

## ANALYSIS OF BIST100 TECHNOLOGY STOCKS AND CRYPTO ASSETS USING TECHNICAL ANALYSIS INDICATORS

### ANÁLISE DAS AÇÕES DE TECNOLOGIA E CRIPTOATIVOS DO ÍNDICE BIST100 UTILIZANDO INDICADORES DE ANÁLISE TÉCNICA

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**Dogan Kutukiz\***

\*Mugla Sitki Kocman University, Tourism Faculty, Mugla, Turkey

Orcid: <https://orcid.org/0000-0002-8363-2681>

[kdogan@mu.edu.tr](mailto:kdogan@mu.edu.tr)

**Yakup Ulker\*\***

\*\*Sivas Cumhuriyet University, Faculty of Economics and Administrative Sciences, Sivas, Turkey

Orcid: <https://orcid.org/0000-0002-3070-0521>

[yakupulker@cumhuriyet.edu.tr](mailto:yakupulker@cumhuriyet.edu.tr)

**Ayse Kizil\*\*\***

\*\*\*Turkish Halk Bank, Scientific Expert, Mugla, Turkey

[ayssseaydogan1994@icloud.com](mailto:ayssseaydogan1994@icloud.com)

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#### Abstract

New assets continuously emerging in capital and other markets present opportunities for investors and attract interest. Stocks, which have been traded in capital markets for many years, offer advantages to both the capital-owning company and investors. In recent years, with the emergence of crypto assets, investors have begun investing in these assets, leading to unexpected increases. Cryptocurrencies carry significant risks as they have no legal basis. Investors conduct numerous analyses when investing. Technical analysis, one of these, has been used for many years to identify short- and medium-term price movements. In this study, 5 BIST100 technology stocks and 5 major cryptocurrencies were analyzed using technical analysis indicators for the 2022-2024 period. The analysis identified increases and decreases based on the assumption that purchases and sales were made according to the buy-sell signals generated during the specified time periods. Additionally, an analysis was conducted and compared using a buy-and-hold strategy during the same time periods. According to the analysis results, it was observed that the indicator signals differed between technology stocks and crypto assets, that there was a difference between periodic signals and buy-and-hold, that the momentum indicator yielded the best results, particularly in the buy-and-hold operation, and that the Bollinger Bands indicator strategy provided the highest profits for

#### Resumo

Novos ativos que surgem continuamente nos mercados de capitais e outros mercados apresentam oportunidades para investidores e atraem interesse. As ações, negociadas nos mercados de capitais há muitos anos, oferecem vantagens tanto para a empresa detentora do capital quanto para os investidores. Nos últimos anos, com o surgimento dos criptoativos, os investidores começaram a investir nesses ativos, levando a aumentos inesperados. As criptomoedas apresentam riscos significativos, pois não possuem base legal. Os investidores realizam diversas análises ao investir. A análise técnica, uma delas, tem sido usada há muitos anos para identificar movimentos de preços de curto e médio prazo. Neste estudo, 5 ações de tecnologia do índice BIST100 e 5 das principais criptomoedas foram analisadas utilizando indicadores de análise técnica para o período de 2022 a 2024. A análise identificou aumentos e quedas com base na premissa de que as compras e vendas foram realizadas de acordo com os sinais de compra e venda gerados durante os períodos especificados. Adicionalmente, foi realizada uma análise comparativa utilizando uma estratégia de compra e manutenção (buy-and-hold) durante os mesmos períodos. De acordo com os resultados da análise, observou-se que os sinais dos indicadores diferiram entre ações de tecnologia e criptoativos, que houve diferença entre sinais periódicos e a estratégia



technology stocks and all crypto assets in all time frames.

**Keywords:** Stocks. Crypto Assets. Technical Analysis. BIST100 Technology Stocks.

*de comprar e manter, que o indicador de momentum apresentou os melhores resultados, particularmente na operação de comprar e manter, e que a estratégia com o indicador Bandas de Bollinger proporcionou os maiores lucros para ações de tecnologia e todos os criptoativos em todos os prazos.*

**Palavras-chave:** Ações. Criptoativos. Análise Técnica. Ações de Tecnologia BIST100.

## 1 INTRODUCTION

People have started buying shares in companies perceived as successful through the stock market. With developments in capital markets and the increase in the number of investors, it is seen that individuals and institutions are evaluating their investments on the stock exchange and Crypto assets, and that this is becoming more and more attractive every day. While stocks are issued to increase companies' equity, crypto assets are assets created using digital and encryption technologies. Cryptocurrencies are distributed, open-source, math-based, peer-to-peer virtual currencies, with Bitcoin, Lite Coin, Ethereum, Ripple, Bitcoin Cash, etc., being the most well-known. Investors focus on certain assets due to the large number of investment assets in financial markets, and interest in these assets fluctuates periodically. Stocks have been traded in financial markets for many years. However, in recent years, crypto assets have begun to be traded intensively in certain markets. Furthermore, since crypto assets are not based on any legal regulations or institutions, they are used for different purposes and have attracted considerable interest due to their high rates of return. Although some countries have imposed restrictions on crypto assets, transactions continue worldwide. The study compared the returns of stocks and crypto assets using technical analysis indicators. Changes in profit/loss situations were observed based on indicators and assets.

## 2 STOCKS AND CRYPTO ASSETS

In recent years, the global economy has been shaped by factors such as technological developments, competition, pandemics, digitalization and wars, creating uncertainty and various risks. These risks may be attractive to investors, but in order for

companies to gain a competitive advantage and maximize profits and value, they must adapt to this environment, assess potential risks, and manage them in the best possible way (Aba, 2022, p. 382).

As long as financial markets exist, risk will continue to be part of the system. It is important for companies and investors operating in these markets not only to minimize risks but also to anticipate the risks they may encounter and take strategic positions based on these predictions (Koldere & Akduğan, 2012, p. 225).

Financial risks must be continuously measured, monitored, and managed. Risks arising in capital and money markets include (Stulz, 2024):

- Market risk,
- Credit risk,
- Liquidity risk,
- Structural interest rate risk,
- Currency risk.

