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Investıgatıon of Borsa Istanbul Bank Index and Monetary Policy Instruments With Johansen Cointegration Method

BORSA İSTANBUL BANKA ENDEKSİ VE PARA POLİTİKASI ARAÇLARININ JOHANSEN KOENTEGRASYON YÖNTEMİYLE ARAŞTIRILMASI

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ABSTRACT

Banks are among the most important actors in the economy due to their role as market makers. The banking sector stands out as one of the sectors with the highest liquidity. Borsa Istanbul (BIST) Bank Index represents the index of banks whose shares are traded on the stock exchange in Turkey. Money supply and policy interest rates are among the main monetary policy instruments most frequently used by the Central Bank (CB) to control liquidity. In this respect, analysing the effects of monetary policy instruments on bank index returns is deemed worthy of research. For this purpose, time series consisting of 225 monthly observations from 01/12/2005 to 01/08/2024, which is the earliest available date, are constructed for BIST Bank index, policy interest rate and M2 money supply. These three time series were subjected to Johansen Co-integration analysis and then the error correction model and the long-run equation of the variables were obtained. As a result of the analyses, it is decided that all three variables are cointegrated in the long run between 2005 and 2024, and it is observed that in case of a possible imbalance between the three variables, the variables converge to each other again in 52.4109 periods and move to a new equilibrium position. In addition, it is determined that a 1% increase in money supply in the long run causes a 0.9% increase in the bank index and a 1% increase in the interest rate causes a 0.7% increase in the bank index.

KEYWORDS

General Equilibrium and disequilibrium: Financial Markets, Money Supply, Interest Rate, Cointegration

ÖZ

Bankalar, piyasa yapıcı olma özelliğinden ötürü ekonomi alanındaki en önemli aktörlerin başında yer almaktadır. Bankacılık sektörü ise likiditenin en yoğun olduğu sektörlerden biri olarak ön plana çıkmaktadır. Borsa İstanbul (BİST) Banka endeksi Türkiye'de payları borsada işlem gören bankaların yer aldığı endeksi temsil etmektedir. Para arzı ve politika faiz oranları Merkez Bankası (MB) tarafından likiditenin kontrolünde en sık kullanılan başlıca para politikası enstrümanları arasında yer almaktadır. Bu bakımdan para politikası araçlarının banka endeksi getirileri üzerindeki etkilerinin incelenmesi araştırmaya değer görülmüştür. Bunun için BİST Banka endeksi, politika faiz oranı ve M2 para arzı için ulaşılan en eski tarih olan 01/12/2005 yılından 01/08/2024 yılına kadar aylık 225 gözlemden oluşan zaman serileri oluşturulmuştur. Oluşturulan bu üç zaman serisi Johansen Koentegrasyon analizine tabi tutularak ardından hata düzeltme modeli ve değişkenlere ait uzun dönem denklemi elde edilmiştir. Yapılan analizler sonucunda 2005-2024 yılları aralığında her üç değişkenin uzun dönemde koentegre olduğuna karar verilerek, üç değişken arasında yaşanması muhtemel bir dengesizlik durumda değişkenlerin 52.4109 dönemde birbirine tekrar yakınsayarak yeni denge konumuna geçtiği gözlemlenmiştir. Ayrıca, uzun dönemde para arzındaki %1'lik artışın banka endeksinde %0.9'luk, faiz oranındaki %1'lik artışın banka endeksinde %0.7'lik bir artışa neden olduğu tespit edilmiştir.

ANAHTAR KELİMELER

Finansal Marketlerde Genel Denge ve Dengesizlik, Para Arzı, Faiz Oranı, Koentegrasyon

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INTRODUCTION

Monetary policy refers to the policies used by central banks to achieve macroeconomic objectives such as price stability, economic growth and employment through the cost and availability of money. In general, monetary policy fulfils the function of controlling and regulating investment and consumption expenditures through changes in money supply through changes in interest rates. An increase in the quantity of money in the market leads to a fall in interest rates, while a decrease in the quantity of money leads to an increase in interest rates. Therefore, contractionary monetary policy is referred to as expensive monetary policy, while expansionary monetary policy is referred to as cheap monetary policy (Gürsoy, 2013: 13-14; Nurel & Yalçınkaya, 2020: 3).

Today, monetary policy can be used in countries with a free market economy. Major developments in the banking and finance sector in recent years have led to an increase in the effectiveness of monetary policies (Öner, 2015: 6).

The banking index is performance of the shares of banks in the banking sector whose shares are traded on the Turkish stock exchange (Akbank A.Ş., Albaraka Türk Katılım Bankası A.Ş., ICBC Turkey A.Ş., QNB Finansbank A.Ş., Şekerbank T.A.Ş., Türkiye Garanti Bankası A.Ş., Türkiye Halk Bankası A.Ş., Türkiye İş Bankası A.Ş., Türkiye Kalkınma ve Yatırım Bankası A.Ş., Türkiye Sınai Kalkınma Bankası A.Ş., Türkiye Vakıflar Bankası T.A.O. and Yapı ve Kredi Bankası A.Ş.), Türkiye Halk Bankası A.Ş., Türkiye İş Bankası A.Ş., Türkiye Kalkınma ve Yatırım Bankası A.Ş., Türkiye Sınai Kalkınma Bankası A.Ş., Türkiye Vakıflar Bankası T.A.O. and Yapı ve Kredi Bankası A.Ş.) as one of the sub-indices with performance indicators (KAP, 2024).

