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ANALYSIS OF PRICE BUBBLES IN BORSA ISTANBUL (BIST) LIQUID BANKING SECTOR STOCK MARKET

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ABSTRACT

The study investigates the stock price bubbles of the liquid banking sector index (XLBNK) and its six constituent banks in the BIST primary sector. Price bubbles are one of the important factors that trigger financial crises. Detection of bubbles in the financial sector serves as a warning for preventing crises and developing preventive policies. The GSADF test method developed by Phillips, Shi & Yu (2015) is used to analyze bubbles. The results show that there has been a structural break in the value of the Turkish XLBNK index and its component stocks since the last quarter of 2021, and more than one bubble has formed. However, there is no statistical evidence of a bubble in the share values of Halk Bank, a component of the XLBNK index.

Regarding bubble formation, the structural break in the XLBNK index and shares since the last quarter of 2021 reflects the inconsistency and structural breaks in Turkey's macroeconomic indicators and monetary policy. The observed bubbles in the share pricing of the XLBNK index and its component banks continued to persist in the third quarter of 2024 when the study was conducted. The revelation that bubbles persist in the current situation contributes to the convergence of asset prices to intrinsic prices through investor decisions, the consistent formation of asset pricing, and the effective functioning of the markets. Regarding portfolio management, the results can be used in making profit realization decisions by removing persistent stocks from the portfolio, reducing portfolio risk, and supporting investment decisions.

Keywords: *Price bubbles, Stock price bubbles, BIST Liquid Banking sector, GSADF test*

1. INTRODUCTION

In the literature, financial crises occur in three stages: 'frenzy, panic, and collapse.' Among the causes of most financial crises, price bubbles that occur when asset prices break away from economic fundamentals are cited (Kindleberger & Aliber, 2014; Özatay, 2014, p. 32; Caspi & Graham, 2018). Price bubbles are defined in the literature as 'when the market price of an asset traded by investors exceeds the intrinsic value of the asset in the market and moves away from the random walk process' (M.H. Smith & G. Smith, 2006; Koy, 2018). Price bubbles will likely occur in almost all asset pricing subject to trading. Price bubbles have a wide range of caus-

es, such as speculative movements, credit expansion, irrational investor behavior, speculative portfolio capital movements, information asymmetry, and moral hazard (Lind, 2009; Chang, Gil-Alana, Aye, Gupta & Ranjbar, 2016; H. Wang, X. Wang, G. Wang, Bu & Pan, 2018). The earliest known examples of price bubbles are the 1637 Dutch tulip price bubble and the 1720 Mississippi South Sea Company stock bubble. The most recent examples are the bubble in Emerging Economies (EMEs) due to credit expansion in 1970, the Japanese asset price bubble in 1980, the bubbles in property prices and stock prices in Asian countries in 1992-997, the bubble in the stocks of internet companies in 1990-2000, and the bubble in the housing sector in the USA in 2008 (Caspi & Graham, 2018; Akdağ, 2020; Yıldırım, 2021; Işıldak, 2022). It is widely recognized in the literature that price bubbles occur in different sectors in different periods, and the pricing of all kinds of commodities and assets is subject to trading in financial markets. For example, real estate price bubbles in the real estate sector, exchange rate bubbles in foreign exchange markets, bubbles in commodity prices such as copper, silver, gold, and oil in commodity markets, cryptocurrency price bubbles such as Bitcoin Ethereum in the crypto asset market, stock market sector indices and securities pricing bubbles such as stocks (Güler & Gökçe, 2020; Shi, 2017; Lucey & O'Connor, 2013; Landgraf, 2016; Yanık & Aytürk, 2011; İskenderoğlu & Akdağ, 2019).

The causes of bubbles in different sectors and the factors triggering the bubble differ according to the sector and the type of financial assets. While low interest rates in the banking system lead to credit expansion and subsequent credit bubbles, the excessive demand and liquidity created may trigger bubbles in housing and other commodity prices (Kushnir, Kovshun, Adamchuk, Tymeichuk & Tsaruk, 2023). Before the 2008 global crisis, the excessive demand created by banks' lending housing loans to sub-threshold individuals for house purchases and people's expectations that house prices would increase more or continue to increase in the future led to housing market bubbles (Güler & Gökçe, 2020). Similarly, in the stock market, expectations that the price of shares will increase trigger stock price bubbles. Theoretically, while the price of an asset should normally be determined based on economic fundamentals, expectations that prices will increase sometimes break the link between asset prices and economic fundamentals and cause price bubbles. For example, in the 1992-2000 period, the economic link between the share values of the US New York Stock Exchange and the national income in the country was broken. While the total value of the stocks in the New York Stock Exchange increased by 295 percent, the national income increased by only 31 percent (Boratav, 2011, p. 143). The detachment from economic fundamentals and expectations paves the way for asset prices to move away from their intrinsic value and become a bubble after a certain threshold. Investors who realize that a bubble has formed in the markets tend to sell for profit realization, causing financial crises in the markets and destabilizing the stability.

The negative effects of the deflation of bubbles are likely to spread to the economy in general, starting from the sector where the bubble was formed. In particular, globalization and technological developments in the financial field and the integration of financial markets increase the speed of the spread of negative effects and the potential to affect the surrounding countries (Özatay, 2014, p. 59; Boratav, 2011, p. 135). There is evidence that Turkish markets have been affected by the bubbles in the US markets and that asset prices have been exposed to the impact of exogenous financial bubbles despite the improvements in the Turkish economy (Hatipoğlu & Uyar, 2011). The negative repercussions of bubbles in financial markets during the deflation phase are much faster than in the real sector due to the speed of the contagion effect. The deflation phase of price bubbles, especially when combined with credit bubbles, affects many components of the overall economic structure, such as economic contraction or recession, unemployment, slowdown in production, and destabilization of financial markets and disrupts

balances (Caspi & Graham, 2018; Yıldırım, 2021; Özatay, 2014, p.28; Jordà, Schularick & Taylor, 2015; Jordà et al., 2016). Studies in the literature show dynamic linkages between stock markets due to the contagion effect and that short-term fluctuations between markets and indices rebalance in the long run (Kadiri, Oukhouya, Belkhoutout & Himdi, 2024). For this reason, it is very important to examine the detection of bubbles in the markets in different time series in order for investors to have foresight about how far the current prices are moving away from the intrinsic price of the asset for the convergence of asset prices to their intrinsic prices and the efficient operation of the markets.

The banking system is one of the institutions that play an important role in the effective functioning of financial markets that manage and direct liquidity in fragile five countries such as Turkey (Akbulut, 2024). The banking sector is one of the important monetary transmission channels of the financial sector and money markets (Siagian, 2023). There are 54 banks in the banking sector in Turkey. The six banks that constitute the stock market (BIST) XLBNK index and analyzed represent more than 50% of the sector in terms of the number of branches, asset size, equity owned by the sector, and number of employees (Table 2). The six banks in the XLBNK index have a significant market share in the entire sector, and the bursting of a bubble that may occur in the sector's stocks has a high potential to affect the real sector and all other sectors in a chain. Therefore, analyzing and monitoring the existence of price bubbles in banking system stocks increases the issue's importance.

In this study, the existence of bubbles in the XLBNK general index, which constitutes the building block of the financial system, is first tested using the GSADF test. Then, the stocks of each Bank constituting the BIST XLBNK index are analyzed individually using the same method. Knowing the beginning and duration of the formation of price bubbles in the stock market, the stage of the bubble, and determining whether the bubble's effects persist are of great importance in making portfolio investment decisions. The results can be used in speculative trading decisions to obtain high returns. Investors can be protected from price fluctuations by staying away from the stocks in question during the peak periods of the bubble. It can support the decisions to include XLBNK stock, where a bubble is detected, in the portfolio or to remove and add all sectors' stocks from the portfolio. Both profit realization and risk can be reduced by removing XLBNK stocks from the portfolio. The results may contribute to the formation of efficient market conditions through trading decisions by warning investors that stock prices are moving away from their intrinsic value. It may inform policymakers and implementers in Turkey, such as the government and the Central Bank (CB), on the relationship between stock market bubbles and macroeconomic indicators.

The paper is designed in three stages. Firstly, a broad theoretical background on price bubbles and their causes is presented. Then, studies on the methods used in the literature to investigate price bubbles are presented. In the second part, price bubbles in the BIST XLBNK sector are analyzed and interpreted using the GSADF test method, which also considers the weaknesses of the ASDF test, which is more up-to-date in detecting bubbles. The analysis results aim to determine whether the BIST XLBNK sector index and the bank share prices that make up the index have moved away from their intrinsic value and relationship with economic indicators.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2. 1. THEORETICAL FRAMEWORK AND PRICE BUBBLES

Bubbles are the deviation between the intrinsic value of stock under efficient market conditions and the price investors trade under market conditions (Lelpo & Kniahin, 2020). The efficient markets hypothesis argues that if the markets are fully efficient, the spread should not

occur. The efficient market hypothesis assumes that an asset's most recent price data reflects all open or closed information that has reached the market until that day. According to the theory, investors make rational decisions to maximize their utility by processing all the information available to the market (Shiller, 2000). Under this assumption, prices should not deviate too far from their intrinsic value. However, it is known that not all financial markets on a global scale have efficient market characteristics and that there are strong, semi-strong, or weakly efficient markets (Fama, 1970). Today, it is not possible for markets to operate fully and efficiently due to problems such as differences in the level of education, differences in the level of information, the existence of insiders, information asymmetry, and the inability to interpret information at the same level. In efficient markets, since investors have similar levels of information, the same level of expectations are formed under the same conditions due to evaluating the available information. In this case, under efficient market conditions, a stock is expected to reach equilibrium by equalizing its intrinsic price and expected price, and the opportunity for investors to make excessive gains is eliminated (Tamer & Kayalıdere, 2002; Sümer & Aybar, 2016).

