BIST Kurumsal Yönetim Endeksinin Facebook Prophet Analizi Yöntemi ile Fiyat Tahmini

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Öz

Kurumsal Yönetim Endeksi (XKURY) ve kriterlerinin etkinliğinin test edilmesi amaçlanan çalışmada, yeni bir analiz metodu olan Facebook Prophet Analizi (FPA) kullanılmış ve 01.03.2019-30.11.2021 arasındaki günlük değerler kullanılarak endeksin 2022 tahminleri gerçekleştirilmiştir. Sonuçlar endeksin 2022'in ilk çeyreğinde yükseliş, ardından ise düşüş trendine girerek yılbaşındaki değerinin altına ilerleyeceğini göstermektedir. 2022 yılını bir önceki yıla benzer bir trend modeli ile artışla kapatacağı gözlemlenmektedir. Kullanılan FPA metodunun tutarlığı Mean Absolute Percent Error (MAPE) metodu ile ölçülmüş ve sonuçların tutarlı olduğunu göstermiştir. Tutarlılık konusunda yapılan diğer analizde ise XKURY Endeksi ile yüksek bir korelasyona sahip BIST 30 Endeksi kullanılmış, elde edilen sonuçlar FPA sonuçlarının tutarlılığını teyit etmiştir.

Anahtar Kelimeler: Kurumsal Yönetim, Facebook Prophet Analizi, Fiyat Tahmini.

JEL Sınıflandırması: G1, G17.

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BIST Corporate Governance Index Price Prediction with a Facebook Prophet Analysis Method

Abstract

In this study, which aims to test the effectiveness of Corporate Governance Index (XKURY), and its criteria, Facebook Prophet Analysis (FPA), was used and the index's predictions for 2022 were made using the daily values between 01.03.2019 and 30.11.2021. The results show that the index will have an upward trend in the first quarter of 2022, and then enter a downward trend and move below its value at the beginning of the year. It will close the year 2022 with a trend pattern similar to the previous year with an increase. The consistency of the FPA method used was measured by the Mean Absolute Percent Error (MAPE) method and confirmed the results. In another analysis on consistency, the BIST 30 Index, which has a high correlation with the XKURY Index, was used, and the results confirmed the FPA results were consistent.

Keywords: Corporate Governance, Facebook Prophet Analysis, Price Forecasting.

JEL Codes: G1, G17.

1. Introduction

In today's globalized economy, where information technologies continue at full speed, management practices are required to be responsible, accountable and transparent. Corporate governance practices have gained importance especially after the corporate governance scandals that emerged in the 2000s. Another reason behind business scandals is the view that management is not effective. For this reason, the necessity of good corporate governance has been revealed. This issue has gained great importance in the international arena, and the quality of corporate governance has become as important as the quality of auditing in investment decisions. In order to prevent all these accounting scandals, both states and business managers have started to include some practices. While the states have implemented legal regulations to increase the quality of auditing, businesses have also tried to implement corporate governance practices (Baş and Uygun, 2020). While companies are trying to develop corporate governance practices to achieve a transparent and accountable structure, researchers are also investigating the relationship of these practices with companies' stocks and financial performance.

The presence of more than one investment instrument in financial markets affects investors at the point of decision-making. There are two basic criteria that the investor should consider in the investment decision to be made regarding the investment to be made in any financial instrument. The first of these is the risk of the investment, and the other is the expected return of the investment. Savers invest in financial markets in order to utilize their savings and earn returns. While investors sometimes tend to prefer financial instruments with a high probability of changes in their values, sometimes they tend to prefer financial assets that they think will not experience a high change in value. Considering the current preference options of the investors; Return and risk factors are two critical investment components that affect the decision processes in transferring savings to investments. Investors give importance to the risk and expected return of the portfolio they will create while making an investment decision (Somuncu and Böyükaslan, 2021).

In today's world, where technological developments continue at full speed, access to information resources has become extremely easy. With the developing technology, investors have started to direct their investments by making use of computer software. However, these software could not go beyond some computer applications. These software do not take into account investor opinions. This situation brings the same expected return at the same risk level for all investors with a common investment cluster (Çalışkan, 2010).

