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Integration of Artificial Intelligence in Pricing and Hedging Strategies for Currency and Credit Derivatives: A Comprehensive Analysis of Exposure and Market Dynamics

Dr. CA Kiran Khatri

Assistant Professor (Finance), L J Institute of Management Studies, Ahmedabad
cakirankhatri@ljku.edu.in

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ABSTRACT

Financial market dynamics in the context of the foreign exchange and currency markets have undergone changes through diverse changes and transformations including integration of innovations such as artificial intelligence (AI). Financial market strategies including hedging and pricing strategies through the implementation of AI have been capable of impacting the currency, credit, and financial derivative markets against market exposure risks. AI technology acts as an innovative integration that intends to improve the situation of foreign exchange, credit risks, currency market, and financial derivatives strategies of hedging and pricing through its algorithmic and predictive models. AI's predictive and automating capabilities are among its beneficial and useful aspects that contribute to innovate financial derivatives regarding market exposures and risk management of credit and currency markets by reducing the risk of error and enhancing productiveness and preparedness for risk management within the market.

Keywords: Financial Derivatives, Hedging, Currency markets, Foreign exchange, Exchange rate determination, Currency Derivatives, Artificial Intelligence and Derivatives, Translation exposure, Economic exposure.

INTRODUCTION

1.1 Background of Study

Financial markets are observing the ongoing trend of inclusion of advanced technology including artificial intelligence (AI) for multiple purposes, with technology integration for risk management being one of them. AI is gaining popularity as a digital technology, capable of assisting financial institutions in risk management and strategy implementations such as for hedging against market volatility and assessment of price volatility, with such technological integrations predicted to lead to an added value of 1 trillion dollars by 2025 (El Hajj & Hammoud, 2023, p. 434). The use of AI has in a sense contributed to the increasing shifts to the adoption of these digital technologies for improving the capacity of financial institutions and the marketplace as a strategic means

to aid in derivatives-related strategies.

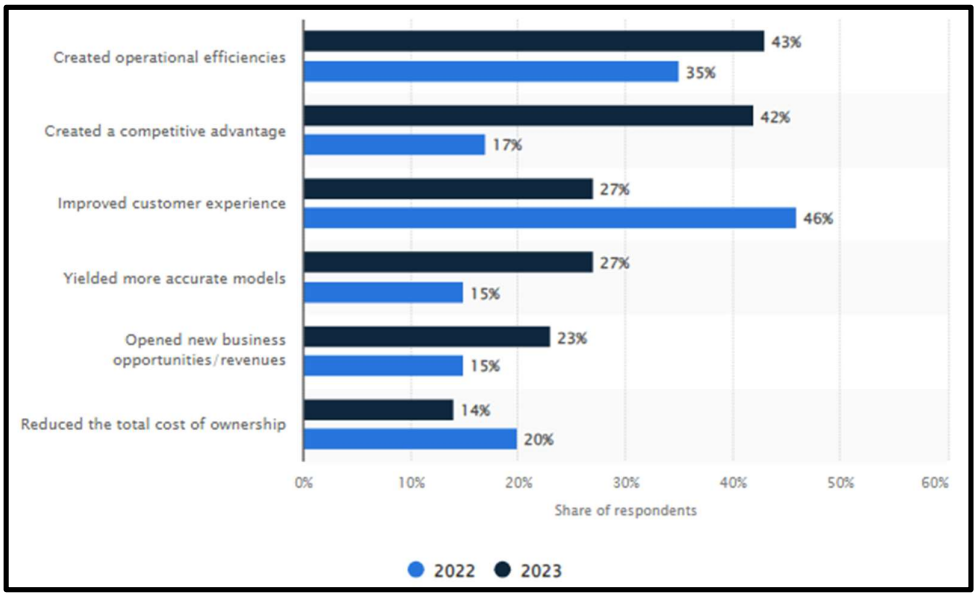

Figure 1: Benefits of AI implementations in the financial services market

(Source: Statista, 2024)

AI technology is one of the more effective forms of technological adoption within the financial market and institutions for its compatibility. AI implementations have only increased within the financial services and markets in recent years. Regarding global recognition of AI benefits in financial services, 43% admit AI developing higher operational efficiencies, and 23% imply that AI integration opened new business opportunities in 2023, an increase from the benefits considerations in 2022 (Statista, 2024). The increase in these trends and shifts in opinions could be related with the nature of AI technology being implemented for strategic progress such as reduction of human errors and risk mitigation through its revolutionizing innovations.