Efficient markets contribute to eliminating short-term price differences between markets through arbitrage transactions and the convergence of prices between markets. In the literature, on the contrary, the unpredictability in the emotions of arbitrageurs, the risks of using leverage, the pressure of managing other people's savings, and the pressure of the risk of failure to reduce their positions in the event of overpricing weaken the power of arbitrage to eliminate Intermarket price differences and its effect on bubble formations (Barberis, Shleifer & Vishny 1998). In other words, it is stated that arbitrage fails to eliminate mispricing or stabilize price formations and prevent price bubbles, and therefore, the efficient markets hypothesis cannot be fully operationalized in financial markets. For the reasons explained above, from time to time, prices in stock markets move far away from their intrinsic value, and price bubbles occur (Seddik, Routaib & Elhaddadi, 2023). Although the intrinsic value of a stock can theoretically be estimated, investor expectations, irrational investor decisions, excessive liquidity, speculative trading, speculative capital movements, and social media manipulations, which have become increasingly widespread in recent years, cause overpricing in stock pricing. Therefore, there has been a growing interest in the finance literature to understand the causes of price bubbles and the factors and mechanisms affecting price formation in recent years. The post-1980 financial globalization and behavioral finance theories developed through the cooperation of psychology and finance disciplines have also brought different perspectives to the research on understanding bubbles (Bohl, 2003; Caspi & Graham, 2018).

Behavioral finance argues that investor psychology and media influence are important in pricing financial assets and forming price bubbles. In the formation of investor psychology in buying and selling decisions in a financial market, there are many factors such as investors' expectations, regrets, overconfidence, over-insufficient or late reactions, intuitions, gambling behaviors, guidance of famous investor experts in the media, differences in trading according to gender, risk appetite, and the comfort of winning (Shiller, 2000; Barber & Odean, 2002). Especially in crisis and uncertain environments, investors may show unpredictable behaviors for reasons such as herd psychology, exaggeration of their abilities, the perception they already know, and optimistic thinking about the stocks they have traded before (Shevchenko, 2023). Their psychological states and prejudices cause them to remain unresponsive in some cases and, in some cases, to make buying decisions in excitement (Küçüksille & Usul, 2013). Such irrational behaviors can sometimes cause unexplained price bubbles in stock markets. Behavioral finance theories, which investigate how people behave under certain conditions, are used to analyze bubbles and try to explain the causes of market bubbles with irrational investor behavior.

While the behavioral finance literature argues that investors trading in the markets are not ra-

tional in reality, traditional finance theory argues that investors behave rationally and prices will be close to real in efficient markets with investors having all the information. The informational heterogeneity of market investors may sometimes pave the way for speculative buying decisions, and price bubbles continue to form even in the absence of speculative movements (Tucker & Xu, 2024). For example, long-term good news about the stock is given to the market in the stock market, and the firm can push the stock price away from its intrinsic value. Studies in the literature show that stocks that have been fed with good news for a long time in the past tend to move away from their intrinsic value after a certain threshold. On the other hand, it has also been found that stocks fed with overly optimistic news provide low average returns. The reason for this is that stocks with good news are first exposed to high pricing and tend to return to their average value after the bubble formed by high pricing deflates (Barberis et al., 1998; Fama & French, 1992; Lakonishok, Shleifer & Vishny, 1994; La Porta, 1996).

As the studies on price bubbles have deepened, it has been revealed that information asymmetry is also among the causes of price bubbles (Chang et al., 2016; Wang et al., 2018). The efficient market hypothesis developed by Fama argues that people behave rationally, and prices in the market are formed after all information is rationally filtered and processed. In other words, the current price data reflects all past information processed by economic agents on prices. Under these conditions, bubbles should not form in the market, and speculative returns are impossible. Investors can make excessive gains only when they access information the market does not know and trade in line with the information they obtain. In recent years, developing technologies and artificial intelligence play an important role in the rapid processing of information in the field of finance. However, it leaves the final decision to the investor himself. (Yuspin & Iksan, 2024). Due to information asymmetry, investors who have the information first or more information motivate the market to believe that the financial asset will rise further, thus creating an environment for prices to move away from their intrinsic value. The bubble bursts when investors decide to sell after a certain threshold to realize their profits in the face of higher-than-expected prices. Apart from information asymmetry, some studies in the literature find that price bubbles are related to capital flows and moral hazard. Sarno & Taylor (1999) argue that the asset price bubbles that caused the Asian crisis were caused by moral hazard. They define moral hazard as financial institutions financing risky investors and risky assets to make their financial structures look strong. They find that financial intermediaries such as banks direct financial resources with low financing costs to risky investors to purchase risky assets. Thus, excessive demand leads to strong asset price bubbles. The panic and collapse caused by the deflation of the bubbles, the fall in prices, the deterioration of the financial structures of financial intermediaries, and the process that continues in a chain with their bankruptcy pave the way for some financial institutions to cease their activities and asset prices to fall rapidly. Afterward, the crisis cyclical movement was completed with the acceleration of capital outflows from the financial market.

While capital outflows deepen the effects of the financial crisis in a cascading manner, they negatively affect asset prices due to the low demand in the stock market. In particular, excessive capital inflows to EMEs such as Turkey through portfolio investment channels may lead to excessive demand in the stock market as excessive capital inflows are directed to the stock market for speculative purposes, which may cause bubbles by increasing prices and expectations upwards. In a study on 27 EMEs, Ahmed, Rosser & Uppal (2010) find that regime changes in capital flows lead to speculative capital flows, most of which fuelled price bubbles in EMEs. In emerging markets such as Turkey, capital inflows aiming to make speculative gains are high in some periods. Capital inflows facilitate investors' access to cash assets and reduce the costs of cash asset acquisition.

The concept of cash assets refers to debt that can be obtained with low financing costs, a dividend payment, a bonus received to be spent, donations, inheritance, and various payments. The high

amount of cash assets investors hold increases the possibility of speculative purchases in stock markets. In the liquidity preference theory, Keynes states that people hold money for three purposes (transaction, precautionary, and speculative). Unlike the classical view, Keynes evaluates money differently other than as a medium of exchange and emphasizes that, apart from the first two, liquidity held for speculative purposes is held for the purpose of making a profit by turning the changes in the prices of possible assets into an opportunity (Keynes, 1936). Liquidity held for speculative purposes will be directed towards the purchase of an asset because of forecasts that the price of any asset will increase in the future or that its current price is too low. Demand after a certain threshold may cause price bubbles by pushing the price of a financial asset away from its intrinsic value. Another reason that increases the amount of cash assets investors hold is credit expansion, in other words, the amount that can be borrowed. According to the liquidity preference theory, banks' lending higher amounts at low interest rates during the expansion phase of the economy - excessive credit expansion - affects the demand for holding money for speculative purposes and increases the demand for asset prices. It is argued that credit expansion leads to asset price bubbles, triggers economic crises, and causes financial instability (Minsky, 1986). A study on the Saudi Arabian stock market for the 1998-2014 period using the GSADF test method shows that credit expansion and money supply affect bubble formation (Alwagdani, 2015). Apart from excessive liquidity expansion, there are approaches such as financial asset pricing theory and expectation theory that explain the reasons affecting the prices of financial assets.

Financial asset pricing theory emphasizes that the price of an asset is formed based on economic fundamentals such as production capacity, profitability, debt ratio, equity adequacy, profit margin, market share, etc. On the other hand, expectation theory argues that the future price of an asset is formed by the cumulative sum of the expectations formed in investors' minds about that asset's future price. In other words, if most investors in the market expect that the price of a financial asset will increase, the price of that asset will most likely increase in the future. This is because other investors will act in line with the expectation formed in the market, and the 'self-feeding expectation prophecy' will most likely cause the asset's price to increase (Özatay, 2014, p. 43). The realization of the formed expectation creates a difference between the intrinsic price of the asset that should be in the market and the price formed due to expectations. This difference is described as a bubble in the finance literature, and after a certain threshold, the bubble deflates with the break at the point where new investors are not added to the expectation chain (Kindleberger & Aliber, 2014, pp. 17-23).

Studies on the prediction of price bubbles argue that some price volatility in the market and excessive price fluctuations may be leading indicators of price bubbles (Brunnermeier & Oehmke, 2012). It is emphasized that price volatility is low in the initial phase of bubble formation. In contrast, price volatility is high at the bubble's peak and in the transition phase to deflation (Kindleberger & Aliber, 2005, pp. 19-23). From another perspective, detecting a bubble in stock markets is a sign that the markets are not operating efficiently (Bozoklu & Zeren, 2013). Using this information, investors can follow strategies such as removing stocks with high price volatility from their portfolios, reducing trading frequency and leverage ratios, setting stop limits on their transactions, and using hedging methods when price volatility is high (Vunjak, 2018).

2. 2. LITERATURE REVIEW

The depth of Turkey's financial markets is not very high, ranking 42 out of 183 countries in the IMF ranking, and needs improvement in increasing financial depth (Şengül & Çinko, 2024). Investors mostly trade in the banking system and the stock market. The two-way pass-through of liquidity from the banking system to the stock market strengthens the relationship between the two markets. Credit expansion and interest rate cuts in the banking system can stimulate the

stock market, and when the stock market rises in Turkey, the banking sector plays a leading role in this rise (Alptürk, 2022). Because bank shares are safer than other businesses, banks in Turkey are audited by the Banking Regulation and Supervision Agency in terms of establishment, management, financial reporting, loans, and equity within the framework of Banking Law No. 5411. They are subject to sanctions in risky situations, and the risk of bankruptcy is minimized. Banks also enjoy privileges such as the ease of obtaining financing from the CBRT as the lender of last resort. For this reason, liquidity freed from deposits will likely be directed towards banking stocks in the stock market. The demand for banking stocks can turn into a bubble when foreign inflows through the portfolio channel and foreign share purchases (Sarnoa & Taylor, 1999), combined with the high profits announced by banks and the idea of investors to compensate for the decreasing value of their savings against high inflation (Alptürk, 2022; Omağ, 2009). In Turkey, the Central Bank is the supreme monetary policy authority and the supreme unit of banks, and its decisions sometimes undermine the efficiency of the markets. Vulnerabilities in interest and exchange rate policies, suppression of interest rates and exchange rates that occur outside the supply-demand balance, rising inflation exposing savers to negative real returns, and returns on assets such as gold and oil affect stock markets (Sevinç, 2014; Güngör & Kaygın, 2015). Investors may be directed to the riskier stock market because their risk-free return deposits are below inflation, increasing the demand for shares and causing price bubbles. The literature also emphasizes that central banks' and governments' expansionary monetary policy interest rates are below inflation, and changes in gold, oil, and other assets may cause bubbles in the stock market.

