Comparison of Four Technical Analysis Indicators: Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator

Syahazwani Nurain Binti Shariman Faizul

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Permanent Address

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BDC, Stampin, 93350,
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Validated by

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DR SHAPIEE ABD RAHMAN
Senior Lecturer (DS52)
Computational Science Programme
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ABSTRACT

This study aims to analyse the comparison of Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator to evaluate their relative effectiveness in predicting stock market trends and facilitating investment decision-making. Given the decline of traditional pension plans and the increased reliance on investing, individuals face greater risk and uncertainty in managing their retirement savings. To address this problem, it is crucial to develop effective investment strategies backed by proper analyses to enhance return on investment (ROI). This study employs a quantitative research design, and the data collection method involves utilising the TradeStation platform, where historical price data of publicly traded companies in the NASDAQ 100 index is accessed directly. The methodology integrates various analytics techniques, including backtesting, optimisation, and walk forward analysis. The findings highlight the MACD indicator's potential for generating profitable trades and the RSI indicator's consistency in identifying profitable trends. Bollinger Bands show promise in capturing significant price movements, while the Stochastic Oscillator exhibits relatively lower performance. The findings revealed valuable insights into the performance and suitability of each indicator, providing practical implications for stock market investors. This study encourages the exploration of indicator combinations, additional technical indicators and different market condition to improve the understanding and application of technical analysis.

Keywords: ***Bollinger Bands, MACD, RSI, Stochastic Oscillator***

ABSTRAK

Kajian ini bertujuan untuk menganalisis perbandingan Indikator Konvergensi dan Divergensi Rata-rate Bergerak (MACD), Indeks Kekuatan Relatif (RSI), Bollinger Bands, dan Osilator Stokastik untuk menilai keberkesanan relative mereka dalam meramalkan tren pasaran saham dan memudahkan membuat keputusan pelaburan. Dalam konteks penurunan pelan pencen tradisional dan peningkatan bergantung pada pelaburan, individu menghadapi risiko dan ketidakpastian yang lebih besar dalam menguruskan simpanan persaraan mereka. Untuk mengatasi masalah ini, adalah penting untuk membangun strategi pelaburan yang efektif berdasarkan analisis yang tepat untuk meningkatkan pulangan pelaburan (ROI). Kajian ini menggunakan reka bentuk penyelidikan kuantitatif, dan kaedah pengumpulan data melibatkan penggunaan platform TradeStation, di mana data harga sejarah syarikat yang disenaraikan awam dalam indeks NASDAQ 100 diakses secara langsung. Metodologi ini menggabungkan pelbagai teknik analitik, termasuk 'backtesting', 'optimisation', dan 'walk forward analysis'. Penemuan ini menggarisbawahi potensi penunjuk MACD dalam menghasilkan perdagangan yang menguntungkan dan ketepatan penunjuk RSI dalam mengenal pasti tren yang menguntungkan. Bollinger Bands menunjukkan keberhasilan dalam menangkap pergerakan harga yang signifikan, sementara Oscillator Stokastik menunjukkan prestasi yang relatif lebih rendah. Penemuan ini memberikan wawasan berharga tentang prestasi dan kesesuaian setiap penunjuk, memberikan implikasi praktikal bagi pelabur pasaran saham. Kajian ini mendorong penyelidikan mengenai kombinasi penunjuk, penambahan penunjuk teknikal tambahan, dan penelitian kondisi pasaran yang berbeza untuk meningkatkan pemahaman dan aplikasi analisis teknikal

Kata kunci: **Bollinger Bands, MACD, RSI, Osilator Stokastik**

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CHAPTER 1

INTRODUCTION

1.0 Background of Study

Investing has become a more popular activity over the past few years given the disappearance of pension plans in the private sector. In the past, many companies offered defined benefit pension plans to their employees, which provided a guaranteed source of income in retirement. However, in recent years, many companies have moved away from these types of plans in favor of defined contribution plans, such as 401(k)s and IRAs, which shift the responsibility of saving for retirement onto the individual. As a result, many individuals have been forced to take a more active role in saving for their own retirement, which has led to an increase in the popularity of investing. An investment, as a whole, can be broadly classified into two distinct types, which are financial assets and real assets (Geltner, et al., 2001).

