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PERFORMANCE OF MOMENTUM AND CONTRARIAN STRATEGIES IN COMMODITY MARKETS

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ABSTRACT

Momentum and contrarian anomalies have been detected in financial markets by multiple previous studies such as De Bondt & Thaler (1985) and Jegadeesh & Titman (1993). The effects of short-term continuation and long-term reversal have proven to be one of the strongest market anomalies and are shown to exist in different geographical areas and across various asset classes (Fuertes & Miffre: 2007; Assness, Moskowitz & Pedersen: 2013). The purpose of this thesis is to examine whether short-term continuation and long-term continuation exist in the commodity markets and do the strategies examined have a potential in portfolio diversification and inflation hedging.

This thesis examines 16 short-term momentum and 9 long-term contrarian strategies in commodity markets. The data used in this thesis covers a time period of January 2000 to December 2018. The purpose is to examine if the strategies examined, are able to produce excess returns in various ranking and holding periods and are they sensitive to these factors. The profitability of the strategies is also tested by using a multifactor model which tests whether the returns of the strategies are compensations for the risk. The correlations between the returns of the strategies and asset classes such as bonds, equities and commodities is also examined. Furthermore, this thesis examines the possible inflation hedging properties of the strategies by examining the correlations between the strategy returns and inflation.

The results obtained in this thesis suggest that the contrarian strategies in commodity markets are not able to produce excess returns. However, 12 out of the 16 momentum strategies are able to generate positive and significant returns with an average of 6.63% annually. Furthermore, the returns cannot be considered as compensation for the risk. In addition, the momentum strategies in commodity markets do have benefits in portfolio diversification due to the low correlation with other traditional asset classes. However, the results for the inflation hedging benefits are controversial and do not suggest that the strategies work in inflation hedging.

KEYWORDS: Momentum, contrarian, commodity futures

1. INTRODUCTION

The performance of momentum and contrarian strategies has been an intriguing topic of modern finance studies since these anomalies are of the only anomalies that have are proven to exist in the markets over a long period of time. The Efficient Market Hypothesis by Fama (1970) suggests that such market anomalies should not exist in efficient markets due to the fact that they use past price data in predicting future prices. However the momentum and contrarian anomalies have been able to challenge the principles of the theory. Utilizing such strategies in pursuit of excess returns motivates to examine these strategies further in commodity markets. Since commodity futures have been proven to have equity like excess returns and on the other hand negative correlation with equity returns (Gorton & Rouwenhorst 2006) the technical analysis benefiting from momentum and contrarian trading patterns is examined in this thesis.

The momentum investing strategy is one of the most commonly benefited market anomalies in pursuit of excess returns. The strategy is simple to exercise and has been popular among individual investors. This long-short strategy consists of long investing in assets that have the best performance over the previous R months and short investing in assets that have the worst performance over the previous R months. This strategy is firmly based on trend following and on the expectation that recent past winner assets keep on winning and on the other hand the loser assets keep on losing. These strategies are often referred as relative strength strategies since the performance of the strategy is based on the performance of a certain asset in comparison to a universe of other similar assets. Momentum is one of the most researched market anomalies which has been noticed to exist in the financial markets from 1960s. This makes it significant to examine how the momentum anomaly performs in the commodity futures markets that are based on different fundamentals than stock markets, such as business cycle factors. (Jegadeesh & Titman 1993; 2001.)

Contrarian strategy can be described as the opposite of the momentum strategy. This is because this strategy is based on taking a long position in assets that have the worst performance over a certain past time period examined and a short position in assets that have the best previous performance over a certain past time period. Although the strategies can be considered to be the opposite, they are still based on the same principles since contrarian strategy also benefits from following the patterns observed from the previous price data of an asset. The expectation of the strategy is that the assets that have been rising in value in the markets and have been able to produce excess returns are overvalued and since are expected to drop in value initially. Furthermore, the strategy expects that the assets that have been losing their value over the examination period and have been generating negative returns are undervalued and hold more potential for a rise in their value in the future. (De Bondt & Thaler 1985.)

The relevance of commodity futures as an asset class in diversified portfolios has emerged during the last two decades due to the increased amount of studies related to them. Commodity futures have been able to produce equity like returns based on the previous studies and the negative correlations with stocks make them a potential addition for diversified portfolios. Furthermore, Bodie and Rosansky (1980) appoint that commodity futures are an effective way of hedging inflation.

The examination of momentum and contrarian strategies in commodity markets is also motivated by the fact that utilizing such strategies in commodity futures is somewhat more convenient since taking a short position is as easy as taking a long position which is not the case in equity markets (Rallis & Miffre 2007: 14). This thesis examines if the momentum and contrarian anomalies exist in commodity markets and are they able to produce excess returns over a long-only investment in commodities.

1.1. Purpose of the study

The amount of studies associated with commodity futures returns has increased during previous few decades because of the very fact that several studies have appointed the potential of commodity futures as an asset class. Commodity futures hold a great history in financial markets since they have been traded in U.S. markets from mid 1850s in Chicago Board Options Exchange (CBOE) and around the globe even earlier. However, the quantity of commodity futures studies is not even close to the amount of for example studies related to equities. Furthermore, since various market anomalies are already tested within the equity markets it is compelling to examine how these anomalies perform among other asset classes.

This thesis examines the commodity futures returns by utilizing technical analysis. This is performed by examining the historical prices of individual commodity futures and using their previous price information in constructing long-short momentum and contrarian strategies. The technical analysis is commonly used way of analyzing asset prices and creating trading strategies based on patterns detected from past asset prices. Technical analysis is a vital part of the momentum and contrarian trading since these strategies are based on the examination of the previous price information. Technical analysis is challenged by the efficient market hypothesis by Fama (1970) who argues that the previous prices of an asset are not a valid predictor for the future prices. However, various previous studies have appointed that the previous price information does have some predictive power in the future asset prices. For example Lo, Mamaysky and Wang (2000) appoint that the previous price information of especially NASDAQ stocks does generate auxiliary information for the development of the future prices.

Futures risk premia is an intriguing topic since they have an effect on the hedging in the form of costs and benefits, and as well as the diversification benefits that result from the addition of futures in diversified portfolios. Furthermore, commodity futures do not hold similar short-selling restrictions when compared to common stocks. Commodity futures have suggested to have some potential in inflation hedging (Bodie and Rosansky 1980). Due to these reasons, commodity futures can be an effective tool for portfolio diversification and even in pursuing excess returns. This thesis examines the commodity futures profitability by examining two possible explanations. These sources of profitability are momentum and contrarian anomalies.

The purpose of this study is to find out is it possible to get better profits, more effective risk diversification and inflation hedge with commodity futures. Due to the relevance of the subject the users of commodity futures in risk management and as profit gaining asset, may gain great results by benefiting from momentum and contrarian signals during the process so it is vital to be aware how these commodity strategies are used and how they perform. In this thesis the performance of these strategies is also compared against a passive buy-and-hold strategy which only invests in the GSCI-index that invests in a universe of commodities.

