

MACROECONOMIC INDICATORS AND LIQUIDITY: LONG AND SHORT RUN DYNAMIC EFFECTS ON THE TÜRKİYE STOCK EXCHANGE WITH THE ARDL APPROACH¹



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ABSTRACT

Stock market liquidity is a key indicator of market functionality, stability and investor sentiment. Furthermore, stock market liquidity serves as a crucial indicator for gauging the depth of liquidity and market dynamics in money and capital markets. In light of the pivotal role of stock market liquidity, this article seeks to examine the dynamic influence of select macroeconomic indicators pertaining to monetary, fiscal, and general economic outlook on stock market liquidity in both the long and short run. To this end, the symmetric ARDL method is employed. The ARDL findings indicate that interest rate, exchange rate, central government expenditures, oil, industrial production index, and consumer price index exert a discernible impact on stock market liquidity.

Keywords: Macroeconomic indicators, trading volume, Amihud illiquidity

JEL Codes: C58, G10, G11

Scope: Economics

Type: Research

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¹ It has been declared that the relevant study complies with ethical rules.

MAKROEKONOMİK GÖSTERGELER VE LİKİDİTE: TÜRKİYE BORSASINDA ARDL YAKLAŞIMI İLE UZUN VE KISA DÖNEMLİ DİNAMİK ETKİLER



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ÖZ

Borsa likiditesi, hisse senedi piyasasının iyi işlediğini, piyasada istikrarın olduğunu ve yatırımcıların hisse senetlerine olan duyarlılığını gösteren en önemli göstergelerden biridir. Borsa likiditesi aynı zamanda para ve sermaye piyasasındaki likiditenin ve piyasa dinamiklerinin derinliğini görmek açısından da önemli bir belirleyici olarak öne çıkmaktadır. Borsa likiditesinin öneminden yola çıkarak bu makalede, para, maliye ve genel ekonomik görünüme ait bazı makroekonomik göstergelerin uzun ve kısa dönemde borsa likiditesi üzerindeki dinamik etkisi simetrik ARDL yöntemi ile incelemek amaçlanmıştır. ARDL bulgularında faiz, döviz kuru, merkezi yönetim harcamaları, petrol, sanayi üretim endeksi ve tüketici fiyat endeksinin borsa likiditesi üzerindeki etkisinin varlığını göstermektedir.

Anahtar Kelimeler: Makroekonomik göstergeler, işlem hacmi, Amihud likidite azlığı

JEL Kodları: C58, G10, G11

Alan: İktisat

Türü: Araştırma

1. INTRODUCTION

Exchange liquidity is the ability of investors to buy and sell significant amounts of securities quickly, at lower transaction costs and without major price concessions (Brennan, Chordia, Subrahmanyam, & Tong, 2001, p. 523). Market liquidity is a key characteristic of the stock exchange, referring to the ease with which assets can be bought and sold by participants who are willing to trade at an agreed price within a short timeframe (Amihud, Mendelson, & Pedersen, 2006, p. 235). Given the significant role of stock liquidity, both governmental bodies and regulatory authorities continuously work to ensure an optimal level of liquidity. One of the primary strategies to enhance market liquidity involves macroeconomic policies, encompassing both monetary and fiscal measures (Chowdhury, Uddin, & Anderson, 2018, p. 2).

Liquidity, or the ease with which an asset can be bought and sold in a timely manner at low cost, plays an important role in money and capital markets (Ahmed, Hudson, & Gregoriou, 2023). A high level of stock liquidity leads to an increase in both the creation of information and the trading of informed decisions (Chang, Chen, & Zolotoy, 2017, p. 1607). This results in the provision of essential information for trading opportunities, an additional incentive for shareholders, and enhancement of market trust. With this in mind, market liquidity is taken into consideration as an indicator of the overall success of the economy in the majority of developed economies. Mainly due to the fact that a growth in stock value has an effect on the entire economic activity through the confidence channel (Ehrmann, Fratzscher, & Rigobon, 2016). In addition, since it determines the magnitude of possible returns for an investor, it is also important in developing more profitable investment strategies. In this respect, stock market liquidity is one of the most important leading indicators both for the development of general economic activity and for determining the size of returns for investors and developing appropriate investment strategies (Naik & Reddy, 2021, p. 1). Similarly, stock markets contribute positively to economic growth as they make an important contribution to the development of industry and trade (Ho & Odhiambo, 2016, p. 136). Due to their liquidity, stock exchanges also play an important role in quickly obtaining the funds that firms need for investment and growth (Camba & Camba, 2020, p. 37). Increased liquidity may adversely affect trading, potentially elevating the company's default risk and resulting in mispricing and heightened volatility (Brogaard, Li, & Xia, 2017, p. 487).

Enhancements in stock market liquidity play a crucial role in bolstering investor confidence by ensuring the efficient dissemination of trading-related information. Moreover, stock markets fulfill essential functions, such as offering an exit strategy for venture capitalists and facilitating liquidity, which promotes

international diversification and the movement of investment portfolios. This, in turn, allows firms to enhance their financial performance by securing necessary capital (Rousseau & Wachtel, 2000, p. 1955). The availability of stock market liquidity is fundamental to a country's financial stability and economic expansion, particularly in times of economic uncertainty. Butler, Grullon, and Weston (2005) suggest that a high level of liquidity contributes to a decline in equity capital costs. This dynamic not only alleviates financial constraints faced by businesses but also strengthens their ability to withstand economic crises. Additionally, liquidity enables the swift realization of financial gains or losses (Zaremba, Aharon, Demir, Kizys, & Zawadka, 2021, p. 2).

High levels of illiquidity not only provide higher gains for investors than liquid markets due to price volatility, but also entail a higher risk of loss. Due to the possibility that illiquid markets may cause significant price changes and thus higher losses, investors are hesitant to make a large securities transaction. Therefore, increasing illiquidity has a negative impact on market development as it reduces capital inflows (Kumar & Misra, 2015). Low liquidity in stock markets is often associated with misallocation of capital and mispricing of assets, leading to fragility in the financial system. Moreover, illiquidity makes IPOs unattractive if it exceeds the cost of equity capital. This can discourage innovation and growth, especially for young start-ups as they tend to rely on financing sources such as IPOs (Brandao-Marques, 2016). One of the leading economic indicators that responds to different macro factors like interest rates and money supply is stock market liquidity, which represents investors' expectations about the return, earnings, and cash flow of firms (Khan, Hussain, & Tajummul, 2022, p. 55).