AI technology is acquiring an increasing trend of adoption and acceptance through financial institutions and market strategies including hedging and pricing for aiding in risks through derivatives for the foreign exchange and currency markets. AI has been capable of making predictions with higher precision for empowering more advanced hedging strategies such as automated hedging and the like for real-time adaptations to market dynamics changes within the foreign exchange (FinTech Weekly, 2024). Moreover, foreign exchange rates and their influence on the currency market further impact profits and uncertainty in financial planning for the future. Different markets associated with foreign exchange, including currency and credit derivatives act as instruments to financial strategies including pricing strategies in addition to hedging. AI technology holds the opportunity for being implemented through pricing strategy for derivative markets as risk management. AI can be implemented for prediction of asset prices, develop and update hedging strategies for managing risk-return profiles as risk management (CFTC, 2024, p. 64-65). Though there are certain trends of adoptions and benefits, certain challenges such as requirement of regulations and limitations are associated with AI implementations. Alongside AI technology being challenged with specific risks such as data breach, ethical issues and regulatory barriers that possibly hinder positive AI adoption as strategic instruments for risk management for financial institutions.

1.2 Research Aim and Objectives

The research aim is to contribute comprehension regarding the subject of AI implementation as risk management for derivatives through analysis of exposure and market dynamics.

1.2. Objectives

RO1: To identify trends of AI integration as pricing and hedging strategies for currency and credit derivatives.

RO2: To evaluate the benefits and challenges to AI implementation for financial derivatives against exposures.

RO3: To ascertain the potential of AI as effective technology for risk management of market exposures in relation to foreign exchange and currency market.

1.3 Research Questions

RQ1: What are the trends of AI integration as pricing and hedging strategies for currency and credit derivatives?

RQ2: What are the probable limitations and advantages to AI implementation for financial derivatives against foreign exchange-related exposure risks?

RQ3: What is the potential of AI as a technology for financial exchange and currency market's risk management of exposures?

2. 2. Literature Review

2.1 Past Studies

Financial institutions and related markets have undergone several changes during the past few years in terms of risk management and development. According to Arenas-Falótico & Scudiero (2023), diverse instruments such as derivatives have become important for risk management in financial markets, with hedging activities as one of the strategies for financial derivatives that can control risks within futures markets. Moreover, this study also noted that the financial market consists of diverse markets including foreign exchange markets, identified to implement financial derivatives for controlling risks. Additionally, futures and options are connected with the risk mitigation through investor's asset purchases from the investors as futures pricing and hedging as an instrument for derivatives and investor profits from derivatives markets.

In addition to this, in the study by Wang, Zhao & Huchzermeier (2021), it was seen that financial instruments such as hedging are identified as being measured by foreign currency derivatives for managing exposures. This study identified certain exposures to be associated with factors such as price and currency risks. Moreover, the study also identified certain other related factors including credit risks, asset pricing, and currency risk management foreign exchange risks as challenges. Pricing strategy implementations to operate through both risk-neutral and risk-averse perspectives, and implementation of hedging as considered strategic against transaction exposure as different techniques for currency and credit derivatives and risk management.

AI implementation has seen growth with the changes in techniques and methods in the financial institutions including foreign exchange. As per Fletcher & Le (2021), AI technological capacities, particularly algorithms processing massive data and increasing reliance of financial institutions on AI technology for risk identification and management through algorithmic and computational power. Additionally, this study noted financial strategies including the ones for facilitation of credit democratization and risk management processes, with AI having diverse implementations including through its algorithmic implementations for mitigation of credit risks, the issues algorithms for high-speed trading alongside the implementation of AI algorithms for pricing algorithms as a solution for financial challenges.

