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IPOs and Evaluation of the Borsa Istanbul IPO Index

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ABSTRACT

This study emphasises the importance of capital markets and focuses on the opportunities and risks of IPOs for companies and investors. Capital markets contribute to economic growth by providing long-term investment opportunities for both domestic and foreign investors. IPOs, one of the most important financial instruments of the capital market, support economic stability by enabling capital to be spread to the mainstream and small investors to be brought into the market. However, opening new accounts only for the purpose of participating in public offerings may limit transactions in the market and pose an obstacle to long-term investments. Financial markets in Turkey have developed rapidly through structural arrangements and global integration efforts. However, fluctuations have been experienced during periods such as financial crises and pandemic events. Public offerings play a critical role in bringing companies to financial markets and transforming resources into investments. For this reason, many projects have been undertaken to increase the number of public offerings and to encourage the development of capital markets. Therefore, considering the importance of public offerings in terms of financial markets and Turkish economy, the issue needs to be examined and analysed in detail. This study provides information on capital markets and IPOs, and in the analysis part, the performance of Borsa Istanbul IPO Index (XHARZ) is analysed, and performance prediction is made. The index is modelled with the traditional ARIMA method, and the artificial intelligence based XGBoost algorithm and forecasts are made using the models. When the performances of the models are compared, it is determined that the machine learning based XGBoost Model provides better forecasting performance.

Keywords: Financial Markets, Financial Time Series, IPO, Borsa Istanbul, Machine Learning.

JEL Classification Codes: C55, D53, G12, G17, G23

Referencing Style: APA 7

Initial public offerings refer to the process by which a private company's shares are offered to the public for the first time through the issuance of shares. IPOs provide resources to companies by allowing a company to raise equity capital by giving investors the right to become shareholders in the company. To make the IPO more attractive, companies usually offer a share premium to potential investors when going public. Investors are more willing to participate in an IPO in order to profit from this situation (Investopedia, 2023). Therefore, more investors are willing to buy the company's shares. In addition, companies may also go for a second public offering after the initial public offering.

When stocks are bought by a large number of investors and traded on the stock exchange, the market becomes more liquid. An investor who wants to sell his/her stock can then trade easily. Therefore, companies always prefer to reach more investors with their shares in public offerings. For this reason, companies make an agreement with a private brokerage firm in the process of going public, allowing them to trade with investors on more favorable terms by trading through the institution. However, these transactions create different costs for the company. Publicly traded companies are required to provide information on this issue to their investors as well as to supervisory and regulatory bodies (Ibbotson and Ritter, 1995).

The ability of a company to raise the required capital by going public depends on the conditions, quality and efficiency of the financial system. It is assumed that the positive performance of IPOs can be achieved by economies with more favorable trends in terms of macroeconomic variables, consistently applied effective legislation, and high levels of institutional and financial information.

In capital markets, the success of the IPO process is evaluated according to the total number and size of IPOs realized during the year. Practice shows that in many countries IPOs have proven to be a good way to finance national growth, attract capital, manage brands, improve employee knowledge and skills, and diversify the shareholder structure.

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While loans from financial institutions will always play an important role for companies, capital markets are the real foundation for strong, stable and long-term financing. Therefore, it is necessary to emphasize the great advantages that developed capital markets offer to investors and companies. This is evidenced by the number and value of transactions in advanced market economies such as the US, China, Japan and Western European countries, which have significant IPO market activity and high performance (Pesterac 2020).

The literature discusses the findings on the short and long-term performance of companies that go public in many countries and the indices that include these companies. Studies analyze differences in average initial returns, the impact of binding regulations or contractual mechanisms, and the characteristics of IPOs (Loughran et al., 1994). A large number of studies are empirical analyses of anomalies in the pricing of initial public offerings (IPOs) of stocks. Some of these include the phenomenon of underpricing, especially in the short run. Another one is the hot issuance, i.e. the excessive interest of market participants in the IPO. This anomaly is often associated with companies in high-profile or high-tech industries. These IPOs are often characterized by excessive demand for short-term gains. However, investors often speculate and plan to sell these shares the day after the IPO. The other anomaly is the overpricing of initial public offerings in the long run (Ritter, 1991).

This paper emphasizes the importance of IPOs in financial markets and highlights the opportunities and risks that IPOs present for companies and investors. In addition, for the sustainability of IPOs, the Borsa Istanbul IPO Index is analyzed and its performance is analyzed using the traditional Autoregressive Integrated Moving Average (ARIMA) Model and the Extreme Gradient Boosting (XGBoost) Model, one of the artificial intelligence based deep learning methods. The results of the analysis show that the IPO index will follow a horizontal course with fluctuations, albeit with a slight depreciation. The results also show that the XGBoost neural network method explains the performance of the index better than the ARIMA Model. Studies in the literature also support that artificial intelligence-based deep learning methods give better results in financial time series. Thus, the overall performance of IPOs can be evaluated more accurately for both companies and investors.

FINANCIAL MARKETS

Financial markets, one of the important elements of national economies, bring together the supply of funds and the demand for funds through financial institutions by using financial instruments. The surplus funds of savers are transferred to investors in need of funds and the transfer of funds in the market is ensured. Thus, new investments can be funded or existing investments can meet their working capital needs. Investments also lead to an increase in demand by affecting expenditures. Increased demand, in turn, retriggers the need for investments. Therefore, financial markets support real markets and contribute positively to the economic growth of the country. The development and stability of financial markets are of great importance in this respect.

Financial markets in Turkey have developed rapidly, especially with the structural adjustments made after 1980, and have started to make significant progress in the process of integration with global markets. With the transition to a free market economy, growth policies that encourage export oriented production were brought to the forefront, while the balance of payments was ensured and the inflation rate was tried to be reduced to reasonable levels. However, the financial crises of 1994, 2001, 2008, 2018 and the COVID-19 pandemic that started in 2020 deeply affected the financial system. During these periods, exchange rates and stock market indices experienced significant fluctuations. Figure 1. shows the graph of the US dollar exchange rates of the Central Bank between 1988 and 2023, and Figure 2. shows the graph of the closing date of the BIST 100 Index between the same dates. When the graphs are analyzed, the fluctuations and the recent rapid trend are visible.

After the pandemic, a rapid recovery process started in financial markets, especially in capital markets. Capital markets have become more attractive for financial investors for many reasons such as the newly implemented economic policies, the low real interest rate on deposits due to the high inflation rate, the decision to terminate the Currency Protected Deposit (FXPD) practice, and the effect of the significant number of IPOs in the Borsa Istanbul equity market.