These risks manifest differently in the volatility of international financial markets. For example, when demand for gold increases, money in circulation is transferred to gold, and the value of gold rises. In contrast, the value of assets such as stocks and bonds falls. Similarly, a change in exchange rates causes changes in companies' receivables and liabilities in local currency terms (Almedia et al., 2017). For example, an increase in the exchange rate will cause an increase in the local currency debt of companies with foreign currency debt. This will have a negative impact on the market.

Therefore, due to the risks mentioned above, changes in capital and money markets have a positive or negative impact on assets. For this reason, investors perform numerous analyses to increase the value of their assets and reduce risk. These analyses reduce risk to a certain extent and minimize potential losses. Today, risks are even calculated and analyzed using artificial intelligence.

## 2.1 Stocks

Stocks represent the company's share capital and grant the holder ownership rights. Stockholders receive a share of the company's profits and may have voting rights at general meetings. Stocks are generally issued to increase the equity capital of companies. According to the legal regulations in Turkey, institutions that can issue stocks

include joint-stock companies, limited partnerships with capital divided into shares, and companies established by special law. Shares are traded on capital markets. The capital market is where medium- and long-term supply and demand for securities such as shares, bonds, and similar instruments meet (Münyas, *The Structure and Functioning of the Capital Market in Turkey*, 2015). Capital markets are markets where investors provide resources to businesses through investment instruments. The most important and common instruments of the capital market are stocks and private sector and government bonds. Along with these, exchange-traded funds, private sector bonds, lease certificates, asset-backed securities, collateralized debt obligations, futures contracts, and options are also considered capital market instruments (Mitchell and Utkus, 2002).

It is certain that a developing and growing capital market will contribute to the overall development and growth of the economy by providing the real sector with access to abundant and cheap financing sources. The desire of domestic savers to invest their savings in this market plays an important role in the development of the capital market. In addition to its intermediary function in financing large investments with small savings, the capital market contributes positively to income distribution by spreading capital to the grassroots and plays an important role in combating the informal economy through reporting standards (State Planning Organization Ninth Development Report, 2007, p. 34).

As in our country, there are stock exchanges in countries around the world where assets are traded on secondary markets. For example, in the Asia-Pacific region, there are the Shanghai, Nikkei, Kospi, and Hang Seng Stock Exchanges; in America, there are the DOW, S&P 500, and Nasdaq; and in Europe, there are the DAX, FTSE 100, CAC40, and IBEX35 stock exchanges.

## **2.2 Crypto assets**

Cryptocurrencies are a combination of the words “crypto” and “currency” and refer to encrypted money. The trading of cryptocurrencies began to spread after the 2008 mortgage crisis. Crypto assets are divided into two categories: Coins and Tokens. Coins are further divided into Bitcoin and Altcoins. The primary purpose and feature of these currencies is to serve as a payment method that can be freely transferred in a “peer-to-peer” (P2P) manner without geographical restrictions or intermediaries in a DLT or

related technology (Karacan & Erişir Karacan, 2021, p. 31). All coins and tokens are cryptocurrencies. Cryptocurrencies are distributed, open-source, math-based, peer-to-peer virtual currencies, with Bitcoin, LiteCoin, Ethereum, Ripple, Bitcoin Cash, etc. being the most well-known cryptocurrencies. Bitcoin is both the first and still the most preferred cryptocurrency today. Because Bitcoin was the first, cryptocurrencies that emerged after it are called AltCoins. Bitcoin is a digital currency and has become quite popular in recent years. Bitcoin operates on a P2P system that facilitates and accelerates investment, shopping, and money transfer transactions while also ensuring security.

Cryptocurrencies are not tied to a central authority, and unlike physical currencies in circulation, there is no central bank or state guarantee managing cryptocurrencies. Cryptocurrencies are digitally created, stored, and transferred.

With the elimination of borders in international trade, cryptocurrencies have begun to be used as an alternative to national currencies. They can be used in the purchase and sale of goods and services, as well as a new investment method, and they also support uninterrupted financial operations, one of the most important features of financial markets.

In recent years, interest and demand for crypto assets have increased worldwide, and they have many advantages and disadvantages compared to traditional currencies. Due to the high volatility in the cryptocurrency market, investors need to be more careful about risk management. In addition, the high growth potential due to it being a newly formed market, the idea that it will be used as the currency of the future, the potential for high profits and rumors, the fact that it can be used for payments, and the existence of its own ATMs can be listed as reasons for its preference. The development of the cryptocurrency market is likened to a ship sailing on rough seas. Therefore, legal support will ensure that these assets are in greater demand and that prices rise (Gate, 2025).

Cryptocurrencies are traded in specific markets, and the blockchain system is used for their replication and storage. Blockchain technology is the software and architectural structure of cryptocurrency, a system for storing and recording data, where data is recorded sequentially and in blocks. Once a block is completed, the production of the next block begins, and the system progresses in a chain-like structure. The system records and verifies the block by confirming the transaction performed by both parties. The information cannot be deleted or altered at a later date (Ünal & Uluyol, 2020).

Each block in the chain has its own rules. These rules include the size of the blocks, how records are stored, how they are sorted, the conditions for producing new blocks, the characteristics of the connections between blocks, how the blockchain is distributed, stored, tracked, and controlled on the network (Güven & Şahinöz, 2022, p. 44).

Investing in crypto assets is an area full of opportunities and challenges, and the complexity and volatility of the market require investors to have in-depth research capabilities and a solid investment strategy. Long-term value investing emphasizes owning underlying assets. Bitcoin and Ethereum are considered the best options for long-term investment due to their technical superiority, application scenarios, and market positions, while promising projects in various sectors, such as Solana and Polygon, may capture new opportunities in the industry's development. In contrast, short-term investments require investors to have quick decision-making skills, use technical analysis tools, and quickly adjust their positions to maintain high short-term returns (Gate, 2025). Analysts estimate that Bitcoin could reach approximately \$122,000 in 2025 and \$366,000 by 2030 (Adviser, 2025).

Bitcoin's volatility is approximately 47%, which is 12% higher than gold and 10.2% higher than global stocks. This volatility can lead to significant gains as well as devastating losses, so investors need to approach it cautiously (Adviser, 2025).