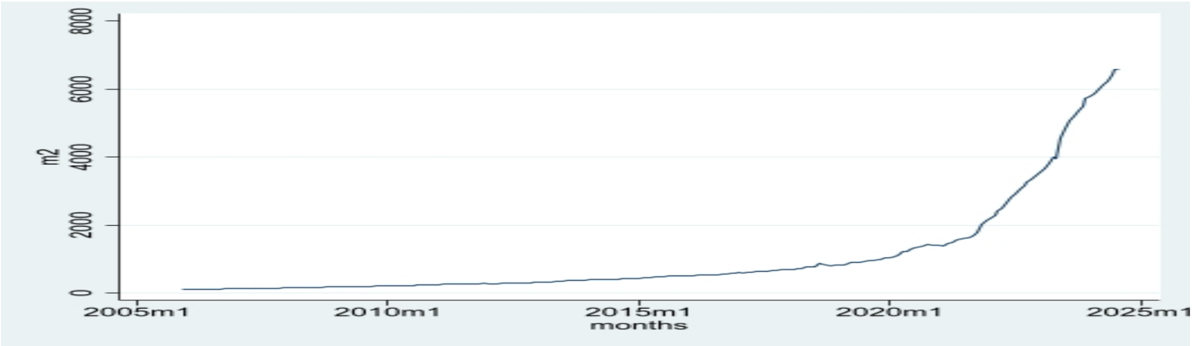
In the theoretical framework of the studies on stock returns in general, Boudoukh and Richardson (1993) investigated the effect of macroeconomic indicators such as expected and current inflation rates on nominal stock returns. Mukherjee & Naka (1995) analysed the relationship between stock returns and exchange rate. Hashemzadeh & Taylor (1988) explained stock returns by using interest rate as one of the macroeconomic indicators. Darrat (1990) proved the relationship between money supply and stock returns. Fama (1981) showed that stock returns have a positive relationship with real economic activity, money supply and inflation. Kaul & Seyhun (1990) found a negative relationship between oil prices and stock returns. Garbade & Silber (1979) explained the stock market indices of developed countries as dominant and the stock market indices of developing countries as satellite markets (Sayılgan & Süslü, 2011). Smith (2001) analysed the relationship between the gold price index, which is accepted as another investment instrument, and the stock market index. In this study, unlike the literature, bank stock returns will be investigated using monetary policy variables.

In the study, firstly, information on the monetary policy implemented in Türkiye between 2005 and 2024 and the course of the BIST Bank index will be given. Then, previous studies in the national and international literature on the research topic will be given. Afterwards, statistical information about the variables of the research topic will be shared and the hypotheses of the research will be formed over the variables that are the subject of the research. Since the hypotheses of the research will be tested through time series analyses, the theoretical information about the econometric methods to be used will be given and then the application part will be started and a decision will be made about the hypotheses formed according to the application results.

1. MONETARY POLICY INSTRUMENTS AND BİST BANK INDEX

After the economic crisis in Türkiye in 2001, following the transition to financial liberalisation policies, the entry of cheap credits into the country was facilitated. Although the inflow of hot money into the country seemed advantageous, it led to an increase in external deficits. Türkiye was able to meet this current account deficit until 2008 (Yeldan, 2009: 17). The global crisis of 2008 caused significant capital outflows from Türkiye. These capital outflows continued throughout 2010-2011. Afterwards, as a result of the expansionary monetary policies of the FED, capital inflows started to be realised in 2012-2013. Due to the capital inflows and outflows in this period, the Central Bank of the Republic of Türkiye (TCMB) first reduced interest rates through the exchange rate policy. As a result of this interest rate policy, capital inflows were achieved again (Çetin, 2016: 85). While the capital inflows experienced since then caused the current account deficit to increase, the Central Bank of the Republic of Türkiye started to implement a more cautious interest rate policy as of 2015 (Tcmb, 2015). With the progressive process, the Central Bank has moved away from rational monetary policies by compromising the autonomy of the Central Bank since 2018 until today. During this period, the Central Bank did not resort to raising interest rates when necessary, could not develop any precautionary policy against macroeconomic imbalances caused by low interest rates and turned to non-standard practices. While this situation prevented the inflow of hot money, it led to the outflow of hot money from the country. These heterodox practices caused credit volumes to increase and asset prices to rise faster (Gürkaynak, Kısacıkoğlu, Lee & Şimşek, 2022).

Figure 1. Central Bank M2 Money Supply (Million Turkish Lira)



Source: Created by Us with STATA 17 Software Using Raw Data.

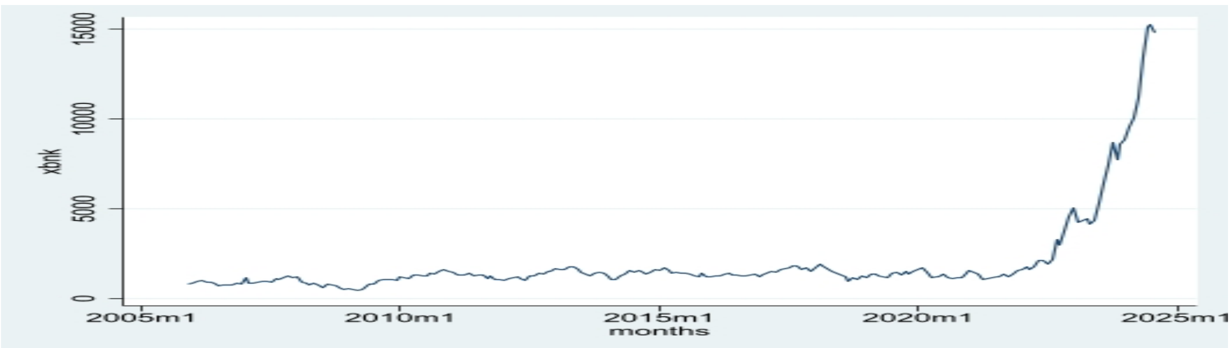
(Figure 1) shows the monthly change in the Central Bank's M2 money supply. As can be seen in the figure, while the M2 money supply followed a constant course from 2005 until the beginning of 2020, the Central Bank started to increase the M2 money supply after 2020.

Figure 2. Central Bank Policy Intrest Rate (Percent) %

Source: Created by Us with STATA 17 Software Using Raw Data.

