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The Synergistic Impact of AI-Driven Strategies on Retail Options Trading within the European Derivatives Market: A Comparative Analysis of Liquidity and Market Efficiency

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Abstract

This study analyzes the synergistic impact of AI-driven strategies on retail options trading in the European derivatives market through comparative analysis of market efficiency and liquidity compared to the US setting. This study employs the mixed-methods approach, and we analyze quantitative data-daily trades volume, bid-ask spread, and volatility indices (VIX/VSTOXX)-as provided by EUREX, CBOE, CME, and Bloomberg, and qualitative data sourced from industry and scholarly publications. The findings indicate that US markets, characterized by more liquid pools of liquidity (average daily SPX contracts of 1.2 million vs. 300,000 SX5E contracts) and narrower spreads (0.25% vs. 0.40%), enable AI algorithms to calculate more economically than in Europe (CBOE Global Markets, 2024; EUREX, 2024). Further, AI technologies improve price discovery chartered by a rise in options volume of 18% vs. 9% after CPI announcement (Bloomberg, 2024)-and minimize behavioral biases among retail traders. However, structural fragmentation and lower AI take-up in Europe constrain these benefits (Acuiti, 2023). We conclude that AI enhances liquidity exploitation and efficiency on both sides of the Atlantic, but that market structure is once again a significant moderator. We suggest additional research on model-specific performance, sectoral research, stress system risk, and coverage to emerging markets.

Keywords: *AI-driven strategies, Retail options trading, Liquidity, Quantitative data, Market efficiency*

1. Introduction

The rapid democratization of financial markets has profoundly influenced the role of individual investors, particularly in the derivatives market. Artificial Intelligence (AI), specifically machine learning and natural

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language processing, has made individual traders capable of utilizing real-time analytics, automated trading execution, and sentiment-driven decision support tools (Level Fields, 2024; Dakalbab *et al.*, 2024). This technological advancement has been especially strong in options markets, where flexibility and strategic diversity make them highly sensitive to AI trading algorithms. Relative to futures contracts, which often satisfy institutional hedging needs, options allow individual investors to tailor positions to market volatility, a feature increasingly optimized by AI technologies.

In fact, in the US, retail participation in options trading has surged exponentially, driven mainly by user-friendly platforms such as Robinhood. As of Q1 2025, Robinhood boasted 25.8 million total users, 14.4 million monthly active users, and over $193 bn in assets under custody—a 88% year-over-year increase. Over 158 million options contracts were traded on the platform alone in October 2024, suggesting the scale and frequency of retail participation. Furthermore, over 30% of the US options market consists of retail investors currently, with short-dated contracts accounting for more than half of all options trading volume (Robinhood Markets, Inc., 2025; CBOE, 2023). This change is as much a result of increased access to derivatives as it is the byproduct of AI-driven instruments helping retail traders make fast, data-driven decisions in progressively complex markets. Although the US derivatives markets—dominated by exchanges such as CBOE and CME—have seen a dramatic increase in retail options volumes, European adoption is more step-by-step. Structural issues such as fragmented trading platforms, higher transaction costs, and slower technology diffusion still set European markets apart from their US counterparts (CBOE Global Markets, 2024; Acuiti, 2023).

Nevertheless, European exchanges such as EUREX's moves towards modernization signal a reducing gap. Scholarly research covers the advent of AI in institutional trading (Zhou and Li, 2024; Henderson and Shleifer, 2024) and the evolution of market liquidity and efficiency theories (Fama, 1970; IMF, 2024). Limited research has been devoted to the intersection of AI, retail market dynamics, and options trading in disintegrated European derivatives markets. Moreover, emerging concerns about systemic risk and market abuse potential through synchronized algorithmic behavior (Sidley Austin LLP, 2024) again highlight the imperative for more extensive studies on this subject.

This research seeks to bridge these gaps by asking the question: How do AI-driven approaches affect market efficiency and liquidity in European retail option trading relative to the US market? To respond to this question, we employ a mixed-methods approach: analyzing historical trading data (e.g., volumes, bid-ask spreads, volatility indices) and integrating insights from recent academic and industry studies.

2. Literature Review

The literature about AI-driven strategies in trading practices covers a wide spectrum of perspectives, including algorithmic trading, which has significantly transformed financial markets. Algorithmic trading, indeed, has enhanced market efficiency by using machine-learning software.

Studies have additionally shown that AI can improve risk-adjusted returns but there are especially external factors that are hard to determine in advance.

The intersection of Artificial Intelligence (AI) and financial trading has become a major area of academic and professional focus, reshaping traditional market dynamics and offering new tools for retail investors. While substantial research has explored AI's transformative role in institutional trading, relatively few studies have examined its specific effects on retail options trading in the European derivatives markets. This literature review synthesizes existing research on AI-driven trading strategies, retail investor sentiment, liquidity and efficiency dynamics, and the structural difference between European and US derivatives markets. It also identifies the key gaps that this research aims to address. AI technologies like Machine Learning (ML), deep learning, and Natural Language Processing (NLP) have also significantly influenced the trading environment. Financial institutions use AI more and more for price forecasting, portfolio optimization, and automatic trade execution (Built In, 2024). The capacity of AI to handle enormous data sets, detect intricate patterns, and respond in real time has offered great improvements over conventional rule-based trading platforms.

Current studies, such as Zhou and Li (2024), emphasize that algorithmic trading systems made possible by AI can achieve significantly higher predictive accuracy than traditional models, particularly in extremely liquid markets such as the US. A systematic review of 143 studies between 2015 and 2023 on AI in financial trading by Dakalbab *et al.* (2024) finds that Long Short-Term Memory (LSTM) networks and reinforcement learning models dominate existing research. Notably, approximately 16% of studies employed fully automated AI trading systems, indicating a trend towards minimizing human intervention in decision-making. Further, real-world applications attest to the increasing prominence of AI. Kraken's takeover of Ninja Trader in 2024 entailed leveraging AI models to optimize due diligence and close deals more quickly (Business Insider, 2025). This shows the trend towards algorithmic decision-making within financial services beyond trading desks in isolation.

However, the use of AI is not without risk. According to Reuters (2024), widespread use of AI trading algorithms creates systemic risks, including flash crashes and liquidity shortages during times of market stress.