CAPITAL MARKETS AND BORSA ISTANBUL

Financial markets are divided into two categories; money markets, where highly liquid investments with a maturity of less than one year can be made, and capital markets, which consist of investments longer than one year. Capital markets in Turkey are based on the

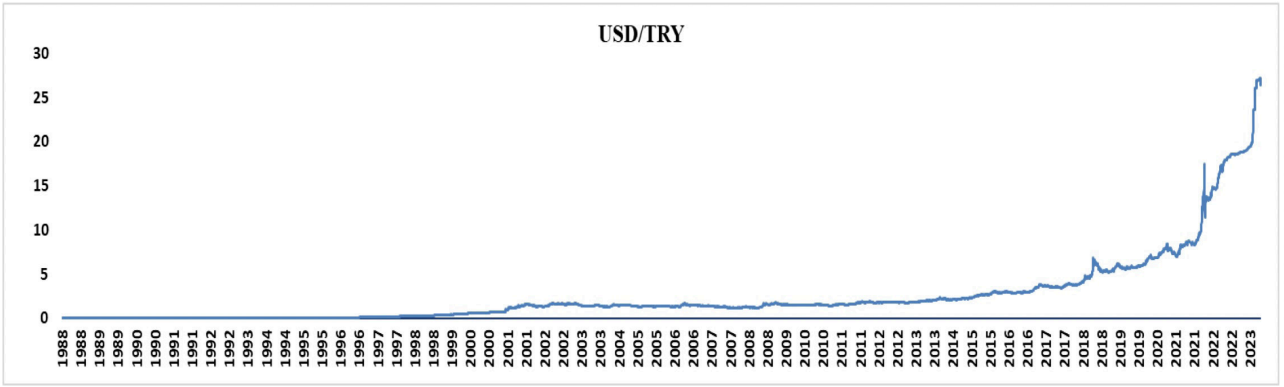

Figure 1. Indicative Central Bank US Dollar Rates (1988-2023)
Source: Central Bank of Turkey, EVDS

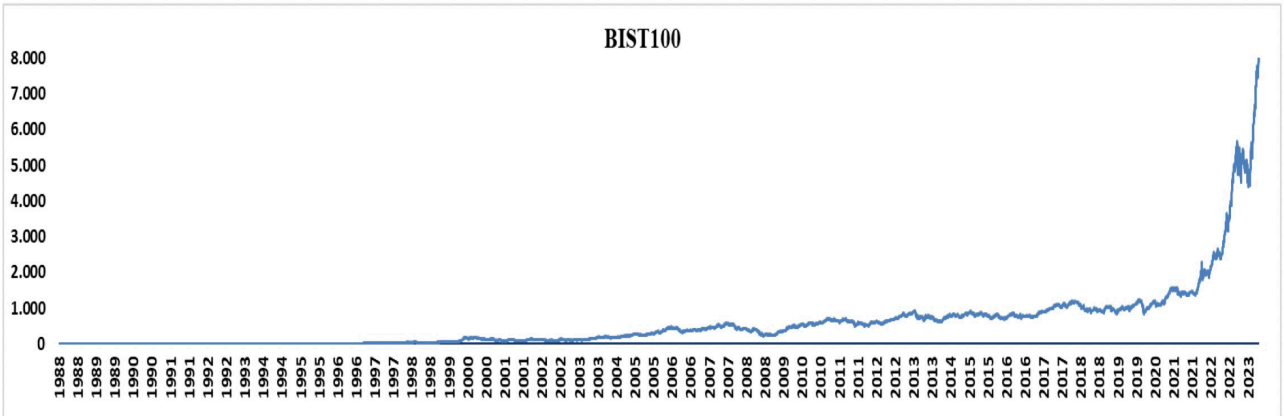

Figure 2. Borsa Istanbul BIST 100 Index Closing Data (1988-2023)
Source: Borsa İstanbul, Datastore

Dersaadet Bond Exchange, which was established in Istanbul in 1973. Bonds of the domestic and foreign debts of the Ottoman Empire and share certificates of foreign companies were traded on the stock exchange. Today, Borsa Istanbul (BIST) is at the center of capital markets.

BIST has Equity Market, Debt Securities Market, Futures and Options Market (VIOP), Precious Metals and Diamond Market. Primary market transactions and secondary market transactions are carried out in these markets. The primary market is the market where securities are offered to the public for the first time, while the secondary market is the market where existing securities that have already been offered to the public are traded by financial investors under market conditions. Having a secondary market for securities increases liquidity for financial investors and increases the demand for the primary market. In addition, BIST includes the Istanbul Settlement and Custody Bank (Takasbank), where the settlement and custody transactions of securities are carried out, and the Central Registry Agency (CRA), which provides custody, data storage, data reporting, investor services, and corporate governance services.

Capital markets offer an attractive environment for foreign investors as well as domestic investors seeking long term investments. Foreign investors generally prefer to invest in the stocks of companies with high potential in the BIST equity market (Data Analysis Platform, 2023). By bringing investors into the economy, foreign currency inflows to the country also increase. Thus, capital markets both enable the transfer of funds among investors and create foreign resources for the country. Therefore, the functioning of the market is of great importance for ensuring economic stability and sustainability.

Capital markets, and the BIST equity market in particular, have recently been among the most popular financial investment instruments. According to Data Analysis Platform data, the total portfolio value of the BIST equity market constitutes approximately 67% of the total portfolio value of all securities in the BIST. Moreover, when the BIST equity market is analysed in terms of the number of investors and portfolio value, while the number of investors was 904,646 and the portfolio value was TL 68,706 million on 31 December 2005, this number reached 6,247,715 investors and a total portfolio value of

TL 3,927,835 million on 31 August 2023. Therefore, in the last eighteen years, the number of investors in the equity market has increased by 691% and the total portfolio value by 5717%. Domestic investors account for 99.6% of the current number of investors, and approximately 41% of domestic investors are young investors under the age of thirty-five. The biggest reason for the rapid increase in the number of investors and portfolio value is explained by the increasing number of public offerings, especially in the last year. Figure 3 shows the number of investors and portfolio value in the Borsa Istanbul IPO index between 2005 and 2023. Especially after 2020, the number of investors and portfolio value will increase rapidly.

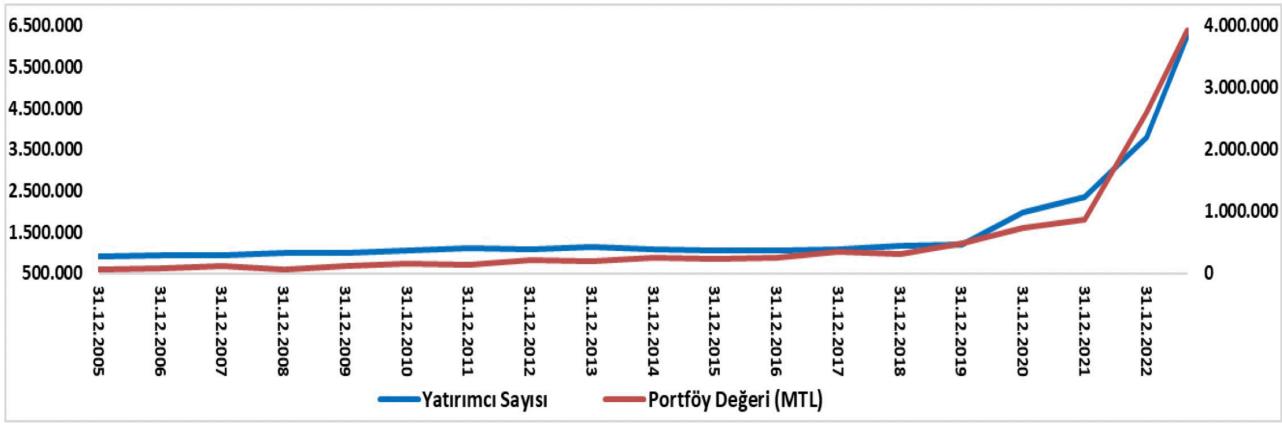

Figure 3. Borsa Istanbul IPO Index Number of Investors and Portfolio Value (2005-2023)
Kaynak: Central Registry Agency

