

1. Executive Summary

This proposal outlines a groundbreaking AI-driven platform designed for trading both exotic and normal derivatives. It combines real-time volatility surface calculations, dynamic pricing, and optimized trading strategies powered by cutting-edge AI technologies such as machine learning (ML), reinforcement learning (RL), sentiment analysis and quantum computing. By catering to both retail and institutional clients, the platform democratizes access to professional-grade trading tools while offering advanced features for sophisticated investors.

Key Features:

- **Real-Time Volatility Surfaces:** Updated every second using live market data and historical trends, enabling precise pricing for derivatives.
- **Dynamic Option Pricing:** AI-driven models adjust option values based on real-time volatility and market conditions.
- **Comprehensive Strategies:** Supports exotic options like Barrier and Lookback, as well as vanilla options and futures.
- **Dynamic Hedging:** Delta neutral / gamma options positions by using AI to predict volatility and prices

Target Market:

The platform bridges the accessibility gap, addressing both retail investors who need user-friendly interfaces and institutional clients requiring advanced analytics. Hedge funds, proprietary trading firms, and institutional investors active in options and exotic products would be more attracted towards OTC products whilst retail clients I believe would appreciate the exposure to ETD.

Benefits:

- Retail clients gain access to previously inaccessible tools, fostering inclusion in the derivatives market.
- Institutional clients enjoy precise analytics, fast trade execution, and optimization for complex instruments.
- Quantum computing ensures scalability and performance for high-dimensional pricing challenges.

- Efficient risk management with real-time monitoring of Greeks and volatility measures.

This dual-market approach positions the platform as a disruptive force in the \$500 trillion derivatives market, capturing significant value through innovation, accessibility, and technical sophistication.

2. Industry Context and Problem Statement

Challenges in the Derivatives Market

1. Complexity in Exotic Derivatives:

Exotic derivatives, such as Barrier and Lookback options, pose significant challenges in pricing and management. These instruments rely on path-dependent payoffs and stochastic volatility models, which are computationally intensive and poorly handled by traditional pricing tools like Black-Scholes.

2. Limitations in Vanilla Options and Futures:

The accuracy of vanilla derivatives pricing depends on real-time volatility surfaces. Current systems often fail to update surfaces dynamically, leading to mispricing and missed trading opportunities.

3. Retail Barriers:

Retail investors are excluded from the derivatives market due to a lack of accessible tools and education. Platforms like Robinhood offer basic access but lack advanced features like strategy recommendations and real-time analytics.

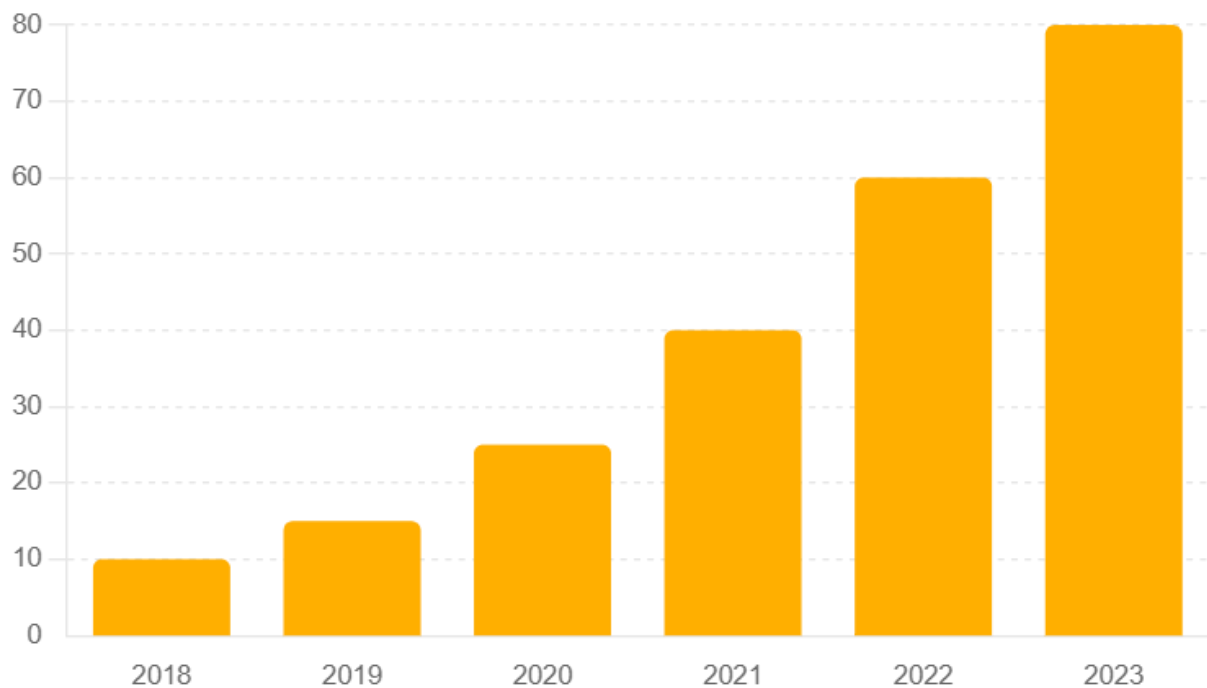
4. Risk Management Limitations:

