Vysoká škola ekonomická v Praze
Fakulta financí a účetnictví

Bakalářská práce

Praha 2019 Peter Kuchár

Vysoká škola ekonomická v Praze

Fakulta financí a účetnictví

Katedra měnové teorie a politiky

Studijní obor: Bankovnictví a pojišťovnictví

Back-testing of trading strategy and application of this strategy on Germany´s stock index DAX30

Autor bakalářské práce: Peter Kuchár

Vedoucí bakalářské práce: Ing. Jan Vejmělek, Ph.D., CFA

Rok obhajoby: 2019

Čestné prohlášení

Prohlašuji, že jsem bakalářskou práci na téma „**Back-testing of trading strategy and application of this strategy on Germany´s stock index DAX30**“ vypracoval samostatně a veškerou použitou literaturu a další prameny jsem řádně uvedl v přiloženém seznamu literatury.

V ..... dne ....

Acknowledgements

I would like to express my deepest thanks to my supervisor Ing. Jan Vejmělek, Ph.D., CFA for his help, patience and advice throughout the thesis work.

Abstract

The main objective of this thesis is to create successful intraday trading strategy by using technical analyses and proper risk management. Thesis will be divided into two parts where first part will consist of theoretical knowledge necessary to understand aspects of the trading and market analyses. Second part will be application of this knowledge in order to create successful trading strategy.

Thesis shows steps necessary for creating successful trading strategy and how to approach historical testing of profitability of trading strategy. As underlying instrument DAX30 was chosen and for the testing period years of various market conditions were picked. Last chapter of thesis sums up performance of trading strategy in recent market and is represented by selected metrics of profitability.

The main contribution of the bachelor thesis is my very own approach to market analyses, creation of profitable trading strategy and conclusion and interpretation of obtained results.

Key words: DAX30, trading, technical analyses, intraday trading strategy, financial markets, market analyses,

Abstrakt: Hlavním cílem mé bakalářské práce je vytvoření úspěšné denní obchodní strategie za pomoci technické analýzy a „risk managementu“. Práce bude rozdělena do dvou části kde v první části se čtenáři obeznámí s teoretickými znalostmi potřebnými k pochopení podstaty obchodování a tržní analýzy. Druhá část bude následná aplikace těchto znalostí s cílem sestavit úspěšnou obchodní strategii.

Práce zobrazuje jednotlivé kroky potřebné pro sestavení obchodní strategie a přistup k historickému testovaní této strategie. Jako podkladové aktivum byl zvolen index DAX30 a historická data která reprezentují různé tržní podmínky. Poslední kapitole bakalářské práce je zaměřena na vyhodnocení úspěšnosti obchodní strategie v aktuálních tržních podmínkách za pomoci zvolených veličin profitability.

Za hlavní přínos téhle bakalářské práce považuji zobrazení mého vlastního přístupu k tržní analýze, vytvoření profitabilní reálné obchodní strategie a vyhodnocení její úspěšnosti.

Contents

Introduction

Investing in financial markets have been present for many years. However, in my opinion many people still only have general idea about what investing in financial markets is, not to mention trading. First, I got in touch with financial markets in high school and my interest have been growing ever since. I was mostly interested in investing and trading of financial securities. Therefore, I decided to take a deeper look into this topic and especially trading of financial instruments which fascinates me most.

I focus on one particular instrument DAX30 which is Germanys stock index of thirty biggest and most liquid companies listed on Frankfurt exchange.

Thesis will first introduce readers into an explanation of financial markets, accessibility and instruments traded on financial market. After understanding main idea thesis will try to explain one of the most popular approach to analyzing markets using technical analyses. Then I will try to explain my approach to analyzing markets and my very own trading strategy created using technical analyses.

Main part of the thesis will be creation of successful trading strategy based on idea that could be easily interpreted using simple technical tools. Strategy will be based on data from the past and once the strategy is created it will be applied on recent market data showing its actual value in present. Last part of the thesis will present obtained results from trading and calculate criterion of profitability which are necessary to determine how trading strategy performed.

1. Basic characteristics of the stock market

1.1 Introduction to theory of financial markets

In every economy there are two types of participants in financial markets. Those with surplus of financial resources and those with insufficient resources. Financial markets provide an opportunity to allocate those resources between these participants in order to ensure the most effective way of exploiting financial resources. The process of transferring funds from one participant to another is carried out by a financial intermediary. Financial intermediaries play important role in this case because they are able to resolve the conflicting needs of market participants. They do so by issuance of financial security which usually satisfies both sides of the transaction. We distinguish three basic types of participants on financial market such as households, businesses and government. Generally financial intermediaries divide into two main categories, banking sector and non-banking institutions like brokers etc. [Veselá,2011]

Financial markets serve four basic functions:

1) Put savings into better use. As mentioned earlier financial markets transfer funds from agents with surplus of financial resources to agents in need of those resources.
2) Determine the price of the security. Price of any good is determined by the law of supply and demand. Financial markets help to determine correct price of the security by matching great number of bids and offers in short time period.
3) Provide liquidity to financial securities. When buying security, you also must think about how expensive it is going to be to get rid of it. Financial markets reduce this risk by putting together lots of orders from different participants which makes the security more tradeable.
4) Reduction of the transaction cost. Various types of information are needed while buying and selling securities. Financial markets provide lot of different pieces of information which would otherwise be difficult and expensive to obtain. In this sense financial markets reduce transaction cost.

Financial markets serve many different participants with different needs and goals. Markets can be divided into four basic categories based on what securities and assets are traded on particular market.

Types of financial markets (based on instruments traded)

a. Money market- deals in short-term assets (maturity up to 1 year) with great liquidity to allow immediate transformation of security into money.
b. Security market- deals with raising new capital, trading of existing shares and bonds (maturity over 1 year and longer)
c. Foreign exchange market (Forex)- deals with trading of different currency pairs. Biggest market in the world with daily volume of $6 trillion.
d. Commodity markets- deals in trading of different kinds of commodities (oil, wheat, gold etc.)
e. Alternative investment market (AIM)- help to raise capital to smaller companies from public. AIM allows companies to list on public exchange that has flexible regulatory requirements compared to the main market.
f. Real assets- deals with trading of actual assets. It is used to prevent your portfolio from inflation and political risks. These markets have huge transactional costs and are extremely illiquid.

Since modernization and rise in use of information technology you can easily drift between these markets when for example buying assets or securities in different currencies.

1.2 Exchange vs. OTC

Nowadays financial markets do their trading as one these two options: Through an exchange or as 'Over-The-Counter' markets (OTC), although some recent electronic facilities blur the traditional distinctions (Cryptocurrency).

In markets that operates with trading exchange, transactions are completed through a centralized source. Mediator connects buyers and sellers using its own trading system. Mediator also works as the regulator for particular market. Every exchange has its comprehensive set of rules which allows for the best security and intelligibility. These rules are publicly accessible, and every participant is responsible for their actions. Exchange uses standardized sizes of contracts in order to ensure liquidity. Standardized contracts make it easy for mediator to pair with each other, however they may be out of reach for retail clients due to its size. Basic examples of exchange traded markets are NYSE, NASDSAQ, EURONEXT etc.[1]

On the other hand, OTC markets are decentralized. There are many mediators who compete to link buyers to sellers which usually leads to reducing the cost of this service to its minimum. Obvious downside of this type of market is they are unregulated, and more prone to untrustworthy and fraudulent mediators. OTC markets are massive in terms of volume traded

[1] Markets: Exchange or Over-the-Counter; [online] IMF avalaible at: https://www.imf.org/external/pubs/ft/fandd/basics/markets.htm

daily. Biggest market in the world FOREX (foreign exchange market) has daily volume of traded instruments of $6 trillion. Main explanation for this can be increase in electronic trading and the rise in alternative investments. OTC markets are open 24 hours a day 5 days a week whereas exchanges are only open for part of day. For example, Deutsche Boerse is open from 9:00-17:30 Mondays till Fridays.

Exchange markets are believed to be less risky than OTC markets and less likely to be manipulated. In my opinion they are less risky in terms of counter party risk since the exchange acts as regulator and is always a counterparty in every transaction. In terms of manipulation OTC markets tend to be more manipulated due to untrustworthy mediators. However, exchange markets prices can also be manipulated by other participants with lot of capital. [2]

1.3 Structure of the capital market

In theoretical part I will mainly focus on exchange market since the stock index DAX30 consists of stocks quoted on Deutsche Boerse in Frankfurt. We identify two main categories in capital markets. Primary market where securities are originally initiated. Investors buy new security in process called IPO which stands for initial public offering. The most active market participants in this process are commercial banks and investment firms which help clients with timing of an offering, distribution to public and financial institutions and production of the prospectus. These must be approved by regulatory authorities before final confirmation. Underwriting syndicate guarantees issuer the minimum price for which the security will be sold and then offers higher price to the public. After successful placement of the security into the market investment firms oversee that there is enough liquidity in secondary market [Keith,2005].

