Determination of the Relations Between European Central Bank Interest Rates and EURONEXT 100 Index

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Abstract. The Euronext stock exchange contributes significantly to the expansion of the European capital market and economic growth. Euronext exchange is the largest stock exchange in Europe. The European Central Bank (ECB) monitors, in particular, the development of wages, interest rates and other indicators using economic analysis. When the literature is examined, there are many studies examining the relationship between country interest rates and the stock market. There are some studies in the literature based on the Euronext stock exchange. However, no study has been found in the literature examining the relationship between the Euronext100 index share value and ECB interest rate. The aim is to fill this gap in the literature. In this study, the interest rate decisions taken by the ECB in the period covering the period 2000:1 to 2024:3; The existence of an effect on the Euronext 100 index, which includes the most liquid stocks traded on the Euronext Stock Exchange, which was formed by the merger of more than one stock exchange in Europe and whose market value is among the leading stock exchanges in the world, was tested with cointegration analysis. As a result of the analysis, it was found that the changes in ECB interest rates did not affect the Euronext 100 index.

1. INTRODUCTION

Stock exchanges are institutions that enable the buying and selling of financial assets in markets organized by certain norms and provide all information, including the price of these assets, to the public. Stock exchanges directly affect the economic and financial structures of countries. For this reason, stock exchanges create economic added value for the countries in which they are located all over the world.

Funding resources are needed for the revival of economies and the existence of businesses and new projects. One of the important sources of funds for businesses is the public offering of shares. Another dimension of this supply is that investors acquire partnership rights from businesses that they cannot own by accumulating sufficient capital on their own, thus allowing the spread of ownership. In this context, stock exchanges where stocks are bought and sold have become the basic institutions of the financial system.

The Euronext stock exchange contributes significantly to the expansion of the European capital market and economic growth. Euronext exchange is the largest stock exchange in Europe, operating in Amsterdam, Brussels, Dublin, Lisbon, Milan, Oslo and Paris. It is a unique market that connects seven European economies (Keskin 2021b, pp. 338-339). Euronext had a return of 1,474.7 billion Euros in the 2023 period. Again, the stock market reached a market value of approximately 6.6 trillion Euros as of the end of December 2023, and there are 1,900 issuers on the stock exchange (Euronext, 2024). Corporate governance at Euronext; It is based on Dutch law, the articles of association and the procedural rules of the board of directors and supervisory board. Euronext is the fifth largest stock exchange in the world by stock market value (Keskin 2021a, p. 1528).

Euronext is one of Europe's leading index providers. More than 100 ESG indices and seven main national indices in Europe are traded, with more than 1,000 indices traded in total. Some of the highlights among these indices are; AEX, BEL 20, CAC 40, İSEQ 20, OSEBX, BENCHMARK and PSI 20. Euronext European indices are; Euronext 100, Climate Europe, Low Carbon100, Next Biotech and ESG 80. Among the indices traded on Euronext, Euronext 100 consists of companies with the highest liquidity and ranking in the main market (Keskin 2021b. p.392). The formula used to calculate the Euronext 100 index is as follows:

$(N100 = D\sum_{i=1}^{n} Pi \times Qi \times Fi).$[1]

The European Central Bank (ECB) is one of the most important banks in the world as it is responsible for the monetary policy of the 20 member countries of the Eurozone. In 1998, the ECB was established in Frankfurt, Germany, and is one of the seven major institutions that make up the European Union (EU). The ECB is one of the institutions of the EU and is governed directly by EU law. The ECB capital value amounts to approximately eleven billion Euros as of 2024 (ECB 2024). ECB executive managers manage EU countries' foreign exchange reserves, monetary targets and key interest rates. The main task of the ECB executive board is to ensure the applicability of the monetary decisions taken by the ECB governing council and to communicate with the central bank managers of the member countries.

