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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

ANALYSIS OF VOLATILITY OF DERIVATIVE FINANCIAL INSTRUMENTS AND CONSTRUCTION OF OPTION STRATEGIES

Specialization: 5301.01 – Domestic Fiscal Policy and Public Finance

Field of Science: Economic sciences

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INTRODUCTION

Relevance of the Topic and Degree of Development. Volatility in financial markets serves as a primary indicator of price fluctuations, and its forecasting enhances the effectiveness of investment decisions. The limited number of existing studies in this area underscores the relevance of the topic. Exploring alternative methods for constructing trading strategies in this field carries particular significance.

In practice, derivative financial instruments are primarily used in two ways. First, as liquid financial instruments serving as investment products in the context of market efficiency. Second, as tools for hedging investment portfolios.

Over the past 15 years, financial markets have experienced significant volatility due to a series of major events — including the Global Financial Crisis (2008), the European Debt Crisis (2009–2019), the Energy Crisis (2014), the Russia–Ukraine conflict (2014–), the Chinese Real Estate Crisis (2020–), and the COVID-19 pandemic (2019–2023). These economic, political, medical, and military crises have led to substantial disruptions. In addition to causing food and energy insecurity, declining purchasing power, social isolation, and supply chain disruptions, these events have affected all sectors, global income levels, and investment plans. In such an environment of uncertainty, the role of derivative financial instruments has grown, and these markets have expanded due to their function in risk mitigation and diversification.

Empirical studies, particularly those conducted by the Milken Institute, indicate that a 1% increase in the size of the derivatives market is associated with a 1.1% rise in gross domestic product (GDP). In a comparative context, it is noteworthy that a 1% increase in employment corresponds to only a 0.6% increase in GDP (Milken Institute, 2020). These findings highlight the significant impact of derivative financial instruments on economic activity and underscore their macroeconomic importance through their interaction with the real sector. Consequently, the effective use and proper regulation of derivative instruments play a crucial role in ensuring sustainable economic development.

The theoretical foundations of this research are based on the

scientific works of prominent local scholars such as F. Ahmadov, F. Aliyev, Y. Kalbiyev, I. Seyfullayev, Sh. Mukhtarov, and N. Gasim, as well as internationally renowned academics including J. C. Hull, S. Neftci, A. Hirsa, F. Black, M. Scholes, R. C. Merton, R. F. Engle, E. F. Fama, A. Damodaran, P. Glasserman, M. Kastenholz, H. Berestycki, J. D. Coval, T. Shumway, D. Dickey, W. Enders, J. Lee, R. Kalaba, L. Tesfatsion, G. S. Maddala, C. R. Nelson, and C. R. Plosser, as well as V. Çobanoğlu, D. Başar, K. İlknur, and R. Şenyay.

Research purpose and objectives of the research. The aim of this research is to determine the directions for managing and constructing investment portfolios based on the application of an alternative method to the existing theses for analyzing volatility in securities markets and to develop option trading strategies. Unlike traditional methods, this approach functions as a scanner of volatility in financial markets. Considering that more than seven thousand option instruments are traded in the United States and more than fifteen thousand globally, the results of this research offer broad opportunities for the construction and management of various investment portfolios.

In accordance with the purpose of the research, the following objectives have been defined:

- To review the fundamental principles of the securities market and the application areas of derivative financial instruments;
- To study the historical role of derivative financial instruments in risk management and analyze the opportunities these instruments offer to market participants;
- To explore the existing theoretical and methodological approaches in the field of volatility measurement and analysis, and to investigate the main problems that arise during the application of these approaches;
- To analyze the key economic and financial factors affecting the formation of option premiums;
- To determine the mechanisms and characteristics of volatility and assess the impact of market changes on volatility;
- To compare different methods with existing models for forecasting expected volatility and propose new approaches;
- To develop a mechanism for managing risks and changes in investment portfolios in advance by identifying high and low volatility levels;
- To determine the formation, development, and prospects of volatility

and option trading in Azerbaijan's securities market;
- To evaluate the development prospects and potential of volatility and option trading in Azerbaijan's securities market;
- To analyze strategic approaches for protecting investment portfolios of capital market participants in Azerbaijan against volatility;
- To evaluate the impact of fluctuations in oil prices on investment portfolios and assess the potential application of option contracts on the Baku Stock Exchange;
- To investigate the potential uses of option contracts as alternative financial products in Azerbaijan and determine their future development directions;
- To forecast volatility using a time-varying coefficient AR model based on economic indicators and evaluate the outcomes of applying this model.

Object and Subject of the Research. The study focuses on the analysis of the volatility of financial instruments traded in capital markets and the option trading strategies built upon this volatility. Specifically, it examines the construction of long and short straddle and strangle strategies by simultaneously buying and selling call and put options on financial assets with low and high levels of volatility, using the same expiration date and either identical or different strike prices.

The core objective is to forecast price volatility of financial assets and, based on these forecasts, to design effective option trading strategies. Within the scope of the research, optimal trading approaches are identified through the application of statistical and mathematical models to assets with varying levels of volatility. The study evaluates the effectiveness of different forecasting methods and analyzes their role in risk management and return enhancement in financial markets. Furthermore, it explores the broader impact of volatility on market behavior, economic development, and the investment climate.

Research methods. The research employs statistical classification, analysis-synthesis, a systematic approach, and situational analysis methods. In addition, advanced statistical techniques such as the Time-Varying Autoregressive Model, Jarque-Bera test, t-test, correlation, and regression analysis have been applied. The theoretical foundation of the study is based on the scholarly works of both local

and international researchers in the fields of securities, financial engineering, and option volatility analysis.

Key Provisions Presented for Defense:

The achievements obtained from the research outcomes form the core theses presented for defense:

1. Measurement and Forecasting of Volatility for Straddle and Strangle Strategy Construction: A new method based on historical data has been proposed for building straddle and strangle strategies. This method aims to forecast future volatility more accurately by comparing historical and actual volatility data of the underlying asset. The proposed algorithmic model is presented as an effective tool for analyzing volatility trends and better understanding market movements. Empirical results prove that this approach generates positive returns.
2. Construction and Optimization of Multi-Leg Trading Strategies: Optimization equations have been developed to determine the maximum and minimum movement probability of volatility. These equations aim to increase returns and reduce risks through multi-leg strategies. The new technique is a valuable tool for traders in building high-yield strategies by adapting to market fluctuations.
3. Derivative Financial Instruments and Risk Management: The current state and prospects of derivative financial instruments in the Azerbaijani financial markets have been examined. The use of instruments such as options and futures in risk management has been specifically emphasized. The effectiveness of derivative financial instruments in managing historical volatility has been empirically justified.
4. Financial Products and Development in Azerbaijani Markets: Proposals have been made for the implementation and issuance of new financial products in Azerbaijan. In particular, the ways in which these new products can contribute to economic development have been analyzed. Strategic directions have been identified for the structuring of financial markets and the application of innovative instruments.