A stock market is a type of financial market that exists for the purpose of issuing, buying, and selling stocks that are listed on a stock exchange (Masoud, 2013). A well-functioning stock market is crucial for economic growth and development as it allows companies to raise capital (Levine, 1997), facilitates the efficient allocation of resources (Demirgüç-Kunt, Levine, & Maksimovic, 1999), serves as an indicator of the economy's health (Rajan & Zingales, 1998), and provides opportunities for individuals to invest and save for their future. It is a vital component of the global economy that plays a key role in promoting economic growth and prosperity.

Stocks are one of the many marketable securities available on the stock market. Stocks represent a small portion of the ownership of a company that is publicly traded (Xu and Wang, 1999). The stock exchange, on the other hand, serves as a marketplace in which investors can buy and sell stocks to facilitate their investments (Fleckner, 2005). The stock exchange sets the

rules and regulations for trading, and also provides a system for pricing and settling trades. One of the most well-known stock exchanges in the U.S is the NASDAQ (National Association of Securities Dealers Automated Quotations). The NASDAQ is an electronic exchange known for facilitating the trading of stocks and securities (Drummer, et al., 2017). It is recognised for its use of technology and automation in the trading process, as well as its focus on technology companies. It also provides indices, such as the NASDAQ 100, which is a market capitalisation-weighted index that includes the 100 largest, most actively traded companies listed on the NASDAQ stock exchange. In the past few years, the NASDAQ 100 has performed well relative to other indices driven by the strong performance of technology and growth companies.

In this study, the researcher has chosen 10 companies listed in the NASDAQ 100 index. The companies are Apple Inc, Microsoft Corporation, Amazon.com Inc, Facebook Inc, Tesla Inc, Alphabet Inc, NVIDIA Corporation, Intel Corporation, Cisco System Inc and Adobe Inc. These companies were selected for several reasons. Firstly, these companies are known for their strong track records of financial performance, as well as their commitment to transparency and clear communication with investors. Secondly, these companies are widely traded and attract significant attention from investors. By focusing on these high-profile companies, the researcher can analyse the performance of widely followed stocks and evaluate the effectiveness of the selected technical indicators in predicting their price movements. Additionally, it aims to identify potential investment opportunities by analysing the performance of these stocks and utilising technical indicators to uncover patterns and signals that can guide investors in their pursuit of maximising returns. Identifying potential investment opportunities is a key component to achieving a high return on investment (ROI). Additionally, to generate a higher (ROI), an investor may need a well-planned investment strategy that incorporates technical analysis.

In the world of investing, technical analysis has assumed a permanent place as one of the most important tools. Therefore, this study will be based primarily on technical analysis and more specifically on the different technical analysis indicators. The purpose of technical analysis is to analyse historical price movements (Rosillo, et al., 2013) in order to gain a comprehensive understanding of what is likely to happen in the future when the market moves forward. Price movement in technical analysis is measured using indicators readily available on chart platforms (Chen, 2010) such as TradeStation, and recommendations are provided regarding potential investment opportunities and potential sales opportunities for investors that might assist them in determining whether to buy or sell a particular security.

A number of different types of trading indicators are available today, each of which adds formulas to the current and historical prices as well as mathematical equations so that they can be plotted on the chart in terms of lines and histograms (Liu, et al., 2020). Generally speaking, the indicators can be categorised into two groups that are the *lagging* indicators and the *leading* indicators (Neamat, 2019). In order to make a comparison of the performances of each type of group, this study will be conducted on two indicators of each type of group. For the *lagging* indicators group, the researcher will use Moving Average Convergence Divergence (MACD) and Bollinger Bands, while for the *leading* indicator group, Relative Strength Index (RSI) and Stochastic Oscillator will be used.

Existing literature has extensively examined the performance of various technical analysis indicators, but there is a dearth of studies focusing on the application of four specific indicators in the context of the U.S. stock market. The specific examination of these four indicators hence represents an under-explored area of research. Therefore, by analysing the performance of Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator within the context of the U.S stock market,

this research aims to uncover valuable insights into their effectiveness, allowing investors to make informed decisions and potentially capitalise on investment opportunities with greater confidence.