The ECB is the only authorized body that makes it possible to print euros (EU 2024). The ECB manages the euro, ensures

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[1]N100: Euronext 100 index value.
n: Number of stocks included in the index (usually 100).
Pi: i. last trading price of the stock.
Qi: i. total number of shares of stock.
Fi: i. share ratio of the stock in free circulation.
D: index divisor.

price stability in the EU region, and directs EU economic and monetary policy. As a result of these policies, the aim is to ensure economic growth within the EU and create new employment opportunities. The ECB is also responsible for the supervision of euro area (Eurozone) credit institutions. The Eurozone is managed by Single Supervisory Mechanism in cooperation with the national competition authorities of Eurozone member countries. By keeping monetary policies separate from supervision and surveillance activities, the features of trust, transparency and accountability in the banking system in the EU have been preserved (ECB 2024).

Within these scopes; The ECB regulates the money supply in circulation while monitoring the banks of member countries (Piekenbrock 2011, p.183). The Bank also oversees price stability and economic aid in member countries. The ECB's directives are carried out by the relevant national central banks. Thus, the bank is independent of national governments or policies. To control inflation, the ECB monitors, in particular, the development of wages, interest rates and other indicators using economic analysis. Thus, the bank publishes a reference value for the development of the money supply and the amount of money in circulation. These procedures provide sufficient flexibility for the ECB to react to fluctuating market requirements. With expansionary monetary policy, the ECB can lower interest rates and allow banks to lend at greater rates. This ultimately translates into more investment and consumption, and the bank can again contribute to the financing of economic institutions to increase economic vitality.

On the other hand, as the economy revives, the ECB may act restrictively by lending less and increasing interest rates, thus it is planned to ensure that banks apply for fewer loans. This can be described as a procedure that aims to achieve a certain target value through indirect influence. At this point, there is indirect control over the management of the money supply (Kriener, 2002, pp.23-36).

The data of the study covers a twenty-four-year period from the time Euronext began trading to the present day. During this period, the Euronext 100 index, which includes the largest and most liquid stocks traded on Euronext, was used. While the study data was provided from the Euronext official website, the ECB's interest-related decisions for the period including 2000: 1 and 2024: 3 were also provided from the ECB's official website.

2. LITERATURE REVIEW

Studies on comparative analysis of central banks' monetary policies and stock prices, and on predicting stock returns in the future with money supply data have become among the popular topics of the 20th century. Some examples of these studies are as follows: Brunner (1961). Sprinkel (1964), Homa and Jaffee (1971), Hamburger and Kochin (1972), Dornbush and Fischer, (1980), Aggarwal (1981), Frankel, (1983), Bernanke and Blinder (1992), Krueger and Kuttner (1996).), Thorbecke (1997) and Conover et al (1999).

The common feature of these studies is that changes in central banks' monetary policy delay stock returns. Most of these studies show that Vector Autoregression analysis is used.

Statistical tests have diversified in studies conducted in the 21st century on the comparative evaluation of monetary policies and stock prices. Among the economic analysis methods; are Panel, ARDL, Johannes cointegration and Granger causality analysis etc. Many mathematical models have been used. Some of the 21st-century studies are as follows: Hatemi and Irandoust (2002), Bernanke and Kuttner (2004), Hayford and Malliaris (2008), Grauwe (2008), Ehrmann and Fratzcher (2009), Lee and Chang (2011), Zare et al. (2013), Tachibana (2018), Delgado et al. (2018), Mroua & Trabelsi (2020), Bhutto et al. (2020), Quan (2022) and Caporale et al. (2024).

When the literature is examined, there are many studies examining the relationship between country interest rates and the stock market. Some of these studies; In their study, Nasseh and Strauss (2000) compared stock prices with variables including interest rates in England, Switzerland, the Netherlands, Italy, France and Germany, covering approximately thirty-three years, and found a relationship between them. Maghayereh (2003) tested the Jordanian market in his study and identified the interest rate among the factors affecting stock returns in his nearly thirteen-year review.