Secondary market is place where securities are traded after they had already been issued. Even though issuer does not receive any more funds from secondary market it is still important since it indicates value of the company. Publicly traded companies are considered more transparent because exchange requires them to publish more information than other non-publicly traded companies which usually leads to reduction of interest rates for newer loans and bonds issuance. Operation of secondary markets depends on market-makers who quote prices and are prepared to buy and sell huge volumes of securities in any given moment. Nowadays exchanges use their own electronic trading systems which allows for immediate execution of orders even in larger volumes.

[2] Markets: Exchange or Over-the-Counter; [online] IMF avalaible at: https://www.imf.org/external/pubs/ft/fandd/basics/markets.htm

1.4 Market participants

Every market participant is driven by his very own motive to enter the market. These motives than determine whether participant want to buy or sell securities. We distinguish five basic categories in which we can assign these participants to. [Keith,2005]

- Brokers- act as a financial intermediary on behalf of third party. Broker do not directly enter the market therefore they do not undergo market risk. Brokers execute client's orders for which they obtain commission. In addition to executions of orders brokers focus on market analysis, research and investment advice for its clients. These services are often free of charge for clients but may be not accessible to people outside the firm.
- Market-makers act as an independent unit. Market maker quote price at which he is willing to buy and the price at which he is willing to sell. Difference between these prices is called spread and it is profit for market maker. By doing so market makers provide liquidity and reliable price information for market participants. However, market makers can benefit from price changes, but they can also loose which means they undergo market risks.
- Arbitrageurs are very specific market participants who benefit from price anomaly. They seek for price misquotations on different market at one given moment and therefore they do not undergo any risk because all the variables of the trade are known in advance. For example, if asset price is higher in market "1" than in market "2" arbitrageurs will start to buy the asset at market "2" and immediately selling it at market "1". This will lead to equalization of prices and there for opportunity for arbitrage is eliminated. Due to modernization of technology nowadays there is a very little room for arbitrage for very short period.
- Hedgers are market participants who enter market without an expectation for profits. They simply want to eliminate their existing risk by purchasing of the security with opposite effect than their original position. Hedging is used for stabilization of their earning which originates from their main economic purpose.
- Speculators are market participants who are willing to undergo market risk in hope of price movements in their favor. Speculator leave their position open so they can benefit from price movements. However, speculation is a risky business and often does not work out as planned. Speculator is thereafter forced to close his position at a loss [Keith,2005].

In practical part I will back test trading strategy and simulate real time trades as a market speculator who will try to create profitable trading strategy that can be applied in actual trading.

2. Financial instruments

As mentioned earlier we distinguish two types of markets where securities are traded. In both markets participants use financial instruments for trading of securities. In exchange market financial instruments are standardized which means there is a certain fixed amount for each contract and maturity to certain dates throughout the year. On the other hand, OTC market offers any modifications of the contracts as long as there is a counterparty willing to be on the "other side" of the trade. Financial instruments also differ in their complexity. Nowadays there is thousands of different financial instruments with different complexity from those with simple payoff structure to those with complex mathematical formulas nested inside of the contract called financial derivatives.

2.1 Cash instruments

are basic financial instruments where you simply purchase instrument hold it for certain amount of time and after closing your position you either profited or lost based on the price movement over the time. They are easy to follow since prices are quoted continuously you can determine value of instrument at any time. Most relevant cash instruments are equities, currencies and bonds.

Equities (shares) are instruments that represents ownership of the company. They represent the claim on the portion of the company's assets and profits (dividends which are optional). If the value of the company goes up owned shares become more valuable and therefore you can sell your stake at the company with profits. You can also profit from decrease in value of company's shares. The process is called short selling and it requires initial loan of shares (for interest) where you immediately sell these shares. As the price decreases you can buy back needed number of shares at lower price and pay back the loan. If your prediction is correct and decrease in price is greater than interest paid on the loan your short sell was successful.

Trading on foreign exchange market always requires a pair of two currencies so you can easily profit either from increase or decrease in value. The development of a currency rate is often linked to the macroeconomic situation of its home country and may be affected by geopolitical events.

Bunds are financial instruments which represent the debt of an issuer to an investor. Investors lend money to issuer by purchasing bond and issuer is obligated to pay back notional value plus interest in some time in the future. Biggest risk investor is facing when trading bonds is counterparty risk where issuer may not be able to payback his liabilities. Generally,

governments bonds are believed to be less likely to default than corporate bonds, however nowadays even corporate bonds of multinational companies may be considered safer than some governments. (Ferrari, Ray ban vs Italy[3]). Rating agencies play a significant role in price of bonds since they issue ratings of these bonds which tend to be respected by lot of investors even though during financial crisis 2008 it was shown that ratings were not accurate at all. (Lehman brothers and AIG had maintained at least A rating which still means investment grade day before Lehman brothers went bankrupt and AIG received first of its several bailouts[4]).

Money market instruments are short-term fixed income obligations, with maturity up to one year. Most common are treasury bills, commercial papers and certificates of deposits. They are considered less risky and more liquid than other investments, however as any other bond investment in the event of default price and liquidity may be adversely affected.

2.2 Financial derivatives

Are instruments where the value of an instrument is dependent on the underlying assets or predefined market conditions. There are many different examples of underlaying assets such as single asset, basket of assets, different interest rates or even specified event. Financial derivatives are exchange agreements between two parties to some exact point in the future. Most common financial derivatives are options, futures, forwards and swaps. All of these are extremely risky and mainly recommended for professional investors and traders. On-exchange derivatives are generally subject to market risk as price in time may change. They are standardized and have centralized pricing source. On the other hand, OTC derivatives are individually negotiated. Clients may ask for any structure to any date in the future which makes it very difficult to value these contracts. For example, two financial institutions may value same requirements from client differently based on their very own pricing models and financial assumptions. In addition, these structured products are highly unstable, and their price may be affected by many factors such as remaining time till maturity, volatility, price of an underlying assets or interest rates.

Derivatives are mainly used by hedgers and speculators. Hedgers seek cheap protection of their original investments to decrease their total exposure whereas speculators voluntarily open their

[3] Ferrari and Ray-Ban deemed a safer bet than Italian government bonds; [online]; Reuters; avalaible at: https://www.reuters.com/article/us-italy-markets-corporates/ferrari-and-ray-ban-deemed-a-safer-bet-than-italian-government-bonds-idUSKCN1IW2G8

[4] Credit Rating Agency Analysts Covering AIG, Lehman Brothers Never Disciplined [online]; Huffington post; avalaible at: https://www.huffingtonpost.com/2009/09/30/credit-rating-agency-anal_n_305587.html

risk exposure to profit from expected events. Using financial derivatives for speculation can lead to extreme profits but also to extreme losses due to its complicated structure and leverage effect. Leverage effect means you borrow significant amount of capital to increase your profit while providing only percentage of your total investments. 1:10 leverage is when you only provide 10% of your total investment (called margin). For example, in order to invest $1 000 000, you would only need $100 000. Some financial derivatives may even lead to unlimited losses due to its nature of an agreement (short options).

2.2.1 CFD (contract for difference)

Is derivative agreement for exchange of price difference between opening and closing price. In CFD there is no physical exchange of assets and differences are settled in cash payments. Client sent orders to broker using electronic trading platform which are then filled in matter of milliseconds. Nowadays brokers offer wide variety of instruments for currencies, indices, shares, bonds and many others. Since there is no ownership required in CFDs, they have very low transactions costs and orders can be filled almost immediately in any volume regardless the position type (long side, short side). CFDs allow even investors with very little capital participate in markets which would otherwise be out of reach for them. CFDs have very little margin requirements which can be as low as 2% for retail clients. CDFs also provide huge leverage which was up to 1:500 before ESMA regulation (1.8.2018) for retail clients. Following structure applies for retail clients now:

- 30:1 for major currency pairs
- 20:1 for non-major currency pairs, gold and major indices
- 10:1 for commodities other than gold and non-major equity indices
- 5:1 for individual equities and other reference values
- 2:1 for cryptocurrencies[5]

However professional clients can decide whether they want to have their account highly leveraged. Main advantages are that CFDs are affordable products which allow many retail

[5] ESMA ADOPTS FINAL PRODUCT INTERVENTION MEASURES ON CFDS AND BINARY OPTIONS;[online]; European securities and markets authority; avalaible at: https://www.esma.europa.eu/press-news/esma-news/esma-adopts-final-product-intervention-measures-cfds-and-binary-options

investors and traders enter the market. They are not limited by exchange hours and trading is available 24 hours 5 days a week. CDFs do not require any additional fees when short selling and many brokers only charge spread.

On the other hand, high leverage makes them extremely risky and without proper risk management retail and inexperienced clients can easily wipe out their account. For professional clients it is even possible to have negative balance in your account when extreme market conditions occur (retail clients are protected by ESMA regulation).

In my opinion CDFs are products that can make trading affordable to everyone and with proper risk management there is minimal chance of losing unexpected amount of money. For my trading strategy I will be using CFDs for DAX performance index quoted by Admiral Makets UK Ltd.