Stock market indicators are a vital indicator for the welfare of the economy due to their pricing properties that enable policymakers and investors to make decisions. They also allow for a sound view of the future state of the economy. Stock market liquidity plays an important role here, as it allows different stakeholders to securely hold and trade exchange instruments (Alaoui Mdaghri, Raghibi, Thanh, & Oubdi, 2021). Indeed, the liquidity indicator is one of the stabilization measures used by the institutions responsible for the functioning of the financial system to make an objective and comprehensive assessment. Market liquidity is one of the important stability indicators used to evaluate the dynamics in financial markets as a whole. In liquid markets, high bid-ask spreads indicate market depth. Market liquidity has emerged as a critical indicator for investors to comprehensively assess financial stability, especially in recent years (Santoso, Harun, Hidayat, & Wonida, 2010). Since the unpredictability of market liquidity is a significant source of risk for investors,

knowing the macroeconomic determinants of its liquidity will be helpful to investors (Choi & Cook, 2006).

The primary aim of this study is to examine how Türkiye-specific macroeconomic factors influence liquidity fluctuations in the Borsa İstanbul (BIST 100) index. Independent variables considered in the analysis include industrial production, inflation, interest rates, government expenditures, energy prices, exchange rates, and gold prices. The introductory section outlines the theoretical background and significance of stock market liquidity. The second section provides a review of empirical studies where stock liquidity is analyzed as a dependent variable. Following this, the third section elaborates on the data set and the econometric techniques employed. Lastly, the findings are presented and interpreted, leading to a discussion that offers policy recommendations in light of the study's conclusions.

2. LITERATURE REVIEW: STOCK MARKET LIQUIDITY AND MACROECONOMICS INDICATORS

Since it is one of the primary areas of finance, liquidity studies have garnered a lot of interest in the literature. Liquidity has been the subject of a great deal of research, both theoretical and empirical. Since liquidity encompasses aspects like trade volume, trading duration, and price impact, there is no universally applicable metric or definition for all markets. A stock's liquidity, on the other hand, indicates its cheap cost, low price effect, and high trading volume, all of which allow for rapid trading. Quantity, velocity, cost, and impact on price are the four aspects of stock liquidity that pertain to this. It is necessary to examine the liquidity literature because liquidity is so important to academics and economists (Le & Gregoriou, 2020). This section provides a concise overview of empirical research on macroeconomic determinants and their influence on stock market liquidity across various global markets.

Ülengin and Yobaş (1997) highlight that macroeconomic variables, including money supply, inflation, output, and interest rates, influence stock market trading volumes in both developed and developing economies, with the extent of this impact differing based on the stock exchange. Karamustafa and Karakaya (2004) establish that inflation, measured via the Consumer Price Index (CPI), has a substantial impact on ISE 100 trading volume. Özgümüş, Korkmaz, and Çevik (2013) find that money supply positively influences transaction volumes in the ISE 100, while inflation exerts a significant negative effect. Liu (2015), analyzing data from the NYSE and AMEX, suggests that investor sentiment enhances both stock market liquidity and trading activity. Additionally, Arjoon, Bougheas, and Milner (2016) demonstrate that institutional ownership

levels significantly affect liquidity and returns, with stocks held predominantly by institutional investors exhibiting strong predictive power.

Ali, Liu and Su (2017) assert that corporate governance improvements contribute positively to liquidity within the Australian stock market. They suggest that enhanced governance mechanisms help lower trading costs and influence price dynamics, leading to increased trading frequency. Similarly, Siikanen, Kannianen, and Valli (2017) reveal that planned and unexpected announcements of NASDAQ-listed firms significantly impact stock market liquidity, particularly due to information leaks occurring before official announcements. Reddy, Wacá and Goyal (2017) highlight that stock market liquidity in India is notably shaped by policy decisions from governmental and financial institutions. Chowdhury et al. (2018) examine the role of macroeconomic factors such as money supply, government expenditures, private sector borrowing, and bank interest rates in determining stock market liquidity across eight emerging economies. Their findings indicate that these factors exert varying effects across different industries. Furthermore, they emphasize that illiquidity is strongly influenced by interest rate fluctuations, short-term borrowing, and government lending practices. Debata, Dash, and Mahakud (2018) explore the impact of investor sentiment on liquidity within 12 emerging markets, concluding that while domestic investor sentiment influences liquidity, foreign investor sentiment plays an even more significant role in shaping stock market liquidity trends. Canbaz (2019) finds no direct causal link between GDP, total loan volume, and deposit volume in explaining stock market trading activity in Türkiye. Through variance decomposition, their study identifies deposits as the primary driver of trading volume fluctuations, followed by GDP and loan volume, with trading volume reacting initially to increases in these variables but declining in response to loan shocks. Lastly, Öztürk, Çetanak and Haykır (2019) establish that no causal relationship exists between economic growth and stock market liquidity in Türkiye.

Ekinci, Akyildirim and Corbet (2019) highlight that announcements related to monetary policy, interest rates, and GDP in the U.S. economy significantly influence liquidity in Borsa İstanbul. Abudy (2020) identifies a strong and positive correlation between retail sales and stock market liquidity, suggesting that retail investors are more inclined to engage in trading when liquidity is high. Conversely, retail investors acting as sellers often execute trades at lower liquidity levels compared to buyers. Çiftçi and Reis (2020) conducted an analysis on the causality link between the BIST Amihud illiquidity measure and Türkiye's risk appetite. Their findings indicate a unidirectional causality, where liquidity influences risk appetite rather than the reverse. Mishra, Parikh, and Spa

(2020) examine the impact of unconventional monetary policies introduced by the Federal Reserve during the 2007–2009 financial crisis, revealing that these policies significantly shaped stock market liquidity, with variations observed across different phases of quantitative easing. Furthermore, the study finds that stock market liquidity experiences growth when Federal Reserve stimulus measures coincide with an increase in bank lending.

Onyele, Ikwuagwu, and Onyekachi-Ony (2020) observe that public spending did not impact stock market liquidity in Nigeria over the long term; however, in the short term, a negative effect was noted. Similarly, Ye, Zhou and Zhang (2020) report that stock market liquidity in China improved following the relaxation of leveraged trading restrictions, whereas credit trading had a positive effect under normal market conditions. In contrast, short-term selling transactions exerted a negative influence. Wan (2020) highlights that short selling and margin buying negatively affect liquidity in the Chinese stock market, with information asymmetry exacerbating liquidity deterioration. Dash, Maitra, Debata, and Mahakud (2021) determine the presence of a bidirectional relationship between economic policy uncertainty and stock market liquidity in G7 countries, underlining the complex interplay between macroeconomic policies and liquidity trends. Güzel and Şekeroğlu (2021) found a causality from CDS premiums to BIST 100 trading volume in Türkiye. According to Altunöz (2021), money supply, credit default swap, inflation rate and interest rate appear to have a significant effect on the transaction volume of the BIST 30 futures contract. In the studies of Elçiçek and Kayalıdere (2021), it was determined that the effect of the ratio of budget deficit to GDP on VIOP 30 futures contracts was positive and significant. Wu and Qin (2021) found a positive relationship between market efficiency and market liquidity in the Chinese market.

