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PERUVIAN EVIDENCE OF THE EFFICIENCY OF TECHNICAL ANALYSIS ON THE LIMA STOCK EXCHANGE

Abstract

In emerging markets such as the Lima Stock Exchange, characterized by lower liquidity and market depth, investors face unique challenges in maximizing returns and mitigating risks. This study aims to evaluate the efficiency of technical analysis on the Lima Stock Exchange, focusing on 14 stocks from the S&P/BVL Peru General portfolio selected for their broad spectrum of economic sectors, high trading frequency, and consistency in the index, totaling 9,802 quotations during the period from June 21, 2021 to June 21, 2024. The results, excluding transaction costs, show that technical tools such as Momentum, Moving Averages, Stochastic Oscillator, and Williams Oscillator offer superior returns compared to the buy-and-hold strategy, especially in short periods of 5, 10, and 15 days, with average excess returns of 24.28%. However, when including transaction costs, only eight of the 14 stocks achieve excess returns, with the Relative Strength Index (RSI), Bollinger Bands, and Moving Averages standing out as the most efficient tools, especially over longer periods. These findings underscore the importance of careful management of transaction costs to optimize the benefits of technical analysis in emerging markets.

Keywords momentum, moving averages, stochastic oscillator, Relative Strength Index, emerging markets, Williams oscillator, investment strategies, buy-and-hold, Peru

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INTRODUCTION

The Lima Stock Exchange (BVL) is an emerging market with distinctive characteristics that make it particularly interesting for financial analysis. Although the BVL is one of the smallest exchanges in Latin America, it has shown significant growth in recent years, driven by key sectors such as mining, agriculture, industry, and public services (Rivera, 2022). However, despite its growth, the BVL continues to face challenges related to liquidity and market depth, leading to inefficiencies that could be exploited by certain investment approaches (Chong et al., 2014).

In this context, technical analysis emerges as a potentially powerful tool for identifying investment opportunities in markets with these characteristics. Technical analysis, based on the premise that asset prices reflect recurring patterns influenced by both economic and psychological factors (Arora, 2016), presents itself as an alternative to traditional passive strategies, such as the buy-and-hold strategy, which seeks to capitalize on long-term asset growth with a low-risk approach (Chovancova & Árendáš, 2015). However, in markets where inefficiencies are more pronounced, the need arises to evaluate whether technical analysis can offer a competitive advantage (Detzel et al., 2021), as is the case with BVL.

The challenge lies in the lack of conclusive evidence on the impossibility of predicting price movements of certain stocks, which suggests that in small and emerging markets, there may be inefficiencies that allow the use of technical analysis tools to enhance returns. In Peru, it is crucial to understand whether investment strategies based on these tools outperform the passive strategy and to determine whether their application in the BVL is truly profitable.

1. LITERATURE REVIEW

In the realm of financial investment, the buy-and-hold strategy and technical analysis have been widely debated and evaluated. Both approaches offer different alternatives to maximize returns and mitigate risks, especially in emerging markets like the Lima Stock Exchange (BVL). The following literature review explores how these methodologies are applied and their effectiveness in contexts characterized by lower liquidity and market depth.

The buy-and-hold strategy is a passive approach that involves acquiring securities to hold them over the long term, regardless of market fluctuations. This approach has been widely supported by studies that highlight its benefits, such as long-term risk reduction and its effectiveness in stable markets (Liu & Kung, 2023). Additionally, due to its lower operating costs compared to more active strategies, it remains an attractive option for traditional investors (O'Brien, 2020). However, this strategy faces significant challenges in emerging markets where volatility and economic instability are more pronounced. However, recent research suggests that with proper risk management, this strategy can be effective even in these more uncertain environments (Tomtosov, 2023). Companies ' consumer loyalty and financial strength also play a crucial role in the success of this strategy, especially in emerging markets (Diaw, 2021; Romaniuk & Nenycz-Thiel, 2016).

On the other hand, technical analysis, which relies on the evaluation of historical and current data to predict price trends, has gained considerable popularity as a tool to guide investment decisions (Gao et al., 2023). The efficiency of technical tools can vary depending on the type of asset and the market environment. In some stocks, combinations of tools such as BiLSTM and RSI have shown improved prediction accuracy, achieving a 68.83% success rate (Lee et al., 2022). In cryptocurrency markets, these indicators are particularly useful in the short term, especially when integrated with machine learning techniques (Tao, 2023). Although these methods do not directly predict bond returns, they are useful in risk estimation (Shi et al., 2023). Furthermore, hardware implementation of these analyses has improved the processing speed in high-frequency markets, such as cryptocurrency (Ali et al., 2024).

Studies in emerging markets have revealed that innovation and risk management are key areas where technical analysis can offer significant advantages. Methods such as the use of fractional models have shown improvements in risk management in bond portfolios (Demirel et al., 2020). Similarly, content analysis has highlighted a growing demand for eco-friendly products, which could influence investment decisions in these markets (Byrareddy et al., 2023). Option modeling suggests that differentiated branding strategies between international and local brands could also benefit from technical analysis (Ghose et al., 2017). However, these studies should be interpreted with caution, considering the potential data biases and the complexity of capturing the full diversity of the market.