Commodity futures can be considered as one of the most common tools in risk management and hedging against the price fluctuations of certain commodities in the future. Commodity futures are generally used for hedging purposes by large corporations who need certain commodities for their business operations or production. Furthermore, commodity futures have become more mainstream assets in speculation purposes due to the possible excess returns. Furthermore, commodity futures returns tend to have a negative correlation with stocks (Bodie & Rosansky 1980: 31).

In this thesis two different anomalies are examined and their performance is compared. Since the qualities of these strategies differ in the form of expected profitability on a certain time periods the momentum and contrarian strategy ranking and holding periods examined in this thesis differ from each other. The momentum strategy ranking periods examined are 1, 3, 6 and 12 months. The holding periods examined for momentum are 1, 3, 6 and 12 months. These ranking and holding periods are motivated by the expected profitability of momentum on short-term time period. The contrarian strategies examined in this thesis are examined by using longer term time periods. The ranking periods examined are 2, 3 and 5 years. These ranking and holding periods are motivated by the previous studies suggest that contrarian strategies tend to perform better on a longer time periods. The strategies examined will be compared against a long-only strategy investing in Goldman Sachs Commodity Index. This index comprises of 24 individual commodity futures contracts.

Since in the equity markets the momentum and contrarian strategies have been able to generate significant excess returns, the expectation for this analysis is that the strategies are able to perform similarly in commodity markets. The time period examined in this thesis is January 2000 to December 2018. This time period includes one of the most significant financial crisis in the form of the 2007-2009 financial crisis when the financial markets experienced one of the largest shocks in the recent history. The performance of the momentum strategy is briefly examined during crisis period in this thesis.

1.2. Research hypothesis

Since previous momentum studies have shown that the momentum profitability in short time periods has been positive in equity and commodity markets the expectations in this thesis are similar. Jegadeesh and Titman (1993, 2001) suggest that the momentum profitability can be noticed to be positive and significant in stock markets in holding periods ranging from 3 to 12 months. Furthermore, Miffre and Rallis (2007) appoint that in commodity markets the momentum strategy is able to generate positive excess returns on a short-term. In this thesis the hypothesis one is tested by using similar methodology as Miffre and Rallis (2007) which includes an examination of a universe of commodity futures that are ranked each month into quantiles based on their performance during the previous R months. Each month the commodity futures that have had the best performance in the ranking period are bought and the commodity futures that have had the worst performance are sold. The first hypothesis examined is following:

> H1: Momentum strategies are able to generate positive excess returns on short-term in commodity markets

The second hypothesis examined in this thesis is related to the performance of contrarian strategies in commodity markets. The contrarian strategies have proven to be profitable on a long-term in stock markets by De Bondt and Thaler (1985) as they suggest that on a longer time period the loser stocks are able to outperform winner stocks. This result is consistent with the overreaction theory, which suggests that people react strongly on news that are unexpected and dramatic. However, Miffre and Rallis (2007) appoint that contrarian strategies cannot generate excess returns in commodity markets over the time period of 1979 to 2004. The second hypothesis in this thesis is following:

H2: Contrarian strategies are able to generate positive excess returns on long-term in commodity markets

The third hypothesis in this thesis is related to the possible explanation behind the profitability of the strategies examined. This hypothesis is tested by using three factors which are bond market returns, stock market returns and commodity market returns. These factors are used in a multifactor model to test the risk-adjusted profitability of the strategies that are detected to be profitable in the first stage. The multifactor model tests if the profitability of the strategies examined can be considered as a compensation for risk. The multifactor model examines the sensitivities of the strategies to the factors that are applied in the model. The third hypothesis is following:

H3: The profitability of the strategies that are able to generate positive returns can be explained by market risks

If the strategies are able to generate significant positive alpha after accounting for the risk metrics it can be stated that the strategies are able to generate positive risk-adjusted alpha. However, if the strategies are not able to generate significant alpha it suggests that the returns are only compensations for the risk.

The fourth hypothesis is tested by examining the correlations between the returns of the strategies and the inflation which is measured as the percentage change in consumer price index.

H4: The strategies examined are able to hedge inflation

1.3. Previous studies

Commodity futures are an asset class that has not been studied in same magnitude as for example bonds and equities. However, after the study by Johnson (1976) the commodity futures have gained more attention in the financial markets since they have been noticed to be able to generate benefits in portfolio diversification, inflation hedging and generating positive alpha. Gorton and Rouwenhorst (2006) appoint that commodity futures do generate equity like excess returns but they benefit the investors further since they have negative correlation with equities and bonds. This is mostly because the commodity futures behave differently in comparison with other asset classes during a business cycle. Furthermore, Gorton and Rouwenhorst (2006) propose that commodity futures have a positive correlation with inflation, unanticipated inflation and sudden shifts in inflation.

The amount of momentum studies in equity markets has been increasing rapidly after the novel research by Jegadeesh and Titman (1993) which suggest that momentum strategies are able to generate excess returns on short-term. Jegadeesh and Titman (2001) continue their examination of momentum anomaly by testing the momentum strategies by examining the explanations behind the profitability of momentum strategies and suggest that the profitability still exist in 1990s which suggests that the profitability is not due to data snooping. Furthermore, they suggest that the investors in financial markets have not drastically changed their investing strategies to eliminate the elements behind success of momentum strategies.

Erb and Harvey (2006) examine momentum profitability in commodity markets by examining a momentum strategy that invests in GSCI-index and appoint that the momentum strategy is profitable with a ranking period of 12 months and a holding period of 1 month. Furthermore, Miffre and Rallis (2007) examine the profitability of 16 momentum strategies by using a dataset of 31 individual commodity futures and ranking them each month based on the previous R months returns. Their results suggest that the momentum profitability exists in commodity futures markets and the profitability cannot be explained as a compensation for risk.

Contrarian anomaly can be considered as the opposite of the momentum strategy which has motivated many previous studies to approach this anomaly as betting against the prevailing market trend. Previous studies have commonly suggested that the contrarian strategies have yielded positive excess returns on equity markets. De Bondt and Thaler

(1985) suggest that market participants tend to overreact to sudden and dramatic news in the markets. They appoint that the "loser" portfolios outperform the "winner" portfolios in the markets which is consistent with the overreaction hypothesis. Furthermore, they suggest that the "winner" portfolios tend to be more volatile compared to the "loser" portfolios.

Daniel, Hirshleifer and Subrahmanyam (1998) suggest that market participants underreact to publicly available news and overreact to insider information. In this model the investors who use contrarian patterns are able to gain returns but are usually the uninformed participants. Dechow and Sloan (1997) examine the reasons behind contrarian strategies by examining a model that uses naive investor expectations as an explanation to contrarian profitability. They suggest that over half of the contrarian returns can be explained by the investor's naive belief on analyst's long-term earnings growth projections.