Pan (2023) suggests that information diffusion related to macroeconomic variables in China has an asymmetric influence on market volatility, subsequently impacting liquidity. Specifically, investor hedging strategies during financial crises have been found to alter short-term liquidity conditions. Das and Yaghubi (2023) investigate the role of political risk in stock market liquidity within the U.S., concluding that heightened political uncertainty leads to liquidity reductions. Moreover, their findings indicate that the impact of political risk on liquidity varies depending on firms' political affiliations. Yılmaz (2023) explores the cointegrated and asymmetric link between BIST 100 liquidity and capital flows influenced by monetary factors. Lyu and Hu (2024) argue that money supply exerts a dynamic influence on stock market liquidity in China, with liquidity fluctuations differing across various time periods and markets. They also highlight that expansionary monetary policies can contribute to liquidity

recovery, provided they establish stable expectations regarding liquidity conditions. Naik and Reddy (2024) determine that while foreign investment inflows and gold prices adversely affect stock market liquidity in India, money supply has a contrasting positive influence. Other macroeconomic variables incorporated into their model further illustrate the intricate relationships governing liquidity dynamics. Other macroeconomic indicators used in the model (including foreign exchange reserves, inflation, interest rates, oil prices, exchange rate, GDP, imports, exports, government final consumption expenditures, current account balance) were not significant.

Macroeconomic variables are important in terms of measuring the overall performance of the economy and learning the economic climate. Investigating the relationship between stock market indicators, which represent real market dynamics, and macroeconomic variables remains an interesting topic. Stock price and trading volume stand out as two important indicators in the stock market. The values of these two indicators are determined by the same market participants. However, in the literature review, the majority of researchers have focused on stock price or return rather than trading volume. In this respect, it has been observed that the number of studies focusing on trading volume as a focal point is low, and in the existing studies, it is generally taken as an explanatory variable. Liquidity and depth in the stock market are measured by trading volume. This situation shows the importance of trading volume in the stock market. The most important focal point that distinguishes this study, in which we examine the effect of macroeconomic variables on stock market trading volume, from other studies is that the BIST 100 trading volume, which is the main indicator of the Turkish stock market, is taken rather than a certain group of stocks. Secondly, we use two different proxy variables for the stock market, namely total trading volume and illiquidity. Thirdly, macroeconomic indicators representing monetary, fiscal and other areas of the economy are used as explanatory variables to test both long and short-term dynamic effects. We believe that this distinguishes our study from other studies conducted in Türkiye and will contribute to the literature by expanding the literature.

3. DATASET, METHOD AND FINDINGS

3.1. Dataset

This paper aims to empirically analyze the dynamic impact of macroeconomic indicators on BIST liquidity with two different models using time series data specific to the Turkish market. In other words, we seek an answer to the question of whether macroeconomic indicators play an important role on the liquidity of the stock market, which represents the real markets in Türkiye.

Today, stock market indicators represent the real markets in the economic system and are seen as a barometer for the general course of the economy in terms of production, investment, demand and savings.

This study utilizes quarterly time series data covering the period from 2006:Q2 to 2023:Q2. Data on central government expenditures are sourced from the consolidated financial statements available on the official website of the Republic of Türkiye's Ministry of Treasury and Finance and are expressed as a ratio to Gross Domestic Product (GDP). BIST 100 trading volume and closing price data, which are necessary for illiquidity calculations, are retrieved from the Finnet analysis expert platform, offering insights into publicly listed companies. Additionally, time series data on key macroeconomic indicators-including gold prices (per ounce), exchange rates, deposit interest rates, Brent oil prices, the industrial production index, and the consumer price index-are collected from the corporate website of the Central Bank of the Republic of Türkiye (CBRT). Further details on the variables and data sources used in this study are provided in Table 1.

Table 1: Variables

Symbol	Variables	Source
VOL	BIST 100 Trade Volume	Finnet Analysis Expert
ILQ	BIST 100 Illiquidity Measure	
CGE	Central Government Expenditures	Ministry of Treasury and Finance
DIR	Deposit Interest Rate	Central Bank of The Republic of Türkiye
GP	Gold Prices	
DER	US Dollar Exchange Rate	
BOP	Brent Oil Price	
IPI	Industrial Production Index	
CPI	Consumer Price Index	

As seen in Table 1, VOL and ILQ are taken as dependent variables in the regression models of our study. Volume in the table is the quarterly trading volume data of the BIST 100, while ILQ is the illiquidity measure of the BIST 100 index calculated by us as calculated by Amihud (2002). Amihud's illiquidity measure (ILQ) is calculated using the following mathematical method.

$$(ILQ_t = 1/D_t \times \sum_{d=1}^{D_t} |Return_{t,d}| / (Trading Volume_{t,d})) \quad (1)$$

In formula 1, t is the quarter period, d is the trading day, D is the total number of trading days in the quarter period, and $||$ is the absolute value. The return value is calculated with the formula $(\text{return}_t = (\text{closing price}_t / \text{closing price}_{t-1}) - 1)$. The research model developed by Ülengin and Yobaş (1997), Yobaş (2014), Choi and Cook (2006), Fernández-Amador et al. (2011), Florackis, Giorgioni, Kostakis, and Milas (2014), Chowdhury et al. (2018), Onyele et al. (2020), Mannoun and Sjöblom (2021), Debata, Dash, and Mahakud (2021), Siddiqi et al. (2021), Chiad and Hadj Sahraoui (2022), and Lyu and Hu (2024) is grounded in an empirical approach.

Our independent variables, which we focus on in this study, are accepted as determinant macroeconomic indicators in the change in stock market performance in the liquidity literature. In this respect, we believe that this study, which aims to analyze the long and short-run dynamic relationship between stock market liquidity and macroeconomic indicators, will provide important evidence on the reflections of monetary and fiscal policy decisions on the stock liquidity of the real sector in Türkiye. The methodology followed in the econometric analysis process for the validity and reliability of the regressions of the models established in the study is as shown in Figure 1.