While financial market movements were explained with traditional methods in the past, today market movements are explained with behavioral finance, which includes more than one new decision-making process. It was created on the basis of distinguishing the effect of psychological, interactive and cognitive aspects of human performance in decision-making progressions and has been the subject of an extensive range of research. Within this perspective, a theoretic scientific framework has emerged, which can be summarized as behavioral economics. To put it briefly, behavioral economics is a process that intentions to incorporate psychological structures into economic and financial decision-making developments, as well as to combine prediction models that will include subjectivity proven by individuals (Ozcan, 2021).

The methods used in the evaluation of investments differ from past to present. Today, investors can make use of two types of analysis when making stock investment decisions. One of them is the fundamental analysis that covers the real values of the stocks, the political situation of the country, the performance indicators of the industry and the economy. The other is technical analysis, which is used to evaluate stocks based on market movements such as

historical values and trading volumes. The purpose of technical analysis is not the estimation of real data. Instead, it is to predict possible behavior patterns and trends in the future with the help of stock charts (Arslankaya and Toprak, 2021).

Stock price predictions are made today by methods called machine learning. Machine learning algorithms are algorithms that improve accuracy and efficiency over time. Therefore, the method enables algorithm developers to get better results and make low-error predictions for the future. Numerous studies have been showed to find the connection between dependent and independent variables using machine learning models and embody this relationship into performance metrics (Özen et al., 2021). For example, the prediction of future movements of crypto assets in the field of Finance was carried out by Facebook Prophet Analysis (FPA) (Oncu, 2021). In this context, in this study, it is aimed to forecast the future prices of the Corporate Governance Index (XKURY) in BIST with Facebook Prophet Analysis (FPA).

2. Corporate Governance

Da Silva and Leal (2005) explores the relationship between the quality of a firm's corporate governance procedures and its valuation and performance by creating a wide firm-specific corporate governance index for Brazilian listed companies. According to the empirical findings, there is a large concentration of ownership and control. Due to the existence of non-voting shares, there is also a big discrepancy between the voting and total capital owned by the largest shareholders. Panel data analysis is used to model differences in behavior between firms and over time with more flexibility. The findings show that just about 4% of Brazilian companies have "excellent" corporate governance standards, and that companies with superior corporate governance perform significantly better (return on assets). Although the results are not statistically significant, there is a positive correlation between Tobin's Q and improved corporate governance procedures.

Kiaee, and Soleimani (2019), explained that corporate administration is an assortment of decides and rules that means to manage organization issue: the detachment of the executives and money or, in a broader way, the partition of the board and possession. Great corporate administration guarantees that the administrators of a business act to assist all partners thus would builds the worth of the firm over the long haul. The OECD Principles of Corporate Governance (OECD Report, 2015) is one of the renowned wellsprings of this sort of standards which contains a few guidelines regarding administrative necessities, investors' freedoms, institutional financial backers, asset

suppliers and data exposure structure of organizations. According to the financer's perspective, the better the nature of corporate administration, the more energetic the financial backers are to utilize value financing. Directors and financial backers don't have equivalent data in the organization and this reality is called topsy-turvy data issue. Great corporate administration declines the topsy-turvy data issue, so there would be lower irreconcilable circumstance between supplier of assets (financial backer) and client of assets (director). Financial backers in the excellent corporate administration firms have less anticipated that profits due should bring down vulnerability later income, thus the expense of value in these organizations is lower comparative with poor corporate administration organizations. Nonetheless, when the organization has frail corporate administration, the potential financer likes to utilize fix return obligation financing, subsequently safeguarding himself from conceivable blunder and low productivity of the organization.

On another hand, Frezatti, (2007), clarify that, different examinations have endeavored to relate the board bookkeeping factors to execution; be that as it may, while considering execution, not all writers have involved such measures as pay, financial worth added (EVA), or income per share. It has been noticed that administration control is the method for ensuring that procedures are followed and that objectives are reached. The board control incorporates such exercises as arranging, coordination, correspondence, assessment, direction, and effect on the people in question, with the end goal of changing their conduct. In evaluating the situation with the board bookkeeping in such administration control, it is likewise seen that administration bookkeeping assumes a significant part in giving directors the monetary information they expect in regulating and controlling the business to the greatest advantage of investors. Moreover, legitimate monetary examination is expected to characterize the situation with the business and to ensure that the picked system is practical and proper.