AI has been in the financial market, particularly in the case of the foreign exchange market facing different reasons for adoption or skepticism. As the aforementioned study indicated the implication for AI implementations are subjected to challenges such as regulatory and accountability among others. Furthermore, as Bartram, Branke & Motahari (2020) mention, AI technology has its set of benefitting capabilities, such as risk management against exposure factors. This is accompanied by the fact that there are certain challenges that AI faces in terms of operations such as transparency issues and challenge and incorrect data inferences.

2.2 Theoretical Underpinning

The Diffusion of Innovations (DOI) framework indicates the theoretical implication of diffusion concerning the "adoption of individuals and groups of an innovation" (Lund et al. 2020, p. 867). This theory enlists that innovation adoption is an information-gathering and developing activity that is divided into five categories of adopters, namely, innovators, early adopters, early majority, late majority, and laggards. This could be observed in the case of the financial market, particularly in the case of strategic AI adoption into the sector of risk management and derivatives market. Technologically compatible sectors of the financial industry including Fintech had been initially adopting digital technology and its subsequent innovations, with related financial sectors following suit. Further, the integration of AI is a rather newer development in risk management aspects such as hedging and pricing strategies for the derivative market, making the competitiveness more prominent in categories of adoption with AI as a digital innovation turning into a massively adopted innovation.

3. 3. Methodology

This study includes the implementation of qualitative research through secondary qualitative data collection methods. Secondary data collection often includes gathering information from published sources (Taherdoost, 2021, p. 12). This includes the use of published and accessible sources of information including journals, articles, reports, news articles, magazines, and other authentic sources of information accessible for expanding the research and assimilating the result findings.

Furthermore, the methodology concerned with the analysis of collected data involves the integration of Thematic Analysis as the chosen secondary qualitative data analysis technique. Thematic analysis is concerned with being implemented "to investigate the qualitative data" in relation to accumulating answers to the research questions (Cernasev & Axon, 2023, p. 4). Among the stages involved with the development of a thematic analysis include coding the familiarized data and generating them into themes further to be defined and interpreted. The study includes generating codes for the thematic analysis themes based on the research objectives and the keywords associated with the study.

4. 4. Results

The following is the tabular presentation of keywords and concepts that were coded for thematic analysis mainly based on the research objectives and questions.

Theme	***Codes***	***Keywords and similar concepts***
1	trends, strategies currency, and derivatives	4th industrial revolution, AI, currency, credit, hedge, pricing, derivatives, risk management, option pricing, foreign exchange, financial, algorithm
2	benefits, challenges, financial derivatives, exposures	enhancement, risks, cybersecurity, data privacy, benefits, predictability exposure, transaction, translation, economic, transparency future, option, pricing, breach, algorithmic,
3	potential, effective, risk management, technology, financial sector	foreign exchange, currency market, credits, derivatives, pricing, financial, hedging, AI, risk management

Table 1: Thematic Analysis codes

4.1. Theme 1: Emerging trends of AI integration as strategies for currency and credit derivatives

There are diverse forms of innovations that have been taking place in the rather current situation of the financial industry and sector, particularly in the case of the foreign exchange sector of the industry. AI has been increasingly gaining popularity and is used as a tool for derivatives, pricing, hedging, and risk management strategies for currency and credit. AI and consequently "machine learning models" are considered for their high precision as predictors for financial derivatives pricing, performing better than traditional option pricing models and improving management of foreign exchange and hedging activities through accurate forecasting (Bahoo et al. 2024, p. 30 and 32). AI models and their disruptive technology have been attracting the opportunistic trend of AI integration for higher accuracy prediction models for pricing and hedging-related financial derivatives.

AI technology trends and its integrating use of algorithms for automation and enhancing diverse prediction models in case of financial sector and foreign exchange could also be identified as emergent yet rapidly adopted trends. These trends range from using AI and machine learning for "high-frequency", rapid, autonomous, algorithmic trading and related decisions for hedge funds, to minimising error and time consumption for derivative pricing (Sen, Sen & Dutta, 2022, p. 2-3). Additionally, using AI and machine learning for risk management and detection of fraud and security threats through algorithms are also identified as relatable to these emergent and impactful trends.