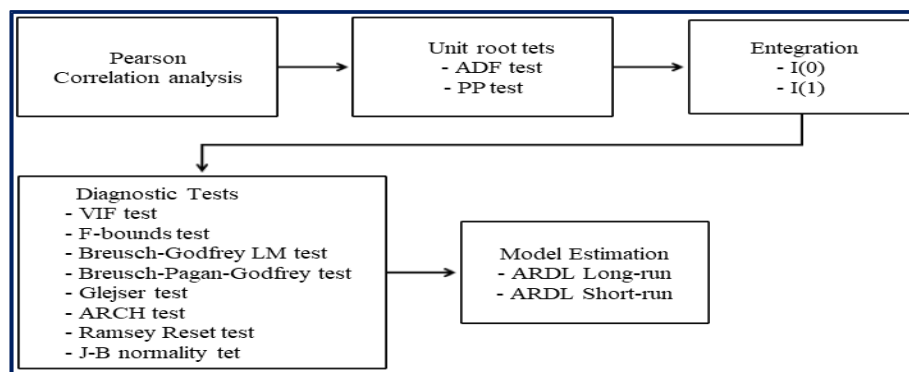


Figure 1: Methodology Flow Diagram

As illustrated in Figure 1, before assessing the long- and short-term impacts of macroeconomic factors on stock market liquidity, it is essential to prevent spurious regression results through appropriate statistical analyses. Accordingly, preliminary tests are conducted in this study to identify the most suitable econometric estimator for regression analysis. Initially, Pearson correlation analysis is applied to determine the correlation coefficients among independent variables. Additionally, stationarity tests, including the Augmented

Dickey-Fuller (Dickey & Fuller, 1981) and Phillips-Perron (Phillips & Perron, 1988) tests, are employed to evaluate the time series properties. Finally, the ARDL model is used to obtain both long-run and short-run estimates following diagnostic tests to ensure model validity.

3.2. Descriptive Statistics

Table 2 presents a summary of the descriptive statistical analysis for the variables included in the study.

Table 2: Descriptive Statistics

	VOL	ILQ	GP	DER	CGE	DIR	BOP	IPI	CPI
Mean	0.067	-0.018	0.021	0.044	0.007	0.017	0.042	0.013	0.031
Maximum	0.532	0.910	0.165	0.297	0.258	0.525	1.663	0.157	0.116
Minimum	-0.278	-0.979	-0.128	-0.087	-0.172	-0.343	-0.793	-0.178	0.004
Std. Dev.	0.203	0.341	0.063	0.081	0.088	0.146	0.291	0.051	0.022
Skewness	0.255	0.452	0.364	1.239	0.320	0.764	2.030	-1.064	1.682
Kurtosis	2.142	3.629	2.927	4.630	2.745	4.788	15.945	6.764	5.835
J-B	2.861	3.485	1.538	25.308	1.365	15.902	52.916	53.777	55.651
P-value	0.239	0.175	0.464	0.000	0.506	0.000	0.000	0.000	0.000
N	69	69	69	69	69	69	69	69	69

When the findings of the descriptive statistics reported in Table 2 are analyzed, it is seen that each variable was analyzed with a total of 69 observations from the second quarter of 2006 to the second quarter of 2023. In the data set, the percentage change of the time series of all variables compared to the previous period was first calculated and then seasonally adjusted with the "Moving Average Methods" method and used in regression analyses.

According to Table 2, which reports the descriptive results of the data, the average of the volume variable is the highest, followed by DER, BOP, CPI, GP, IPI, CGE, ILQ, respectively. The highest change compared to the previous period is BOP, ILQ, DIR, VOL, DER, CGE, GP, CPI, IPI, and the smallest change is CPI, DER, IPI, GP, VOL, DIR, BOP, ILQ. As for the standard deviation, which represents volatility, the highest is BOP, followed by VOL, ILQ, DIR, CGE, IPI, DER, GP, CPI. One of the important statistics in the table is that according to the skewness and kurtosis values indicating the normal distribution of the data set, it is seen that there is no skewness and kurtosis at a level that would disrupt normality in the data set.

3.3. Correlation

The Pearson correlation coefficients, which indicate the degree of association among the study variables, are displayed in Table 3.

Table 3: Correlation Findings

Variables	VOL	ILQ	GP	DER	CGE	DIR	BOP	IPI	CPI
VOL	1								
ILQ	-0.373***	1							
GP	-0.080	0.047	1						
DER	0.025	0.093	-0.249**	1					
CGE	-0.072	0.179	0.076	-0.071	1				
DIR	-0.208*	0.071	-0.287**	0.203*	-0.024	1			
BOP	0.124	-0.377***	0.214*	0.008	-0.082	-0.149	1		
IPI	0.313***	-0.051	0.113	-0.199	-0.250**	-0.080	-0.136	1	
CPI	0.022	0.077	-0.086	0.445**	0.032	0.330**	-0.052	-0.117	1

*** <0.01, ** <0.05, * <0.1.

Before implementing dynamic regression models, it is crucial to examine the relationships among independent variables and construct a correlation matrix to detect potential multicollinearity issues. The findings of the Pearson correlation analysis applied to the time series data, as presented in Table 3, indicate that volume exhibits the highest correlation with IPI at 31.3%, while illiquidity shows the strongest correlation with BOP at 3.7%. Further analysis of correlation values among independent variables reveals that CPI and DIR share the highest correlation at 33%, followed by BOP and DER with 0.8%. Based on these results, the correlation analysis assesses whether multicollinearity is present among the explanatory variables in the regression models. Kennedy (2003) states that when correlation coefficients remain significantly below the 80% – 90% threshold, multicollinearity is unlikely to pose a problem in model estimation. In econometric analyses involving time series data, conducting a test for linearity is essential. Additionally, stationarity and stability should be taken into consideration to ensure the robustness of the model.

3.4. Unit Root Analysis

In the context of unit root analysis, the null hypothesis assumes the presence of a unit root, whereas the alternative hypothesis suggests its absence, depending on the chosen test specification. Accordingly, before selecting the

appropriate econometric approach for this study, unit root tests were conducted using the Augmented Dickey-Fuller and Phillips-Perron methods to examine the stationarity properties of the time series. In unit root tests, the Schwarz Information Criterion (Schwarz, 1978) in ADF and Bartlett Kernel in PP are tested with Newey and West (1994) method.