PUBLIC OFFERING

Public offering or going public is defined as the sale of shares of capital market instruments of joint stock companies to investors through a call and announcement. Companies may offer their shares to the public for the first time, or companies that have already offered their shares to the public may make a secondary public offering. Companies wishing to go public may also offer their existing shares to the public or increase their capital for public offering. Companies going public are subject to the Capital Markets Law prepared by the Capital Markets Board (CMB), the regulatory and supervisory authority of capital markets (CMB, 2022). Public offerings have many benefits for companies, investors, and the national economy.

Public offering is one of the financing methods used by companies to meet their resource needs and is less costly compared to other methods. Since the financing is long term and provides liquidity, it is highly preferred by companies. In addition, the public offering process provides publicity and prestige for companies. In a sense, IPOs also accelerate the institutionalization process of companies, as companies are required by the CMB legislation to have independent external audits, apply International Financial Reporting Standards (IFRS), inform the public on time and accurately through the Public Disclosure Platform (PDP), establish an investor relations department, and be transparent. In this case, the completion of corporate governance processes increases the recognition of companies in international markets and can increase the potential of foreign investors. Confidence in companies can also increase their creditworthiness. In addition, companies may also go for a second public offering after the initial public offering.

From the perspective of financial investors, the public offering of shares of joint stock companies provides investors with an alternative financial investment instrument and an opportunity for return. Small investors in the market can utilize their savings as partners in companies. Since publicly traded companies are subject to CMB legislation, they are considered reliable by investors. The fact that share certificates can be easily converted into cash also provides an advantage for investors. However, it should not be forgotten that the high return potential offered by public offerings also carries a great risk. Because equities are financial investment instruments with a high level of risk. Therefore, investors need to have a high level of financial literacy, to be able to understand, follow, and interpret financial markets and parameters to make the right investment decisions. Investors should also have sufficient information about the company they become a shareholder of by purchasing shares.

When IPOs are evaluated from the perspective of the national economy, one of the biggest benefits of IPOs is to ensure the spread of capital to the grassroots.

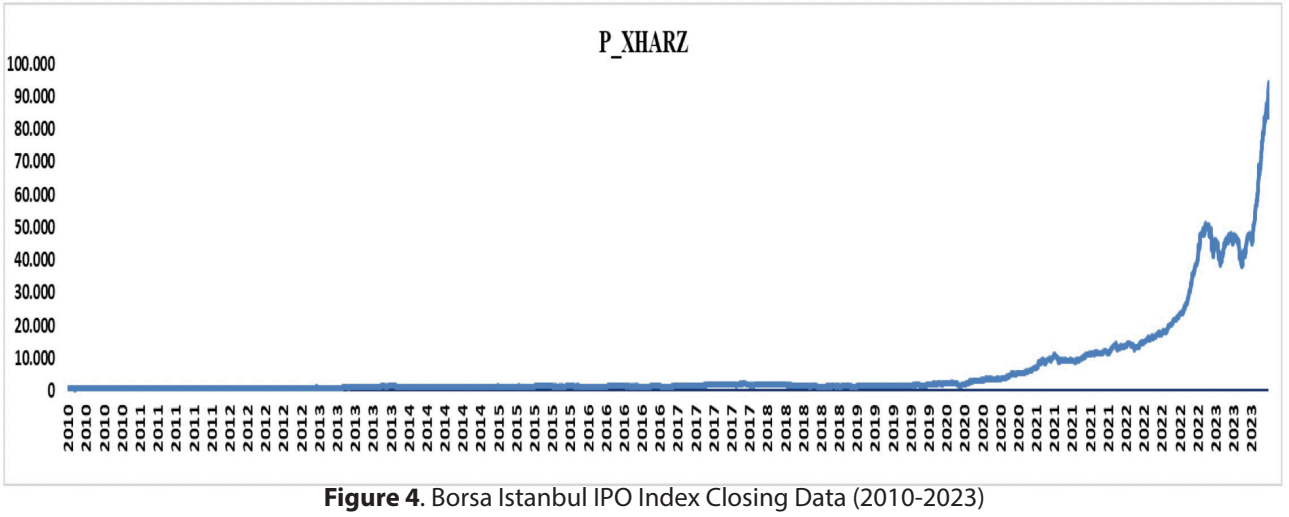

Figure 4. Borsa Istanbul IPO Index Closing Data (2010-2023)
Source: Borsa İstanbul, Datastore

Small investors also participate in the market through IPOs and the number of investors in the market increases. However, the opening of new accounts only for participation in public offerings may cause limited transactions in the market and the number of investors may not be sustainable. Public offerings are also important in bringing companies to the financial markets and transforming the funds provided into investments.

Since IPOs contribute greatly to the development of capital markets, the IPO Mobilization project was launched in 2008 by the CMB, BIST, Istanbul Chamber of Industry (ICI), and the Union of Chambers and Commodity Exchanges of Turkey (TOBB) to increase the number of publicly traded companies. The project aimed to increase the number of publicly traded companies and promote the development of capital markets. In this way, confidence in the market would be increased, the number of investors would increase, and savings would be transformed into long term investments. A total of 110 companies went public between 2008 and 2015 (Vergipedia, 2020). Although IPOs decreased between 2016 and 2021, they increased again in 2021, with 52 companies going public in 2021 and 40 companies going public in 2022. Since the demand for IPOs, especially in the recent period, is very high, the companies that have gone public can sell in limited quantities with equal distribution methods to meet the demands of the investors. Although this situation limits the investor's risk, it creates an obstacle to long term investment and gives investors the habit of short-term investment. In 2023, when the offerings until August 31 were analysed, 32 companies went public, total proceeds reached approximately 42.9 million, and 10,506,242 new accounts were opened. The number of investors under the age of thirty-five in the equities market increased by 91% to 2,568,862. The data shows the intensity of demand for public offerings in 2023.