From different perspective of Botero-Pinzón et al. (2019), the internationalization of the organization is a mind boggling and complex peculiarity. It is notable that the internationalization procedure shows itself in various kinds of exercises that go past contribution items and administrations outside public lines, influencing the whole association. Internationalization, in this manner, has cross-cutting ramifications in the organization, in those areas connected with advertising, yet in addition in tasks, the administration of human and monetary assets, and so on, in any case, most exploration in the field of global business has thought about the degree of internationalization of the organization in an extremely straightforward manner. Whenever

the works have zeroed in on little and medium endeavors, most have been utilizing trade execution, expecting that the internationalization of this sort of organization is decreased to the extent of its deals that are made to clients from business sectors outside the nation of beginning. Past, particularly on account of worldwide organizations, as far as internationalization, different perspectives connected with the methods of passage, the utilization of global coalitions, joint endeavors, direct ventures abroad, global acquisitions, number of auxiliaries abroad, and so forth, have been thought of, as well as the broadness and assortment of global business sectors to which the organization focusses its exercises.

CMB (Capital Markets Board) Corporate Governance Compliance Report "Corporate Governance Principles" was first published by Capital Markets Board in 2003 after various updates. "Corporate Governance Communiqué No. II-17.1" was issued in 2014 during the process of harmonization with the Capital Markets Law. Regarding the implementation of the Communiqué, the CMB has decided that since 2019, compliance reporting will be done via Public Disclosure Platform (KAP) using the Compliance Report Form (URF) and Corporate Governance Information Form (KYBF) templates (BIST, CMB, 2020).

Corporate Governance Compliance Report (URF) via the Corporate Governance Compliance Reporting Public Disclosure Platform (KAP) in accordance with the "Corporate Governance Communiqué" published in the Capital Markets Board (CMB) Bulletin with its Decision dated 10.01.2019 and numbered 2/49 at the beginning of 2019; and it was made using Corporate Governance Information Form (KYBF) templates. It is emphasized that companies listed on the stock exchange should prepare a separate section on corporate governance in their annual reports and/or include this report on their websites (Gündüz, 2021). The headings related to corporate governance in the report are listed as:

- Statement of compliance with corporate governance principles,
- Shareholders,
- Public disclosure and transparency,
- Stakeholders and
- The Board of Directors.

3. Literature Review

Many studies to predict future prices constitute a large literature. Different methods have been used to predict future prices in the studies. In addition to traditional models such as Artificial Neural Networks, Markov Chains, GARCH, methods that provide machine-based learning are used to predict future prices.

Ergeç (1996), one of the first studies in the field, tried to determine the future price of a stock quoted on the ISE, using Markov chains, based on the previous year's prices. With the data obtained from the analysis, the value of the stock price one day later was successfully calculated with the daily cumulative change rates.

Chen et al. (2007) clarified a Fuzzy Time Series model aimed at stock market forecasting in Taiwan. In the analysis, stock prices in the five-year period and stock index data in the 13-year period were used as input variables. The findings were compared with the studies by Chen (1996) and Yu (2005) in which the future price of the stock was predicted. According to the findings, the Fuzzy Time Series model can predict with higher accuracy than the Chen (1996) and Yu (2005) studies.

In their study, Tsai, and Wang (2009) tried to predict the future prices of stocks so that investors can make better decisions in choosing stocks. In the study, Artificial Neural Networks and Decision Trees methods were used to make the necessary predictions. Stock data of companies in the electronics industry in Taiwan were used to test the methods. According to the authors, the accuracy rate of the model applied by integrating Artificial Neural Networks and Decision Trees has been found to be higher than the accuracy rate in the models in which Artificial Neural Networks and Decision Trees are applied separately.