(Figure 2) shows the monthly changes in the policy interest rates of the Central Bank. According to the figure, the interest rate, which was above 10% in 2005, started to be reduced in 2008 and this low interest rate policy continued until the first months of 2014. Afterwards, there was a partial increase in the first months of 2014 and followed a constant course until 2018. In the following period, there was a leap in 2019 and it increased to 20%. This rise was gradually reduced until 2020 and then entered an upward trend again. Afterwards, in 2021, interest rates continued to be reduced until 2023, but since 2024, they have been continuously increased monthly and reached record levels by increasing to 50% in 2024.

Figure 3. Borsa Istanbul Bank Index (Index) Points



Source: Created by Us with STATA 17 Software Using Raw Data.

(Figure 3) shows the monthly change in the BIST Bank index. According to the figure, the index follows a flat course between 2005-2021. However, starting from the end of 2020, it entered an upward momentum in 2021 and continued to rise continuously on a monthly basis and reached maximum levels in 2024. In this respect, although the BIST Bank index follows a similar course to the money supply graph in the same periods, it also displays a parallel outlook with the policy interest rate graph for the period 2005-2024.

In general, considering the period between 2005 and 2024, it is possible to say that the BIST Bank index follows a constant course when monetary policy instruments are kept constant, while the BIST Bank index gains an upward momentum when expansionary monetary policies are applied.

2. LITERATURE REVIEW

In the literature, international and national studies using macroeconomic indicators, other investment instruments and global stock returns to investigate stock returns are as follows.

Dritsaki-Bargiota & Dritsaki (2004) concluded that there is a long-run relationship as well as a causality relationship between the national stock market index, industrial production index, inflation rate and interest rate using the Johansen Co-integration method for Greece in the 1988-2003 period.

Çıtak (2003) investigated the variables of Istanbul Stock Exchange (IMKB 100) index, money supply and budget deficit/surplus for Türkiye between 1986-1991 using VAR analysis and Granger causality method and concluded that there is no relationship between the variables.

Tabak (2006) found that there is no long-run relationship between stock prices and exchange rates for Brazil in the 1994-2002 period according to Engel Granger co-integration results, but there is a unidirectional Granger causality relationship from stock prices to exchange rates.

Erbaykal, Okuyan, & Kadıoğlu (2008) study on stock prices for Türkiye between the years 1987-2006 using ARDL method with the variables of consumption expenditures, industrial production index, employment level, fixed investments and inflation rate supports Fama's (1981) proxy hypothesis.

Gay (2008) uses ARIMA method for BRIC countries for the period 1999-2006 and finds positive results between stock returns and oil prices for all countries.

Siddiqui (2009) conducted a study between the stock market indices of twelve Asian countries and the US stock market indices between the years 1999-2008 and found that there is co-integration between the stock markets analysed, the correlation degree of the markets other than Japan is medium and high, and the effects of the US market are not found.

Mukhuti & Bhunia (2013) proved that there is a cointegration relationship between the Indian Sensex and Nifty indices and gold prices in the period 1999-2012 for India.

Aksoy & Topçu (2013) showed the long-run relationship between stocks, gold, bonds, consumer price index and producer price index for Türkiye between 2003-2011 using Johansen cointegration method.

Srinivasan & Prakasam (2015) have analysed the long-run relationship between exchange rate, gold and stock prices using ARDL method for India for the period 1990-2014.

Akel & Gazel (2015) analysed the relationship between stocks, gold and selected macro variables by using the GARCH method for Türkiye between 2004 and 2014 and investigated whether gold is reliable for stocks during crisis periods and concluded that gold is not safe.

Öncü, Çömlekçi, Yazgan & Bar (2015) found unidirectional Granger causality from exchange rate and gold to BIST 100 and unidirectional Granger causality from gold to exchange rate among BIST 100, gold and exchange rate variables for Türkiye between 2002-2013.

Kaya, Çömlekçi & Kara (2015) prove that there is a positive relationship between stock returns and money supply and a negative relationship between stock returns and exchange rates for Türkiye between 2002 and 2012.

Coşkun & Ümit (2016) investigated the long-run relationship between the BIST 100 index, exchange rate, gold, deposit interest rate and real house price indices for Türkiye between 2000-2014 using Johansen and Maki cointegration methods. According to the results of the study, Johansen co-integration method yielded a single cointegration result, while no cointegration result was obtained with the Maki method.

Açıkalın & Başçı (2016) found a long-run relationship between BIST 100 and Gold price index variables by Engel Granger cointegration method between 2012-2015 for Türkiye and concluded that there is a unidirectional Granger causality from BIST 100 to Gold price index.

3. DATA SET AND HYPOTHESES OF THE RESEARCH

The application of the research was carried out through three different variables. These variables are; xbnk: BIST banking index, m2: Central Bank money supply and ir: Central Bank policy interest rates. The time interval of the variables covers the period based on the oldest data available for the money supply variable. Accordingly, time series with a frequency of 225 were created using monthly data between 01/12/2005 and 01/08/2024. All of the variables xbnk (Investing, 2024), lnm2 (Tcmb, 2024) and ir (Trading Economics, 2024) are secondary data.