The amount of studies related to contrarian strategies in commodity markets is relatively low. Miffre and Rallis (2007) continue to examine the profitability of commodities by examining the long-term reversal effects in commodity markets. Although they observe that short-term momentum strategies gain positive returns in commodity markets, the contrarian strategies do not work and only produce negative returns in holding and ranking periods of 2, 3 and 5 years. Drew, Bianchi and Fan (2015) observe a combination of momentum and reversal effects in commodity strategies. They find that the combination of momentum and reversal signals is able to produce even higher profits than the single-sort momentum strategy. However, the contrarian strategies are not generating excess returns when used individually.

1.4. Structure of the thesis

The remainder of this thesis consists the following. Chapter two presents the theory of efficient markets and introduction of technical analysis. Chapter three includes the basic theories of futures contracts, commodity futures, futures hedging and futures speculation.

Furthermore, basic theories of commodity futures pricing are introduced. Chapter four concentrates on the theoretical background of momentum and contrarian anomalies. Additionally, previous studies related to commodity strategies are addressed. Chapter four also presents the most relevant studies related to the anomalies examined and some further information related to them.

Next section in this thesis is the chapter five consisting of the data description and methodology used to obtain the empirical results of this thesis. The data section includes the presentation of the data, which commodity futures are used, what are the benchmark indexes and the time period used in this study. The methodology part consists of describing how the empirical part of the thesis is executed. This includes the equations used in the calculations and also what regression models are used to test the profitability of the strategies.

Chapter six presents the empirical results obtained in this study. The chapter includes the profitability of momentum and contrarian strategies in commodity markets. Furthermore, the performances of the strategies are compared to the performance of relevant commodity index that is passively managed. Furthermore, the results from multifactor model are presented. Chapter seven also examines the possibility of portfolio diversification and inflation hedging with the strategies. The chapter seven concludes the main observations from this thesis.

2. THEORY OF EFFICIENT MARKETS

Market efficiency is one of the most significant topics in finance studies since the level of efficiency is one of the most defining factors in asset pricing. The expectation is that if the markets reflect all available information that is affecting the asset prices then the prices should be at their correct levels. One of the first studies related to the market efficiency was introduced by Eugene Fama (1970) as he proposed the Efficient Market Hypothesis (EMH). The studies by Fama have been a significant pioneer for the modern finance studies since the EMH suggests that an individual investor cannot beat the market by active portfolio management since the financial markets are efficient. However, this is not always true because there are many factors which have proven to disturb the financial market efficiency. Many previous studies related to the market efficiency and excess return are based on the proposition that the markets are inefficient or that the investors are making irrational decisions in the financial markets (Daniel, Hirshleifer & Moskowitz 1998; Malkiel 2003). Since momentum and contrarian are examined in this thesis by using technical analysis it is significant to examine market efficiency and the effects which market efficiency may have in this analysis.

2.1. Efficient market hypothesis

Fama (1970: 387) introduced the theory of Efficient Market Hypothesis which states three conditions that must be fulfilled to reach market efficiency:

1. When trading securities, there are no transaction costs
2. All available information is available for all market participants without costs
3. Market participants make rational decisions in the financial markets

The basic expectation of EMH is that it is not possible for an individual investor to earn excess returns by using widely available information since all the information is already reflected into the prices of assets. Thus, by examining the past prices of assets it should not be possible to forecast the future prices of an asset nor by using fundamental analysis, which benefits from using financial information to find assets that are not priced correctly rather than holding a portfolio consisting a selection of randomly selected assets. (Malkiel 2003.)

"Random walk" is often associated with efficient market hypothesis. Random walk is a commonly used term in finance literature which is defined by that the price changes of certain assets are randomly departed from the previous prices. Random walk is based on the idea that if the flow of information does not have any barriers the information should instantly be reflected into the asset prices. This leads into a situation where tomorrow's price changes will only reflect tomorrow's news and will not be affected by the price changes today. However, since news are typically unpredictable, the changes in asset prices must be likewise random and unpredictable. This results in full price reflection for all known information to asset prices which enables the uninformed investors who invest in a diversified portfolio to reach the same rates of return as expert investors. (Malkiel 2003: 59.)

Fama (1970: 383) divides the market efficiency into three categories which define the efficiency of the markets in various levels. These categories are weak form, semi-strong strong form and strong form of market efficiency. These categories suggest that the level of efficiency in the markets can be viewed by examining how much information is available currently and how well does it reflect into the stock prices. These levels of efficiency are the main factors that are examined in the studies by Fama (1970) about EMH.

The weak form of EMH can be described as a form of market efficiency where the asset prices reflect all price, trading volume and information generated by the markets from earlier trades related to assets (Fama 1970: 389). Furthermore, even in the weak form of market efficiency, the earlier market data cannot be used as a proxy for future asset prices. Thus, it can be stated that the asset prices reflect all available current information. However, the weak form of market efficiency has not always been able to hold its expectations in certain markets. Taylor (1992: 105) examines currency futures markets, futures returns and the state of market efficiency. The results obtained by Taylor (1992) appoint that in the weak form of efficient markets it is possible to find excess returns that are higher than risk-free rate since stating that the currency futures markets are not totally efficient. These results are based on technical analysis rules and past price history of securities.

The semi-strong form of EMH can be described as a more efficient version of weak form market efficiency. The definition of semi-strong efficiency is that the asset prices reflect all available public information. The most significant requirement compared to the weak form is that the information reflection is instant and information is fully reflected into the asset prices. Based on the semi-strong form of EMH, no investor is able to reach excess returns by using any information available for public. Due to these requirements fundamental ratios, which benefit from using information from companies financial statements, cannot be used as a predictor since the information from them is already expected to be reflected into asset prices. (Fama 1970: 388, 415.)

Finally, the strong form of EMH tests whether some market participants hold information that is not publicly available for all market participants and use it for the asset pricing (Fama 1970: 388). The requirements for strong form of EMH is that asset prices fully reflect instantaneously to all publicly available and also private information. Thus, the insider information should already be fully reflected into the asset prices. Furthermore, the strong form of EMH covers all the requirements of weak and semi-strong forms of efficiency and then stating that the markets are fully efficient.

However, it is hardly ever true that all the requirements for EMH are fulfilled. Since there are transaction costs, investors are making irrational choices and all the information is not available for all the market participants. Furthermore, the behavioral aspect of investing has proven that investors tend to be more confident in investing in assets that has experienced rise in their value and tend to expect it to rise even more which leads into biases in the markets. (Malkiel 2003.)

2.2. Market efficiency and technical analysis

The efficient market hypothesis suggests that past information of asset prices is not able to predict the future prices of assets. Furthermore, EMH suggests that the asset prices are just "random walks" and thus, not predictable. However, technical analysis has been gaining more attention after the studies about EMH since several authors have shown that there are detectable patterns in asset prices that hold predictive power in future asset prices (Fama and French 1988; Lo and Mackinlay 1988, 1997). Furthermore, the technical analysis has been able to benefit of using market anomalies that should not be able to predict asset prices and gain excess returns according to EMH.