Yang and Panvada (2012) tried to predict future prices in the Australian Stock Exchange in their research. As input variable in the study, time, price, size, date, trade indicator, complexity and sector index corresponding to individual stock were used for each transaction. Using various sector data, the distribution of intraday stock prices was examined, and prices were estimated with the GARCH method. According to the results, the system correctly predicts the next price 71% of the time.

In the study of Ilarslan (2014), stock price movements were tried to be estimated using the Markov Chains method. In the study, the daily closing data of the stocks of 10 banks in the BIST were used. As a result, the next

day's stock price movements of all banks except the Industrial Development Bank of Turkey were successfully predicted.

Li et al. (2016) performed stock index estimation with extreme learning machines in their research. In the analysis, news published about the stock market and technical indicators were used as input values. According to the findings, it is observed that the predictions made with extreme learning machines are both faster and more accurate than predictions made with support vector machines and artificial neural networks.

Özçalıcı (2016) investigated which characteristics of stocks are predicted to be of higher quality. For this purpose, he estimated the prices of all the stocks in the BIST 50 Index with the extreme learning machine method, and it was seen that the closing price of the securities with higher risk and low return could be predicted more successfully with the extreme learning machine method.

In the study of Bagcı (2020), taking into account the values realized in the first 11 months of 2019 for the variables of Gold, Euro, Dollar, BIST 100, Government Securities and Time Deposit Accounts, which are the most preferred financial investment instruments in Turkey, Gray System Theory Separate GM(1,1) models of the variables were made with as a outcome of the investigation, it is seen that the GM(1,1) model is useful enough and makes predictions with a great accuracy rate.

The studies using the Facebook Prophet Analysis (FPA) method are mentioned below.

In the study of Sevli and Başer (2020), the future prediction of the Covid-19 epidemic data was carried out with the Facebook Prophet Analysis study. According to the authors, the trend in the number of future cases and survivors is upward.

In the study of Güleryüz and Özden (2020), the estimation of crude oil prices was carried out with Facebook Prophet Analysis. In the study, using the data between 1988 and 2020, it was estimated that crude oil prices were in a downward trend.

In the study of Usher and Dondio (2020), GBP (Sterling) movements were estimated in the changing political climate in England. ARIMA and Facebook Prophet Analysis models were used for prediction. It was concluded that ARIMA better predicts GBP movements.

Toharudin et al. (2020) tried to predict air temperatures Long Short-Term Memory (LTSM) and FPA. According to the findings, FPA predicts minimum air temperature degrees better and LTSM predicts maximum air temperature degrees better.

Garlapati et al. (2021), stock estimations were made with Facebook Prophet Analysis. According to FPA findings, there will be a slight price decrease in 2021 after the first rise.

In the Oncu (2021) study, Non-Fungible Tokens market volume information from June 23, 2017, to October 1, 2021, obtained from the nonfungible.com website, was used to estimate the Non Fungible Tokens market volume. Conferring to the outcomes, an effective prediction was made by Facebook Prophet Analysis, excluding for the current data where Non-Fungible Token prices showed an extreme increase. According to the trend analysis for 2022, it has been found that the anticipation is in the upward path.

Borneklint (2021) made a future price prediction using Bitcoin and Google stock prices between January 1, 2015 and May 4, 2021. According to the findings, the Facebook Prophet Analysis can successfully predict future prices.

Jackson et al. (2021), Reliance stock price prediction for 2021 was made using the 10-year Reliance stock price. Despite the sharp decline in the stock in 2010, FPA predicted a successful uptrend for 2021.

4. Data

BIST Corporate Governance Index, shown with the XKURY transaction code, is the index that includes companies that implement corporate governance principles. The purpose of creating this index is to measure the performance of the companies that are traded in the most competitive market of BIST, Star Market (Yıldız Pazar), and have high enactment in the institutional sustainability performance. The corporations traded in Borsa Istanbul markets should have a corporate governance compliance score of minimum 7 out of 10 besides and at least 6.5 out of 10 for each main heading. In this study, closing prices of XKURY index between 01.03.2019 and 30.11.2021 were used as an input for Facebook Prophet Analysis.