Table 1. Summary Statistics of Raw Data

Variable	Obs.	Mean	Std. dev.	Min.	Max.
xbnk	225	1949.121	2364.988	450.36	15249.36
m2	225	1064.541	1493.672	99.74	6589.27
ir	225	13.03556	9.275897	4.5	50

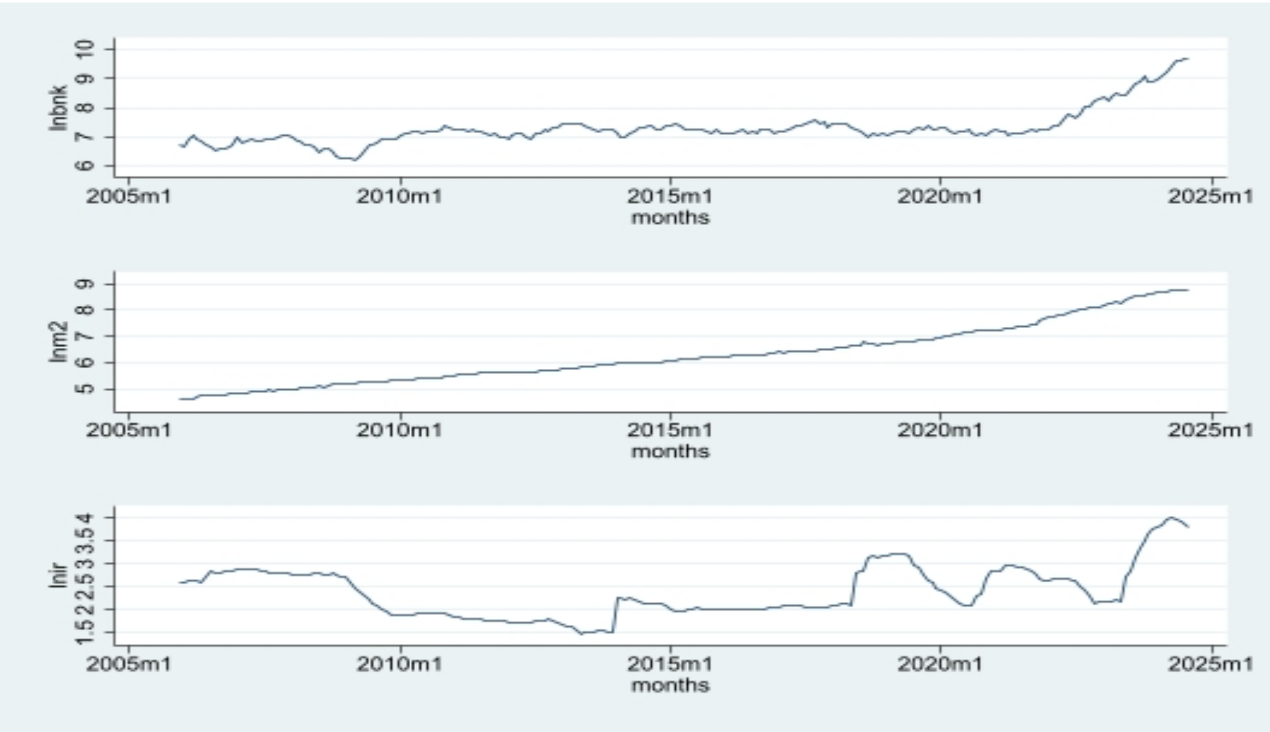
(Table 1) presents the summary statistics of the raw data of the variables to be used in the study. In case of using monthly data in time series, seasonal effects should be taken into consideration. For this purpose, the raw data of the variables are subjected to X-11 filtering and seasonal effects are removed. In addition, logarithmic transformation was performed to give the variables a linear form.

Table 2. Summary Statistics of Data Ready for Processing

Variable	Obs.	Mean	Std. dev.	Min.	Max.
lnbnk	225	7.294242	.6149906	6.222989	9.724494
lnm2	225	6.291002	1.105314	4.59327	8.782988
lnir	225	2.393531	.5570091	1.492559	4.007307

(Table 2) shows the summary statistics of the time series of the variables that will be used in the application of the research and made ready for analysis.

Figure 4. Graph of Data Prepared for Processing



Source: It was created by us with STATA 17 software using the data made ready for processing.

(Figure 4) shows the final view of the time series of the variables that have been processed and made ready for analysis. The hypotheses of the research are based on the time series analyses to be applied to three vectors representing three different variables as shown below;

H_1: In the long run, there is no cointegration relationship between the three vectors of all three variables.

H_2: In the long run, there is at least one cointegration relationship between the three vectors of all three variables.

H_3: In the long run, there are at least two cointegration relationships between the three vectors of all three variables.

H_4: As a result of a possible deviation between the three vectors of all three variables in the long run, the vectors do not converge again afterwards.

H_5: As a result of a possible deviation between the three vectors of all three variables in the long run, the vectors then converge again.

H_6: In the long run, independent variables do not cause an effect (increase or decrease) on the dependent variable.

H_7: In the long run, independent variables cause an effect (increase or decrease) on the dependent variable.

The test is designed to be tested in the form of a test.

4. THEORETICAL FRAMEWORK AND METHODOLOGY

The hypotheses formulated for the research will be tested through the time series of the three variables to be used in the research. In other words, time series analysis will be used as a method in the research. Therefore, the theoretical explanations about the time series analyses to be used in the research are given under this heading.

4.1. Augmented Dickey Fuller Unit Root Test

In order to test the stationarity of the variables used in time series analyses, Dickey and Fuller (1979) & (1981) developed the unit root test method. If the time series of the variables tested have a unit root, it is understood that these series are not stationary. In the following process, it was proved that Dickey Fuller unit root test cannot be used in case of autocorrelation in the error term. If there is autocorrelation in the error terms, it causes a p-order relationship between the error terms.

$$\varepsilon_t = \theta_1\varepsilon_{t-1} + \theta_2\varepsilon_{t-2} + \ldots.. + \theta_3\varepsilon_{t-3} + \varepsilon_t \quad (1)$$

Equation (1) contains the method developed by Dickey and Fuller to eliminate this problem by including the lagged values of the dependent variable as independent variables in the model. This new method is called ADF (Augmented Dickey Fuller) extended Dickey Fuller test in the literature. With this new method, the inclusion of lagged values of the time series of a variable in the model eliminates autocorrelation (Holden & Perman, 1994: 61). Three different models are used in the ADF test (Endres, 1995: 225). These are;

$$\Delta Y_t = \beta_1 Y_{t-1} + \sum_{i=1}^{k} \lambda_i \, \Delta Y_{t-1} + \varepsilon_t \quad (2)$$

The first model is the (none) model with constant coefficients and no trend as shown in equation (2).