### **3 TECHNICAL ANALYSIS AND INDICATORS**

Unlike fundamental analysis, technical analysis does not use economic outlook and company financial data. Technical analysis analyzes the price movements of an asset on the relevant exchange (Rampini et al., 2014). It attempts to determine the timing and price of buying and selling by using charts, trends, formations, and indicators to assess the likelihood that an asset's past price movements in the market will repeat in the future. Technical analysis has been used for many years to determine the value of stocks for short-term trading. However, we also see it being used to determine the short-term value of cryptocurrencies (Gate, 2025). One of the basic rules of technical analysis is that it does not involve certainty and is based on probabilities (Pring, 2014, 29).

The emergence of technical analysis is based on the old and well-known Dow Theory. The Dow Theory is a theory that explains how assets in the markets will change

in the short, medium, and long term. The Dow Theory argues that all factors that can affect prices, such as fundamental, political, psychological, expectations, etc., are reflected in the price (Murphy, 1999, 25). Technical analysts believe that prices reflect all information related to stocks, while focusing solely on prices, unlike fundamental analysts who are concerned with fundamental factors (Mitra, 2011, 199-206). There are three types of trends in the Dow Theory.

These trends are:

- Primary trend,
- Secondary trend,
- Minor trend.

The primary trend is a trend that lasts for years, at least one year. These are trends that result in gains or losses following broad upward or downward movements. Trends that move in the opposite direction of the primary trend line are called secondary trends and are known as corrective movements. Secondary trends can last for one or several months. Minor trends are trends that show daily or short-term price fluctuations in averages. Since they are short-term price formations, they can be subject to manipulation. It is accepted that price movements within the day, daily fluctuations, and sometimes even secondary trends can be subject to manipulation. However, even if secondary trends or minor trends have an opposite effect for up to several weeks, the main trend does not change.

There are numerous methods and indicators in technical analysis. Not all of these methods and indicators are used in analyses. The analyst uses the methods and indicators that they believe most accurately identify the market from their perspective. However, the most widely accepted methods and indicators are considered the most accurate.

Support and resistance methods are among the most commonly used methods in technical analysis. The price levels at which stocks pause while rising or falling are called resistance and support levels. In other words, these are the levels that indicate at which point the price will pause and move in the opposite direction.

In technical analysis, trading volume appears in the form of bars at the bottom of price charts, and it is important to compare the trading volume with the changes in price. This is because trading volume provides insight into the continuity or reversal of the current trend. If the trading volume of a financial asset in an uptrend is also high, it

suggests that the trend may continue; if the volume is declining, it may indicate a potential change in the trend direction.

Support and resistance levels indicate the price levels previously reached by the asset being analyzed within a specific time frame. Levels below the current price that the financial asset has previously tested are support levels, while levels above the current price are resistance levels. However, support and resistance levels may not always be accurate (Capital Markets Licensing, Registry, and Education Authority, p. 148).

### 3.1 Indicators used in technical analysis

The word “indicator,” which entered our language from French, means “sign” in Turkish. It provides information about the direction or strength of a trend by performing numerous mathematical calculations using price movements over specific periods (Lo, et al., 2000). Indicators are usually displayed on price charts and are used to forecast medium- and long-term price movements. Indicators provide more objective results than other technical analysis methods. However, using them in conjunction with other methods yields more accurate results (Münyas & Atasoy, Capital Market Fundamental and Technical Analysis Methods, 2021, p. 140).

Numerous studies have been conducted on technical analysis.

- Lo and MacKinlay (1988) found that when weekly period signals are used, past prices can be used to predict future returns to a certain extent. This is accepted by all technical analysts.
- Chong and Ng (2008) used the MACD (Moving Average Convergence Divergence) indicator in their study, which examined the past 60-year period of the FT30 index on the London stock market. They determined that MACD and the Relative Strength Index (RSI) provided higher returns in most cases compared to the buy-and-hold strategy.
- Gunasekarage and Power (2001) demonstrated the validity of technical analysis trading rules in their study of the Bombay, Colombo, Dhaka, and Karachi markets in South Asia.
- Studies by Tabell (1964), Treynor and Ferguson (1985), Brown and Jennings (1989), and Rouwenhorst (1998) demonstrated the importance of technical analysis in calculating future values from past data through practical applications.

- Lo, Mamaysky, and Wang (2000) revealed that technical analysis, particularly the head-and-shoulders and double bottom formations, adds value to investment processes.
- Zhu and Zhou (2009) stated that technical analysis results yield stronger results in currency markets than in stock markets.
- Neely (1997) argued that the use of moving averages provides high returns in foreign exchange markets, and Gehrig and Menkhoff (2006) also suggested that technical analysis is as important as fundamental analysis for currency managers.
- Wong, Meher, and Boon-Kiat (2003) stated that moving averages and RSI (Relative Strength Index) yielded positive results on the Singapore Stock Exchange.
- Park and Irwin (2007) reviewed 95 studies on the benefits of technical analysis and determined that 56 of these studies produced positive results, 20 produced negative results, and 19 produced mixed results.

The most commonly used methods in technical analysis are briefly outlined below.

#### **Moving Average (MOV)**

This is the most commonly used indicator in technical analysis and is easy to calculate. It represents the average of the price movements of a financial asset over a specific time period. As the market price of the relevant stock changes, its moving average also changes (Ünver, 2012, p. 136). The moving average indicator can be calculated in three different ways: simple, exponential, and weighted average.

**The Simple Moving Average (SMA)** takes into account the daily closing prices of a financial asset over a certain period of time. For example, it is calculated by dividing the sum of a financial asset's 14-day closing prices by 14.

**The Weighted Moving Average (WMA)** is calculated by giving more weight to prices from more recent periods when calculating the average of a financial asset's closing prices over a specific period. This average is calculated based on the idea that price movements each day do not carry the same importance. It is believed that this method is more effective in capturing price movements in analyses.

**The Exponential Moving Average (EMA)**, on the other hand, calculates the average of a financial asset's price movements within a specified period by giving more weight to recent price movements. The most common use of the moving average by

investors is that if the price crosses the average upwards, it should be interpreted as a buy signal, and if it crosses downwards, it should be interpreted as a sell signal.