Scientific Novelty of the Research. The following points are considered the scientific innovations of this research:

- Volatility Forecasting Methodology: This study proposes the calculation of underlying asset price volatility over a predetermined time interval using advanced statistical and mathematical methods. As a result, it becomes possible to forecast expected future volatility. This approach enables a deeper and more precise analysis of price movements in financial markets.
- Modeling of Optimal Holding Period:Based on the volatility estimation process, mathematical modeling techniques are applied to determine the optimal holding period. This methodology ensures the visual presentation of results through bar charts, thereby improving forecasting accuracy and making the decision-making process more structured.
- Enhancement of Traditional Models:Classical volatility models, such as Black-Scholes, typically rely on market prices or implied volatility for evaluation. However, the new approach enables a more accurate analysis and forecasting of interest-based volatility indicators. It also allows for the inclusion of factors such as market sentiment and optimal holding periods.
- Development of an Algorithmic Approach: The research introduces algorithms that utilize historical price volatility to forecast future volatility and apply multi-leg option strategies. This approach aims to enhance the efficiency of financial markets by enabling precise and timely evaluation of volatility indicators in line with the needs of institutional and individual investors.

Theoretical and Practical Significance of the Research. The practical outcomes of the research have been developed to a level that allows for direct application. These recommendations can be utilized by investors in constructing and managing volatility-based portfolios and can contribute to the development of derivative financial instruments in Azerbaijan. Moreover, the findings provide a foundation for integrating financial engineering with machine learning and high-frequency automated trading methods, thereby enabling the implementation of modern approaches to risk management.

Dissertation's Main Provisions and Approval. The key propositions, theoretical-methodological findings, and scientifically substantiated results of this research have been published in six

scientific articles and four theses in various languages in academic journals recommended by the Supreme Attestation Commission under the President of the Republic of Azerbaijan. The major findings of the dissertation were also presented at national and international scientific-practical conferences between 2019 and 2024 and have been extensively included in the published proceedings of these events. Notably, a scientific article published in 2024 in the Q1-ranked journal "Risks" represents the highest-rated academic work written in Azerbaijan on this topic. This confirms the scientific standing of the research within the academic community and attests to the broad recognition and credibility of its findings.

The name of the organization where the dissertation work was carried out is Azerbaijan State University of Economics.

Structure of the Work. The dissertation consists of an introduction (18,752 characters), three chapters (Chapter I – 56,689 characters, Chapter II – 63,383 characters, Chapter III – 78,471 characters), a conclusion (17,586 characters), and a bibliography of 135 sources. It includes 26 charts, 6 figures, and 10 tables. The total length of the work is 234,881 characters.

STRUCTURE OF THE DISSERTATION

Introduction

Chapter I. CHARACTERISTICS OF FINANCIAL SECURITIES AND DERIVATIVE INSTRUMENTS

1.1. Financial Markets and Key Features of Securities

1.2. Origins of Derivative Financial Instruments and Their Role in Risk Management

1.3. Option Contracts: Theoretical Foundations and Price-Determining Factors

Chapter II. THE CONCEPT OF VOLATILITY AND ITS MANAGEMENT IN FINANCIAL MARKETS

2.1. The Concept of Volatility, Its Types, and Influencing Factors

2.2. Overview of Main Statistical and Econometric Models for Volatility Estimation

2.3. Managing Volatility in Capital and Money Markets through Derivative Instruments

Chapter III. DEVELOPMENT AND EMPIRICAL ANALYSIS OF A NEW OPTION STRATEGY

3.1. Theoretical Foundations and Structural Elements of the Strategy

3.2. Statistical Assessment of the Strategy's Effectiveness

3.3. Potential for Use in Azerbaijan and Its Importance for Economic Development

Conclusion

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MAIN SCIENTIFIC POINTS PRESENTED FOR DEFENSE

1. Volatility measurement and forecasting

The fundamental foundations of financial markets evolve under the influence of historical events, processes, and technological factors. The application of advanced technology leads to the rapid advancement of financial markets, which results in changes in the volatility of securities in the global economy, further increasing their significance. The introduction of advanced technology is leading to the rapid development of financial markets and the change and increase in the importance of securities volatility in the global economy. Derivative financial instruments were first mentioned in the works of the Greek scientist Thales. These are considered commodity futures contracts concluded on olive production. Currently, due to the influence of technological development, dozens of securities are traded on derivative financial instruments in world markets. Derivative financial instruments are financial instruments whose value is determined based on the performance of underlying assets. Underlying assets include indices, stocks, bonds, currency rates, interest rates, and commodities. Options are one of the most common and widely used of these instruments. Each investment instrument has a specific level of risk and return and is classified by Masters and Roberts using a pyramid model based on the principle of high risk-high return, low risk-low return (Figure 1).

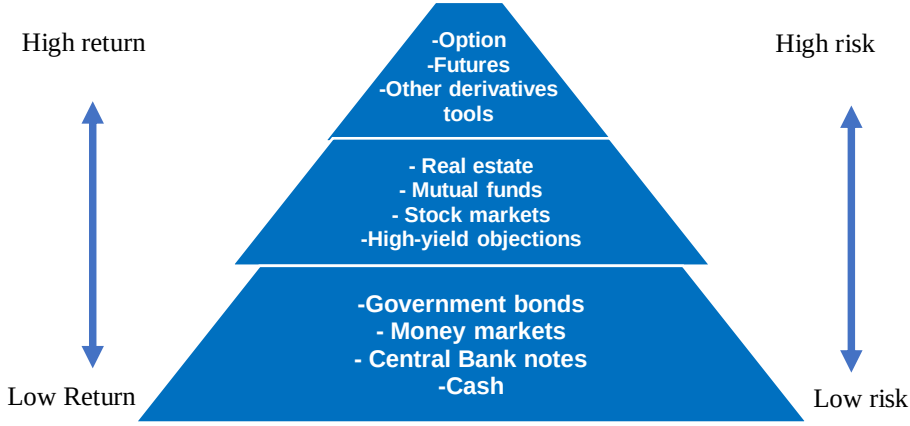


Figure 1. Investment risk pyramid

Source: Masters, Robert. "Study Examines Investors' Risk-Taking Propensities," Journal of financial planning, Vol. 2, №3, 1989. səh.151-156.

Derivative financial instruments are considered among the riskiest types of securities and are primarily used to ensure market efficiency and hedge portfolio risks. Successful trading with these instruments requires a proper understanding of market risks and volatility. The value of options is influenced by several factors, including the price of the underlying asset, time to expiration, volatility, and interest rates. Changes in option premiums can lead to unlimited gains or losses during buying and selling. Table 1 illustrates the impact of these factors on the depreciation of options up to their expiration date.

Table 1. Variation of option premiums in the face of factors

Factor affecting to option premiums	on Call Premium Effect	on Put Premium Effect
Increase in the value of the underlying asset	↑	↓
Increase in intrinsic value	↓	↑
Increase in time value	↑	↑
Increase in volatility	↑	↑
Increase in interest rates	↑	↓
Increase in dividends	↓	↑

Source: Compiled by the author

A deep understanding of market volatility is a fundamental prerequisite for achieving stable returns and sustainability in the securities market. Historically, derivative financial instruments have been used both for risk mitigation and speculative purposes. Volatility reflects the directional and sharp price movements of an asset over time and serves as a key indicator that measures the statistical dispersion of a security's return.