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \sum_{i=1}^{k} \lambda_i \, \Delta Y_{t-1} + \varepsilon_t \quad (3)$$

Equation (3) represents the second model of this test with only a constant coefficient.

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 \, trend + \sum_{i=1}^{k} \lambda_i \, \Delta Y_{t-1} + \varepsilon_t \quad (4)$$

Finally, equation (4) shows the third and final model in which both fixed coefficient and trend are included.

The null hypothesis of the ADF test is that the series has a unit root, while the alternative hypothesis of this test is that the series is stationary. When the calculation value is greater than the table critical value z(t) of the test statistic, the null hypothesis is rejected and the series is judged to be stationary.

4.2. Phillips Perron Unit Root Test

Another unit root test was developed by Phillips & Perron (1988) and is included in the literature as an alternative to the ADF test. Again, there are three models in this test as in the ADF test. These are;

$$Y_t = \alpha Y_{t-1} + \varepsilon_t \quad (5)$$

Equation (5) is the representation of the first model with constant coefficient and no trend (none).

$$Y_t = \mu + \alpha Y_{t-1} + \varepsilon_t \quad (6)$$

Equation (6) represents the second model with a constant coefficient but no trend.

$$Y_t = \mu + \beta\,(t - \tfrac{1}{2}\lambda) + \alpha Y_{t-1} + \varepsilon_t \quad (7)$$

Equation (7) is the third model with a constant coefficient and trend.

The main and alternative test hypotheses of the PP (Phillips-Perron) test are formulated similarly to the ADF test. The calculated test statistic and the table critical value are compared and if the calculated value is greater than the table value, the null hypothesis is rejected and the series is accepted as stationary.

4.3. Johansen Co-integration Analysis

Engel & Granger (1987) developed the cointegration method used in time series for the linear combinations between non-stationary variables to be in cointegration relationship in the long run. Upon some deficiencies in this method, Johansen (1988) introduced a different method based on the most similarity method. This method allows the estimation and testing of cointegrated vectors as well as testing some restrictions on the parameters. Johansen and Juselius (1990) further extended the limitations of the method by adding a constant number and trend to the Vector Autoregressive Model (VAR) and even shadow (dummy) variables expressing seasonality, if any, to the model. In the Johansen method, calculations are based on eigenvalues and eigenvectors.

$$z_t = \pi_1 z_{t-1} + \pi_2 z_{t-2} + \ldots + \pi_p z_{t-p} + \varepsilon_t \quad (8)$$

In Equation (8), z_t: represents the unrestricted VAR equation with p lags representing n endogenous variable vectors. In the model, π: represents the (nxn) matrix of coefficients and ε_t: represents the zero-mean error term.

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \Gamma_2 \Delta z_{t-2} + \ldots + \Gamma_{p-1} \Delta z_{t+p-1} + \pi . z_{t-p} + \varepsilon_t \quad (9)$$

Equation (9) expresses the VAR form after applying the ADF test to multivariate equations in higher order autoregressive processes. In this new equation;

$$\Gamma_1 = -(I - A_1 - \ldots - A_i) \quad (10)$$

Γ_1: shown in Equation (10) shows the short-term changes in the variable zt.

$$\pi = -(I - A_1 - \ldots - A_p) \quad (11)$$

In Equation (11), π : represents the long-run changes in the variable zt . In this equation, the rank of the matrix π gives the number of cointegrated vectors.

$$A = [a_{ij}]_{mxn} \neq 0 \quad (12)$$

Equation (12) represents the rank of a matrix. Among the quadratic sub-matrices of this matrix, the one whose determinant is different from zero and whose rank is the largest is denoted as Rank [A] and the rank of matrix A is accepted.

If Rank [π] = 0, there is no long-run relationship between the series.

Rank [π] = 1 indicates that there is an independent and linear combination between the series and there is a single long-run relationship between the series.

Rank [π] > 1 implies that there is more than one cointegration relationship between the series in the long run.

The existence of a cointegration relationship is determined by using two test statistics. In the first one, the Trace Test Statistic shown in equation (13) is used.

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} [ln\{1-\lambda_i\}] \quad (13)$$

In equation (13), λ_i: represents the characteristic roots obtained from the matrices, T: the number of observations, r: represents the number of co-integrated vectors, while in this equation, the null hypothesis of the existence of a number of cointegration vectors equal to or less than r is tested.

$$\lambda_{max}(r, r+1) = -T\, ln\{1-\lambda_{r+1}\} \quad (14)$$

The other test statistic used is the Maximum EigenValue Test Statistic shown in equation (14). In equation (14), r: denotes the number of cointegration vectors, T: the number of observations and λ_{r+1}: the characteristic roots estimated from the matrix π. With this equation, the null hypothesis that the number of cointegration vectors is r and the alternative hypothesis that the number of vectors is r+1 are tested.

If the calculated values are greater than the critical values, the number of cointegration vectors is determined. By comparing the trace and maximum eigenvalue statistics with the table critical values, it is determined whether there is co-integration between the variables and if so, how many (Johansen, 1995).