Additionally, analyses are conducted using multiple averages. When two moving averages are used on charts, if the shorter-term average crosses above the other, it is considered a buy signal, and vice versa (Münyas & Atasoy, *Capital Market Fundamental and Technical Analysis Methods*, 2021, p. 144).

### **Relative Strength Index (RSI)**

This indicator uses values ranging from 0 to 100 on charts and is used to measure the strength of prices based on the closing prices of any financial asset (Münyas & Atasoy, *Capital Market Fundamental and Technical Analysis Methods*, 2021, p. 145). The relative strength index is used in short- and medium-term analysis, and 14-day periods are used on many trading platforms. Keeping the period longer than 14 days may be more useful in terms of measuring trend strength, but timing errors in detecting buy-sell signals are more frequent than in the short term (Takmaz, p. 60).

The Relative Strength Index is evaluated as the 30 level for oversold and the 70 level and above for overbought. That is, if the signals investors receive are 30 and below, the RSI curve rising above this level is considered a buy signal, while the RSI curve falling below this value when it is 70 and above is considered a sell signal.

### **Momentum**

A momentum indicator shows the percentage change in a financial asset's exchange rate over a predetermined period. In the momentum indicator, when the indicator bottoms out in a trend and turns upward, a "BUY" decision should be made, and in the opposite case, a "SELL" decision should be made. When this indicator makes a new low or high, it is interpreted as the current trend continuing, but the rate of increase in prices slowing down and prices possibly falling thereafter.

### **Moving Average Convergence/Divergence (MACD)**

This indicator is used to detect convergence or divergence between two moving averages. MACD is an indicator that can be used both to follow trends and as an indicator (Takmaz, p. 66). The indicator is created by the convergence and divergence of moving averages.

The MACD indicator is also used to identify overbought and oversold conditions. If the MACD line rises rapidly above the signal line, it signals an excessive rise and a subsequent rapid correction.

### **CCI (Commodity Channel Index)**

The CCI indicator is a versatile indicator that can be used to identify a new trend relative to the average price level over a specific time period or in overbought/oversold zones. It typically compares current prices to an average price over 14 periods and moves above +100 and below -100. In analyses, movements above +100 are used as the overbought zone and movements below -100 as the oversold zone (Çetinyokuş & Gökçen, 2002).

### **Stochastic Indicator**

It is effective in short-term charts with high trading volume during a specific period and can also be used to identify overbought and oversold zones (Münyas & Atasoy, Capital Market Fundamental and Technical Analysis Methods, 2021, p. 154). It provides reversal signals by calculating the ratio of the closing prices of a financial product to its lowest and highest levels.

In the indicator, above the 80 level is considered an overbought zone, while below the 20 level is considered an oversold zone.

### **Bollinger Bands**

The Bollinger Bands indicator widens when prices are highly volatile and narrows when volatility is low. There are three bands in total: middle, lower, and upper. According to the Bollinger Band, when prices exceed the upper band, a correction is expected, and selling begins. If prices fall below the lower band, this is interpreted as a buy signal (Raşo & Demirci, 2019).

## **4 APPLICATION**

The study tested 5 companies listed on the BIST technology index and 4 crypto assets, including Bitcoin, between January 1, 2022, and January 1, 2024. The net profit/loss emerging from the 1-hour, 4-hour, daily, and weekly time charts using the technical analysis indicators MACD, RSI, Momentum, Stochastic, and Bollinger Bands is listed. The application strategy test was conducted via <https://tr.tradingview.com>. During the test, an initial capital of 100,000 TL was entered, and 1 order was placed based on indicator signals using 10% of this capital. The amount shown in the buy and hold row indicates the profit or loss obtained at the end of the test period when the entire capital is

used for the first transaction. Commission rates used on stock exchange trading platforms for daily transactions were disregarded throughout the test.

Binance cryptocurrency platform data was processed while testing BTC and other crypto assets. Additionally, transactions were tested using the Turkish Lira equivalent of these crypto assets. Binance is a cryptocurrency exchange that provides a platform for buying and selling various cryptocurrencies. Binance has become the world's largest cryptocurrency exchange in terms of trading volume (Binance, 2024).

The purpose of the study is to calculate the profits or losses resulting from buy orders, sell orders, and hold orders based on the most commonly used indicator signals in technical analysis for 5 stocks and 5 crypto assets included in the technology index during the specified periods. Then, compare the technology stocks with the crypto assets to determine which indicator and time frame yields the highest profit or loss for which stock or crypto asset. .

Hypotheses:

H1. Indicator signals differ between technology stocks and crypto assets.

H2. There is a difference between periodic signals and hold signals.

Tests were conducted on the top 5 companies in the BIST Technology Index, listed in alphabetical order.

**Table 1**

*Companies Analyzed and Their Symbols*

<b>Company</b>	<b>Symbol</b>
Alcatel Lucent Teletaş Telecommunications Inc.	ALCTL
Ard Group Information Technologies Inc.	ARDYZ
Arena Computer Industry and Trade Inc.	ARENA
Aselsan Electronics Industry and Trade Inc.	ASELS
ATP Software and Technology Inc.	ATATP

Five crypto assets that have been increasingly traded in certain markets in recent years were analyzed. These assets are listed in Table 2.

**Table 2**

*Examined Crypto Assets and Their Symbols*

<b>Crypto Asset</b>	<b>Symbol</b>
BITCOIN	BTC/TRY
TETHERUS	TETHER/TRY

AVAX	AVAX/TRY
RIPPLE	E XRP/TRY
CHILIZ	CHZ/TRY

#### 4.1 Strategy tests

Strategy tests examine the movements of indicators on the asset being considered for investment. Strategy tests are conducted through backtests, taking into account the period the investor wishes to monitor on the platform, and the signals generated by the indicators can be monitored. Strategy tests were conducted during trading hours when trading was open and available.

The trades were conducted and compared in two different ways.

1. Numerous buy and sell transactions were executed based on the buy and sell signals of the indicators in hourly, 4-hour, daily, and weekly periods, depending on the timeframe.
2. One buy and hold transaction was executed for each period, based on the specified period and indicator signals.

