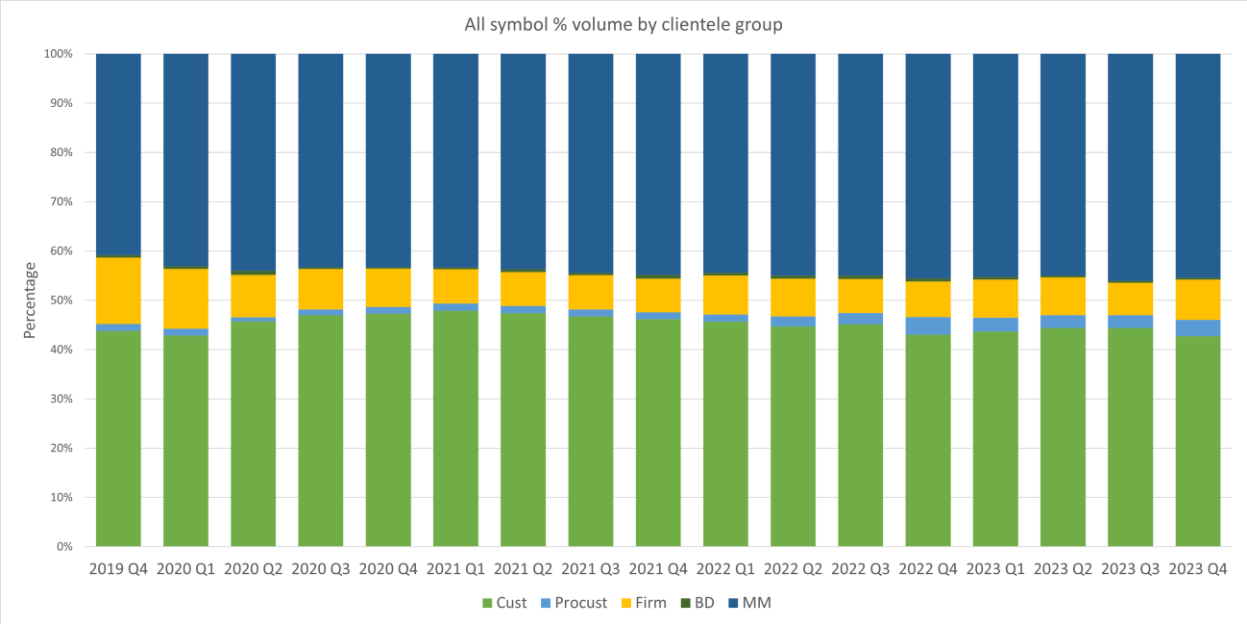

Figure 1d. Percentage of Trading Volume by Clientele Group

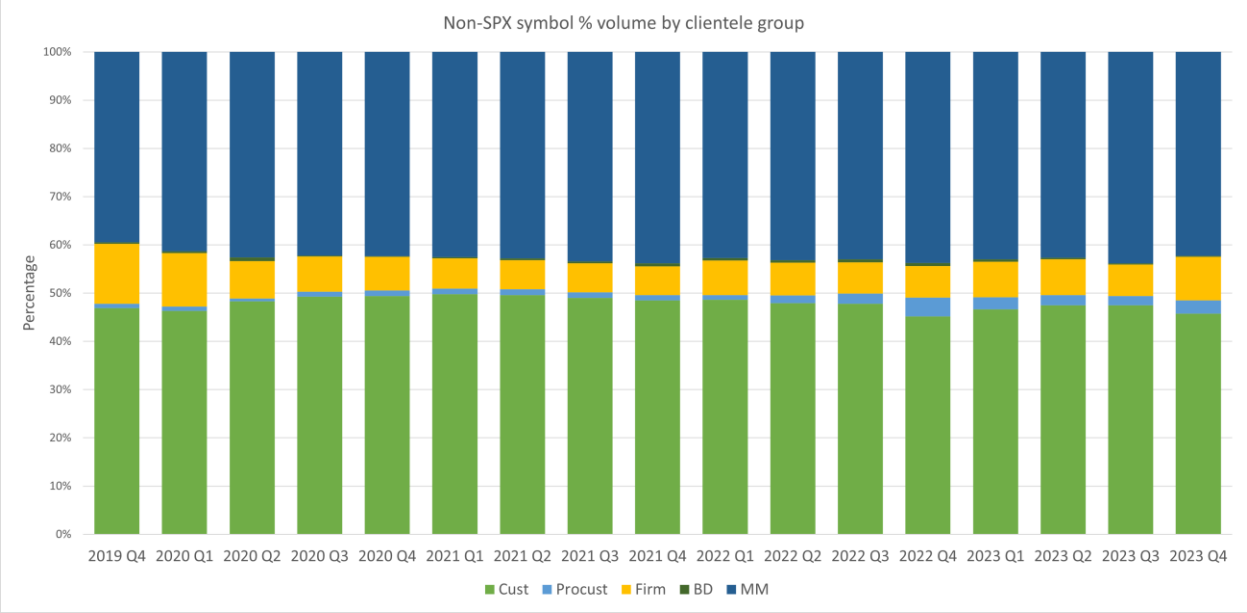

Figure 15c. Percentage of Total Volume on C1 by Clientele Group, Excluding SPX Options.