4.4. Error Correction Model (ECM)

In the Engel Granger cointegration estimation model, an error correction model is obtained to test whether there is spurious regression between the variables through the error term of the estimated model.

$$\Delta Y_t = \alpha + \beta_1 \Delta X_t + \beta_2 u_{t-1} + \varepsilon_t \quad (15)$$

In Equation (15), the error correction model created with the error term obtained from the Engel Granger cointegration model of X and Y variables is given. This model shows the short or long term relationship of variable X on variable Y. In case of a possible deviation in the equilibrium state of the variables, it expresses the transition to the new equilibrium state by converging to variable X within how long the variable Y will converge to the new equilibrium state.

$$\Delta Y_t = \alpha + \beta_0 \Delta X_t + \beta_1 (Y_{t-1} - \beta_2 X_{t-1}) + \varepsilon_t \quad (16)$$

The coefficient in brackets in Equation (16) indicates the error correction term. The error correction term equal to zero indicates the equilibrium state, the parameter β_0 indicates the effect of a possible increase in the X variable on the Y variable in the short term, and the parameter β_1 indicates how long it takes for both variables to return to the new equilibrium state in case of deviation from equilibrium between X and Y variables. Therefore, the error term should have a value in the range $-1< \beta_1 < 0$ (Best, 2008: 10-11).

5. ANALYSIS AND EMPIRICAL FINDINGS

In the application part of the research, unit root tests (ADF and PP) will be applied to determine the stationarity of the time series of the variables, and first the VAR model and then the Johansen cointegration model will be estimated for the long-run relationship between the variables. If the estimated cointegration model is significant, the error correction coefficient will be obtained by obtaining the error correction model and the error correction coefficient. If the error correction coefficient is significant, the long-run model with the long-run coefficients of the variables will be constructed. Diagnostic tests will be applied to the estimated Johansen cointegration model and the model will be accepted if the estimation model passes the diagnostic tests. Then, the hypotheses formed for the research will be tested through the estimation model. The calculations related to the application of the research were made with STATA 17 and Eviews 13 software.

5.1. Unit Root Test Results

In the theoretical explanation of the methods to be applied in the research, three-model representations for ADF and PP unit root tests are given. However, for this research, the second model with a constant coefficient, which is frequently preferred in the literature in terms of application, and the third model with both constant coefficient and trend will be tested.

Table 3. Unit Root Test Results of Variables

Variable	test statistic	ADF Test Intercept	ADF Test Intercept & Trend	PP Test Intercept	PP Test Intercept & Trend
lnbnk	1%	-3.459494	-3.999552	-3.459494	-3.999552
	5%	-2.874258	-3.430013	-2.874258	-3.430013
	10%	-2.573625	-3.138555	-2.573625	-3.138555
	Z(t)	(2.045340)	(0.658863)	(2.022871)	(0.603568)
	p (Value)	0.9999	0.9996	0.9999	0.9995
Δlnbnk	1%	-3.459627*	-3.999740*	-3.459627*	-3.999740*
	5%	-2.874317**	-3.430104**	-2.874317**	-3.430104**
	10%	-2.573656***	-3.138608***	-2.573656***	-3.138608***
	Z(t)	(-14.51817)	(-14.78999)	(-14.61058)	(-14.81627)
	p (Value)	0.0000	0.0000	0.0000	0.0000
lnir	1%	-3.459898	-4.000122	-3.459494	-3.999552
	5%	-2.874435	-3.430289	-2.874258	-3.430013
	10%	-2.573719	-3.138717	-2.573625	-3.138555
	Z(t)	(-2.326268)	(-2.695380)	(-1.383314)	(-1.769576)
	p (Value)	0.1646	0.2396	0.5901	0.7164
Δlnir	1%	-3.459898*	-4.000122*	-3.459627*	-3.999740*
	5%	-2.874435**	-3.430289**	-2.874317**	-3.430104**
	10%	-2.573719***	-3.138717***	-2.573656***	-3.138608***
	Z(t)	(-5.234782)	(-5.310600)	(-12.67812)	(-12.72194)
	p (Value)	0.0000	0.0001	0.0000	0.0000
lnm2	1%	-3.459494	-3.999552	-3.459494	-3.999552
	5%	-2.874258	-3.430013	-2.874258	-3.430013
	10%	-2.573625	-3.138555	-2.573625	-3.138555
	Z(t)	(4.939476)	(2.055066)	(4.011652)	(1.574695)
	p (Value)	1.0000	1.0000	1.0000	1.0000
Δlnm2	1%	-3.459762*	-3.999740*	-3.459627*	-3.999740*
	5%	-2.874376**	-3.430104**	-2.874317**	-3.430104**
	10%	-2.573687***	-3.138608***	-2.573656***	-3.138608***
	Z(t)	(-7.9830029	(-13.02912)	(-12.98915)	(-13.36052)
	p (Value)	0.0000	0.0000	0.0000	0.0000

*%1, **%5 ,***%10 Stationary at Significance Level, ()Test Statistic Value in Parentheses.

In unit root tests applied to time series, the stationarity of the series at the level is expressed as I (0), and the stationarity of the series in the first difference is expressed as I (1). The stationarity of the series subject to the application in the I (0) condition indicates that there is a short-term relationship between the series and the stationarity of the series in the I (1) condition indicates that the series have a long-term relationship with each other (Dickey & Fuller, 1981). In (Table 3), according to the ADF and PP unit root test results (at α=0.01, α=0.05 and α=0.10 significance levels) for the series belonging to lnbnk, lnir and lnm2 variables with constant coefficients and models with both constant coefficients and trend, the values calculated for both variables are smaller than the test statistic values ($t_{calculate} < Z(t)$ and $p > 0.05$). As a result of the ADF and PP tests applied to the series at first difference (at α=0.01, α=0.05 and α=0.10 significance levels), it was concluded that the series were stationary at first difference as the values calculated for the models of Δlnbnk Δlnir and Δlnm2 series with constant coefficients and with both constant coefficients and trend were greater than the test statistic value ($t_{calculate} > Z(t)$ and $p < 0.05$) (Wooldridge, 2013a). According to the results of this application, the fact that both series are stationary at first difference I(1) indicates the existence of a long-run relationship between the series.

5.2. VAR Model Estimation

As a result of the unit root tests, after obtaining the results that there may be a long-run relationship between the variables, the VAR model estimation stage was started. Firstly, the VAR model was estimated with two lag lengths and the VAR model was re-estimated with the appropriate lag length determined by searching the most appropriate lag length for the model.