3. Technical analysis

When it comes to analyzing financial markets, we distinguish three basic approaches to market analyses. Fundamental, technical and psychological analyses. These analyses serve different purposes and should be use simultaneously to achieve best results however, in my practical part I will only be using technical analyses since it is the most suitable one for short time period.

Technical analyses (TA) is one of the oldest ways of analyzing markets but it has become significantly more popular with digitalization of trading and improvements of analytical software and indicators. Main task of TA is timing rather than finding "true value" of an instrument (fundamental analyses). TA is based on these three assumptions that[6]

- Market discounts everything – all pieces of information are absorbed by price of instrument. Traders are influenced by these pieces of information and therefore supply and demand of the instrument is derived from their willingness to purchase or sell given instrument.
- Creation of certain patterns – throughout the history we can recognize certain patterns that can be found on any timeframe. These patterns repeat themselves thus it is believed they can be used to forecast future price movements if recognized in early stage and later confirmed.
- History repeats itself – Supply and demand is influenced by market participants who are likely to react similarly to certain situations that had already occurred. Traders assume that what was happening in the past is going to keep happening.

3.1 Charting

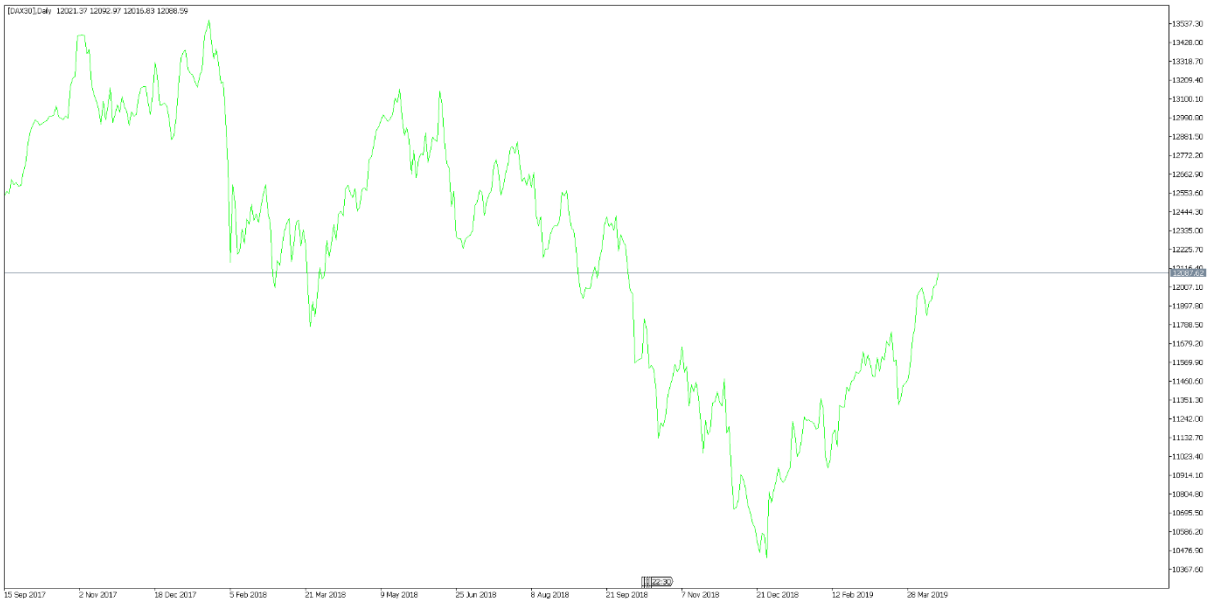
TA focuses solely on price of an instrument. Main purpose of TA is to identify trend and time your entry for best possible price to serve you purpose. Traders use different types of charts to better understand price of an instrument in given time. Some of the most popular charts are line chart, bar chart and candlestick chart. Different charts provide traders with different information based on their trading strategy.

- Line chart – is the simplest type which is mostly used by webpages and economists to purely show evolution of price of instrument over the given period. Line chart connects closing prices of an instrument on selected period so for example daily line chart only shows connected

[6] VESELÁ, Jitka a Martin OLIVA. *Technická analýza na akciových, měnových a komoditních trzích*. Praha: Ekopress, 2015. ISBN 978-80-87865-22-4.

closing daily prices of an instrument. These charts are easy to explain but they do not show what was happening during the day.

Figure 1: DAX daily line chart



Source: Own processing based on data from MT5 Admiral Markets UK Ltd.

- Bar chart – comes to us as a solution in previous stated problem. Line chart only shows closing price which for many traders is not enough. To get better picture of the market traders need to know what is happening with the price of instrument during the day. Traders want to know where instrument opened, what was the maximum and minimum, and where instrument closed. To see this information, traders use so called OHLC bar chart (Open, High, Low, Close). Most traders also use colors to see the direction of the movement which provides us with better visualization of the price than if the chart was monochromatic.

Figure2:DAX daily bar hart

Source: Own processing based on data from MT5 Admiral Markets UK Ltd

- Candlestick chart – is the most popular chart in my opinion. It works on OHLC principle too, so it does not provide us any additional information compared to bar chart however it displays it differently. Wicks show us minimum and maximum and body of the candle shows the difference between opening and closing price. Positive difference between opening and closing price signals movement up and negative difference between opening and closing price signals movement down. I consider this type to be most useful. You can clearly see what the price was doing, and I will be using this type of chart when working on my trading strategy.

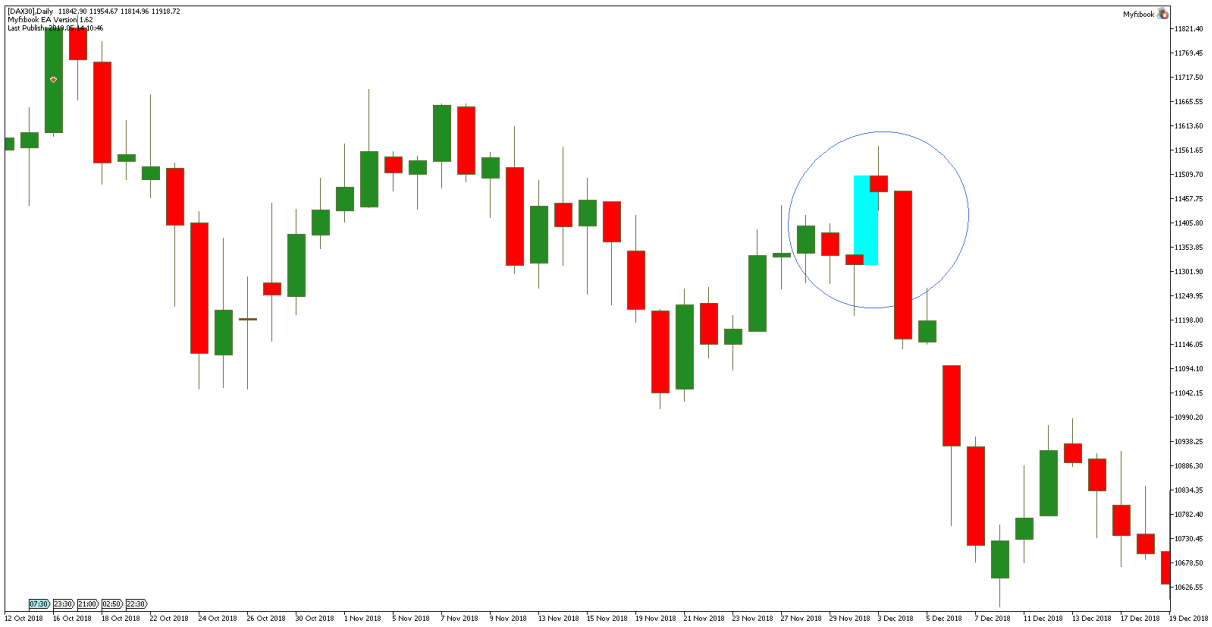
Figure 3: DAX daily candlestick chart

Source: Own processing based on data from MT5 Admiral Markets UK Ltd

During the day most of the charts are continuous and closing price of previous candle is opening price of the next one. In some cases, during volatile periods or when market is opening after weekend, it can experience gaps. Gap is difference between an opening price and closing price of previous candle. If markets experience event which is unexcepted price can move violently creating empty space on the chart. Gaps play significant role in trading especially if we trade using orders. If our order is located in gap it means that it is going to be executed at different price because market did not quote the price we wanted. This can have positive and also negative impact on our trading. Let's suppose we hold long DAX position over the weekend with stop loss at 11000. If Dax opens at 10900 on Monday, we suffered additional loss of 100 points even though we wanted to close our position at 11000. Market simply did not offer us our price. This can be very dangerous especially during market meltdowns when there are no counterparties to fill in your orders. [7]

[7] IŽIP, Ronald, Valér DEMJAN a Martin MORAVČÍK. *PRAVDA A MÝTY O FOREXE* [online]. 2011 [cit. 2019-04-16]. ISBN ISBN 978-80-970630-9-2.