The interaction between technical analysis and investor psychology is another critical factor in the effectiveness of investment strategies in emerging markets. Although technical analysis is popular, its effectiveness can be limited by market inefficiencies and psychological factors, such as emotions and investor confidence, which often influence decision-making (Putra & Miharja, 2023). In particular, psychological barriers such as round numbers can affect predictability in these markets (Lobão et al., 2020). These barriers are more pronounced in novice traders, who tend to rely more on intuition than rational analysis, highlighting the importance of psychology in investing (Kubińska et al., 2016).

Among technical tools, Moving Averages (MA) are frequently used to smooth prices and detect future trends, although their effectiveness can vary depending on market conditions and investor behavior (Kouaissah et al., 2020). In the crude oil market, en-

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hanced MAs that incorporate daily data have shown greater predictive power (Wen et al., 2022), while in forex markets, an adjustable MA has proven to be more effective in volatile environments (M'ng & Zainudin, 2016). Similarly, the RSI has been used to measure price momentum and detect overbought or oversold conditions. Its accuracy increases when combined with other indicators, especially in volatile markets such as cryptocurrencies (Hasan et al., 2024; Zatwarnicki et al., 2023).

Momentum is another relevant tool used to analyze the tendency of prices to continue in the same direction based on their past performance. Although effective in favorable economic contexts, its success depends heavily on market context and investor psychology (Hameed et al., 2023). However, this strategy carries significant risks, especially in emerging markets where volatility is higher (Dierkes, 2022). Other tools, such as the Stochastic Oscillator and Williams %R, are also used to identify overbought and oversold conditions, showing variable effectiveness depending on market conditions (Escobar et al., 2018; Sundlöf & Krantz, 2016). Lastly, Bollinger Bands, which are used to assess volatility and detect trading opportunities, have shown variable effectiveness in different markets, being particularly useful in forex markets (Chakrabarty et al., 2024; Dockery & Todorov, 2023).

In other words, both the buy-and-hold strategy and technical analysis have their merits and limitations, especially in emerging markets. Technical analysis, with its ability to adapt to changing market conditions, could offer a competitive advantage in these environments. However, its effectiveness is tempered by market inefficiencies, making the integration of a technical approach with a deep understanding of market behavior essential to maximize returns in a stock market. According to the reviewed literature, the aim of this study is to assess the effectiveness of technical analysis on the Lima Stock Exchange (BVL), focusing specifically on an emerging market environment characterized by limited liquidity and depth.

Likewise, the following hypothesis is proposed:

H1: Due to the inefficiencies present in the BVL, technical analysis tools generate superior returns compared to the buy-and-hold strategy.

2. METHODS

In this study, 14 stocks from the S&P/BVL Peru General portfolio of BVL were selected to analyze the efficiency of various technical analysis tools compared to the passive buy-and-hold strategy. The selection of these stocks was based on two fundamental criteria: their prolonged inclusion in the index and the continuity of their series. These criteria ensure a robust and consistent analysis throughout the study period. The selected stocks represent a broad spectrum of economic sectors, with a high trading frequency ranging between 92% and 100%. This ensures that the results obtained are relevant and representative of the market.

The analysis period spans from June 21, 2021 to June 21, 2024. This interval was chosen to avoid price distortions associated with the high volatility observed during lockdown measures due to the pandemic in Peru. By excluding earlier periods, the study aims to ensure that the data reflect more stable market behavior, allowing the results to be applicable to normal market conditions rather than extreme events.

2.1. Data collection and sources

The daily closing prices of the 14 stocks were obtained from the historical quotations of the Lima Stock Exchange using the following algorithm: visit the website: https://www.bvl.com.pe/, navigate to companies, company listing, select company, historical quotations, and enter the desired period. The prices were adjusted for dividends to ensure accuracy in the calculation of the returns. A total of 9,802 observations were analyzed. The technical analysis tools selected for this study include Moving Averages (MA), Relative Strength Index (RSI), Stochastic Oscillator, Bollinger Bands, and Momentum. These tools were chosen for their wide acceptance in the literature and their ability to provide clear buy and sell signals.

2.2. Analysis procedure

The performance of each technical analysis tool was calculated by executing buy and sell transactions based on the signals indicated by each tool. The cumulative return was calculated as the varia-

tion in the investor's wealth, assuming an initial investment amount of S/. 100,000, using the following formula:

$$Cumulative\,Return = \frac{V_{t+n} - V_t}{V_t} \cdot 100, \qquad (1)$$

where V_{t+n} is the final value of the investment at the time of the last sale and where V_t is the initial value of the investment. For the "buy-and-hold" strategy, buy-and-sell transactions were executed annually: a purchase was made on 06/21/2021 and a sale on 06/20/2022; then, a purchase on 06/21/2022 and a sale on 06/20/2023; and finally, a purchase on 06/21/2023 and a sale on 06/21/2024. The results are presented as average annual returns by dividing the cumulative return by three.

2.3. Consideration of transaction costs

Returns were calculated with and without considering transaction costs. According to the Lima Stock Exchange (June 28, 2024), transaction costs include: BVL fees (0.021%), guarantee funds (0.0075%), CAVALI S.A. ICLV fees (0.04095%), contributions to the SMV (0.0135%), average net brokerage commissions (1.0%), and VAT (18% on commissions). The total transaction cost used was 1.277881%, applied to the amount of each buy and sell stock transaction.

2.4. Implementation and validation

The analysis was carried out using a spreadsheet developed by the authors. Cross-validation tests were performed to ensure that the models and selected technical analysis tools behaved consistently with the theory and practice observed in previous studies. Table 1 presents the S&P LSE Peru General stocks that comprise the sample.