Table 4. Appropriate Lag Length for VAR Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-575.8448	NA	0.041642	5.334975	5.381701	5.353850
1	955.2695	3005.782	3.36e-08	-8.693728	-8.506821*	-8.618226*
2	965.7453	20.27577	3.32e-08	-8.707330	-8.380243	-8.575201
3	976.0119	19.58691	3.28e-08	-8.719004	-8.251737	-8.530247
4	989.1012	24.61041*	3.16e-08*	-8.756694*	-8.149247	-8.511310
5	994.8346	10.62127	3.26e-08	-8.726586	-7.978959	-8.424576
6	998.2831	6.293049	3.43e-08	-8.675420	-7.787613	-8.316783
7	1006.118	14.08083	3.47e-08	-8.664680	-7.636693	-8.249416
8	1011.161	8.923488	3.60e-08	-8.628207	-7.460040	-8.156316

* It refers to the most appropriate lag length for the model according to all information criteria.

In (Table 4), the information criteria used in the search for the most appropriate lag length of the VAR model and the statistical values of these criteria are given. Akaike and Schwarz information criteria are accepted as the most preferred information criteria in the literature. Considering the information criteria in the table and the statistical values of these criteria, it is decided that the most appropriate lag length for the VAR model to be re-estimated should be four according to each information criterion. Afterwards, the VAR model with four lag lengths was estimated and the model output in (Appendix-1) is given in (Table 9).

5.3. Johansen Co-integration Model Estimation

In order to determine the long-run relationship between the variables of the study, Johansen cointegration test was performed over the previously estimated four-lag VAR model.

Table 5. Johanesen Co-integration Test

Hypothesis	Trace Statistics		*Critical Values*		Max-Eigen Statistics		*Critical Values*	
	%1	*%5*	*%1*	*%5*	*%1*	*%5*	*%1*	*%5*
r = 0	54.99759*	54.99759**	41.19504	35.19275	37.86697*	37.86697**	27.06783	22.29962
r ≤ 1	17.13063	17.13063	25.07811	20.26184	11.41975	11.41975	20.16121	15.89210
r ≤ 2	5.710873	5.710873	12.76076	9.164546	5.710873	5.710873	12.76076	9.164546

*%1, **%5, It indicates that there is co-integration at significance level.

(Table 5) presents the Johansen cointegration results for the variables. The hypotheses of the method used according to the output and the trace and maximum eigenvalue statistics at 1% and 5% significance levels to test these hypotheses are shown separately for comparison with critical values. According to the values in the output, the null hypothesis of no cointegration is rejected at 5% significance level for both test statistics. In addition, the null hypotheses of at least one and at least two cointegration relationships are not rejected. Therefore, it is concluded that there are at least two cointegration relationships between the variables in the long run.

5.4. Error Correction Model

As a result of the Johansen cointegration test, a cointegration relationship was found between at least two vectors in the long run. In the following process, the error correction model will be estimated and the Johansen cointegration model will be verified.

Table 6. Error Correction Model

MODEL	VARIABLE			
Error Correction	Δlnbnk	Δlnir	Δlnm2	C
EC_{t-1}	-0.019080	0.016737	-0.005816	
p (Value)	(0.00897)	(0.00919)	(0.00191)	
test statistic	[-2.12747]	[1.82153]	[-3.04543]	
Long Run Cointegration				
EC_{t-1}	1.000000	-0.702001	-0.936175	0.288479
p (Value)		(0.34907)	(0.21019)	
test statistic		[-2.01104]	[-4.45404]	

Model Statistics			
R-squared	0.093629	0.183791	0.201184
Adj. R-squared	0.036431	0.132282	0.150773
F-statistic	1.636933	3.568176	3.990887
Log likelihood	219.8786	214.5480	560.1545
Akaike AIC	-1.871624	-1.823163	-4.965041
Schwarz SC	-1.655665	-1.607205	-4.749083

(Table 6) shows the output of the error correction model. As can be seen in the table, the coefficient of the error correction term is -0.019080. In other words, the error correction term is in the range $-1< EC_{t-1} < 0$ and it is decided that the necessary condition is met and the error correction model works. In the following process, it was calculated from the error correction model (1 / -0.019080 = 52.4109) that the running rate of the error correction term is 52.4109 periods (months). According to the estimated error correction model, in case of a possible deviation from equilibrium between the variables in the long run, it takes approximately 52.4109 periods (months) for the variables to converge back to each other and reach equilibrium.

In addition, (Table 6) presents the long-run coefficients of the variables and shows to what extent the independent variables affect the dependent variable in the long run.

$$\Delta lnbnk = -0.288479 + 0.702001\Delta lnir + 0.936175\Delta lnm2 \quad (17)$$

Equation (17) shows the long-run equation of the forecasting model. According to the equation, in the long run, a 1% increase in the Δlnir variable causes a 0.7% increase in the Δlnbnk variable and a 1% increase in the Δlnm2 variable causes a 0.9% increase in the Δlnbnk variable.

5.5. Diagnostic Tests

At this stage, diagnostic tests of the estimated Johansen Co-integration model are included and tests for the validity of the estimation model are performed.

Table 7. Autocorrelation Test

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	13.37665	9	0.1463	1.495949	(9, 489.3)	0.1463
2	22.32179	9	0.0779	2.519205	(9, 489.3)	0.0779
3	11.68602	9	0.2316	1.304632	(9, 489.3)	0.2316
4	7.988827	9	0.5353	0.888526	(9, 489.3)	0.5353
5	7.765555	9	0.5579	0.863497	(9, 489.3)	0.5580

Firstly, the autocorrelation test of the estimation model is performed and the results are given in (Table 7). As can be seen in Table 7, $p=0.1463> 0.05$ for L1, $p=0.0779> 0.005$ for L2, $p=0.2316> 0.005$ for L3, $p= 0.5353> 0.005$ for L4 and $p= 0.5580> 0.005$ for L5, the main hypotheses are accepted at α=0.05 significance level and the null hypothesis of no autocorrelation is accepted. According to the result of Breush-Pagan Heteroskedasticity test, the main hypotheses are accepted at α=0.01 significance level with $p=0.0452 \leq 0.05$ and there is no problem of changing variance. Then, according to the result of JB normality test, the main hypotheses are accepted at α=0.01 significance level with $p=0.0140 > 0.01$ and it is concluded that the error term of the model is normally distributed (Wooldridge, 2013b).