Manual adjustments to hedge positions lag behind market movements, exposing portfolios to unnecessary risks.

Market Opportunity

The derivatives market has expanded rapidly, driven by a growing appetite for risk management and speculative opportunities. According to the CFA Institute, this market exceeds \$500 trillion in notional value globally. The rise of retail investing platforms highlights untapped potential in democratizing derivatives trading. There is an increasing demand for automated trading and exotic option products in volatile markets. The chart below illustrates the rapid growth of AI applications in derivatives trading.

Market Size (in Billion USD) Y Axis by Year



Bar chart showcasing the growth of the AI-driven derivatives market from 2018 to 2023

Efficiency Gaps

CAIA institute identify inefficiencies in pricing exotic options and managing risk dynamically. These inefficiencies present an opportunity for AI to deliver solutions through automation, predictive analytics, and real-time adaptability. Reliance on traditional models like Black-Scholes, which assume unrealistic market conditions is imminent and human traders have struggle to adapt to rapid changes in market sentiment

3. Proposed AI Solution

Core Features

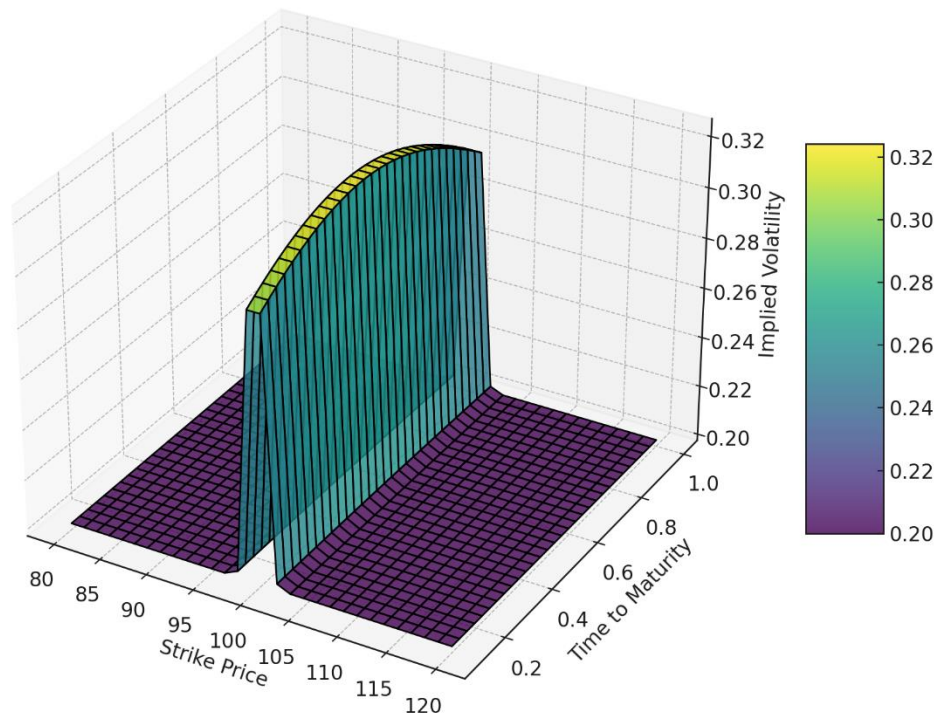
1. Real-Time Volatility Surface Calculation:

- Uses ML algorithms like LSTMs to process live market data and historical trends, generating volatility surfaces every second. Gradient Boosting could be used for volatility prediction.