Historically, sophisticated trading strategies were limited to institutional investors. Thanks to the democratization of AI, retail investors can now leverage sophisticated trading strategies. AI-driven analytics, predictive modeling, and real-time sentiment analysis are now widespread, lowering the barriers to entry (Level Fields, 2024). Biz4Group (2024) highlights how AI technologies such as predictive analytics, Robotic Process Automation (RPA), and NLP are empowering retail option traders. These systems assist the operators in finding profitable opportunities, managing exposure to risk, and optimizing trading plans in multiple markets simultaneously.

In addition, a Medium article (2025) highlights that AI-powered platforms allow retail investors to overcome common behavioral biases such as loss aversion and herding, making better-quality decisions. AI capabilities to screen and process information in real time have been most beneficial for short-horizon trades, particularly on markets such as 0DTE (zero-days-to-expiry) options, a pattern especially prevalent in US retail traders. Increased participation of retail investors in options markets is a broad range of strategies and risk attitudes, as characterized by Weller and Yagan (2024), emphasizing the significance of AI tools in enabling informed decision-making in heterogeneous trading styles. This transformation is most strongly felt within the options marketplace. Compared to stock markets, options require higher levels of predictive forecasting of volatility and timing—areas where AI is better poised to offer quick assistance. Market efficiency and liquidity are fundamental concepts of finance. Liquidity refers to the ability to buy or sell assets without creating substantial price fluctuations, whereas market efficiency, according to Fama (1970), is the extent to which asset prices reflect all available information. The influence of AI on liquidity is two-pronged. Tribe AI (2023) opines that algorithmic and AI-based trading enhances liquidity in the form of smaller bid-ask spreads and higher volumes of trade. The International Monetary Fund (IMF, 2024), however, cautions that AI can also increase volatility if numerous AI models respond in a similar manner to events in the market, thereby siphoning liquidity during shocks.

However, Henderson and Shleifer (2024) demonstrate that artificial intelligence-based liquidity providers can adaptively adjust bid-ask spreads according to market conditions, thereby contributing to better liquidity even in Over The Counter (OTC) markets.

As regards efficiency, AI significantly improves price discovery. Innovations such as sentiment analysis engines allow market participants to react faster to news, reflecting new information in asset prices almost in real time (Traders Magazine, 2024). Nevertheless, the threat of "overreactions" by algorithms amplifying fleeting news remains a regulatory concern.

A key perspective to understanding the role of AI is investor attention. Recent work by the Federal Reserve Board (2025) shows that investor attention to macroeconomic news, including CPI releases, drives market volatility surrounding news events.

Artificial intelligence systems that track attention patterns—by news monitoring, social media mood, and keyword spikes—increasingly are being used to predict market activity prior to the major announcements.

Such abilities enable retail traders who are AI-powered to react strategically to macro-news surprises, a trait traditionally reserved for institutional investors. The AI role in handling unstructured news data and

redistributing attention therefore supports its ability to influence liquidity and efficiency indirectly. The market structures of European and US derivatives markets make significant contextual considerations regarding the impact of AI. The US derivatives market dominated by the CME and CBOE is more liquid, with tighter bid-ask spreads and more retail participation, particularly in trading of daily options (CBOE, 2023).

Europe, however, is plagued with problems of multiplatform fragmentation, higher regulatory complexity, and higher trading costs (Acuiti, 2023). EUREX, the biggest European derivatives exchange, has made strides in developing AI-based surveillance and trading support systems but lags US exchanges in retail access and technology (CBOE, 2023). In addition, European markets are more dependent on Over The Counter (OTC) trades, which restrict openness and hinder the use of AI-facilitated public trading platforms (Acuiti, 2023).

The differing structures point to why the adoption of AI and its implications on liquidity as well as efficiency may occur differently by regions.

Previous research has comprehensively investigated the impact of AI on institutional trading, price discovery, and market-making activities within the market. Few have directly examined the effects of AI-based strategies on retail options trading in the European derivatives market, particularly from a liquidity and efficiency standpoint.

Most of the comparative research is conducted in equity markets instead of derivatives. Therefore, this research responds to an essential gap by investigating how AI synergies—specifically by means of automation, predictive analysis, and sentiment modeling—transform retail involvement, market behavior, and efficiency measures in Europe versus the US.

3. Theoretical Framework

In recent years, the convergence of Artificial Intelligence (AI) and retail investment has reshaped financial markets worldwide. Retail investors, once passive participants, are being empowered by AI-driven tools offering real-time analysis, automated trades, and sentiment analysis (McKinsey & Company, 2023).

Nowhere is this change more pronounced than in the derivatives market, where retail participation in options trading has surged, particularly in the United States. This research focuses on the European derivatives market, analyzing closely the effect AI-driven approaches have on retail options trading, market efficiency, and liquidity, contrasting it with the more mature and active US setting.

Derivatives are financial contracts whose worth depends on an underlying asset, i.e., an index, stock, or commodity. Some of the most traded derivatives are futures and options (Investopedia, 2024). Although both instruments are widely used for hedging, speculation, and arbitrage, the current research accounts for options only.

The rationale behind the consideration is their growing popularity among retail investors, their flexible risk-return profile, and their sensitivity to behavioral and sentiment-driven strategies, a sphere where AI tools offer significant advantages.

Firstly, the term ‘Option’ must be defined. An option is a derivative instrument that gives the owner the right, but not the obligation, as ‘Futures’ on the other hand, to purchase or sell an underlying asset on or before a specified date at a specified price (the strike price).

Or as described by Hull (2022): Options confer the right, but not the obligation, to purchase or sell an asset at a specific price before a specific expiration date. Options are used for many different reasons, such as hedging, income generation, and speculation. As Bradfield (2007) underlines, the relationship between options and economic efficiency is analogous to the relationship between economic efficiency and the capital structure of firms. Therefore, options have a broader impact from an economic perspective the just generate personal income, they benefit on a larger scale companies, and therefore stake- and shareholders.

Call options give the holder the right to purchase, and put options give the holder the right to sell. ‘Calls’ are mainly used when the price of the underlying asset is expected to increase. On the other hand, a put option gives the holder the right, but not the obligation, to sell an underlying security at a specified strike price before the expiry date of the option. Put options are used when the trader expects the price of the underlying security to decrease.