Table 4: Findings of Unit Root Test

	Augmented Dickey Fuller (ADF)			Phillips-Perron (PP)			Integration
	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None	I(0)&I(1)
VOL	-7.64***	-7.78***	-7.01***	-7.85***	-9.29***	-7.02***	I(0)
ILQ	-9.27***	-9.21***	-9.29***	-9.82***	-10.01***	-9.75***	I(0)
GP	-6.78***	-6.76***	-6.39***	-6.79***	-6.78***	-6.41***	I(0)
DER	-6.36***	-7.34***	-5.31***	-6.38***	-7.31***	-5.46***	I(0)
CGE	-12.40***	-12.31***	-12.39***	-20.87***	-20.92***	-16.68***	I(0)
DIR	-4.45***	-6.16***	-4.42***	-4.58***	-4.64***	-4.55***	I(0)
BOP	-10.52***	-10.48***	-10.29***	-10.53***	-10.49***	-10.25***	I(0)
IPI	-8.86***	-8.81***	-8.40***	-9.57***	-9.51***	-8.41***	I(0)
CPI	-12.49***	-12.52***	-12.54***	-16.94***	-44.75***	-15.32***	I(1)

As presented in Table 4, the results of the unit root tests indicate that VOL, ILQ, GP, DER, CGE, DIR, BOP, and IPI are stationary at the 1% significance level according to the ADF and PP tests, regardless of trend and constant specifications. Additionally, CPI is found to be stationary at the first difference at the I(1) level with a 1% significance threshold. The stationarity properties of the time series at both I(0) and I(1) levels suggest that the ARDL (Autoregressive Distributed Lag) Bound Test method is appropriate for multiple regression analysis. This selection is based on the consideration of I(0) and I(1) critical values, as outlined in the F-bounds test proposed by Pesaran, Shin, and Smith (2001) for ARDL long-run and short-run estimations.

3.5. Econometric Model

To examine the presence of cointegration between stock market liquidity and macroeconomic variables in Türkiye, this study employs the linear ARDL method introduced by Pesaran et al. (2001). This approach is widely utilized in econometric research due to its flexibility in handling variables with different

stationarity properties. The ARDL methodology enables researchers to estimate both short-run and long-run equilibrium relationships while incorporating the lagged Error Correction Mechanism (ECM) to capture adjustment dynamics.

In the linear ARDL framework, the unit root test is applied to assess the stationarity characteristics of the time series at levels $I(0)$, first differences $I(1)$, or a combination of both, as noted by Bekhet and Matar (2013). The mathematical equations of the ARDL methodology (Equation 2, 3, 4, and 5), which are theoretically appropriate for the econometric analysis of the models established after the unit root analysis results, are formulated below. The mathematical equations used in the ARDL econometric method are as in equations 2 and 3.

Model I: ARDL Equation:

$$\begin{aligned} \Delta VOL_t = & \gamma_0 + \psi_1 VOL_{t-1} + \psi_2 GP_{t-1} + \psi_3 DER_{t-1} + \psi_4 CGE_{t-1} + \\ & \psi_5 DIR_{t-1} + \psi_6 BOP_{t-1} + \psi_7 IPI_{t-1} + \psi_8 CPI_{t-1} + \sum_{i=1}^p \phi_{1i} \Delta VOL_{t-i} + \\ & \sum_{i=0}^q \phi_{2i} \Delta GP_{t-i} + \sum_{i=0}^r \phi_{3i} \Delta DER_{t-i} + \sum_{i=0}^s \phi_{4i} \Delta CGE_{t-i} + \\ & \sum_{i=0}^k \phi_{5i} \Delta DIR_{t-i} + \sum_{i=0}^l \phi_{6i} \Delta BOP_{t-i} + \sum_{i=0}^l \phi_{7i} \Delta IPI_{t-i} + \\ & \sum_{i=0}^l \phi_{8i} \Delta CPI_{t-i} + \omega_9 ECM_{t-1} + \varepsilon_t \end{aligned} \quad (2)$$

Model II: ARDL Equation:

$$\begin{aligned} \Delta ILQ_t = & \gamma_0 + \psi_1 ILQ_{t-1} + \psi_2 GP_{t-1} + \psi_3 DER_{t-1} + \psi_4 CGE_{t-1} + \\ & \psi_5 DIR_{t-1} + \psi_6 BOP_{t-1} + \psi_7 IPI_{t-1} + \psi_8 CPI_{t-1} + \sum_{i=1}^p \phi_{1i} \Delta ILQ_{t-i} + \\ & \sum_{i=0}^q \phi_{2i} \Delta GP_{t-i} + \sum_{i=0}^r \phi_{3i} \Delta DER_{t-i} + \sum_{i=0}^s \phi_{4i} \Delta CGE_{t-i} + \\ & \sum_{i=0}^k \phi_{5i} \Delta DIR_{t-i} + \sum_{i=0}^l \phi_{6i} \Delta BOP_{t-i} + \sum_{i=0}^l \phi_{7i} \Delta IPI_{t-i} + \\ & \sum_{i=0}^l \phi_{8i} \Delta CPI_{t-i} + \omega_9 ECM_{t-1} + \varepsilon_t \end{aligned} \quad (3)$$

In Equations 2 and 3, Δ is the first difference operator, γ is the constant coefficient, ψ is the long-run coefficients, ϕ is the short-run coefficients, ω is the ECM coefficient and ε is the error term. The ECM coefficient in the models is calculated by mathematical equations 4 and 5. For ARDL, the null hypothesis (H_0 : $\psi_1 = \psi_2 = \psi_3 = \psi_4 = \psi_5 = \psi_6 = \psi_7 = \psi_8 = 0$) is the absence of cointegration, while the alternative hypothesis (H_1 : $\psi_1 \neq \psi_2 \neq \psi_3 \neq \psi_4 \neq \psi_5 \neq \psi_6 \neq \psi_7 \neq \psi_8 \neq 0$) is the presence of cointegration.

Model I: ECM Equation:

$$\begin{aligned}\Delta VOL_t = & \gamma_0 + \sum_{i=1}^p \phi_{1i} \Delta VOL_{t-i} + \sum_{i=0}^q \phi_{2i} \Delta GP_{t-i} + \sum_{i=0}^r \phi_{3i} \Delta DER_{t-i} + \\ & \sum_{i=0}^s \phi_{4i} \Delta CGE_{t-i} + \sum_{i=0}^k \phi_{5i} \Delta DIR_{t-i} + \sum_{i=0}^l \phi_{6i} \Delta BOP_{t-i} + \\ & \sum_{i=0}^l \phi_{7i} \Delta IPI_{t-i} + \sum_{i=0}^l \phi_{8i} \Delta CPI_{t-i} + \omega_{9i} ECM_{t-1} + \varepsilon_t\end{aligned}\quad (4)$$