In their study, Alam and Guddin (2009) tested the sensitivity of stock markets of selected countries in Australia, Asia, South America, Europe and South Africa to interest rates between January 1988 and March 2003, using time series and panel regression. Although they generally found a weak relationship between the stock market and interest rates, they reached different conclusions when evaluated on a country basis. Again in the same study; For Malaysia, the relationship between interest rate and share price could not be determined. While there is a positive relationship between Japanese interest rates and share prices; A negative relationship has been found between stock prices and interest rates in Bangladesh, Colombia, Italy and South Africa. In addition, the study found that the relationship between stock prices and interest rates was significantly negative in Australia, Canada, Chile, Germany, Jamaica, Mexico, Venezuela and Spain.

In this study, Kim (2009) examined the capital market returns and market effects of information about the target interest rate news of the US FED and the European Central Bank between 1999 and 2006, using the GARCH family of models on twelve stock exchanges in the Asia Pacific. While the study found a consistent relationship between the spread of interest rate news and returns, unexpected interest rate increases caused negative returns in the markets.

Cordemans and de Sola Perea (2011) emphasized the effects of the changes in ECB interest rates on monetary policies, including risk premiums, and the securities market, in line with the efforts to alleviate the consequences of the crisis that started in 2007 and whose effects were felt in the Eurozone for a long time.

Köylü and Yücel (2019) examined the impact of the Federal Reserve System (FED) interest rate decisions on the Borsa Istanbul BIST 100 index in the 1988-2018 period and determined the effect of the change in FED interest rates on the BIST 100 index. In the studies of Keskin & Yücel (2023), the effect of the interest rate decisions implemented by the Central Bank of the Republic of Turkey between 2010 and 2022 on the BIST100 index traded in Borsa Istanbul was examined with correlation analysis and linear regression model. They determined a statistically significant and strong relationship at the 95 % level between the interest rate decisions of the Central Bank of the Republic of Turkey and the BIST 100 index value movements.

There are studies in the literature based on the Euronext stock exchange. Some of these studies are as follows: Benito et al. (2007) in their study, explained the development of the daily Euro overnight interest rate in the 1999-2003 period by using the ARCH-Poisson-Gaussian process component model with autoregressive conditional specification (ARJI).

Nielsson (2009) empirically investigated the effects of the Euronext stock exchange merger on the listed countries. It also examined how stock market consolidation affected stock liquidity and how the impact varied by company, and emphasized the increase in Euronext's market share with the merger. Again, Kothari, (2008) examined the NYSE-Euronext merger, while Khan and Vieito (2012) in their study; They examined the impact of stock market mergers on information market efficiency. They focused

on the merger of the Portuguese Stock Exchange under the name Euronext Lisbon in 2002. Using the serial correlation test (ACF test) in the study, they concluded that the Portuguese Stock Market was inefficient in the pre-merger period. Brown (2013) is among the researchers who study the combinations of Euronext exchanges.

Horta, Mendes and Vieira (2010) commented that news about the FED's monetary policy and the global financial crisis from January 2005 to April 2008 had a contagion effect on industrial and financial indices in European stock exchanges in the NYSE Euronext group. Creel et al. (2016) in their article, they examined EBC monetary policies and bond issuances in the 2007-2014 period using the VAR method and concluded that the change in interest rates was effective. In their study, Rosa and Verga (2018) examined the effect of the ECB on the price process in the Euribor futures market. They concluded that news about the ECB's monetary policy systematically had significant effects on Euribor futures prices in the 1999-2001 period.

Barros et al. (2020) examined whether company stock values in Euronext stock exchanges between 2000 and 2017 were related to the decision to pay dividends, the decision to pay regular dividends and the amount of dividends, using fuzzy set qualitative comparative analysis (fsQCA). Barros et al. have found that dividend policy has significant effects on stocks and that the size of the company is the most important indicator of the dynamics of dividend policy.

Espinosa et al. (2020) analyzed the Euronext stock exchange using the correlation model in their study. They emphasized that the interdependence between the Euronext stock exchange and the markets is increasing. Keskin (2021b.) used correlation analysis in the study to observe the impact of FED interest rate decisions on Euronext 100 in the 2000-2020 period and found that FED interest rate change rates remained largely constant (59.8%) and remained narrow-band (mostly It was thought that its impact on the Euronext 100 was quite limited due to the fact that it was stuck with a 100 basis point reduction and a maximum 50 basis point increase).