For the same period, we also tested the performance of Borsa Istanbul 30 Index, which has a transaction code of XU030. The companies in the index are selected amongst the Star Market companies by considering the trading volume and market value of the companies. The aim is to measure the performance of the XU030 index with the same method, Facebook Prophet

Analysis and compare the results for robustness. One of the reasons that we have chosen this index for control purposes is that only 14 out of 30 stocks traded in XU030 are in the XKURY Index therefore it would not cause a direct effect on the correlation. The XKURY Index consists of 57 different companies from each sector and only 14 is amongst the "best thirty". The second reason is that XU030 Index contains the best 30 companies traded in BIST, which have been amongst the companies with the highest market value, and daily average trading value, which is accepted as representing the liquidity, has a very high correlation with the XKURY. Daily closing prices of XU030 are used for the analysis with the same methodology for controlling the robustness of the methodology used.

5. Methodology

Compared to known traditional methods, FPA based on machine learning yields better prediction findings. The Fourier series is used in the FPA content, and the data are seasonally separated. Thus, due to its nature, the FPA produces consistent estimates.

Facebook Prophet Analysis (FPA) is open basis software available in Python and R for predicting time series information (Oncu, 2021). Facebook's Core Data Science team shaped FPA then shared the codes in 2017 for researchers to access. It is an algorithm that can make annual, daily, monthly forecasts for non-linear data and can perform these forecasts by considering the specified holidays. The key components of the Prophet model are growth; g (t), seasonality; s (t), holidays; h (t) and error term ε (t). The formula is expressed as Equation (1).

$$y(t) = g(t) + s(t) + h(t) + \mathrm{e}t \tag{1}$$

The development function models the overall tendency of the information. A piecewise linear or logistic growth arch is used to model non-periodic variations in time series. The novel impression incorporated into the Facebook Prophet Algorithm is that the development trend can be existing at all facts in the data or can be changed at what the algorithm calls "points of change". Seasonality is based on the Fourier series, thus creating a flexible model for the detection and analysis of seasonality in data. The Holiday functionality of the algorithm consents Facebook Prophet to regulate the forecast when a holiday or main event could modify the forecast.

The Average Absolute Percent Error (MAPE) method is used to measure the performance of the forecast model. The MAPE method is a reliable method used to measure future price prediction consistency. Sevli

and Başer (2020), Güleryüz and Özden (2020), and Usher and Dondio (2020), which are mentioned in the literature part of the study, were used to measure consistency in their studies.

The MAPE formula is shown in the equation below.

$$M = \frac{1\,0\,0}{n}\sum_{t=1}^{n}\left|\frac{A^t - F^t}{A^t}\right| \tag{2}$$

In the equation, *N* is the number of samples, A^t is the actual value of the index, and F^t is the predicted value.

The correlation between the two indices should have been very close as the common shares would have been high in number for each period. Therefore, we have decided to test the parallel movement of the two indices before we have applied the same testing for them. The correlation coefficient can take values between -1 and +1. If the correlation coefficient is 0, it indicates unrelatedness, and the positive correlation coefficient indicates the presence of a positive relationship between the variables.

$$r_{xy} = \frac{\sum (x_i - \bar{x})\,(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}} \tag{3}$$

BIST 30 and XKURY indices are similar to each other in terms of the stocks they included. The correlation results prove the similarity between them. XKURY and BIST30 indices were chosen to observe the consistency of the FPA analysis.

6. Findings

The first analysis that we have done is to test the correlation between the two indices. When the stock in the index is considered, it is observed that there are 14 out of 30 stocks in the XU030 Index are also takes place in the XKURY Index. This number is less than the half of the whole universe for the XU030. Therefore, from this analysis we cannot say that the XU030 and XKURY are fully correlated. However, the results of the correlation analysis in Table 1 below shows that there is a strong relationship between XU030 and XKURY indices. In the light of this analysis, we expect that the FPA would give parallel results for both analysis.