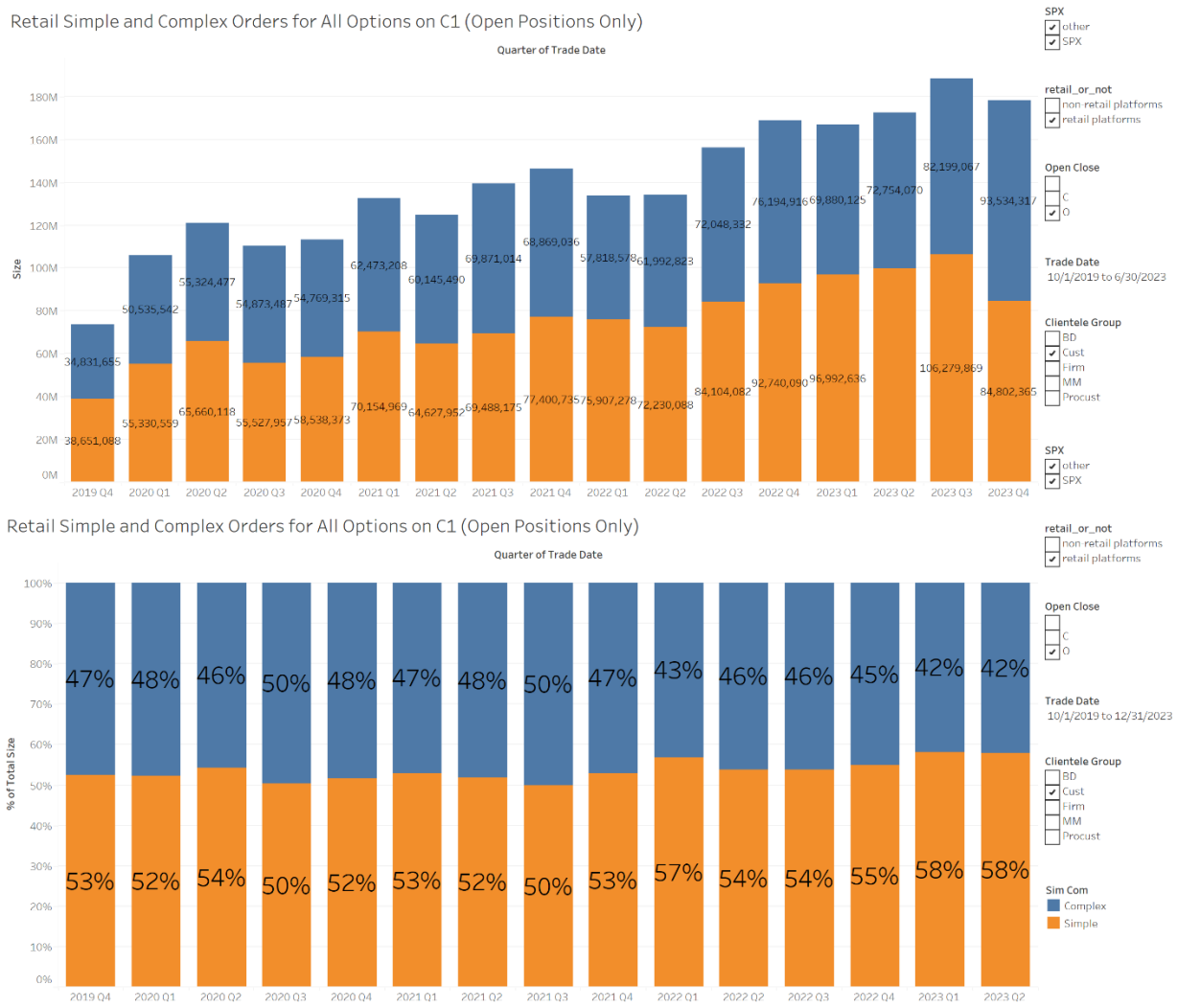

Figure 2b. Proportion of Volume for Simple and Complex Order Options Traded by Retail Investors, Open Positions Only (10/2019 - 12/2023)