Chantakis (2021) examined the policies regarding EBC interest rate levels in the 2009-2021 periods and their impact on the German DAX 30, French CAC 40 and British FTSE 100 indices using GARCH analysis. It was concluded that the covariance between stock and interest rates is affected by the application of negative interest rates.

No study has been found in the literature examining the relationship between the Euronext100 index share value and the ECB interest rate. Therefore, this study differs from other studies in the literature.

3. METHODOLOGY AND DATA

Cointegration analysis was used in the study to observe the impact of ECB interest rate decisions on Euronext 100. In the cointegration analysis developed by Johansen and Juselius (1990), the existence of a long-term relationship between non-stationary time series is examined.

The data used in the study was created by combining ECB interest rate decisions and Euronext 100 data for the period 2000:1-2024:3. The data was provided by compiling the information on the ECB and Euronext official websites.

By using cointegration analysis, the study examines whether ECB interest rate decisions have any impact on the Euronext stock exchange; If there is, its direction has been investigated. The feature that distinguishes this study from the literature is that the aim is to determine the impact, direction and duration of ECB interest rate decisions on stock values in the Euronext stock exchange, which is developed and has a large trading volume. The limitation of the study is that Euronext stock market data covers a twenty-four-year period. Interest ECB decisions during the period 02 January 2000 - 20 March 2024; It remains within the range of a maximum increase of 50 basis points and a reduction of a maximum of 75 basis points. Key ECB interest rates are shown in Figure 1.
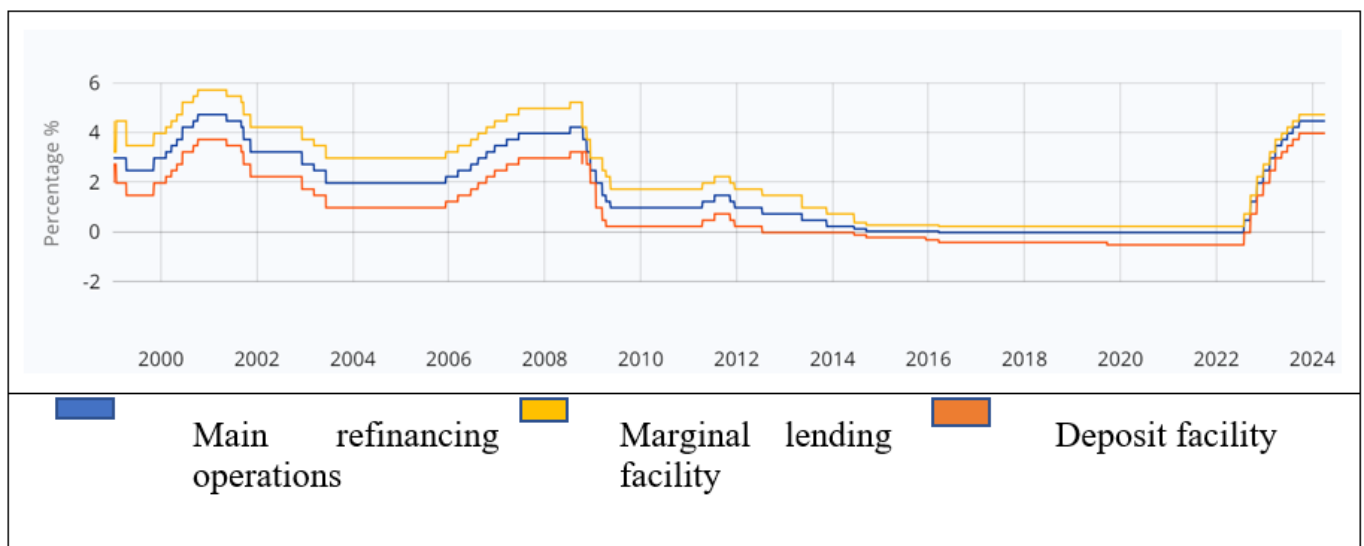

Figure 1: ECB Interest Rates Historical Trend.
Source: ECB, 2024b.