Based on EMH the technical analysis cannot be used in the process of forecasting future asset prices. This in because the public information that is available for all market participants at minimal costs should, according to weak form of EMH, lead into a situation where all the available information is already reflected into the asset prices. Since the prices already reflect all available information, individual investors should not be able to reach excess returns above the risk-free returns. (Fama 1970)

Lo, Mamaysky and Wang (2000) examine technical analysis and its predictive power on future stock prices. They use a methodology of empirical distributions of daily stock prices to the conditional distribution and by using technical analysis indicators such as head-and-shoulders or double-bottoms. Their results suggest that over the time period of 1962 to 1996 there can be found several indicators that appoint that technical analysis provides practical information which can be used in forecasting process of future asset prices.

Malkiel (2003: 61) continues by examining short-term momentum and underreaction related to new information in the markets. The results obtained in this his study appoint that the stock price movements cannot be considered as "random walks" and that there can be detected short-run momentum in stock prices. However, Malkiel (2003: 62) continues that due to the transaction costs it is unlikely, by using momentum patterns as a predictor of future stock prices, to reach excess returns above a buy-and-hold strategy.

Lukac, Irwin and Brorsen (1988) examine technical trading rules by investigating 12 different systems. They appoint that 11 out these 12 are able to produce positive returns and four out the 11 are able to produce significant risk-adjusted returns, thus suggesting that technical analysis is able to reach positive excess returns.

2.3. Technical analysis and futures markets

Lukas, Brorsen and Irwin (1988) examine the technical analysis in futures markets for a time period of 1978 to 1984. They examine technical analysis by examining dual moving average crossover system, close channel system and directional parabolic system for 12 futures markets. For the six year time period examined they find significant positive returns which range from 3.8% to 5.6%. Furthermore, they appoint that when the futures markets are experiencing large information shocks, the market experiences rapid changes and moves to a new equilibrium which results in profitability for a trading system.

Beck (1994) examines the efficiency of futures markets by using co-integration techniques in five commodity market in time periods of 8 weeks and 24 weeks. The study results by Beck (1994) suggest that the commodity markets have experienced time periods of inefficiency but on a long term the markets can be viewed as efficient. McKenzie and Holt (2002) examine the agricultural futures markets and its efficiency by using co-integration and error correction models with GQARCH-in-mean processes. Obtained empirical results by McKenzie et al. (2002: 1525) appoint that futures markets are efficient on the long-run, but do experience short-term inefficiencies.

Taylor (1994) approximates the efficiency of technical analysis in currency futures markets by following technical trading rule called channel rule. The channel rule states that the long futures position is shifted to short position after the price of the futures contract drops below the minimum price during the previous L days (Irwin & Uhrig 1984). The same applies for switching from short position to long position with the exception that price has to be more than the maximum price during the previous L days. Taylor (1994) appoints that the channel trading rule does not have the predictive power for the future prices since it is only able to produce information about the sign of the change: negative or positive. The results by Taylor (1994) suggest that the model is able to provide relevant information about the changes for the direction of the futures prices. Furthermore, the study results suggest that likewise previous studies, the model supports that the technical analysis trading rules are able to produce excess returns in currency futures markets.

Raj and Thurston (1996) examine the technical analysis performance in Hong Kong futures markets by using two different technical analysis trading regulation: Moving-Average-Oscillator and Trading Range Break-Out. The trading regulations are being compared to a simple buy-and-hold strategy. This test is a simple test against the theory of Efficient Market Hypothesis which suggests that technical analysis should not be able to reach excess returns over the market return. They propose that the buy-and-hold strategy is able to generate excess returns that are significant, although it holds the risk of large negative returns during periods when the market crashes. Furthermore, both technical analysis benefited strategies are able to produce positive excess returns and especially the Range Break-Out strategy generates significant positive returns for the buy signal.

3. THEORY OF COMMODITY FUTURES

Commodity futures are an asset class that have been traded in the U.S. markets from mid 1850s, have been proven to have similar returns as equities and on the other hand tend to have negative correlation with equities (Gorton & Rouwenhorst 2006). They also hold the benefit of having no short-selling restrictions such as stocks have. Furthermore, commodity futures are able to benefit in inflation hedging and as a way of portfolio diversification.

In this section the theory of commodity futures is introduced. This includes the basic theories about futures contracts and commodity futures. Furthermore, the section presents the commodity futures pricing models, risks included in commodity futures trading and the main purposes of use of commodity futures contracts.

3.1. Theory of futures contracts

Futures contracts are commonly used derivatives which hold two main purposes of use, these are hedging and speculation. Out of these two main purposes of use of commodity futures the original purpose was to hedge a certain risk related to an asset. Hedging in general is a term for reducing risk of unexpected price movements of a certain security, currency or a commodity. Furthermore, the definition of speculation is making a financial transaction, which contains risk but at the same time includes the possibility of making financial gains. Assuming that there is a possibility of trading with a certain futures contract related to a commodity it is more convenient for a speculator to buy a futures contract rather than buying the commodity itself for the spot price. Speculation with derivatives has been a highly discussed topic in the recent past due to the amount of leverage in derivatives trading. Since the amount of leverage can be high it is possible for the speculator to experience large losses when speculating with derivatives. For example, in 1995 speculation with derivatives caused the collapse of Barings Bank. This scandal was caused by a derivatives trader who was doing derivatives trading out of his area of responsibility, thus causing the bank to go bankrupt.

Historically the futures contracts returns have been close to zero but they still have become more widely used assets in well diversified portfolios (Bodie & Rosansky 1980: 31). This is because the addition of commodity futures into a diversified portfolio can improve the performance of a portfolio. Szymanowska, De Roon, Nijman and Goorbergh (2014) appoint that futures contracts are zero-cost securities which denotes for the lack of requirement of an initial investment. This leads to the conclusion that the expected returns are composed only of the risk premiums.

According to Bodie and Rosansky (1980) the mean returns of commodity futures do not differ from returns on common stocks over the time period on 1950 to 1976. Although the more relevant finding by Bodie and Rosansky (1980) is that the futures returns tended to be positive in years when common stock returns were negative and vice versa. They continue by stating that futures premiums support the normal backwardation theory but on the other hand the results found by them suggests that the mean returns and corresponding beta coefficients are against the usual capital asset pricing model. Jensen, Johnson and Mercer (2000) appoint that commodity futures can be an attractive addition to a diversified portfolio since the correlation with security returns has noticed to be rather low.