Model II: ECM Equation:

$$\begin{aligned}\Delta ILQ_t = & \gamma_0 + \sum_{i=1}^p \phi_{1i} \Delta ILQ_{t-i} + \sum_{i=0}^q \phi_{2i} \Delta GP_{t-i} + \sum_{i=0}^r \phi_{3i} \Delta DER_{t-i} + \\ & \sum_{i=0}^s \phi_{4i} \Delta CGE_{t-i} + \sum_{i=0}^k \phi_{5i} \Delta DIR_{t-i} + \sum_{i=0}^l \phi_{6i} \Delta BOP_{t-i} + \\ & \sum_{i=0}^l \phi_{7i} \Delta IPI_{t-i} + \sum_{i=0}^l \phi_{8i} \Delta CPI_{t-i} + \omega_{9i} ECM_{t-1} + \varepsilon_t\end{aligned}\quad (5)$$

In order for the ARDL model to be stable, short-run adjustments with the ECM using equations 4 and 5, the coefficient should be negative and this coefficient should be statistically significant. The ECM works as a mechanism to adjust the speed at which shocks to independent variables in the short run lead to equilibrium in the long run.

3.6. Co-integration Analysis

3.6.1. Diagnostic Tests

Before presenting the coefficients of the ARDL analysis, diagnostic tests should be performed to ensure that the regression is not misleading. The hypotheses for the model estimation of the research are as follows:

H_0 = There is no cointegration between macroeconomic variables and stock market liquidity.

H_1 = There is cointegration between macroeconomic variables and stock market liquidity.

The coefficients of the diagnostic tests calculated to verify the existence of cointegration between the dependent and independent variables in the long run in the ARDL analysis are reported in Table 5.

Table 5: ARDL Diagnostic Test

Test	Model I ARDL (4, 4, 4, 5, 5, 5, 0, 3, 3)		Model II ARDL (1, 0, 2, 0, 0, 0, 0, 2)	
	Value	k	Value	k
F-Bounds Test	8.43	7	15.98	7
F-statistic	8.43	7	15.98	7
Critical border values				
Significance level (%)	I(0)	I(1)	I(0)	I(1)
%10	2.38	3.45	2.38	3.45
%5	2.69	3.83	2.69	3.83
%2,5	2.98	4.16	2.98	4.16
%1	3.31	4.63	3.31	4.63
R ²	0.915		0.738	
Adjusted R ²	0.838		0.711	
Breusch-Godfrey LM	0.311 F(5.21) [0.598]		1.081 F(5.48) [0.383]	
Breusch-Pagan-Godfrey	0.467 F(37.26)[0.121]		0.615 F(13.53)[0.831]	
Glejser	0.591 F(37.26)[0.930]		0.901 F(13.53)[0.557]	
ARCH	0.935 F(5.53) [0.466]		0.448 F(5.56) [0.813]	
Ramsey Reset	0.637 df(1.25) [0.432]		0.846 df(1.52) [0.362]	
J-B	1.836 [0.399]		3.763 [0.152]	
VIF	<5.5		<8.3	

Note: The numbers in parentheses [] are probability (p) values.

According to Table 5, which presents the diagnostic test results for assessing the reliability of the analysis, the critical values of the F-statistic for both models exceed those associated with I(0) and I(1) significance thresholds. Since the F-statistic value, as indicated by Pesaran et al. (2001), surpasses the critical values at all significance levels, the null hypothesis is rejected, and the alternative hypothesis (H_1) is accepted. This confirms the presence of a cointegration relationship among the variables in the long run.

The selected macroeconomic indicators account for 91.5% (R^2) and 73.8% (R^2) of the variation in stock market liquidity, respectively. Potential correlation issues within the models were evaluated using the Breusch-Godfrey LM test, variance homogeneity through the Breusch-Pagan-Godfrey test, and additional assessments such as Glejser's test, ARCH, Ramsey Reset for functional form, and Jarque-Bera (J-B) for normality distribution. The

insignificance of obtained coefficients suggests no structural issues within the models. Additionally, the Variance Inflation Factor (VIF) values remaining below 10 indicate that multicollinearity among explanatory variables is not a concern. Furthermore, based on the Akaike Information Criterion (Akaike, 1974), the optimal maximum lag length for both models was determined to be 5.

3.6.2. Long and Short Run Estimation

Following the identification of a cointegration relationship between liquidity and macroeconomic variables, the ARDL methodology was applied to examine both the long-run and short-run impacts of macroeconomic factors on stock market liquidity. The results detailing the effect coefficients for the volume model are presented in Table 6, while Table 7 provides the corresponding findings for the illiquidity model.

Table 6: ARDL Model I (4, 4, 4, 5, 5, 5, 5, 0, 3, 3) Findings

Dependent variable = ΔVOL_t				
Independent variables	Coefficient	Std. Error	t-Statistic	p-value
Long-run coefficients				
GP	-0.3708	0.3318	-1.1176	0.2740
DER	-1.7004	0.7260	-2.3421	0.0271**
CGE	4.2976	1.6897	2.5434	0.0173**
DIR	-0.2226	0.2181	-1.0205	0.3169
BOP	0.0127	0.0479	0.2659	0.7924
IPI	3.8427	1.5520	2.4760	0.0201**
CPI	4.1730	1.3886	3.0051	0.0058***
Short-run coefficients				
$\Delta(\text{VOL}(-1))$	0.9696	0.1999	4.8493	0.0001***
$\Delta(\text{VOL}(-2))$	1.0601	0.1791	5.9197	0.0000***
$\Delta(\text{VOL}(-3))$	0.9187	0.1350	6.8076	0.0000***
$\Delta(\text{GP})$	-1.3796	0.2797	-4.9324	0.0000***
$\Delta(\text{GP}(-1))$	-0.8062	0.3369	-2.3930	0.0242**
$\Delta(\text{GP}(-2))$	0.5395	0.3415	1.5800	0.1262
$\Delta(\text{GP}(-3))$	0.8977	0.2937	3.0566	0.0051***
$\Delta(\text{DER})$	-1.1765	0.2954	-3.9827	0.0005***
$\Delta(\text{DER}(-1))$	1.9472	0.3712	5.2465	0.0000***
$\Delta(\text{DER}(-2))$	2.7440	0.3077	8.9184	0.0000***
$\Delta(\text{DER}(-3))$	1.5939	0.2848	5.5975	0.0000***
$\Delta(\text{DER}(-4))$	0.4844	0.2396	2.0218	0.0536*
$\Delta(\text{CGE})$	1.5075	0.2775	5.4319	0.0000***
$\Delta(\text{CGE}(-1))$	-4.2388	0.6864	-6.1752	0.0000***
$\Delta(\text{CGE}(-2))$	-2.7364	0.5722	-4.7823	0.0001***