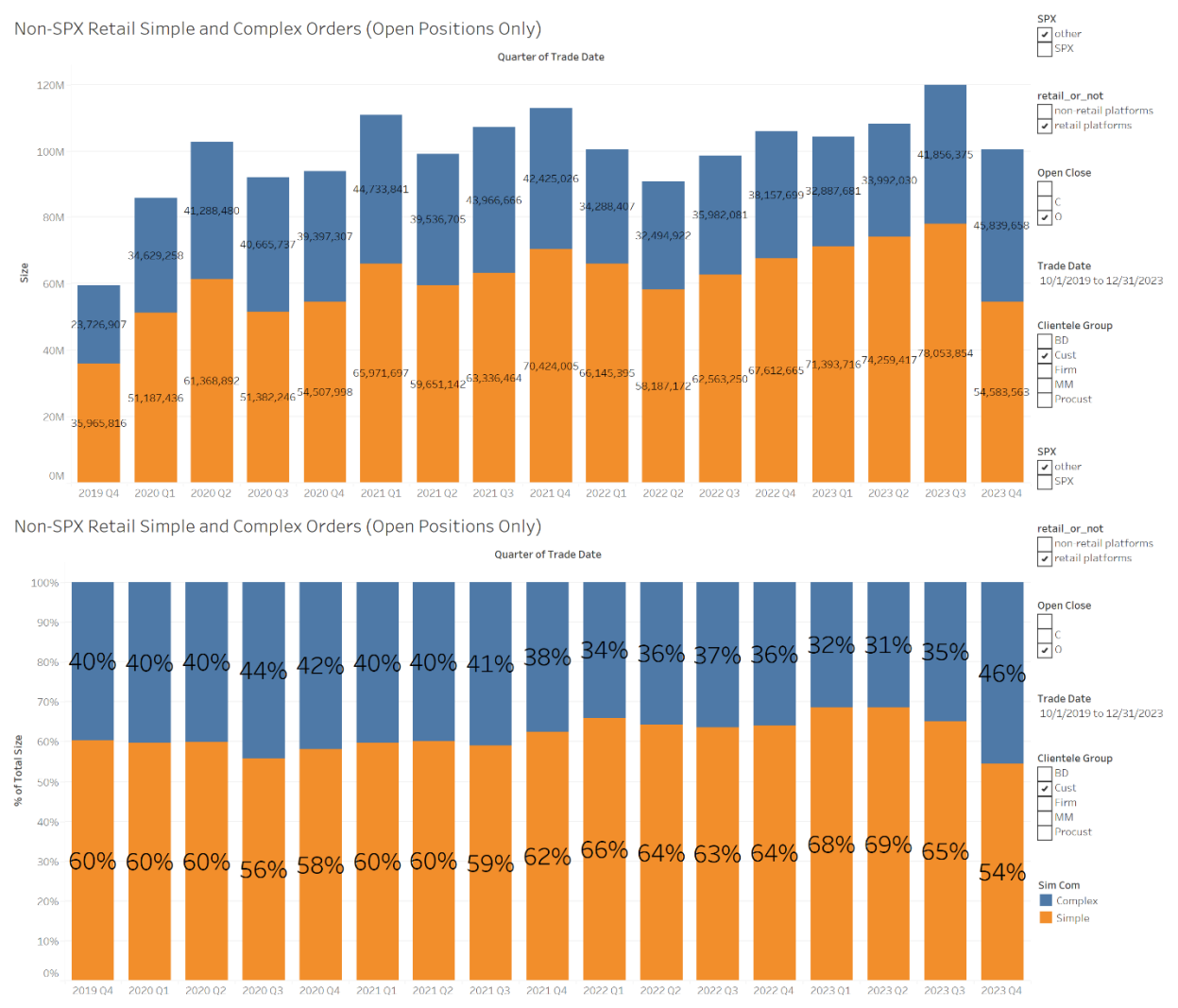

Figure 16b. Volume of Retail Simple and Complex orders on C1, Excluding SPX Options