Figure 4: DAX daily candlestick chart, 190 points Gap (cyan rectangle) on 30.11.2018-3.12.2018



Source: Own processing based on data from MT5 Admiral Markets UK Ltd

"Trend is your friend" Jesse Livermore

Using TA traders try to enter market early with trend and "ride" your winning positions for as long as possible. Trends can be found on any time frame depending on trading strategy applied. We distinguish three types of trend.

- Uptrend (bullish trend)- where previous "lows" are increasing over time.
- Downtrend (bearish trend)- where previous "highs" are decreasing over time.
- Sideways (horizontal trend)- where market does not have strength to form trend, so it is trading in range and only form temporary "tops" and "bottoms".

As mentioned earlier technical analysts focus on price. Traders look for interesting patterns, formations, levels in the charts and try to identify them in advance so they can form the conclusion about market. One of the most useful charting methods traders use are support and resistance levels. These are levels with high concentration of orders therefore price can react very aggressively when meeting such a level. Support levels are formed under the price and they work as a place where there is higher probability that the price might turn. Resistance levels are formed above the price and work on the same principle. Many traders tend to place their orders, SL´s and TP´s close to these levels which makes them important to understand. Once the support is broken and price falls under it can become resistance and vice versa. This

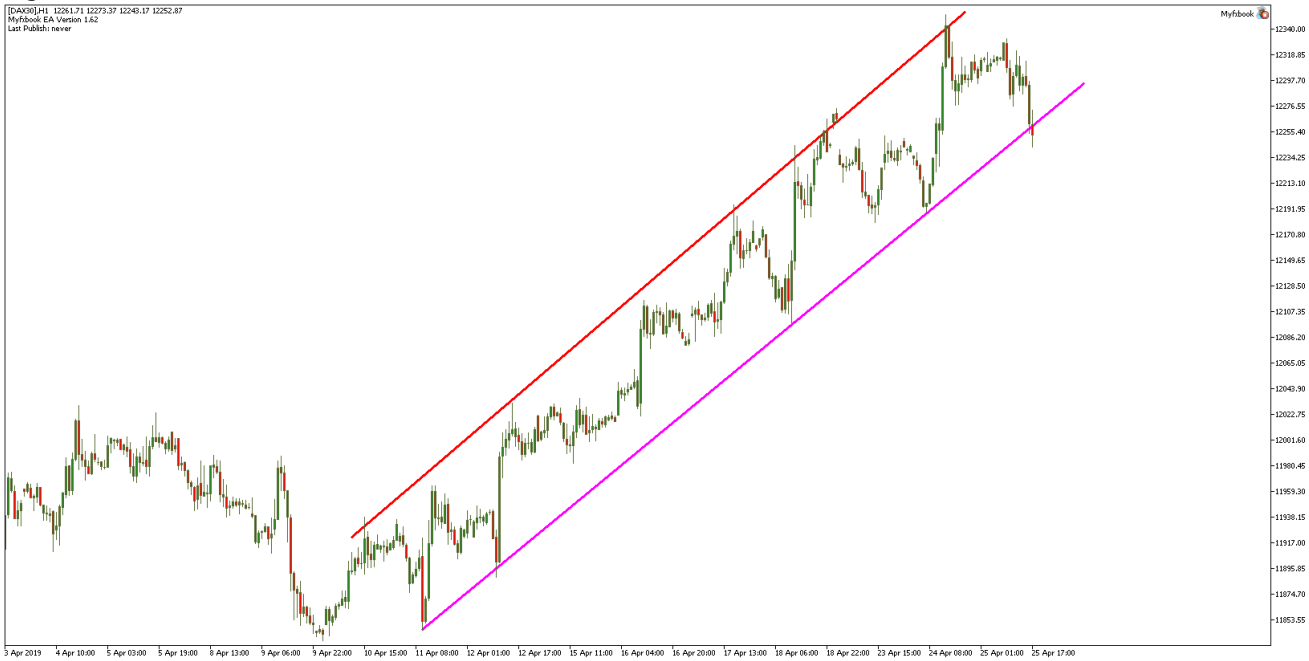
happens because traders recognize importance of the level and place their orders around. Generally, it is believed that the more aggressive move towards the zone the higher the probability that the zone will hold (which can also be seen in the figure below).

Figure 5: Support and resistance example on DAX, 11.10-31-10.2018

Source: Own processing based on data from MT5 Admiral Markets UK Ltd

Another useful charting method that is widely used by traders is called trend lines and channels. It works on the same principle as support and resistance. Traders identify zones with higher probability of bounce by connecting zones where price bounced previously. You can either use trendline which is only connects "lows" of the trend or form a channel where price also bounces from an opposite side and moves in one direction continuously. Trend lines can be little bit tricky because they strongly depend on timeframe you are using. While you can find uptrend on daily chart, you can also find downtrend on hourly chart from the same period. Therefore, you should look for confirmation from for example support and resistance and place you SL and TP within the range you are trading.

Figure 6: Trend line and channel on DAX, 10.4-25.4.2019



Source: Own processing based on data from MT5 Admiral Markets UK Ltd

Besides trend lines support and resistance levels traders can also identify certain pattern and formations. These formations are said to forecast market movement when recognized in early stage. Traders wait after formation is formed and then enter market based on this formation. Some of the most recognizable formations are Head and Shoulders, Double tops and Double bottom, flags and so on. I personally am not a huge fan of formations. I considered to them to be too subjective and every trader can interpret them differently. They can be found on any time frame. In my opinion after studying formations and patterns too much traders persuade themselves that they identified them even though they did not. However, despite my opinion many traders use them and that is why I think it is important to understand them and they are worth mentioning.[8]

3.2 Indicators

To identify trends traders usually use trendlines and indicators such as Moving average, Momentum or RSI. Nowadays there is wide selection of indicators to choose from accessible even for retail clients. Brokers provide these indicators implemented in the trading platform, so traders do not have to struggle with complex calculations, but it is still necessary to understand them for best interpretation.

[8] VESELÁ, Jitka a Martin OLIVA. *Technická analýza na akciových, měnových a komoditních trzích*. Praha: Ekopress, 2015. ISBN 978-80-87865-22-4.

Indicators can provide useful information regarding market, but your strategy should not be based solely on indicators. Generally, indicators are believed to be delayed or "present" (showing what is happening now) which does forecast directions of the market. However, they can be used as confirmation for your trading strategy.

Indicators can be divided into five basic categories which are

- Trend – they show trend existence and its strength. In this category we can find SAR, ADX, MACD and moving averages.
- Oscillators – are indicators which moves around certain given value and their function is to show possible strength and length of the movement. We can find here CCI or RSI.
- Volatility indicator – tell us how volatile market is and how big can possible price change be. Most common are ATR and Bollinger bands.
- Volumes – they can mostly be used on exchange traded market since they require to know traded volumes. They measure volumes traded on the market and compare it change in price (very difficult to apply in OTC markets which also contains CFDs trading).
- Custom indicators – indicators created by combination of two or more indicators or creation of indicator on your own. They require special programming and mathematical skill.

3.3 Risk management

Since no trading strategy can grant 100%-win rate, traders must take into account that they will suffer loss from time to time. Another very important part of trading is money management. It is method of controlling undergone amount of risk so one bad trade will not result in losing significant amount of account. Your analyses and your money management must be synchronized in order to achieve successful results.

As John Maynard Keynes said: "Market can remain irrational longer then you can stay solvent"

This famous quote is now even more relevant than ever before. Nowadays traders use leveraged accounts which without proper risk management can lead to catastrophic scenarios. Risk management is a key ability of successful trader and every trader should understand topic of money management before getting into trading.

As TA suggests successful trading means ride your "winners" and cut your "losers". Risk management is a discipline which helps to achieve this state of trading. Proper risk management suggest that every trader should set beforehand amount (% of total equity) that he is willing to

lose on one trade. Traders should also have maximum limit on amount they are willing to lose in one trading day before taking time off and going over what went wrong.

One of key tools of risk management are orders. Generally, traders do not have to "sit" in front of computer and wait for the market to reach the price where they want to execute their trade. Instead traders analyze markets and then "tell" broker to execute their trade when market reaches their level. Same principle applies for closing of positions.

Basic orders that traders use are:

- Stop-loss (SL) – This is considered to be the most important order. SL means that trader is willing to close his position at certain price in case trade goes does not go as anticipated. This order is key tool of risk management and traders should always know their SL beforehand. However, many beginning traders tend to move their SL which denies whole idea of this order.
- Take Profit (TP) – is an opposite type of order to SL. TP means that trader is willing to close profitable trade at predefined price. These two orders help us to remove emotions from our trading and prevent us from acting emotionally on drastic market movements. We know beforehand what will happened to our trade if price moves.

We can derive more complex orders to help us get rid of emotions even more. Traders can set price where they want to enter the market. We distinguish four basic orders to enter market.