A futures contract gives the holder the right to buy or sell an asset for certain price at an agreed point of time in the future. The details of a futures contract are determined by the marketplace where a certain futures contract is traded which makes them standardized contracts. Furthermore, the price of a futures contract is determined by the markets since every futures contract in the markets has a certain future price and a delivery month. The futures exchange determines the size of every contract, the units for every price quotation, minimum price fluctuation allowed and the margin requirements for the market participants. When the contract is dealt the price which is quoted for the futures contract is the delivery price for the underlying asset. During the life of the contract the price for the futures contract varies in the markets until the contract initially expires. The exchange where the futures contract is traded has to determine the last trading days for each futures contract. Usually the last trading date is the third Friday of the month or optionally the last business day of the month. (Hull 2015: 26-28.)

Initial margin in commodity futures is described as the amount of funds required when taking a certain position in a futures contract. The initial margin can be defined as the deposit which makes the contract to be unbiased for both parties. The initial margin is deposited in the margin account at a brokerage firm. The way the initial margin works is that when the balance in the margin account declines below the demanded initial margin, the holder of the account receives a margin call and is required to deposit extra funds to the account to reach the initial margin again. (Hull 2015: 29-30.)

In futures contracts trading one of the participants takes the long position which means that this participant agrees to buy the asset for a certain price at a certain point of time in the future. The other participant takes the short position which means that the participant agrees to sell the asset for a certain price at a certain point of time in the future. The participant who sells the futures contract is the one who makes the decisions related to the delivery. The delivery is typically possible on any day of the delivery month. The delivery of the contract depends on the underlying asset. There are financial futures contracts which include an asset which is delivered to the other participant at the delivery date. However, certain futures contracts such as stock index futures are delivered in cash. In the case where the underlying asset is a commodity such as oil, the delivery can be either settled physically or by settling with cash. When the contract is settled physically the asset underlying is delivered on the date which is specified in the futures contract. However, most of the futures contracts are not exercised and are traded out before the set delivery date and the difference between original price and closing price is settled with cash. (Hull 2015: 8, 27.)

3.1.1. The payoff of futures contracts

The price of forward contract is calculated by using the following formula:

(1) $$F_0 = S_0 * e^{rt},$$

where

F_0 = forward price

S_0 = Spot price

r = continuously compounded risk free rate of return

t = time to maturity

Generally the payoff for a long position is:

(2) $$S_t - K,$$

where

K = delivery price

S_t = spot price of the asset at the maturity

The payoff for a short position is:

(3) $$K - S_T$$

where

K = delivery price

S_t = spot price of the asset at the maturity

These payoffs can be negative or positive. Since it is free to enter into a forward contract, the payoff from the contract consists of the total profit or the total loss from the contract. Payoffs of futures contracts are presented in **figure 1**. (Hull 2015: 7.)

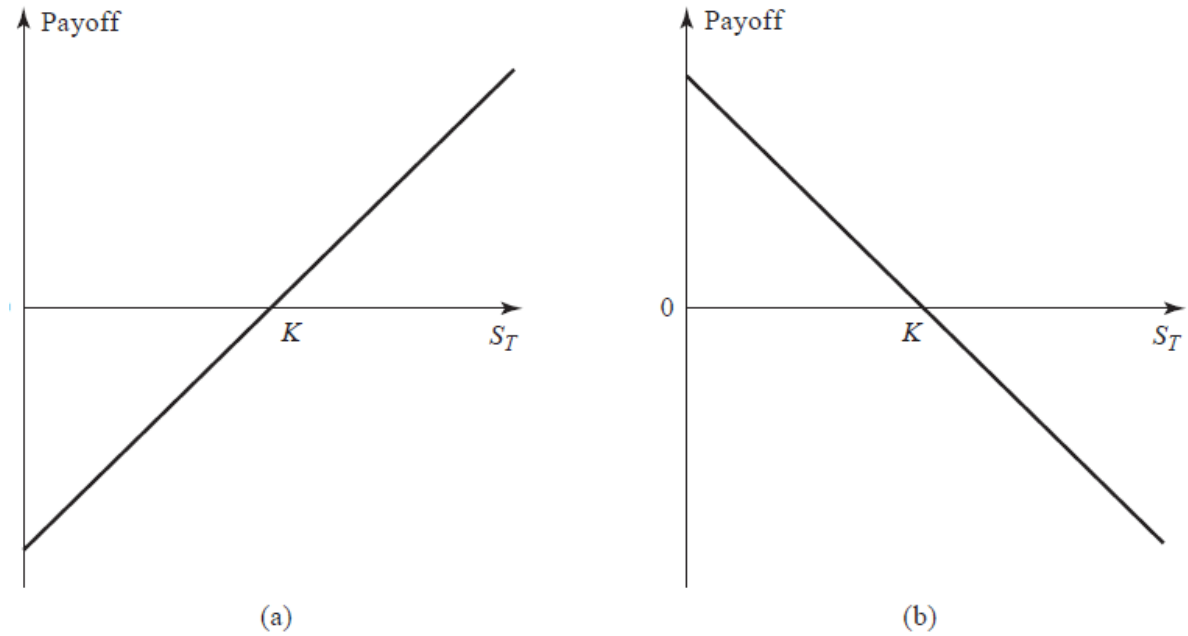

Figure 1. Payoffs of forwards and futures contracts. (Hull 2015: 7.)

3.2. Commodity futures

Commodity futures contracts are agreements for buying or selling an underlying asset in the future for a predetermined price, at an agreed point of time in the future and for a certain amount of the underlying asset. These futures contracts are used for hedging and speculating purposes. Examples of such commodities that can be underlying assets are crude oil, wheat, gold and copper. Commodity futures are traded in futures markets known also as futures exchanges. Few of the biggest futures markets are Chicago Mercantile Exchange (CBOE) and New York Mercantile Exchange (NYME). Since the contracts are traded in exchanges it makes commodity futures standardized contracts which states that the prices and delivery dates of the contracts are determined by the markets. At the beginning when the commodity futures contract is issued the price of the contract is the delivery price of the underlying asset. Although, commodity futures markets is a huge asset market, Gorton and Rouwenhorst (2006) appoint that commodity futures are quite unknown assets even though they have been traded for over 100 years in the United States commodity markets.

Commodity futures can be used for two main purposes which are hedging and speculation. Hedging with commodity futures holds a vast history behind it since the first early hedging agreements in commodities date in mid 1850s. Hedging with commodity futures is mainly useful for producers and other benefiters of certain commodities. Hedging makes it possible to determine the price of the commodity to be at a certain level in the future which may be beneficial for the users of commodity futures. However hedging does not remove all risks the risks included and there will always remain a certain risk called basis risk.

Basis risk includes three variables. The first part of the basis risk is that the price of the asset underlying does not move in the same direction as the futures contract price. The second part of the risk is that the delivery date for the commodity does not have an exact delivery date in the future. The third part is that the contract may have to be closed before the date of expiration, which is determined in the original contract. Gorton and Rouwenhorst (2006) appoint that commodity futures and for example stocks have quite large differences such as (1) commodity futures are derivatives contracts (thus, not claims on corporations), (2) further, they are short maturity claims on assets such as commodities and (3) commodities differ from financial assets since they are affected by seasonality in price levels and their volatilities. Bodie and Rosansky (1980) appoint in their research that commodity futures have a role in inflation hedging which means that they are able to protect the investor against the loss of value of a currency against the increased prices. (Hull 2015: 54-56.)