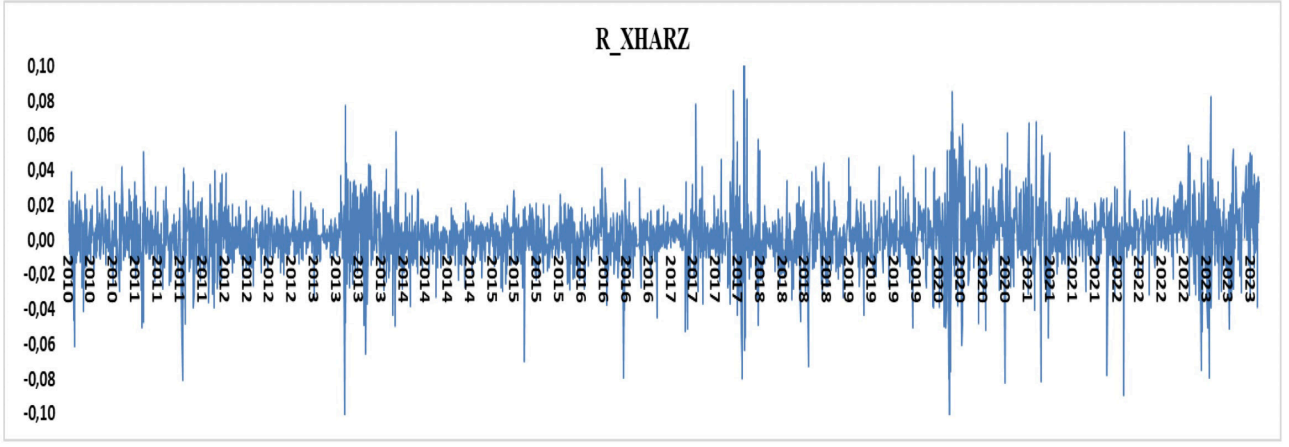

Figure 5. Borsa Istanbul IPO Index Return (2010-2023)
Source: Borsa İstanbul, Datastore

Borsa Istanbul IPO Index

The BIST IPO Index (XHARZ) consists of the stocks of companies that have been offered to the public and started trading on Borsa Istanbul. The index has been calculated since April 26, 2010. As of September 10, 2023, there are ninety two companies in the index (KAP, 2023). IPO companies remain in the index for 2 years (BIST, 2023).

When the XHARZ closing value graph is analysed, it is seen that the index has gained value from year to year due to the positive impact of public offerings on the market. The fluctuations seen in the return graph are indicative of the volatility in the index.

Studies on Borsa Istanbul IPO Index

There are many different studies and analyses in the literature on IPOs in financial markets, their economic effects, and performance evaluations. These studies contribute to the understanding and management of IPOs both in the academic world and in the finance sector.

It has been analysed whether the change in the operating performances of the IPOs made in Borsa Istanbul has occurred in a positive or negative direction in the periods following the IPOs. According to the results, it was determined that the operating performance of the firms decreased after the initial public offering period and decreased significantly in all performance indicators in the following year. Yıldırım and Dursun (2016) analysed the first day low price anomaly in initial public offerings in BIST in terms of the sector to which the company belongs and the IPO techniques. While the study did not reveal any significant difference depending on the sector and technique, it was determined that the first day anomaly continued on the first day and even on the second day (Yıldırım and Dursun, 2016). In another study on the prices at which IPOs are made, Avcı et al. (2020) determined that the prices are statistically significantly lower and that this does not vary by sector, while the size of IPOs is directly proportional to the size of companies.

FINANCIAL TIME SERIES FORECASTING METHODS

Financial time series are observations taken consecutively over time (Box et al., 2016). Statistical methods are generally used in time series forecasting. Among these, linear regression, autoregressive moving average, autoregressive conditional variance, and error correction models are the most used methods. However, in financial markets that contain uncertainty and can be affected by many factors, it becomes difficult to predict multivariate financial time series. Because time series are considered to be randomly distributed, modeling can be done by ensuring stationarity and making some assumptions. Therefore, it may be difficult to obtain accurate results in long term forecasts (Wang and Wang, 2015). Recent studies show that artificial intelligence based deep learning methods, which are frequently used in recent times, and which are developing further with technology, can provide better forecasting results in modeling the series. Many price forecasting algorithms used in price forecasting of financial investment instruments are also improving day by day. Aygören et al. (2012) forecasted the BIST 100 Index as a dependent variable and gold prices, interest rate, interbank transaction amount, and dollar closing values as independent variables using the ARMA model and artificial neural network methods and found that the ARMA model is more unsuccessful than the model obtained with artificial neural networks. Özdemir (2008) used the ARIMA model and artificial neural networks to forecast the BIST100 Index with monthly time series. According to the results, the modeling with artificial neural networks is better than the ARIMA model. Pabuçcu (2019), Gündüz et al. (2017), Tkac and Verner (2016), Telli and Coşkun (2016), Babu and Reddy, (2015), Hanias et al, (2012), Maciel and Ballini (2010), Kutlu and Badur (2009), Thawornwong et al. (2003), Desai and Bharati (1998) have studies showing that the use of artificial intelligence method provides better performance.

Autoregressive Integrated Moving Average

Financial time series are generally used for forecasting purposes. In time series analysis, the relationship between a single variable and its past values is examined (Brooks, 2014). The series is nonstationary due to trend, seasonality, random fluctuations, and cyclical fluctuations. For this reason, the necessary differencing (d) process is performed to make the series stationary. Now, the equation for the mean is written with the most appropriate Autoregressive Model AR(p) and Moving Average Model MA(q). Thus, the Autoregressive Integrated Moving Average (ARIMA (p, d, q)) model is estimated (Box and Jenkins, 1970). Finally, the adequacy of the model is tested. The error term of the model refers to the unexplained unexpected events and shocks in the model, while AR(p) indicates the number of lagged dependent variables in the model and MA(q) indicates the relationship between the current and past values of the model's error term (Tsay, 2010).

	Tarih (GG.AA.YYYY) / Date (DD.MM.YYYY)	Kapanış Değeri / Closing Value
0	2010-04-27	591.82
1	2010-04-28	600.34
2	2010-04-29	602.83
3	2010-04-30	616.39
4	2010-05-03	611.37

Table 1. First 5 Rows of Control Data for Control Purposes in ARIMA Model
Source: Borsa İstanbul, Datastore

Extreme Gradient Boosting

The Extreme Gradient Boost (XGBoost) machine learning algorithm (Chen and Guestrin, 2016) is a supervised forecasting method consisting of a scalable decision tree and conditions. The model is based on the optimisation of the objective function. By combining parallel decision trees, unnecessary downward excessive branching in the decision tree is prevented. Thus, the time spent in the model is shortened and faster results are obtained. Each parallel decision tree produced minimises the error in turn (Bonaccorso, 2017).

The method uses the boosting method and has structures that are added on top of each other sequentially. It chooses the most appropriate one among the conditions created for prediction and continues until it reaches the result and moves to the next condition. In the model, each new decision tree is added on top of the previous one at certain weight ratios, and the model is improved with the reduced difference in each iteration. For each data, a different decision tree is required. Thus, the Extreme Gradient Boosting Model provides more accurate prediction by making inferences from the previous training samples with supervised learning. Different parameters can also be used in the model (Mitchell and Frank, 2017).

Analysis of Borsa Istanbul IPO Index with ARIMA and XGBoost Methods

The study forecasts the Borsa Istanbul IPO Index (XHARZ) by using the daily closing data between January 27, 2010 and August 31, 2023. The data used are taken from Borsa Istanbul Historical and Reference Data Platform, Datastore (Borsa Istanbul, 2023).