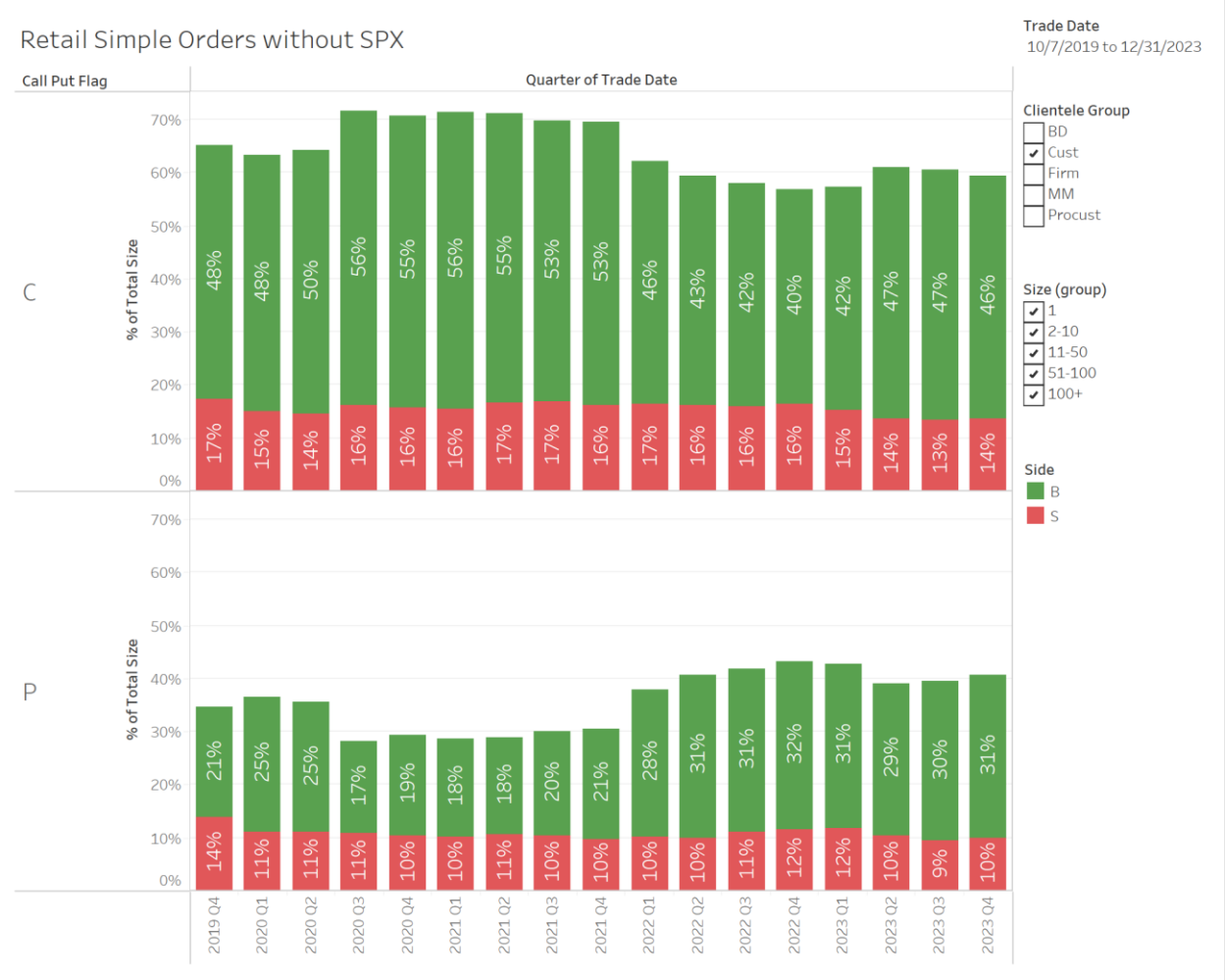

Figure 17b. Breakdown of Retail Simple Orders in Volume, Excluding SPX Options