$\Delta(\text{CGE}(-3))$	-1.4526	0.4124	-3.5228	0.0016***
$\Delta(\text{CGE}(-4))$	-0.3809	0.2347	-1.6233	0.1166
$\Delta(\text{DIR})$	0.1011	0.1506	0.6709	0.5082
$\Delta(\text{DIR}(-1))$	0.5244	0.1728	3.0349	0.0054***
$\Delta(\text{DIR}(-2))$	0.0607	0.1575	0.3856	0.7029
$\Delta(\text{DIR}(-3))$	0.4871	0.1819	2.6773	0.0127**
$\Delta(\text{DIR}(-4))$	0.5469	0.1681	3.2537	0.0032***
$\Delta(\text{IPI})$	3.8888	0.4609	8.4383	0.0000***
$\Delta(\text{IPI}(-1))$	-3.0828	0.5620	-5.4855	0.0000***
$\Delta(\text{IPI}(-2))$	-2.3701	0.4757	-4.9824	0.0000***
$\Delta(\text{CPI})$	4.4682	1.4402	3.1025	0.0046***
$\Delta(\text{CPI}(-1))$	-2.1459	1.6258	-1.3199	0.1984
$\Delta(\text{CPI}(-2))$	-8.3527	1.5317	-5.4534	0.0000***
$\text{CointEq}(-1)^*$	-1.8803	0.2032	-9.2531	0.0000***
C	-0.2332	0.0412	-5.6633	0.0000***
@trend	0.0043	0.0096	4.5684	0.0001***

*** <0.01, ** <0.05, * <0.1.

The long-run symmetric ARDL estimation results for Model I, as presented in Table 6, indicate that stock market trading volume is significantly influenced by several macroeconomic factors. Specifically, the DER exhibits a significant negative effect, while CGE, the IPI, and the CPI have a significant positive impact. Furthermore, the coefficients for the DER, CGE, and the IPI are statistically significant at the 5% level, whereas the CPI coefficient is significant at the 1% level. According to Table 6, a 1% increase in DER decreases the trading volume by 1.7004%, while a 1% increase in CGE, IPI and CPI increases the trading volume by 4.2976%, 3.8427% and 4.1730%, respectively. The long-run effects of gold, DIR and oil prices on trading volume are not significant.

The short-run coefficient estimates for Model I suggest that the deposit interest rate, one of the macroeconomic variables considered in this study, has a positive influence on transaction volume in the short term. Meanwhile, the short-run impacts of other macroeconomic variables on transaction volume fluctuate between positive and negative values. The estimated coefficient for the error correction mechanism ($\text{CointEq}(-1)^*$) in Model I is -1.8803 and is statistically significant at the 1% level. The significance and negative sign of the ECM coefficient indicate the presence of both short-term dynamic adjustments and long-term effects. Additionally, the macroeconomic variables incorporated in the model stabilize at a rate of 188.03% following any external shock in the long run.

Table 7: ARDL Model II (1, 0, 2, 0, 0, 0, 0, 0, 2) Findings

Dependent variable = ΔILQ_t				
Independent variables	Coefficient	Std. Error	t-Statistic	p-value
Long-run coefficients				
GP	0.4507	0.5317	0.8476	0.4005
DER	-1.2785	0.7405	-1.7266	0.0901*
CGE	0.5200	0.3443	1.5105	0.1369
DIR	0.2092	0.2213	0.9452	0.3488
BOP	-0.2894	0.1205	-2.4017	0.0199**
IPI	-0.2590	0.6561	-0.3948	0.6946
CPI	4.2048	2.4285	1.7314	0.0892*
Short-run coefficients				
$\Delta(DER)$	0.9280	0.3988	2.3272	0.0238**
$\Delta(DER(-1))$	1.5393	0.4704	3.2723	0.0019***
$\Delta(CPI)$	0.2051	2.4636	0.0833	0.9340
$\Delta(CPI(-1))$	-6.5880	2.6067	-2.5273	0.0145**
CointEq(-1)*	-1.2392	0.1031	-12.0253	0.0000***
C	-0.0480	0.0696	-0.6892	0.4937
@trend	-0.0017	0.0018	-0.9605	0.3411

*** <0.01, ** <0.05, * <0.1.

In Model II, the stock market trading volume, calculated using the Amihud illiquidity method, serves as the dependent variable. Within this framework, negative coefficients on illiquidity indicate increased liquidity, whereas positive coefficients suggest reduced liquidity. According to Table 2, which outlines the results of Model II, an increase in exchange rates and Brent oil prices exerts a negative impact on stock market illiquidity, whereas the consumer price index has a positive effect on liquidity. While the influence of Brent oil is statistically significant at the 5% level, both the exchange rate and consumer price index effects are significant at the 1% level.

In terms of short-run dynamics, the exchange rate effect is observed to be negative, whereas the consumer price index effect is positive. The estimated ECM coefficient for the model is -1.2392, which is both negative and statistically significant at the 1% level. This outcome suggests the presence of long-term stability and cointegration between macroeconomic factors and stock market trading volume. Furthermore, the negative and significant ECM coefficient implies that short-term effects are influential, and in the long run, macroeconomic variables stabilize 123.92% of the time when exposed to external shocks. To

further validate the stability and reliability of Model I and Model II, CUSUM and CUSUMQ tests were conducted, with their graphical representations provided in Figure 2.