1.1 Problem Statement

With the decline of traditional pension plans and the shift towards individual retirement savings, more individuals are relying on investing as a means of securing their financial future (Mitchell, Ogden, & VanDerhei, 2017). However, this increased reliance on investing also leads to greater risk and uncertainty, as market fluctuations and individual investment decisions can greatly impact the success of one's retirement savings (Mitchell,2018). Stock prices, for example, can fluctuate and be unpredictable in response to a variety of economic and market factors both locally and internationally (Nguyen, 2019). As a result of the fluctuating and unpredictability of the stock markets, investors are prone to making a number of mistakes when it comes to making investment decisions that could be detrimental in the long run.

To be able to make good investment decisions, investors need to have an effective strategy by conducting proper analyses in order to yield better return on investment (Torries, 1998). In order to achieve this, the best technical analysis indicators should be applied. Nonetheless, the interpretation of indicators can be a complex process for amateur investors, since it calls for knowledge, skill, and a detailed understanding of how to use them properly.

Thus, the purpose of this study is to make a comparison between four different technical analysis indicators: Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator. These indicators are recognised widely as an effective tool for capturing market trends (Ni and Yin, 2009). Through a thorough analysis, this study seeks to determine the most effective technical indicator among the four,

thereby equipping investors with valuable insights to make informed investment decisions. To facilitate the comparison of the four different technical analysis indicators, a suitable platform is required. TradeStation will serve as the platform of choice due to its provision of built-in indicators, accompanied by its extensive historical data coverage and real-time market data updates enabling researchers to accurately assess and compare the performance of different indicators over time.

1.2 Objectives

The aim of this study comparing four technical analysis indicators such as Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator would be to evaluate their relative effectiveness in predicting stock market trends and facilitating investment decision-making.

The objectives of such a study could include:

1. To evaluate the performance of each indicator in historical market conditions, measured by key performance metrics such as the total net profit, number of trades, maximum profit, percent profitable, and drawdown achieved.
2. To determine the best strategy for real trading, measured by overall profitability, robustness, profits consistency, and maximum drawdown percentage generated during the Walk-Forward Optimisation period.

1.3 Methodology

Methodology, in the simplest terms, can be described as the systematic and organised process through which researchers conduct their studies (Synder, 2019). It is very important, as it will act as a crucial guide and a roadmap, providing researchers with clear direction as they embark on their research journey. In the case of this study, the methodology employed involves a quantitative approach utilising historical data to analyse and compare four technical analysis indicators: Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator. Data collection is conducted by directly accessing historical price data from the TradeStation platform, which offers a comprehensive database of publicly traded companies listed in the NASDAQ 100 index. The selected time period spans from June 2012 to June 2022, providing a substantial historical context for analysis.

The analysis techniques employed in this study encompass several stages. Firstly, backtesting is conducted, where each indicator is applied to the historical data to generate buy and sell signals. The performance of each indicator is evaluated based on the achieved total net profit, number of trades, maximum profit, percent profitable, and drawdown. Subsequently, optimisation of indicator parameters is performed to identify the optimal parameter values for each indicator. This optimisation process involves selecting suitable strategies to be optimised, defining the parameter ranges and step sizes, and employing suitable optimisation methods.

Furthermore, a walk-forward analysis is carried out to assess the performance of the indicators across different market periods. This analysis involves data segmentation and evaluating strategy's performance within each segment by implementing cluster analysis. By considering multiple markets periods, this aims to evaluate the strategies' adaptability to varying market conditions.

After conducting a walk-forward analysis, testing the indicators' strategy on the selected stocks to further test the consistency and robustness. The evaluation of the indicators is based on specific criteria, including their total net profit, number of trades, maximum profit, percent profitable, and drawdown. These criteria serve as benchmarks for assessing the performance of each indicator in predicting stock market trends and facilitating investment decision-making.

By following this comprehensive methodology, it aims to provide valuable insights into the performance of the selected technical analysis indicators, thereby contributing to the understanding of their utility in predicting stock market trends and aiding investment decision-making.

1.4 Scope

The scope of this study focuses on comparing the performance of these four technical analysis indicators: Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator. The analysis is conducted using historical price data of publicly traded companies listed in the NASDAQ 100 index, specifically focusing on the top 10 companies including Apple Inc, Microsoft Corporation, Amazon.com Inc, Facebook Inc, Tesla Inc, Alphabet Inc, NVIDIA Corporation, Intel Corporation, Cisco System Inc, and Adobe Inc. The study spans a specific time period, from June 2012 to June 2022, providing a comprehensive historical context for the analysis. The study aims to evaluate the relative effectiveness of these indicators in predicting stock market trends and facilitating investment decision-making. The findings will provide valuable insights into the performance of the selected technical analysis indicators for investors that seek to enhance their investment strategies and optimise their returns. The TradeStation platform is utilised for data collection, technical analysis indicators implementation, analytical techniques implementation such as backtesting, optimisation and walk-forward analysis.