Table 1. Correlation Matrix of XU030 and XKURY

Variables	XKURY	XU030
XKURY	1	0.978
XU030	0.978	1

In the study, we applied FPA to XKURY and XU030 closing prices between the dates 01.03.2019 and 30.11.2021. The results are presented as forecast graphs in Figure 1 for both XKURY and XU030 prices for two years, 2022 and 2023 respectively.

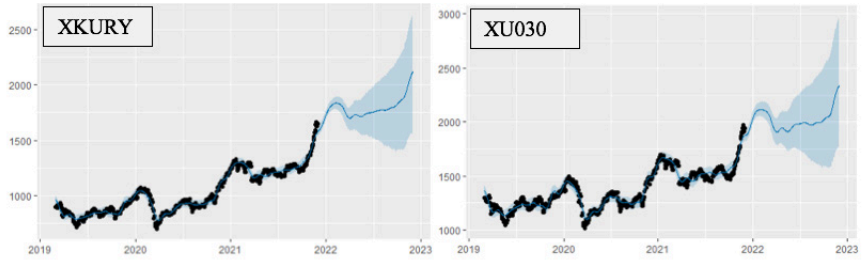

Figure 1. XKURY and XU030 Indices 2023 Forecast

In Figure 1, the blue lines show the forecasted values for the indices and the black dots show the actual price movements. The levels where the prices return as if hitting an obstacle after the rise are called resistance, while the levels where the price continues to rise by bouncing back during the decline are called support.

According to Figure 1, both indices seem to rise with the New Year but after a short while would encounter a resistance point. After hitting the resistance that seems to be in February or March, the indices would enter a short downtrend in the first quarter of 2022. After the first half of the year, index values would enter an upward trend reaching and seem to duplicate the increase in 2021. The trend seems to be smoother for the XKURY index where the XU030 Index would mimic the same trend however with a noisier trend.

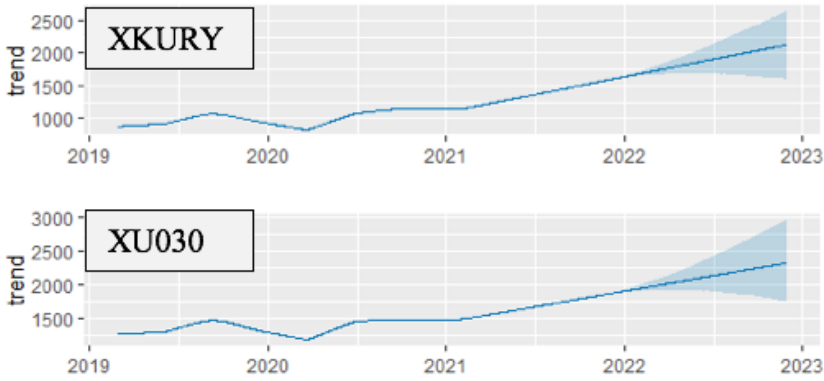

Figure 2. XKURY and XU030 2022 and 2023 Trend

The movement of the price in a certain direction for a certain period constitutes the trend. If the prices have an upward trend in general, the trend is accepted as ascending. The rising trend is found by combining the support levels. According to Figure 2, the trend expectation for 2023, which emerged because of the analysis, is in the upward direction.

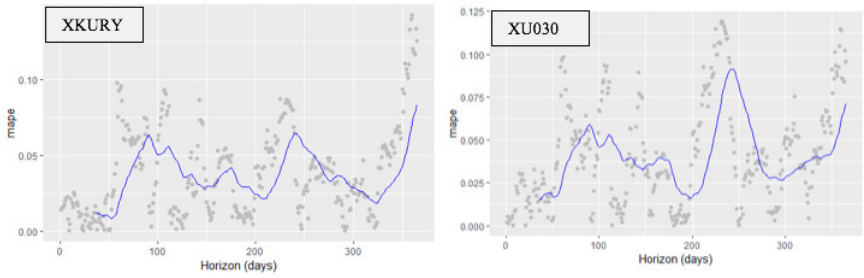

Figure 3. XKURY and BIST-30 MAPE

Figure 3 shows the Mean Absolute Percent Error (MAPE) figures, which measures the consistency of the estimate. The MAPE is the average of the absolute percentage errors of the estimates. The error value is obtained by subtracting the estimated value from the observed value. MAPE is obtained by summing the percentage errors without looking at the sign. Since absolute percentage mistakes are used, the problematic for canceling negative and positive errors is avoided. The quantitative reduction of the MAPE value increases the consistency of the analysis (Swamidass, 2000). The change in the MAPE value on a daily basis is shown in Figure 3.