The ARIMA model used in the analysis was implemented using the Pandas library of the Phyton program, which provides high performance, data structures and data analysis tools. The data obtained were converted into DataFrame. The graphics of the study were created with the Matplotlib module. The main library of the ARIMA model is Statsmodels.tsa.arima.model. Numerical Python (Numpy) is a basic Phyton library for scientific calculations. Optuna is a hyper parameter parameter optimization algorithm that gives better results with fewer trials. It automates this process instead of manual trial and error. Scikit learn (sklearn) is a library of machine learning algorithms in Python. Its main purpose is to allow users to easily create and train machine learning models. Scikit learn supports machine learning tasks such as classification, regression, clustering, dimensionality reduction, and many more.

The accuracy of the data was checked with the first five rows and the XHARZ graph was plotted again to check the data.

The hyper parameter optimization algorithm Optuna finds for the Autoregressive Integrated Moving Average (ARIMA (p, d, q)) model.

The Mean Absolute Percentage Error (MAPE) value is used to test the ARIMA model. The MAPE value is a percentage error measure used to evaluate the model's performance. It gives the proportional amount of error between the prediction values and the actual values in the modeling created in the analysis. A MAPE value below 10% indicates that the performance of the estimated model has a high degree of accuracy. A value between 10% and 20% indicates that the model is a correct prediction. Models with a MAPE value above 50% are considered to be inaccurate forecasting models (Smith and Johnson, 2020).

The Model Average Absolute Percentage Error (MAPE) value realized with ARIMA (1, 0, 2) values is approximately 38.30%. Starting from 2010, the graph of the one-year forecast made by training the model with all data is shown in Figure 7.

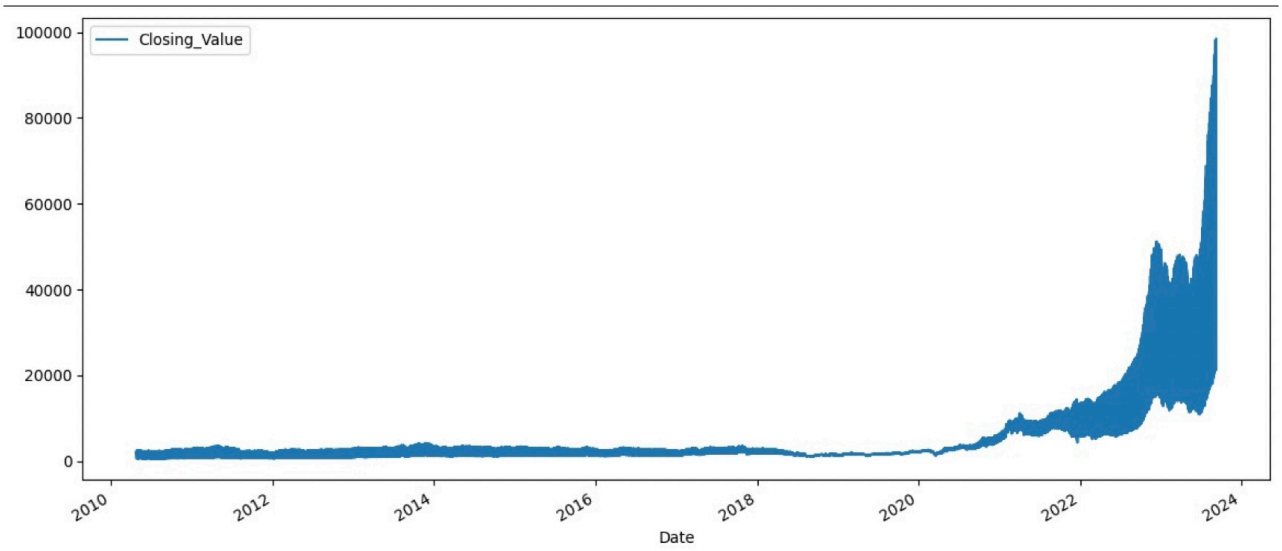

Figure 6. Matplotlib Module Outputs of Borsa Istanbul IPO Index Data
Source: Borsa İstanbul, Datastore

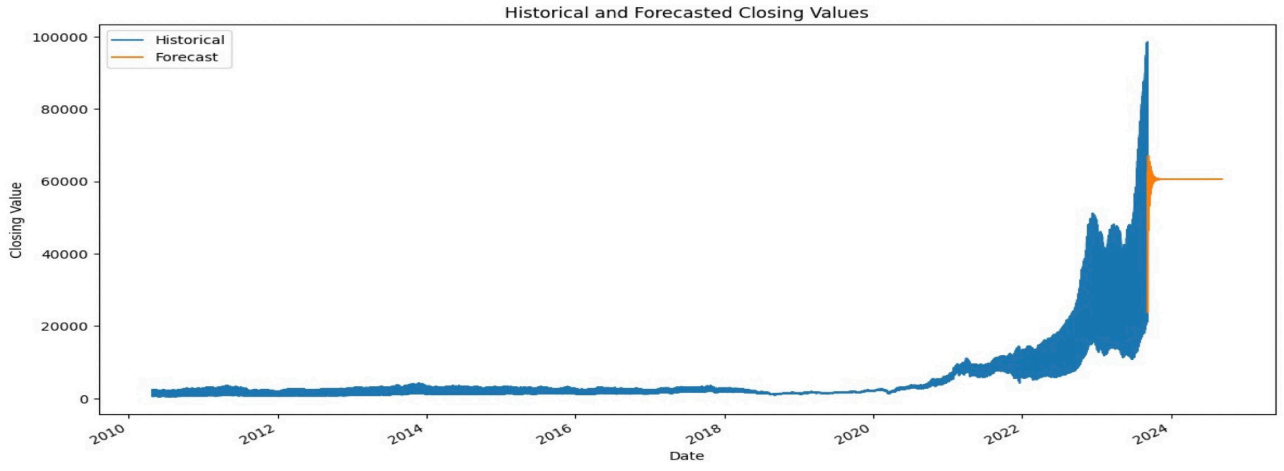

Figure 7. 1 Year Forecast Graph of Borsa Istanbul IPO Index Data Obtained by Training ARIMA Model
Source: Borsa İstanbul, Datastore

In the XGBoost Model, as in the ARIMA model, the application was made using the Pandas library of the Phyton program used in the analysis, and the data obtained were converted into DataFrame. Graphs were created with the Matplotlib module. The main library of the XGBoost model is XGBoost. Numpy Phyton library was used. The Optuna optimization algorithm was also used to train the sub parameters of the model. Scikit learn (sklearn) is a library of machine learning algorithms in Python.

The accuracy of the data was checked with the first five rows and the XHARZ plot was drawn again to check the data.

For the XGBoost Model, 90% of the approximately 13 years of data is used in the training data part of the study, while 10% is used for the test data. Figure 9 shows the comparison of the 10% test data generated with the XGBoost model of Borsa Istanbul IPO Index data with real data.

The calculated MAPE value of the XGBoost Model is approximately 12.52%. Figure 12 shows the one-year prediction graph of the model with 90% training data and 10% test data since 2010. Figure 10 is the 1-year prediction graph of the XGBoost Model obtained by training 10% test data.