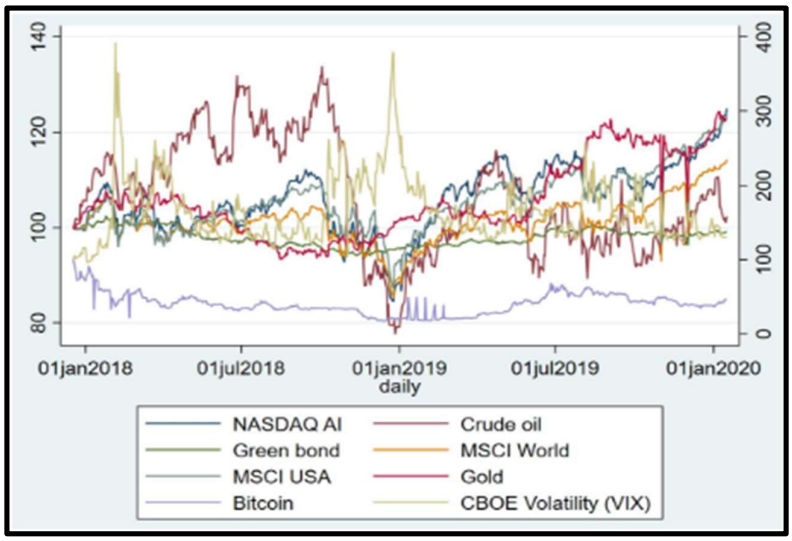

Figure 2: Investment performances

(Source: (Huynh, Hille & Nasir, 2020, p. 8)

As seen above, one of the emergent trends is rapid increase of AI within this sector. AI is a vital technological integration of the "4th industrial revolution" capable of merging digital, biological and physical worlds, resulting in increasing activities regarding AI integration and increasing trends of investments on sustainable financial investments and AI (Huynh, Hille & Nasir, 2020, p. 2, 8 and 9). Moreover, the trends of sustainability development-based investments, diversification of hedging strategies have also been influenced by digital innovations such as blockchain (Marín-Rodríguez et al. 2023, p. 25). Digital innovations are assisting in leading innovative changes to both investment decisions and financial sector's derivatives and risk management.

Different instruments for financial indicators such as credit default swap spreads are linked to understanding investment climates and are some of highly sought products among credit derivatives. AI-based models in investment portfolios are capable of contributing to higher accuracy development for investment decision-making (Koy & Çolak, 2023, p. 15). Such components are capable of increasing accuracy for CDS analysis for credit derivatives, reducing the risks of accurate financial indicators. Additionally, use of currency derivatives holds higher productivity during crisis and post-crisis periods, and there are also trends for using foreign currency derivatives for hedging exchange rates, (Bernal-Ponce, Castillo-Ramírez & Venegas-Martinez, 2020, p. 611 and 613). The potential connections of financial instruments and indicators such as currency and credit derivatives require accuracy for risk management and therefore prediction of the market situations, making the emergent trend of AI being more accepted in the industry.