3.3. Commodity futures pricing

The approximation of the price of a commodity futures is beneficial for the users of the commodity futures but also for the academic world since the amount of studies related to commodity futures has consistently increased. Commonly the prices of the commodity futures contracts are based on the predicted future value of the underlying commodity. This is the case for commodities which are more commonly known, are more frequently traded and whose prices can be predicted more accurately due to their higher trading volumes. When the commodity does not meet these basic expectations for the pricing process, the pricing becomes more complex since the approximations are not as accurate as for more frequently traded commodities. The prices of commodity futures contracts are determined by the exchange where the certain futures are traded. The purpose of commodity markets is to make the trading with commodities more secure for the users of the derivatives and also to make the prices as accurate as possible. (Hull 2015: 120-123.)

3.3.1. Theory of storage

Commodity futures pricing has two commonly known but different approaches. The first theory related to the pricing is called the theory of storage, where the convenience yield in storage options was introduced by Kaldor (1939). The theory of storage is illustrates the difference between contemporaneous spot price and futures price in relation of forgone interests in storing a commodity, costs of warehousing and the convenience yield on stock. (Fama & French 2016: 56.)

The most significant statement of the Theory of Storage is that the difference between spot and futures price is a determined by using fundamental supply-and-demand conditions. Furthermore, the theory of storage explains the fluctuations of spot and futures prices with storage costs, inventory levels and convenience yields. The theory explains that the spot price of a futures contract is expected to rise by the same amount as the net cost of carrying the commodity over time. The convenience yield denotes for the situation where the underlying asset in futures contract is a commodity, the holders of the commodities earn a convenience yield which was originally introduced by Keynes (1930), Kaldor (1939), Working (1949), Brennan (1958) and Telser (1958). Thus, the theory of storage states that the spot price and futures price difference is equal to the cost of storage including interest and a definite benefit that producers or consumers obtain by holding inventories that include commodities. (Cootner 1960: 396.)

According to Working (1949: 1255) the theories by Kaldor can be extended by adding the role of futures markets into decisions about storage. Furthermore, Working (1949: 1256) appoints that arbitrage states that the futures price has to equal the spot price plus the carrying costs. The Cost-of-Storage theory explains the variation between the futures price and spot price by stating that interest foregone in storing a commodity, warehousing costs and convenience yield received from holding an commodity inventory. The following equation states that the cost-of-carry hypothesis in equilibrium suggests that the return from buying a commodity at time t and selling it for delivery at time $t + t\Delta$ is denoted by:

(4) $$F(t, \Delta t) = S(t)(1 + r(t, \Delta t) + w(t, \Delta t) - c(t, \Delta t))$$

3.3.2. Standard Cost of Carry

The standard cost-of-carry model was created for the purpose of pricing futures and forward contracts. However, there are many available forms of the cost-of-carry models because the model has been created to match different types of underlying assets and different markets.

The standard cost of carry model suggests an alternative approach for commodity futures pricing by splitting the futures price into expected risk premium and prediction of the future spot price (Cootner 1960, Dusak 1973, Breeden 1980, Hazuka 1984). Szymanowska, De Roon, Nijman and Goorbergh (2014) identify two sources for the risk premiums for commodity futures returns which are the spot premia related to the risk in in the underlying commodity and the term premia related to changes in the basis of the commodity. Gorton and Rouwenhorst (2006) appoint that commodity futures differ from corporate securities by not raising resources for the corporations to invest but on the other hand they allow corporations to get insurance for their future outputs and inputs of their business processes.

Hull (2015) appoints that the cost of carry can be used to measure the prices of commodity futures by using the storage costs when added to interest that is paid in financing the asset less the income that is yielded from the asset. When pricing a commodity futures contract the c is the cost of carry. The following equation is used to price a commodity in cost of carry model:

(5) $$F_0 = S_0 e^{cT}$$

3.4. Commodity futures risks

Since there are expected returns in commodity futures trading there are also risks included in commodity trading. However, since the expected returns in commodity futures have been relatively low historically the risks related to commodity futures are also rather low. Furthermore, the correlations between different commodities vary seasonally and during periods which include turbulence in the markets. (Till 2006: 9-10.)

When examining the risk of an individual commodity futures contract it can be obtained that the volatilities differ significantly since some of the commodities which include derivatives trading hold more volatility due to changes in the market states. These changes could be for example related to supply shocks, natural disasters or weather changes. These factors may cause the prices of the commodity futures to vary drastically over very short time periods.

Kat and Oomen (2007) examine commodity futures and the price and the volatility fluctuations they experience annually. The average volatility for commodity futures was 27.8% annually. However some commodity futures experience volatilities which are much higher than for the average commodity futures volatility. When comparing commodity futures with common stocks, the differences were not that high since the average US large cap stock experiences 29.5% volatility. Kat and Oomen (2007) continue by pointing out three observations related to commodity futures risks. First, the movements which currencies experience can affect the commodity price volatilities. Second, in the case of agricultural commodities the natural variation in supply can be an explaining factor for the commodity futures volatility. Third, most of the commodities experience larger volatility when the forward curve is in backwardation rather than in the situation of contango.

Gorton and Rouwenhorst (2006) appoint that the differences in risks when comparing stocks and commodities is significantly different. This is mostly because the risks in stocks are driven by the performance of a certain company. If a company does not perform well in the markets the stock value of the company will most likely decrease. However, this is not the same for commodities since their price fluctuations are not based on the performance of a certain company directly.

3.5. Hedging and speculation with derivatives

As mentioned earlier, in derivatives there are two main purposes of use for the derivatives traded. These purposes are hedging and speculation. The huge amount of futures traded daily appoints that futures trading is a significant part of the financial markets and the users are able to benefit from futures trading. Furthermore, since futures exchanges are one of the oldest financial exchanges it is safe to say that they are highly significant for the whole financial markets.

3.5.1. Hedging

The original purpose of use for the futures contracts was hedging and the first evidence of systematic hedging is from mid-1800s when grain farmers started to make contracts about the prices of the grain in the future. There are many examples existing of the ways of hedging with futures but for example a transporting company can benefit by using futures contract to hedge against the price changes in crude oil in the future to make sure that the gasoline price in the future would be at a reasonable level. When the futures contract is held to the maturity the user neutralizes the risk related to the price fluctuations. On the other hand if the futures contract is not held to maturity, most of the risk will be hedged.

Still some of the risk related to futures contracts remains. This risk is called the basis risk. The basis risk includes three essential parts which have to be considered when trading with futures contracts (Hull 2015: 54-55).