3. RESULTS

3.1. Moving averages

When analyzing the average annual returns of the Moving Average (MA) without including transaction costs, Table 2 shows that the buy-and-hold strategy for the CASAGRC1 stock generated the highest return (67.82%), suggesting that holding this stock long-term was the most profitable strategy. However, the 20-day Moving Average applied to MINSURI1 also showed a notable return of 63.90%, indicating that this indicator was effective in capturing short-term price movements in this specific stock. In the case of BBVAC1 and INRETC1 stocks, all Moving Averages consistently outperformed the returns of the buy-and-hold strategy, suggesting that, in these cases, the short- and medium-term trends identified by MAs offered superior return opportunities.

In Table 3, it is evident that when transaction costs are included, the results change significantly. Although CASAGRC1 remains the most profitable stock with the buy-and-hold strategy (60.36%), the Moving Averages show a considerable decrease in returns, with the only exceptions being the 100, 150, and 200-day MAs for BBVAC1 and the 100

Table 1. Stocks from the S&P LSE Peru General Index that make up the sample

No.	Ticker	Stock	Sector
1	CASAGRC1	Casa Grande SAA	Process Industries
2	CPACASC1	Cementos Pacasmayo SAA	Non-Energy Minerals
3	MINSURI1	Minsur SA	Non-Energy Minerals
4	CVERDEC1	Sociedad Minera Cerro Verde SAA	Non-Energy Minerals
5	BBVAC1	Banco BBVA Perú SA	Finance
6	FERREYC1	Ferreycorp SAA	Distribution Services
7	BACKUSI1	Unión de Cervecerías Peruanas Backus y Johnston SAA	Perishable Consumables
8	IFS	Intercorp Financial Services Inc.	Finance
9	INRETC1	InRetail Perú Corp	Retail
10	UNACEMC1	Unacem Corp SAA	Non-Energy Minerals
11	BVN	Compañía de Minas Buenaventura SAA	Non-Energy Minerals
12	ALICORC1	Alicorp SAA	Perishable Consumables
13	BAP	Credicorp Ltd.	Finance
14	VOLCABC1	Volcán Compañía Minera SAA	Non-Energy Minerals

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Table 2. Moving averages (MA): Average annual return per stock, excluding transaction costs

Stock	MA 5	MA 10	MA 20	MA 50	MA 100	MA 150	MA 200	BHIS (*)
CASAGRC1	24.58%	46.70%	29.37%	–9.00%	–14.18%	–7.03%	–10.83%	67.82%
CPACASC1	–12.08%	–9.71%	–10.63%	–14.64%	–12.10%	–8.70%	–10.96%	–5.89%
MINSURI1	39.12%	51.32%	63.90%	–2.49%	–2.25%	–4.16%	–2.73%	30.75%
CVERDEC1	46.52%	44.46%	31.84%	–8.43%	–3.56%	–6.91%	–6.75%	52.17%
BBVAC1	–6.95%	–6.85%	–6.84%	0.15%	–2.69%	–4.87%	–4.84%	–7.53%
FERREYC1	8.12%	6.59%	16.01%	8.52%	–5.39%	–8.13%	–8.97%	31.18%
BACKUSI1	–11.04%	–10.92%	–17.38%	–8.45%	–4.44%	–8.11%	–11.59%	11.09%
IFS	10.04%	13.04%	8.79%	8.78%	–1.31%	–12.00%	–10.26%	–3.73%
INRETC1	12.55%	27.35%	18.56%	0.81%	–1.35%	–4.61%	–2.26%	–6.37%
UNACEMC1	13.45%	20.46%	31.72%	–6.43%	–1.44%	–4.11%	–10.06%	9.35%
BVN	–2.25%	2.90%	1.51%	36.51%	–4.56%	–5.13%	–14.18%	27.10%
ALICORC1	42.97%	33.35%	15.78%	3.41%	–0.49%	–2.59%	–5.44%	0.28%
BAP	–0.27%	6.88%	5.66%	9.17%	–1.83%	–8.73%	–8.13%	11.07%
VOLCABC1	5.87%	14.64%	24.45%	–19.50%	–12.59%	–3.66%	–4.28%	–19.29%

Note: (*) Buy-and-hold investment strategy.

Table 3. Moving averages (MA): Average annual return per stock, including transaction costs