When the theoretical background of price bubbles is analyzed, it is seen that they have many causes. Thanks to the broad background presented in this study section, investors can have an in-depth and multidimensional perspective on how bubbles are formed. The gain obtained may contribute to investors' analyses of the relational dimensions of bubbles in stock markets. In addition, the fact that investors have the competence and knowledge to detect the existence of stock bubbles within the framework of the analyses made below may contribute to developing many alternative strategies to reduce portfolio risk in case of possible sudden deflation of bubbles using the above information. It may inform monetary policymakers, such as the Central Bank of Turkey, on the relationship between stock market bubbles and macroeconomic indicators.

Turkey experienced many crises in the long term in 1994, 1998, 2001, 2018, and 2021 due to exchange rate shocks and failures in the banking system. The banking system is one of the most important parts of Turkey's financial system, and the stability in this sector can potentially affect the entire financial market. The study can contribute to the financial system's stability in Turkey by detecting the bubbles in the banking sector stocks in the BIST stock market and adding a leading indicator of a possible crisis to the literature. It can support portfolio investors in portfolio diversification decisions by supporting their analyses and selection decisions regarding the sector.

The studies in the literature generally focus on the stock market indices of a country or cross-country stock market indices and the effects of economic and financial indicators such as USD, Gold, Bitcoin, interest, and inflation on bubble formations. In the literature, it is not analyzed in detail which stocks constituting the sector component feed the bubble in a sector index (Table 1). In addition, it is weak in explaining how the information and findings obtained to determine the existence or deflation of price bubbles will be used in portfolio management and its relationship with portfolio management. This is because portfolio construction and decisions to add or remove new stocks can only be made after a stock-by-stock analysis. In this respect, the study fills the gap in the literature in terms of identifying the stocks that feed the bubble on the index by analyzing the BIST liquid banking index (XLBNK) and the six banks that make up the index separately and combining the information and findings obtained with portfolio management theories. In the literature, many methods are used to detect bubbles, and studies on the

detection of price bubbles with new methods developing daily attract great attention. Extensive literature on the detection of price bubbles and the methods they use is presented in Table 1.

Table 1. Methods and findings used in the literature to detect price bubbles

Author	Year	Variables	Method	Findings
Sarnoa & Taylor (1999)	Data period varies by country	8 East Asian countries, Japan and Australia, monthly aggregate stock price and dividend data	RALS cointegration test and standard cointegrated regression Dickey-Fuller statistics	Price bubbles exist in all countries except Australia. Capital inflows cause them to go through the portfolio channel created by financial intermediaries and moral hazards. Bubble deflation causes a cyclical movement of capital outflows. Bubbles and capital inflows were the triggers of the 1998 East Asian crisis (China, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand, Japan, and Australia).
Altay (2008)	1998-2006	7 indices in BIST	Linear and nonlinear unit root tests (Extended Dickey-Fuller unit root and KPSS stationarity tests)	Price bubbles are detected in BIST indices, but the study does not explain which stocks feed the bubbles in the indices.
Ahmed et.al.,2010)	1995).-2006	Daily equity market returns in 27 EM markets in Asia, Africa, South America, and Eastern Europe	For the possible existence of nonlinear speculative bubbles using the Hamilton regime-switching model and Hurst Exponent - Rescaled interval (R/S) Analysis	27 provides strong evidence for the existence of speculative bubbles in country equity markets in EME markets. The detection of bubbles in many country stock markets suggests that bubbles are a global problem.
Yanık & Aytürk (2011)	2002-2010	BIST100 index	Nonparametric time dependence test	Under extreme positive return conditions, the Turkey BIST 100 index does not experience a price bubble, proving that excess returns do not cause bubbles.
Bozoklu & Zeren (2013)	1998-2013	BIST stock price and return index	Conventional and hidden cointegration tests	A long-run relationship exists between the BIST return and stock price indexes. However, this relationship does not cause a bubble in the stock market.
Rotermann & Wilfling (2014)	Artificial 21-year monthly dataset with 250 observations	Artificial Stock price	Evans bubble test, Evans bubbles with current-valued stock price model (Evans, 1991).	Bubbles create volatility in stock prices, and price volatility peaks during the bubble-bursting phase. Price volatility is an indicator of a bubble.
Cağlı & Mandacı (2017)	2006-2016	21 indices and dividend rates in BIST	Tested for the existence of a rational speculative bubble using the GSADF test	A speculative bubble is detected in all indices except for the Banking and Holding indices, which constitute the subcomponent of the Financial sector index, and the Trade Industries indices, which constitute the subcomponent of the Food and Service sector. Exchange rates, real sector confidence index, and total industrial production index have a negative effect on BIST indices.

Author	Year	Variables	Method	Findings
Koy (2018)	January 2001 to July 2017	BIST100: Turkey, BOVESPA: Brazil, IDX Composite: Indonesia, IPC: Mexico, IPSA: Chile, KOSPI: South Korea, MCX: Russia, NIFTY50: India, QE All Share: Qatar, WIG20: Poland)	(SADF) Sup Augmented Dickey-Fuller and (GSADF) Generalized Sup Augmented Dickey-Fuller test	Multiple bubbles were found in the indices of all markets except the Polish WIG20 index. The results draw attention to the existence of multiple bubbles in many countries.
Nartea, Cheema & Szulczyk (2018)	1970-2013	Indonesia and Singapore stock market closing prices and stock market indices	Application of Duration dependence test to stock closing prices	No bubble was detected in the Singapore stock market. In the Indonesian stock market, a bubble was detected in weekly data, but no bubble was detected in analyses with monthly data. It was pointed out that the duration dependence test is sensitive to data frequency and may not give accurate results. It is recommended to be used with other tests. According to the results, using different methods to detect bubbles may strengthen the accuracy of the results.
Caspi & Graham (2018)	July 1996 - November 2014	Book-to-market ratios of 583 companies in 7 sectors of the Israeli stock exchange,	SADF and GSADF tests	Tests using book-to-market ratios in seven sectors of the Israeli stock market (Insurance, Banking, Investment and Holdings, Oil and Gas Exploration, Trade and Services, Real Estate, construction, and Manufacturing) did not reveal a bubble.
Cağlı & Mandacı (2018)	2002-2017	39-country stock market monthly dividend yields	GSADF method	A price bubble exists in most of the stock markets of the countries analyzed. Bubbles intensified during the 2007-2008 global financial crisis period
Anavatan & Kayacan (2018)	03.01.1996-15.03.2018	BIST 100 index	Balloon detection algorithm LPPL (log-periodic power law) model	The existence of a bubble in the period 28.04.2008-06.10.2008 indicates that bubbles are associated with crises.
Ozkarakoç (2019)	Variable time interval by country	BUX: (Hungary), BSESN: (India), JKSE: (Indonesia), KLSE: (Malaysia), MXX: (Mexico) SETI: (Thailand) WIG (Poland) XU100 (Turkey) stocks and price dividend rates	GSADF test	No bubble was detected in Indonesian, Hungary, Mexico, Poland, Thailand, or Turkish stocks. However, a speculative bubble was detected in India and Malaysia before the 2008 global financial crisis.
Lelpo & Kniahin, (2020)	1990-2017	3 central US and 3 major European equity market indices	A model that considers the deviation between macroeconomic data and stock prices as a bubble indicator	Between 1990 and 2017, bubble formation was detected only in the S&P500 and Dow Jones stock indices.
Bezgin & Başar, (2020)	1997-2018	BIST100, Financials, Industrials and Services indices	GSADF test, causality analysis	Three bubbles were detected in the BIST-100 index. Interest rate, credit volume, and money supply cause bubbles in the BIST 100 index.

Author	Year	Variables	Method	Findings
Yildırım & Akdag (2021)	11.03.2020 31.12.2020	Daily data for BIST Financials, Services, Banks, Simple Metals, Information Technology, Industrials, Tourism indices	GSADF test	Price bubbles were observed in other indices except for the BIST Financial and Services indices. The results imply that investors behave more rationally in their decision-making processes when trading financial and service sector stocks.
Işıldak (2022)	2018-2022	All indices on BIST and Dollar, gold	The GSADF test tested whether it was affected by speculative movements.	Six bubbles were detected in all BIST indices. BIST: All indices are sensitive to the formation of bubbles.
Cakar (2022)	2019-2021	BIST Participation 30-50 indices Participation Model Portfolio Index BIST-100 and BIST Financial and Services	Generalized Ecus Augmented Dickey-Fuller Test (GSADF)	Bubbles in traditional banking indices are higher than price bubbles in participation banking indices. This is because participating banks carry out interest-free transactions.
Alptürk (2022)	14.09.2021-14.09.2022	BIST Bank index	GSADF method	In the XBANK index, 12 bubbles were detected within one year.
Karcıoğlu & Ozcan (2023)	08.2010-10.2022	USD, Euro, Bitcoin, CDS and deposit rates, BIST	SADF-GSADF	The bubbles in USD and Euro exchange rates increase the volatility in the BIST 100 index.