1.5 Significance of Study

The significance of this study is to provide investors with a comprehensive evaluation of four commonly used technical analysis indicators, Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator. Other than that, trading in the U.S stock market allows investors to take advantage of favourable market conditions, such as a strong U.S. dollar, which can increase the value of their investments. This can be particularly beneficial for investors in Malaysia, as it allows them to offset any currency risk associated with investing in a foreign market. Moreover, the U.S stock market is highly transparent, with well-established regulations and infrastructure which can help to promote greater investor confidence in the U.S market, which may lead to increased investment flows from Malaysia into the U.S. This can help to strengthen economic ties between two countries and promote economic growth in both markets.

The results of this study in identifying the best indicator to use in different market conditions can help investors to make more informed decisions and enhance their trading performance. Additionally, the study would also contribute to the existing body of literature on technical analysis by providing a comparison of four commonly used indicators in the U.S. stock market.

1.6 Project Schedule

Figure 1.1 show the project schedule in a Gantt Chart form.

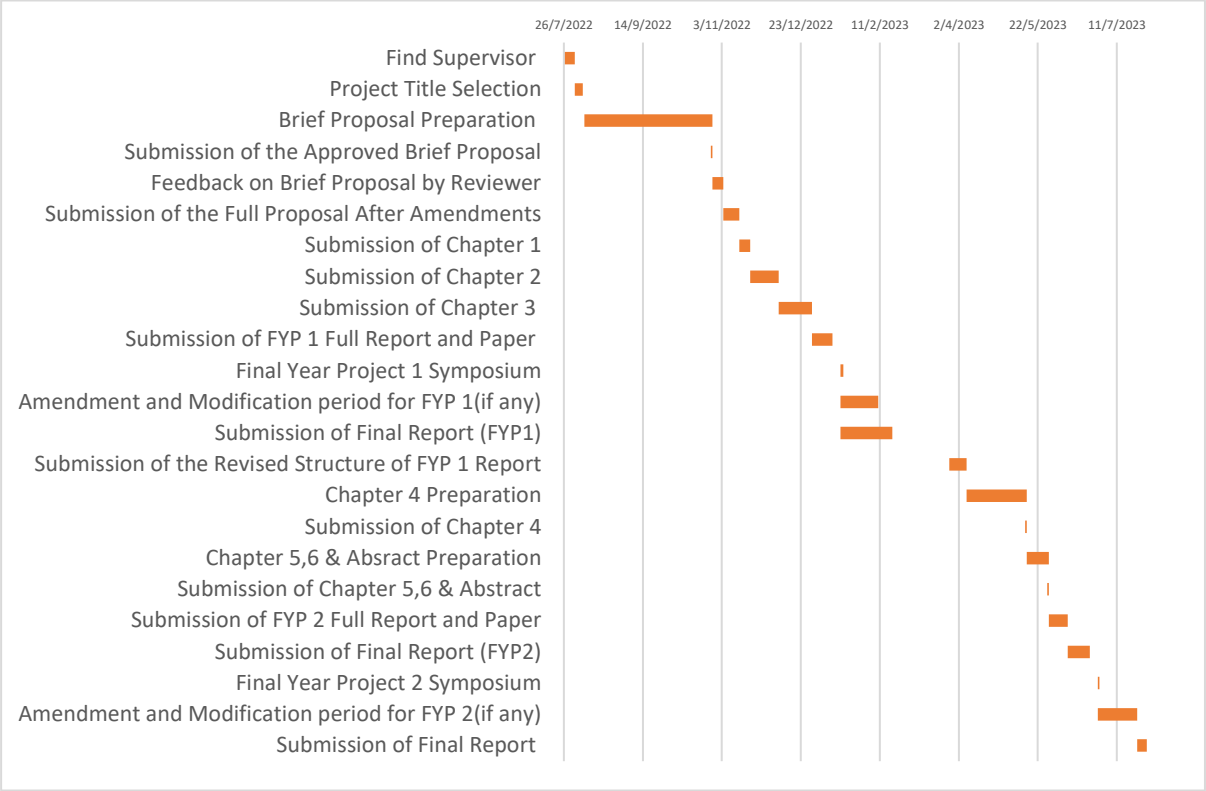

Figure 1.1: Project Schedule FYP

1.7 Expected Outcome

The completion of this study will yield a comprehensive analysis of the performance of each technical analysis indicator, Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator, over a period of 10 years in the U.S. stock market. Through a comprehensive analysis of historical data and rigorous evaluation, this study aims to determine which indicator is most efficient in predicting stock market trends and facilitating investment decision-making. The findings are expected to contribute to the field of technical analysis and provide investors with evidence-based guidance for selecting and utilising effective indicators to enhance their investment strategies.

Additionally, the study may uncover any patterns or trends in the data that can further inform investment practices and potentially identify new avenues for investment returns.

1.8 Summary

The study aims to compare four widely used technical analysis indicators, namely Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), Bollinger Bands, and Stochastic Oscillator, in terms of their effectiveness in predicting stock market trends and aiding investment decision-making. The research design adopts a quantitative approach and utilises historical data analysis. The data is collected directly from the TradeStation platform, focusing on the top 10 companies listed in the NASDAQ 100 index over a 10-year time period from June 2012 to June 2022. Various analysis techniques, including backtesting, optimisation, and walk forward analysis, are employed to obtain the optimal parameter strategy for each indicator. The expected outcome of this study is to provide investors with valuable insights into the performance of the selected technical analysis indicators and help them make informed decisions to optimise their investment strategies and potentially achieve higher returns. Overall, this research contributes to the field of technical analysis and offers empirical evidence to enhance investors and researchers' understanding of these indicators in the context of the U.S. stock market.