Volatility expresses the uncertainty and amount of risk regarding changes in the value of a security. High volatility indicates that the asset's price can change within a wider range, which could lead to a rapid increase or decrease in the security's price within a short period. Low volatility, on the other hand, refers to a period where the price does not change sharply and is more stable. Volatility measurement can be done through several mathematical and statistical methods, including

standard deviation, variance, or beta coefficients. During periods of low volatility, the market generally experiences a quiet and stable phase. Both of these conditions have an impact on option premiums. It has been previously mentioned that option premiums lose their value by the expiration date of the contract. This is because, when the price of the underlying asset moves in one direction, either a call or put option gains value, while the other loses its value, or both options lose their value.

There are several models to measure price fluctuations and volatility, with the most widely used being the Black-Scholes model. However, this model also has several limitations. The model assumes the risk-free rate and volatility as fixed variables, does not account for dividend payments, and does not apply individual approaches for European and American-style options. Furthermore, the model's assumption of lognormal stock price movements may not accurately reflect real-world price changes. Moreover, the model is based on variables that are assumed to be constant.

In this dissertation, the application of an alternative approach to volatility analysis has been explored. Specifically, a particular period—optimal holding period—has been selected, and attention has been given to measuring the volatility of the underlying asset during this period. This involves comparing the historical volatility of the asset during the optimal holding period with the expected future volatility. The proposed new method aims to enhance the accuracy and profitability of the option strategies by forecasting expected volatility based on historical volatility obtained from the underlying asset's price data.

Throughout history, various studies have been conducted in the direction of volatility analysis, and many researchers have developed different evaluation and analysis models. Straddle and strangle option strategies are directly related to market volatility and aim to benefit from significant changes in the price of the underlying asset. The straddle strategy is formed by purchasing both call and put options with the same strike price and expiration date for the same underlying asset. This strategy aims to benefit from price changes regardless of the market direction. The strangle strategy, on the other hand, involves purchasing call and put options with different strike prices; typically, the call option has a higher strike price, and the put option has a lower

strike price. Both strategies are based on the expectation of significant changes in the price of the underlying asset, and their profitability is unlimited (Figure 2). Therefore, measuring and forecasting volatility becomes crucial.

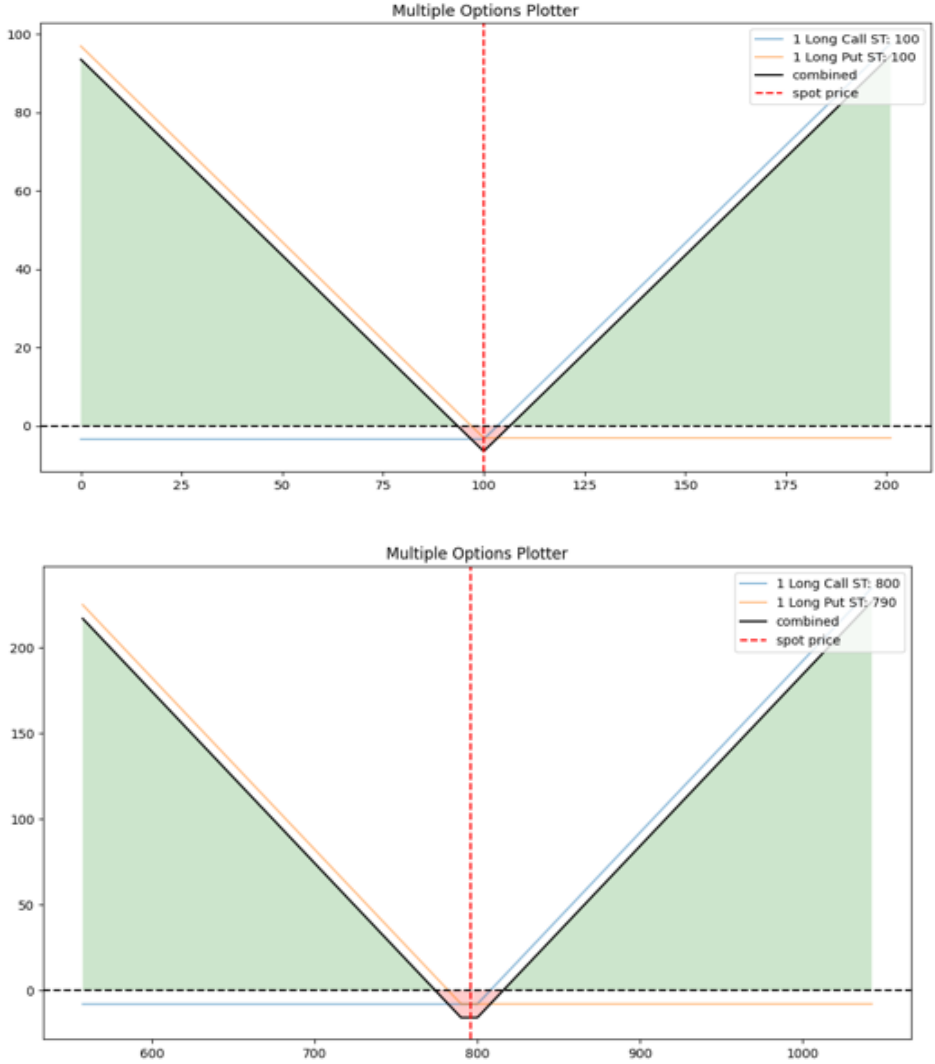


Figure 2. payoff chart of Straddle and Strangle option strategies

Source: Compiled by the author

In a study conducted by Coval and Shumway in 2001, it was determined that such trading strategies generate overall negative returns due to volatility risk. However, research conducted by students at Rice University in 2018 revealed that although this strategy tends to yield negative returns in normal periods, it can be profitable during periods of increased market activity.

The new method proposed in this dissertation aims to enhance the accuracy and profitability of the mentioned option strategies by forecasting expected volatility based on the volatility derived from the historical prices of the underlying asset. As a result, the importance of constructing various types of multi-legged option strategies, such as Straddle and Strangle, has been emphasized. An algorithmic model has been suggested to analyze both historical and actual volatility. This algorithm helps investors and traders make informed investment decisions by providing insights into volatility trends and market movements. The empirical results presented show that this algorithm has generated positive returns on the analyzed stocks, proving the effectiveness of the Straddle strategy.

2. Development and Optimization of Multi-Period Trading Strategies

Optimization equations have been developed and applied to determine the maximum and minimum movement probabilities of volatility. These equations have been identified as a crucial tool for constructing multi-legged trading strategies that maximize profits and minimize losses by adapting to market conditions. The research highlights the practical results of the new technique and demonstrates that this approach will be a valuable tool for traders who want to optimize their strategies. Potentially, more stable and higher returns can be achieved by forecasting market volatility more accurately.

To this end, an algorithmic model has been designed, and a web application has been developed using Python and Django programming languages. By selecting an optimal holding period, the mathematical and statistical models for volatility analysis are being formulated through this application to construct trading strategies for derivative financial instruments based on stock price fluctuations. The maximum and minimum movement potential of the asset is evaluated based on the

identified historical ranges, and trading strategies suited to market conditions are considered.