Source: Compiled by the author from academic databases

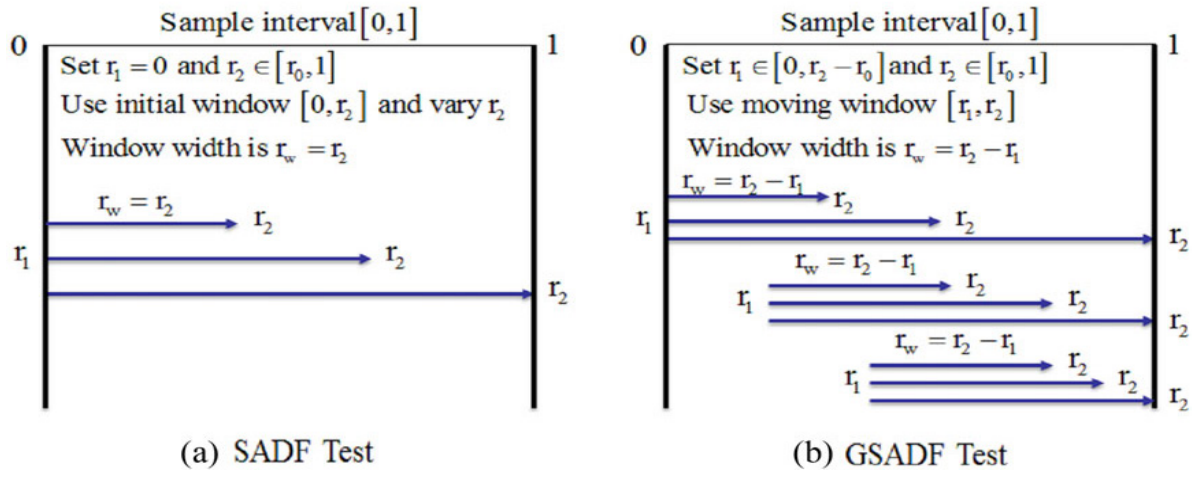
Table 1 shows that many methods are used to detect price bubbles. Studies focus on bubbles in the stock market index of a country or countries and the effects of economic and financial indicators such as USD, Gold, Bitcoin, interest rate, and inflation on bubble formations. It is not considered that the bubble in a sector index is formed due to the stocks of the index component moving away from their intrinsic value. The fact that the index component stocks are not focused on individual stocks makes using the findings in portfolio management difficult. This is because portfolio construction and decisions to add or remove new stocks to the portfolio can only be made after a stock-by-stock analysis. Analyzing the XLBNK index and each stock that constitutes the index separately in the study provides forecasts to portfolio managers about the price formations and course of the stocks to be held in the portfolio, removed from the portfolio or added to the portfolio in portfolio management strategies. In this respect, the study fills the gap in the literature in terms of detecting bubbles on the BIST liquid banking index (XLBNK), revealing the stocks that feed the bubbles, and combining the information and findings obtained with portfolio management theories.

3. DATA SET AND METHODOLOGY

BIST Liquid Bank (XLBNK) index and stock price data of the banks constituting the index were obtained from www.investing.com. Since XLBNK index data started to be published as of 01.05.2019, this date was chosen as the lower limit of the index. The banks' data constituting the index consists of the average daily opening and closing data of 01 January 2019 - 05 August 2024. The Generalised Sup ADF (GSADF) test, a very powerful method for detecting bubbles and has been used in many studies, was used (Table 1). GSADF gives more robust results than indirect methods and eliminates the inadequacies of the ADF test in tests with long-time data. ADF test is inadequate as a method when the data contains more than one multiple balloons. To overcome this inadequacy, Phillips et.al., (2015) propose a generalized sup ADF (GSADF) method and a recursive backward regression technique to time-stamp the start and end dates

of the bubble. The GSADF test follows the ADF and SADF tests as econometric methods. The window width used in the GSADF test is more flexible than the SADF test. GSADF does not fix the starting point of the window at the initial observation value but 'expands the sample coverage by changing the start and end point of the recursion within a suitable flexible window interval' (Figure 1). In this way, multiple bubbles and bursts in the data can be detected as more subsamples of the data are covered. The GSADF test, which also considers structural breaks in the long run, is a right-tailed and self-regressive test developed by Phillips et al., (2015) and introduced to the literature.

Figure 1. Sample Series and Window Widths of SADF and GSADF Tests



Source: (Phillips et al., 2015)

The H_0 hypothesis of the GSADF test statistic tests the existence of a unit root, i.e. (no bubble), while the alternative hypothesis H_1 tests the absence of a unit root (a price bubble). The hypotheses are tested with the formula (1) and (2) below (Phillips & Magdalinos, 2007).

$$H_0: yt = d_T + d_{t+1} + \varepsilon_t \quad (1)$$

$$H_1: yt = d_T + \delta y_{t-1} + \varepsilon_t \quad (2)$$

The first step of the analysis to measure the GSADF test statistics is to estimate the iterative regression equation 3, shown below. In the GSADF test, the parameter θ estimated by the specification ($\{yt\}Tt=0$) is calculated by the ADF t-statistic as in Equation 3 below

$$y_t = \mu + \delta y_{t-1} + \sum_{i=1}^{\rho} \phi_i \Delta y_{t-i} + \varepsilon_t \quad (3)$$

The GSADF test consists of a recursive method in which the ADF test statistics are estimated over windows that move forward and provide a spanning sample. Therefore, without fixing the start of the recursion, the sample coverage is extended by changing the start and end point of the recursion within a feasible range of flexible windows. In the GSADF test statistic, equation (3) is 'repeatedly estimated for multiple sub-samples using subsets in a forward-dated manner, creating sub-samples in which the starting points change dynamically in r1 and diverge from the zero point' (Phillips et al., 2015). To calculate the GSADF test statistic, the recursive regression equation 4 is estimated using recursive flexible estimation windows (Philips et al., 2015, p. 1049; Lei & Graham, 2018).

$$\Delta y_t = \tilde{\alpha}_{r_1,r_2} + \tilde{\beta}_{r_1,r_2} y_{t-1} + \sum_{i=1}^{\rho} \tilde{\psi}_{r_1,r_2} \Delta y_{t-i} + \tilde{\varepsilon}_t \quad (4)$$

The equation, p, represents the lag length, and r_1 and r_2 represent the sub-sample start and end points for the iterative regression estimations. Subsequently, in the GSADF test statistic, equation (4) is 'repeatedly estimated for multiple sub-samples using subsets at a forward date,

creating sub-samples in which the starting points change dynamically in r1 and diverge from the zero point'. Thus, the GSADF test can detect multiple bubbles in the series in the time series data analysis. Considering that the whole sample interval is [0, 1], the starting points of the subsamples will take values in the range [0, $r_2 - r_0$], and the endpoints will take values in the range [r_0, 1]. r_0 is the minimum estimation window length. With these definitions, the GSADF statistic can be calculated using equation (5) below (Philips et al., 2015, p. 1049; Caspi & Graham, 2018).

$$GSADF\,(r_0) = sup_{r2} \in_{r1 \in [0,\, r2-r1]} [r_{0,1}]\ \{ADF^{r2}_{r1}\} \qquad (5)$$

In the study, XLBNK index data consists of 1189 observations since it started to be created by BIST as of 05.11.2019. Since the data date of XLBNK index component banks was selected as 01.01.2019, the number of observations is 1396. Therefore, when calculating the GSADF test statistics, the window size was 74 for the XLBNK index and 81 for the index component banks. The GSADF test statistics are calculated with a 95% critical value for each observation with 100 Bootstrap and Monte Carlo simulations. The critical values used for the GSADF test are based on the Monte Carlo simulation developed by Phillips, Wu & Yu (2011a) and Phillips & Yu (2011b). The results are evaluated using the critical values calculated based on Monte Carlo simulation at 1%, 5%, and 10% significance levels.

4. DATA ANALYSIS STAGES AND RESULTS

4. 1. DESCRIPTIVE STATISTICS

Statistical information and descriptive statistics of the banks used in the study are presented in Table 2.

Table 2. XLBNK index component banks' size and share in the sector (%)

Bank	Year of Establishment	Total Assets	Total Loans	Total Deposits	Total Equity	Net Profit/ Loss for the Period	Number of Branches (Pieces)	Number of Employees (Pieces)
Vakıf Bank	1954	3.237.503	1.731.833	2.152.316	191.259	19.192	950	18.579
İş Bank	1924	2.886.231	1.446.543	1.848.702	285.498	29.151	1.072	21.010
Halk Bank	1938	2.611.039	1.367.664	2.161.565	136.081	8.258	1.094	22.083
Garanti Bank	1946	2.313.106	1.309.101	1.601.677	279.319	44.839	804	19.250
Akbank T.A.S.	1984	2.180.576	1.100.126	1.403.594	221.093	24.108	700	12.983
Yapı Kredi Bank	1944	2.178.173	1.159.341	1.231.819	183.093	17.405	781	15.409
XLBNK Total index component banks		15.714.537	8.317.080	10.464.600	1.331.697	148.575	5.644	113.216
Total of Turkey's banking sector		25.779.288	13.672.851	16.124.457	2.294.021	281.624	9.461	189.592
Ratio in the total banking system %		60,96	60,83	64,90	58,05	52,76	59,66	59,72

Source: Banks Association of Turkey (BAT ,2024). Bank Ranking According to Asset Sizes (Million TL-June, 2024). The report, Access address:https://www.tbb.org.tr/istatistiki-raporlar/2024-haziran-aktif-buyukluklerine-gore-banka-siralamasi. *As of 30.06.2024, there are 54 banks in total (Table created by the author)

Table 2 shows the shares of the 6 XLBNK index component banks in the total banking sector. Six banks account for 60.96 percent of the total assets of 54 banks in Turkey's banking system. Their share in total loans extended by the sector is 60.83 percent. In converting savings into deposits, these banks collect 64.90 percent of total deposits. Six banks represent 58.05% of total shareholders' equity, 52.76% of total profit, 59.66% of total number of branches, and 59.72%

of total employees. All of the banks are national banks ranked among the top 10 banks in terms of asset size. The deflation of the index formed by banks of this size and representativeness and the deflation of the bubbles in the share prices of banks could profoundly impact the Turkish financial system. In this sector, Turkey suffered great economic losses due to the crisis in 2001 but recovered from the crisis thanks to the International Monetary Fund (IMF)-backed long-term stabilization program (Özatay, 2014, p. 82). In this context, scrutinizing and analyzing the bubbles in the Turkish banking sector, which is among the five fragile countries, may provide the preliminary signs of a possible crisis. It may offer insights to portfolio managers in their decisions to include banking sector stocks in their diversification strategies.