In the analysis part of the study, to predict the performance of the Borsa Istanbul IPO Index, forecasts are first made with the traditional Autoregressive Integrated Moving Average (ARIMA) Model and the artificial intelligence based Extreme Gradient Augmentation Model with the data between January 27, 2010, and August 31, 2023. Then, the performances

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0	2010-04-27	591.82
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3	2010-04-30	616.39
4	2010-05-03	611.37

Table 2. First 5 Rows of Control Data for Control Purposes in XGBoost Model
Source: Borsa İstanbul, Datastore

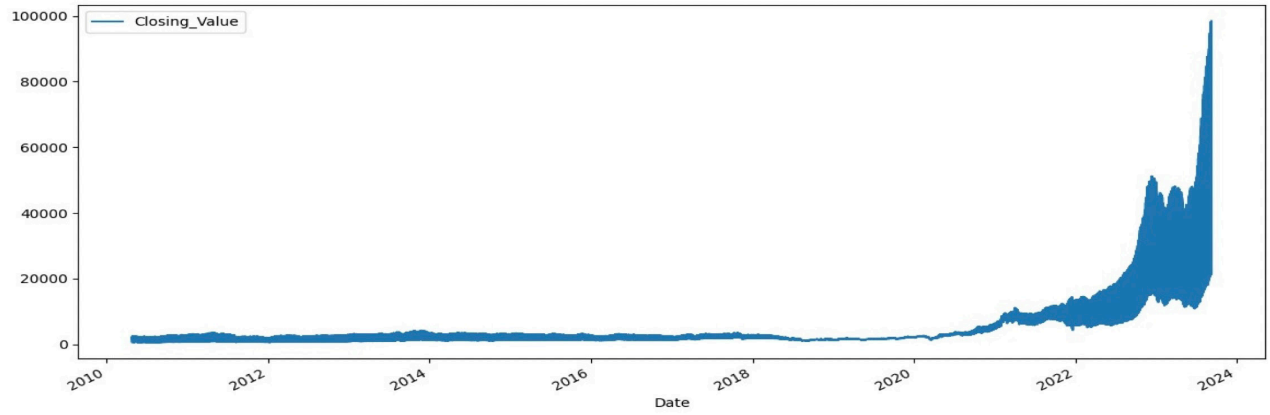

Figure 8. Matplotlib Module Output Graph of Istanbul IPO Index Data
Source: Borsa İstanbul, Datastore

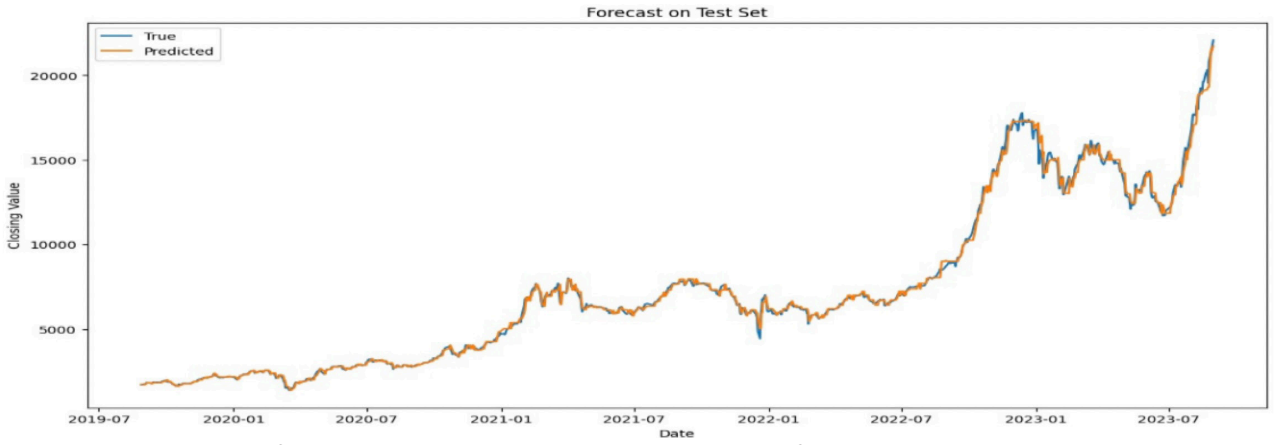

Figure 9. Comparison of 10% Test Data Generated with XGBoost Model of Borsa Istanbul IPO Index Data with Real Data
Source: Python, XGBoost Model Output

of the traditional model and the machine learning algorithm are compared and the model that gives the best forecasting performance for XHARZ is preferred. Thus, more reliable forecasts can be obtained by combining different methods. According to the results of the analysis, the MAPE value of the ARIMA (1, 0, 2) Model, which is a traditional model, is approximately 38.30%. The MAPE value of the XGBoost Model, one of the artificial intelligences based deep learning methods, is approximately 12.52%. The results of the analysis show that the XGBoost neural network method explains the performance of the Borsa Istanbul IPO Index better. Therefore, the results of the study support other studies in the literature and show that artificial intelligence based deep learning methods provide more accurate results in financial time series.

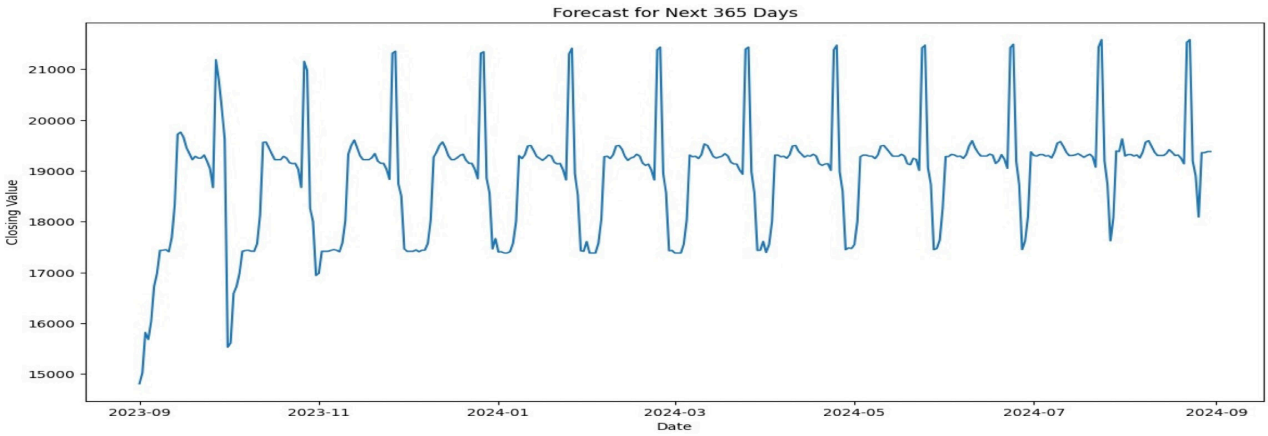

Figure 10. 1 Year Forecast Graph of Borsa Istanbul IPO Index Data Obtained by Training XGBoost Model
Source: Python, XGBoost Model Output