5.6. Evaluation of Research Hypotheses

In the last part of the application of the research, the seven hypotheses formed for the research will be evaluated according to the results of the analyses made so far.

Table 8. Research Hypotheses and Evaluation

Hypothesis	Verify	Table/Graph/Equation	Decision
H_1	r = 0	Table 5	Denied X
H_2	r ≤ 1	Table 5	Accepted √
H_3	r ≤ 2	Table 5	Accepted √
H_4	$-1< EC_{t-1} < 0$	Table 6	Denied X
H_5	$-1< EC_{t-1} < 0$	Table 6	Accepted √
H_6	Δlnir %0.7↑ & Δlnm2 %0.9↑	Equation 17	Denied X
H_7	Δlnir %0.7↑ & Δlnm2 %0.9↑	Equation 17	Accepted √

(Table 8) presents the seven hypotheses formulated for the research and the rationale and results obtained from the time series analyses used to test these hypotheses. As seen in the table, four of these seven hypotheses are accepted while three hypotheses are rejected.

CONCLUSION

Banks, which are the main actors of market makers, steer the financial sector where liquidity is the most intense. In this context, the monetary policies implemented by the Central Bank directly affect not only the markets but also the financial sector and the position of banks. Money supply and policy interest rate are the most frequently used monetary policy instruments of the Central Bank that directly affect the position of banks. In other words, these instruments have a strong impact on the profit/loss situation in the balance sheets of banks. The banking index, on the other hand, represents the index for the stock returns of banks whose shares are traded on the stock exchange. Investors invest in bank shares by taking into account the profitability expectation or profitability status of banks and the banking index.

In this study, the long-run relationship between money supply and policy interest rate, which are among the monetary policy instruments, and BIST Bank index between 2005 and 2024 is investigated. For this purpose, time series of all three variables were created and Johansen Co-integration analysis was performed between these variables. According to the results of the analysis, at least two of the three variables were found to be cointegrated in the long run. After this determination, the error correction model is estimated and in case of a possible imbalance between these three variables, which are in equilibrium in the long run, the vectors of the variables are expected to converge to each other again after approximately 52.4109 periods (months). In addition, the long-run equation of these three variables is obtained and it is decided that a 1% increase in money supply causes a 0.9% increase in the bank index and a 1% increase in the interest rate causes a 0.7% increase in the bank index in the long run. According to these findings, similar results were obtained with Tabak (2006) with the exchange rate variable, Mukhuti & Bhunia (2013) with the relationship between the two indices, Srinivasan & Prakasam (2015) with gold and exchange rate variables, Öncü et al. (2015) and Açıkalın & Başçı (2016) using the gold variable.

According to these results obtained from the research, it is concluded that monetary policy instruments have an impact on the stock returns of banks as of 2005 and 2024, which is the research period. In this respect, it is recommended that investors investing in banks' shares, information users or researchers working on the bank index should take monetary policy instruments into consideration.

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APPENDIX I

Table 10. VAR Model with Four Lags

Variable (Lag)	LNBNK	LNIR	LNM2
LNBNK(-1)	0.961294	-0.052854	-0.013051
	(0.06969)	(0.06952)	(0.01481)
	[13.7934]	[-0.76032]	[-0.88098]
LNBNK(-2)	0.087840	0.020709	0.035246
	(0.09617)	(0.09593)	(0.02044)
	[0.91337]	[0.21589]	[1.72407]
LNBNK(-3)	-0.081021	0.057093	-0.001037
	(0.09439)	(0.09415)	(0.02006)
	[-0.85841]	[0.60643]	[-0.05170]
LNBNK(-4)	0.022992	0.001998	-0.026131
	(0.07155)	(0.07137)	(0.01521)
	[0.32133]	[0.02799]	[-1.71800]
LNIR(-1)	-0.044612	1.076623	-0.012073
	(0.06767)	(0.06749)	(0.01438)
	[-0.65931]	[15.9515]	[-0.83934]
LNIR(-2)	0.022923	0.065398	0.036031
	(0.10052)	(0.10027)	(0.02137)
	[0.22804]	[0.65225]	[1.68623]
LNIR(-3)	0.020044	0.076668	-0.057941
	(0.10119)	(0.10093)	(0.02151)
	[0.19808]	[0.75958]	[-2.69360]
LNIR(-4)	0.011203	-0.255867	0.034447
	(0.06828)	(0.06811)	(0.01451)
	[0.16408]	[-3.75686]	[2.37329]
LNM2(-1)	-0.669468	0.374746	1.101703
	(0.31911)	(0.31830)	(0.06783)
	[-2.09792]	[1.17734]	[16.2412]
LNM2(-2)	0.972449	0.240373	-0.034152
	(0.47433)	(0.47313)	(0.10083)
	[2.05014]	[0.50805]	[-0.33871]
C	-0.091998	-0.110038	0.009381
	(0.10794)	(0.10767)	(0.02295)
	[-0.85227]	[-1.02199]	[0.40884]
Model Statistics			
R-squared	0.978736	0.974418	0.999693
Adj. R-squared	0.977509	0.972942	0.999675
Sum sq. resids	1.781489	1.772454	0.080501
F-statistic	797.8226	660.2213	56449.75
Log likelihood	219.1034	219.6652	561.3154