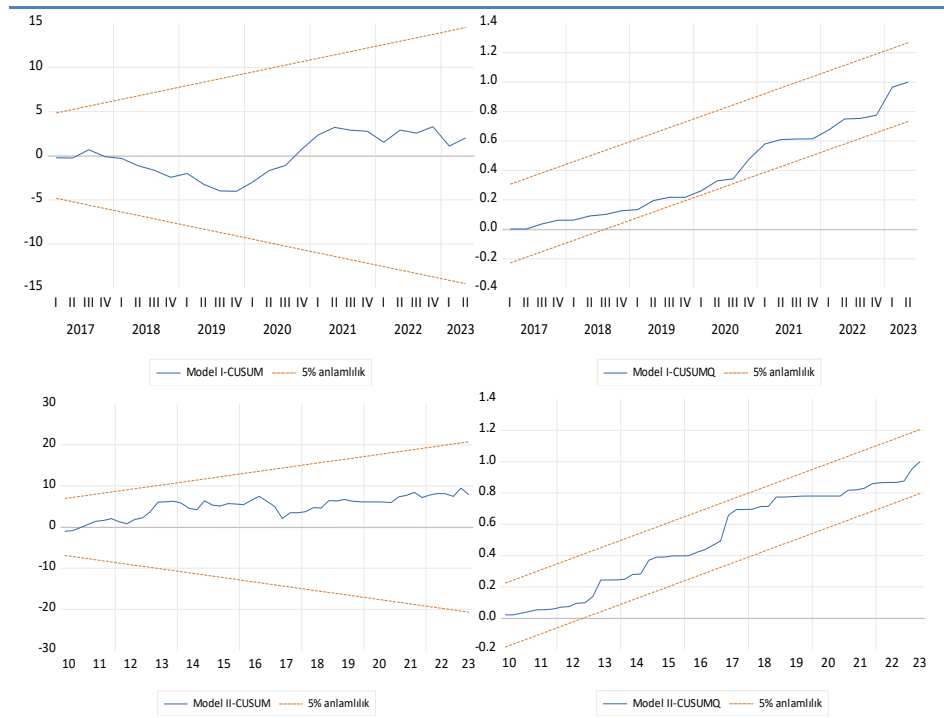


Figure 2: CUSUM and CUSUMQ Graphs

The CUSUM and CUSUMQ graphs in Figure 2 indicate that the models remain within the red lines. This suggests that all regression coefficients fall within the critical limits at the 5% significance level, confirming the stability of the models (Brown, Durbin, & Evans, 1975). Results obtained using two different liquidity measures in an emerging market context suggest that monetary and fiscal policy tools exert significant influence on stock liquidity fluctuations in both the long and short run. In our empirical analysis, exchange rates and inflation exhibit notable long- and short-run effects across both liquidity models. However, a comparison between the results in Tables 6 and 7 suggests that the relationship between macroeconomic indicators and BIST 100 liquidity, as measured by two different approaches, lacks full consistency.

Our empirical results show that the macroeconomic consequences of monetary and fiscal policy actions taken by governments in Türkiye are important

for the efficiency and stability of the stock market. Therefore, when the economic authorities want to intervene in the market by regulating the amount of liquidity through expansionary and contractionary monetary and fiscal policy, they should pay special attention to strengthen the liquidity expectation management of investors in the stock market so that stock market liquidity is not adversely affected. In this respect, institutional policies and strategies for the stock market should be compatible with liquidity dynamics in order to make investors' perceptions more attractive, increase market depth, provide confidence and increase stock market performance by ensuring stability. This is because economic policies that are prepared in a way to take into account the financial dynamics of the market are thought to increase the liquidity provision activities in stock markets, the liquidity of capital market instruments, and thus the ability of these instruments to be traded, making them more durable. Therefore, considering the importance of market liquidity for the general economy, since all companies operate within the macroeconomic cycle, the relationship between macroeconomic dynamics and stock market liquidity should not be ignored in terms of investment decisions, investment performance and economic policies.

The findings between both liquidity measures and some macroeconomic indicators used in the study support the evidence of macroeconomic indicators used by Ülengin and Yobaş (1997), Chordia et al. (2001), Karamustafa and Karakaya (2004), Mousa (2016), Chowdhury et al. (2018), Ekinçi et al. (2019), Siddiqi et al. (2021), Naik and Reddy (2024).

4. CONCLUSION AND RECOMMENDATIONS

Today, the stock market has become an important institution that attracts considerable attention from investors, stakeholders and governments. Liquidity, which is an important function of this market, is a product of modern finance and is a monetary amount generated as a result of buying and selling activities in the stock market. Stock liquidity is recognized as an important indicator for the development and efficiency of stock markets, which have a dynamic structure. Moreover, since stock markets represent the real markets in the economic system and are seen as a barometer for the general course of the economy, it is important to analyze the dynamics of these markets. In this respect, how stock liquidity is affected by external macroeconomic dynamics has attracted a great deal of attention in institutional and modern macro finance research in recent years.

Based on the importance of stock market liquidity in terms of investment and economic policies, it is investigated whether the liquidity movements of the BIST 100, which includes the 100 companies with the highest trading volume and market capitalization in Türkiye and is considered as the main indicator of

the stock market, are affected by macroeconomic indicators, and if so, in which direction. Two different measures of stock liquidity are analyzed in the study. The data set of the study consists of 69 quarterly linear data corresponding to the variables from March 2006 to June 2023. According to our long-run analysis results, higher central government expenditures, industrial production index and consumer price index imply higher trading volume in Türkiye, while exchange rate implies lower trading volume. In the case of illiquidity, higher exchange rate and oil prices correspond to higher liquidity and lower liquidity in the consumer price index. The short-run effects are either positive or negative. Overall, we believe that our findings will be useful in providing economic information to market conditions and hence investor expectations. The literature review reveals that many studies have been conducted on the relationship between macroeconomic indicators and stock liquidity and these studies have been conducted especially in developed economies. In Türkiye, Karamustafa and Karakaya (2004), Canbaz (2019), Güzel and Şekeroğlu (2021) and Yılmaz (2023) examined the relationship between stock market liquidity with Turkish data. We believe that both the small number of studies in Türkiye and the macroeconomic indicators, different liquidity measures and different methods used in our study will make the study unique and make a significant contribution to the gap in the literature.

Finally, liquidity, which is an important function of capital market development, financial market stability and stock market, has become a critical issue among academics, regulators and practitioners due to its possible relationship with various macroeconomic variables within the basic dynamics of the stock market. A comprehensive investigation of the relationship between macroeconomic policies and the stock market liquidity mechanism provides an important output for policy makers in terms of seeing the effects of the implemented economic stabilization policy on the markets. This is because once academic research in the field understands the impact of economic policies and trade rules on stock market dynamics, both policymakers and individual and institutional fund managers can better strategize on market characteristics and regulations to improve stock market liquidity and efficiency.

Given the results of the relationship between macroeconomic policies and stock market liquidity, it is recommended that more studies be conducted to understand this relationship, especially in emerging economies. These studies will provide more comprehensive findings and policy implications for regulators and market participants. In the future, researchers are advised to conduct new studies considering different countries, country groups, econometric methods and liquidity measures such as TURNEOVER, ROLL, HLCS, LOT, QSPREAD.

5. CONFLICT OF INTEREST STATEMENT

There is no conflict of interest between the authors.

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7. AUTHOR CONTRIBUTIONS

TY, AA: Idea;

AA, TY: Design;

TY, AA: Processing and/or processing of resources;

TY: Analysis and/or interpretation;

AA, TY: Literature review;

TY, AA: Written by;

TY, AA: Critical review

8. ETHICS COMMITTEE STATEMENT

The methods and data used in the study do not require ethics committee approval.

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