Figure 1 shows that interest rates sharply dropped in 2009. Between 2009 and 2011 maintained the same level, it increased a little during 2012 and after that again decreased. Between 2016 and 2022 remained at the minimum level. From the second part of the year 2022, it became increasing. But still, the level is under the level of 2001 and 2008.

In this study, a cointegration relationship was sought using EBC interest rate decisions and Euronex 100 index data between 2000-2024. In the study, no cointegration vectors were found, and a model was created using the generalized least squares estimation method. Since it was determined that both variables became stationary at their first difference, only the constant term was added to the model and first-order autoregressive moving average (AR [1])[2] was used.

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[2] ARMA model includes the time series forecasting method called Box-Jenkins models, named after George Box and Gwilym Jenkins, and is

ARMA model is used to understand the values of the series in future periods and to predict the error. The autoregressive part (AR) and [1] show the degree of the autoregressive part. In the model defined as AR[1], it was concluded that ECB interest rates did not have a significant effect on Euronext 100 performance throughout the period included in the analysis. Euronext 100 Index share price data for the period 2000-2024 are given in Figure 2.
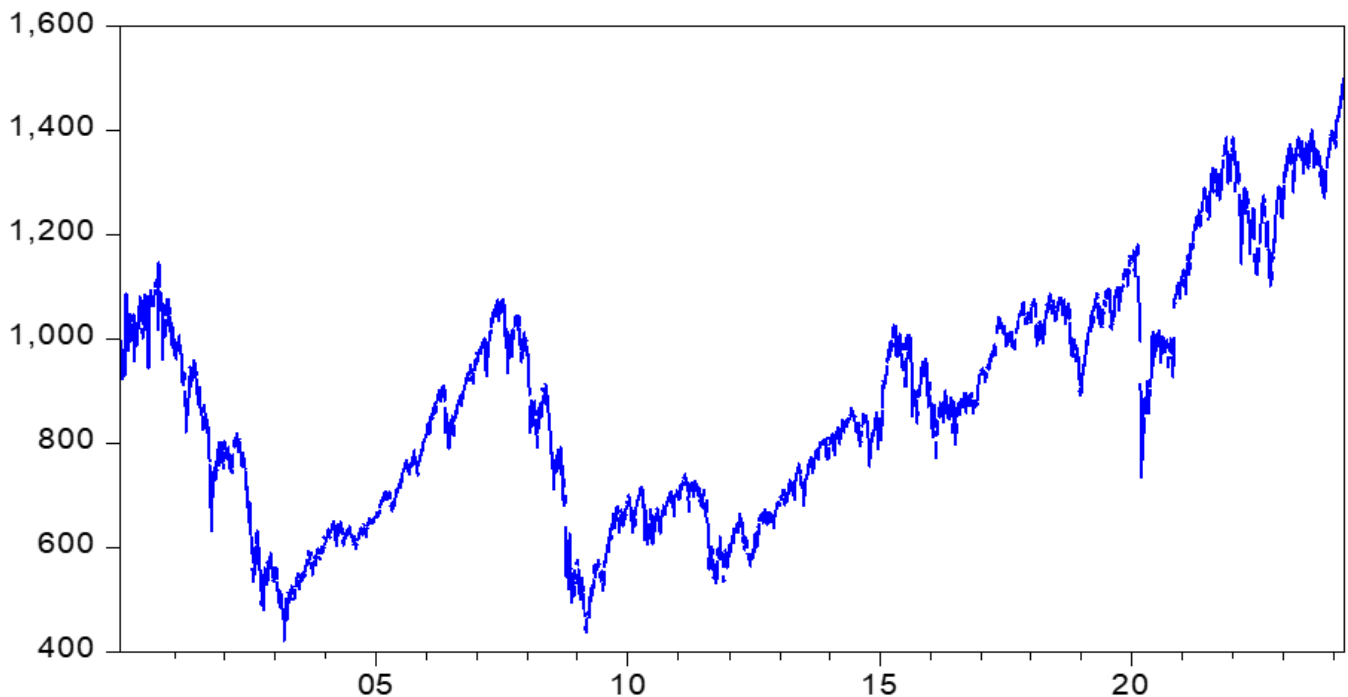

Figure 2: Euronext 100 Historical Share Prices.