- Limit Entry Order – is placed to either buy below the market or sell above the market at certain price. If we expect price to reverse but below the actual market price, we will set buy limit order. For example if DAX is in downtrend and currently trading at 12000 and we expect it to reverse at 11900 we can either sit in front of PC and wait until the price reaches our level or we can set buy limit order at 11900 and therefore when market reaches the price broker will execute it at closest price to 11900. With this order we eliminated the factor of waiting and also emotional part of us which could be hesitant to hit buy when the price actually reaches our level.
- Stop Entry Order – is opposite to Limit Entry Order and is used when we want to buy above the market or sell bellow the market. Stop orders are used if trader wants to enter in the position in hopes of another movement in direction with the trend. If we use previous example but we expect DAX to continue in its downtrend we would set our Sell Stop Order at 11900 in hopes that DAX will later trade even lower. This again guarantees us the best price that broker can provide and emotional stability.

- Trailing Stop – Loss – is very useful tool which helps traders to secure profits. As the name suggest Trailing SL moves with the price as you position gets more and more profitable but stays same when position reverses. Traders can define how close should Trailing SL be in terms of pips. This order is usually used when position showed returns and traders want to secure part of their profits in case position starts going in opposite direction. Let's suppose we are holding profitable long DAX position which we bought at 12000. If DAX is currently trading at 12500 it means we can possibly lose 500 points of profit. We can prevent that by setting Trailing Stop at 12400 with 100 points difference. This means that if DAX will trade even higher our SL will automatically follow with difference of 100 points behind the price. In case DAX starts reversing our SL stands still so in case that trend reverses our positions will still be closed as profitable. [9]

  All these tools are mostly used to help traders get the best price they can and to get rid of emotions. Emotions play significant role in trading and traders should try to avoid them as much as possible.

[9] IŽIP, Ronald, Valér DEMJAN a Martin MORAVČÍK. *PRAVDA A MÝTY O FOREXE* [online]. 2011 [cit. 2019-04-16]. ISBN ISBN 978-80-970630-9-2.

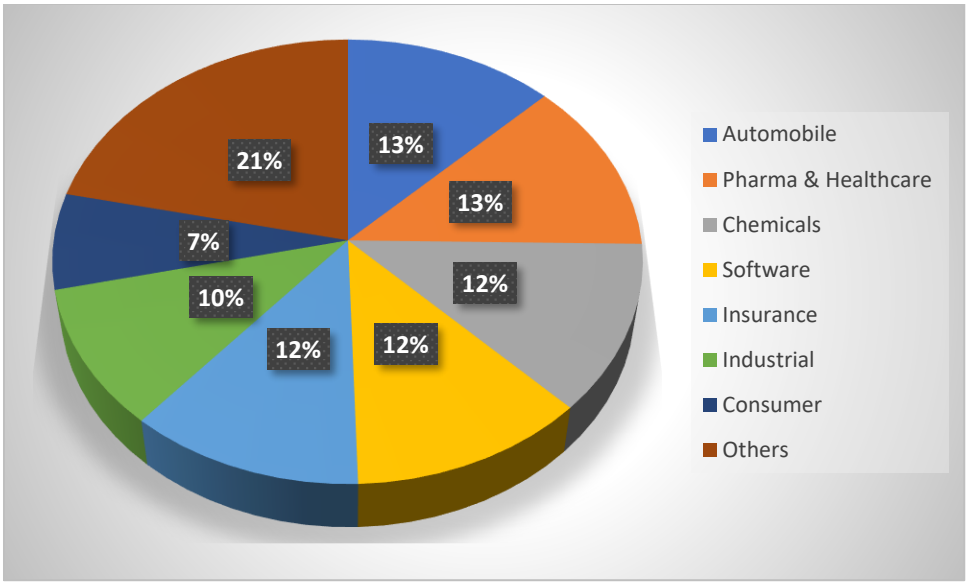
4. Characteristics of stock index DAX30

4.1 General information

Since my trading strategy is an intraday strategy it will require increased volatility and vivid price movements. I decided to use DAX performance index which meets all the requirements above. DAX is Germanys stock index that represents 30 "blue chip" stocks that trade on Frankfurt stock exchange using system Xetra. The DAX represents about 80% of aggregated prime standard market capitalization. Index started on 31.12.1987 at value of 1000 points. It reached its high of 13600 points on 23rd January 2018. As of March 2019 DAX, is currently trading at 11460 (11.3.2019). [*Guide to the Equity Indices of Deutsche Börse AG,2018*]

DAX is mostly represented by technical companies, almost by 30% which is far more than other indices. On the other hand, financial sector is only represented around 20%. Nowadays there are many modifications of DAX index such as MDAX (includes 60 "mid-caps"[i] companies), TecDAX (30 largest and liquid technological companies) or DAX ex Financials (DAX composition-based index excluding "FIRE supersector"[ii]). It very often shows sentiment of European stock market since Germany is Europe's largest economy.

Figure 7: DAX sector composition as of 31.10.2018



Source: Own processing based on data from https://www.dax-indices.com/documents/599858594/616692974/Factsheet_DAX.pdf

4.2 Index calculation

The selection indices of the DAX® family are capital weighted. Only the shares in the free float are considered when calculating the capitalization. The indices are each calculated as price and performance indices. Price index only takes price into account while performance index also adds dividends and additional returns. The performance index is popular among investors because it shows more accurate image of stock market even though price index is more like indices quoted in other countries.

The indices in the DAX® family use the Laspeyres index formula and are calculated as:

Figure 8: Laspeyres index formula

$$\text{Index}_t = K_T \cdot \frac{\sum p_{it} \cdot ff_{iT} \cdot q_{iT} \cdot c_{it}}{\sum p_{i0} \cdot q_{i0}} \cdot \text{Base}$$

Source: available at https://www.dax-indices.com/document/Resources/Guides/Guide_Equity_Indices.pdf

whereby:

c_{it} = Adjustment factor of company i at time t

ff_{iT} = Free float factor of share class i at time T

n = Number of shares in the index

p_{i0} = Closing price of share i on the trading day before the first inclusion in an index of Deutsche Börse

p_{it} = Price of share i at time t

q_{i0} = Number of shares of company i on the trading day before the first inclusion in an index of Deutsche Börse

q_{iT} = Number of shares of company i at time T

t = calculation time of the index

K_T = Index-specific chaining factor valid as of chaining date T

$_T$ = Date of the last chaining

"The index composition of DAX® is reviewed quarterly based on the Fast Exit and Fast Entry rules. The index composition of DAX® is reviewed every September based on the Regular Exit and Regular Entry rules

The selection of companies in the DAX® indices is based on the quantitative criteria of free float market capitalization and order book volume.

A company in the selection index is replaced if it has a worse rank than the 'candidate rank' in one of the two criteria of free float market capitalization or order book volume. It is replaced by the company with the highest free float market capitalization that has the corresponding

ranking positions for both criteria in the ‘alternate candidate rank’ stated in the Overview of rules.

A company is included in the selection index if it has the same or better rank than the ‘candidate rank’ in both the free float market capitalization and order book volume criteria (e.g. smaller than or equal to rank 25 for the free float market capitalization criterion and smaller than or equal to rank 25 in the order book volume criterion in the DAX® ranks)”.

10

[10] Deutsche Börse. *Guide to the Equity Indices of Deutsche Börse AG* [online]. Deutsche Börse AG November 2018. Avalaible at: https://www.dax-indices.com/document/Resources/Guides/Guide_Equity_Indices.pdf

5. Description of the trading strategy

Trading strategy I will be using in this thesis, is based on an assumption of trend following and proper risk management. Main idea behind my trading strategy is that once DAX trading opens at 8:00 and liquidity starts pouring in, initial move in first trading hour can trigger other investors to follow this move which leads to one day trend with minimal turns. I will scan three phases of general trend in market in order to obtain enough data to form effective trading strategy that can be applied in actual market.

5.1 Tools used

To avoid gaps and overnight holding fees (swap points in case of CFDs instruments) I decided that my trading will only take place during the day. I chose CFD on DAX index because this index is wildly known between investors therefore ensuring high liquidity, volatility and low transaction cost which in this case is only the spread. I decided to pick broker Admiral Markets UK Ltd due to their flexibility, transparency, effectiveness and easy access to trading platform and instruments. I got my data from platform Metatrader5 and, I will perform my trading using DEMO account provided by Admiral Markets UK Ltd.

5.2 Details of trading strategy

In this part I will present detailed description of my trading strategy with entries, exits and risk management explanation.

As mentioned earlier my trading strategy will be based on the assumption that traders are likely to follow trend and “ride” it for as long as possible. I will monitor opening hour of DAX index which would be from 8:00 till 9:00. At the opening price of second trading hour I will enter the market in the direction of opening hour so if the move in first hour was bearish my position will be short and vice versa. Based on my back-testing I will set my Stop-loss and trailing Stop-loss in terms of standard deviation. Take profit will be set on similar principle using average daily moves and support and resistance levels. Take-profit will consist of 2 parts where TP1 will ensure higher profitability and TP2 maximum profitability. TP1 will be set to fixed value of average open close daily move. TP2 will be based on support and resistance zones and average open close daily move. I will look for the closest support and resistance zone within the range of average daily open close move. If none of my closing orders will be filled during the day, I will manually close my open position at the end of the trading day which is at 21:59 for the

CFD Dax index provided by Admiral Markets UK Ltd. Exact parameters for trades will be presented in the part results of back testing.