Table 3. Descriptive statistics of BIST XLBNK index component banks (Share price)

	AKBNK	GRNT	HLKBNK	ISBNK	SKRBNK	TSKB	VKFBNK	YP-KRDBNK
Mean	14.15855	22.46150	8.108302	3.378642	1.811240	2993.712	7.416160	7.300961
Median	6.600000	10.40500	5.890000	1.112000	1.183000	1590.000	4.760000	2.623000
Maximum	69.80000	132.9000	19.82000	17.62000	6.088000	13120.00	25.20000	37.96000
Minimum	4.030000	5.760000	4.180000	0.642000	0.634000	0.638000	3.220000	1.278000
Std. Dev.	15.40835	25.46904	4.054250	4.018818	1.282982	3117.059	5.025692	8.444239
Skewness	2.044099	2.254916	1.073036	1.754470	1.536772	1.331918	1.513925	1.756108
Kurtosis	6.433603	7.965478	2.876860	5.204872	4.315977	3.944775	4.508559	5.213215
Observations	1396	1396	1396	1396	1396	1396	1396	1396

Source: The data of the banks obtained from www.investing.com for the period 01 January 2019 - 05 August 2024 were obtained using ewievs 15 software

Table 3 presents the descriptive statistics of the banks constituting the BIST XLBNK index. The arithmetic means of the stock values of banks show a heterogeneous structure. The arithmetic mean alone does not provide complete information about the series, and the maximum and minimum values should be evaluated together due to the effect of extreme values on the arithmetic mean. The difference between the maximum and minimum values of AKBN, GRNT, ISBNK, and YPKRDBNK is quite high and far from the average. The fact that the extreme values are extremely higher than the average indicates that the stock has moved away from its intrinsic value; in other words, it is a bubble. When the standard deviation values, which show the distance of each value in the data from the average and express the degree of risk of that stock in portfolio theory, are analyzed, heterogeneity is observed among stock values. The higher the standard deviation, the more the value of the stock fluctuates in a wide price range, and the higher the returns and losses of the stock will increase at the same rate. The table shows GRNT: 25.46 and AKBNK: 15.40 with the highest standard deviation, followed by YPKRDBNK: 8.44 and VKFBNK: 5.02.

Regarding portfolio theory, it can be said that including GRNT and AKBNK shares in the same portfolio will increase the portfolio risk. The fact that the data are very far from the average and have a widespread and high standard deviation strengthens the predictions that the price of these stocks has moved away from its intrinsic value. Excessive deviation of prices from the average can be considered a bubble indicator, in a sense. If stocks with high standard deviation are included in the portfolio, they are likely to increase the portfolio's risk. Regarding portfolio management, a high standard deviation means high volatility and risk in banks' share prices. The skewness and kurtosis values of all banks except Halk Bank support the above findings. In addition, it is also important to examine the correlation coefficients between stocks in terms of portfolio management and diversification. The correlation coefficients between the stock prices of the index component banks are presented in Table 3.

Table 4. Correlation table between stocks

Correlation	AKBNK	GRNT	HLKBNK	ISBNK	VKFBNK	YPKRNDBNK
AKBNK	1.000000					
GRNT	0.989271	1.000000				
HLKBNK	-0.252082	-0.263731	1.000000			
ISBNK	0.990300	0.983778	-0.300316	1.000000		
VKFBNK	0.956358	0.949915	-0.238523	0.972100	1.000000	
YBKRNDBNK	0.992306	0.976917	-0.315303	0.993336	0.963123	1.000000

Source: The data of the banks obtained from www.investing.com for the period 01 January 2019 - 05 August 2024 were obtained using ewievs 15 software.

When the interbank correlation values are analyzed, HLKBNK has a low level of negative correlation with all banks during the period in question. AKBNK, GRNT, ISBNK, VKFBNK, and YPKRDBNK are highly correlated with all other banks at a level close to +1. These results indicate that HLKBNK's share price moves in the opposite direction from all other bank stocks. The low correlation of HLKBNK shares with the share prices of other banks will increase the probability of reducing the portfolio risk if included in the portfolio. The high correlation close to +1 between the stock values of other banks except HLKBNK indicates that the share values of these banks move together and in the same direction, which will increase the portfolio risk if they are included in the same portfolio. The t-statistic results of the GSADF test performed to test the bubbles in the data consisting of the daily average stock prices of the BIST XLBNKA index and its component banks and the critical values calculated based on Monte Carlo simulation at 1%, 5%, 10% significance levels are presented in Table 5.

4. 2. GSADF TESTS RESULTS AND FINDINGS

Table 4 presents the t-statistic results of the GSADF (Right-Tailed ADF Tests) performed to test for bubbles in the data consisting of the daily average stock prices of the BIST Liquid Bank (XLBNKA) index in the BIST primary sector in Turkey and the 6 banks that constitute its components. The critical values were calculated based on Monte Carlo simulation at 1%, 5%, and 10% significance levels.

Table 5. GSDAF test statistic values

Right-Tailed GSADF Tests / (Sample: 1/02/2019 8/06/2024) / Null hypothesis: BIST_XLBNK has a unit root

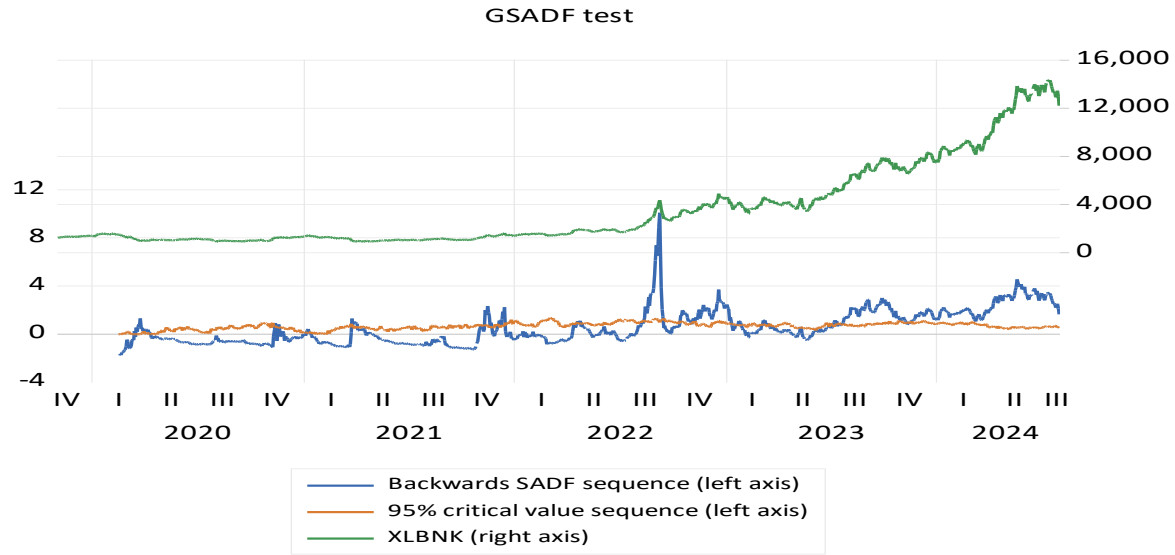
	Included observations	t-Statistic 1% level	Test critical values**: 5% level	10% level		Prob.*
BIST_XLBNK	1189	10.08196	2.798184	2.444108	2.240560	0.0000*
AKBNK	1396	5.922865	2.720665	2.393082	2.123908	0.0000*
GRNT	1396	7.307438	2.720665	2.393082	2.123908	0.0000*
HLKBNK	1396	1.235233	2.720665	2.393082	2.123908	0.7400
ISBNK	1396	11.31050	2.720665	2.393082	2.123908	0.0000*
VKFBNK	1396	24.00225	2.720665	2.393082	2.123908	0.0000*
YPKRDBNK	1396	6.969248	2.720665	2.393082	2.123908	0.0000*

Note: 1. Since data generation started after 05.11.2019, the number of observations of the BIST XLBNK index is 1189. 2. The optimal number of windows is 74 for the BIST XLBNK index and 81 for the index component banks. 3. The critical values are common Since the number of observations and windows are the same for banks. 4. Generalised sup augmented Dickey-Fuller statistic (GSADF) critical values are obtained from Monte Carlo simulations with 100 replications

Source: The data of the banks obtained from www.investing.com for the period 01 January 2019 - 05 August 2024 were obtained using ewievs 15 software

Table 5 presents the results of the analyses testing the existence of bubbles in the stock prices of the BIST- XLBNKA index and its component banks using the GSADF method. According to the table, t-statistic values greater than the test statistic critical values at 1%, 5%, and 10% significance levels indicate bubbles in banks' stock prices. In contrast, smaller values mean that there is no price bubble. BIST- XLBNKA index GSADF test t-Statistic value=10.08438 is greater than the Monte Carlo simulation test statistic critical values at 1%, 5%, and 10% significance levels. Therefore, the null hypothesis of the GSADF test is rejected at all three levels: BIST_XLBNK has a unit root (there is no bubble in stock prices) is rejected. The results confirm that there is a bubble in the BIST XLBNKA index. When the bank stocks that comprise the index are analyzed in detail, the null hypothesis H0 that there is no bubble is rejected at a 1% significance level for all banks except Halk Bank ($P<0.05$). According to this result, there was no price bubble in the share prices of Halk Bank during the period in question, but there was a bubble in the share prices of other banks. The graphical results of the GSADF test for detecting a price bubble in the BIST- XLBNK index and its component banks are presented below (Graph 1- 7).