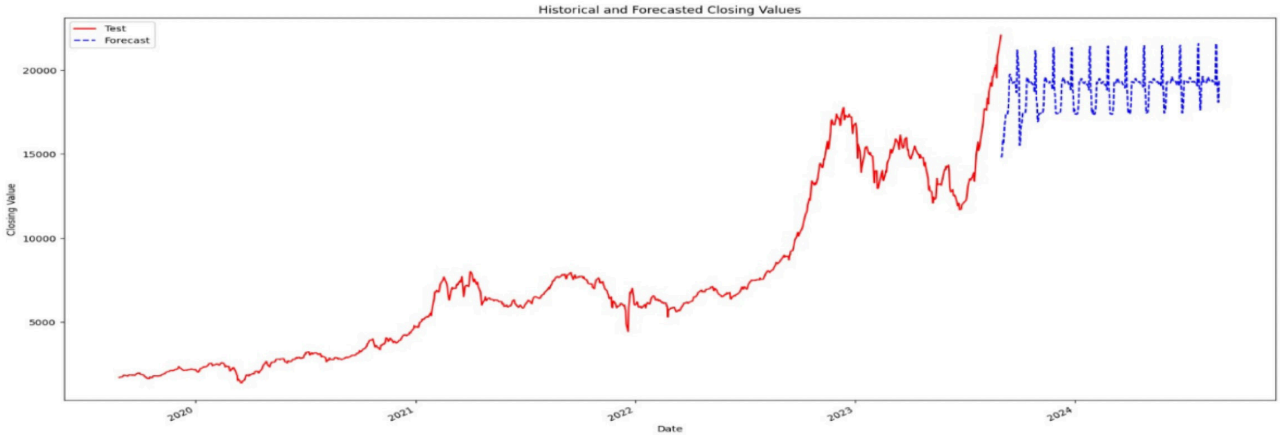

Figure 11. 1 Year Forecast Graph of Borsa Istanbul IPO Index Data Obtained by Training 10% Test Data with XGBoost Model
Source: Python, XGBoost Model Output

CONCLUSION

IPOs are an important source of financing for financial markets and can help businesses grow, diversify investors, raise investor awareness, increase employment, and stimulate economic growth. However, the regulation and management of IPO processes is also a very important issue, as negative results of IPOs can potentially cause great damage to both capital markets and the national economy. For this reason, it is important to monitor the Borsa Istanbul IPO Index values and closely monitor them by making the necessary analyses.

In this study, the forecasting of the Borsa Istanbul IPO Index with the data of the preferred period was made with the ARIMA time series model and XGBoost neural network methods, and models were developed to predict the future value of the XHARZ index. The accuracy of the models was tested by MAPE performance evaluation method and the predicted models were compared. The estimated ARIMA (1, 0, 2) model shows lower performance than the XGBoost neural network model. The results confirm that deep learning methods provide more accurate outputs in financial time series. In addition, the results show that the XHARZ Index will continue its horizontal course with a slight depreciation and fluctuations within a year.

When the analysis is evaluated in general, it is determined that the XGBoost Model, which is one of the artificial intelligences based deep learning methods among the prediction models created with the data of the Borsa Istanbul IPO Index in the preferred period, performs better than the other methods and the method explains the XHARZ index better.

Machine learning models, which are frequently used in financial markets, have developed even more with the technological developments in recent years. Since deep learning algorithms can be trained, it is supported by studies in the literature that time series models built using these algorithms perform better. The results of the study also confirm that the neural network models tested give better results than traditional models.

Therefore, the use of machine learning methods in financial time series analysis can help to create better forecasting models by examining complex relationships in more detail, processing big data more easily and faster, and to analyze data better, as there may be many factors affecting financial markets. Thus, the IPO data in the capital markets analyzed in the study will be interpreted more accurately and IPOs can be closely monitored, the performance of financial markets will be evaluated more accurately with deep learning algorithms, and the stability of the markets will be monitored and better protected.

REFERENCES

Avcı, S.B., Akdoğu, E., Şimşir, Ş.A. (2020). Borsa İstanbul ilk halka arz piyasa dinamikleri ve düşük fiyatlama. *Center of Excellence in Finance Araştırma Raporu*. Sabancı Üniversitesi. 1-24

Aygören, H., Sarıtaş, H. ve Morallı T. (2012). İMKB 100 Endeksinin Yapay Sinir Ağları ve Newton Nümerik Arama Modelleri ile tahmini. *Uluslararası Alanya İşletme Fakültesi Dergisi*, 4 (1), 73-88

Babu, A.S., Reddy, S.K. (2015). Exchange rate forecasting using ARIMA. Neural Network and Fuzzy Neuron, *Journal of Stock Forex Trading*,4, 155

Bonaccorso, G., (2017). Machine Learning algorithms. Birmingham: Packt Publishing

Box, G. E. P., Jenkins, G. M., Ljung, G. M. (2016). *Time series analysis: Forecasting and control*. 5th Edition, NJ: John Wiley and Sons

Box, G, E, P., Jenkins, G, M. (1970). *Time series analysis forecasting and control*. San Francisco: Holden Day Inc

Borsa İstanbul, Veriler, Geçmişe dönük veri satışı. Borsa İstanbul Tarihsel ve Referans Veri Platformu. Erişim: 01.09.2023. https://datastore.borsaistanbul.com/

Borsa İstanbul, Endeksler, Halka arz endeksi. Erişim: 09.09.2023. https://borsaistanbul.com/tr/sayfa/166/bist-halka-arz-endeksi

Breiman L., (2001). Random forests. *Machine Learning*, 45(1):5-32

Brooks, C., (2014). *Introductory econometrics for finance*. 3rd Edition, NY: Cambridge University Press

Chen, Z., Li, C., Sun, W. (2020). Bitcoin price prediction using Machine Learning: An approach to sample dimension engineering. *Journal of Computational and Applied Mathematics*, 365, 112395

Chen, T., Guestrin, C. (2016). XGBoost: A Scalable Tree Boosting System, In Proceedings of The 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining

Clarke B, Fokoue E, Zhang H. (2009). *Tree-based classifiers. Principles and Theory for Data Mining and Machine Learning*. 1st Edition, London NY: Springer Dordrecht Heidelberg, p.262.