The research results show that, in line with previous findings, the expected volatility of stocks tends to increase before the release of corporate reports. This leads to investors purchasing option contracts at a high premium, which, over time, results in a loss as their value decreases. To mitigate this issue, it is suggested that the volatility of the underlying stock be measured over a predetermined period and compared with historical volatility. This approach allows for more accurate assessment of market fluctuations and the development of more effective trading strategies.

This algorithmic model is designed to analyze the historical and actual volatility of stocks in terms of currency (price). The software presented in Figures 3 and 4 allows for the visualization of results and enables more comprehensive and accurate forecasting. As seen in Figure 3, the volatility for MCD on September 15, 2022 (15.41%) appears historically low. The probability of a movement exceeding $4.75 in the following period is calculated.

str 20	Expire Date: Sept. 21,2022						
Search:							
Symbol	**Sector**	**Last Price**	**Beta (5Y Monthly)**	**Short Min**	**Short Max**	**Last Bar**	**Last Bar In %**
PEP	Financial	168.8	0.560926	2.09	15.85	6.30	32.54
MCD	Consumer Cyclcol	255.72	0.570115	2.68	20.58	4.75	15.41
MSFT	Technology	252.22	0.942868	5.02	34.15	9.36	18.41
CIS	Consumer Defensive	74.42	0.319216	0.95	8.41	2.22	20.32
CSCO	Technology	43.96	0.942469	0.74	9.58	1.71	14.88

Today: 2022-09-15 03:07:20 (Chicago Time): 5 Days Left						
Add to	**S/L**	**Long Min**	**Long Max**	**Last Bar**	**Last Bar in%**	**Add to**
	1.38	0.01	12.02	4.57	39.17	
	1.76	0.06	20.44	2.70	16.66	
	1.59	0.04	29.71	5.87	22.68	
	1.19	0.01	6.82	1.86	29.45	
	1.61	0.00	6.83	1.06	18.97	

Figure 3. Table of volatility levels of selected stocks

Source: Compiled by the author

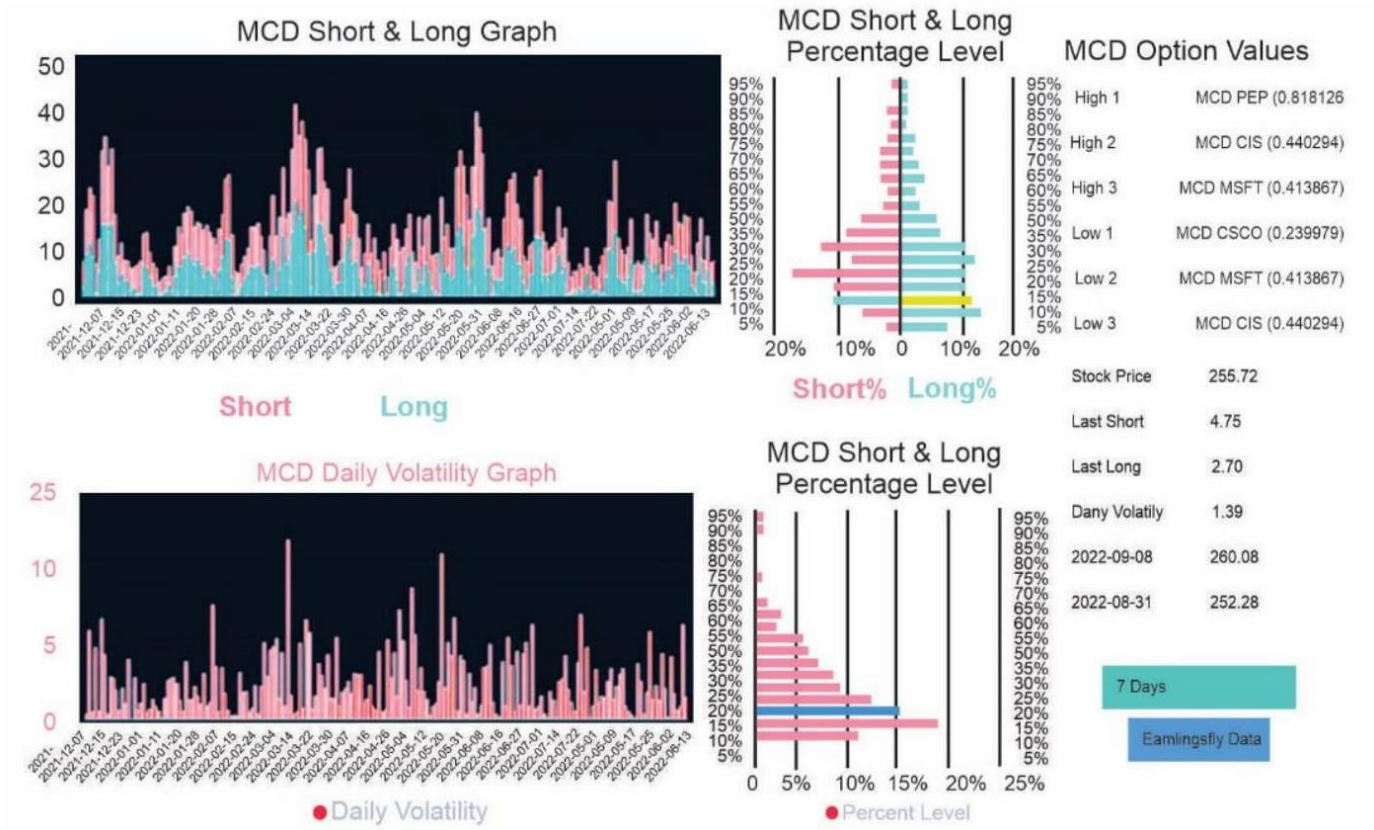


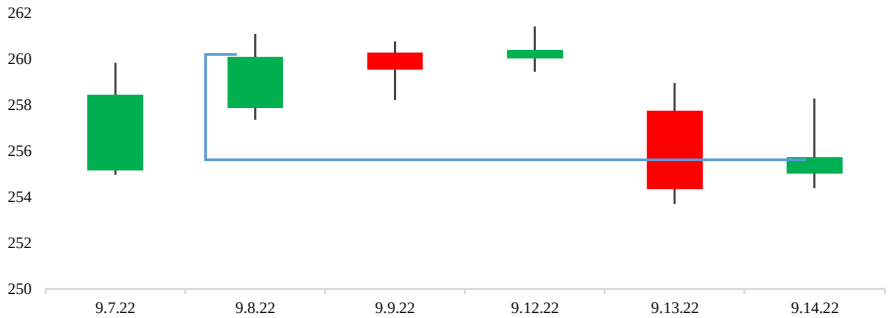
Figure 4. Visual levels of stocks with low volatility

Source: Compiled by the author

Figure 4 provides a comparative view of these percentage levels. Based on this analysis, it can be concluded that setting up neutral option strategies for this asset is appropriate. Examining Figure 3 further shows that from the day of analysis to the end of the month, the asset's value decreased by 10.9%. During the same period, the S&P 500 index declined by 5% (with a beta coefficient of 0.6 between the stock and the index).