Numerous trades were executed based on the signals generated by the indicators during the specified periods, and profit/loss calculations were made. The profit/loss calculation represents the total amount of multiple trades executed within the relevant time period. In calculating the totals, profits were added and losses were subtracted. The number of trades during the specified periods varies depending on the number of signals generated by the indicators. Based on the indicator analysis, profit/loss calculations were made using buy/hold options, assuming a single trade was executed for each period. In other words, the analyses were conducted in two different ways. Trades are assumed to be executed based on the signals provided.

The table below shows the profit/loss results of the strategy tests in hourly, 4-hour, daily, and weekly timeframes.

**Table 3***Technology Stocks Trading Results*

Companies	Indicators	Transaction Information	1 Hourly	4 Hourly	Daily	Weekly
		First Transaction	07.01.2022	19.01.2022	11.03.2022	23.01.2023
		Last Transaction	27.12.2023	29.12.2023	08.12.2023	27.11.2023
ALCATEL	MOMENTUM	Net Profit/Loss	-2.758	10.046,20	17.983,90	12.763,10
		Buy and Hold	200.393,30	182.557,90	192.316,20	182.557,90
	MACD	Net Profit/Loss	19.281,30	5.693,80	7.586,80	1.664,30
		Buy and Hold	185.752	172.479,30	173.465,60	-11.886,20
	RSI	Net Profit/Loss	-7.249,90	-24.108,20	-20.612,10	-
		Buy and Hold	202.764,80	180.491,60	188.971,30	-16.692,30
	BOLLINGER BANDS	Net Profit/Loss	-15.773,20	-19.601,60	-1.775,90	-
		Buy and Hold	202.764,80	193.453,80	215.277,20	145.318
STOKASTİK	Net Profit/Loss	382,27	27,56	993,28	-	
	Buy and Hold	-34.154,23	-30.761,10	8.490,57	23.706,90	
ARD GRUP	MOMENTUM	Net Profit/Loss	14.800,20	13.285,76	21.629,24	-1.237,06
		Buy and Hold	249.582,48	266.274,24	221.963,10	399.615,02
	MACD	Net Profit/Loss	16.907,82	729,62	19.856,30	787,68
		Buy and Hold	262.205,44	254.329,92	415.397,24	184.715,64
	RSI	Net Profit/Loss	-16.922,64	-11.808,16	-876,32	-
		Buy and Hold	251.480,82	238.701,06	192.363,60	145.105,12
	BOLLINGER BANDS	Net Profit/Loss	-9.770,48	-11.678,26	-13.436,66	-
		Buy and Hold	255.295,02	238.701,06	193.017,30	288.076,80
STOKASTİK	Net Profit/Loss	5.683,84	-9.036	-8.528,06	9.660,60	
	Buy and Hold	262.205,44	233.490,62	185.949,44	142.368,76	
ARENA	MOMENTUM	Net Profit/Loss	7.455,22	14.808,06	5.270,70	354,06
		Buy and Hold	138.421,20	139.499,28	123.858,88	122.281,68
	MACD	Net Profit/Loss	7.740,70	13.754,72	-1.006,44	5.064,68
		Buy and Hold	132.782,30	120.714,48	136.977,96	146.240,64
	RSI	Net Profit/Loss	-1.461,68	-11.080,40	1.845,90	-
		Buy and Hold	146.240,64	121.967,44	103.876,08	94.078,96
	BOLLINGER BANDS	Net Profit/Loss	-13.751,94	-10.832,32	-1.827,26	185,42
		Buy and Hold	137.698,66	136.627,40	103.876,08	130.068,18
STOKASTİK	Net Profit/Loss	-4.465,80	3.816,30	7.380,24	462,26	
	Buy and Hold	135.927,60	145.860	102.876,08	94.078,96	
ASELSAN	MOMENTUM	Net Profit/Loss	2.675,30	12.559	-3.272,90	10.556,55
		Buy and Hold	316.657,80	264.367,05	310.944,60	216.893,60
	MACD	Net Profit/Loss	6.160,85	4.898,15	-371,25	3.804,65
		Buy and Hold	287.908	310.944,60	371.196,95	60.426,75
	RSI	Net Profit/Loss	-4.452,30	-13.764,45	993,05	-
		Buy and Hold	301.766,40	287.908	343.342,20	199.980
	BOLLINGER BANDS	Net Profit/Loss	-4.055,90	-8.837,85	-21.234,05	4.282,20
		Buy and Hold	301.766,40	291.282,50	343.342,20	199.980
STOKASTİK	Net Profit/Loss	-8.120,25	2.995,45	-15.466,05	29.811,20	
	Buy and Hold	298.211,30	278.139,30	326.517,10	303.566,80	
	MOMENTUM	Net Profit/Loss	3.000,80	-6.667,50	9.803,90	1.989,40
		Buy and Hold	295.099,20	295.099,20	211.762,20	264.154,80
	MACD	Net Profit/Loss	10.541	3.208,60	-1.607,80	2.508

ATP SOFTWARE AND Technology Inc.	RSI	Buy and Hold	315.295,50	203.067	238.873,60	306.617,60
		Net Profit/Loss	-8.141,50	-511,20	2.333,50	-
	BOLLINGER BANDS	Buy and Hold	281.232	241.224	233.039,60	82.422,90
		Net Profit/Loss	-12.120,80	-5.186,20	-2.717,20	2.486,40
	STOKASTİK	Buy and Hold	306.617,60	241.224	258.790,40	403.042,80
		Net Profit/Loss	-9.883,90	3.292,80	-5.556,70	9.774,80
		Buy and Hold	308.360,80	241.224	269.634,40	303.288,80

Table 3 shows that in the time periods identified in the analysis using technical analysis indicators for technology stocks in the BIST100 index, the momentum indicator yielded good results, whereas the stochastic indicator mostly closed at a loss. For Alcatel shares, the best MACD indicator was found in the hourly time frame; for ARD Group shares, the best momentum indicator was found in the daily time frame; for Arena shares, the best momentum indicator was found in the 4-hour time frame; the stochastic indicator for Aselsan shares in the weekly time frame, and the best momentum indicator for ATP shares in the daily time frame. Furthermore, the buy-and-hold strategy was found to yield higher profits in most cases.