5.3 Risk management and position sizing

Since my trading strategy will generate one trade per day on highly volatile instrument such as DAX then risk management will be essential key to creating a successful trading strategy. Generally, it is believed that risking 1% of your trading account is rather conservative approach since it allows you to be wrong 100 times before losing an entire account. I decided use more aggressive approach and risk 2% of my trading account allowing me to be wrong 50 times before losing an entire account. My initial starting capital will be set to 10.000€ so I will risk around 200€ per trade allowing me to buy around 2,5 contracts per trade using 1:20 leverage.

6. Results of the back-testing (2016-2018) uptrend, range, downtrend

Back-testing of trading strategy means that you applied your trading strategy on historical data and therefore come up with a result either defining trading strategy as profitable or not. In this sense my back-testing was slightly different. I first formed a thesis and observed three market scenarios uptrend, range and downtrend during 2016-2018. I measured daily and hourly changes and calculated standard deviations and average moves of those changes in order to get most suitable values for my SL and TP. Simulated trading will be applied to first 4 months of the year 2019.

Figure 9: Tested time period.

Source: Own processing based on data from Admiral Markets UK Ltd

6.1 Uptrend

Uptrend period lasted from 11.2.2016 8:00 until 16.6.2017 22:00. Out of 267 trading days in 124 cases, daily move followed direction of first trading hour which is 46,44% success rate. Average moves are calculated from first difference of given price (Open/Close, High/Low) as a simple average. Standard deviation is therefore calculated from these simple averages.

Table 1: Results of tested up trend period

Trading days	267
Successful days	124
%	46,44%
Avg. daily Open/Close	77,56
Avg. daily High/Low	140,7
Avg. Open/Close move	16,2
Avg. High/Low total	32,8
ST. dev. hourly H/L	18,17
ST. dev. hourly O/C	22,61
ST. dev. daily O/C	32,52
ST. dev. daily total H/L	47,32

where: Avg. stands for Average

ST. dev. Stands for standard deviation

Source: Own processing based on data provided by Admiral Markets UK Ltd

6.2 Range

Range period lasted from 19.6.2017 8:00 until 17.6.2018 22:00. Out of 245 trading days in 127 cases, daily move followed direction of first trading hour which is 51,84% success rate. This period is not the best example of market trading in range. Range does not have clear support and resistance zones where it bounces, however main trend had disappeared and therefore I assumed it is closer to range market than trending market.

Table 2: Results of tested range period

Total	245
Succes	127
%	51,84%
Avg daily Open/Close	77,57
Avg daily High/Low	163,48
Avg Open/Close hourly move	17,66
Avg High/Low hourly total	36,04
ST. dev hourly H/L	25,46
ST. dev hourly O/C	19,22
ST. dev daily O/C	27,59
ST. dev daily total H/L	46,39

where: Avg. stands for Average

ST. dev. Stands for standard deviation

Source: Own processing based on data provided by Admiral Markets UK Ltd

6.3 Downtrend

Downtrend period lasted from 18.6.2018 8:00 until 28.12.2018. Out of 136 trading days in 66 cases, daily move followed direction of first trading hour which is 51,84% success rate. As anticipated downtrend period is significantly shorter than other two. This may be due to the fact that market tends to drop faster than going up. Higher average moves and standard deviations also show increased volatility which we could observe during market correction at the end of the year 2018.

Table 3: Results of tested down trend period

Total	136
Succes	66
%	48,53%
Avg daily Open/Close	73,17
Avg daily High/Low	170,56
Avg Open/Close hourly move	20,61
Avg High/Low hourly total	41,89
ST. dev hourly H/L	24,16
ST. dev hourly O/C	20,34
ST. dev daily O/C	25,63
ST. dev daily total H/L	46,60

where: Avg. stands for Average

ST. dev. Stands for standard deviation

Source: Own processing based on data provided by Admiral Markets UK Ltd

6.4 Combined

Combined time period lasted from 11.2.2016 8:00 until 28.12.2018 22:00. Obtained results were very similar for every period which allowed me to average SL and TP parameters for general usage in any market. Out of 648 trading days in 317 cases DAX daily move followed the direction set in first trading hour. Average daily high-low move was 158,25 pips which can also be understood as our daily volatility over 2 years. Standard deviation of the move gives us perspective of how strong the move can be with certain amount of probability. One standard deviation gives us the strength of the move with 68,2% chance and two standard deviations give us the strength of the move with 95,45% chance.

Table 4: Results of all tested periods combined

Total	648
Succes	317
%	48,92%
Avg daily Open/Close	76,10
Avg daily High/Low	158,25
Avg Open/Close hourly move	18,16
Avg High/Low hourly total	36,91
ST. dev hourly H/L	22,59
ST. dev hourly O/C	20,72
ST. dev daily O/C	28,58
ST. dev daily total H/L	46,77

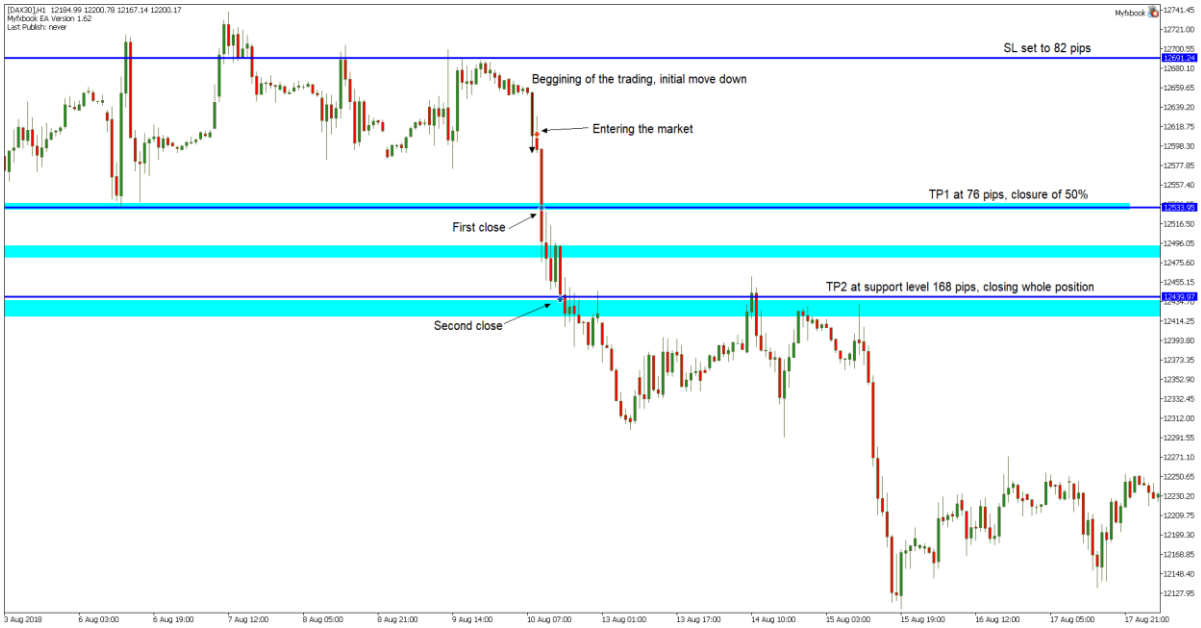
where: Avg. stands for Average

ST. dev. Stands for standard deviation

Source: Own processing based on data provided by Admiral Markets UK Ltd

Since I picked more aggressive approach to my trading strategy risking 2% of the account on every trade I decided to go for higher probability of not being out by wild moves and therefore setting my SL to average hourly high/low move and 2 standard deviations which totals to 82 pips. I will use the same value for trailing stop-loss. TP1 will be set to average daily open/close move totaling 76 pips where I will close 50% of the positions size. TP2 will be set ahead of closest support/resistance zone around value of average high/low move of the day totaling 158 pips where I will close remaining 50% of the position. For better clarification I chose an example to demonstrate.