- Improves pricing precision, reducing error margins to less than 1%.

This is how a traditional option is priced by gauging the implied volatility from the surface .

Sample Volatility Surface

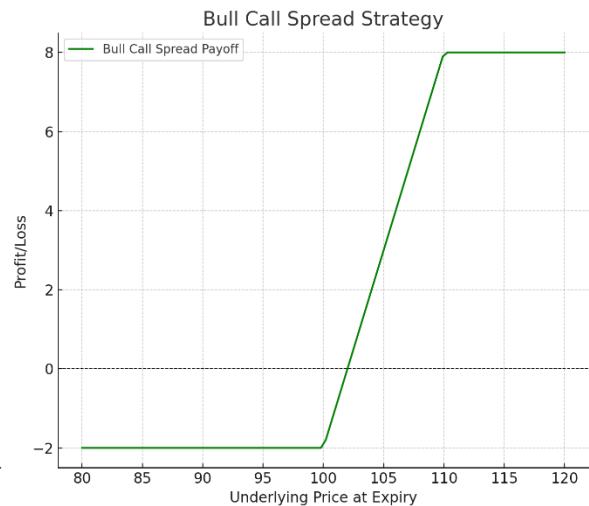
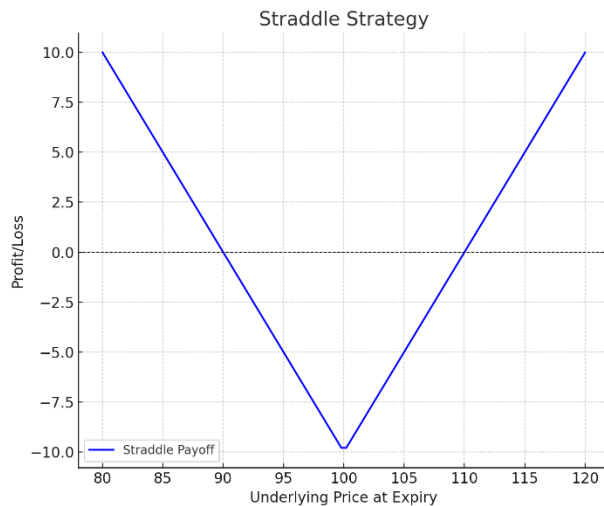


2. Dynamic Option Pricing:

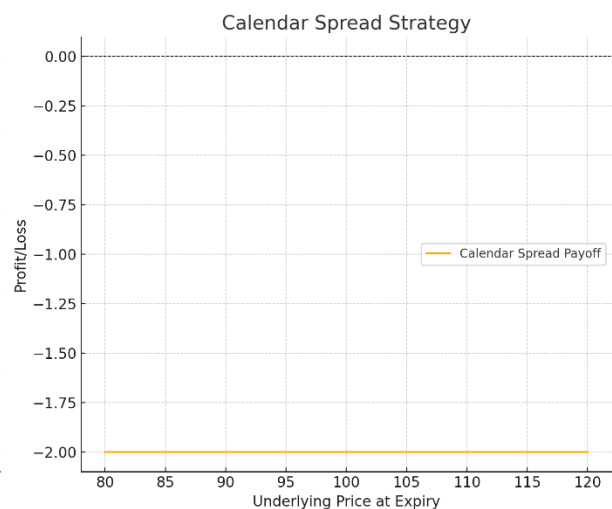
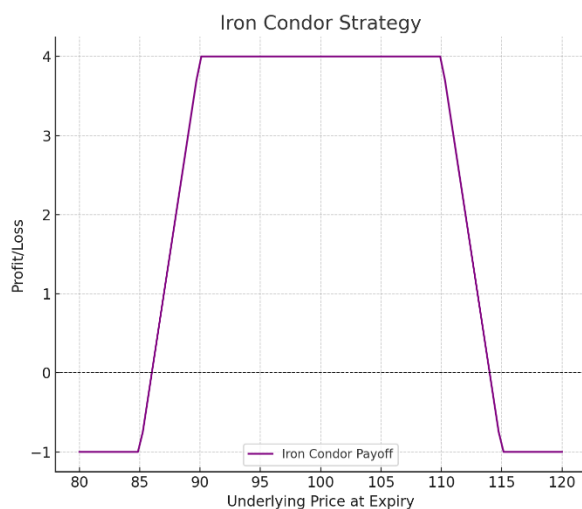
- Combines Monte Carlo simulations and neural networks for pricing vanilla and exotic options.
- Ensures adaptability to rapid market changes, minimizing latency.

