Czech University of Life Sciences Prague

Faculty of Economics and Management

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Bachelor Thesis

Technical analysis of ExxonMobil's stock

Thi Lien LUONG

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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BACHELOR THESIS ASSIGNMENT

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Thesis title

Technical analysis of ExxonMobil's stock

Objectives of thesis

The primary objective of this bachelor thesis is to check profitability and physicality of trading strategies and statistic long-term profitable based on historical stock's data of the ExxonMobil. In order to achieve this objective, three groups of indicators were included; trend, momentum and volatility. Once the indicators were selected, the strategies were created and developed by adjusting parameters. Moreover, the results of the strategies enabled us to understand how the indicators work with different parameters and how equity curve changed during period of 2013-2018 in different strategies. Therefore, I can compare the effectiveness between strategies as well as recommend other ways in order to achieve better results.

Methodology

In this bachelor thesis, the indicators used are Moving averages, MACD, RSI, Parabolic SAR to establish strategies for trading Exxon Mobil stocks (XOM). Another indicator called ATR could help control loss. Data including Open, High, Low, Close, Adj Close, Volume from 10/2013 to 10/2018 can be accessed from Yahoo Finance and Metatrader4 platform provided by the broker-AvaTrade. All the remaining data or indexes were adjusted in MS Excel files by the author.

The proposed extent of the thesis

40 – 60 pages

Keywords

ExxonMobil, stock, technical analysis, indicator, trading strategy, optimization, swing and position trading

Recommended information sources

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The Bachelor Thesis Supervisor

Ing. Karel Malec, Ph.D.

Supervising department

Department of Economics

Electronic approval: 18. 2. 2019

prof. Ing. Miroslav Svatoš, CSc.

Head of department

Electronic approval: 20. 2. 2019

Ing. Martin Pelikán, Ph.D.

Dean

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Declaration

I declare that I have worked on my bachelor thesis titled "Technical analysis of ExxonMobil's stock " by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any their person.

In Prague   _____

                                                        Thi Lien LUONG

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I would like to thank my supervisor Ing. Karel Malec, Ph.D for his expert suggestions and advice during the thesis process as well as my family members and friends who supported me throughout my studies.

Technical analysis of ExxonMobil's stock

Abstract

This bachelor thesis aims to check profitability and feasibility of trading strategies and statistic long-term profitable based on technical analysis of ExxonMobil. In order to achieve these goals, process of developing the strategies is the sub-objective. The thesis is divided into three main parts: methodology, literature review and practical part. The methodology is an import part because it provides introduction of indicators, their formulas and the methods to evaluate a trading strategy's performance, which support for practical part. Additionally, essential knowledge background of the stock market, trading, price action, chart analysis and risk management are offered in literature review. Based on the two parts that were mentioned, the own process and outcome are available in the practical part. In order to develop trading strategies, the indicators are selected, then adjusted parameters or added another indicator to reduce lag and false signals. The results of the trading strategies represent the performances, how indicators work and support each other, and the importance of selecting the correct input parameters which could help the readers determine whether they should trade with ExxonMobil's stock or not.

Keywords: ExxonMobil, stock, technical analysis, indicator, trading strategy, optimization, swing and position trading

Technická analýza akcií společnosti ExxonMobil

Abstrakt

Cílem této bakalářské práce je zkontrolovat ziskovost a proveditelnost obchodních strategií a statisticky dlouhodobý zisk na základě technické analýzy společnosti ExxonMobil. K dosažení těchto cílů je proces rozvoje strategií dílčí cíl. Práce je rozdělena do tří hlavních částí: metodologie, přehled literatury a praktická část. Metodika je importní součástí, protože poskytuje zavedení ukazatelů, jejich vzorce a metody hodnocení obchodní strategie, které podporují praktickou část. Kromě toho jsou v přehledu literatury nabízeny základní znalosti o akciovém trhu, obchodování, cenové akci, analýza grafů a řízení rizik. Na základě dvou zmíněných částí je v praktické části k dispozici vlastní postup a výsledky. Za účelem vypracování obchodních strategií jsou indikátory vybrány, upraveny parametry nebo přidány další indikátory ke snížení zpoždění a falešných signálů. Výsledky obchodních strategií představují výkony, způsoby práce a vzájemné podpory ukazatelů a důležitost výběru správných vstupních parametrů, které by mohly čtenářům pomoci rozhodnout, zda mají obchodovat s akciemi společnosti ExxonMobil nebo nikoli.

Klíčová slova: ExxonMobil, akcie, technická analýza, indikátor, obchodní strategie, optimalizace, swing a pozice obchodování

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List of Abbreviations

AF	Acceleration Factor
AMEX	American Stock Exchange
ATR	Average True Range
EMA	Exponential moving average
EP	Extreme point
Etc.	Et cetera
MA	Moving Average
MACD	Moving Average Convergence/Divergence
NASDAQ	National Association of Securities Dealers Automated Quotation
NYSE	New York Stock Exchange
OTC	Over the Counter Market
PSAR	Parabolic Stop and Reverse
RSI	Relative strength index
SMA	Simple Moving Average
US	United States
XOM	Name of ExxonMobil's stock traded on the NYSE

1 Introduction

According to the MSCI World Index (2019), average annual net return in the stock market of more than 1600 companies is 4.82% since Dec29, 2000, which the highest return of 29.99% in 2009 and the lowest return of -40.71% belongs to the year of world's economic crisis 2008. In general, it represents profitable stock market, however, very high volatility stock market and not all stock markets bring profit for the traders. Therefore, the traders should understand the features of the stock market movement before starting trade to avoid high risks.

Thanks to the strong development of technology, nowadays many websites, brokers, and books offer a diversity of trading options for the traders. Despite it being a big advantage, the traders should select a suitable indicator and trading strategy. This process allows us to find potential as well as unprofitable market before starting to trade in a high-risk investment.

Stock market analysis is an important method which enables us to achieve our objectives. The two main types of stock market analysis are technical analysis and fundamental analysis. Fundamental analysis focuses on evaluating the stock of a company and the factors that affect prices while technical analysis aims to find the potential opportunities to trade. In this thesis, I will focus on the technical analysis of one of the biggest energy companies in the world- ExxonMobil.

2 Objectives and Methodology

2.1 Objectives

The primary objectives of this bachelor thesis are to check profitability and feasibility of trading strategies and statistic long-term profitable based on historical data of the ExxonMobil's stock. In order to achieve these objectives, process of developing the strategies is sub-objective. The three groups of indicators used were trend, momentum and volatility. Once the indicators were selected, the strategies were created and optimized by adjusting the parameters or applying the indicator called Parabolic Stop and Reverse. Moreover, the results of the strategies enabled us to understand how the indicators work with different parameters and how equity curve changed during the period of 2013-2018. Therefore, the strategies could be compared the performances as well as recommend other methods to achieve better results.

2.2 Methodology

In this bachelor thesis, the indicators used are Moving averages (MA), Moving average convergence/divergence (MACD), Relative Strength Index (RSI), Parabolic Stop and Reserve (Parabolic SAR or PSAR) to develop trading strategies of ExxonMobil's stocks (XOM). Another indicator called Average True Range (ATR) could help control loss. Data including Open, High, Low, Close, Adj Close, Volume from 10/2013 to 10/2018 can be accessed from Yahoo Finance and Metatrader4 platform provided by the broker- AvaTrade. All the remaining data or parameters were adjusted by author.

2.2.1 Moving averages (MA)

Moving averages are the simplest and the most popular trend indicators. They are used to identify and confirm trends or reverses and develop trading systems. All moving averages are known as lagging in market action because they are calculated based on past prices. Most popular types include Simple Moving Average (SMA) and Exponential Moving Average (EMA). (Murphy, 1999, p.197)

- **Simple moving average (SMA)**

The SMA is calculated with the following formula (Elder, 2014, p.74):

$$SMA = \frac{P1 + P2 + \cdots + PN}{N} \qquad (1)$$

where P is the price being averaged

N is number of days (periods) in the moving average

The number of periods is selected by the traders; however, it is most common to use 10-20 (10 SMA- 20 SMA) for short terms trends, 50 for mid-term trends and 200 for long-term trends. (tradingsim.com, 2019)

- **Exponential moving average (EMA)**

EMA is less lagging than SMA by added recent data and does not drop old data as the SMA does. It is essential in volatility market for buying and selling signals to be generated sooner, which can help increase profit and reduce loss. The number of periods usually falls between 10-30 days but is up to the traders. EMA with periods below 8 days are not recommended in order to avoid having more false signals. (Elder, 2014, p.76) Based on the suggestion above, I decided to choose 10-day (10 EMA) and 20-day (20 EMA) as the periods of moving average strategies.

The formula to calculate EMA is as follows (Elder, 2014, p.76):

$$EMA = Ptod \; x \; K + EMAyest \; x \; (1 - K) \tag{2}$$

where $K = \dfrac{2}{N+1}$

N is the number of days (periods) in the EMA

P_{tod} is today's price

EMA_{yest} is the EMA of yesterday

- **Trading according to Moving averages:**

Murphy (1999, p.201) suggests a trading strategy based on one moving average. When the close price crosses above the MA, buy signal is formed. The position will be closed when the close price crosses below the MA. However, he claimed that the strategy would produce more trades and results in many false signals because the moving average is sensitive. Another author, Elder (2015) recommends the strategy called as "a of pair moving averages" which is a combination of one shorter (fast) and one longer (slow) MA. He claimed that the pair of moving averages would be good for trends and work better in trading ranges. If the fast- MA crosses above the slow-MA, the trend is considered up; therefore, buy signal is generated. The position will be closed if the fast- MA crosses below the slow- MA (stockchart.com, 2018). The strategies will be described more clearly in the practical part.

2.2.2 Moving average convergence/divergence (MACD)

MACD is one of the simplest and most effective momentum indicators developed by Gerald Appel. It offers momentum and trend together, which helps us to identify trends and reversals. The MACD indicator is consists of the MACD line and Signal line where the MACD line is made up by convergence and divergence of two exponential moving averages. (Elder, 2014, p.81). The two EMAs are called convergence when they are moving towards each other and divergence when they are moving away (stockchart.com, 2018). The MACD is calculated as follows:

$$MACD\ Line: (12\ day\ EMA\ -\ 26\ day\ EMA) \tag{3}$$

$$MACD\ Histogram: MACD\ Line\ -\ Signal\ Line \tag{4}$$

Where Signal Line is 9-day EMA of MACD Line

Stockchart.com, 2018 suggests three ways to trade with MACD: Signal line crossovers, Centerline crossovers and Divergences. In this thesis, the MACD- Signal line crossovers will be chosen as a trading strategy.