Desai, V. S., Bharati, R. (1998). A comparison of Linear Regression and Neural Network Methods for predicting excess returns on large stocks. *Annals of Operations Research*, 78(0), 127-163

Emekli, G. (1995). Yararlanma bakımından Türkiye topraklarının bölünüşü ve zamanla gösterdiği değişmeler. *Ege Coğrafya Dergisi*, 8, 225-236

Fischer, T., Krauss, C. (2018). Deep Learning with Long Short-term Memory Networks for financial market predictions. *European Journal of Operational Research*, Vol. 270, 654-669

Fu, X., Du, J., Guo, Y., Liu, M., Dong, T., Duan, X. (2018). A Machine Learning framework for stock selection. Online: https://doi.org/10.48550/arXiv.1806.01743

Gündüz, H., Çataltepe, Z., Yaslan, Y. (2017). Derin Sinir Ağları ile borsa yönü tahmini. 25th Signal Processing and Communications Applications Conference (SIU)

Hanias, M., Thalassinos, E. L., Curtis, P. (2012). Time series prediction with Neural Networks for the Athens Stock Exchange indicator. *European Research Studies Journal*, 15(2), 23- 31

Ibbotson, R. G., Ritter, J. R. (1995). *Handbooks in OR & MS*. Chapter 30, Initial Public Offerings

Investopedia, Initial public offering (IPO): What it is and how it Works. Erişim: 01.09.2023. https://www.investopedia.com/terms/i/ipo.asp

Kamuyu Aydınlatma Platformu, Endeksler, BIST Halka Arz. Erişim: 10.09.2023. https://www.kap.org.tr/tr/Endeksler

Kilimci, Z. H. (2020). Borsa tahmini için Derin Topluluk Modelleri (DTM) ile finansal duygu analizi. *Gazi Üniversitesi Mühendislik Mimarlık Fakülte Dergisi*. 35(2), 635- 650

Krauss, C., Do, X. A., Huck, N. (2017). Deep Neural Networks, Gradient-boosted Trees, Random Forests: Statistical arbitrage on the S&P 500. *European Journal of Operational Research*, 259(2), 689-702

Kurtaran Ç.M. (2016). Firmaların ilk halka arz sonrası faaliyet performanslarının değerlendirilmesi: Borsa İstanbul örneği. *Uluslararası Yönetim İktisat ve İşletme Dergisi*, 12 (27), 267-282.

Kutlu, B., Badur, B. (2009). Yapay sinir ağları ile borsa endeksi tahmini. *Yönetim*, Yıl:20,63, 25-4

Loughran, T, Ritter, J. R., Rydqvist K. (1994), Initial public offerings: International insights, *Pacific-Basin Finance Journal*, Vol.2, Issues 2–3,165-199

Maciel, L., Ballini, R. (2010). Neural Networks applied to stock market forecasting: An empirical analysis. *Journal of the Brazilian Neural Network Society*, 8(1), 3-22.

Mitchell, R.; Frank, E. (2017). Accelerating the XGBoost Algorithm Using GPU Computing, *PeerJ Computer Science*, Vol.3, 127-164

Olah, C., (2015). Understanding LSTM networks. Colah's blog, Online: https://colah.github.io/posts/2015-08-Understanding-LSTMs/

Oncharen, P., Vateekul, P. (2018). Deep Learning for stock market prediction using event embedding and technical indicators. 5th International Conference on Advanced Informatics: Concept Theory and Applications (ICAICTA), 19-24

Özdemir, Ö. (2008). Zaman serisi modellemesinde yapay sinir ağlarının kullanımı ve bir uygulama. Anadolu Üniversitesi, Fen Bilimleri Enstitüsü, İstatistik Anabilim Dalı, Yüksek Lisans Tezi, https://earsiv.anadolu.edu.tr/xmlui/bitstream/handle/11421/5537/547648.pdf?sequence=1

Pabuçcu, H. (2019), Borsa endeksi hareketlerinin tahmini: Trend belirleyici veri. *Selçuk Üniversitesi Sosyal Bilimler Yüksekokulu Dergisi*, 22 (1), 246-256

Pešterac, A. (2020). The importance of initial public offering for capital market development in developing countries. *Economic Themes*, 58(1), 97-115

Ritter, J.R. (1991). The long-run performance of initial public offerings. *The Journal of Finance*, 46, 3-27

Ruiz Gazen, A, Villa N. (2007). Storms prediction: Logistic regression vs. random forest for unbalanced data. Case Studies in Business, Industry, and Government. Statistics (CSBIGS), 1(2):91-101

Sermaye Piyasası Kurulu, (2022). Yatırımcı bilgilendirme kitapçıkları, Halka arz https://spk.gov.tr/data/61e34f9a1b41c61270320792/10-Halka%20Arz.pdf.

Siami Namini, S., Namin, A. S. (2018). Forecasting economics and financial time series: ARIMA vs. LSTM. Texas Tech University, Department of Agricultural and Applied Economics, https://arxiv.org/ftp/arxiv/papers/1803/1803.06386.pdf

Smith, J., Johnson, J., (2020). Ortalama Mutlak Yüzde Hata (MAPE) yöntemi ile tahmin değerlendirmesi. *Veri Analizi ve Tahminde İleri Yöntemler Dergisi*, 25(3), 345-36

Telli, Ş. Coşkun, M. (2016). Forecasting the BIST 100 Index using Artificial Neural Networks with consideration of the economic calendar. *International Review of Economics And Management*, 4 (3), 26-46

Thawornwong, S., Enke, D., Dagli, C. (2003). Neural Networks as a decision maker for stock trading: A technical analysis approach. *International Journal of Smart Engineering System Design*, 5(4), 313-325

Tkac, M., Verner, R. (2016). Artificial Neural Networks in business: Two decades of research, *Applied Soft Computing*, 38, 788-804

Tsay, R.S. (2010). *Analysis of financial time series*, 3rd Edition, NY: John Wiley and Sons

Türkiye Cumhuriyet Merkez Bankası, İstatistikler, Gösterge niteliğindekiMerkezBankasıkurları.Erişim:01.09.2023. https://www.tcmb.gov.tr/wps/wcm/connect/tr/tcmb+tr/main+menu/istatistikler/doviz+kurlari/gosterge+niteligindeki+merkez+bankasi+kurlarii

Wang, J., Wang, J. (2015). Forecasting stock market indexes using principle component analysis and stochastic time effective. *Neural Networks. Neurocomputing*, 156, 68–78

Weibo, L., Zidong, W., Xiaohui, L., Nianyin, Z., Yurong, L., Fuad, A. (2016). A survey of Deep Neural Network Architectures and their applications, *Neurocomputing*, 234

Velankar, S., Valecha, S., Maji, S. (2018). Bitcoin price prediction using Machine Learning, 20th International Conference on Advanced Communication Technology (ICACT), IEEE, 144-147

Veri Analiz Platformu, Yatırımcı istatistikleri, Portföy dilimi bazında yatırımcı sayıları. Erişim: 09.09.2023. https://www.vap.org.tr/portfoy-dilimi-bazinda-yatirimci-sayilari.

Vergipedia, (2020). Türk şirketlerinin halka arz performansı yeterli mi. Erişim: 09.09.2023. https://vergipedia.com/makale/turk-sirketlerinin-halka-arz-performansi-yeterli-mi/

Yıldırım, D., Dursun A. (2016). Borsa İstanbul'daki İlk Halka Arzlarda İlk Gün Düşük Fiyat Anomalisi. *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi*, 30(1), 189-202

Yunpeng, L., Di, H., Junpeng, B., Yong, Q. (2017). Multi-step ahead time series forecasting for different data patterns based on LSTM Recurrent Neural Network, 14th Web Information Systems and Applications Conference (WISA), IEEE; 05-310