**Table 4**

*Trading Results of Crypto Assets*

Crypto Assets	Indicators	Transaction Information	1 Hourly	4 Hourly	Daily	Weekly	
BITCOİN	MOMENTUM	Net Profit/Loss	-2.183,64	-1.224,49	11.110,44	4.509,34	
		Buy and Hold	102.122,75	105.489,70	134.379,96	112.759,13	
	MACD	Net Profit/Loss	-4.959,65	4.670,24	8.624,85	-3.774,93	
		Buy and Hold	104.432,17	112.393,13	146.134,13	89.199,94	
	RSI	Net Profit/Loss	-10.005,03	4.600,07	5.718,83	6.187,75	
		Buy and Hold	104.695,14	142.372,40	160.851,33	266.142,01	
	BOLLINGER BANDS	Net Profit/Loss	-1.740,97	-4.966,19	7.419,64	2.022,37	
		Buy and Hold	103.295,62	110.131,27	170.480,33	266.142,01	
	STOKASTİK	Net Profit/Loss	-6.964,95	-14.788,14	4.065,19	164,96	
		Buy and Hold	108.098,08	121.248,28	173.259,07	272.099,83	
	TETHERUS	MOMENTUM	Net Profit/Loss	-10.477,21	-224,60	1.826,22	-
			Buy and Hold	132.411,40	127.887,55	119.196,70	105.432,32
MACD		Net Profit/Loss	-10.157,02	855,70	-928,04	3.450,15	
		Buy and Hold	127.190,46	116.275,11	122.914,92	51.302,72	
RSI		Net Profit/Loss	-30,33	165,93	-	-	
		Buy and Hold	126.358,62	133.091,15	118.408	83.585,19	
BOLLINGER BANDS		Net Profit/Loss	203,36	-1.185,05	-5.051,38	-	
		Buy and Hold	126.517,98	133.091,15	124.732,91	83.585,19	
STOKASTİK		Net Profit/Loss	-1.164,21	-4.148,22	-3.900,80	-	
		Buy and Hold	126.694,43	117.963,28	122.914,92	90.696,26	
AVAX		MOMENTUM	Net Profit/Loss	29.939,48	21.653,65	23.600,73	-111,77
			Buy and Hold	-16.815,22	-18.385,22	0	-14.510,25
	MACD	Net Profit/Loss	10.294,82	17.104,49	23.094,33	-5.875,71	
		Buy and Hold	-21.667,79	-2.380,75	26.269,74	266.701,66	
	RSI	Net Profit/Loss	-22.294,40	-468,95	-65,90	-	
		Buy and Hold	-20.511,26	-17.266,42	48.680,24	139.287,32	
	BOLLINGER BANDS	Net Profit/Loss	-7.426,49	-25.756,51	1.043,48	24.870,91	
		Buy and Hold	-19.341,82	-11.823,64	38.019,51	155.724,22	
	STOKASTİK	Net Profit/Loss	-21.800,29	-33.594,33	6.764,42	4.231,37	
		Buy and Hold	-14.118,87	-21.598,85	25.482,69	187.010,77	
		MOMENTUM	Net Profit/Loss	-7.296,02	11.550	9.499,27	3.174,13
			Buy and Hold	67.144,82	65.736,99	80.329,85	97.745,66

RIPPLE	MACD	Net Profit/Loss	6.352,21	-6.291,84	-7,36	2.068,16
		Buy and Hold	65.769,48	72.992,90	93.662,78	152.336,43
	RSI	Net Profit/Loss	-1.209,81	-15.511,53	-2.267,40	-
		Buy and Hold	68.573,90	85.261,28	113.521,54	46.016,82
	BOLLINGER BANDS	Net Profit/Loss	24.004,35	-12.951,89	-8.407,11	4.064,81
		Buy and Hold	70.834,26	75.210,18	123.714,40	163.877,81
STOKASTİK	Net Profit/Loss	-9.827,25	-12.700,41	3.382,34	11.138,13	
	Buy and Hold	66.299,41	63.281,06	128.837,93	182.650,75	
CHILIZ	MOMENTUM	Net Profit/Loss	145.346,78	66.952,86	15.547,20	1.062,23
		Buy and Hold	-31.619,74	-35.244,69	-26.527,78	-31.030,34
	MACD	Net Profit/Loss	-1.033,16	9.497,74	13.987,50	-1.916,60
		Buy and Hold	-35.486,23	-35.003,72	13.034,19	-29.026,28
	RSI	Net Profit/Loss	-391,47	-556,13	1.443,85	-
		Buy and Hold	-31.085,65	-36.066,37	4.835,51	-43.350,60
	BOLLINGER BANDS	Net Profit/Loss	21.142,70	14,73	554,72	5.648,94
		Buy and Hold	-29.262,43	-39.168,79	12.745,10	-39.863,80
	STOKASTİK	Net Profit/Loss	382,27	27,56	993,28	-
		Buy and Hold	-34.154,23	-30.761,10	8.490,57	23.706,90

The -(minus) symbol in the figures in the table indicates a loss. Net profit/loss amounts represent the amounts resulting from multiple trades based on signals given within a timeframe, while buy-and-hold amounts represent the amounts resulting from a single trade within a timeframe.

Table 4. When examining the performance of the most actively traded crypto assets over time periods determined by technical analysis indicators, the momentum indicator shows the best results for the BITCOIN crypto asset in the daily time frame, while all technical analysis indicators show quite poor results for the TETHERUS crypto asset across all time periods. AVAX cryptocurrency shows the best results in the hourly time frame of the momentum indicator, RIPPLE cryptocurrency shows good results in the hourly time frame of the Bollinger Bands indicator, and CHILIZ cryptocurrency shows the best results in the hourly time frame of the momentum indicator. Furthermore, in the buy-and-hold strategy, it has been revealed that all cryptocurrencies generate high profits across nearly all time frames in all technical analysis indicators.