This asymmetry allows traders to construct highly complex strategies, particularly when combined with real-time sentiment analysis, volatility prediction, and algorithmic pattern recognitional of which are core competencies of AI-assisted trading platforms.

Futures contracts, conversely, entail an obligation to buy or sell the underlying assets at expiry, making them both riskier and less appropriate for short-term, emotion-driven retail strategies. Indeed, Options can be a great source of revenue for traders. However, the risks of these trading practices are slightly different from regular stock investment strategies. Especially for retail participants, as mentioned by CBOE Global Markets (2024) it is crucial to make informed decisions, as delays or inaccuracies in data can lead to missed opportunities or unexpected losses. Continuously changing volatility figures and the contract duration influence an option trade, overall Return On Investment (ROI). For a long time, derivatives markets in Europe, including SXXP and SX5E markets, tend to be viewed as less liquid than US markets (Figure 1). This study will explore the causes of this phenomenon and examine ways AI-powered strategies can help improve liquidity and market efficiency, by analyzing also the impact of external factors, like market sentiment and geo-economic events.

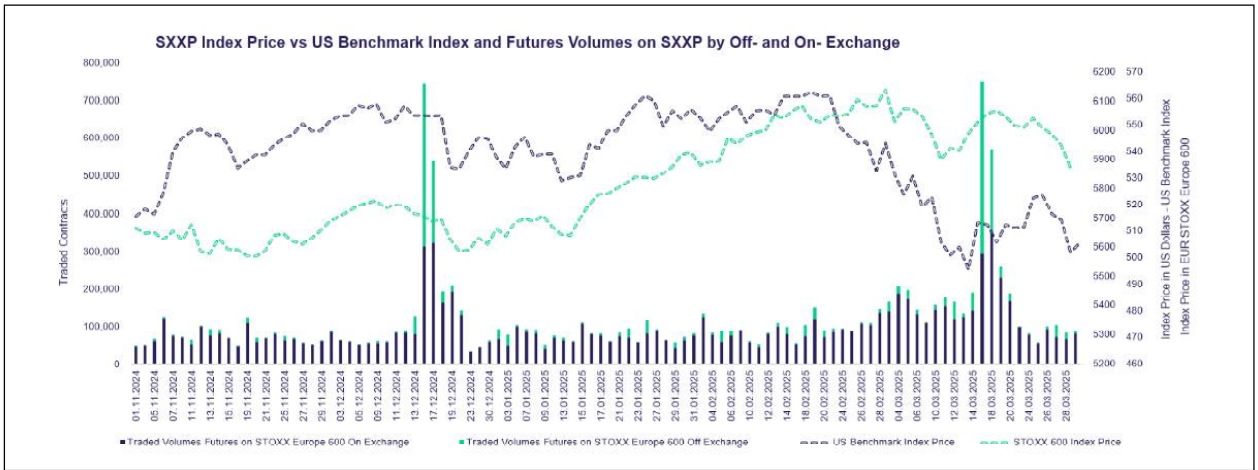

Figure 1: SP500 Index Price Development vs. STOXX 600 Index Price

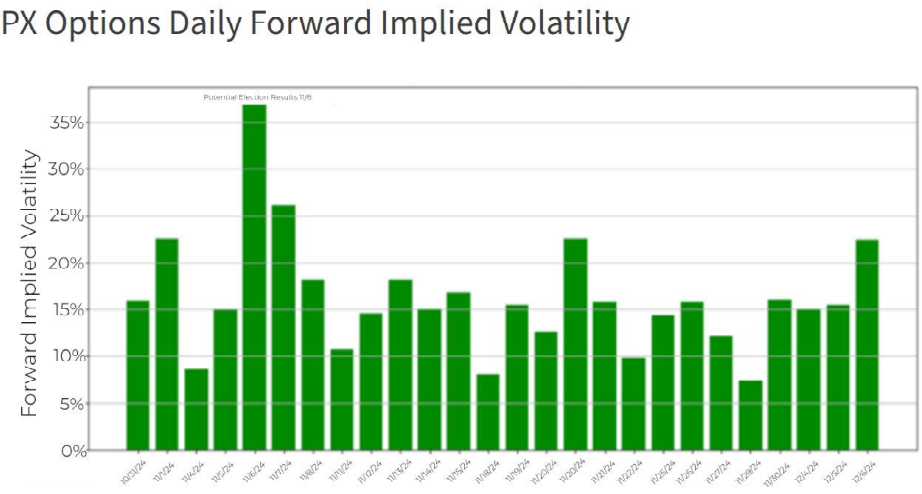

Figure 2: SPX Options Volatility

In fact, market sentiment and geo-economic events have still an enormous impact on derivatives and security trading. The CBOE Global Markets (2024) conducted an analysis of the daily options on SPX before and after November 2024 US. Elections (Figure 2).

Daily index options, or 0 days to expiration (0DTE) options, are options contracts that expire on the close of trading on the same day. They provide traders with the potential to make short-term directional wagers on an index, e.g., SPX, Nasdaq 100 (NDX), or Invesco QQQ Trust (QQQ) and for the European indices, SX5E.

With daily expirations, traders can capitalize on intraday price movement, so these options are ideal for day trading, hedging short-term risk, and speculation.

The low capital commitments and more frequent trading (HFT, high frequency trading) opportunities make daily options extremely interesting, especially for retail traders.

However, they are very sensitive to market volatility and external geopolitical events. For example, during the US elections market volatility reached a peak of 35% p.a. These correspond to a daily standard deviation of ±2.2% (CBOE Global Markets, 2024). As the chances of moving beyond ±4.4% were extremely low, the thesis that timing, risk management and real time data are crucial tools in order to increase efficient trading practices and can benefit overall product liquidity.

Another example of how geopolitical events can affect index prices and product liquidity is shown in Figure 3. Figure 4 is showing how geopolitical events impacted the DAX Index price from August 2017 until December 2024.