Figure 10: Projection of trading strategy

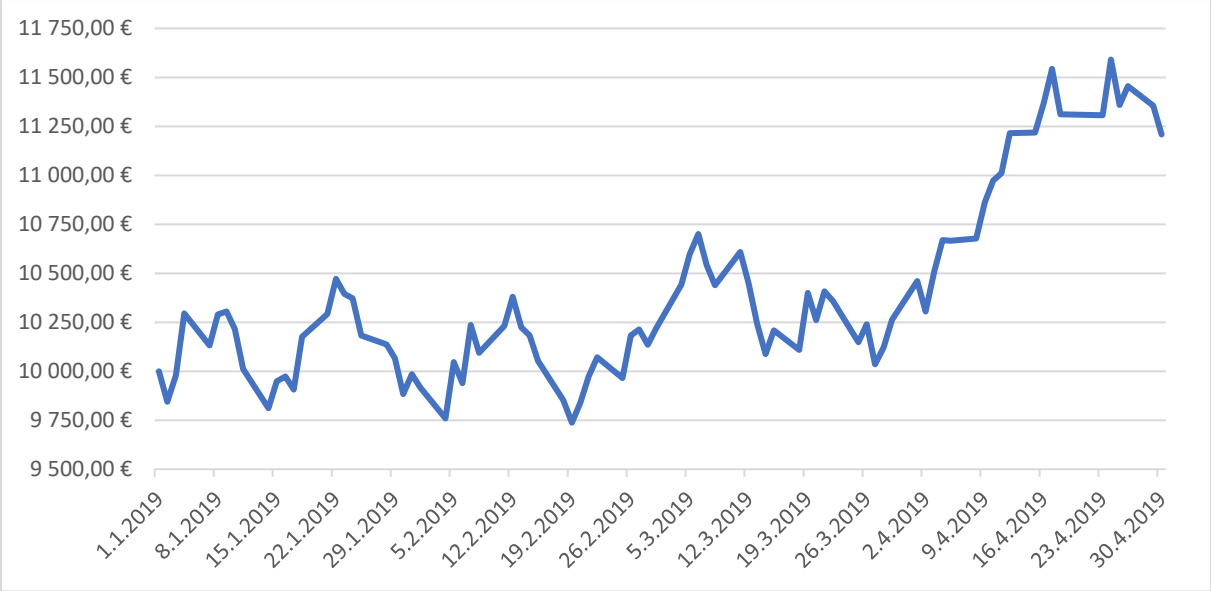


Source: Own processing based on data from Metatrader 5 Admiral Markets.UK Ltd

7. Results obtained from the real time trading

Over the period where I applied my trading strategy (2.1.2019-30.4.2019), system generated return of 12,09% or 1.208,65€ over 4 months.

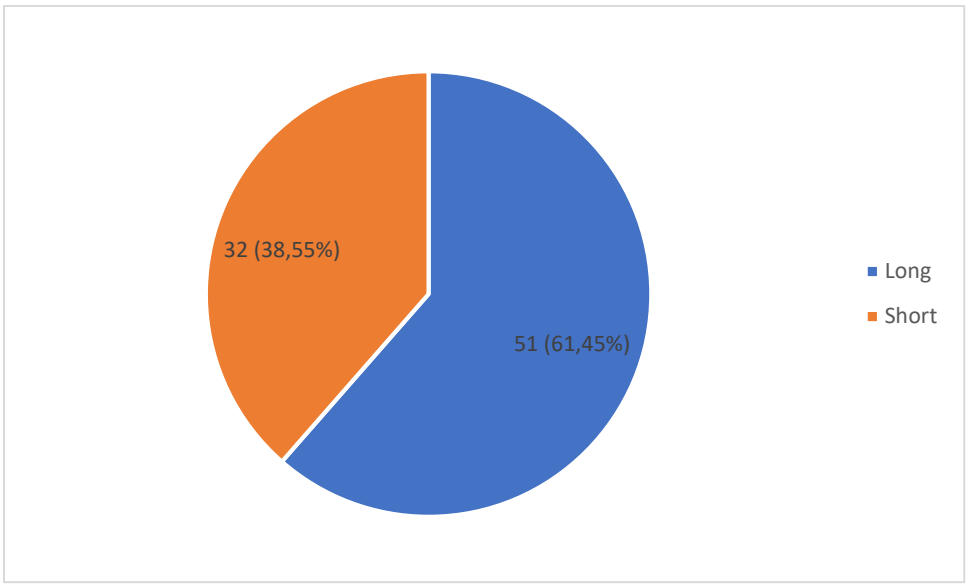
Figure 11: Account balance throughout the trading period



Source: Own processing based on data provided by Admiral Markets.UK Ltd

During first two months strategy struggled to systematically generate profits due to "choppy" market conditions. As the figure below shows the most profitable period was April where market started heavily trending and strategy started to consistently generate stable profits. Despite the poor first two months, strategy's risk management to defend its capital only allowed maximum closed loss of -2,62%. Win rate of trading strategy was slightly higher than calculated win rate based on testing period totaling 51,81% of the trades ending up positive. Out of all 83 taken trades for one day in trading period, number of long trades (51) was significantly higher than number of short trades (32).

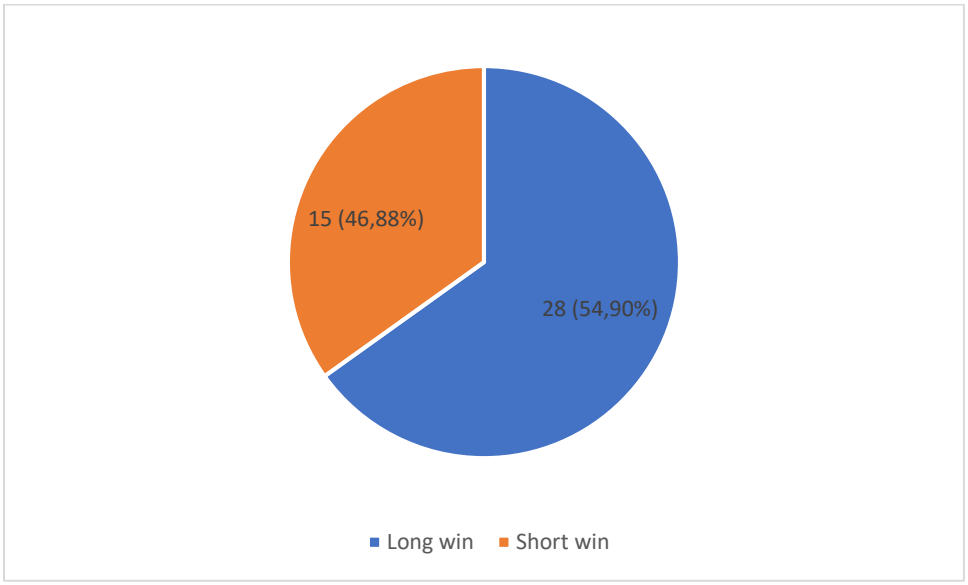
Figure 12: Number and percentage of trades



Source: Own processing based on data provided by Admiral Markets.UK Ltd

After analyzing the trading period, we can now conclude that this imbalance between number of long and short trades was most likely caused by great up trend of the Index where it opened at 10499 (2.1.2019 8:00) and closed at 12367 (30.4.2019 22:00). However, number of successful trades on each side is quite similar where long positions were successful 54,90% of the times and short positions were successful 46,88% of the times.

Figure 13: Success rate of the trades



Source: Own processing based on data provided by Admiral Markets.UK Ltd

Due to increased balance on my trading account and provided leverage of 1:20 I was able to slowly increase position sizing from 2,4 contracts at the beginning of trading period to 2,8 contracts at the end of trading period while remaining risk per position on 2%. Worst trade my trading system suffered in terms of euros was trade from 25th of April where it suffered 231,82€ loss. However, this amount is still within risk management rules and in term of pips loss did not exceed predefined value of stop-loss 82 pips. On the other hand, system´s most successful trade was on very beginning. On 4th of January our system generated profit of 314,03€ which is equal to 179 pips.

During the trading period our trading system suffered 4 major drawdowns. Drawdown is measure of distance from the peak to the trough. It is usually represented in percentage and it shows how far from the peak has the value of our account declined. Drawdowns are dangerous factors to trading system since 50% drawdown require 100% profit to get back to original value. Drawdowns in our trading strategy were all sustained within the acceptable amount. First drawdown occurred on 10.1.2019 and over 5 trading days value of my trading account declined by 3,88%. It was caused by 3 consecutive losses. Next drawdown occurred on 23.1.2019 where value of my trading account declined by 5,29% due to 6 consecutive losses. Third drawdown occurred on 13.2.2019. This drawdown in terms of percentage and was responsible for 6,19% decline in value of my trading account. Forth major drawdown occurred on 7.3.2019 and was responsible for 6,22%% decline in my trading account and therefore making it a maximum drawdown of my trading strategy. Drawdowns affecting my trading strategy could have been caused by choppy market conditions, increased volatility and panic.

When comparing two trading systems with different amount of capital or periods over which they generated profits absolute or percentage returns are not relevant ways to conclude which one performed better. Traders rather use various ratios that provide with more objective answer. I decided to measure success of my trading system by profit factor and Sharpe ratio.

Profit factor is defined as gross profit divided by gross loss including commissions. This metric tells us how many times gross profit is greater than gross loss. Value above 1 means that trading system is profitable and vice versa.[15] Certainly, it does not forecast that our next trade will be

[15] JEAN FOLGER, Interpreting a Strategy Performance Report [online] Avalaible at:https://www.investopedia.com/articles/fundamental-analysis/10/strategy-performance-reports.asp , What's Your Profit Factor? Here's An Assignment For You…, [online] Avalaible at:http://tradingmarkets.com/recent/whats_your_profit_factor_heres_an_assignment_for_you-657965.html

profitable however it says that over longer period we can expect our trading system to end up being profitable. In case of my trading strategy gross profit value is 6.341,18€ and 5.132,53€ is gross loss value. After division we find out that profit factor of this trading strategy is 1,24.