Stock	MA 5	MA 10	MA 20	MA 50	MA 100	MA 150	MA 200	BHIS (*)
CASAGRC1	–25.84%	–14.21%	–7.04%	–19.81%	–21.24%	–13.47%	–17.19%	60.36%
CPACASC1	–31.15%	–27.97%	–25.96%	–25.29%	–22.41%	–16.54%	–16.44%	–7.91%
MINSURI1	–21.83%	–6.53%	16.69%	–11.21%	–10.46%	–9.55%	–4.99%	26.02%
CVERDEC1	–20.32%	–13.76%	–8.02%	–20.18%	–12.51%	–14.85%	–13.77%	45.86%
BBVAC1	–30.48%	–28.04%	–23.80%	–11.09%	–8.99%	–8.28%	–6.94%	–9.44%
FERREYC1	–29.28%	–26.13%	–16.03%	–11.24%	–18.20%	–14.79%	–18.72%	26.42%
BACKUSI1	–29.41%	–27.09%	–27.44%	–18.78%	–8.55%	–14.29%	–17.73%	7.81%
IFS	–27.72%	–20.74%	–16.54%	–9.94%	–13.12%	–20.86%	–18.77%	–5.91%
INRETC1	–26.04%	–11.50%	–6.63%	–14.36%	–8.56%	–12.19%	–6.67%	–8.36%
UNACEMC1	–24.89%	–18.72%	0.14%	–14.52%	–5.97%	–9.51%	–16.64%	6.20%
BVN	–30.73%	–27.72%	–23.37%	6.47%	–12.16%	–10.35%	–20.93%	22.64%
ALICORC1	–18.84%	–12.76%	–8.70%	–11.85%	–10.37%	–10.13%	–12.28%	–2.20%
BAP	–30.16%	–25.07%	–19.99%	–9.10%	–14.90%	–17.39%	–14.78%	7.79%
VOLCABC1	–27.85%	–21.27%	–7.83%	–26.03%	–18.83%	–5.85%	–5.73%	–20.33%

Note: (*) Buy-and-hold investment strategy.

and 200-day MAs for INRETC1, which managed to outperform the passive strategy. This indicates that in the long term, and when considering the costs associated with transactions, longer-period Moving Averages tend to be more efficient, likely due to their ability to filter out market noise and reduce the frequency of trades.

3.2. Momentum

The average annual returns obtained by the Momentum tool, excluding transaction costs, are shown in Table 4. The highest return was 83.97% on the 5-day Momentum for CASAGRC1, surpassing the 67.82% return of the buy-and-hold strategy. The returns for IFS, INRETC1, ALICORC1, and VOLCABC1 exceeded those of the buy-and-hold strategy. Additionally, the returns for CPACASC1 (5, 7, and 10 days), MINSURI1 (7, 10, and 15 days), BBVAC1 (7, 10, 15, and 20 days), UNACEMC1 (5, 7, 15, and 20 days), BVN (20 days), and BAP (20 days) also outperformed the buy-and-hold strategy, indicating that this tool is effective in capturing short-term trends.

Considering the transaction costs, Table 7 shows that most of the returns from the Momentum tool are negative, with the passive buy-and-hold investment strategy yielding the best returns. The highest return obtained by the Momentum tool was 3.24% for the CVERDEC1 stock (20-day Momentum). The Momentum returns for INRETC1 (15 days) and VOLCABC1 (10 days) are the only ones that outperform the buy-and-hold strategy.

Table 4. Momentum: Average annual return per stock, exclusion of transaction costs

Stock	Momentum 5	Momentum 7	Momentum 10	Momentum 15	Momentum 20	BHIS (*)
CASAGRC1	83.97%	44.62%	35.63%	28.80%	24.10%	67.82%
CPACASC1	8.67%	0.08%	1.52%	–8.48%	–9.06%	–5.89%
MINSURI1	21.41%	52.18%	46.40%	39.11%	13.48%	30.75%
CVERDEC1	28.59%	34.96%	40.92%	47.98%	47.42%	52.17%
BBVAC1	–10.90%	2.83%	–4.18%	–3.31%	–3.10%	–7.53%
FERREYC1	12.51%	2.07%	20.20%	4.87%	10.27%	31.18%
BACKUSI1	–1.60%	0.50%	–0.67%	–2.12%	–3.72%	11.09%
IFS	6.60%	6.01%	26.24%	3.47%	9.30%	–3.73%
INRETC1	16.66%	12.66%	22.26%	22.26%	6.54%	–6.37%
UNACEMC1	13.44%	12.31%	9.18%	10.49%	34.26%	9.35%
BVN	16.67%	3.52%	–5.32%	–0.80%	32.52%	27.10%
ALICORC1	14.76%	13.81%	20.58%	11.03%	18.80%	0.28%
BAP	–4.92%	–2.18%	3.41%	3.66%	14.54%	11.07%
VOLCABC1	17.65%	17.71%	26.85%	–2.25%	–7.93%	–19.29%

Note: (*) Buy-and-hold investment strategy.

Table 5. Momentum: Average annual return per stock, including transaction costs

Stock	Momentum 5	Momentum 7	Momentum 10	Momentum 15	Momentum 20	BHIS (*)
CASAGRC1	–18.15%	–18.53%	–17.67%	–9.20%	–11.59%	60.36%
CPACASC1	–28.42%	–28.29%	–25.21%	–26.05%	–26.21%	–7.91%
MINSURI1	–25.68%	–16.67%	–6.77%	–2.17%	–11.59%	26.02%
CVERDEC1	–26.09%	–20.03%	–12.11%	–4.08%	3.24%	45.86%
BBVAC1	–30.71%	–27.74%	–28.07%	–23.58%	–21.29%	–9.44%
FERREYC1	–28.50%	–29.09%	–22.63%	–21.84%	–15.51%	26.42%
BACKUSI1	–28.90%	–26.57%	–22.99%	–23.19%	–23.96%	7.81%
IFS	–28.42%	–23.18%	–13.98%	–20.09%	–14.03%	–5.91%
INRETC1	–24.08%	–22.05%	–13.84%	–5.45%	–10.60%	–8.36%
UNACEMC1	–25.11%	–22.42%	–20.54%	–13.49%	–2.73%	6.20%
BVN	–28.32%	–27.91%	–28.15%	–24.50%	–5.71%	22.64%
ALICORC1	–26.61%	–23.42%	–15.82%	–13.24%	–9.73%	–2.20%
BAP	–30.16%	–28.36%	–23.59%	–18.95%	–9.91%	7.79%
VOLCABC1	–26.21%	–23.89%	–15.23%	–22.15%	–21.83%	–20.33%

Note: (*) Buy-and-hold investment strategy.