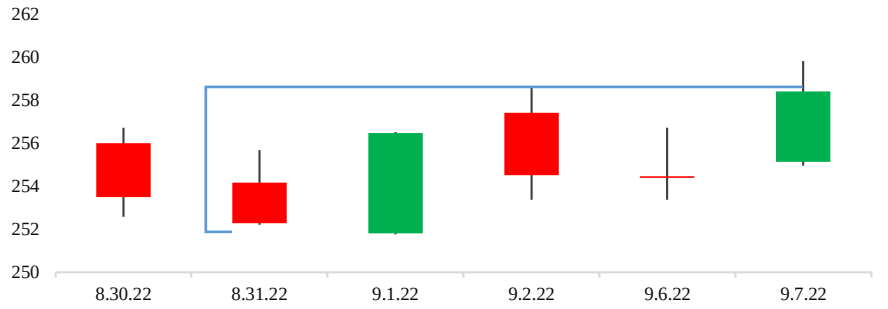
Based on the analysis of September 15, 2022, the last closing price of MCD on the last trading day, September 14, 2022, was $255.72 (Chart 1). The closing price 5 days earlier was $260.08, while the closing price 5 days later was $252.28 (Chart 2). Thus, the 5-day directional closing price movements were -4.36 and +7.8, respectively.

Chart 1. Price movement from September 08-14, 2022



Source, https://finance.yahoo.com/quote/MCD/history/?period1=1693526400&period2=1757060561

Chart 2 Price movement from August 31 to September 07, 2022

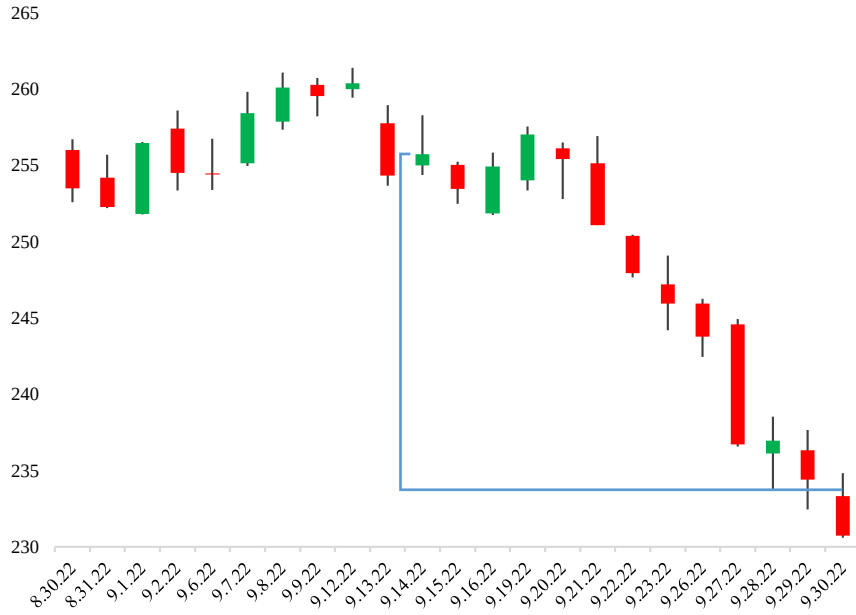


Source : https://finance.yahoo.com/quote/MCD/history/?period1=1693526400&period2=1757060561

The analysis of the algorithmic model results showed that the asset moved a maximum of $4.75 in one direction. When combined with the percentage chart, it visually becomes apparent that a $4.75 movement in one direction for MCD could be considered small, as the majority of the other bars were higher than $4.75. This strengthens the probability that the price could move more than $4.75 in the next 5 days with 95% confidence. However, to make this more precise, it is necessary to look at the daily volatility, as shown in the second graph of Figure 3.1.4. The chart shows that the volatility on the last trading day was low, and additionally, significant periods of high volatility for MCD are clearly observed. This suggests that when the option premium is approximately $4.75, implementing a neutral strategy is likely to be profitable.

Based on the analysis visualized by the software, it can be concluded that establishing neutral option strategies for MCD is appropriate.

Graph 3. Analysis result



Source : https://finance.yahoo.com/quote/MCD/history/?period1=1693526400&period2=1757060561

Based on long-term research and empirical work experience, the "Analytical Option Navigator" model has been further developed and adapted for open-source use. The algorithm has proven its effectiveness by being able to predict the success of trading strategies with a 95% confidence interval, enabling the construction of Straddle and Strangle strategies based on estimated price volatilities. Currently, the modified model has been adapted to the Pinescript programming language and is actively implemented on the TradingView platform (Figure 5).

Figure 5. EUR/USD exchange rate volatility

Source https://www.tradingview.com/chart/?symbol=CMCMARKETS%3AEURUSD

In the example conducted on the EUR/USD exchange rate, the blue histograms presented reflect the volatility level. The two marked lines on the chart indicate points where large histogram bars are close to the historical minimum levels of volatility. This situation confirms the initiation of price movement in one direction, based on price volatility.

To check the accuracy and usability of the developed volatility forecast model, an econometric model has been used. To validate the forecast results, the difference between the daily highest and lowest prices of Caterpillar (CAT) stock from January 4, 2021, to December 29, 2023, has been considered, focusing on volatility characteristics. During the selection of the Straddle and Strangle strategies, the

efficiency of the forecast model was evaluated. The primary goal of the analysis was to model the behavior of the high-low price difference (CAT H-L).

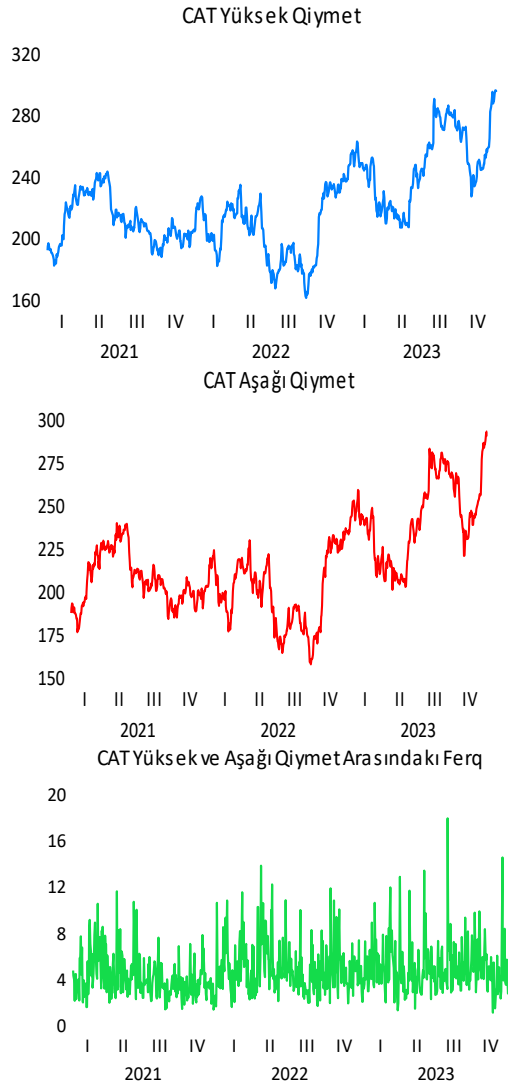


Figure 6: Time-variable CAT graphs

Figure 6 shows the movement of the CAT variable over time. The graphs indicate that the high and low prices move similarly, with non-

linear trends observed. The fluctuations in the difference sequence are prominent, and descriptive statistics (Table 2) confirm that none of the three sequences follow a normal distribution. The results of the Jarque-Bera test also reject the hypothesis of normal distribution.