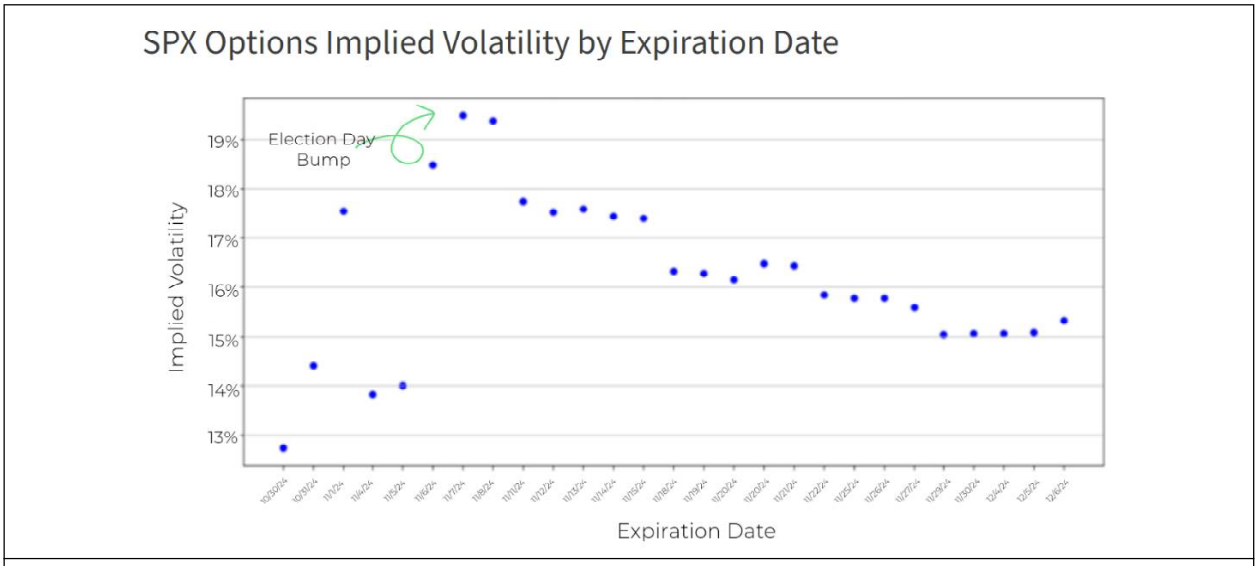

Figure 3: SPX Options Volatility Geopolitical Events

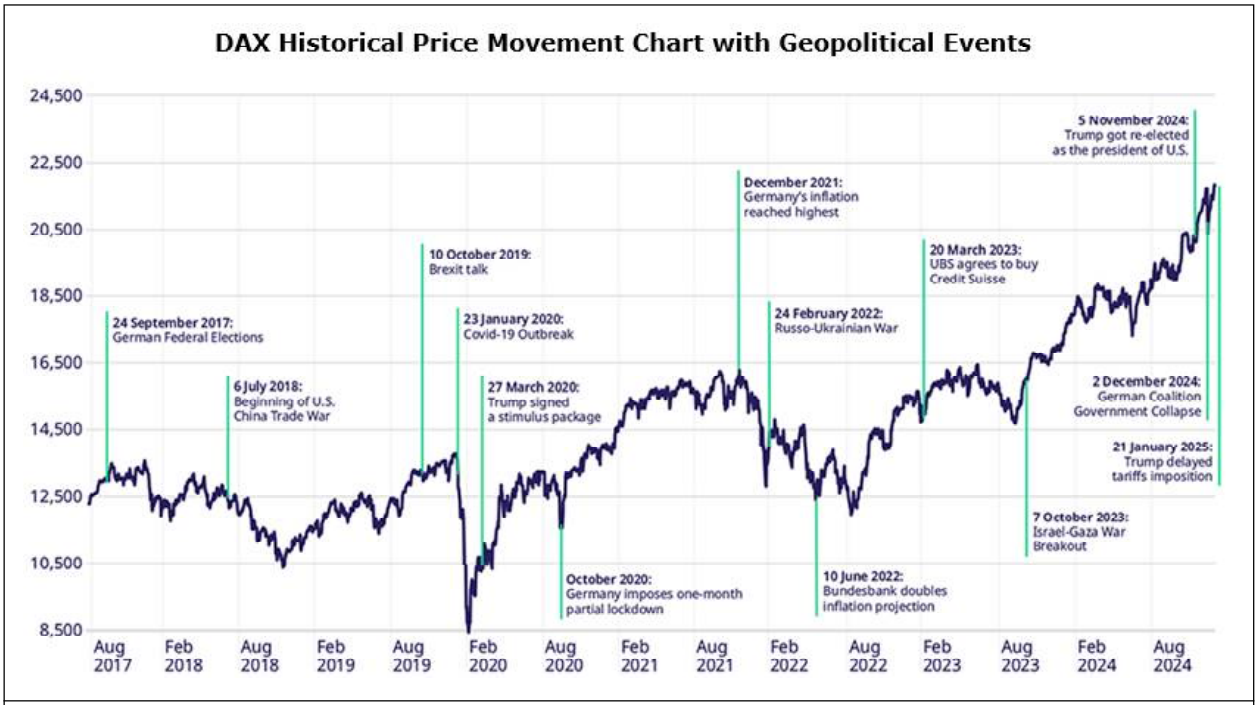

Figure 4: DAX Index Performance and Geopolitical Events

Figure 5: SX5E Index Performance

If we compare Daily Options on Euro STOXX 50 (OEXP) to the overall index performance (Figure 5), it's clear that the relationship between market sentiment and liquidity is correlated to the relationship between liquidity and index price performance. The graphical representation shows volumes for OEXP and the percentage of Put and Calls from the overall volumes (Figure 6).

Although Put volumes increase around February 17th, relating to the additional executive orders from President Trump and the possible ceasefire between Russia and Ukraine, the Index rose because of increased trading activities on European derivatives during these crucial weeks.