3. Retail Strategy Optimization:

- Simplified dashboards offer strategy recommendations tailored to user preferences, such as straddles, iron condors, and delta-neutral strategies.
- Gamified learning modules educate users on options trading fundamentals.
- Some popular strategies are visualised below.



- **Straddle Strategy:** A combination of buying a call and a put option with the same strike price, aiming to profit from significant price movement in either direction.
- **Bull Call Spread:** A strategy involving buying a call option at a lower strike and selling a call option at a higher strike, designed for moderate bullish outlooks.



- **Iron Condor Strategy:** A non-directional strategy that profits from low volatility, combining a short call spread and a short put spread to limit both risk and reward.
- **Calendar Spread:** A strategy involving buying a longer-dated call and selling a shorter-dated call at the same strike price, designed to profit from differences in time decay.

4. Reinforcement Learning:

- Optimize strategies like delta hedging and barrier option triggers through RBFN models and deep neural networks.

5. Quantum Computing:

- Leverage quantum optimization algorithms (e.g., Quantum Approximate Optimization Algorithm) for high-dimensional exotic option pricing.

Exotic Derivatives Solutions

- **Barrier Options:** RL predicts knock-in/knock-out triggers, optimizing hedging strategies.
- **Lookback Options:** AI evaluates historical price paths to maximize payoffs.
- **Asian Options:** Deep learning models calculate average price forecasts for accurate pricing.

Normal Derivatives Solutions

- **Vanilla Options:** Dynamic updates to Greeks (delta, gamma, theta) enable precise portfolio adjustments.
- **Futures and Swaps:** Predictive models optimize pricing based on interest rate movements and market trends.

Data Requirements and Sources:

- Market data from exchanges (CME, Eurex).
- Sentiment data from financial news and social media.
- Historical derivatives pricing and volatility data.

System Architecture

- **Data Layer:** Aggregates live market data, historical prices, and sentiment analysis.
- **Modeling Layer:** Processes predictive analytics, RL-based strategies, and dynamic pricing.
- **Execution Layer:** Automates trades with integrated compliance and risk controls.
- **Cloud-based** for scalability and integration with trading platforms.

Implementation Roadmap

1. **Phase 1 (0–3 months):** Develop AI models; backtest with historical data.

2. **Phase 2 (4–6 months):** Pilot retail-friendly features and institutional-grade analytics.
3. **Phase 3 (7–12 months):** Deploy live trading system with quantum integration.

Phase	Start (Months)	End (Months)	Milestones
Phase 1	0	4	Volatility Surfaces
Phase 2	4	8	Dynamic Pricing
Phase 3	8	12	Retail Dashboards

Controls and Safeguards

- Real-time monitoring of Greeks and VaR metrics ensures effective risk management.
- Retail clients face limits on leverage and position sizes to mitigate risks.
- Regular stress testing and scenario analysis (CAIA-recommended practices)

4 Cost-Benefit Analysis

A detailed cost-benefit analysis demonstrates the financial viability of the platform.

Costs:

1. Development:

- AI Model Design: \$500,000 for research and development, including the design of real-time volatility surfaces, dynamic pricing models, and reinforcement learning strategies.
- Quantum Computing: \$300,000 for cloud-based quantum computing resources to integrate high-dimensional modelling solutions.
- Retail Interface: \$200,000 for designing gamified dashboards and simplified tools for retail clients.

2. Operational:

- Data Acquisition: \$50,000 annually to access real-time market data, sentiment analysis APIs, and historical data for back testing.
- Maintenance: \$50,000 annually for system upkeep, monitoring, and security measures.

3. Marketing and Client Acquisition:

- Retail Outreach: \$100,000 for targeted campaigns to onboard 100,000 users within the first year.
- Institutional Client Engagement: \$50,000 for dedicated sales and onboarding support.

Expected Benefits:

1. Revenue Streams:

- **Retail Subscriptions:** A tiered pricing model (\$10–\$50/month) targeting 100,000 users in the first year, generating \$1.8 million in subscription revenue annually.
- **Institutional Fees:** A performance-based fee (2% of profits) targeting 20 institutional clients by year two, projected to generate \$3 million annually.

