



An Integrated Technical and
Fundamental Stock Analysis Model for
the Saudi Stock Market (Tadawul)

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Abstract

The available literature on stock market trading signal prediction largely relies upon either technical analysis of market data or fundamental analysis of company financial data. Technical analysis methods are more suitable for identifying short-term movements in the market, while fundamental analysis can provide information regarding the financial strength of the listed companies. Thus, an AI model can be created that incorporates both of these analyses in order to help generate short-term trading signals for the Saudi Stock Market (Tadawul).

The dataset used in this model consisted of five years of trading and financial data for 20 companies listed on the Tadawul stock exchange. The raw data contained 24,966 observations, but was cleaned and preprocessed into a dataset containing 19,742 observations. Furthermore, the dataset exhibits a degree of class imbalance in its outcomes, with 32.00% of trading outcomes being successful in the initial dataset, and 25.78% in the out-of-sample test set of the data. A successful trading outcome was identified as outcomes in which the stock price reached the take-profit level of +5% before reaching the stop-loss level of -2%.

Each of the datasets was utilized to train machine learning models in an attempt to recognize the characteristics of successful trading outcomes for the Tadawul Stock Exchange. Two models were created: one of the Bidirectional Long Short-Term Memory (BiLSTM) neural network models using 60 days of market data for each company, and another of the XGBoost machine learning model that used technical indicators and financial ratios of each company. The trading signals from each of these models were combined into a weighted ensemble model, with the XGBoost model contributing 60% to the formation of trading signals and the BiLSTM model contributing the remaining 40%.

The models were evaluated using a range of metrics, both classification-based and those related to trading performance. Furthermore, a backtesting strategy was utilized for thresholds in the predicted trading signals between 0.50 and 0.75, as well as costs of 0.15% per trade. The results of the backtesting indicate that the hybrid model outperformed the individual models in terms of risk-adjusted trading performance. Specifically, the hybrid model showed that fewer trades had to be executed in order to maximize the returns of the trading strategy, as indicated by the increase in the Sharpe ratio and the decrease in the maximum drawdown for the strategy at various thresholds.

The integration of technical and fundamental analysis methods within an AI framework indicates that each approach has the potential to enhance trading signal prediction for the Saudi Stock Market. Furthermore, the use of publicly available information for these models allows for transparency in the trading signals of the strategy, as well as its suitability within the Saudi Stock Market regulatory regime.

Chapter 1: Introduction

1.1 Background and Problem Definition

The Saudi Stock Market, also known as Tadawul, is one of the largest stock markets in the Middle East and North Africa (MENA) region.

The Saudi Stock Market has become increasingly liberalized in recent years with various reforms introduced as part of the Vision 2030 initiative. These reforms have increased the number and size of the companies that trade on the market and increased the complexity of trading activity within the market.

Despite the benefits of such reforms, the increased complexity of the market has increased the volatility of the market. Furthermore, the volatility has introduced nonlinearity in the price movements of the stocks that trade on the market.

Investors in the stock market typically employ two main methods to make trading decisions within the market: technical analysis or fundamental analysis of the stocks that they trade. Technical analysis is beneficial for generating short-term trading signals. However, it does not provide information about the financial strength of the companies that trade on the market. Fundamental analysis of stocks provides an understanding of the financial strength of those companies. However, it fails to provide trading signals for short-term trading activities.

Furthermore, the bulk of machine learning literature is based on the use of statistical models to maximize the accuracy of trading signals. However, the stock markets that are regulated in the Kingdom of Saudi Arabia require that trading systems are easily interpretable and comply with specific regulations. Hence, there is a need for a prediction model that is based on regulation compliance and can generate short-term trading signals for the Saudi Stock Market.

1.2 Research Methodological Positioning

This study will use experimental research methods to test the performance of various models. Furthermore, the study will employ machine learning methods to develop these models.

Rather than using the stock market's price movements to determine trading signals, this research will use the information in the stocks' financial reports. Furthermore, the problem of trading signal generation will be represented as a classification problem, where the classification of trades will be based on whether a predefined target return is achieved before a stop-loss is triggered for a stock during a trading period.

Performance of the models will be evaluated using a set of financial metrics that represent the economic performance of the trading strategy rather than statistical accuracy measures. Furthermore, a method will be used that ensures that the model is tested on data that was available to traders at the time of trading (chronological out-of-sample testing) to ensure that it can be used for making trading decisions.

1.3 Research Objectives

The objective of this research is to develop a trading signal model for the Saudi Stock Market that is based on artificial intelligence.

Furthermore, this model will have the following sub-objectives:

To develop a model that can combine technical and fundamental indicators of company strength.