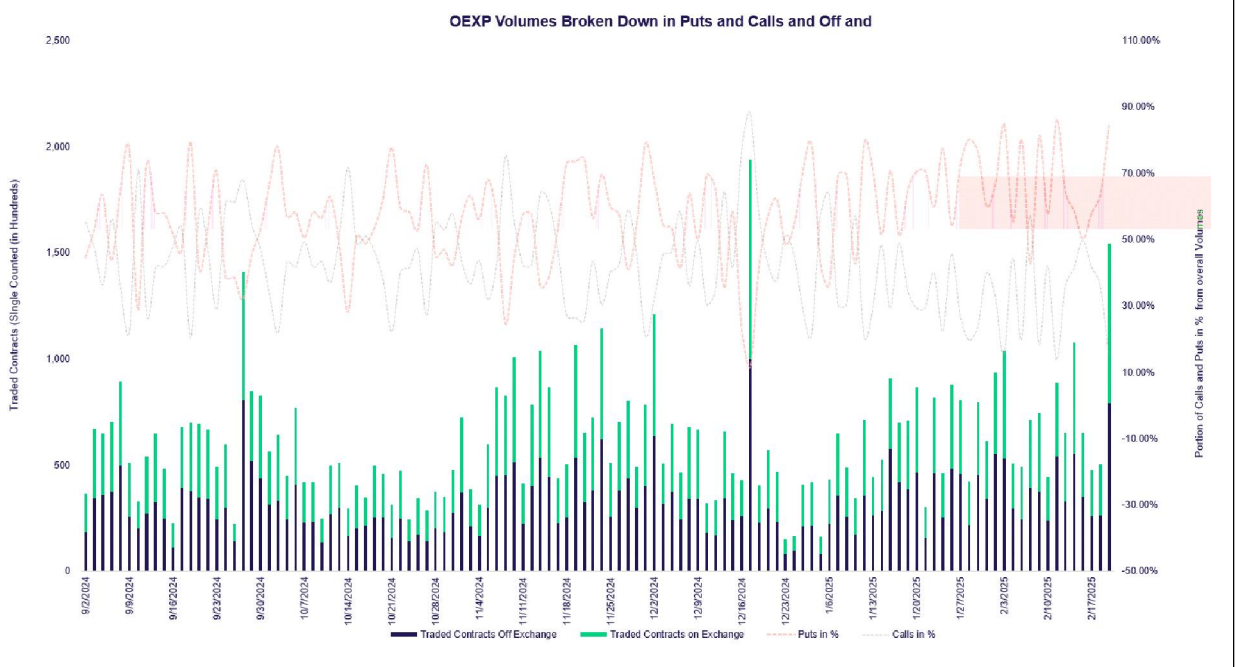

Figure 6 : OEXP Volumes Puts vs. Calls

As researched by Shishlenin *et al.* (2021) algorithm-based trading strategies perform better in 80% of the analyzed cases, especially in terms of risk adjusted returns. These are mainly achieved due to major exposure to smart Beta, which will be mentioned as well in the Data and analysis section of this research and advances in raw tick processing. Additionally, algorithm trading is closely linked to AI and Generative AI, as it is mainly used for risk management and HFT, as already mentioned.

Theoretically, this study is based on the principles of market liquidity, market efficiency, and behavioral finance. Liquidity, i.e., the capability to purchase or sell assets without significantly affecting their price, is crucial for functional derivatives markets. Market efficiency refers to the extent to which asset prices reflect all information. In highly efficient markets, arbitrage opportunities are fewer, and prices adjust rapidly to news and sentiment. AI technologies are increasingly being leveraged to increase both liquidity and efficiency. Such examples are automated market-making algorithms that facilitate smoother and tighter order flow, and sentiment analysis engines that parse enormous volumes of unstructured data (e.g., financial news, social media) to capture shifts in market sentiment before they manifest in price action (BIS, 2022).

Not only do such features increase trade volume and reduce friction, but they also challenge traditional assumptions of human-led market rationality. Additionally, the paper draws on behavioral finance theory, which establishes that investors are more likely to be driven by psychological biases, emotions, and heuristics than by calculating reason. AI-driven trading systems—invulnerable to fear or greed—offer a potential corrective to these inefficiencies. In this way, AI acts both as a stabilizer and an impetus to greater market engagement, particularly on the part of retail investors wishing to execute sophisticated strategies with limited resources or experience. By comparing the US and EU derivatives settings, the research compares retail involvement, AI adoption, as well as market structure. Despite the US market being more liquid and efficient in general, European exchanges such as EUREX are rapidly embracing smart technologies to match and become contemporary. The comparative approach allows the research to gauge not only the impact of AI approaches on trading outcomes, but also how market maturity and infrastructure moderate their efficacy. Lastly, this paper's theoretical foundation supports a multi-dimensional exploration of the influence of AI-driven methods on the behavior, performance, and involvement of retail investors in options markets, with broader ramifications for regulators, market designers, and financial technologists on both sides of the Atlantic. While both options and futures are well-liked derivatives, this study is focused on the analysis of options because they are more retail investor-friendly, more sensitive to sentiment, and more integrated with AI-retail trading strategy in the case of short-term options.

Futures, however, are typically utilized by institutional players as a hedge or commodity exposure, and thus are less reflective of the AI-retail dynamic under study.

4. Research Methodology

This paper examines the synergistic effects of AI-driven strategies on retail options trading in the European derivatives market. Liquidity and market efficiency will be the subject of the study, comparing European derivatives and their US counterparts, e.g., S&P500 (SPX).

A combined approach will be employed in the study, with quantitative data analysis supplemented by qualitative data and past research conducted in the market. Trading history, market reports, and academic research will provide the main sources of data. Individual products such as the derivatives on STOXX Europe 600 (SXXP) and EURO STOXX 50 (SX5E) will be analyzed to provide liquidity and market efficiency comparisons with US derivatives, as volatility indices as VIX and derivatives on SXP.

Analysis will be conducted in two main phases. Firstly, the data collection process will include quantitative data, primarily from historical trade reports and financial statements from sources as exchanges (EUREX CBOE, CME), secondary financial data basis, as Yahoo. Finance and market research firms. During this phase the focus will rely on a comparison of key measures such as returns, liquidity and volatility, to identify possible efficiency gaps.

Additionally qualitative secondary data will be gathered through a review of literature, such as academic journals, industry reports, and published research regarding the usage of AI in trading practices. Qualitative data will be used to further underline common themes and conclusions gained through the collected data

points that will further assist in analyzing the implications of AI-based models and strategies on market sentiment and behavior.