When we compare the XKURY and XU030 Index analysis for MAPE it can be said that the XU030 Index have higher errors while trend (errors)

in XKURY is usually smoother. However, although the XU030 Index has different stock more than half in total it is also mimicking the pattern of the XKURY Index which indicates same performance for both indices.

7. Conclusion

Studies on stock price estimation can be divided according to their types. While there are studies that perform stock price predictions, there are studies that investigate whether there are abnormal movements. In the research, the direction of the movements of the stock can be predicted or precise predictions can be made for the stock prices.

Stocks are one of the investment tools that individual and institutional investors use to evaluate their excess funds. The primary goal of investors is to earn above market average profits. A successful stock price prediction can yield above-market returns to the investor. However, according to the effectual market theory, stock prices in the market are continuously in equilibrium. In case of additional information regarding prices, this new information is reflected on the prices as soon as possible, thus keeping the pricing balance intact. In this case, according to the theory, no investor can provide an excessive return by using the available information in the market. It is understood from the studies on stock price prediction that there is no consensus yet on the predictability of stock price based on past price movements.

Although the results obtained in this study are successful, it does not appear that stock prices are a result of previous prices. In the period of the study, excessive volatility is observed in the market due to macroeconomic conditions. There is a connection between stock price and many variables such as inflation rate, interest rate, GDP, foreign trade balance and gold prices. Future price predictions using only past price movements do not care about many external factors.

Due to its structure, FPA makes successful predictions by removing the seasonality in the data. The data period used in the study is sufficient for the future prediction and it is expected that the extension of the period will not affect the future results due to the content of the FPA analysis. However, using the historical data, the forecast graph of the previous periods can also be observed for the future studies.

Developing stock markets are affected as well as developed stock markets due to exchange rate policies. Expected future adjustments in the exchange rate change the flow of foreign capital into national shares. Due to the national policies followed and factors related to the market, it is possible

to expect that the value of the national currency will decrease. The expectation causes volatility in the stock markets. Thus, the level of investments to be made in stocks and stock prices are affected (Ayvaz, 2006).

Turkey has been living in an economic crisis that has been going on for years and cannot be avoided. The financial sector is primarily affected by these crises, which can increase in depth from time to time and manifest themselves with major devaluations (Önal et al., 2002: 31).

Corporate governance, which is a management philosophy where companies are managed and audited within the framework of certain rules, will provide advantages to companies. Companies that can use resources optimally, especially during the pandemic period, will gain an advantage over their competitors. There is a causal connection between stock prices and exchange rate (Erbaykal and Okuyan, 2007). The values of companies that reach low quotations due to the exchange rate will move towards equilibrium over time. Due to the situation in Turkey, it is expected that the companies in XKURY may be more popular than the others.

Especially nowadays, with the technological developments, new research techniques have emerged. With the emerging new algorithms, more efficient and effective research can be done. Financial market studies take an important place among the researches made using new algorithms. Due to the emergence of financial gains, research is not only academic but also important in the market. New algorithms can be used to determine the next movement of the stock market in order to obtain maximum profit from the financial markets. The Facebook Prophet Algorithm has also been made available to researchers as of 2017. In the research, it has been found that the price predictions for 2023 are in an upward trend with Facebook Prophet Analysis. According to the estimations made in the study, a decrease will be observed in the XKURY index in 2022 and then a period of increase in prices will be seen. The consistency of the analysis was measured with MAPE, and the resulting low rates indicate that the analysis in this study was consistent.

Scientists working on the field have created a project called Neptune. In the Neptune project, FPA analysis can be made not only from historical data, but also from short-term, instantaneously changing data. In future studies, it will be possible to compare short-term instant prices and estimation studies using long-term prices as data.

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