Sharpe ratio is defined as difference of returns of our portfolio/investment and risk free rate divided by standard deviation of returns of our portfolio/investment. Sharpe ratio shows risk adjusted returns. It measures how much additional returns you receive due to holding a riskier asset. The higher the ratio the better because higher value means greater returns for holding riskier assets.[16] For my trading strategy I calculated two Sharpe ratios for better representation. For the first sharp ratio as risk free rate I used 10Y German government bunds. As of May 1st rate on these bonds was 0,016% p.a. where effective equivalent for 4 months would be 0,0159991%. Standard deviation of returns in terms of percentage was 1,504% bringing Sharpe ratio to 8,03. I consider using German government bonds as most appropriate since DAX represents 30 German companies with biggest market capitalization and liquidity. However, such a small rate may overestimate my Sharpe ratio, so I also decided to use 1Y US Treasury bills for my second calculation. As of May 1st 1Y US Treasury bills were trading at 2,31% p.a. where effective equivalent for 4 months would be 2,29%. After modification Sharpe ratio of my trading strategy is 6,51 which is still considered very high.

Graphical review of all the trades taken during the trading period. Excel file with exact values is available in attachments.

[16], NICK K. LIOUDIS Understanding the Sharpe Ratio, [online] Avalaible at: https://www.investopedia.com/articles/07/sharpe_ratio.asp

Figure 14: Application of trading strategy

Source: Own processing based on data from Metatrader 5 provided by Admiral Markets.UK Ltd

Table 5: Statistical values of trading period. Calculations available in mentioned excel file.

Net profit (€)	1 208,65 €
Net profit (%)	12,09%
Number of trades	83
Long	51
Short	32
Long win	28
Short win	15
Long (%)	61,45%
Short (%)	38,55%
Long win (%)	54,90%
Short win (%)	46,88%
Win rate	51,81%
Best trade (pips)	179
Worst trade (pips)	-83
Best trade (€)	314,03 €
Worst trade (€)	-231,82 €
Gross profit	6 341,18 €
Gross loss	5 132,53 €

Profit factor	1,24
Absolute low	9 737,62 €
	-2,62%
Drawdowns	3,88%
	5,29%
	6,19%
	6,22%
St. dev of returns (%)	1,504%
German 10Y Bunds	0,016000%[17]
Effective 4 months rate	0,015999%
Sharpe ratio	8,03
1Y US Treasury bills	2,31%[18]
Effective 4 months rate	2,29%
Sharpe ratio	6,51

Source: Own processing based on data provided by Admiral Markets.UK Ltd

[17] Sunny OH; The German 10-year bond yield will slide back toward zero, says economist [online] Avalaible at:https://www.marketwatch.com/story/the-german-10-year-bond-yield-will-slide-back-toward-zero-says-economist-2018-06-25

[18]US Department of treasury; [online]; Avalaible at: https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=billrates

Conclusion

As stated in the introduction thesis was supposed to serve two main objectives. Provide readers with theoretical information on topic of trading and investing in financial markets and financial markets in general. Second objective was to practically use information from theoretical part to form trading strategy that could consistently make profits with manageable amount of risk taken.

In theoretical part I described functions and participants of the financial markets. Readers were introduced to instruments traded on financial markets with proper description of advantages and risks that come with every one of them. Basic approach to analyzing markets was explained by popular method technical analysis and main features for it to work were discussed in order to fully comprehend practical part.

Practical part was more enjoyable for me. I found it rather interesting working with data and analyzing markets. First, I analyzed periods throughout the years 2016, 2017, 2018 to get the most accurate data. During these years market experienced moves in every possible direction which gave me good perspective for my trading strategy to work. General idea was to form trend following intraday strategy that would be easily applicable and did not require complex calculations and indicators. In my opinion I accomplished this goal well since my trading strategy only required inputs such as standard deviation, average hourly and daily moves and proper risk management which was later confirmed by application of this trading strategy to first 4 months of the year 2019. Strategy generated stable profit of 12,09% while amount of risk undergone was sustained at 2%. Transaction costs were already included in individual trades. When trading CFDs brokers profit from spreads. Therefore, by using bid and ask prices spread is already part of total profit or loss of individual trades. However, total amount of spread was 167,89 €. I think main advantage of my trading strategy is that it does not forecast the future but rather simply work with amount of risk taken and probability of success which during trading period was 51,81%. Another great advantage is easy interpretation which was achieved by simple general idea that suggested that initial liquidity in first trading hour could start daily trend.

In my opinion greatest contribution of this thesis is understandable introduction into trading and steps leading to creation of trading strategy for beginning traders. There are certainly

improvements that would make my trading strategy even more profitable and that could lead to further discussion.

List of figures and tables

Figures

Tables:

Sources

Literature:

1. DURČÁKOVÁ, Jaroslava a Martin MANDEL. Mezinárodní finance. 3., rozš. a dopl. vyd. Praha: Management Press, 2007. ISBN 978-80-7261-170-6.
2. IŽIP, Ronald, Valér DEMJAN a Martin MORAVČÍK. *PRAVDA A MÝTY O FOREXE* [online]. 2011 [cit. 2019-04-16]. ISBN ISBN 978-80-970630-9-2.
3. PILBEAM, Keith. *Finance and financial markets*. 2nd ed. New York: Palgrave Macmillan, 2005. ISBN 9781-4039-4835-9.
4. REJNUŠ, Oldřich. *Finanční trhy: učebnice s programem na generování cvičných testů*. Praha: Grada Publishing, 2016. ISBN 978-80-247-5871-8.
5. SVOBODA, Martin, Werner H. HEUSSINGER a Christian W. ROHL. *Asset Guide: Průvodce finančními indexy*. Brno: Computer Press, 2006. ISBN 80-251-1284-5.
6. VESELÁ, Jitka. *Investování na kapitálových trzích*. 2., aktualiz. vyd. Praha: Wolters Kluwer Česká republika, 2011. ISBN 978-80-7357-647-9.
7. VESELÁ, Jitka a Martin OLIVA. *Technická analýza na akciových, měnových a komoditních trzích*. Praha: Ekopress, 2015. ISBN 978-80-87865-22-4.

Electronic:

8. Deutsche Börse. *Guide to the Equity Indices of Deutsche Börse AG* [online]. Deutsche Börse AG November 2018. Available at: https://www.dax-indices.com/document/Resources/Guides/Guide_Equity_Indices.pdf
9. Deutsche Börse The DAX index universe [online] Deutsche Börse AG October 2018. Available at : https://www.dax-indices.com/document/Resources/Brochures/dax_index_universe.pdf
10. ESMA ADOPTS FINAL PRODUCT INTERVENTION MEASURES ON CFDS AND BINARY OPTIONS;[online]; European securities and markets authority; avalaible at: https://www.esma.europa.eu/press-news/esma-news/esma-adopts-final-product-intervention-measures-cfds-and-binary-options
11. Credit Rating Agency Analysts Covering AIG, Lehman Brothers Never Disciplined;[online]; Huffington post; avalaible at: https://www.huffingtonpost.com/2009/09/30/credit-rating-agency-anal_n_305587.html
12. Markets: Exchange or Over-the-Counter; [online] IMF https://www.imf.org/external/pubs/ft/fandd/basics/markets.htm
13. Randall Dodd;Markets: Exchange or Over the counter [online] Avalaible at: https://www.imf.org/external/pubs/ft/fandd/basics/markets.htm
14. Ferrari and Ray-Ban deemed a safer bet than Italian government bonds; [online]; Reuters; avalaible at: https://www.reuters.com/article/us-italy-markets-

corporates/ferrari-and-ray-ban-deemed-a-safer-bet-than-italian-government-bonds-idUSKCN1IW2G8

15. Sunny OH; The German 10-year bond yield will slide back toward zero, says economist [online] Avalaible at:https://www.marketwatch.com/story/the-german-10-year-bond-yield-will-slide-back-toward-zero-says-economist-2018-06-25
16. Michael Galarnyk; Explaining the 68-95-99.7 rule for a Normal Distribution; [online] Avalaible at;https://towardsdatascience.com/understanding-the-68-95-99-7-rule-for-a-normal-distribution-b7b7cbf760c2
17. US Department of treasury; [online]; Avalaible at: https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=billrates
18. INFORMATION ABOUT FINANCIAL INSTRUMENTS; [online]; Avalaible at https://wholesale.banking.societegenerale.com/en/compliance-regulatory-information/market-regulation/mifid/information-about-financial-instruments/

[i] Mid-caps are companies with medium market capitalization that follow 30 companies with biggest market capitalization

[ii] Fire supersector is composed of banks, financial services and insurance