AI-driven strategies to be incorporated are automated trading, where the AI programs carry out the trades using pre-set parameters, thus eliminating the emotional aspect of decision-making and ensuring maximal efficiency.

Pattern identification, by the application of AI to sift through vast datasets to identify patterns and predict trends, providing real-time, actionable intelligence. Sentiment analysis, by Natural Language Processing (NLP) of social media tweets, news headlines, and earnings call transcripts to detect shifts in market sentiment, providing advanced warning of market movement.

Risk management tools, where AI continually detects market conditions aiming to protect investments and suggesting real-time adjustments of trading strategy to reduce potential losses.

Reinforcement learning, in which AI agents learn to interact with the market and improve their decision-making with time, maximizing profitability through reward functions.

Mobile trading platforms, where AI-driven mobile platforms enable traders to remain connected and informed, with real-time updates and notifications, so that traders can respond immediately to market changes (e.g., Robin Hood)

The findings will be presented in tables and figures to reflect quantitative data and trends. It will provide a holistic picture of the impact of AI-driven strategies on retail options trading in the European derivatives market, in comparison with US equivalents. These findings will benefit market participants, regulators, and researchers of the evolution in the transatlantic derivatives markets.

5. Data and Analysis

One of the strongest trends in the US options marketplace is the phenomenal increase in zero-day-to-expiry (0DTE) options, which has effectively transformed retail investor behavior and trading volume allocation. SPX 0DTE trading volume has grown over fivefold since 2021, with average daily volumes of nearly 2 million in early 2025, according to Cboe Global Markets (2025) (Figure 7). What began as a niche product utilized only by institutional hedgers is now dominated largely by retail traders, who account for up to 50% to 60% of SPX 0DTE volume (Cboe Global Markets, 2025).

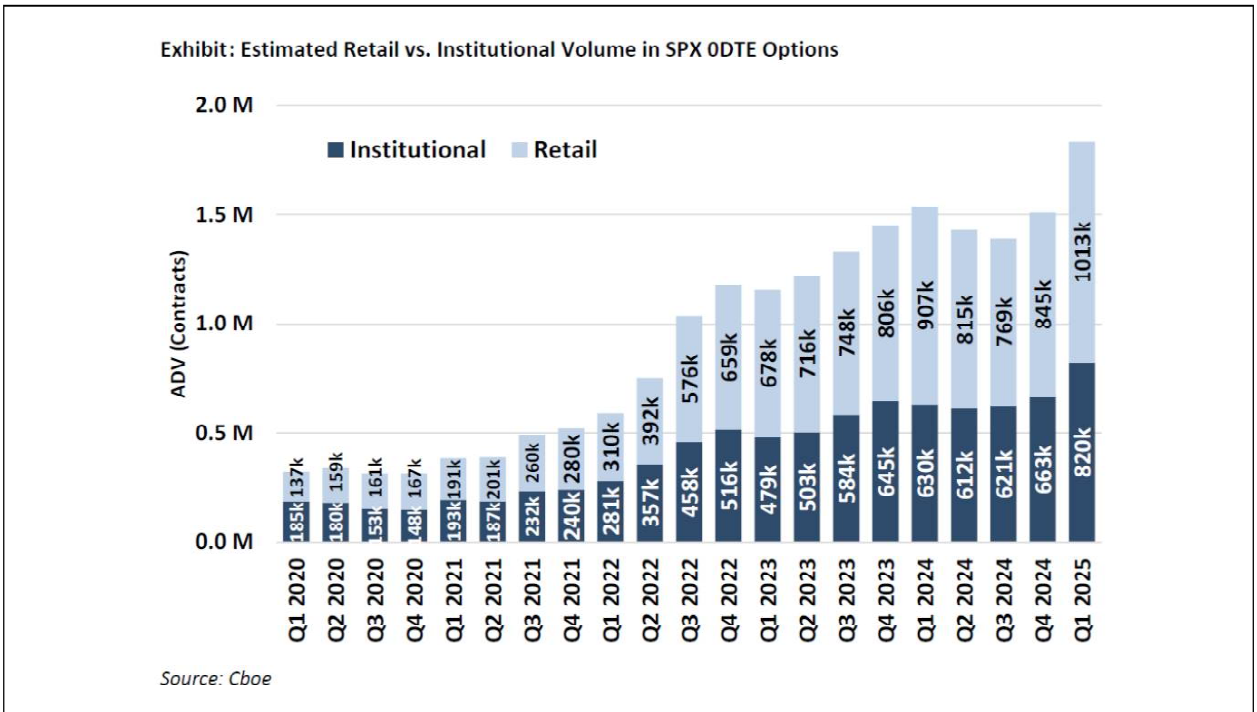

Figure 7: Retail vs. Institutional Volume SPX 0DTE Options

This growth is in line with the rise of AI-driven trading platforms that allow private investors to execute short-term strategies using institutional-level tools. These platforms integrate real-time data, predictive analytics, and sentiment indicators that allow retail traders to respond to intraday macroeconomic incidents and volatility spikes with accuracy (Figure 8). Short-dated instruments are also becoming more widely favored in market-wide patterns: as of 2025, roughly 60% of all S&P 500 index options contracts traded daily are 0DTEs, notes the industry (Wall Street Journal, 2025).