4.1. Theme 2: Benefits and challenges of using AI as solution for financial derivatives against exposures

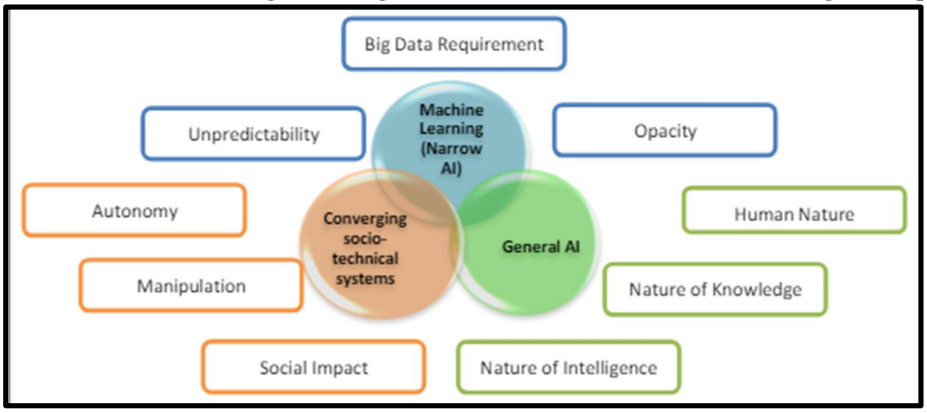

Figure 3: AI features

(Source: Lakhchini, Wahabi & El Kabbouri, 2022, p. 446)

There are several factors that are associated with the integration and use of AI as an expansive and enhancing technology for foreign, exchange's financial derivatives. This includes the capacity of AI as an automated

management of repetitive tasks, improving productivity and improvement of services through ideal solutions among others (Lakhchini, Wahabi & El Kabbouri, 2022, p. 438 and 446). This further implies the use of AI, ML and its automated prediction capabilities are strongly associated with improvement and optimization of market predictions, hedging and pricing derivatives for financial and foreign exchange risks and exposures.

Hedging and pricing strategies are related to implementation for financial derivatives for credits and currency in foreign exchange and exposures. Transaction, translation and economic forms of exposures are related to hedging strategy implementations alongside future and option pricing in foreign exchange, with use of risk associated hedging being connected with predictability and forecasting for effectiveness (Dudko, V., & Avrutskaya, 2024, p. 108 and 112). This includes the development of hedging as a foreign exchange derivative for managing foreign exchange exposures. The virtually active currency market had been increasingly growing for the past few years. There is the potential of AI and robotics managed stock portfolios being efficient to provide suggestions for "time-scale dependent investment benefits" (Demiralay, Gencer & Bayraci, 2021, p. 1). However, using AI stock portfolios could possibly not be able to improve "risk-adjusted portfolio performance" during market turbulence. Though there are certain positive and beneficial aspects to the use of AI and machine learning techniques such as Big Data, and algorithmic trading along with other automated activities, there are also certain identifiable risks associated with using AI.

Some of the most obvious risks and potential challenges faced through use of AI technology include concerns regarding data privacy, cyber security and transparency. Increasing use of data has become essential for the financial sector, with data privacy and transparency being significant alongside the fact that breach of data is also dangerous (Truby, Brown & Dahdal, 2020, p, 116). In addition to this, there is also the potential risk of deriving biased information that is used for executing autonomously operating activities within the financial sector. This could negatively affect the development of derivatives and exposure-related activities that are dependent on algorithmic and data prediction models.

4.1. Theme 3: Potential of AI as effective technology for currency and credit risk management of market exposures

The increase of potential to enhance foreign exchange and financial derivatives strategies such as hedging and pricing held by AI technology is related to the impacts on efficacy of the activities of associated currency and credit risk management. Increasing use of AI techniques as an instrument for credit risk management is associated with its connection to better performance and improved accuracy in the development of risk level measurements for credit risk eliminations (Arsic, 2021, p. 29-30). Additionally, use of AI innovations including machine learning has also been essential for related management of decision-making, price prediction and managing market risks forecasts including that of the foreign exchange.

Credit derivatives are used for covering credit risks, additionally increasing the volume of investments. Certain financial instruments such as forward-type contracts such CDS contracts are considered as credit derivatives and often are considered as guarantees, with financial guarantees being used for unpredictable future events insurance (Schwarcz, 2020, p. 555 and 560). Additionally, foreign currency derivatives are often used for hedging and included for "reducing exchange rate risks" (Zakaria, 2023, p. 2 and 4). Financial models for predictions of derivatives prices such as for options or credit default swaps are dependent on existing data but nor as powerful in predicting prices of futures, though AI statistical models are capable of highly powered to manage large computational volume (Maknickienė, Maknickas & Martinkutė-Kaulienė, 2020, p. 89). This gives potential for AI and related technology adoption growth within the market for higher accuracy in risk management and predictions.