1. The price of an asset which is being hedged may not be exactly equivalent as the price of the underlying asset in the futures contract
2. The date when the asset will be bought or sold may be unknown for the hedger
3. The futures contract may have to be closed prior to the expiration date.

Basis risk can be defined as the difference of spot price of the asset being hedged and the future price of the instrument which is used in the hedging: (Hull 2015: 55)

(6) $$Basis = Spot\ price\ of\ the\ asset - Futures\ price\ of\ the\ contract$$

To achieve a zero basis risk the asset which is hedged and the asset underlying in the futures contracts should be the same when the futures contract is expired. Before the expiration it is possible that the basis risk is either negative or positive. When the spot price of the asset increases to a level higher than the futures price the basis will increase and vice versa. These changes in the basis are called either strengthening of the basis or weakening of the basis. (Hull 2015: 54-55)

One essential feature related to the hedging is the minimum variance hedge ratio. This ratio is described as a ratio which measures the variance of the position and the purpose of the ratio is to find the optimal hedging position. The optimal position appoints the optimal amount of futures contracts needed to hedge a certain position. When the hedger is long for the asset and short for the futures contract the change in the value of the position the hedger has is following (Hull 2015: 59):

(7) $$\Delta S - h\Delta F,$$

where ΔS describes the change in the spot price and $h\Delta F$ describes the change in the futures contract price. If the investor is long for the futures contract and short for the asset:

(8) $$h\Delta F - \Delta S$$

The variance for the change in the value for the position in these situations is described by the following:

(9) $$\sigma \ = \sigma 2 \ + h2\sigma 2 \ - 2h\rho\sigma \ \sigma \ SFSF$$

Which leads into:

(10) $$\frac{\partial\sigma}{\partial h} = 2h\sigma_F^2 - 2\rho\sigma_S\sigma_F$$

When this is set equal to zero, the equation shows that the value for h that shows the minimum variance is:

(11) $$h^* = \rho\frac{\sigma_S}{\sigma_F}$$

In this equation the h^* describes the hedge ratio which appoints the minimum variance of the position the hedger has, ρ describes the coefficient for the correlation between δS and δF which describe the change of the spot and futures price. σ_S and σ_F describe the standard deviations for the spot and futures price. By using this equation the optimal hedge ratio is the coefficient of correlation between δS and δF and the ratio for the standard deviation of the δS to standard deviation of the δF. (Hull 2015: 59-60.)

3.5.2. Speculation

Speculation can be described as an action where an investor seeks an excess return in the financial markets by investing in assets that are expected to rise (fall) in value for a certain reason. Speculator then takes the long (short) position in the asset and awaits for the rise (fall) to occur in the price and gains the amount which exceeds the original amount invested. Speculation is an essential purpose of use for the commodity futures. This is mostly because investors and researchers have noticed that the possibility of gaining excess returns is achievable. However, futures contracts have a feature which makes the possible losses to be unlimited. This feature is the amount of leverage often involved in futures trading. The amount of leverage used in futures trading is far greater than the amount in equity trading (Bologna & Cavallo: 184). Due to the amount of leverage involved, the possibility of experiencing significantly larger losses in futures trading than in equity trading, increases the risks in futures trading.

Working (1960: 186) appoints that speculation can be defined in the ordinary usage, as a way of seeking profits from certain transaction which includes risk especially for that purpose. He also appoints that this definition could be considered to include arbitrage but typically arbitrage is not considered to be as speculation. Furthermore, Working (1960: 186-187) defines that speculation with commodities consists of holding a net long or net short position to profit and not as a typical benefit from business operations such as producing or merchandising.

Kyle (1989) examines informed speculation and imperfect competition by examining a “schizophrenia” problem occurring in financial markets. The “schizophrenia” problem can be described by that market participants take the equilibrium price as given, although every trader is able to influence the price by their actions (Hellwig 1980). Kyle (1989) examines the schizophrenia problem by suggesting a model which states that the market participants react to incentives to acquire information in the markets in reasonable way.

Irwin, Sanders and Merrin (2009: 377) examine how the speculative activities in commodity markets create a “bubble” affecting the prices of commodities which leads the prices to surpass their fundamental values. They appoint that the significant boom and bust effects experienced in commodity markets during mid-2008 cannot be proven to be caused by speculative activity. However, they suggest that the main drivers for the commodity price movements was affected strongly by a demand shock of commodities from China, India and few emerging markets thus leading into a price drops since the financial markets experienced one of the most dramatic crises in the recent past in 2008.

Gilbert (2010) examines speculation in commodity markets and suggest that speculation occurs in commodity markets in the form of futures use since it eliminates the costs and concerns of managing the commodity itself. He continues that the possibility of taking the long or short position at the same cost makes the commodity futures market an attractive speculation possibility. Furthermore, Gilbert (2010) suggests that excessive speculation performed in futures markets can have an effect on futures prices and since lead to possibilities for arbitrage to affect spot price to levels that are not in line with the supply and demand equilibrium.

Knittel and Pindyck (2016) observe the effects of speculation on storable commodity prices. Their main focus is in the oil price since the oil price changes due to speculation has gained the most attention among all commodities when speculation is considered. Furthermore, they examine the role of speculation in the dramatic changes in oil prices in 2004. Although the rapid changes in oil prices in 2004 were blamed on speculators, the empirical results obtained in their study suggests else. Knittel et al. (2016) appoint that the role of speculation in the price changes cannot completely be ruled out but it also cannot be considered as the only driver of the rapid price changes.

Robles, Torero and Von Braun (2009: 2) describe speculation as a possibility of risk of experiencing losses in return for the possibility of a return. They also point that the speculators in futures markets have possibility of being long or short in the transaction, but the actions of speculators has to offset any net imbalances when considered the hedgers long and short positions in the markets. Du, Cindy and Hayes (2011) examine speculation and volatility spillovers in commodity markets by observing crude oil and agricultural commodities. The purpose of their study is to investigate the role of speculation when examining the oil price fluctuations. They suggest that the speculation performed in commodity markets acts as a driver in oil price changes. They test this by using a Bayesian Markov Chain Monte Carlo methodology.

4. MOMENTUM AND CONTRARIAN ANOMALIES

In this section the momentum and contrarian anomalies are presented. These market anomalies have been significant topics in the modern financial research when examined the risk premiums of various asset classes. Most of the anomalies that have existed in the financial markets have disappeared over time which makes it even more intriguing to examine two market anomalies that have existed for decades and are not showing signs of disappearing even in 21st century. In this thesis the momentum and contrarian anomalies are examined in commodity futures markets. However these anomalies have been studied mostly in the equity markets thus making the examination of other asset markets fascinating.