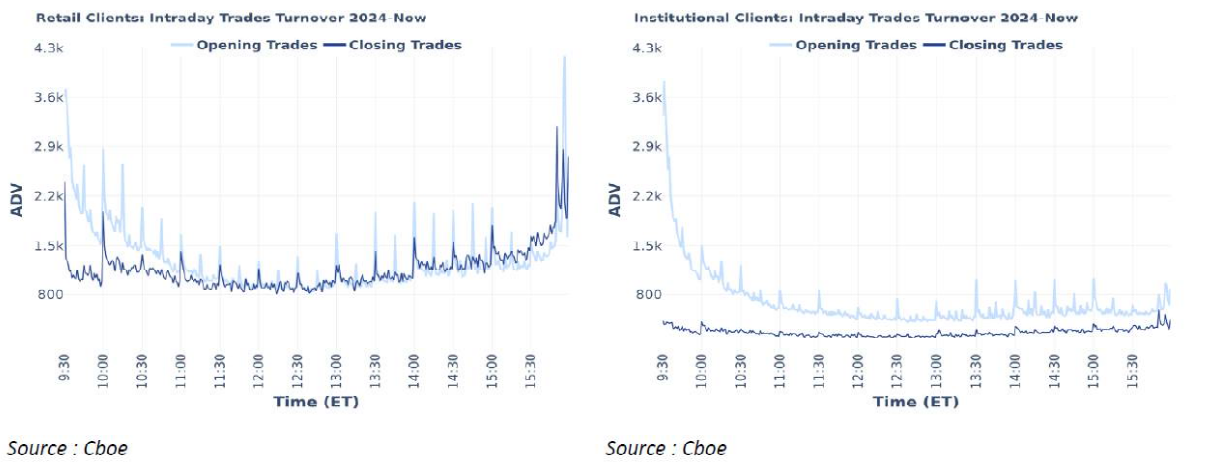

Figure 8: Intraday Trades Turnover

These trends validate the argument that AI-driven strategies boost short-term opportunity recognition and market participation, particularly in markets like the US market which has high liquidity and execution velocity. Moreover, the retail-fueled surge in 0DTE volumes illustrates how democratized access to AI technologies is redefining risk-taking and speculation activity in real-time.

Further a comparative analysis of Eurex and OCC exchange-level statistics suggests a strong post-pandemic demand surge in both Single-Stock Equity Options (SSEO) and equity index options—more so in the US market. Combined volume in index options on Eurex stood at 370.6 million contracts in 2024 with a notional value of approximately €16.7 tn. Single-stock options were 173.8 million contracts, i.e., a notional value of €812.6 bn (Eurex, 2024). But if dissected according to A account activity (institutional or professional large accounts, typically), index option volumes grew by 19.31% from 2020 to 2022 but declined by 4.73% from 2023 to 2024. In contrast, SSEO volumes grew modestly by 2.18% pre-2022 but grew vigorously by 14.27% post-2023, reflecting an unmistakable shift of focus toward single-stock derivatives in the post-pandemic period.

The growth has been more aggressive in the U.S. The OCC cleared 6.52 billion index option contracts and 1.05 billion single-stock options contracts during 2024 (OCC, 2025). Volumes themselves of index options went up by 55.85% from 2020 to 2022 and continued to rise by 16.11% from 2023 to 2024. Similarly, SSEO volumes grew by 37.05% until 2022 and 8.92% in the past year. This continued upward trend, especially in index options, indicates a strong shift towards vehicles of broader market exposure, both reflecting institutional positioning and rising take up among US retail traders of AI-based strategies. These observations underscore the way in which post-COVID volatility and rapid-track technology uptake have transformed derivatives demand. In Europe, heightened single-stock option interest reflects increased speculative retail demand, while the US market reflects broad, sustained growth in both institutional and retail channels, supporting comparative efficiency and depth of American derivatives infrastructure. A deeper look into trading activity within US and European derivative markets shows the presence of very large differences in liquidity, patterns of volatility, and market efficiency, particularly where retail options trading is supported by AI-driven approaches.

First and foremost, liquidity of US options markets, as defined by the S&P 500 (SPX) options, is invariably superior to that in European markets such as the EURO STOXX 50 (SX5E). According to CBOE Global Markets (2024), SPX options average around 1.2 million contracts per day, with a median bid-ask spread of merely 0.25%.

Comparing this, EUREX data (2024) indicates an average daily volume of 300,000 contracts for SX5E options, with a wider median spread of 0.40%.

These findings suggest that AI-based strategies trading on US markets are supported by larger liquidity pools and lower costs of transaction and thus become more efficient and profitable. European retail traders, on the other hand, experience higher trading friction that can partly hinder full exploitation of AI-based advantages.

Liquidity here refers to the ease with which options contracts are tradeable without significantly influencing their price—tended to be measured by bid-ask spreads and trading volume. Smaller spreads and larger books in the US market enhance execution quality, allowing AI-based strategies to execute more precisely. Market efficiency, on the other hand, is the speed and accuracy with which present information is pounded into prices (Fama, 1970). The more robust and faster reaction of macroeconomic news in the US options market, compared to Europe, indicates higher semi-strong form efficiency, particularly when complemented with AI platforms (Federal Reserve Board, 2025; Bloomberg, 2024). Volatility profiles also reflect the dynamic conditions under which AI systems must operate. During key geopolitics events—such as the 2024 US elections and Ukraine ceasefire negotiations—both US and European options markets experienced dramatic volatility increases. The VIX index peaked to 35%, which is akin to a ±2.2% daily standard deviation in SPX options, while the VSTOXX climbed to 32% for European markets (CBOE Global Markets, 2024; EUREX, 2024). Although both intervals of volatility levels were elevated during these instances of global shocks, the trading response magnitude and speed were much larger in the US.

This difference indicates the significance of AI tools to counter short-run risk exposures and exploit volatility-based trades, with greater gains accruing to markets with more liquid and lower latency executions.

On capturing market efficiency, and in digestion of macro news, results coincide with recent work from the Federal Reserve Board (2025). SPX option markets have registered an 18% increase in trading volumes within the first one-hour period after seminal Consumer Price Index (CPI) announcements against a 9% increase in SX5E options (Bloomberg, 2024). This imbalance means that US retail traders, with the help of AI platforms that can track and analyze news in real time and measure sentiment, are likely to exploit information shocks.

European markets, being sensitive, appear to be both slower and less intense, possibly because of lower levels of AI adoption among retail investors and structural disintegration in the trading environment (Acuiti, 2023). Additionally, the evolution of smart beta has primarily been a function of innovations in Machine Learning (ML) and Artificial Intelligence (AI).

Traditional smart beta methods, reliant on explicit factors such as low volatility, value, or momentum, would usually anticipate linear relationships and might prove to be rigid when it comes to reacting to varying market landscapes. Recent research highlights the capacity of ML models, such as neural networks and random forests, to capture complex, non-linear patterns in financial data to enhance factor selection and portfolio construction (Baesens *et al.*, 2021). For instance, ML algorithms are able to process large datasets that include financial reports, market news, and social media sentiment to identify relevant factors that affect asset performance. With real-time data-driven dynamic portfolio weight changes, these AI-enhanced strategies can better track market change and improve risk-adjusted return (Hain *et al.*, 2022). Moreover, the application of alternative data sets and advanced risk management tools improves portfolio optimization beyond the limitations of traditional smart beta strategies (Parn and Edwards, 2019). This infusion of AI in smart beta investing not only heightens investment strategies' flexibility and performance but also falls under the broader move toward democratizing sophisticated financial instruments to retail investors.