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The literature review chapter presents an in-depth analysis of the existing body of literature pertaining to technical analysis indicators and their role in predicting stock market trends and facilitating investment decision-making. Through an extensive examination of previous studies, theoretical frameworks, and empirical evidence, this literature review aims to establish a solid theoretical foundation for the current research and identify any research gaps that need to be addressed.

2.1 Overview of Literature on Topic Discussed

2.1.1 Investment

In general, an investment is a property, item, asset, or concept that is accrued or acquired with the intention of generating future income or recognition. In the words of Bodie et al., (2014), "*An investment is the current commitment of money or other resources in the expectation of reaping future benefits*". From this definition, the two most important components of investment are time and the future, both of which play crucial roles in the investment process and contribute significantly to the success of the investment.

According to the general principles of asset classification, the investment assets can be classified into two types:

A. Real assets

Ankrim and Hensel (1993) describe the concept of real asset as one that is identifiable as having intrinsic value based on its substance and properties (i.e., a tangible asset). Generally, assets that are classified as real include precious metals, commodities, land, equipment, and natural resources. It is through real assets that

portfolio diversification can be achieved, since they often move in opposite directions to financial assets such as stocks and bonds (Fan et al., 2013). A real asset typically has a higher level of stability than a financial asset, but it tends to be less liquid as well.

B. Financial assets.

Financial assets are liquid assets whose value is derived from a contractual right or ownership claim (Geromichalos, et al., 2022). A financial asset is something that has value or is in the form of cash, stocks, bonds, mutual funds, or a bank deposit. A financial asset, in contrast to property, land, commodities, or other tangible assets, does not necessarily correspond to a physical asset in the sense of inherent physical value or even a physical form. They can far more accurately be described as commodities whose value reflects both factors of supply and demand (Delgado, 2003) within the market in which they trade, as well as the degree of risk they bear.

As mentioned earlier, the two types of assets (real assets and financial assets) have different elements that impact their evaluations, and both types have their own market. As part of this research, the researcher examines the market related to the financial assets, which is called the financial market.

2.1.2 Financial Market

Markets, such as the financial market, are specific places or locations in which buyers and sellers meet in order to make a deal involving some commodity they are interested in trading (Widia Astuty and AK, 2015). In the words of Bailey (2005), "*Financial markets encompass a broad, continually evolving and not altogether clearly delimited collection of institutions, formal and informal, that serve to facilitate the exchange of assets*". Historically, financial markets have been driven by the supply of issuers and the demand of investors (El Wassal, 2013). Other than that, there are a number of key functions of financial markets that go