Graph 1. BIST-Liquid Bank index (XLBNKA) index GSADF test graph

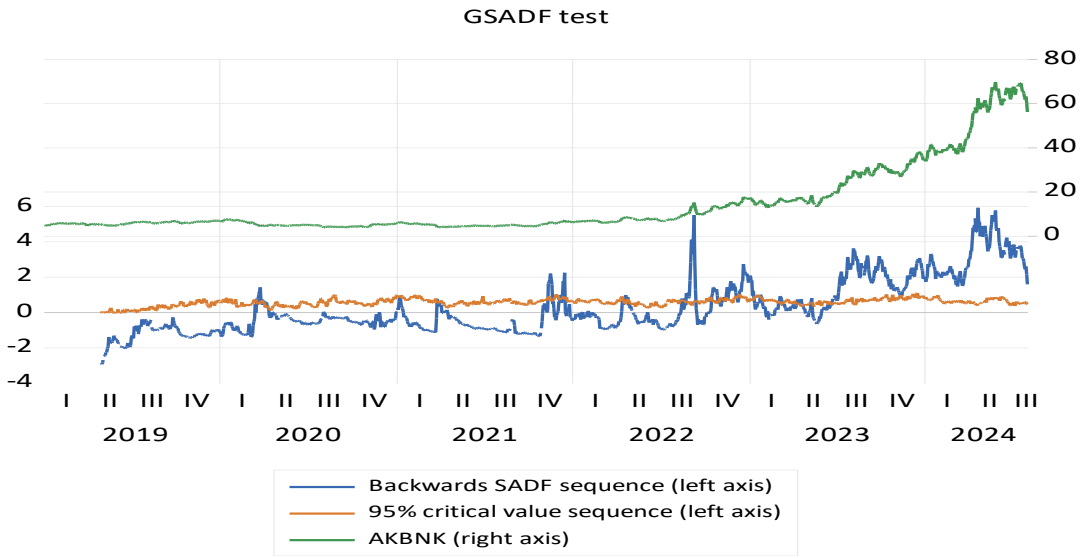


Notes: The blue line represents the forward-looking ADF series, while the red line shows the series at the 95% critical value. The green line represents the observation series for the XLBNK index series

The orange line in Chart 1, which is parallel to the zero value, represents the 95% confidence limit, the blue continuous line represents the forward-looking GSADF series, and the green line represents the graph of the level values of the BIST Banking Sector (XLBNK) index. The forward-looking GSADF results of the BIST XLBNK index show that the index has been above the 95% confidence limit since the third quarter of 2022. This result means that there is a strong bubble effect at the beginning of the third quarter of 2022. The bubble deflated at the beginning of the fourth quarter of 2022, but its effect continued in the fourth quarter. After deflating in the 2023 I and II quarters, the bubble formed again in the third quarter, and the bubble still exists in the third quarter of 2024, when the study was conducted. One of the most important reasons for the bubble in the index is that the incompatibility between the MB's low-interest rate policy and high inflation has driven investors away from deposits. From the end of 2019 until the sixth month of 2023, the deposit interest rate, which hovered in the 10-15% band range, provided a negative real return against inflation, which rose to 36% at the end of 2021 (CBRT, evds). The fact that the real return on deposit rates turned negative to a large extent triggered investors who wanted to protect their savings to invest their liquid assets in foreign exchange and equities. As of the second half of 2023, the MB gradually raised the policy rate to 50%, and the market began

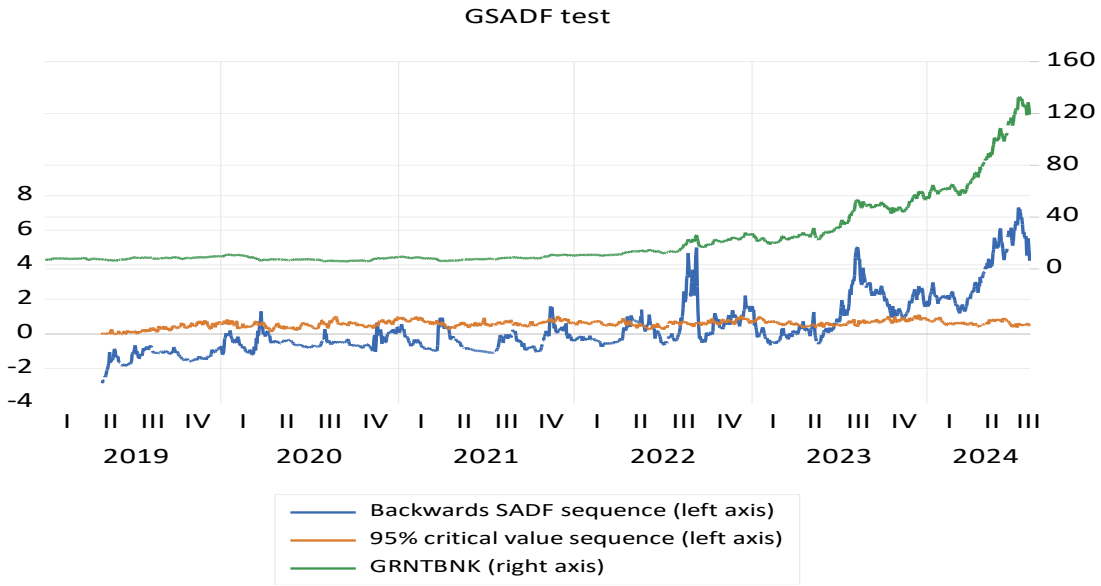
to feel the determination to implement a tight monetary policy; the stock market index fell, and the bubble started to deflate, which supports the above proposition. At this stage, it is important to investigate which banks' stocks feed the bubble detected in the index. Determining which banks' share prices in the sector move away from their intrinsic value directly affects investors' decisions to keep or remove these shares from their portfolios. For this purpose, the detailed GSADF test analysis results of the banks constituting the index are presented in Chart 2-7 below.

Graph 2. BIST Akbank GSADF test Graph



A price bubble is observed in 2021 Q4, 2022 Q3 and Q4, 2023 Q3 and Q4, and 2024 Q1, Q2, and Q3 of Ak bank stock price changes and price levels (Chart 2). In other words, the orange line showing the forward-looking GSADF series in these periods exceeds the 95% confidence limit. The effect of the strong price bubble in AKBNK share prices at the beginning of the third quarter of 2022 has deflated just at the end of the third quarter of 2022. The price bubble formed in the fourth quarter of 2022 deflated at the beginning of the first quarter of 2023, falling below the 95% confidence limit. The 2023 Q3 bubble deflated briefly in Q4 of the same period and turned into a long-term bubble that continued in 2024 Q1 and Q2-Q3. The long-term bubble tends to deflate in the third quarter of 2024.

Graph 3. Garanti Bank GSADF Test Graph



In Chart 3, no bubble is observed in the pricing of Garanti Bank stock until the beginning of the third quarter of 2022. However, there was a break in the third quarter of 2022, and many successive bubbles occurred in the third quarter of 2024, the first, second, and third quarters of 2024. The bubble formed in 2022 III. quarter deflated at the end of the period. The very weak bubbles observed until the beginning of 2023 Q3 turned into a strong bubble in 2023 Q3. This bubble, which weakened very briefly in the fourth quarter of 2023, increased afterward and reached its peak at the end of the second quarter of 2024. After this period, the deflation phase of the bubble continues until the third quarter of 2024. GRNTBNK stock bubbles follow a parallel course with the periods of the bubbles observed in the BIST XLBNK general index (Chart 1).

Graph 4. Halk bank GSADF test graph

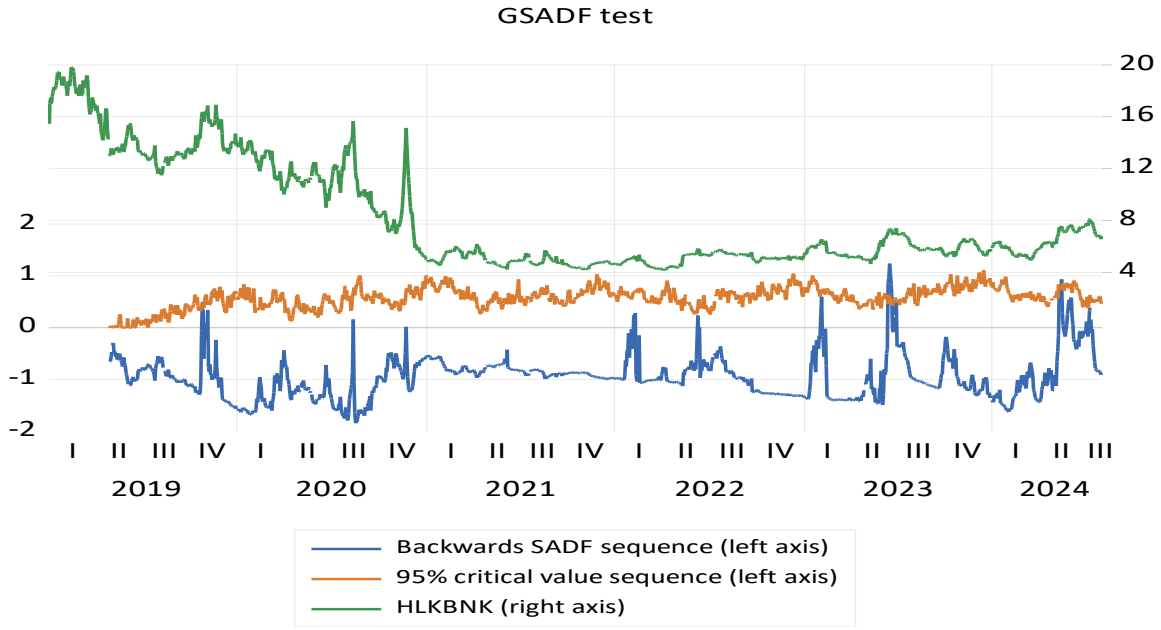


Chart 4 shows the bubble formation in Halk Bank (HLKBNK) stock prices. When the chart is analyzed, no bubble has formed in HLKBNK share prices. In this respect, it differs from the BIST XLNBNK general index and the stock pricing of other banks. Even during the period when there was the strongest bubble in the BIST XLNBNK general index in the third quarter of 2022, no bubble was detected in HLKBNK stock pricing. In fact, it is seen that the share prices, which were approximately 20 TL at the beginning of 2019, continued to decrease until the first quarter of 2021, and after this period, it is seen that it changed in the band range of 4-8 TL until the third quarter of 2024. It is evaluated that the reason for this anomaly in Halk bank stock pricing and the differentiation during the general index may be the effect of the trial process carried out in the USA about HLKBNK. The trial process may have reduced domestic and foreign investors' demand for the stock. This anomaly confirms the thesis that if pessimistic information about a stock is constantly disseminated to the market, the demand for the stock will decrease, and investors' decisions to purchase the stock will be negatively affected, so there may be negative changes in the pricing of the stock.