3.3. Relative Strength Index (RSI)

Table 6 presents the comparative analysis, which reveals that, excluding transaction costs, the 20-day RSI indicators generally offer better returns than the 10- and 15-day RSIs, even outperforming the BHIS strategy in some cases, such as BVN and BAP. However, when transaction costs are included, the RSI returns deteriorate considerably, especially over the 10- and 15-day periods, where they become negative and significantly lower than the BHIS. This suggests that although the RSI may be useful in certain circumstances, the BHIS strategy is more robust and less affected by transaction costs, raising questions about the effectiveness of the RSI as an investment tool when these costs are considered.

Table 6. Relative Strength Index (RSI): Average annual return per stock

Stock	Excluding Transaction Costs				Including Transaction Costs			
	RSI 10	RSI 15	RSI 20	BHIS (*)	RSI 10	RSI 15	RSI 20	BHIS (*)
CASAGRC1	19.62%	17.48%	36.63%	67.82%	4.65%	9.15%	26.68%	60.36%
CPACASC1	3.44%	4.09%	–2.89%	–5.89%	–10.12%	–3.60%	–5.85%	–7.91%
MINSURI1	–8.07%	–5.47%	1.48%	30.75%	–14.74%	–10.03%	–2.70%	26.02%
CVERDEC1	–1.44%	12.12%	12.91%	52.17%	–10.46%	3.72%	7.36%	45.86%
BBVAC1	–7.82%	–0.79%	–3.22%	–7.53%	–15.03%	–7.47%	–7.50%	–9.44%

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Table 6 (cont.). Relative Strength Index (RSI): Average annual return per stock

Stock	Excluding Transaction Costs				Including Transaction Costs			
	RSI 10	RSI 15	RSI 20	BHIS (*)	RSI 10	RSI 15	RSI 20	BHIS (*)
FERREYC1	–0.51%	11.35%	13.47%	31.18%	–9.18%	2.17%	7.85%	26.42%
BACKUSI1	4.41%	12.88%	10.43%	11.09%	–6.94%	4.33%	4.21%	7.81%
IFS	–8.76%	1.34%	11.43%	–3.73%	–15.71%	–5.79%	6.06%	–5.91%
INRETC1	–10.13%	–5.65%	–1.88%	–6.37%	–16.69%	–11.34%	–7.03%	–8.36%
UNACEMC1	1.58%	–8.84%	–8.13%	9.35%	–9.54%	–12.86%	–10.58%	6.20%
BVN	34.24%	26.23%	32.28%	27.10%	15.14%	16.47%	25.91%	22.64%
ALICORC1	–9.36%	–8.11%	2.24%	0.28%	–17.81%	–13.80%	–3.59%	–2.20%
BAP	–2.24%	17.15%	15.64%	11.07%	–11.02%	5.77%	8.68%	7.79%
VOLCABC1	–20.47%	13.15%	24.95%	–19.29%	–24.57%	1.76%	14.17%	–20.33%

Note: (*) Buy-and-hold investment strategy.

3.4. G. Lane index or stochastic oscillator (%K)

Table 7 shows that, excluding transaction costs, the Stochastic Oscillator demonstrated remarkable performance, especially in FERREYC1, where the 10% K at 10 days achieved a return of 75.47%, exceeding the buy-and-hold strategy. Furthermore, in several stocks, such as CPACASC1, BBVAC1, and BACKUSI1, the return of the Stochastic Oscillator exceeded the passive strategy, indicating its effectiveness in capturing short-term opportunities. However, when considering transaction costs, the performance of the Stochastic Oscillator is significantly affected, with most results turning negative and none surpassing the buy-and-hold strategy. This suggests that although the Stochastic Oscillator is promising in theory, the costs associated with its implementation reduce its practical effectiveness, particularly in markets with high trading frequency.

3.5. Williams %R oscillator

Table 8 shows that, excluding transaction costs, the Williams %R Oscillator demonstrated superior performance in stocks such as CPACASC1, BBVAC1, and BACKUSI1, consistently outperforming the buy-and-hold strategy. Similarly, BAP (5 days) and VOLCABC1 (10 days) also exceeded the passive strategy, indicating the effectiveness of %R in identifying short-term opportunities. However, when transaction costs are included, almost all returns from the Williams %R Oscillator turn negative, and none outperform the buy-and-hold strategy. This suggests that while %R may be effective in theory, its practical utility is limited by operational costs, especially in markets with high trading frequency.