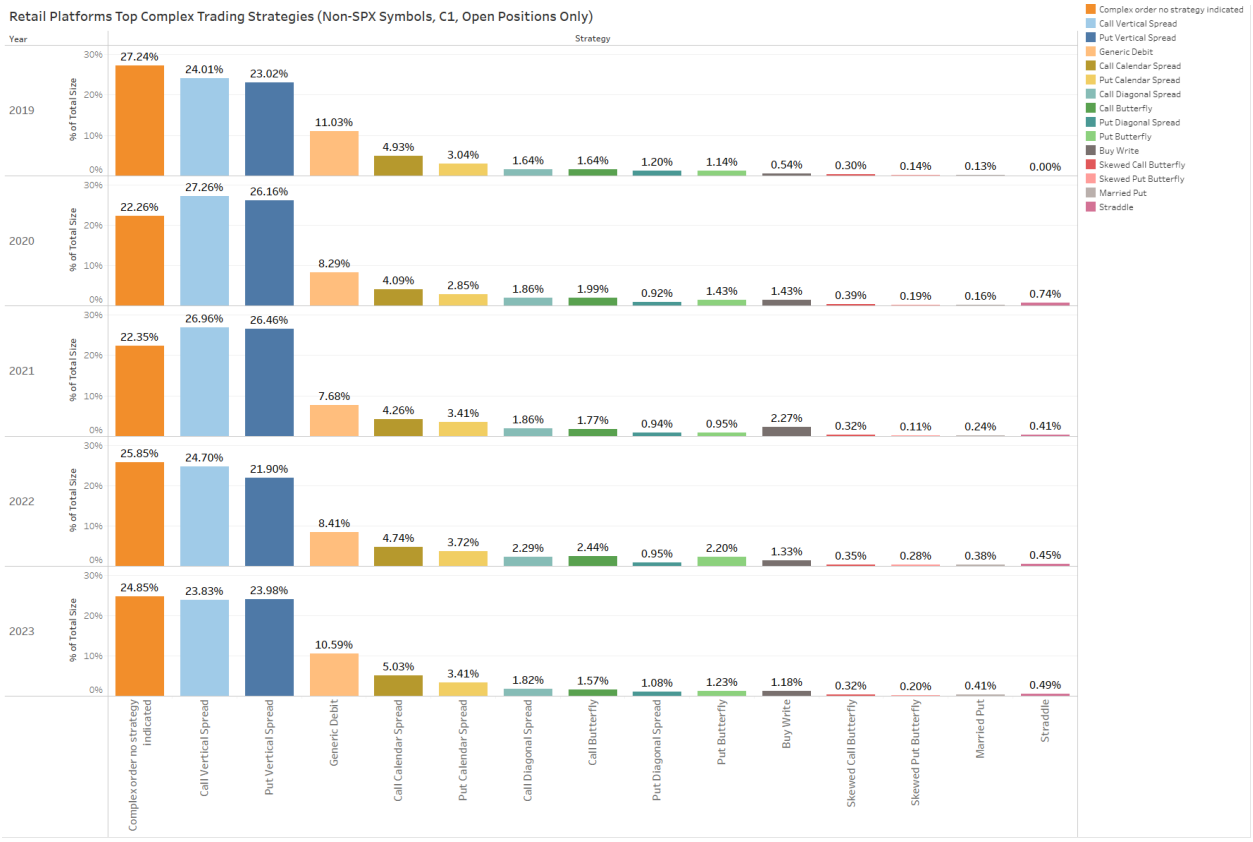

Figure 18b. Common Retail Complex Trading Strategy in Non-SPX Options, Ranked by Volume.