2.2.3 Relative strength index (RSI)

Developed by J. Welles Wilder and published in the 1978 book, *New Concepts in Technical Trading Systems*, the Relative strength index (RSI) is the most popular momentum oscillator that measures the speed and changes of price movements. RSI oscillates between 0 and 100. RSI is 0 when the average gain equals to zero and is 100 when the average loss equals to zero. Using the 14-day default, the traders are traditionally set at 30 for oversold and 70 for overbought (stockchart.com, 2018). However, some commercial packages are using Exponential moving average of n-period instead of Simple moving average and the traders can set different a level of overbought and oversold. The RSI is formulated by Wilder as follows:

$$RSI = 100 - \frac{100}{1+RS} \tag{5}$$

Where

$$RS = \frac{(Average\ of\ 14 - period's\ gain)}{(Average\ of\ 14 - period's\ loss)}$$

For first calculation, we need 14- periods close prices:

First average gain= sum of gains for the previous 14 periods/14

First average loss= sum of losses for the previous 14 periods/14

Next average gains (losses) are calculated as Simple moving averages of 14-period's gain (loss)

Average Gain= [(previous average gain) x13+ today's gain]/14

Average Loss= [(previous average loss) x13+ today's gain]/14

2.2.4 Stop loss (risk control)

Based on the concept of Average True Range (ATR), Keltner Channel is an indicator used to measure stock price's volatility and to set a stop loss (Elder, 2015). The Keltner Channel is developed by J. Welles Wilder and calculated by follow steps:

Step 1: Wilder started calculating True Range (TR)

Method 1: Current High- Current Low (CH-CL)

Method 2: Current High- previous Close (absolute value)

Method 3: Current Low- previous Close (absolute value)

After that, Wilder measured the distance between two points (the result of deduction by each method). The highest value will be used as TR. For example, result by method 1 is 0.83, method 2 is 0.23 and method 3 is 0.6. Therefore, the TR in this case is 0.83 because 0.83 is the highest value.

Step 2:
$$Current\ ATR = \ [(Prior\ ATR\ x\ 13)\ +\ Current\ TR]\ /\ 14 \qquad (6)$$

With the first TR = High- Low and the first ATR is average daily TR values for the last 14 days.

Stop loss could be defaulted as 1ATR, 1.5 ATR, 2ATR but it depends on the traders, however, 1.5ATR is the most common. (stockcharts.com, 2019).

2.2.5 Backtesting and Optimization

Backtesting is the process to generate results, check potential profit and analyze risk buy a applying a trading strategy in historical data before implementing a real trade. In the thesis, SMA, EMA, MACD and RSI are used four indictors to run the backtests.

Optimization is the process of testing to add new indicator or change the parameters to find which would have worked the best on historical data. (Rockefeller, 2011, p.68) In the thesis, Parabolic SAR is the added indicator to optimize the strategies.

Parabolic SAR is a time/price reversal system developed by Welles Wilder. The acronym SAR stands for "stop and reverse". When the price trend is rising, PSAR dots are below prices and PSAR dots are above prices when the trend falls. (Murphy, 1999, p.381). PSAR was selected because it is effective way to reduce lag and false signals therefore, trading results would be improved. Calculation of PSAR is divided into 2 parts **Rising trend** and **Falling trend**:

- Rising trend

$$Current\ SAR\ =\ Prior\ SAR\ +\ Prior\ AF\ x\ (Prior\ EP\ -\ Prior\ SAR) \hspace{2cm} (7)$$

Where

Prior SAR: The SAR value for the previous period

Extreme point (EP): The highest high of the current uptrend.

Acceleration Factor (AF): is multiplied by the different between EP and the prior period's SAR. It increases by 0.02 each time the EP makes a new high and can reach 0.2 as maximum.

- Falling trend:

$$Current\ SAR\ =\ Prior\ SAR\ +\ Prior\ AF\ x\ (Prior\ EP\ -\ Prior\ SAR) \hspace{2cm} (8)$$

Where

Prior SAR: The SAR value for the previous period

Extreme point (EP): The lowest low of the current uptrend.

Acceleration Factor (AF): AF increases by 0.02 each time the EP makes a new low and can reach 0.2 as maximum (stockchart.com, 2018)

2.2.6 Evaluation of trading strategies

A strategy performance report is an evaluation trading strategy's performance. The traders can create the report analyze results of real trading or backtest. In a trading performance report, there are variety of metrics, however; total net profit, profit factor, percent profitable, average trade net profit and max drawdown are the five key performance metrics (Investopedia.com,2019). The principles and calculation will be described as follows:

- Total net profit represents the bottom line for a trading system over a period of time.

$$Total\ Net\ Profit = \ Gross\ profit\ of\ all\ winning\ trades - \qquad (9)$$
$$Gross\ loss\ of\ all\ losing\ trades\ (including\ commissions)$$

- Profit factor represents the amount of profit per unit of loss, which is considered a profitable strategy if the value is greater than 1 and loss if the value is smaller than 1.

$$Profit\ Factor = \ Gross\ profit/\ Gross\ loss \qquad (10)$$

- Percent Profitable also known as probability of winning trade or percentage of total number of trades which is calculated as follows:

$$Percent\ Profitable = \ Number\ of\ winning\ trades/ \qquad (11)$$
$$Total\ number\ of\ trades$$

- Average Trade Net Profit is the amount of money that was earned or lost per trade.

$$Average\ Trade\ Net\ Profit = \ Total\ net\ profit/ \qquad (12)$$
$$Total\ number\ of\ trades$$

- Maximum Drawdown measures the greatest distance, or loss compared with the previous equity peak and it enables us to measure the amount of risk incurred by a strategy. (Breakingdownfinance.com, 2019) offers the way of calculation as follow:

$$DD_t = \min(0, \frac{p_t - p_{max}}{p_{max}}) \qquad (13)$$
$$MDDt = max(DDt)$$

Where DD_t is drawdown at time t

                     P_{max} is historical peak

                     P_t: current value of investment

                     MDD_t is max drawdown

3 Literature Review

3.1 The Stock Market

The stock market is where regular activities of buying, selling and insurance of shares of publicly held companies are traded (investopedia.com, 2018). Two major classes of exchanges are Registered Exchanges (also is called as institutionalized formal exchanges) and the Over the Counter Market (OTC). The Registered Exchanges such as the NYSE and the AMEX, are stock trading facilities which have accepted the terms and file registration statement with the Securities Exchange Commission. OTC means that the stocks are traded directly between two parties without any supervision or intervention of an exchange. When a company is small and cannot meet exchange listing requirements, stocks are traded OTC. (Wyss, 2001). The stock exchanges make money by fees from transactions and selling data such as real-time data, historical data.

New York Stock Exchange (NYSE)

The NYSE is the largest equites marketplace in the world, located at Wall Street. In 2017, total market capitalization of the NYSE is $30 trillion, represents approximately 40% of the total market in the world. With exchange trades stocks for more than 2400 companies, the NYSE has been the premier exchange of choice for visionaries, and leaders for over 225 years. XOM is the name of Exxon Mobil's stock on the NYSE and number of shares that were traded in 2017 is 2.7 billion. (nyse.com, 2018).

American Stock Exchange (AMEX)

Located in New York city, the AMEX is the third largest stock exchange in the US with 10% of all securities traded in the US. The biggest competitor of the AMEX is the NYSE. In order to become more competitive with the biggest competitor, the AMEX developed a website that helps investors analyze listed companies and teaches them about basic trading. The AMEX also offers many options for the investors to increase the potential profit and control risk. These websites are www.americanstocks.com and www.amex (Wyss, 2001, p.5).

National Association of Securities Dealers Automated Quotation (NASDAQ)

Basing on market capitalization, the NASDAQ is the second largest stock exchange in the world. It has been known as an industry innovator since 1971 and was the first to use computers to gather and match sell-buy orders. There are more than 3000 stocks listed on this exchange with the largest technology companies such as Apple, Microsoft, Intel and Google. Unlike the NYSE, stocks are traded on the NASDAQ by an electronic network between brokers. (Investopedia.com, 2018)

Primary versus Secondary stock markets

Primary markets allow companies to sell and issue new shares to the public, governments or other groups for the first time through. This process is called as initial public offerings (IPO). An investment bank will support the companies when dealing with investors, set a beginning range stock's price for the first time resulting in the companies being able to raise their capital for long-term growth. The secondary market such as the NYSE, the AMEX, NASDAQ are where investors can buy and sell their own shares through stock brokers. Thus, investors pay more in secondary markets than in primary markets (Investopedia.com, 2018).

Stock brokers versus dealers

Stock brokers also known as registered representative or account executive are licensed professionals, who act as agents for investors. They are responsible for acting on behalf of the investors as intermediaries between the investors and the stock exchanges by helping the investors to buy and sell stocks. (Wyss, 2001). The stock brokers make money by fees, referral bonuses or commissions. Choosing a broker is one of the most important decisions of an investor. According to (StockBrokers.com, 2018) Fidelity, TD Ameritrade, E*Trade or Interactive Brokers are known as the best online brokers. Dealers are companies that buy and sell stocks for their own account. Unlike stock brokers, the dealers do not act on behalf of the investors. They make money by deciding between bid- ask prices and adding liquidity to the market.

3.2 Approach of the stock market

3.2.1 Fundamental Analysis

By examining economic, financial, qualitative and quantitative factors, fundamental analysis evaluates security in the hope of accessing its intrinsic value, as well as determining whether the security is over or undervalued. In order to achieve this, a fundamental analyst studies areas that affect security such as microeconomic (e.g. corporate management) and macroeconomic factors (e.g. GDP, and inflation). (Invespedia.com, 2018)

3.2.2 Psychological Analysis

Trading psychology is used to determine a person's expected behavior when trading, as well as their character. It includes analyzing the emotions and mental states of people in order to determine whether trading securities will be successful or not. Trading psychology can be as important as other attributes such as knowledge, experience and skill in determining trading success. Four common emotions in trading are Herd mentality (trading behavior of an individual trader is influenced and adjusted by other traders), Overconfidence (the traders believe that they are better than other traders at ability of forecasting and choosing good stock with buying/selling decision), Excessive Optimism (they believe that their trading decision in the future will be better than reality) and Fear of loss. (Investopedia.com, 2018).

3.2.3 Technical Analysis and Dow theory

Technical Analysis

Technical Analysis is the study of how past and present price action in a given financial market may help determine its future direction". A technical analyst studies how to find high-probability potential opportunities to trade and determines the highest probability reactions to past and current price movement in the financial market rather than predicting the future. (Chen, 2010, p.2)

Although, according to others, technical analysis is a systematic evaluation of price, volume and open interest to forecast price. A systematic approach may include a chart, some rules and all available power calculation. It is the study of chart patterns or identifying a trend and

it consists of market analysis, used indicators, reversals, and the evaluation of tests results of trading strategies. (Kaufman, 2013, p.1)

Dow theory

The Dow theory is the oldest, and by far the most publicized method of identifying major trends in the stock market. For the theory to be executed, changes in primary or major movements of the market must be determined. It is focused on the direction of the trend but does not take part in predicting a value about the overall duration or size of it. Once determined, a trend is said to exist until its reversal is proven. (Pring, 2014, p.29)

There are 6 basic axioms of the theory as follow:

- The averages discount everything: change in the daily prices reflects all information and the opinions of all market participants.