Table 7. Stochastic oscillator (%K): Average annual return per stock

Stock	Excluding Transaction Costs				Including Transaction Costs			
	%K 5	%K 10	%K 14	BHIS (*)	%K 5	%K 10	%K 14	BHIS (*)
CASAGRC1	58.99%	57.05%	40.96%	67.82%	–3.35%	16.88%	13.57%	60.36%
CPACASC1	0.97%	2.91%	6.54%	–5.89%	–22.19%	–14.69%	–10.02%	–7.91%
MINSURI1	–7.07%	–6.42%	–12.55%	30.75%	–25.83%	–18.38%	–18.43%	26.02%
CVERDEC1	–0.56%	6.13%	–0.31%	52.17%	–22.95%	–13.02%	–11.39%	45.86%
BBVAC1	3.54%	–2.88%	–2.93%	–7.53%	–21.95%	–15.98%	–13.13%	–9.44%
FERREYC1	15.58%	75.47%	10.84%	31.18%	–17.85%	22.64%	–6.15%	26.42%
BACKUSI1	36.47%	23.36%	23.92%	11.09%	–13.88%	–4.16%	–0.71%	7.81%
IFS	–6.85%	–10.57%	–7.63%	–3.73%	–24.95%	–20.68%	–17.91%	–5.91%
INRETC1	–15.78%	–15.50%	–16.42%	–6.37%	–27.48%	–22.07%	–21.20%	–8.36%
UNACEMC1	–6.37%	–3.21%	–4.72%	9.35%	–24.58%	–16.17%	–14.80%	6.20%
BVN	–1.50%	23.64%	25.11%	27.10%	–23.76%	–8.82%	–0.87%	22.64%
ALICORC1	–15.59%	–8.64%	–4.88%	0.28%	–27.42%	–18.52%	–14.91%	–2.20%
BAP	19.02%	–0.24%	–4.13%	11.07%	–18.73%	–15.85%	–13.92%	7.79%
VOLCABC1	–23.70%	–16.13%	–20.86%	–19.29%	–29.49%	–24.48%	–25.05%	–20.33%

Note: (*) Buy-and-hold investment strategy.

Table 8. Williams %R Oscillator: Average annual return per stock

Stock	Excluding Transaction Costs				Including Transaction Costs			
	%R 5	%R 10	%R 14	BHIS (*)	%R 5	%R 10	%R 14	BHIS (*)
CASAGRC1	43.34%	45.10%	40.87%	67.82%	–8.43%	10.24%	13.51%	60.36%
CPACASC1	0.97%	2.91%	6.54%	–5.89%	–22.19%	–14.69%	–10.02%	–7.91%
MINSURI1	–5.90%	–6.42%	–12.55%	30.75%	–25.69%	–18.38%	–18.43%	26.02%
CVERDEC1	–0.56%	6.13%	–0.31%	52.17%	–22.95%	–13.02%	–11.39%	45.86%
BBVAC1	3.54%	–3.81%	–2.93%	–7.53%	–22.24%	–16.51%	–13.13%	–9.44%
FERREYC1	15.58%	20.47%	10.84%	31.18%	–17.85%	–5.65%	–6.15%	26.42%
BACKUSI1	41.21%	23.36%	23.92%	11.09%	–13.09%	–4.16%	–0.71%	7.81%
IFS	–6.85%	–10.57%	–7.63%	–3.73%	–24.95%	–20.68%	–17.91%	–5.91%
INRETC1	–15.78%	–15.50%	–16.17%	–6.37%	–27.48%	–22.07%	–21.02%	–8.36%
UNACEMC1	–6.37%	–3.21%	–4.72%	9.35%	–24.58%	–16.17%	–14.80%	6.20%
BVN	0.51%	23.64%	25.11%	27.10%	–23.41%	–8.82%	–0.87%	22.64%
ALICORC1	–15.59%	–8.64%	–4.88%	0.28%	–27.42%	–18.52%	–14.91%	–2.20%
BAP	19.02%	–0.24%	–6.02%	11.07%	–18.73%	–15.85%	–15.17%	7.79%
VOLCABC1	–23.70%	–16.13%	–20.86%	–19.29%	–29.49%	–24.48%	–25.05%	–20.33%

Note: (*) Buy-and-hold investment strategy.

3.6. Bollinger bands

Table 9 shows that, excluding transaction costs, Bollinger Bands outperformed the buy-and-hold strategy in stocks such as CPACASC1, BBVAC1, and VOLCABC1, demonstrating their effectiveness in identifying profitable entry and exit points. They also offered superior returns in 20-day IFS, 50-day INRETC1 and ALICORC1, and 10-day BAP, highlighting their utility across different analysis periods. When transaction costs are included, Bollinger Bands continue to outperform the passive strategy in several cases, especially in CPACASC1, BBVAC1, and INRETC1 for 50-day periods. This suggests that, while costs reduce overall profitability, Bollinger Bands can still be effective, particularly over longer time horizons and in specific markets.

Table 10 shows that, excluding transaction costs, the most effective technical analysis tool is Momentum, particularly for stocks such as CASAGRC1, CPACASC1, and VOLCABC1, where it shows significantly higher returns than the buy-and-hold strategy. Moving Averages also proved to be suitable, especially for MINSURI1 and INRETC1, while the Stochastic Oscillator was more effective for BBVAC1 and FERREYC1. Williams %R stood out particularly for BACKUSI1. Overall, these technical analysis tools, especially