Table 2: Descriptive statistics for the rows

	CAT High	CAT Down	CAT Difference
Average	224.7448	219.5955	5.149329
Median	220.8400	215.5800	4.650009
Maximum	299.2000	296.0400	18.28000
Minimum	164.5700	160.6000	1.529999
Std.Distribution.	27.81494	27.56553	2.122944
Baldness	0.469295	0.465157	1.449126
Kurtosis	2.792045	2.799850	6.540525
Jarque-Bera	29.84391	29.24150	676.0320
Probability	0.000000	0.000000	0.000000
Observation number	775	775	775

The stationarity of the CAT H-L (high-low price difference) series was tested using both the ADF (Augmented Dickey-Fuller) and Fourier-ADF tests. The results of the ADF test reject the null hypothesis, confirming that the series is stationary. The Fourier-ADF test, on the other hand, indicates that the fluctuations in the series are statistically significant. Therefore, it has been concluded that the CAT H-L series is stationary.

The most suitable model for the CAT H-L series was selected as ARMA(2,0) (Table 3). Based on this model:

When the difference one day ago increases by one unit, the difference on the current day increases on average by 0.2712 units.

When the difference two days ago increases by one unit, the difference on the current day increases on average by 0.0796 units.

Table 3: Results of the ARMA(2,0) Model

Variables	Ratio	St. error	t- statistics	Probability
stable	3.3433	0.2312	14.4632	0.0000
CAT_YAQF $_{t-1}$	0.2712	0.0359	7.56127	0.0000
CAT_YAQF $_{t-2}$	0.0796	0.0359	2.21682	0.0269
Regression Tests				
R ^{2}	0.0927	$\bar{R}^2$	0.0903	
Tests	Test statistics			Probability
LM test	1.7085			0.1638
White Test	0.6121			0.5425
Ramsey RESET Test	1.5695			0.1169

The model confirms its usefulness by showing that the residuals are free from autocorrelation and heteroscedasticity.

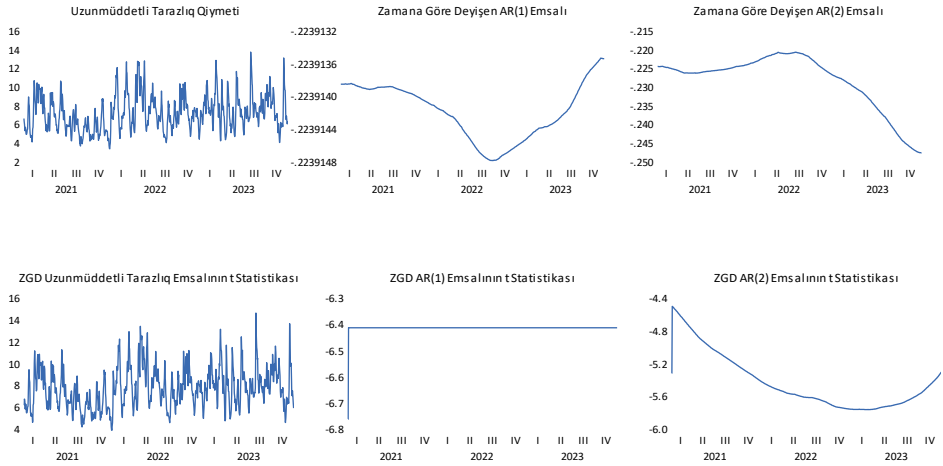


Figure 7: AR Model with Time-Varying Coefficients

Figures 7 and 8 display the changing AR model and volatility for the CAT H-L series. The analysis reveals that periods of low volatility are followed by increases in volatility. Based on these results, it is recommended to implement straddle and strangle strategies. These strategies allow for unlimited profit from price changes, regardless of the direction.

Figure 8: CAT volatility

Source: https://www.tradingview.com/chart/?symbol=NYSE%3ACAT

The research results demonstrate that the price volatility of the CAT stock can be effectively analyzed using econometric methods.

This outcome provides a more accurate and practical framework for applying straddle trading strategies compared to traditional volatility estimation models. The effectiveness of the proposed method is highlighted by its strong performance under various volatility conditions. Table 4 presents a comparison of the research findings with other existing models, where the advantages of the new method are more clearly showcased.

Table 4. The research of the results other available with models which difference

Aspect	New approach (Analytical Option Navigator)	Traditional Models
Volatility Measurement	Measures volatility in terms of currency, providing a more intuitive understanding of potential price movements.	Typically measures volatility as a percentage.
Optimal Holding Period (OHP)	Introduces the concept of an optimal holding period to calculate stock price volatility.	Generally does not account for optimal holding periods.
Algorithm Development	Presents a unique algorithm that forecasts upcoming volatilities based on historical data and market sentiment.	Often relies on simpler metrics like historical or implied volatility.
Empirical Validation	Empirically validated with positive returns across different volatility conditions.	May not perform well in all market scenarios.
Comparison with Historical Volatility	Compares actual volatility in currency with historical volatility to predict future implied volatility.	Typically uses historical volatility without such detailed contextual adjustments.

Source: author

3. Derivative Financial Instruments and Risk Management:

In the case of Azerbaijan, the use of derivative financial instruments serves as effective tools for managing currency exchange rate regulation and protecting against shocks caused by fluctuations in oil prices. Credit institutions, capital market participants, insurance companies, and other market participants use derivatives to manage risks associated with foreign currency reserves and portfolios. For instance, an institution wishing to meet its foreign currency needs may

not be able to cover its future needs with a one-year foreign currency option contract. This approach helps to reduce the impact of potential shocks in financial markets, thus contributing to more stable portfolio management. A significant portion of foreign currency in Azerbaijan is linked to the export of hydrocarbon products, and fluctuations in oil prices influence the exchange rate of the manat and the central bank's foreign exchange reserves (Chart 4).