**Table 5***Profit/Loss Numbers for Assets According to Indicator Timeframes*

			<b>1 Hourly</b>	<b>4 Hourly</b>	<b>Daily</b>	<b>Weekly</b>
Technology Stocks Number of Profitable or Loss-Making Trades	MOMENTUM	Net Profit/Loss	4(1)	4(1)	4(1)	4(1)
	MACD	Net Profit/Loss	5(0)	5(0)	2(3)	5(0)
	RSI	Net Profit/Loss	0(5)	0(5)	3(2)	-
	BOLLINGER BANDS	Net Profit/Loss	1(4)	2(3)	0(5)	4(1)
	STOKASTİK	Net Profit/Loss	3(2)	4(1)	2(3)	5(0)
			1 Saatlik	4 Saatlik	Günlük	Haftalık
Crypto Assets Number of Profitable or Loss-Making Transactions	MOMENTUM	Net Profit/Loss	3(2)	3(2)	4(1)	2(3)
	MACD	Net Profit/Loss	2(3)	3(2)	2(3)	2(3)
	RSI	Net Profit/Loss	0(5)	2(3)	2(3)	-
	BOLLINGER BANDS	Net Profit/Loss	2(3)	1(4)	4(1)	4(1)
	STOKASTİK	Net Profit/Loss	1(4)	1(4)	4(1)	3(2)

The profit/loss figures for the technology stocks shown in Table 3 and the crypto assets shown in Table 4 are presented as amounts. Strategy signals periodically yielded very high profits in some periods, while others resulted in losses. To demonstrate which indicator resulted in greater profits in which time period, the information provided in Table 3 and Table 4 above, along with the profitable/loss trade numbers in Table 5, will help determine which indicators are more preferable. Analysis of BIST100 technology stocks and crypto assets using technical analysis indicators in the specified time periods:

- The momentum indicator shows that technology stocks made profits in nearly all of the specified time periods, while the profit rate for crypto assets remained lower than for technology stocks.
- The MACD indicator shows that technology stocks made profits in all of the specified time periods except daily, while the profit rate for crypto assets was close to half.
- The RSI indicator shows that technology stocks and crypto assets made losses in nearly all of the specified time periods.
- The BOLLINGER BANDS indicator shows that technology stocks profited significantly in the weekly period and lost significantly in other periods, while crypto assets experienced losses in all periods except the 1-hour period.
- The STOCHASTIC indicator shows that technology stocks profited nearly half as much in the 4-hour and weekly periods as in other periods. Crypto assets

profited significantly in the daily and weekly periods and lost significantly in other periods. In short, in terms of profit and loss figures, technology stocks were mostly profitable according to momentum indicators, while they were incurring losses according to the RSI indicator. Crypto assets, on the other hand, showed significant profits in the daily and weekly periods, as evidenced by Bollinger Bands and Stochastic indicators. The tables below show the signals generated by the indicators for both BIST100 technology stocks and cryptocurrencies, along with the resulting profit or loss in the case of a BUY/HOLD transaction. The resulting profit or loss is shown in the time charts, whichever is more profitable. For example, when tested with the BTC Momentum indicator for 1-hour, 4-hour, daily, and weekly periods, the daily signal profit was taken because the most profit was obtained from the daily timeframe.

**Table 6**

*Highest Buy-Hold Profit/Loss Results for Stocks According to Indicator Signals*

INDICATOR	ALCTL BUY-HOLD	ARDYZ BUY-HOLD	ARENA BUY-HOLD	ASELS BUY-HOLD	ATATP BUY-HOLD
MOMENTUM	200.393,30 TL 1 Saatlik Grafik	399.615,02 TL Haftalık Grafik	139.499,28 TL 4 Saatlik Grafik	316.657,80 TL 1 Saatlik Grafik	295.099,20 TL 4 Saatlik Grafik
MACD	185.752 TL 1 Saatlik Grafik	415.397,24 TL Günlük Grafik	146.240,64 TL Haftalık Grafik	371.196,95 TL Günlük Grafik	315.295,50 TL 1 Saatlik Grafik
RSI	202.764,80 TL 1 Saatlik Grafik	251.480,82 TL 1 Saatlik Grafik	146.240,64 TL 1 Saatlik Grafik	343.342,20 TL Günlük Grafik	281.232 TL 1 Saatlik Grafik
BOLLINGER BANDS	215.277,20 TL Günlük Grafik	288.076,80 TL Haftalık Grafik	137.698,66 TL 1 Saatlik Grafik	343.342,20 TL Günlük Grafik	403.042,80 TL Haftalık Grafik
STOKASTİK	23.706,90 TL Haftalık Grafik	262.205,44 TL 1 Saatlik Grafik	145.860 TL 4 Saatlik Grafik	326.517,10 TL Günlük Grafik	308.360,80 TL 1 Saatlik Grafik

Findings Regarding Technology Stocks - The ALCTL momentum strategy generated a loss on the 1-hour chart, but a profit on the 4-hour, daily, and weekly charts. The BUY-HOLD strategy generated a profit on all charts. The MACD generated a profit on all timeframes. The RSI indicator traded unclosed on the weekly chart, but a loss was observed on all other timeframes. The Bollinger Bands indicator generated a loss on all timeframes. The Stochastic indicator strategy generated a profit on the weekly chart, but a loss on all other timeframes. - The ARDYZ momentum strategy generated a profit on the 1-hour, 4-hour, and daily charts, but a loss on the weekly chart. The BUY-HOLD strategy generated a profit on all charts. The MACD strategy generated a profit on the 1-hour and daily charts, but a small profit on all other timeframes. The RSI strategy generated a profit on the daily chart, but a loss on all other timeframes. The Bollinger

Bands strategy generated a loss on all timeframes. The stochastic strategy generated profits on the 1-hour and weekly charts, but incurred losses on other timeframes. - The ARENA momentum strategy generated profits on the 1-hour and 4-hour charts, but incurred losses on the other timeframes. The BUY-HOLD strategy generated profits on all timeframes. The MACD strategy generated profits on the 1-hour, 4-hour, and weekly charts, but incurred losses on the daily timeframe. The RSI strategy generated losses on the 1-hour and 4-hour charts, but incurred losses on the daily timeframe. The Bollinger Bands strategy generated profits on the daily and weekly charts, but incurred losses on other timeframes. The stochastic strategy generated profits on all timeframes. - The ASELS momentum strategy generated profits on all timeframes. The BUY-HOLD strategy generated high profits on all timeframes. The MACD strategy generated low profits on the 1-hour, 4-hour, and weekly charts, but incurred losses on the daily timeframe. In the RSI strategy, open trades were observed on the weekly timeframe, generating profits on the hourly timeframe and resulting in losses on other timeframes. In the Bollinger Bands strategy, generating low profits on the weekly timeframe and resulting in losses on other timeframes. In the Stochastic strategy, generating profits on the 4-hour and weekly timeframes and resulting in losses on other timeframes. - In the ATATP momentum strategy, generating losses on the 1-hour, 4-hour, and weekly timeframes, generating profits on the daily timeframe. In the BUY-HOLD strategy, generating profits on all timeframes. In the MACD strategy, generating low profits on the 1-hour, 4-hour, and weekly timeframes, resulting in losses on the daily timeframe. In the RSI strategy, generating losses on the 1-hour timeframe and resulting in profits on other timeframes. In the Bollinger Bands strategy, generating losses on the 1-hour, 4-hour, and daily timeframes, generating high profits on the weekly timeframe. In the Stochastic strategy, generating profits on the 4-hour and weekly timeframes and resulting in losses on other timeframes.