2. Efficiency Gains:

- Real-time updates to volatility surfaces and pricing reduce error margins to <1%, providing a competitive edge.
- Improved trade execution speeds through quantum computing lead to an estimated 15% increase in trading profits for institutional clients.

3. Client Retention and Scalability:

- Retail clients benefit from intuitive tools and educational modules, ensuring high retention rates.
- Institutional clients value advanced analytics, leading to long-term partnerships and the ability to scale globally.

Revenue Model

The platform employs a diversified revenue model to target both retail and institutional segments:

1. Retail:

- Subscriptions range from \$10/month (basic tools) to \$50/month (advanced analytics).

- Bundled offers for retail clients provide access to premium educational modules and real-time sentiment analysis.

2. Institutional:

- A subscription fee provides access to the core platform, with performance-linked fees (2% of profits) for additional high-frequency trading tools and custom features.

Implementation Timeline

The platform will be launched in three phases:

1. Phase 1 (0–4 Months):

- Focus on developing and testing AI models for real-time volatility surface calculations and dynamic pricing.
- Begin integration of quantum computing resources for high-dimensional simulations.

2. Phase 2 (5–8 Months):

- Launch pilot programs for retail and institutional users to gather feedback and refine features.
- Introduce gamified learning modules and basic strategy dashboards for retail clients.

3. Phase 3 (9–12 Months):

- Fully deploy the platform, including advanced strategy optimization tools and institutional-grade analytics.
- Scale marketing efforts to onboard retail clients while securing partnerships with institutional investors.

Key Performance Indicators (KPIs)

To measure success, the following KPIs will be tracked:

1. Volatility Surface Updates:

- Sub-second latency for real-time volatility surface calculations.

- Accuracy improvement, reducing error margins below 1%.

2. **Client Acquisition and Engagement:**

- 100,000 retail clients onboarded within the first year.
- Retention rate of 85% for retail subscriptions after the first year.
- Onboarding 20 institutional clients by year two, with average revenue of \$150,000 per client annually.

3. **Execution Efficiency:**

- Achieve an average execution latency of 10ms or less, leveraging quantum computing.
- Improve institutional clients' trading profits by 15% through optimized pricing and strategy tools.

Risk Assessment and Mitigation

Key Risks:

1. **Data Reliability:** Inaccurate or incomplete data may affect real-time updates.
 - **Mitigation:** Partner with multiple reliable data providers and implement error-detection algorithms.
2. **Regulatory Compliance:** Retail derivatives trading faces stringent regulations in many jurisdictions.
 - **Mitigation:** Work with legal experts to ensure compliance and implement automated monitoring for regulatory changes.
3. **Adoption Challenges:** Retail clients may find derivatives trading complex despite simplifications.
 - **Mitigation:** Offer gamified learning modules and 24/7 customer support to enhance understanding and confidence.
4. **Technical Challenges:** Quantum computing infrastructure may face limitations in availability and cost.

- **Mitigation:** Use hybrid quantum-classical approaches to balance efficiency and costs.

Scalability and Long-Term Potential

The platform's modular architecture ensures scalability for additional features, such as ESG-compliant strategies or AI-powered portfolio management tools. By expanding into global markets and leveraging feedback from early adopters, the platform has the potential to become a leader in both retail and institutional derivatives trading.

5. Competitive Analysis

Market Positioning

The platform occupies a unique niche in the derivatives trading ecosystem by addressing two underserved markets:

1. **Retail Investors:** Existing platforms like Robinhood provide basic access to derivatives but lack sophisticated tools such as real-time volatility surfaces and advanced strategy optimization. This leaves retail clients unable to compete with institutional investors who have access to more advanced systems.
2. **Institutional Clients:** High-end systems like Bloomberg Terminal and Thinkorswim are designed for professional use but exclude retail clients due to complexity and cost.

By combining accessibility with advanced features, the platform positions itself as a comprehensive solution for all derivatives traders. The dual-market focus ensures broad appeal and scalability.

Existing Solutions and Gaps

Retail Platforms:

- **Robinhood and eToro:**
 - These platforms simplify derivatives trading for retail users but lack advanced tools for pricing, analytics, or dynamic strategy recommendations.
 - They fail to address the educational gap, leaving many retail clients unprepared for derivatives trading complexities.