Figure 2 shows that Euronext 100 index follows a wavy course. It dropped to a minimum level in 2003 and 2009. After the 2009 crisis, it began increasing. Although there was a decrease in 2020, it recovered quickly and the upward trend continued.

4. EMPIRICAL FINDINGS

Study data were obtained from Euronext and ECB websites. Table 1 shows the descriptive statistics of the series included in the model.

Table 1: Descriptive Statistics of the Series.

Series	Abbreviation	Log	Min.	Maks.	Average	SS	J-B(p)
ECB Interest Rate[1]	Interest	LNINTEREST	0.000	4.750	2.539	1.484	3.628(0.163)[a]
Euronext[2]	Price	LNPRICE	459.08	1367.78	906.34	258.891	1.956(0.376)[a]

Source: [1]: ECB: Key ECB interest rate, [2]: Euronext100 daily close   J-B: Jarque-Bera [a]: After logarithmic transformation.

Logarithmically Extended Dickey-Fuller (ADF) unit root test was used to determine the stationarity of the transformed series. Table 2 shows the unit root test results.

Table 2: Unit Root Statistics for Series.

Series	Model	Unfixed	Fixed	Fixed + Trendy
LNINTEREST	At the level	-1.421	-1.587	-1.101
	1st difference	-3.994**	-3.977**	-4.126**
LNPRICE	At the level	0.331	-1.571	-1.796
	1st difference	-5.087**	-5.043**	-5.146**

Note: *: Significant at 5% level **: Significant at 1% level (-1): First delay.

According to the ADF unit root test results applied for models without a constant term, with a constant term, and with a constant term and trend, it was determined that both series were not stationary at the level, and both series were stationary when the first differences of the series were taken. In other words, it has been determined that both series are integrated of first order. By estimating the vector error correction model (VECM) before cointegration, trace and trace tests were carried out to determine the cointegration vector numbers for all Johansen (1992) models with the smallest AIC and SIC values, without constant term, without constant term trend and with constant term trend.

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applied at equal time series intervals.

Table 3: Trace and Max-Eigen Test Results.

	Trace	Max-Eigen	AIC Integration Sequence	SC Entegresyon Sequence
No constant term, no trend	0	0		
Constant term, no trend	0	0		
Constant term, trendless, linea	0	0	0	0
Constant term, trending, linear	0	0		
Constant term, trend, quadratic	0	0		

According to the findings in Table 3, no cointegration vector was found in any of the models without constant term, without constant term trend and with constant term trend. Considering that both series are stationary when their unlagged first differences are taken, the effect of ECB interest rates on Euronext 100 performance was examined by the least squares estimation method.

Table 4: Regression Analysis Results With Least Squares Estimation Method.

The dependent variable: D(PRICE)	B	SH	t	p
D(LNINTEREST)	0.100	0.039	2.547	0.014
C	0.003	0.016	0.195	0.845
R^2=0.058 ΔR^2=0.039 $F_{(1;\,49)}$=3.000 p=0.090 Durbin-Watson=1.489				
Breusch-Godfrey LM Test F= 3.702 (p=0.060) Harvey Heteroscedasticity Test F=3.160 (p=0.061)				