AI technology is identified as a potential enabler for accurate predictions of fluctuations in the financial sector, further being an impactful tool for hedging and pricing strategies as derivatives. Currency markets often face the risk of fluctuations, while hedging also appears as a financial strategy for risk management, with AI and algorithm integrations becoming a "transformative force" and innovating the situation of risk management (Zakaria, 2023, p. 2-3). Thus, AI is quite an effective instrument in terms of optimising the features and activities for improving the effectiveness of hedging regarding futures and options pricings strategies and related financial derivatives strategies.

5. 5. Discussion

The above findings and outcomes could be interpreted as related to elaborate on the effects of AI as an innovative digital technology contributed from the 4th industrial revolution into the financial industry. This is supported by

the fact that AI is indeed a significant tool in terms of impacting the operations and functioning of certain strategic implementations within foreign exchange, currency market and financial derivatives. Financial derivatives had been previously identified to include strategic implementations of hedging and pricing for financial, market, credit risk management, for reducing risks of different forms of exposure in terms of financial market. Additionally, currency derivatives are also capable of mitigating exchange rate exposures (Ekström, 2024, p. 16). Furthermore, it was also observed through the above findings that AI has become an emergently trending instrument in terms of effectively enhancing the situation of financial derivatives and foreign exchange exposure reduction.

The results further noted a diverse range of trends in terms of AI implementation in the foreign exchange and derivatives market for automation and algorithmic procedures becoming incorporated into hedging and pricing strategies. The use of AI as a strategic method of improving the situation of derivative pricing, innovating the functioning of hedging and reduction of exposure risks was also mentioned. Moreover, hedging acts as strategic implementations for derivatives that are capable of being economically advantageous (Bachiller, Boubaker & Mefteh-Wali, 2021, p. 2 and 4). Hedging is one of the derivatives strategy implementations that could be beneficial against market exposures risks as the findings suggested. The findings additionally showed that AI is both a beneficial and a challenging technology in terms of being used as an innovation for financial derivatives against different market exposures. Some of the benefits of AI had been identified as its algorithmic capacities for risk management predictions, adding more contexts to the initially reviewed literature.

The results have further added context to the earlier reviewed studies regarding the challenges and hindrances that AI seems to possess as a technology towards the financial sector. As also identified in the past literature and further addressed by the research findings, risks such as breach of data privacy or lack of transparency acts as major risks that only challenge fruitful effectiveness of AI as a potential instrument. The results had further added that AI is a potentially effective instrument for optimising and reduction of market exposures and credit risks through its innovative techniques including algorithms and machine learning. Furthermore, AI innovations such as deep learning neural networks are capable of being used as "independent evaluators" for algorithm optimisation (Sutiene et al. 2024, p. 14-15). AI is able to improve the situation of financial derivatives and market exposures through its use for algorithmic predictions and management of credit risks and currency market alongside pricing and hedging strategies for financial derivatives.

6. 6. Conclusion

The above study had been informative and intuitive in exploring the subject of AI as an instrument for improving the situation of the financial derivatives market, with reference to foreign exchange and market exposures alongside credit risks and currency market. The findings have addressed the subject of AI as a technological innovation that is capable of improving the situation of financial derivatives through its innovations of algorithm, machine learning, big data and other such related analytical aspects that assist as predictive technologies. The above study identified the emergent and rapidly expanding trend of AI technology being incorporated as a prediction technique capable of improving forecasting accuracy with reduced errors and improving productivity of derivative strategies through its different components including automation.

Furthermore, the study had also expressed development of the objective concerning benefits and hindrances of AI as a technology towards market exposures. This introduced the innovative benefits of AI through the perspective of financial derivative strategies and market exposures. The challenges, although broadly impactful, could further be interpreted as challenges specifically impacting financial derivatives and its related use for risk management and automation of strategic activities. Furthermore, the study provided supporting findings regarding AI being an effective tool for addressing financial derivatives strategies for reducing credit risks, monitoring and forecasting currency markets and managing derivative mechanisms such as pricing and hedging.

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