Table 9. Bollinger bands: Average annual return per stock

Stock	Excluding Transaction Costs				Including Transaction Costs			
	BB 10	BB 20	BB 50	BHIS (*)	BB 10	BB 20	BB 50	BHIS (*)
CASAGRC1	21.95%	18.11%	13.65%	67.82%	10.59%	9.68%	9.09%	60.36%
CPACASC1	2.01%	1.73%	1.17%	–5.89%	–6.65%	–4.02%	–1.37%	–7.91%
MINSURI1	–5.27%	2.90%	–3.48%	30.75%	–9.86%	–3.04%	–5.68%	26.02%
CVERDEC1	3.23%	17.86%	–2.43%	52.17%	–4.28%	9.48%	–4.71%	45.86%
BBVAC1	–3.11%	–6.06%	–6.57%	–7.53%	–10.52%	–11.10%	–7.90%	–9.44%
FERREYC1	–1.03%	12.42%	4.81%	31.18%	–6.32%	3.96%	2.00%	26.42%
BACKUSI1	1.88%	9.63%	2.64%	11.09%	–3.12%	3.52%	0.85%	7.81%
IFS	–5.88%	–2.51%	–5.05%	–3.73%	–11.52%	–7.56%	–7.13%	–5.91%
INRETC1	–10.63%	–7.75%	4.40%	–6.37%	–16.19%	–11.39%	2.52%	–8.36%
UNACEMC1	–1.37%	–4.59%	–4.80%	9.35%	–7.28%	–8.68%	–6.91%	6.20%
BVN	24.80%	–3.56%	–5.37%	27.10%	14.05%	–7.79%	–6.76%	22.64%
ALICORC1	–8.35%	–6.34%	7.63%	0.28%	–14.47%	–10.76%	4.61%	–2.20%
BAP	14.97%	7.42%	9.20%	11.07%	4.07%	–0.11%	6.06%	7.79%
VOLCABC1	–16.86%	–11.11%	–5.47%	–19.29%	–20.58%	–15.22%	–7.52%	–20.33%

Note: (*) Buy-and-hold investment strategy.

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Table 10. Tools generating the best average annual returns per stock excluding transaction costs

Stock	Tool	Period	Tool return	BHIS return (*)	Excess return
CASAGRC1	Momentum (M)	M 5	83.97%	67.82%	16.15%
CPACASC1	Momentum (M)	M 5	8.67%	–5.89%	14.56%
MINSURI1	Moving Averages (MA)	MA 20	63.90%	30.75%	33.15%
CVERDEC1	Momentum (M)	M 15	47.98%	52.17%	–4.19%
BBVAC1	Stochastic Oscillator (%K)	%K 5	3.54%	–7.53%	11.07%
FERREYC1	Stochastic Oscillator (%K)	%K 10	75.47%	31.18%	44.28%
BACKUSI1	Williams %R Oscillator	%R 5	41.21%	11.09%	30.12%
IFS	Momentum (M)	M 10	26.24%	–3.73%	29.97%
INRETC1	Moving Averages (MA)	MA 10	27.35%	–6.37%	33.72%
UNACEMC1	Momentum (M)	M 20	34.26%	9.35%	24.91%
BVN	Moving Averages (MA)	MA 50	36.51%	27.10%	9.42%
ALICORC1	Moving Averages (MA)	MA 5	42.97%	0.28%	42.69%
BAP	Stochastic Oscillator (%K)	%K 5	19.02%	11.07%	7.95%
VOLCABC1	Momentum (M)	M 10	26.85%	–19.29%	46.14%

Note: (*) Buy-and-hold investment strategy.

in short periods (5, 10, and 15 days), outperformed the passive strategy in nearly all stocks, except for the case of CVERDEC1. The excess returns averaged 24.28%, with outstanding returns in VOLCABC1 (46.14%), FERREYC1 (44.28%), and ALICORC1 (42.69%), highlighting the effectiveness of these tools in maximizing returns when transaction costs are excluded.

Table 11 shows that, when considering transaction costs, the most effective technical analysis tools for average annual return were the Relative Strength Index (RSI) for stocks like CASAGRC1, BACKUSI1, and VOLCABC1; Bollinger Bands for CPACASC1, CVERDEC1, and INRETC1; Moving Averages for MINSURI1 and BBVAC1; and the Stochastic Oscillator for FERREYC1. In most cases, longer periods proved to be the most effective. However, compared to the buy-and-hold strategy, only eight stocks (including CPACASC1, BBVAC1, and IFS) showed superior returns, with an average return of -1.10%. The highest gains were recorded in VOLCABC1 (34.50%), IFS (11.97%), and INRETC1 (10.87%), indicating that while some tools can outperform the passive strategy, most do not after adjusting for costs, underscoring the importance of transaction costs in choosing technical analysis strategies.

The hypothesis proposed in the study suggests that due to market inefficiencies, technical analysis-based strategies would outperform buy-and-hold strategy. However, the results show that while some technical analysis tools, such as Momentum and short-term Moving Averages, outperformed the

Table 11. Tools generating the best average annual returns per stock, including transaction costs