According to the regression findings in Table 4, it was determined that the model showing the relationship between ECB interest rates and Euronext 100 was appropriate (F=3.70; p<0.10), although not at the 0.05 level. When the regression coefficient was examined, it was determined that the ECB interest rate had a positive and significant effect on Euronext 100 closing prices (t=2.55; p<0.05). According to the Harvey Heteroscedasticity Test, it was determined that there was no heteroscedasticity problem in the model, and according to the Breush-Godfrey LM test results, there was no autocorrelation problem in the model. However, since the test statistics were found to be very close to the p = 0.05 significance level, heteroscedasticity and autocorrelation problems cannot be rejected at the p = 0.10 level. Durbin-Watson test statistics indicate the autocorrelation problem. The F test result showing model fit, autocorrelation and heteroscedasticity problems may mean that the model is incorrectly specified (that is, wrong in a sense) or that some key variables are missing from the model. A specification error of the functional form can also cause such serial correlation. Autocorrelation in the model causes the least squares estimation method to not be a minimum variance estimator. It also causes the estimated variances of the regression coefficients to be biased, leading to unreliable hypothesis tests. This type of serial correlation occurs when error in one period is correlated with errors in other periods.

The generalized least squares (GLS) estimation method is a more flexible and general method for linear regression. GLS does not assume that the regression model's error terms are uniformly distributed or have a constant variance, but instead allows for heteroskedasticity (unequal variance) and autocorrelation (correlation between error terms) in the error structure and adjusts coefficient estimates accordingly. GLS minimizes the weighted sum of squared errors, where the weights are inversely proportional to the variance of the error terms. The GLS estimation method was used in the model as a solution to the autocorrelation problem, and the AR(1) term was added to the model. The model results, which were established with the Gauss-Newton optimization method and the ARMA generalized least squares estimation method, are shown in Table 5.

Table 5: GLS Estimation Method.

The dependent variable: D(PRICE)	B	SH	t	p	VIF
D(LNINTEREST)	0.083	0.068	1.232	0.224	1.179
C	0.003	0.020	0.167	0.868	-
AR(1)	0.259	0.153	1.695	0.097	1.179
R^2=0.120 ΔR^2=0.083 $F_{(2;\,48)}$=3.220 (p=0.048) Durbin-Watson=1.888					
Breusch-Godfrey LM Test F= 0.614 (p=0.689) Harvey Heteroscedasticity Test F=2.498 (p=0.120)					

When the results in Table 5 were examined, it was determined that there were no autocorrelation and heteroskedasticity problems in the model and that the ECB interest rate did not have a significant effect on Euronext 100 (t=1.23; p>0.05), free from autocorrelation effects.

5. DISCUSSION AND CONCLUSION

The Euronext stock exchange contributes significantly to the expansion of the European capital market and economic growth. Euronext exchange is the largest stock exchange in Europe. The European Central Bank (ECB) monitors, in particular, the development of wages, interest rates and other indicators using economic analysis. The bank publishes a reference value for the development of the money supply and the amount of money in circulation. When the literature is examined, there are many studies examining the relationship between country interest rates and the stock market. There are some studies in the literature based on the Euronext stock exchange. However, no study has been found in the literature examining the relationship between Euronext100 index share value and ECB interest rate.

In this study, the relationship between ECB interest rates and Euronext 100 performance was examined, data between the years 2000:1-2024:3 were used. Considering that the series are integrated in their first differences, a cointegration relationship was sought. Since it was understood that there was no cointegration vector between the variables at any lag and model (constant, unconstant, trending, trendless, linear, quadratic), a relationship was sought with the least squares estimation method. Since it was determined that both variables became stationary at their first difference, only the constant term was added to the model. Since autocorrelation was detected between the series in the established model, the generalized least squares estimation method, which is one of the most suitable methods to solve this problem, was used. In the model defined as first-order autoregressive (AR[1]), findings were obtained that ECB interest rates did not have a significant effect on Euronext 100 performance.

Literature research also shows that, while monetary liberalization or tightening decisions, whether originating from the country or the ECB or FED, are effective in the capital markets of developing countries, it is seen that in countries with developed capital markets, such decisions have a limited or no effect on the stock markets. While this result does not coincide with the findings of Köylü and Yücel (2019) in their study on the example of a developing economy country, it is similar to the result reached in Keskin's

(2021b.) study. Researchers may be advised to test and interpret indices for different sectors using alternative analysis techniques in studies to be carried out after this study.

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