**Table 7**

*Buy-Hold Highest Profit/Loss Results of Crypto Assets Based on Signals*

INDICATORS	BTC BUY-HOLD	TETHER BUY-HOLD	AVAX BUY-HOLD	XRP BUY-HOLD	CHZ BUY-HOLD
MOMENTUM	112.911,67 TL daily signal	27.865,18 TL daily signal	150.218,70 TL daily signal	42.915,04 TL 4-hour signal	204.442,43 TL daily signal
MACD	8.624,85 TL daily signal	3.450,15 TL Haftalık Grafik	23.094,33 TL Haftalık Grafik	6.352,21 TL 1-hour signal	13.987,50 TL Haftalık Grafik

RSI	6.187,75 TL Haftalık Grafik	165,93 TL 4-hour signal	3.407,62 TL daily signal	62,67 TL 1-hour signal	4.979,53 TL Haftalık Grafik
BOLLINGER BANDS	7.419,64 TL daily signal	756,99 TL 1-hour signal	24.870,91 TL Haftalık Grafik	24.004,35 TL 1-hour signal	21.142,70 TL 1-hour signal
STOKASTİK	4.065,19 TL daily signal	-1.164,21 TL 1 Saatlik Grafik	6.764,42 TL daily signal	11.138,13 TL Haftalık Grafik	6.026,20 TL daily signal

### *Findings Regarding Crypto Assets*

- In the 2022-2023 period, buy-and-hold trades based on indicator signals were observed to yield profits across all indicators and timeframes except for the Tethers crypto asset's stochastic indicator.
- While profits were achieved across all timeframes based on the BTC/TRY asset's momentum buy-and-hold strategy, the highest profit was observed for the CHZ crypto asset on the daily timeframe.
- According to the MACD buy-and-hold strategy, the highest profit was observed for the AVAX crypto asset on the weekly timeframe, while according to the RSI buy-and-hold strategy, the highest profit was observed for the BTC crypto asset on the weekly timeframe. According to the BOLLINGER BANDS buy-and-hold strategy, very high profits were observed for all assets except the 1-hour timeframe for the Tether crypto asset on all timeframes. Points emerging from the technical analysis indicators of

#### *BIST100 Technology Stocks and Crypto Assets during the 2022-2024 period:*

- Indicator signals differ between technology stocks and crypto assets, confirming the H1 hypothesis.
- There is a difference between periodic signals and buy-and-hold signals, confirming the H2 hypothesis.
- The best results for investors were achieved with the momentum indicator. It was particularly effective in BUY-HOLD transactions, while it resulted in lower profits for other assets.
- The MACD indicator strategy, while yielding good results for many assets on weekly timeframes, can be said to carry some risks due to its lack of stability.
- The RSI indicator strategy was generally found to be profitable but yielded low results for all assets. • The Bollinger Bands indicator strategy was found to yield the highest profits for technology stocks and all crypto assets across all

timeframes. These results demonstrate that the Bollinger Bands strategy provides accurate results in analyzing crypto assets.

- The stochastic indicator strategy generally results in low profits for both BIST 100 technology stocks and crypto assets. This suggests that stochastic indicator analysis is not a suitable indicator for crypto assets.
- It is observed that buy-and-hold transactions yield higher profits for all indicator signals for crypto assets, and that buy-and-hold transactions are more appropriate.
- Indicators vary over time, indicating that trading with a single indicator can be risky.

## 5 CONCLUSION

Today, with developments in capital markets and the increasing number of investors, individuals and institutions are evaluating their investments in the stock market and crypto assets, and this is becoming more and more attractive every day. While stocks are issued to increase companies' equity, crypto assets are assets created using digital and encryption technologies. Cryptocurrencies such as Bitcoin, Lite Coin, Ethereum, Ripple, Bitcoin Cash, etc. are the most well-known virtual currencies. Since there are numerous investment assets in financial markets, investors tend to focus on certain assets. Many analyses are performed when making investments. Technical analysis methods are most commonly used for short- and medium-term investments. Technical analysis is performed using specific indicators. In our study, technical analysis indicators such as momentum, MACD, RSI, Bollinger Bands, and Stochastic indicators were used to analyze 5 stocks listed on the BIST100 Technology Index and 5 cryptocurrencies through strategy tests. The tests were conducted by buying and selling based on the signals given by the indicators in hourly, 4-hour, daily, and weekly time frames between January 1, 2022, and December 31, 2023. Additionally, buy-and-hold positions were taken in the same specified time frames to calculate the profit/loss of the stocks and crypto assets.

The analysis revealed that the momentum indicator yielded the best results for investors. It was particularly effective in buy-and-hold strategies. While the MACD indicator strategy produced good results in weekly time frames for many assets, it was inconsistent. The RSI indicator strategy generally provided profitable but low results across all assets. The Bollinger Bands indicator strategy yielded the highest profits across all time frames for technology stocks and all crypto assets. The stochastic indicator

strategy resulted in low profits for both BIST 100 technology stocks and crypto assets. However, it has been found that the buy-and-hold strategy yields higher profits across all indicator signals for crypto assets and is more suitable.

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**Authors' Contribution**

Both authors contributed equally to the development of this article.

**Data availability**

All datasets relevant to this study's findings are fully available within the article.

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