As platforms backed by AI grow more widespread, retail investors are in a position to harness such advanced techniques to make more complex investment choices, bringing the difference between institutional and individual market actors to a narrowing level. Overall, the findings validate the supposition that AI-driven trading algorithms improve strengths within highly liquid environments with effective adjustment mechanisms for prices and advanced technology settings. Though European exchanges such as EUREX are working diligently to catch up, structural differences continue to influence the performance and spread of AI technologies across the transatlantic derivatives marketplace (CBOE Global Markets, 2024; Acuiti, 2023).

6. Discussion

The findings of this study highlight the pivotal position that AI-driven approaches take in shaping the dynamics of retail options trading on the European derivatives market, especially when compared to the more mature US market. Several key implications are made regarding liquidity, efficiency, and investor behavior, shedding light on the interdependent nature of financial market evolution and technological advancement. Firstly, the analysis confirms that improved liquidity and narrower bid-ask spreads in US options markets present a lucrative source for AI-driven trading systems to thrive (CBOE Global Markets, 2024). Deep liquidity sources allow AI algorithms to execute high volumes of trades with minimal price effect, which is beneficial particularly for those strategies that involve high-frequency trading, arbitrage, and volatility capturing.

On the other hand, European markets, as captured through the EURO STOXX 50 (SX5E) options, are characterized by higher frictional expenses and multi-dealer trading platforms (Acuiti, 2023), limiting retail-focused AI strategies' efficiency. The implication from this difference is that technological progress is a key but insufficient factor; market structure remains a key driver of AI effectiveness.

Second, the evidence confirms the belief that AI improves market efficiency, particularly through faster price discovery following macroeconomic news releases. Testimony of SPX options volume growth of 18% in the first hour after CPI announcements (Bloomberg, 2024) supports Fama's (1970) Efficient Market Hypothesis, especially its semi-strong form in which prices rapidly adjust to publicly available information. The lower and slower trading volume response in the European options markets is a function of relative lag in information assimilation, spurred by lower penetration of AI technology amongst retail investors and variations in market infrastructures. From a behavioral finance point of view, the importance of AI in curbing cognitive biases among retail traders cannot be emphasized.

Classical behavioral models bring to the fore the tendency towards herding, overreaction, and loss aversion among individual traders (Barberis and Thaler, 2003). AI-driven tools, including sentiment analysis engines and predictive models, assist retail traders in processing complicated data more objectively, thus avoiding irrational trading practices. However, the efficacy of these tools is still highly sensitive to market conditions: in less liquid and slower-moving markets like Europe's, the payoffs of behavioral bias reduction are less clear.

In addition, the findings affirm research by the Federal Reserve Board (2025) on investor attention. AI systems monitoring attention spikes—on macroeconomic releases, earnings reports, or geopolitical news—give retail traders vital informational advantages. But full realization of these benefits depends on market responsiveness: when markets like the US react almost in real time to news due to high liquidity and technological sophistication, AI traders can make money from fleeting inefficiencies; when reactions are slow, as in Europe, opportunities disappear faster.

Finally, while AI technologies undeniably offer major advantages to retail traders, they also introduce new forms of systemic risk. Reuters (2024) warns that coordinated algorithmic action could heighten market volatility during times of stress, a risk that is especially timely as AI adoption continues to rise. Regulators and participants must therefore be vigilant and ensure that safeguards keep up with technological advancements. As Sidley Austin LLP (2024) highlights, the widespread deployment of AI systems introduces novel risks related to market abuse and systemic instability, necessitating the development of more sophisticated oversight frameworks

In brief, the analysis highlights that AI-based approaches enhance exploitation of liquidity, market efficiency, and behavior moderation bias—but that these benefits also vary with the structure and maturity of the underlying market. US European market differences underline the need for a more harmonized technological and regulatory environment in Europe if similar benefits are to be equally attained by retail participants.

7. Conclusion

The current study had set out to examine the synergy that AI-powered approaches have on retail options trading within the European derivatives market when contrasted against the more matured US environment under consideration of liquidity as well as efficiency in markets.

The findings confirm that AI innovations significantly improve retail traders' capacity by responding faster to the market, mitigating behavioral bias, and accelerating price discovery. In highly liquid and technologically advanced markets such as the US, AI-driven strategies operate at optimal levels, complemented by tighter bid-ask spreads, faster absorption of macro-news, and greater trading volumes (Federal Reserve Board, 2025; CBOE Global Markets, 2024).

Contrarily, in Europe, structural challenges such as fragmented trading platforms, wider spreads, and delayed adoption of retail AI platforms currently limit the complete potential of such technological benefits (Acuiti, 2023). However, European markets are also developing encouraging signs of modernization, especially through listings such as EUREX that are heavily committing to AI-enabled infrastructure. Long-term, there is potential that greater retail involvement, regulatory change, and tech integration can progressively close the transatlantic divide in liquidity and efficiency. Results from this research highlight that, although AI significantly improves retail trading performance, the structure of markets is an essential variable in projecting the extent and size of the impact of AI.

Areas for Further Research

Several areas warrant deeper exploration.

First, a finer categorization of different types of AI models—i.e., reinforcement learning algorithms versus deep neural networks—may provide clues on which technologies perform best under varying market conditions.

Second, a categorization of the sector-specific use within European derivatives markets may provide clues on whether specific industries (e.g., tech, energy, finance) gain more value from AI-driven trading strategies than others. Third, considering emerging concerns of systemic threats of coordinated algorithmic behavior (Reuters, 2024), future research can examine the resilience of AI-driven retail trading platforms during periods of increased market stress or policy change.

Last but not least, the extension of research to other regions of the world beyond Europe and the US—e.g., emerging markets where AI adoption is still in its early stages—would give a more comprehensive view globally on how AI is revolutionizing retail derivatives trading.

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