- There are three movements in the market: primary movement, secondary reaction and minor movement.

   Primary movement is the large movement of prices, covering the market can usually last from less than one year to several years. The broad upward movement is known as a primary bullish market and the broad downward is known as primary bear market. Secondary reaction is defined as an important decline in a bull market or advance in a bear market, usually lasting from three weeks to several months. (Martin, 2014, p.31). Lastly, minor movement is short-term fluctuations (maximum 6 weeks) and don't have value to forecast for long-term investors.

- Three phases of market trends:

   The first phase is accumulation in the bull market, far-sighted investors will look at business and expect on rapid growth of stock price or selling. The second phase is participation, when the business activity and revenue are raising attractive market attention. This is a profitable period for technical stock traders. The third phase is when financial news of the business is very good, and the stock price is unimaginably high. The less experienced purchase stocks while far-sighted investors have found anomaly high of stock prices and think about selling stocks.

- The averages must confirm each other:

   The Industry Average and the Transportation Average must support each other. When one average confirms a new primary trend, but the actual market is not indicated until another average confirms it. (Pring, 2014, p.35)

- Volume must confirm the trend:

  Dow recognized volume as the second factor but no less important in confirming price signals. The volume will increase in the direction of the main trend.

- A trend is assumed to continue until a reversal signal is indicated:

  A primary trend with sudden reversal signal is rare. In this case, the traders find it difficult to determine whether it is a primary trend or just a secondary trend.

3.3 Chart analysis

3.3.1 Line chart

Said to be the most basic charts used in finance, a line chart connects a series of data points and is used to monitor closing prices by traders. The line is drawing by connecting the points of all closing prices. Timeframe is selected by traders: 1 minute, 5 minutes, 30 minutes, 1 hour, 4 hours, 1 day, 1 week or anything in between. (Investopedia. com, 2018). The chart follow is the line chart of ExxonMobil where the timeframe is 1 day. Each point represents the trading information at the end of every day.

Figure 1. Line chart of XOM

Source: market.com, 2018

3.3.2 Bar chart

The bar chart is one of the most common charting methods which is used to form the price plot of a period (e.g. daily, weekly or several months) where high, low and close are required. The high and low are "represented by the top and bottom of the vertical bar and the close is the short horizontal line crossing the vertical bar." Weekly charts are based on Friday's close and a combination of the high and low for that week. However, in daily charts,

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there is an individual bar for representing the highs, lows and close of a certain day. Depending on the data available, a bar chart can include the open option or not. This would mean that the addition of the open price would be displayed as a short horizontal line reaching to the left bar. (Stockcharts.com, 2018)

Figure 2. Bar structure
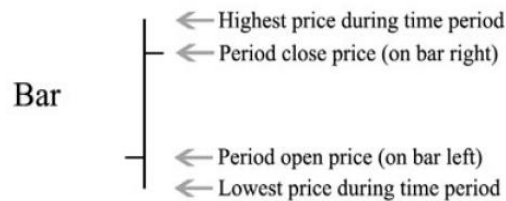
Source: (Chen, 2010 p.36)

Figure 3. Bar chart of XOM
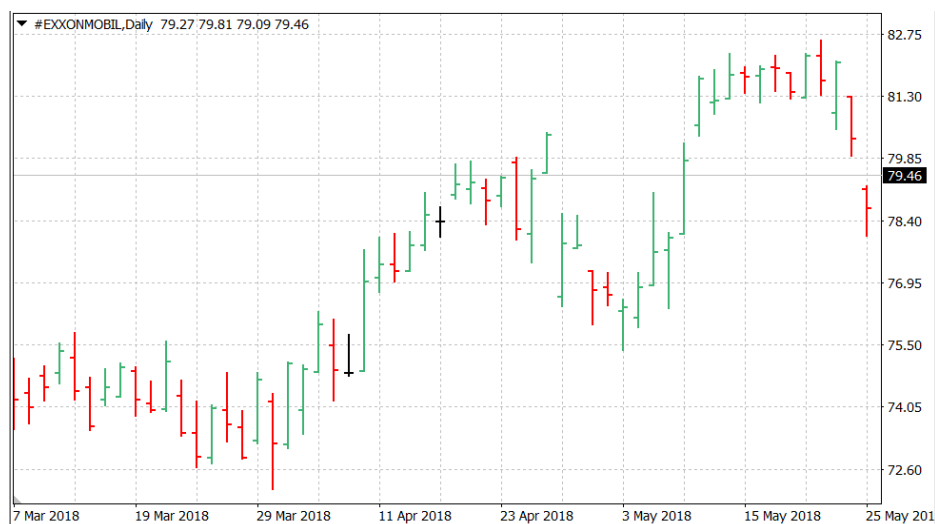
Source: Metatrader 4, 2018

3.3.3   Candlesticks chart

Japanese rice traders began using candlestick charts some two centuries before the first chartists appeared in America. Instead of bars, their charts had rows of candles with wicks at both ends. The candlesticks were created by shading a piece of the bar between the opening and closing prices and the body was the shaded area. If shaded black it meant that the closing price was lower, on the contrary, if it was white it meant that the closing price was higher than the opening price.

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The extended lines above and below the body are called shadows, where the tip of the upper wick represents the high of the day and the bottom of the lower rick represents the low of the day. Rather than focusing on the highs and lows, the Japanese found it more important to analyze the relationship between the opening and closing prices, which included several candles. (Elder, 2014, p.53) Nowadays, instead of black/ white real bodies, some commercial websites such as market.com use the red/ green real bodies.

Figure 4. Candle construction and Real bodies

Candle Construction   Real bodies
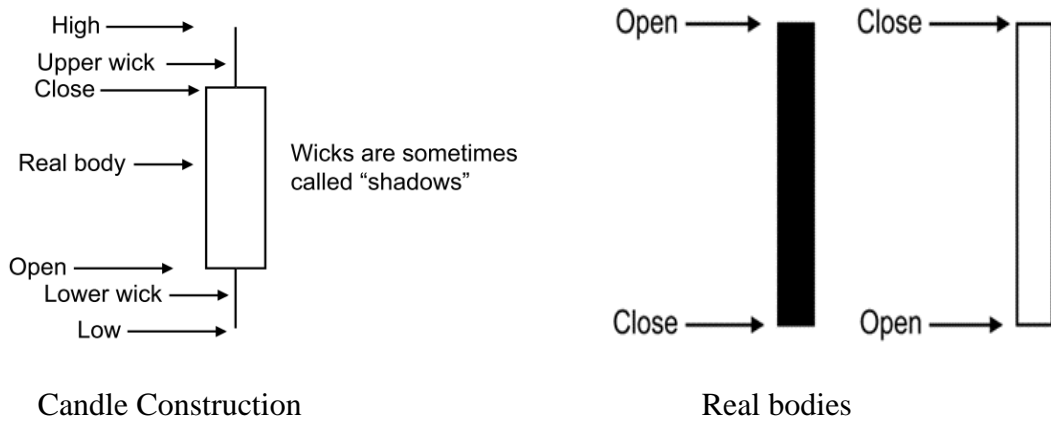
Source: Pring, 2014, p.342

Figure 5. Candle stick chart of XOM
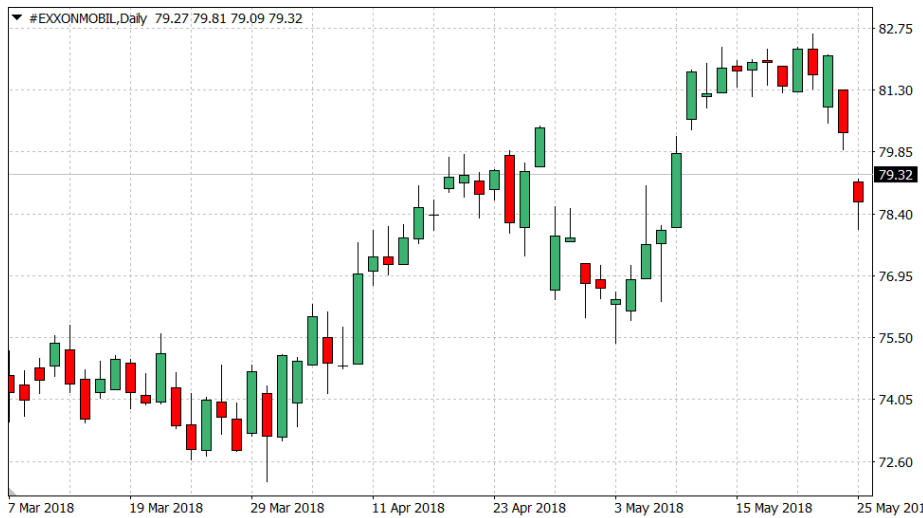
Source: Metatrader 4, 2018

3.3.4   Point and figure chart

Price movement is the focus of point & figure charts and is represented in the chart by columns of X's and O's. The X columns stand for the rising prices and the O columns

stand for the falling prices, each price box "represents a specific value that price must reach to warrant X and O" (stockcharts.com, 2018). The Point& Figure chart has well-defined trading rules; however, the trend will be unchanged if prices don't change direction by reversal value (Kaufman, 2013, p.195).

Figure 6. Point and figure chart

Source: stockchart.com, 2018

3.4 Price action

3.4.1 Trend lines

Pring (2014, p.70) described a trendline as a straight line that connects either a series of ascending bottoms in a rising market or the tops of a descending series of rally peaks. Trendline is used to identify current trend, confirm a reversal of the current trend and help the traders exit their positions at the right time.

- The uptrend is created by drawing a line from at least two troughs, each of them being higher than the previous.
- The downtrend, however, is creating by drawing a line from at least two peaks, each of them being lower than the previous one.

If a line touches price more time, it is considered more valid. In general, the traders draw a trendline by two points and use third point to confirm the validity. The angle of trendline and horizontal line represents the strength of price movement which the larger angle proves

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more significant rising or falling price. (stockchart.com, 2018) The chart below shows downtrend is stronger than uptrend because the angle is larger.