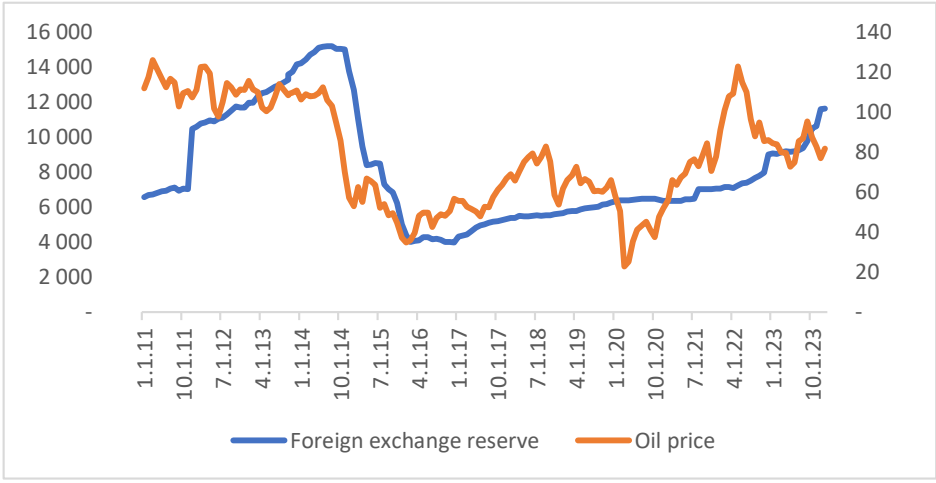


Chart 4. Global oil prices and Central The bank Foreign currency reserves[1]

Source : Azerbaijan Republic Central Bank, Bloomberg

As shown in Chart 4, despite the pressures caused by falling oil prices in the early 2010s, the Central Bank ensured the stability of the manat exchange rate, resulting in the stability of the exchange rate over the years due to the demand-supply balance in the foreign exchange market. After the two devaluations in 2015, the exchange rate of the manat against the US dollar was set at the level of 1.7. Regulatory authorities, banks, investment companies, and businesses involved in foreign trade play a crucial role in the formation of foreign exchange markets.

The research presents a new technique for implementing the straddle strategy based on volatility forecasts and highlights the role of

[1] https://cbar.az/page-40/statistical-bulletin

derivatives and risk management. Derivative instruments, such as options, act as synthetic instruments related to the underlying financial assets, allowing the transfer of specific financial risks. The proposed algorithm can be used by both institutional and individual investors to understand market sentiment and adjust positions accordingly to achieve positive returns. This approach demonstrates how derivative instruments, through advanced forecasting and optimization methods, can be effectively applied to manage risks in existing investment portfolios and how they can be used to establish new investment portfolios.

In conclusion, derivative instruments and their proper use methods can help reduce risks in financial markets and enhance resilience.

4. Financial Products and Development in Azerbaijani Markets:

The presence and impact of financial markets is one of the significant parts of Azerbaijan's economy. The influence of financial markets goes beyond just numbers; it shapes investment opportunities, employment prospects, and overall economic stability.

The developing capital market of Azerbaijan includes the Baku Stock Exchange (BSE). Operating as a closed joint-stock company, the BSE provides a platform for trading stocks, bonds and other securities. A strong capital market is important in terms of attracting investments, supporting entrepreneurship and diversifying the economy. This market also strengthens the development of the non-oil sector and the role of financial institutions in economic growth.

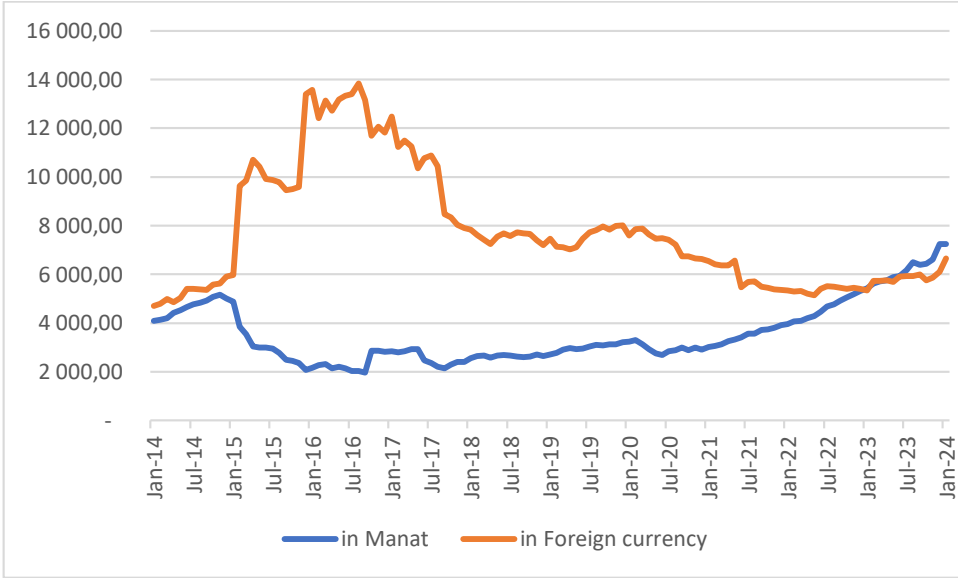
Azerbaijan's dependence on oil exports makes the foreign exchange market a key actor in the balance of payments. Fluctuations in oil prices directly affect the national currency and budget. The devaluations of 2015 made it necessary to manage this dependence. The Central Bank's foreign reserves reached $11,613 million in 2023 (+29%), approaching the level of 2015. Against the backdrop of the pandemic and geopolitical risks, measures were taken to target inflation, deepen the financial sector and maintain economic stability. These processes created conditions for diversifying the economy and creating new financial products.

Azerbaijan's financial markets can be classified in terms of the potential applications and possibilities of derivative financial instruments. Although some financial instruments are currently being

used, this can be expanded to include the development of products such as stocks, exchange rates, interest rates, interest rate derivatives, financial futures, forwards, commodity products, and other structured products.

In recent years, reforms implemented by the Central Bank and innovations applied aim to accelerate the development of financial markets and facilitate these processes. In the first quarter of 2024, the Central Bank approved rules related to the investment activities of local banks. According to these rules, banks will initially have the opportunity to offer securities and derivative financial instruments issued in Azerbaijan. This initiative creates conditions for further development of financial markets and the emergence of new opportunities. For example, in the future, individuals or companies in need of debt funds will be able to obtain liquidity through repo transactions by pledging securities held in commercial banks. This step will not only ensure liquidity but also contribute to the deepening and increasing the effectiveness of financial markets.

In recent years, the reforms implemented by the Central Bank have been aimed at accelerating the development of financial markets. In the first quarter of 2024, regulations concerning banks' investment activities were approved, allowing them to offer domestically issued securities and derivative instruments. This initiative fosters market development and creates new opportunities. In the future, individuals and companies will be able to use securities held at banks as collateral to obtain liquidity through repo transactions. This will enhance both liquidity provision and the depth and efficiency of the market.



Graphic 5. Term deposits[2]

Source : Azerbaijan Republic Central Bank

The attraction of foreign currency-denominated assets to financial markets, particularly for the trade of derivative financial instruments, can stimulate the market, create conditions for the development and circulation of new financial products. At the same time, this approach can increase the interest of foreign investors and stimulate the expansion of international financial relations. Among the key financial products that can be developed in this direction are options and futures on commodity products, structured financial instruments, and option contracts on currency pairs. The offering of these products can contribute to enhancing competitiveness in both local and international financial markets.