Graph 5. İşbank GSADF test Graph

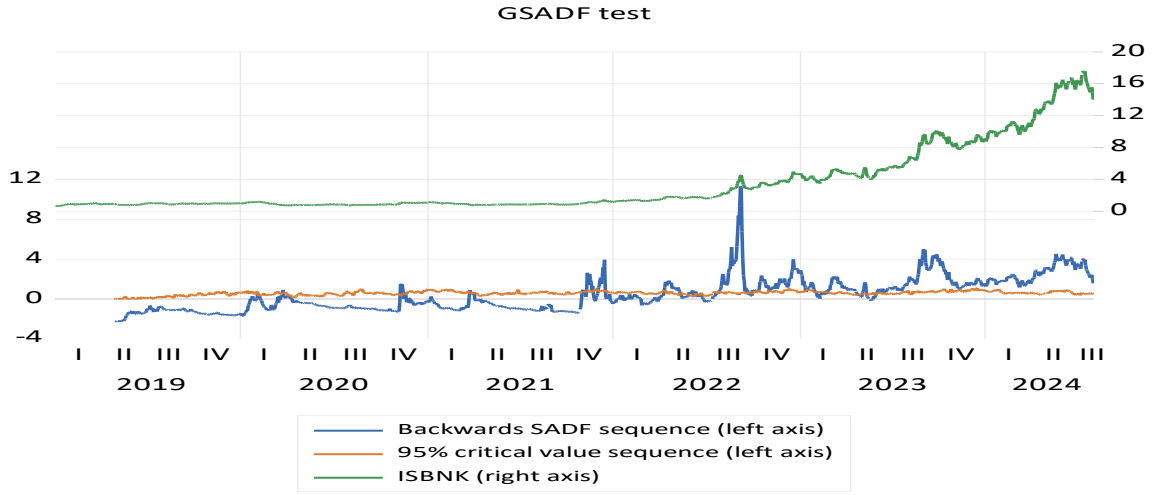
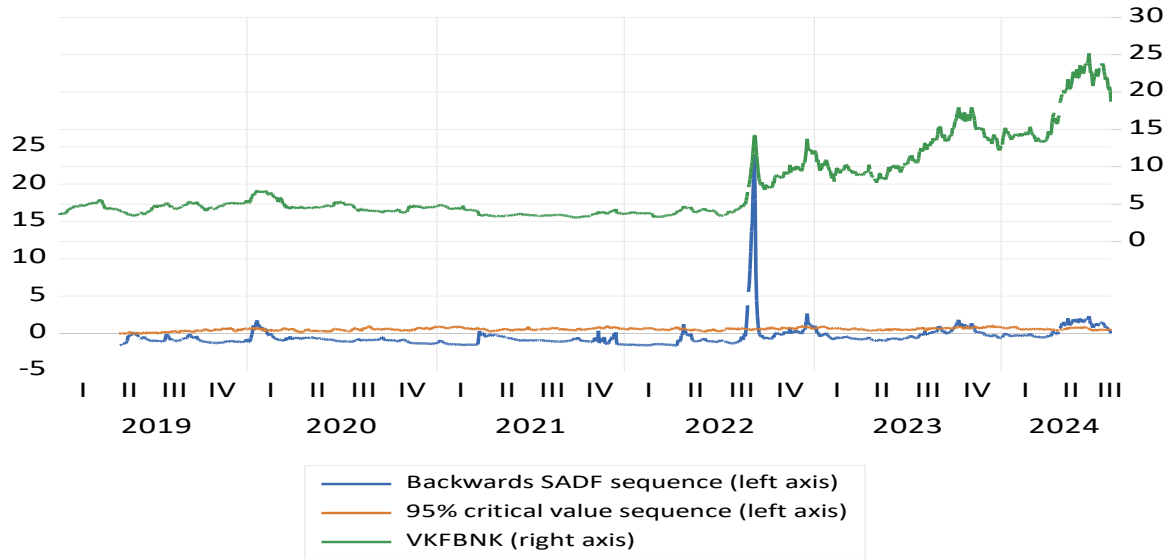


Chart 5 shows that many bubbles have formed because of a structural break in İşbank (ISBNK) stock pricing since the third quarter of 2022. The first bubble in 2021 Q4 is very weak. The second strong bubble, which formed at the beginning of the third quarter of 2022 by increasing the forward-looking GSADF series shown by the orange line well above the 95% confidence limit, deflated at the end of the third period. The bubble's deflation and its effects continued from the fourth quarter of 2022 to the first quarter of 2023. The third bubble, which was observed in the middle of 2023 Q3, continued weakly until 2023 Q4 and the beginning of 2024 Q1. The fourth bubble, which reappeared in the 2024 I quarter, continued to increase during the 2024 II quarter and tended to deflate in the 2024 III quarter. These results align with the BIST XLBNK index and feed the bubble formation in the index.

Graph 6. Vakıfbank GSADF test Graph



Between 01 January 2019 and August 2024, Vakıfbank (VKFBNK) share prices formed a bubble only in the third quarter of 2022 (Chart 6). This single bubble formed in the third quarter of 2022 was parallel to the bubble in the BIST XLBNK general index of VKFBNK share prices and deflated in the same period (Chart 1). In the following period, although bubble formations were detected in the BIST XLBNK index, no bubble formation was detected in VKFBNK shares. In this respect, it can be concluded that VKFBNK share pricing had no effect on the subsequent

bubbles in the BIST XLBNK index. The bubble formation in VKFBNK share price differs from the bubble formations in other banks in this respect (except for the third quarter of 2022). Although VKFBNK share prices increased from approximately 5 TL to 25 TL in nominal prices after the bubble formation in the third quarter of 2022, no bubble formation was detected.

Graph 7. Yapı Kredi Bank GSADF Test Graph

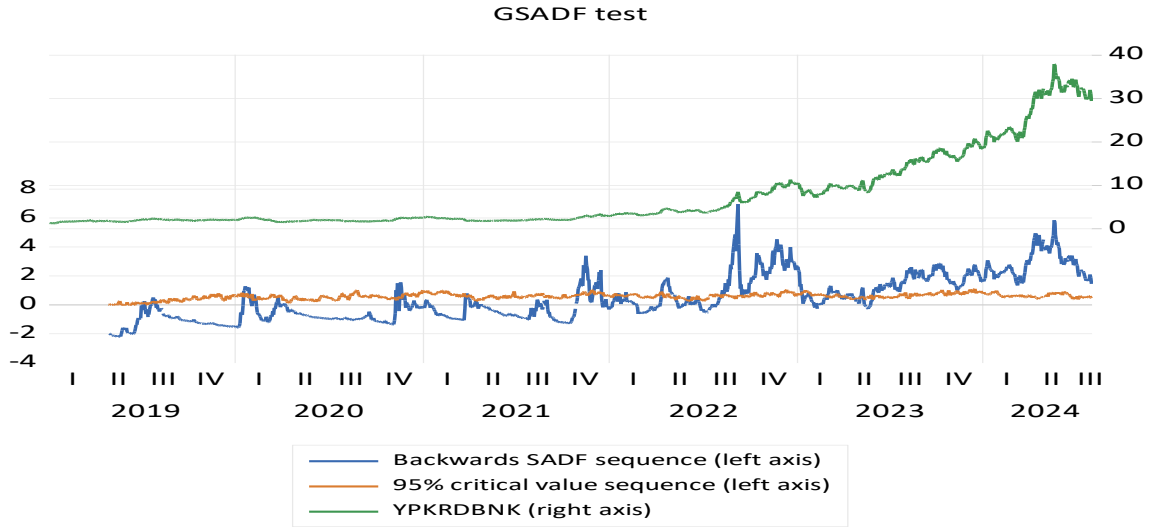


Chart 7 shows the stock price change of Yapı Kredi Bank (YPKRDBNK) and at which stage of the price levels a bubble occurred. The first weak bubble in YPKRDBNK share prices formed at the beginning of the fourth quarter of 2021 and deflated at the end of the same period, pricing, which returned to normal for a short time afterward; a strong bubble formed again at the beginning of the third quarter of 2022 in parallel with the XLBNK general sector index and deflated immediately. Immediately after the deflation, another bubble wave formed during the fourth quarter of 2022, and this bubble wave deflated in the first quarter of 2023. Although the bubble, which was observed again in the middle of the third quarter of 2023, deflated very briefly at the beginning of the fourth quarter of 2023, it continued to increase partially during the second quarter of 2024 I. II. quarter and entered the deflation phase as of the beginning of the third quarter of 2024. This course aligns with the bubble formations in the BIST XLBNK general index. In other words, YPKRDBNK share price formation feeds the bubble formation in the sector index. The aggregated form of the bubble periods detected in the graphs of the GSADF test statistics of the banking sector general index and (XLNBNK) and the banks belonging to the components of this index are presented in Table 6. A black square in the table indicates that no bubble was observed, a (+) sign indicates that a strong bubble was detected, and a (-) sign indicates that the detected bubble was weak.