Figure 7. Trend lines of XOM

Source: Metatrader 4, own processing, 2018

3.4.2 Support/ Resistance levels

Prices in markets are driven by an excess in supply and demand, these forces meet because of support and resistance. Supply is associated with bearish, bear and selling whereas demand is associated with bullish, bulls and buying. (stockcharts.com, 2018)

Support is a price level where buying is strong enough to interrupt or reserve a downtrend. Support is represented on a chart by a horizontal line connecting two or more bottoms. (Elder, 2014, p.55). As price declines and reaches support, stocks become cheaper and thus buyers are inclined to spend their money. On the other hand, sellers become demotivated and are less inclined to sell. In order to prevent the price from falling below support, demand will have to overcome supply. (Stockcharts.com, 2018)

In order to interrupt prices from rising and a reserve, resistance is used. Resistance is represented on a chart by a horizontal line connecting two or more tops. (Elder, 2014, p.55). When price advances towards resistance, sellers are encouraged to sell and subsequently, buyers are less inclined to buy stocks. In order to prevent the price from exceeding resistance, demand will have to be overtaken by supply. (Stockcharts.com, 2018)

When a support level is broken (the price is below the support level), a technical analyst considers that the support level would turn into resistance. When a resistance level is broken (the price is above resistance level), a technical analyst considers that the resistance level would turn into support. They call support and resistance as equals. (Stockchart.com, 2018)

Figure 8. Support and resistance levels

On the chart, the green line represents resistance level and the red line represents support level.

Source: Metatrader 4, Own processing, 2018

3.5 Types of trading

Based on the period of time, which the traders keep a position opened, there are four common types of trading:

- Day/Intraday trading: buying and selling securities within the same day. Even get losses, the traders are rarely hold the position over night.

- Scalping: the position is opened, then closed very quickly and is held for a period lasting from some seconds to some minutes.

- Position trading: the position is opened and held for a period, lasting from several days to several weeks, or even months.

- Swing trading: the position is opened and held for a period lasting more than one day but the period of time is shorter than position trading. (Investopedia, 2018).

The thesis will focus on swing and position trading where a position is opened and held from one day to several weeks, even several months until closed signals are generated.

3.6 Costs against trading profits

3.6.1 Online trading costs

A commission is a service charge assessed by a broker or investment advisor in return for providing investment advice and/or handling the purchase or sale of a security" (Investopedia.com, 2019). Here are costs of some online brokers:

Table 1. Online commissions

Online Broker	Commission	Minimum deposit
Ally Invest	$4.95/ trade	$0.00
Charles Schwab	$4.95/ trade	$0.00
E*Trade	$6.95/ trade	$500.00
Fidelity	$4.95/ trade	$0.00
Interactive Brokers	$0.005/share	$0.00
Lightspeed	$4.50/ trade or $0.006/share	$10 000.00
TD Ameritrade	$6.95/ trade	$0.00
TradeStation	$5.00/ trade or $0.01/share	$500.00

Source: Stockbroker.com, 2018

Table 1 shows different the commissions costs and types between the brokers. There are two types of commissions: per trade (flat) or per share. Per trade commission means that each trade placed is charged by the brokers and the traders could purchase up to thousands of shares, while per share commission means a price is charged for every share traded. (Stockbroker.com, 2018).

For example, if the traders would like to purchase 100 shares and they choose "per share commission" with the commission of 0.005/share, they must pay $0.5. Two weeks later, the price of the shares rises, they want to sell and pay more $0.5. Therefore, the traders would pay $1 for commissions of the two transactions. On the other hand, if the traders purchase with "per trade" (flat rate) commission of $5.00, it will cost them a total of $10 for entry and exit the position. Thus, for small size of a position, "per share" commission is considered better than "per trade" commission. But when the size of a position is 2000, "per trade" commission is more economical.

3.6.2 Bid- ask spreads

There are two prices for any trading vehicle: a bid and an ask. A bid is what people are offering to pay for that security at the moment, an ask is what sellers are demanding in order to sell it. A bid price is lower, and an ask price is higher. (Elder, 2014, p.7)

A Bid-ask spread is calculated by subtracting Bid price from Ask price and it is different between the markets. This must be considered by traders because it is amount of money that they must pay for market maker (cost of trading).

Figure 9. Bid-ask spreads

Source: Market.com, 2018

For example, the traders want to trade by market.com, at the moment, bid price is $80.78 and ask price is $80.98. Therefore, Bid-ask spread= $80.98- $80.78= $0.02 and it is amount of cost per share that they must pay for market.com. The spread as percentage is defined as bid-ask spread divided by ask price $0.02/$80.98 or 2.47%. If the traders purchase one share at $80.98 and sell it at 81.05, they will lose $0.13.

3.6.3 Margin and leverage

Margin is a loan extended by the broker that allows us to enter larger trades. In order to do so, we must use margin and be approved for a margin shortcut. The borrowed money isn't free, we must pay the broker with interest, which is often between 5%- 10%. We use margin to create leverage. Leverage is the use of borrowed money from brokers to increase the potential of profit.

$$Margin = \frac{1}{Leverage} \qquad\qquad (14)$$

For example, 10:1 leverage= 10% margin required, 2:1 leverage= 50% margin required. In the stock market, the traders typically utilize a 2:1 leverage. (Investopedia.com, 2018). If the traders have $11 000 and want to purchase 200 shares of Exxon Mobil with the price being $110 per share, without margin, they will not able to purchase the number of shares expected. But with 2:1 leverage, they can purchase two times of their equity (2 x $11 000 =$22 000) worth of stock by $11 000 from their equity and $11 000 margin.

3.7 Loss control (risk management)

3.7.1 Stop-loss orders

Unreliability of indicators and emotional response to loss is overcome by stop-loss orders. When a trade goes against the trader in some amount, a stop-loss order allows them to tell their broker to exit their position. For a buyer, a stop-loss order means sell and for sellers it means buy. (Rockefeller, 2011, p.80)

3.7.2 Types of controlling losses

The Two Percent Rule

The most important rule of risk control is the two percent rule: never risk more than 2% of your account equity on any given trade (Elder, 2015).

If one has $11 000 in their account, maximum risk on any trade will be $220. Suppose they want to purchase the ExxonMobil stock with $110 per share and put a stop at $107.8 ($2.2 risk per share), the maximum number of shares that they should by is $220/ $2.2= 100 shares.

Risk-ward ratio

Risk ward ratio is a ratio used by traders to compare the amount of expected gain with the amount of expected loss. (Rockefeller, 2011, p.82)

For example, a trader purchases Exxon Mobil's stock at $100/share and places a stop loss order at $98, which means expected loss is $2/share. The trader believes that the stock price could reach $104/share, which means expected gain is $4/share. The risk-ward ratio is calculated by expected gain/expected loss=2:1 ($4/$2). The higher risk ward ratio reflects higher expectation of the trader on potential gain.

Trailing stops

Trading stop is used to manage risk and optimize profits by following the price (raising the stop as the trade makes profits). (Rockefeller, 2011, p.83). For open long position, the trailing stop is set at a predefined distance from the instruments of the current market price.

For example, the traders purchased Exxon Mobil stock at $100/share. Currently, price is at $120/share. Many would like to secure this potential profit, keep accumulating

more and minimizing risk. In order to achieve their expectation, they decide to secure part of their current potential profit and set a trailing stop at $5 below the current price. If the price raises at $125/share, the trailing stop will be $120. Assuming at $127, the price starts to fall and reaches the trailing stop limit at $120 as placed, and so the sell order will be executed. By this way, the traders get a profit of $20/share. At the same time, they can place a limit on potential profit and set a limit on losses.

Using indicator

In order to control loss or set a target price, the traders can use indicators such as volatility indicators (Bollinger Bands, ATR), Fibonacci numbers, and Parabolic SAR. As aforementioned in the methodology, Parabolic SAR will be used to control loss, reduce lag indicators and false signals in this thesis. (Rockefeller, 2011, p.84)

4 Practical Part

4.1 Trading strategy based on SMA

4.1.1 10 SMA and Close price crossovers

Input parameters:

- Types of trading: swing and position
- 10/2013 – 10/2018; 100 shares; capital: **15,000 USD**
- Stop-loss: As it was mentioned in the methodology part, Average True Range (ATR) is used to set the stop loss level, where 1.5 ATR is the most common. The average of ATRs of Exxon Mobil stock (XOM) from 10/2013 to 10/2018 calculated by Excel is $1.33. Thus, stop loss= 1.5ATR= 1.5 x 1.33=**$2** (per share), means if any loss reaches $2 per share, the position will be automatically closed, and the stop loss level is fixed in the entire practical part.
- Costs of commissions: Based on the comparison between "per trade" and "per share" commission in the literature review part, $0.005/ shares were assumed.
- Buy signal is generated when the 10 SMA (orange line) crosses below the close price of XOM (Murphy 1999, p.201)
- Sell signal is given when the 10 SMA (orange line) crosses above the close price of XOM or reaches stop-loss

Figure 10. Trading with 10SMA- Close price crossovers

Source: Metatrader 4, Own processing, 2018

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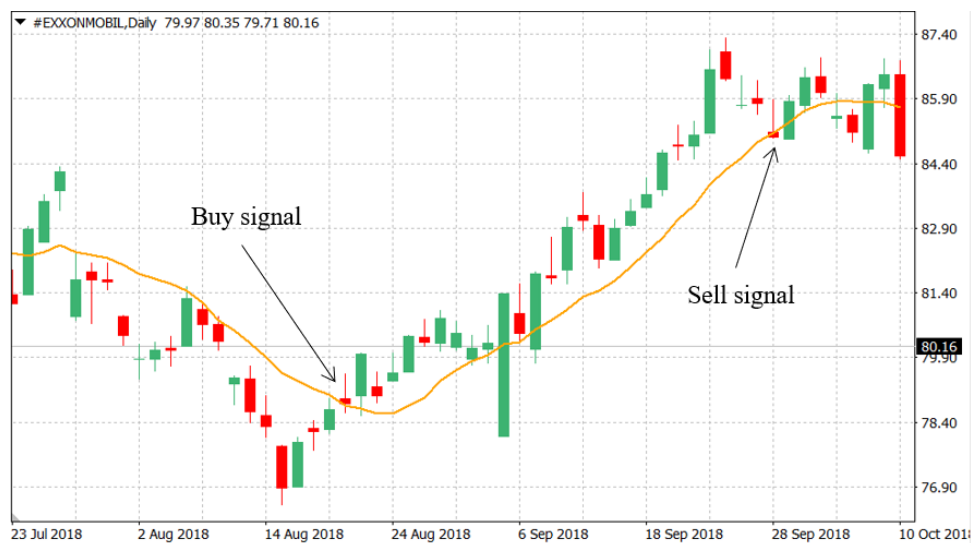
Table 2. 10 SMA- Close price crossovers strategy report

Total net profit	-$2737.00	Number of trades	126
Gross profit	$7047.00	Gross loss	-$9784.00
Profit factor	0.72	Max drawdown	27.12%
Profit trades	30	Loss trades	96
Avg. winning trade	$234.90	Avg. loss trade	-$101.92
Profit trades (% total number of trades)	23.81%	Loss trades (% of total number of trades)	76.19%
Largest profit trade	$629.00	Largest loss trade (if stop loss have not applied)	-$455.00
Avg. trade net profit	-$21.72		