Enhancing financial literacy remains one of the key priorities. Within the framework of the Central Bank's "2024–2026 Financial Sector Development Strategy," the share issuance and digital awareness campaign conducted by ABB in the second half of 2024 significantly increased public interest. Additionally, a "Special Regulatory Regime"

[2] https://cbar.az/page-40/statistical-bulletin

was approved to pilot innovative financial services, facilitating their market entry and strengthening their competitiveness.

The fact that Azerbaijan's GDP is primarily based on natural resources suggests that commodity-linked derivative instruments could promote both exports and imports. Muxtarov, Kalbiyev, and their co-authors (2018) emphasize a long-term positive relationship between financial development, energy consumption, and economic growth in the country. The experiences of the Gulf countries and Kazakhstan highlight the significant role of equities in financial markets. However, in Azerbaijan, the limited number of stocks and low trading volumes hinder the development of derivative instruments, which in turn weakens investor interest and international cooperation.

For the development of Azerbaijan's financial markets, transparency, the enhancement of legal and regulatory frameworks, technological innovation, and secure trading mechanisms are of critical importance. Strengthening the capital, debt, and derivative markets, along with ensuring liquidity and price transparency, will enhance market efficiency. Cooperation with international financial institutions is essential for the introduction of new financial products and the strengthening of investor confidence. The Central Bank's "2024–2026 Financial Sector Development Strategy" targets the advancement of insurance, capital markets, and payment systems. This strategy aims to increase financial inclusion, reduce risks, and expand market opportunities. Derivative financial instruments play a key role in this process, contributing to the strengthening of the financial ecosystem, as well as to market stability and growth.

According to informal surveys conducted with local banks and investment firms, interest in currency forwards and options is growing due to their high profit margins. Forwards are primarily used for currency hedging by specific clients. Currency options, however, are still relatively new and less frequently utilized. More than 90% of the executed contracts are based on foreign currency. Additionally, currency swaps are also traded in Azerbaijan. Despite the stability of the exchange rate, banks' use of currency and deposit swaps indicates the sector's growth potential.

Derivative financial instruments offer significant advantages in Azerbaijan in terms of risk management, enhancing market efficiency, and expanding investment opportunities. Most investment companies offer these instruments to investors, and they are also utilized at the institutional level. However, the effective application of these instruments requires prudent regulation, investor education, and the implementation of risk-mitigating strategies. Such approaches help minimize potential adverse effects and enable the full realization of the benefits of derivative instruments.

In 2023, under a decree by President Ilham Aliyev, the privatization of state-owned enterprises through private investment was initiated. As part of this initiative, the publication of these enterprises' financial data on the Bloomberg platform is expected to improve transparency for foreign investors and enhance the country's investment appeal. Consequently, investors will be able to use local derivative instruments to diversify their portfolios, reduce risks, and strengthen the resilience of the financial market.

CONCLUSIONS

The results of this dissertation demonstrate that analyzing price changes of securities in financial markets through volatility models and selecting appropriate strategies significantly impacts optimizing investment decisions, effectively managing risks, and enhancing portfolio profitability. The key findings of this work have shown the efficiency of the developed models and tools, presenting new approaches that align with the demands of modern financial markets.

1. Impact of Volatility Analysis on Investment Decisions: The dissertation demonstrates that analyzing price changes through volatility models and selecting appropriate strategies significantly optimizes investment decisions, enhances risk management, and improves portfolio profitability. The developed models and tools align with the demands of modern financial markets.

2. Efficiency of the "Analytical Option Navigator" Program: The proposed program provides a more accurate analysis of historical and current volatility, enabling the selection of suitable option strategies. Unlike traditional models, this approach offers flexible and precise results, helping investors make decisions aligned with market conditions.
3. Multi-Stage Approach and Algorithmic Models: The study's multi-stage approach and algorithmic models allow for more accurate risk evaluation and forecasting. These tools enhance decision-making by providing a deeper understanding of market volatility and its implications.
4. Dynamic Hedging Strategies: The application of dynamic hedging strategies, particularly delta-hedging, effectively reduces risks and increases profitability during periods of market uncertainty. Neutral option strategies, such as straddle and strangle, further enhance risk protection during high volatility.
5. Portfolio Management and Optimization: Integrating volatility models into portfolio management ensures more stable returns by accounting for market volatility. This approach optimizes portfolios, balancing risk and return, and supports investors in making balanced and profitable decisions under varying market conditions.
6. Potential for Azerbaijani Financial Markets: The findings highlight the significant potential of applying volatility models and derivative financial instruments in Azerbaijan's financial markets. The use of options and other instruments can improve risk management and enable more effective market participation.
7. Contribution to Local Market Development: The adoption of these approaches by financial institutions in Baku could enhance the competitiveness and development of the local financial market. This includes fostering innovation, improving risk management practices, and attracting more investors.
8. Theoretical and Practical Contributions: The dissertation provides new theoretical and practical insights into the application of volatility analysis and option strategies. These contributions help investors protect against market volatility, manage risks more

effectively, and achieve stable returns.

9. Innovations and Future Opportunities: The innovations introduced in this work, such as the "Analytical Option Navigator" and advanced hedging strategies, offer practical solutions for both individual and institutional investors. They also create opportunities for the development of new financial instruments and strategies in Azerbaijan's financial markets.

The main content of the research is reflected in the author's published scientific works listed below:

1. O.V.Rustamov, F.M.Aliyev, R. Ajayi, E.B.Suleymanov. A New Approach to Build a Successful Straddle Strategy: The Analytical Option Navigator. Risks, 12(7), 113. - https://www.mdpi.com/2227-9091/12/7/113
2. O.V.Rustamov, F.M.Aliyev, A.N.Sahinler. The Nexus between Cryptocurrencıes and The Fear Index: Evidence from Bitcoin and Ethereum. 2023 IEEE 17th International Conference on Application of Information and Communication Technologies (AICT), 2023, (s.1-5) - https://ieeexplore.ieee.org/document/10313168
3. O.V.Rustamov. Closing the Gap: A Data-Driven Trading Strategy for Financial Markets. (2023). VII International Scientific Conference of Young Researchers (s. 595-598).
4. O.V.Rustamov. Statistical Advantage Trading Strategy of Gap Analysis in Financial Markets. (2023). İqtisadi Artım və İctimai Rifah (s. 141–151).
5. O.V.Rustamov. Options Trading in Azerbaijan: Analysis of Organizational Structure, Advantages, and Challenges. (2023). Doktorant və Gənc Tədqiqatçıların XXVI Respublika Elmi Konfransı (s. 480–484).
6. O.V.Rustamov. Innovation and Technological Advancements in the Azerbaijan Financial Market: Trends and Implications. (2023). Elmi Xəbərlər, № 4 (İctimai və Texniki Elmlər Seriyası) (s. 155–157).
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8. O.V.Rustamov. Analyzing the Advantages and Disadvantages of Options Straddle Trading. (2024). Elmi Xəbərlər, № 1 2024 (İctimai və Texniki Elmlər Seriyası) (s. 78–82).
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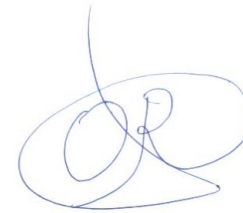

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