Stock	Tool	Period	Tool return	BHIS return (*)	Excess return
CASAGRC1	Relative Strength Index (RSI)	RSI 20	26.68%	60.36%	–33.67%
CPACASC1	Bollinger Bands (BB)	BB 50	–1.37%	–7.91%	6.54%
MINSURI1	Moving Averages (MA)	MA20	16.69%	26.02%	–9.33%
CVERDEC1	Bollinger Bands (BB)	BB 20	9.48%	45.86%	–36.39%
BBVAC1	Moving Averages (MA)	MA200	–6.94%	–9.44%	2.50%
FERREYC1	Stochastic Oscillator (%K)	%K 10	22.64%	26.42%	–3.78%
BACKUSI1	Relative Strength Index (RSI)	RSI 15	4.33%	7.81%	–3.48%
IFS	Relative Strength Index (RSI)	RSI 20	6.06%	–5.91%	11.97%
INRETC1	Bollinger Bands (BB)	BB 50	2.52%	–8.36%	10.87%
UNACEMC1	Moving Averages (MA)	MM20	0.14%	6.20%	–6.06%
BVN	Relative Strength Index (RSI)	RSI 20	25.91%	22.64%	3.27%
ALICORC1	Bollinger Bands (BB)	BB 50	4.61%	–2.20%	6.81%
BAP	Relative Strength Index (RSI)	RSI 20	8.68%	7.79%	0.88%
VOLCABC1	Relative Strength Index (RSI)	RSI 20	14.17%	–20.33%	34.50%

Note: (*) Buy-and-hold investment strategy.

passive strategy in specific cases (e.g., CASAGRC1 and MINSURI1), overall, the buy-and-hold strategy was more effective when transaction costs were considered. This partially refutes the hypothesis, indicating that the efficiency of the BVL market might not be as low as initially thought and that transaction costs play a crucial role in the profitability of technical analysis strategies.

4. DISCUSSION

This study provides important information on the efficiency of the technical analysis of the Lima Stock Exchange (LSE). Excluding transaction costs, tools such as Momentum, Moving Averages, and the Stochastic Oscillator tend to generate returns superior to the buy-and-hold strategy for most of the stocks evaluated. This suggests that in a market with lower liquidity and depth, such as the Peruvian market, technical analysis can offer competitive advantages, particularly in the short term. However, when transaction costs are incorporated, the landscape changes significantly. The buy-and-hold strategy, which initially appeared less profitable, proved to be more efficient in net terms for most stocks. This outcome highlights the importance of considering the costs associated with frequent trading, which can significantly erode the returns obtained through more active strategies. This is consistent with previous studies that indicate that technical strategies can outperform buy-and-hold strategies in less efficient markets with low liquidity, although their effectiveness can diminish when transaction costs are considered (Chou & Chen, 2019; Hung & Lai, 2022). Technical analysis can be advantageous in certain contexts, but its success depends on market conditions and trading frequency, underscoring the importance of carefully considering transaction costs and the specific characteristics of the market (Chuang et al., 2024; Hung & Lai, 2022). A study on the Chinese stock market, for example, showed that while some technical strategies were promising, many failed to outperform the results of the passive strategy once transaction costs were considered, especially in scenarios with high trading frequency (Chuang et al., 2024).

The finding that Momentum is the most effective tool for several stocks reinforces the idea that past trends can be valuable indicators for predicting future movements in emerging markets. This aligns with previous studies showing that Momentum has been successful in various markets, including Latin America, outperforming the passive strategy (Jegadeesh & Titman, 2023). Past economic trends are positively correlated with future market development, generating significant returns (Zhang et al., 2024). Although some aspects of Momentum can be explained by fundamentals, much remains unexplained, highlighting the complexity of this strategy and its potential enhancement through innovative predictive models (Guo, 2022; Xiang et al., 2023).

Importantly, despite the lower efficiency observed with some technical tools when transaction costs are included, tools such as the Relative Strength Index (RSI) and Bollinger Bands showed positive net returns in certain cases. This suggests that, under specific conditions, these tools can still be useful. This finding is consistent with studies that demonstrate that technical indicators can be predictive and profitable in less efficient markets (Alhashel et al., 2018), as observed in Asian real estate markets and the Chinese stock market, where technical strategies generate excess returns in contexts of high information asymmetry and low liquidity (Wang & Sun, 2015). Although some indicators may not directly predict future prices, they can improve risk management and the estimation of value at risk (Shi et al., 2023).

The results of this study indicate that technical analysis can be a viable strategy for the Lima Stock Exchange, particularly in the short term and in the absence of transaction costs. However, the buy-and-hold strategy tends to be more efficient when transaction costs are considered. This raises questions about the efficiency of the Peruvian market and suggests that, while there may be opportunities to exploit inefficiencies through technical analysis, investors should be cautious and consider operational costs when implementing active investment strategies.

Future studies could focus on developing predictive models that better integrate technical analysis with cost management strategies, thus optimizing net profitability in emerging markets like the BVL. Furthermore, conducting comparative studies in other emerging markets would allow for the validation of these findings, exploring whether the technical strategies that show effectiveness in Peru can also be successfully applied in similar contexts with different cost structures and levels of market efficiency.

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CONCLUSIONS

The technical analysis applied to the Lima Stock Exchange has proven to be efficient, outperforming the returns of the buy-and-hold strategy. Tools such as Momentum, Moving Averages, the Stochastic Oscillator (%K), and the Williams %R have shown the best returns, especially in short-term periods (5, 10, and 15 days). However, when transaction costs are considered, tools such as the Relative Strength Index (RSI) and Bollinger Bands stand out, with longer periods being the most suitable.

Although the technical analysis proves to be more effective than the passive strategy in 13 of the 14 stocks studied, when transaction costs are included, only eight of these stocks achieve excess returns. This underscores the importance of carefully evaluating operational costs when implementing active strategies, as they can significantly erode potential benefits. In conclusion, technical analysis offers opportunities to improve returns on the LSE, but its success depends on the market context and careful management of transaction costs.

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