Source: Own processing, 2019

Figure 11. Equity curve of 10 SMA-Close price crossovers during 2013-2018
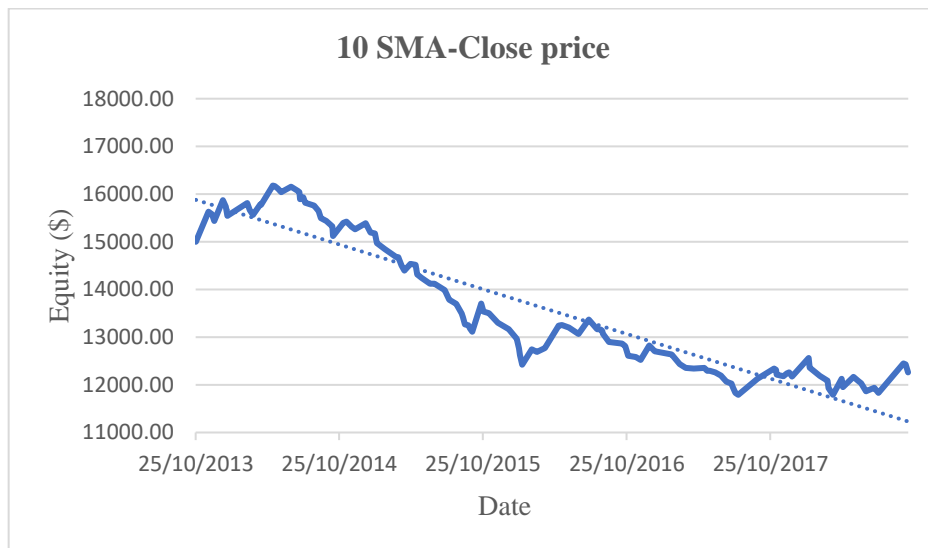
Source: Own processing, 2019

According to table 2, the trading strategy based on 10 SMA close price crossovers ended in negative numbers of $-2 737 over 5 years. Due to sell signals being provided too late and generating false signals, unexpected results were brought to light. This is proven in Murphy's claim "the strategy would produce more trades and results in many false signals because moving average is sensitive". The strategy offered 126 trades; however, the majority of these trades were losses because SMA works well in strong trend, but it is unsuitable for trading ranges. The abovementioned reasons along with, a significant decline of equity during the period of 10/2013- 10/2018 shown in the chart and the greatest loss distance of

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the previous equity peak (max drawdown) of 27.12%, all indicate a very high risk and unsuitable strategy. Assuming that stop loss was not applied, the largest loss trade would have been -$455.00, which strongly influenced total net profit. This showed us the importance of using stop loss in trading.

4.1.2 Optimization of 10 SMA and Close price crossovers

Input parameters:
- Buy signal is generated if 10 SMA (orange line) crosses below the close price and PSAR dots appear underneath the XOM
- Sell signal is active if 10 SMA (orange line) crosses above the close price and PSAR dots appear above the XOM or reaches stop loss
- Other parameters are unchanged

Figure 12. Trading with 10 SMA- Close price crossovers and PSAR
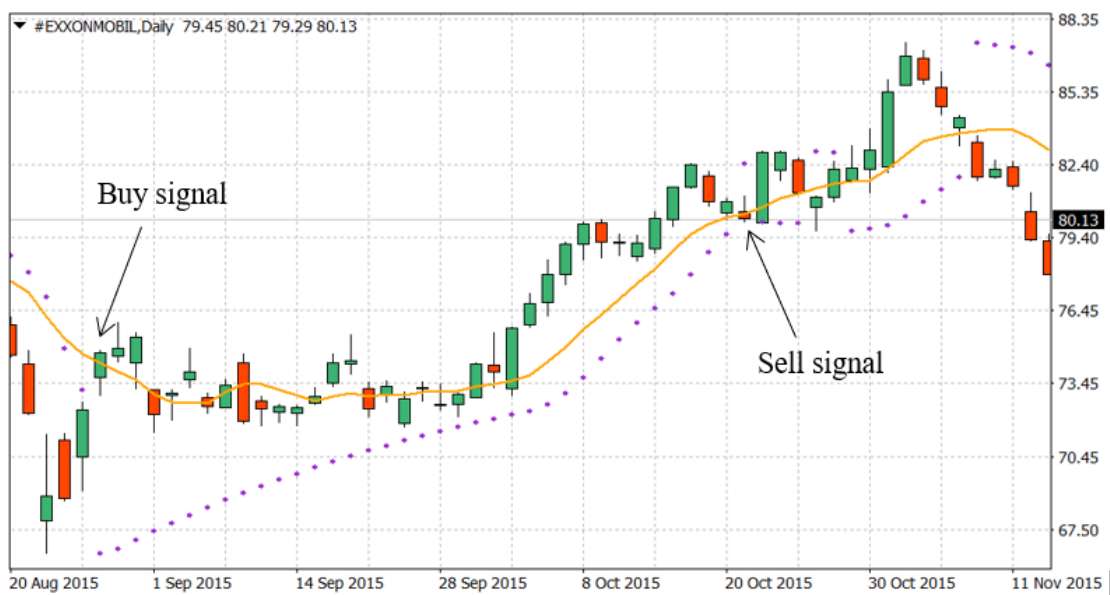
Source: Metatrader 4, Own processing, 2018

Table 3. Optimization of 10 SMA - Close price crossovers strategy report

Total net profit	$1171.00	Number of trades	51
Gross profit	$6126.00	Gross loss	-$4955.00
Profit factor	1.24	Max drawdown	10.58%
Profit trades	19	Loss trades	32
Avg. winning trade	$322.42	Avg. loss trade	-$154.84
Profit trades (% total numbers of trades)	37.25%	Loss trades (% total number of trades)	62.75%
Largest profit trade	$763.00	Largest loss trade (if stop loss have not applied)	-$628.00
Avg. trade net profit	$22.96		

Source: Own processing, 2019

As expected, the combination of 10 SMA and PSAR turned out to be a profitable result with $1171.00 gained, which represents a return on account of 7.81% over 5 years. Comparing with 10 SMA without PSAR, number of loss trades decreased and profit trades account for total trades were higher. Moreover, this optimization could bring average winning trade of $322.42 and the largest profit trade reached up to $763.00. PSAR follows the stock price much like a trailing stop, which helps distribute more exactly the times of entry and exit the positions. SMA is the sensitive indicator, therefore, applying PSAR could reduce false signals; especially in trading ranges. Figure 12 is the example which proves the numbers of trades were different between 10 SMA- Close price crossovers without PSAR strategy and the optimization (when PSAR is added) during the period of 20/08/2015-21/10/2015. There was only one position was formed by the optimization and bring the profit of more than $5. At the same time, trading based on 10 SMA-Close price crossovers without PSAR generated 7 trades and 6 of them were losses. Additionally, more lost trades were produced mean that the traders must pay more commissions for the broker, which could influence on total net profit.

Although the total net profit was positive and the average trade net profit might be acceptable, but the return on the account was low. Thus, it should be more analyzed and improved before risking any real trade.

Figure 13. Equity curve of optimized 10 SMA-Close price crossovers during 2013-2018
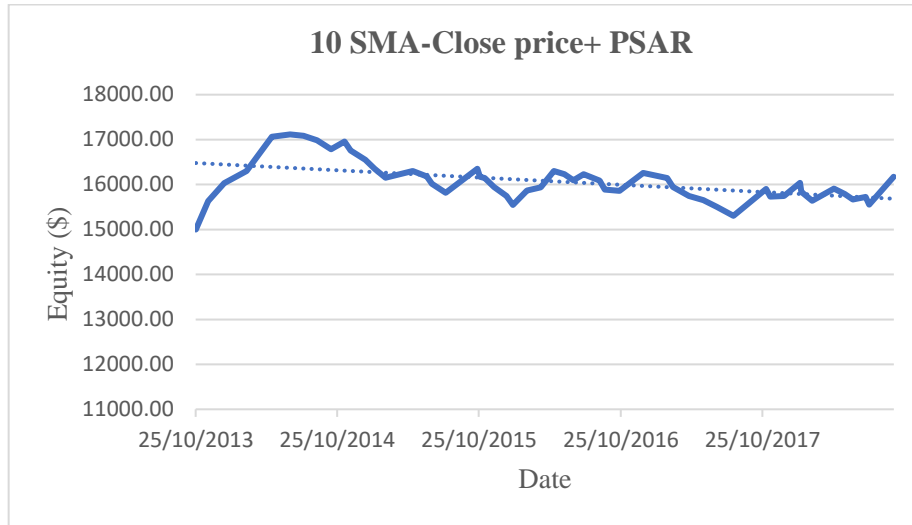
Source: Own processing, 2019

4.1.3   10 SMA- 20 SMA Close price crossovers (pair of SMAs crossovers)

Input parameters:

- Buy signal is generated when the fast 10 SMA (orange line) crosses above the slow 20 SMA (black line) (Elder, 2015)
- Sell signal is created when the fast 10 SMA crosses below the slow 20 SMA or reaches stop loss and other parameters are unchanged

Figure 14. Trading with 10 SMA and 20 SMA

Source: Metatrader 4, Own processing, 2018

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Table 4. 10 SMA- 20 SMA crossovers strategy report

Total net profit	$1068.00	Number of trades	34
Gross profit	$3659.00	Gross loss	-$2591.00
Profit factor	1.41	Max drawdown	4.79%
Profit trades	16	Loss trades	18
Avg. winning trade	$228.69	Avg. loss trade	-$143.94
Profit trades (% total number of trades)	47.06%	Loss trades (% total number of trades)	52.94%
Largest profit trade	$483.00	Largest loss trade (if stop loss have not applied)	-$506.00
Avg. trade net profit	$31.41		

Source: Own processing, 2019

The strategy based on 10 SMA- 20 SMA resulted in a total net profit of $1086, which represents 7.12% return on account over 5 years. Comparing to the 10 SMA- Close price crossovers strategy, number of lost trades and max drawdown of this strategy are lower that demonstrate the false signals are reduced. On the other hand, a high average winning trade should be higher to produce a better result.