To formulate a target that can be used to train the model based on economic trading logic.

To test and evaluate the performance of the model using financial metrics.

To ensure that it complies with regulations of the Saudi Stock Market by using publicly available data.

To develop a framework for the model that can be replicated for other trading applications.

1.4 Research Hypotheses

Hypothesis 1: The artificial intelligence model that is developed for this research will exhibit risk-adjusted returns that are superior to those of standalone technical or fundamental models.

Hypothesis 2: The artificial intelligence model will experience less drawdown in its returns than the standalone models.

Hypothesis 3: The signals that are produced by the model will be based on public and structured data, and these signals will be sufficient to develop AI trading systems that can effectively trade in the Saudi Stock Market.

Hypothesis 4: The developed model will exhibit stability in its performances under validation on different market conditions.

1.5 Scope of the Study

The scope of this study is limited to the analysis of 20 listed liquid companies on the Saudi Stock Market (Tadawul) between 2021 and 2025. These companies span a variety of sectors within the Saudi economy, including banking, petrochemicals, telecommunications, and energy.

This study examines whether the strategy could be used to generate trading signals over short periods rather than attempting to determine the value of the stocks over longer periods or attempting to directly forecast the price of the stocks.

Furthermore, trades will be made when the price of the stock reaches a take-profit level of +5% of the initial price of the stock, or, alternatively, should reach a stop-loss level of -2% of the initial price of the stock. Thus, trades are only considered successful if the price of the stock reaches the take-profit level prior to reaching the stop-loss level.

Only market and financial data will be utilized to inform the trading strategy. Market data will be based upon daily prices of the stocks, while fundamental data will be based upon the annual financial statements of each of the companies. Data on sentiment, news, social media, or other non-structured data will not be incorporated into this framework.

The costs of 0.15% per trade will be incorporated into the backtesting of the strategy as a means of providing an estimate of the costs of executing the strategy. However, costs such as bid-ask spreads, liquidity, and slippage are not accounted for within this strategy, and are therefore a limitation of the study that can be addressed in future research.

Finally, this framework is for academic purposes only. The strategy is not financial advice, and should not be implemented as a trading system without first carefully considering its risks.

1.6 Research Contributions

This study makes a few contributions to the existing literature on artificial intelligence-based trading signal generation.

1.6.1 Model Development Contribution

The main contribution of this study is the development of a hybrid artificial intelligence model that incorporates two different machine learning models: Bidirectional Long Short-Term Memory (BiLSTM) and XGBoost. The trading signal is determined as a result of ensembling the predictions from each of these models.

1.6.2 Trading Framework Contribution

Most existing research on artificial intelligence and trading signals focuses upon the task of directly predicting the price of financial instruments. However, this study formulates the problem as one of predicting the outcomes of trades according to pre-defined trading rules that consider both take-profit and stop-loss levels for each trade.

1.6.3 Risk-Oriented Evaluation Contribution

In addition to providing classification accuracy metrics for the model, this study also evaluates the models according to several financial metrics related to trading, such as total return, win rate, the Sharpe ratio, and maximum drawdown.

1.6.4 Saudi Market Contribution

This study applies the created trading signal model to the Saudi Stock Market, using publicly available market and financial data. Thus, this study contributes to the limited existing research on artificial intelligence and trading signal generation within the Saudi Tadawul market.

1.6.5 Literature Contribution

The main way that this study contributes to the existing literature is through the creation of a framework that simultaneously considers technical indicators, fundamental financial metrics, trading rules, and risk-oriented evaluations of trading signal models.

1.7 Thesis Organization

The remainder of this thesis is organized as follows. Chapter 2 presents the theoretical background and related studies regarding stock market prediction, technical analysis, fundamental analysis, machine learning, deep learning, and hybrid financial prediction models. Chapter 3 describes the proposed methodology for the study, including the preparation of the datasets, the feature engineering processes, the construction of the models, the integration of the models to form the hybrid model, and the backtesting of the models. Chapter 4 presents the results of the experiments performed on the proposed models, as well as a discussion of the predictive and trading performance of those models. Finally, Chapter 5 draws conclusions regarding the study, its implications, its limitations, and future research in this area.

1.8 Research Clarification

The research described in this paper is entirely based on structured and publicly available data regarding the Saudi Stock Market. Both daily and annual financial

data are used to create the various features of the technical and fundamental analysis of the market. Furthermore, no private or sentiment data were used in the determination of the features of the stocks in this study.

The model created is for academic purposes only and is not to be used as a recommendation for financial markets or as financial advice. Any results from the model are to be used in the same manner as the research itself.