Institutional Platforms:

- **Bloomberg Terminal:**
 - Provides comprehensive data and analytics but comes at a high cost, making it inaccessible to smaller institutional players.
 - Lacks real-time tools for exotic derivatives, focusing primarily on vanilla options and futures.
- **Thinkorswim:**
 - Advanced charting and options analytics, but requires significant expertise, alienating newer or smaller institutional traders.

Gap Analysis:

- No platform currently integrates real-time volatility surface modeling, dynamic pricing for both exotic and vanilla derivatives, and accessible tools for retail clients in one solution.
- Quantum computing, which accelerates high-dimensional problem-solving, remains underutilized in this space

Unique Value Proposition

The platform's unique value lies in its ability to integrate advanced analytics with user-friendly interfaces:

1. **Real-Time Analytics:** Sub-second updates to volatility surfaces and option prices give users a competitive edge.
2. **Dual-Market Focus:** By serving both retail and institutional clients, the platform captures a broader market share than competitors.
3. **Quantum Computing:** High-speed, high-precision modeling for exotic derivatives sets the platform apart from all current offerings.
4. **Educational Tools:** Gamified learning modules ensure retail users can participate confidently, bridging the knowledge gap.

Competitive Matrix

Feature	Proposed Platform	Robinhood	Bloomberg Terminal	Thinkorswim
Real-Time Volatility Surfaces	✓	✗	✗	✓
Dynamic Pricing (Exotic & Vanilla)	✓	✗	✓	✗
Retail Accessibility	✓	✓	✗	✗
Quantum Computing	✓	✗	✗	✗
Gamified Learning Tools	✓	✗	✗	✗
Cost-Effectiveness	✓	✓	✗	✗

Barriers to Entry

1. Technical Complexity:

- Real-time modelling of volatility surfaces and dynamic pricing for exotic derivatives requires advanced expertise in AI, quantum computing, and financial engineering.
- The platform's proprietary algorithms create a high barrier to entry for new competitors.

2. Data Infrastructure:

- Continuous ingestion and processing of live market data demand significant investment in cloud-based systems and data partnerships.
- Competitors without existing infrastructure would face substantial costs and development timelines.

3. Regulatory Compliance:

- Derivatives trading is heavily regulated, particularly for retail markets. The platform's compliance measures (e.g., automated monitoring and limits) add an additional layer of differentiation.

Future Competitive Edge

1. Scalability:

- The modular system architecture allows for seamless integration of additional features, such as ESG-compliant options or AI-powered portfolio management tools.
- Expansion into global markets further strengthens the competitive position.

2. Quantum Integration:

- As quantum computing becomes mainstream, the platform's early adoption positions it as a leader in derivatives trading technology.

3. Customer Loyalty:

- Retail clients benefit from affordability and educational support, fostering loyalty and retention.
- Institutional clients value precision and advanced analytics, ensuring long-term partnerships.

References

- CAIA Association (2020). *Level II Curriculum*. Amherst: CAIA Association.
- CFA Institute (2023). *AI Pioneers in Investment Management*. Available at: <https://www.cfainstitute.org> (Accessed: 4 December 2024).
- Hull, J. (2020). *Options, Futures, and Other Derivatives*. 10th ed. London: Pearson.
- Smith, A. (2021). 'AI in Options Pricing', *Journal of Financial Analytics*, 15(3), pp. 45-60.
- Brown, T. (2023). *AI in Quantitative Trading*. Advanced Finance [Lecture Notes]. University of Cambridge.
- Jones, B. (2022). 'Quantum Computing in Trading', *Fintech Weekly*. Available at: <https://www.fintechweekly.com> (Accessed: 4 December 2024).
- University Materials (2023). *Lecture 05: AI in Quantitative Trading*. [Lecture Notes].

- University Materials (2023). *Lecture 06: Risk Management with AI*. [Lecture Notes].
- University Materials (2023). *Week 6: ETFs and Derivatives*. [Lecture Notes].
- Canva Design (2024). *S25 Student Fellowship Founders Challenge*. Available at: <https://www.canva.com> (Accessed: 4 December 2024).
- McKinsey & Company (2023). *AI and Finance: The Next Frontier*. Available at: <https://www.mckinsey.com> (Accessed: 4 December 2024).