Figure 15. Equity curve of 10 SMA- 20 SMA crossovers during 2013-2018
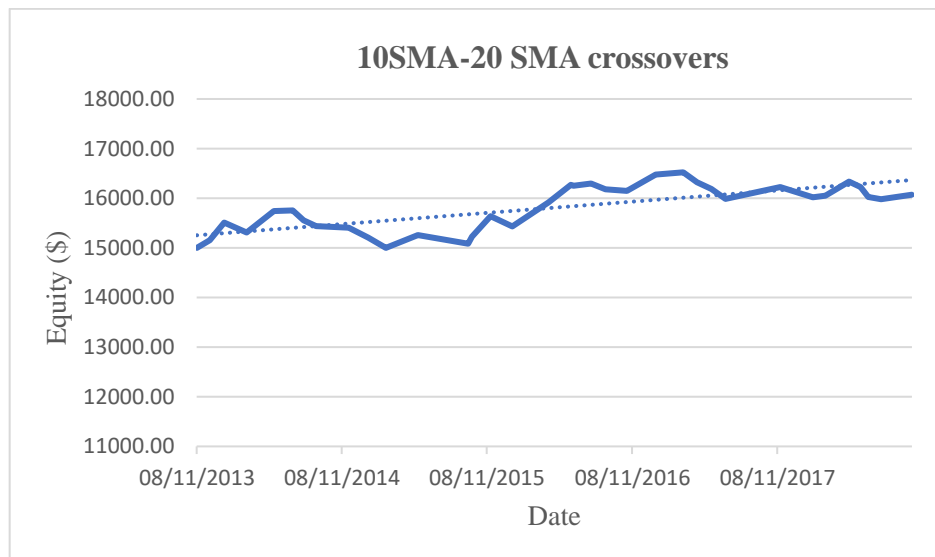
Source: Own processing, 2019

4.1.4　Optimization of the pair of SMAs crossovers

- Buy signal is generated if the fast 10 SMA crosses above the slow 20 SMA and PSAR dots appear below the XOM close price (trend of PSAR is rising).
- Sell signal is activated if the fast 10 SMA crosses below the slow 20 SMA and PSAR dots appear above the XOM close price (trend of PSAR is falling) or reaches stop loss
- Other parameters are unchanged

Table 5. Optimization of 10 SMA- 20 SMA crossovers strategy report

Total net profit	$1186.00	Number of trades	27
Gross profit	$3640.00	Gross loss	-$2454.00
Profit factor	1.48	Max drawdown	5.82%
Profit trades	11	Loss trades	16
Avg. winning trade	$330.91	Avg. loss trade	-$153.38
Profit trades (% total number of trades)	40.74%	Loss trades (% total number of trades)	59.26%
Largest profit trade	620.00	Largest loss trade (if stop loss have not applied)	-506.00
Avg. trade net profit	$43.93		

Source: Own processing 2019

Although PSAR is applied, the total net profit is insignificantly increased. Despite the average trade net profit was really high, the number of generated trades is only 27 and figure 16 shows the equity curve has not reached $17000. Other key metrics such as profit factor, profit trades (% total number of trades) max drawdown were not improved. Overall, applying PSAR didn't show a change in this case.

Figure 16. Equity curve of optimized 10 SMA- 20 SMA crossovers during 2013-2018

10 SMA- 20 SMA crossovers +PSAR
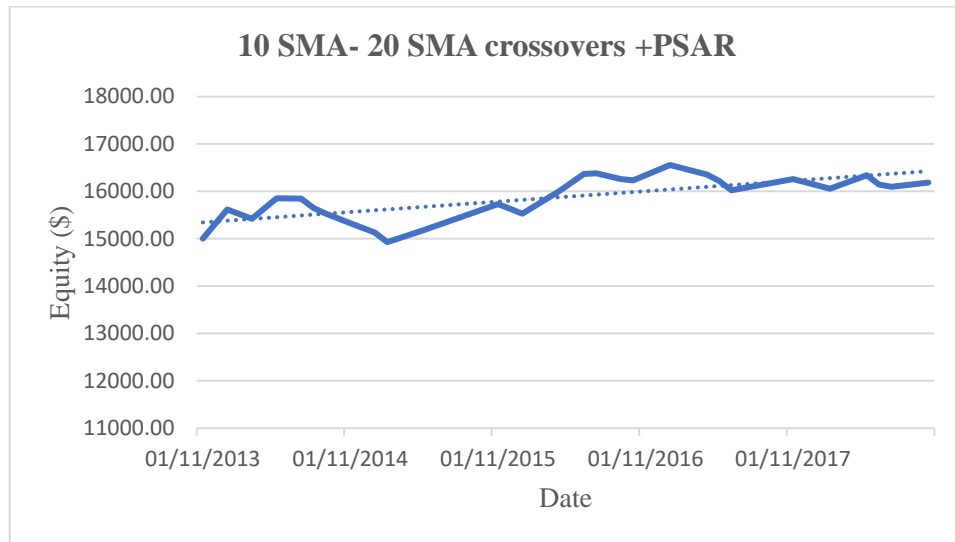
Source: Own processing, 2019

4.2 Trading strategy based on EMA

4.2.1 10 EMA and Close price crossovers

Input parameters:

- Buy signal is generated when the EMA crosses below the close price. (Murphy, 1999)

- Sell signal is activated when the EMA crosses above the price or reaches stop loss

- Other parameters are unchanged

Table 6. 10 EMA- Close price crossovers strategy report

Total net profit	-$1709.00	Number of trades	119
Gross profit	$7342.00	Gross loss	-$9051.00
Profit factor	0.81	Max drawdown	22.12%
Profit trades	28	Loss trades	91
Avg. winning trade	$262.21	Avg. loss trade	-$99.46
Profit trades (% total number of trades)	23.53%	Loss trades (% total number of trades)	76.47%
Largest profit trade	$897.00	Largest loss trade (if stop loss have not applied)	-$455.00
Avg. trade net profit	-$14.36		

Source: Own processing 2019

Figure 17. Equity curve of 10 EMA- Close price crossovers during 2013-2018
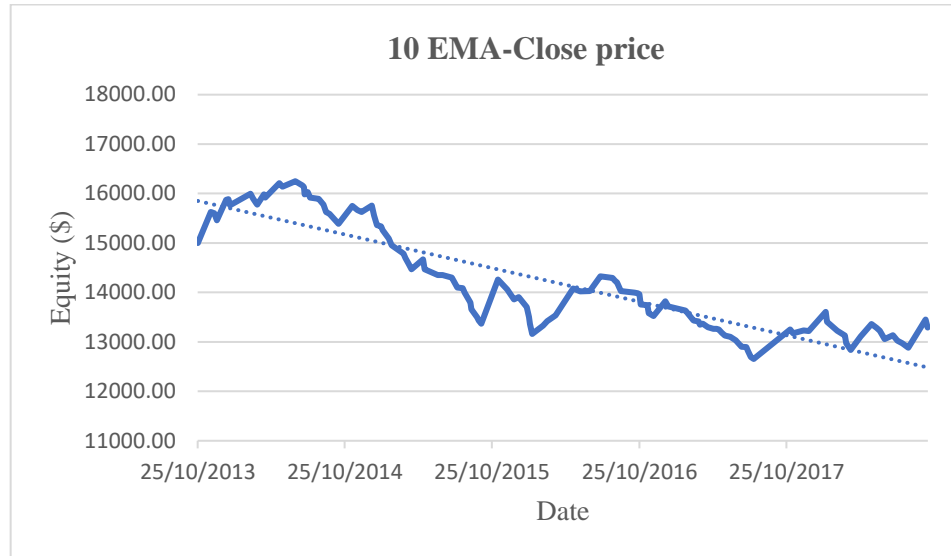
Source: Own processing, 2019

4.2.2 Optimization of 10 EMA and Close price crossovers

Input parameters:

- Buy signal is generated if the EMA crosses the close price from the top and PSAR dots appear below the close price of the XOM
- Sell signal is activated if EMA crosses the close price from the bottom and PSAR dots appear above the close price of the XOM or reaches stop loss
- Other parameters are unchanged

Table 7. Optimization of 10 EMA- Close price crossovers strategy report

| Total net profit	$1369.00	Number of trades	48
Gross profit	$6006.00	Gross loss	-$4637.00
Profit factor	1.30	Max drawdown	8.01%
Profit trades	19	Loss trades	29
Avg. winning trade	$316.11	Avg. loss trade	-$159.90
Profit trades (% total number of trades)	39.58%	Loss trades (% total number of trades)	60.42%
Largest profit trade	$709.00	Largest loss trade (if stop loss have not applied)	-$628.00
Avg. trade net profit	$28.52		

Source: Own processing 2019

Trading strategy 10 EMA close price crossovers and its optimization resulted similar to 10 SMA close price crossovers. This optimization created profitable trading results. Comparing to 10 SMA, 10 EMA lost less and was more profitable which is indicated by total net profit.

Without applying PSAR, the strategy based on 10 SMA lost more than 1.5 times the loss of the strategy based on 10 EMA. Additionally, the number of trades based on 10 EMA is less than the number of trades based on 10 SMA, this proves that the lag and false signal were partly restricted. As mentioned by Elder, EMA is less lagging than SMA because of the addition of recent data and not dropping old data as the SMA does.

Optimizing 10 EMA- Close price crossovers by PSAR could bring $1369.00 over 5 years, which represents 9.13% return on account. Comparing with 10 SMA- Close price crossovers, this number is insignificantly improved.

Figure 18. Equity curve of optimized 10 EMA-Close price crossovers during 2013-2018
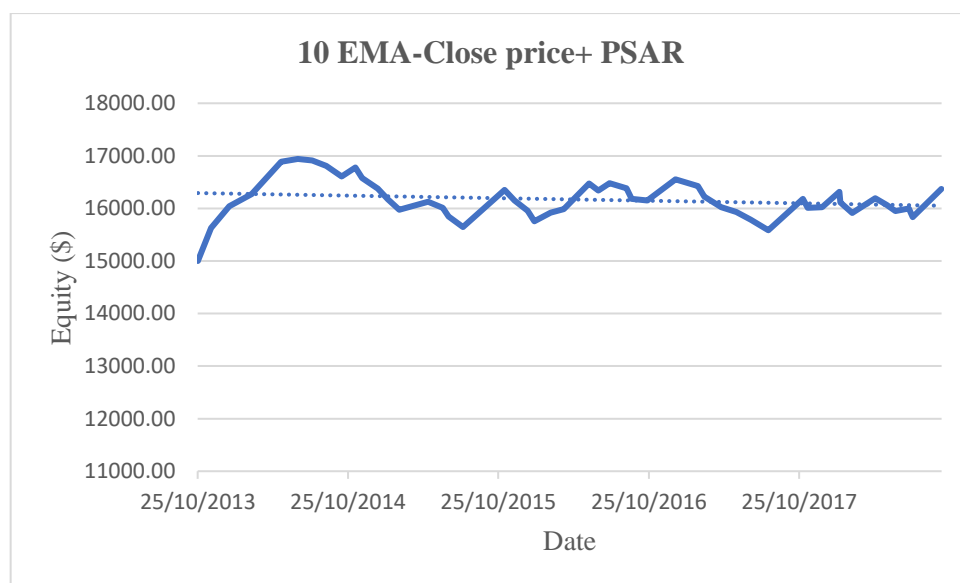
Source: Own processing, 2019

4.2.3   10 EMA- 20 EMA Close price crossovers (pair of EMAs crossovers)

Input parameters:

- Buy signal is generated when the fast 10 EMA crosses above the slow 20 EMA (Elder, 2015)
- Sell signal is given when the fast 10 EMA crosses below the slow 20 EMA or reaches stop loss
- Other parameters are unchanged

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Table 8. 10 EMA- 20 EMA crossovers strategy report

Total net profit	$667.00	Number of trades	23
Gross profit	$3163.00	Gross loss	-$2496.00
Profit factor	1.27	Max drawdown	5.62%
Profit trades	8	Loss trades	15
Avg. winning trade	$395.38	Avg. loss trade	-$166.40
Profit trades (% total number of trades)	34.78%	Loss trades (% total number of trades)	65.22%
Largest profit trade	$1107.00	Largest loss trade (if stop loss have not applied)	-$406.00
Avg. trade net profit	$29.00		

Source: Own processing, 2019

Trading strategy based on 10 EMA-20 EMA crossovers was slightly profitable. Despite the largest profit trade reaching $1107.00 and the highest average winning trade compared to the mentioned strategies, the total net profit was lower than the value I expected. The profit earned by large profit trade rather than a high number of profit trades. Return on account of 4.45% over 5 years is not considered as a "good" strategy. Therefore, the strategy could not be profitable in real trades.