Table 6. Aggregated Table of GSADF Test

Banka ismi	2019				2020				2021				2022				2023				2024			
	I	II	II	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Genel endeks BIST XLBNK	■	■	■	■	■	■	■	■	■	■	■	▭	■	■	✚	▭	■	■	▭	▭	▭	✚	✚	
Akbank T.A.Ş. AKBNK	■	■	■	■	■	■	■	■	■	■	■	▭	■	■	✚	▭	■	■	▭	▭	✚	✚	✚	
Garanti BBVA GRNT	■	■	■	■	■	■	■	■	■	■	■	■	■	■	✚	▭	■	■	✚	▭	▭	✚	✚	
Türkiye Halk Bankası HLKBNK	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	▭	■	■	■	■	
Türkiye İş Bankası ISBNK	■	■	■	■	■	■	■	■	■	■	■	▭	■	■	✚	▭	■	▭	✚	✚	▭	▭	▭	
Vakıfbank VKFBNK	■	■	■	■	■	■	■	■	■	■	■	■	■	■	✚	■	■	■	■	■	■	■	▭	
Yapı Kredi YPKRDBNK	■	■	■	■	■	■	■	■	■	■	■	▭	■	▭	✚	✚	■	▭	✚	▭	✚	✚	✚	

Note: In the table, a black square indicates that no bubble was observed, a (+) sign indicates that a strong bubble was detected, and a (-) sign indicates that the detected bubble was weak.

Source: It was created from the combination of the analyses of graphs (1-7)

Table 6 The pricing of the BIST XLBNK index and its component stocks has experienced a break in the direction of moving away from its intrinsic value since the last quarter of 2021. Starting from this period, low-level bubbles started to form in AKBNK, ISBNK, and YPKRDBNK stock pricing. The strongest bubble occurred in the third quarter of 2022 in the overall index and other stock pricing, except for HLKBNK. HLKBNK share pricing differs from that of the sector index and other banks due to the absence of a bubble in the sector. The reason for the absence of a bubble in Halk Bank is the effect of the lawsuit filed against the Bank in the USA and the pessimistic news in the press resulting from the lawsuit. Studies also show that good news has a positive effect on share prices, while bad news has a negative effect on share prices. (Barberis et al., 1998; Fama & French, 1992; Lakonishok et al., 1994; La Porta, 1996). This results in HLKBNK share prices being consistent with the information in the literature. The bubble that emerged in the XLBNK index in the second and third periods of 2024 was fuelled by the bubbles in AKBNK, GRNT, and YPKRDBNK share prices. The results confirm that there has been a bubble in the Turkish banking sector stock market, which is among the EMEs and fragile five countries, since the last quarter of 2021. The results are consistent with the results of (Çağlı & Mandacı, 2017; Koy, 2018; Çağlı & Mandacı, 2018; Yıldırım & Akdağ, 2021; Çakar, 2022; Alptürk, 2022). This break in the last quarter of 2021 points to the change in Turkey-specific monetary and macroeconomic policies affecting stock markets or the lagged effects of past policies.

4. 3. DISCUSSION

The most important development that will change Turkey's monetary and economic policies within the analysis period is the COVID-19 pandemic, which deeply affected the global economy and financial markets after 17 November 2019. In order to mitigate the negative effects of the economic and financial activities that slowed down during the pandemic, the CBRTs of countries with reserve currencies (USA, EURO zone, UK, Japan, China), which carry out the vast majority of world trade and financial transactions, implemented excessive monetary expansion and low-interest rate policy (Emsen, 2021). In addition, other countries' monetary expansion, low-interest rate policies, and the CBRT in their local currencies increased domestic liquidity (Danacı, 2022). Low-interest rate policy and excessive monetary expansion, combined

with low financing costs, facilitate access to liquidity and stimulate the stock market with a lag (Rjoub, Civcir & Resatoglu, 2017). Studies in the literature also confirm the existence of a negative relationship between nominal interest rates and stock prices (Yahyazadehfar & Babaie, 2012). The study conducted in the French, German, and UK stock markets shows that more than half of the annual movement in stocks is affected by long-term interest rates (Peiro, 2015). In Turkey, it was found that the increase in money supply during the pandemic period had significant effects on the stock returns of the BIST 30 index (Sevinç, 2014). The results indicate that the bubble in the BIST XLBNK sector after 2021 is due to the reflection of the lagged effects of the policies implemented during the pandemic.

The linear relationship between monetary expansion and inflation is known. In most advanced economies and EMEs, monetary expansion during the pandemic triggered inflation (Danacı, 2022). The increase in inflation reduced the real returns on investments and directed investors to risky assets that would protect their savings from the corrosive effect of inflation. Studies on the Turkish stock market in the literature highlight the positive relationship between the BIST financial index and inflation and money supply and emphasize the negative relationship between the financial index and long-term interest rates (Omağ, 2009). A negative relationship exists between deposit interest rates and portfolio investments (Albeni & Demir, 2005). In other words, increasing inflation and low interest rates stimulate the stock market. Some studies prove these two variables affect bubble formation (Bezgin & Başar, 2020). In Turkey, inflation, which was 12% at the beginning of 2020, increased to 36% at the end of 2021. The average inflation in 2022 was 71%. However, deposit interest rates remained below inflation from the end of 2019 until the sixth month of 2023, providing a negative real return in the 10-15% band (CBRT, evds). The mismatch in these two indicators resulted in investors' inability to protect their savings in real terms. It can be said that investors' channeling their savings from deposits to the stock market under these conditions triggered the formation of price bubbles after 2022.

Another important variable affecting the stock market is exchange rates. There is a positive relationship between exchange rates and stock prices (Güngör & Kaygın, 2015). In other words, an increase in exchange rates increases stock prices. Turkey's average USDTL exchange rate is 5.67 TL in 2019, 7.01 TL in 2020 due to abundant liquidity and low interest rates, and 8.83 TL in 2021. 2022 due to the monetary tightening of the CB of developed countries and the currency crisis in Turkey, the exchange rates increased by 100% to an average of 16.54 TL in 2022 and 23.69 TL in 2023 (CBRT evds). These increases accelerated capital inflows to the Turkish markets through the portfolio channel, stimulated demand in the stock market with new public offerings and supported the formation of a bubble by distancing stocks from their intrinsic prices. It can be argued that this irrational policy in exchange rates was a major factor in directing investors to the stock market in Turkey.

The monetary expansion also stimulates credit expansion. Studies show that money supply and credit expansion affect bubble formation (Alwagdani, 2015). In addition to causing asset price bubbles, credit expansion also triggers economic crises and causes financial instability (Minsky, 1986). The annual percentage change in the M2 monetary base after Covid 2019 in Turkey was 19.76% in 2019, 37.20% in 2020, 29.14% in 2021, 72.79% in 2022 and 61.75% in 2023. In terms of monetary expansion, Turkey experienced a major break in 2022. The liquidity generated by monetary expansion has a high potential to trigger price bubbles by flowing into the stock market through monetary transmission channels with the driving effect of low interest rates. Monetary expansion increases disposable speculative liquidity, facilitates access to liquidity, and leads to credit expansion through the banking system.

5. CONCLUSION

In Turkey, the banking sector is the most important component of the financial system. Bubbles that may occur in this sector have a high potential to affect other sectors with the effect of crisis misfire and contagion. Turkey BIST XLBNK sector index and the value of the stocks of its component banks follow a normal course without moving away from their intrinsic value until the last quarter of 2021. A major break occurred in the last quarter of 2021; many bubbles formed in the sector, and bubbles became permanent in recurring cycles (Table 6). The multiple bubbles that emerged in the value of the XLBNK index and its component stocks after 2021 point to the structural break in Turkey's macroeconomic indicators since this date and the reflections of the incompatibility in monetary policies. Turkey has implemented a monetary expansion policy, low interest rates, and high inflation since the 2020 Covid-19 pandemic. Low interest rates reduced the cost of capital acquisition, increased the appetite for borrowing, and caused banks to unwind savings in deposit deposits and turn to assets with high return expectations and high risk, such as stocks. These policies, which were also implemented by other developed countries on a global scale, accelerated the divergence of XLBNK stocks from their intrinsic value as global liquidity was directed to emerging markets such as Turkey with high speculative return opportunities. The results reinforce that the inconsistencies in the interest rate, exchange rate, inflation, and expansionary monetary policies of the Central Bank (CB) are some of the important factors that feed the bubble formation in the stock market. Policymakers and implementers such as the Central Bank of Turkey (CBT) must consider stock markets when using monetary policy tools. By changing the direction of liquidity with their decisions, they can prevent share prices from moving away from their intrinsic value and increase the efficiency of the financial system and markets.

Including XLBNK sector stocks in the portfolio at the beginning of the bubble provides the opportunity to make speculative gains. Especially at the bubble's peak, share purchase decisions cause huge losses in the deflation phase of the bubble. Professional investors can reduce risks by using derivative instruments. Small investors in the market do not have full knowledge about the use of derivative instruments and suffer huge losses. In order to reduce losses, profit realization can be made by deciding to dispose of the shares of the sector at the peak of the price bubble. Using the above tables and graphs, they can make speculative gains by including stocks at the beginning of the bubble in their portfolios using fundamental and technical analysis methods. Portfolio managers can actively use hedging methods to reduce risk during bubble periods. If investors consider the coherence of MB monetary policies in their portfolio decisions, it will strengthen the possibility of predicting the rise and collapse phases of price bubbles. In future studies, the bubble map of the BIST stock market in Turkey can be mapped, and structural breaks can be identified by analyzing the bubbles in the value of the primary sector indices such as technology, construction, tourism, textile, transport, food and beverage, and each index component stock. The relationships between structural breaks and macroeconomic indicators can be analyzed by using the VAR analysis method and impulse response functions. Thanks to the information to be obtained, monetary policy instruments can be used to increase the efficiency of the stock market by reducing bubble formations and structural breaks.

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The authors report there are no competing interests to declare.

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