Figure 19. Equity curve of 10 EMA- 20 EMA crossovers during 2013-2018
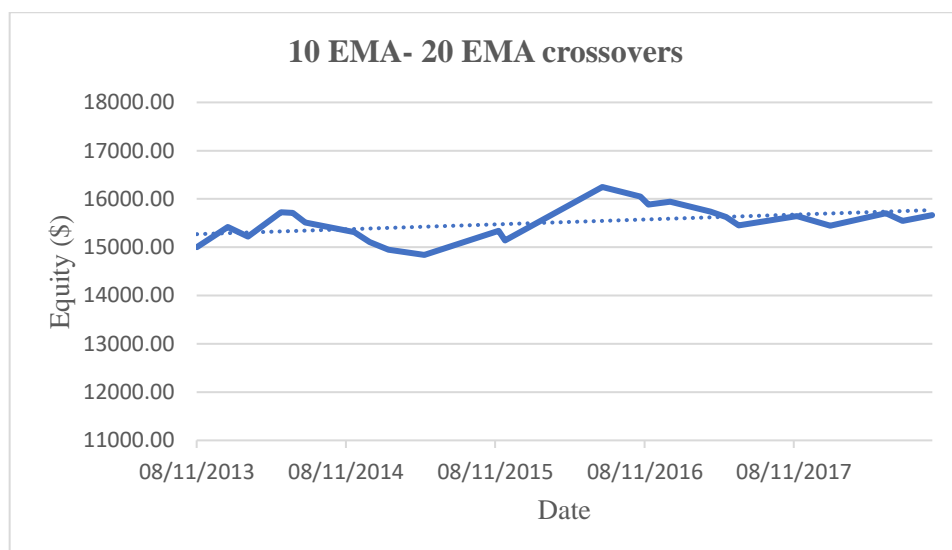
Source: Own processing, 2019

4.2.4 Optimization of the pair of EMAs crossovers

Input parameters:

- Buy signal is generated if the fast 10 EMA crosses above the slow 20 EMA and PSAR dots appear below the XOM close price (trend of PSAR is rising).
- Sell signal is activated if the fast 10 EMA crosses below the slow 20 EMA and PSAR dots appear above the XOM close price (trend of PSAR is falling) or reaches stop loss
- Other parameters are unchanged

Table 9. Optimization of 10 EMA- 20 EMA crossovers strategy report

Total net profit	$925.00	Number of trades	21
Gross profit	$3130.00	Gross loss	-$2205.00
Profit factor	1.42	Max drawdown	5.88%
Profit trades	8	Loss trades	13
Avg. winning trade	$391.25	Avg. loss trade	-$169.62
Profit trades (% total number of trades)	38.10%	Loss trades (% total number of trades)	61.90%
Largest profit trade	$1107.00	Largest loss trade (if stop loss have not applied)	-$462.00
Avg. trade net profit	$44.05		

Source: Own processing, 2019

Although the profit factor of 1.42 and average winning trade of $391.25 are acceptable, the total net profit of this optimization was not strongly improved and number of loss trades were not much reduced compare to 10 EMA- 20 EMA crossovers, which PSAR were not accompanied. Furthermore, applying three indicators could result in more complicated strategy. Thus, the optimization of 10 EMA- 20 EMA crossovers would not be suggested.

Figure 20. Equity curve of optimized 10 EMA- 20 EMA crossovers during 2013-2018
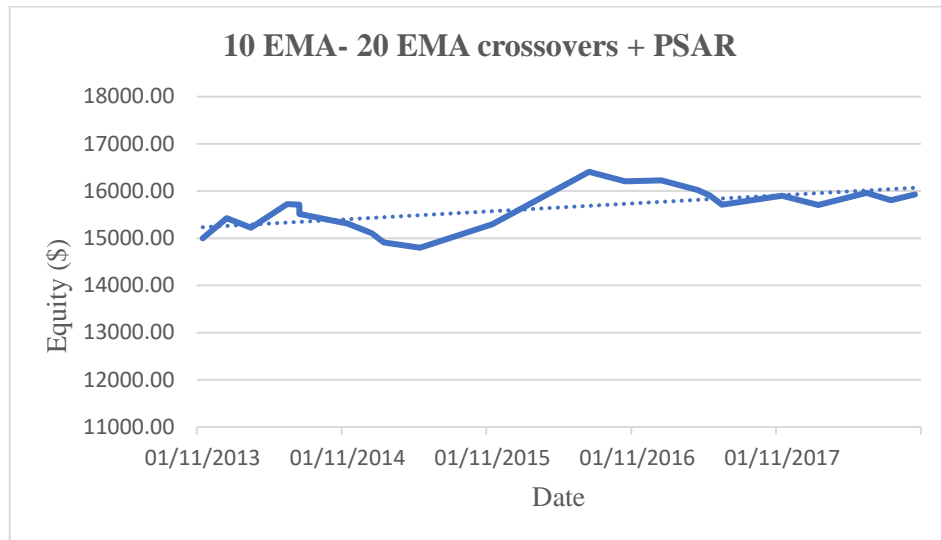
Source: Own processing, 2019

Through all results of moving averages and their optimization strategies, the performances are different between the strategies. When only one moving average was selected (SMA or EMA), the total net profit is negative because moving average is the sensitive indicator and produces more lost trades. Therefore, the strategies base on moving average- close price crossovers are not suggested. When PSAR is added, the trading strategies are profitable because lag and false signals were reduced. Although three indicators which consist of a pair of moving averages and PSAR were profitable, total net trade profit insignificantly changed and could make the strategies become more complicated.

4.3 Trading strategy based on MACD- Signal line crossovers

4.3.1 MACD- Signal line crossovers

Input parameters:
- Buy signal is generated when the MACD line (black line) turns up and crosses above the signal line (blue line) (Elder, 2014, p.82)
- Sell signal is given when MACD turns down and crosses below signal line or reaches stop loss and other parameters are unchanged

Figure 21. Trading with MACD- Signal line crossovers

Source: Market.com, Own processing, 2018

Table 10. MACD- Signal line crossovers strategy report

Total net profit	-$1125.00	Number of trades	52
Gross profit	$4477.00	Gross loss	-$5602.00
Profit factor	0.80	Max drawdown	17.53%
Profit trades	14	Loss trades	38
Avg. winning trade	$319.79	Avg. loss trade	-$147.42
Profit trades (% total number of trades)	26.92%	Loss trades (%total number of trades)	73.08%
Largest profit trade	$670.00	Largest loss trade (if stop loss have not applied)	-$595.00
Avg. trade net profit	-$21.63		

Source: Own processing, 2019

Trading strategy based on MACD-signal crossovers was unprofitable with total net profit being -$1125.00. The table shows that approximately three-fourths of trades are losses and the average amount of money loss per trade is $21.63, this proves that the majority of generated signals are false. Similar to SMA, MACD works well in strong trend, but it is too sensitive in trading ranges, which resulted in more unexpected trades being produced. Max drawdown is very high and not considered good. The chart shows that equity declined and did not reach $16000 over 5 years. Hence, this strategy is unsuccessful.

Figure 22. Equity curve of MACD- Signal line crossovers during 2013-2018
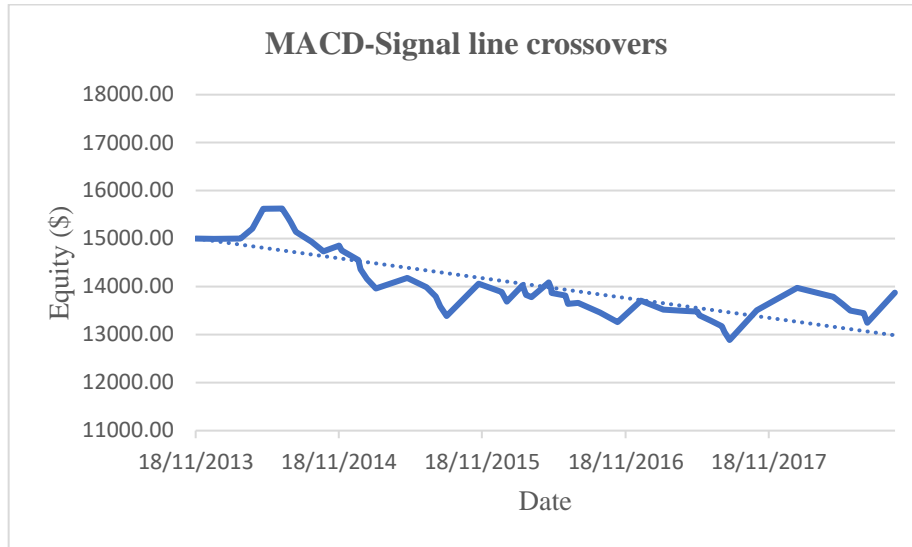
Source: Own processing, 2019

4.3.2 Optimization of MACD-Signal line crossovers

Input parameters:

- Buy signal is generated if the MACD crosses above the signal line and PSAR dots appear below the XOM close price (trend of PSAR is rising).
- Sell signal is active if MACD crosses below signal line PSAR dots appear above the XOM close price (trend of PSAR is falling) or reaches stop loss
- Other parameters are unchanged

Table 11. Optimization of MACD- Signal line crossovers strategy report

Total net profit	-$541.00	Number of trades	41
Gross profit	$4328.00	Gross loss	-$4869.00
Profit factor	0.89	Max Drawdown	12.08%
Profit trades	14	Loss trades	27
Avg. winning trade	$309.14	Avg. loss trade	-$180.33
Profit trades (% total number of trades)	34.15%	Loss trades (% total number of trades)	65.85%
Largest profit trade	$730.00	Largest loss trade (if stop loss have not applied)	-$628.00
Avg. trade net profit	-$13.20		

Source: Own processing, 2019

Figure 23. Equity curve of optimized MACD- Signal line crossovers during 2013-2018
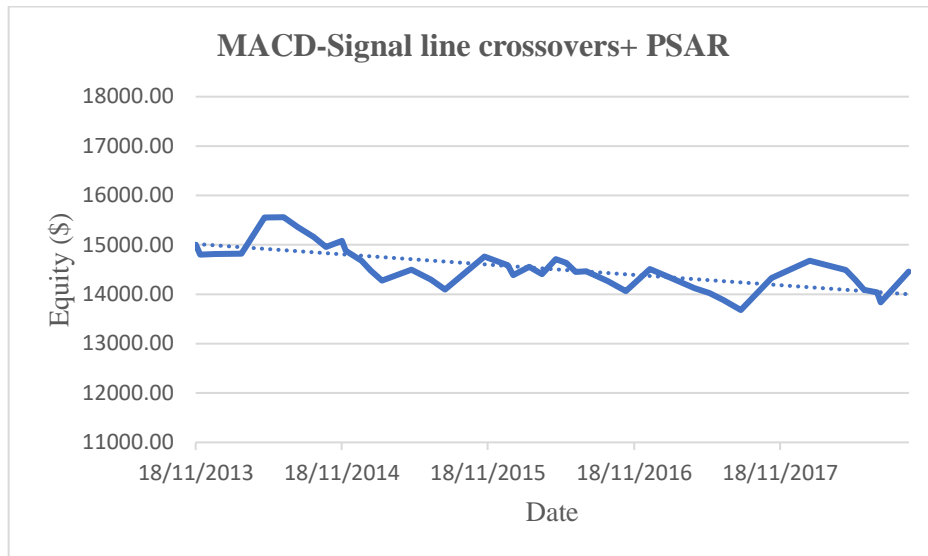
Source: Own processing, 2019

Even though the strategy is optimized by applying PSAR, total net profit did not turn positive and the equity was not able to reach $16000. On the other hand, number of loss trades decreased compared to MACD-signal crossover without PSAR, this represents a reduction of false signals. Overall, trading with MACD-signal line crossovers and its optimization are unprofitable by swing and position trading.

4.4 Trading strategy based on RSI

Input parameters:

- RSI period- 14
- Buy signal is generated when RSI breaks below oversold level of 30
- Sell signal is given when RSI breaks above overbought level of 70 (Rockefeller, 2011, p.237)
- Other parameters are unchanged

Trading with RSI is considered unsuccessful because there were only few trades over 5 years. In fact, when uptrend was strong, RSI reached overbought many times. Therefore, instead of giving buy signal, sell signal was formed. This majority cause is the same as Murphy, 1999, p.245 claimed "a market is overbought or oversold are usually premature and can lead early exit from a profitable trend". The chart below is an example, which shows several overbought readings during strong uptrend which lead to early exit and resulted in losing potential profits.

Figure 24. Trading with RSI

Source: Own processing, 2019

Additionally, depending on the trend of a market, as well as which stock we bought, oversold level and overbought level are different. Elder, 2014 mentioned that some traders use levels of 40 (oversold) -80 (overbought) in bull markets and 20-60 in bear markets. Thus, the level of overbought and oversold of this trading strategy should be changed to avoid exiting too early the potential profit position in strong uptrend and RSI is needed to combine with a suitable indicator to achieve better results.

5 Results and Discussion

This chapter will show the comparison of trading strategies above as well as recommending other strategies and types of trades.

Table 12. Strategies comparison

Strategy		Total net profit	Return on account over 5 years	Number of Trades	Max Drawdown
SMA	with Close price	-$2737.00	-18.25%	126	27.12%
	With Close price and PSAR (Optimization)	$1171.00	7.81%	51	10.58%
	Pair of SMAs	$1068.00	7.12%	34	4.79%
	Pair of SMAs and PSAR (Optimization)	$1186.00	7.91%	27	5.82%
EMA	with Close price	-$1709.00	-11.39%	119	22.12%
	with Close price and PSAR (Optimization)	$1369.00	9.13%	48	8.01%
	Pair of EMAs	$667.00	4.45%	23	5.62%
	Pair of EMAs and PSAR (Optimization)	$925.00	6.17%	21	5.88%
MACD	with Signal line	-$1125.00	-7.50%	52	17.53%
	with Signal line and PSAR (Optimization)	-$541.00	-3.61%	41	12.08%

Source: Own processing, 2019

The table 12 clarifies the difference between tested results of 10 strategies. There are 4 loss strategies and 6 slight profit with the return on account over 5 years around 3-10%.

Applying PSAR reduced lag and false signal, however, the ability of this deduction of these signals is based on each strategy. In general, the strategies based on moving averages- close prices crossovers without applied Parabolic SAR have very high max drawdown, represents high risk of trading. Some strategies resulted being profitable, however, the returns on accounts were and might not be worth trading in the high-risk market of ExxonMobil's stock. I consider that combinations of moving average-close price crossovers accompanied PSAR are potential and might give high profit with adjusted parameters are in intraday trading.

Unlike moving average indicators, neither MACD-signal crossovers nor its optimization were profitable. I extrapolate optimizing MACD with Commodity Channel index developed Donald Lambert, Stochastic Momentum Index in intraday trading or the "Impulse system "developed by (Elder, 2015) which combines EMA and MACD-Histogram might have better results. The strategies based on RSI were unsuitable, therefore, the traders should change the level of overbought and oversold due to bullish or bearish market and avoid exiting too early the potential profit position.

Overall, trading with XOM based on these simple strategies are below expectation and should be adjusted to be suitable in the different stock markets. Although some strategies are slightly profit, they might be loss in real trade. Therefore, the traders should test with variety of indicators and try to develop trading strategies before implementing any real trade.

Conclusion

The primary objectives of the thesis are to check profitability and feasibility of trading strategies based on the technical analysis of the ExxonMobil's stock (XOM)- one of the largest energy companies in the world. Therefore, the process of developing trading strategies is the sub-objective. In order to create the strategies, the indicators were selected, then adjusted the parameters in historical data such as periods and types of crossovers. The process which adding another indicator to reduce lag and false signals called optimization.

To achieve all objectives, the important data were: Open, High, Low, Close price and Volume and the methods to calculate four indicators include the Simple Moving Average (SMA), Exponential Moving Average (EMA), Moving Average Convergence/Divergence (MACD) and Relative Strength Index (RSI). Furthermore, the strategy performance reports which include the five key metrics are total net profit, profit factor, percent profitable, average trade net profit and maximum drawdown enabled us to evaluate the strategies performances as well as check how the indicators work.

As the background, the principles, definitions of the stock market and technical analysis were summarized. I started with general overview of the stock market, where stock is exchanged, the features of each type of the stock market. Both of technical analysis and fundamental analysis are used to analyze the financial stock market, however, they have many differences. In this thesis, technical analysis was emphasized. After that, I mentioned the types of popular charts used for trading and price action. Nowadays, there are many brokers, websites and books that offer diversity of trading options and strategies. Choosing suitable types of trading is an important factor in order to be successful. Moreover, the traders also should decide whether to hold stock for more than one day to several months or buy and sell in the same day. To check profitability of trading strategies where stock is held overnight, as well as the generalization of the XOM in long-term; swing and position trading was selected.

In the high-risk market, the traders should consider costs of trading, determine a broker and manage risk. As mentioned, some popular brokers which offer different levels or types of commissions of trading and required minimum account. The two types of commissions which the traders should distinct are "per trade" and "per share" to be more economical. Another important factor determines success of a trading strategy is loss control. A stop loss order allows us to exit a trade when stock starts dropping below a certain price.

Some common methods to control loss are the "two percent rule", risk-ward ration, trailing stop and using an indicator. In this thesis, Average True Range (ATR) is the method used to set a stop loss.

The practical is divided into four sections which are based on the indicators: SMA, EMA, MACD and RSI. The optimization of each strategy is formed by the addition of the indicator called Parabolic Stop and Reverse (PSAR).

There were two ways to trade with *moving averages* (MA- includes SMA and EMA): called *MA- close prices crossovers* and *a pair of moving averages crossovers*. Trading with SMA and EMA have similar results. Trading with SMA-close prices crossovers ended in loss. Moreover, the majority of trades were losses and very high max drawdown proved a high risk and unprofitable strategy. The primary causes of many loss trades were the generation of false signals and the late appearance sell signals which lead to a decline in potential profits. The strategy based SMA-close prices crossovers *accompanied PSAR* (optimization of SMA- close price crossovers) was profitable. The PSAR help the strategy reduce lost trades and delay of provided signals. Despite number of loss trades decreased and average trade net profit increased, the return on account over 5 years was low. The strategy should be developed further to gain higher profit.

Both pair of SMAs crossovers without applied PSAR and its optimization was profitable, however, the total net profit of the optimization was not satisfied. In general, EMA and SMA have similar results. However, EMA seems to be less lagging than SMA because some trading strategies based on EMA resulted in more profit and less loss than SMA. Overall, characteristics of moving averages, which are proved by trading results are true based on the claims of two authors Elder and Murphy. I would like to recommend the *one moving average and PSAR*. Despite the selecting pair of moving averages accompanied PSAR which could bring profit (three indicators), the strategies would not recommend because the results are not improved compare to pair of moving averages, and they make strategies more complicated.

Trading with MACD-signal crossovers was unprofitable and the majority of generated signals were false, along with max drawdown was high, all proved high risk and unsuitable strategy. Even though the strategy is optimized by applying PSAR, total net profit did not turn into positive result, representing that the combination of MACD-Signal line and PSAR was not effective.

Trading strategy based on RSI is considered unsuccessful because there are only few trades over 5 years. Once again, Murphy's claim of cause and result are correct. In the strong uptrend, RSI reached overbought many times and it can lead early exit from a potential profit position. Depending on bullish or bearish market, the traders should adjust overbought and oversold level to be appropriate for each trend of the market.

In general, some strategies were profitable. However, in the high-risk market, the low return on account might not be worth trading. PSAR and momentum or oscillators indicators do not support each other and all results of these are unprofitable. The parameters of indicators should be changed to generate more correct signals.

The results in the practical part could help the readers determine whether to trade with XOM or not. It also showed how the indicators worked when the parameters were changed and proved the importance of selecting correct indicators and periods. Technical analysis is a good approach to analyze the stock markets, but stock price is influenced by many factors. Therefore, the traders should combine more approaches, for example fundamental analysis and psychological analysis to gain expected profit.

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Appendix

Appendix A   Close price and Volume during the period of 2013-2018

Close price and Volume during period 2013-2018