4.1. Momentum

Momentum is one of the most commonly researched anomalies in the area of finance studies. Momentum can be described as an investing strategy which is based on the historical prices of an asset and which includes investing in assets which have been performing well for the last 3 to 12 months and by short selling assets that have been performing the worst for the last 3 to 12 months (Jegadeesh & Titman 1993). Basically momentum anomaly is based on the idea that the assets are experiencing a positive trend which is expected to continue, i.e. momentum. The basic standpoint of momentum is that the winner stocks keep on winning and the loser stocks keep on losing on a longer term (Ansari & Khan 2012). Furthermore, momentum anomaly has been detected to exist globally (Assness, Moskowitz & Pedersen 2013). The momentum effect in financial markets is often described as a short-term continuation.

One of the earliest studies related to momentum strategies is a study by Levy (1967) where he examines a relative strength trading rule which indicates that the stock price movements can be predicted by using patterns detected from the previous price data. This study is related to momentum since Levy’s study in 1967 concludes that by buying stocks whose prices are notably higher than their average prices have been over the recent 27 weeks have generated excess returns that are significant. The reason why momentum has been examined so widely is most likely since according to the weak forms of efficiency of EMH the previous price information of an asset should not be an indicator for the future prices of an asset.

After almost a decade after their highly recognized momentum research Jegadeesh and Titman (2001) provide more information about momentum and it’s still existing effects in the financial markets. As previously stated momentum is one of the strongest market anomalies and the studies by Jegadeesh and Titman (2001) gives more robust evidence for this statement. Their study in 2001 focuses on the part of examining the momentum risk premium and reasons behind the profitability. The results from 1993 study have been highly referred and it has given a stable base for explaining momentum profits, but on the other hand it has generated claims that the momentum profits can be based on risk compensations or data mining. The results from their 2001 research appoint that the magnitude of the momentum is still in the same level compared to the earlier results which leads into the conclusion that momentum profitability is not based on data mining. Jegadeesh and Titman (2001) also examine further reasons for the momentum profitability. Their findings appoint that the delayed overreactions can be explained by behavioral explanations. They also remind that this explanation cannot be considered as the ultimate truth for the momentum profitability but rather more as a partly explanation. (Jegadeesh and Titman 2001: 699–701, 718–719.)

4.1.1. Momentum returns

Since the reasons behind the profitability of the momentum strategies are not totally clear and commonly accepted it is essential to examine the possible reasons behind the excess returns and different aspects which may influence the momentum profitability. Few of the more notable reasons behind momentum profitability are: industry related factors, stock specific factors or macroeconomic factors. However since momentum is considered to be a market anomaly the existence of the momentum appoints that more traditional theories in finance literature such as the Efficient Market Hypothesis does not hold since momentum anomaly violates the basic principles of the theory. The controversy around market anomalies such as momentum has led to the point that researchers have claimed that the momentum anomaly is only a temporary disturbance and the effects will disappear over time. However the studies related to the momentum profitability have examined the robustness of the momentum strategy and for example Jegadeesh and Titman (1993, 2001) appoint that the momentum still exists for over a decade after their first studies about the anomaly.

Jegadeesh and Titman (1993) state in their study that the positive returns of momentum strategy are not based on to systematic risk or lead-lag effects which are due to the delayed reactions of prices of stocks to the common factors. They also argue that the positive returns are not totally based on to the overreactions (return reversals) or underreaction (return persistence) since they seem to be too simplistic reasons for the momentum returns. On the other hand Jegadeesh and Titman (1993) appoint that the reasons behind momentum returns are more likely based on the effect that by buying the past winners and selling past losers it causes the prices to shift from the long-term average prices which leads into overreaction on the prices. Furthermore, they suggest that the reason behind the over- and underreactions could be more likely due to the market overreaction to the long-term expectations of companies and on the other hand the market underreactions to the short-term expectations of companies. They also find that the returns for momentum strategy are statistically significant for the holding period of 3 to 12 months. The returns for the momentum strategy observed are from 1.49% to 0.59% which can be considered to be quite low for the time period but they are still statistically significant. (Jegadeesh and Titman 1993: 66–69, 89–90.)

Grundy and Martin (2001) examine momentum strategy profitability in short-term. They investigate the risks included in the strategy and the possible origin of the profitability of a momentum strategy that is long for the past winners and short for the past losers. They use the three Fama-French factors to examine if they have any explanatory power in the momentum profitability in equity markets. They compare the performance of two strategies. The first defines that the profitability of winner and loser portfolios is measured as the stock-specific profits. The second strategy takes long position on winners and short position on losers but only accounts for the total profitability. Their study results suggest that the strategy that accounts for the stock-specific profitability is able to yield significantly more positive returns. This result suggests that stock-specific components hold a significant explanatory power in momentum profitability.

Griffin, Ji and Martin (2003) examine the momentum profitability by investigating macroeconomic risks that may affect momentum profitability. Their results suggest that the profitability of momentum portfolios is positive abroad, and the co-movement across countries is weak. Furthermore, in the 17 markets examined the macroeconomic risks cannot be considered to have a relationship with the momentum profitability cannot be considered to have a relationship with the momentum profitability.

Daskalaki, Kostakis and Skiadopoulus (2014) examine the returns of momentum strategies and common factors behind the returns of individual commodity futures. Their methodology includes using various macro-models which are relevant for commodity futures. The factors they examine in their paper are theoretically sound commodity specific which are evaluated by cross-sectionally setting. The results obtained in this study appoint that the factors they examine, are not able to price the commodity futures cross-section. Furthermore, they do find more support on the previous studies by Erb et al. (2006) and Kat et al. (2007), that commodity futures markets are significantly heterogeneous.

The most common theory which is against the momentum profitability, is the theory of efficient markets hypothesis. According to the theory of efficient markets hypothesis, the past performance of a certain asset does not work as an indicator for forecasting future profits of the asset (Fama 1970). A topic for discussion has also been the performance of the momentum strategy against the contrarian strategy, which includes buying the recent loser assets and by shorting recent winner assets (Lakonishok, Schleifer & Vishny 1994). Momentum investors are able to gain profits by chasing trends but on the other hand usage of simple strategies may lead into overreaction on longer term (Hong & Stein 2000). As previous studies related to momentum anomaly appoint, most of the commodity futures momentum profits can be explained by hedging pressure, which indicates that if the demand of short hedging is higher than the long speculation, the long speculators should earn higher risk premiums (Dewally, Ederington & Fernando 2013; Basu & Miffre 2013).

The performance of momentum strategies on different time terms is also one of the questions associated to momentum profitability. The most relevant studies appoint that momentum is performing best on a short-term period. Jegadeesh and Titman (1993) appoint that momentum strategy gains the best profits on a period of 3 to 12 months and on a longer term the strategy loses its profitability significantly. Rouwenhorst (1998) appoints that the momentum profitability is highest on midrange period of time and the profits of the strategy keep on rising for approximately one year period.

Novy-Marx (2012) examines the momentum profitability by comparing two point of views for the momentum data collection. The first view is by collecting data by using intermediate time horizon. The second observed way is by collecting data of a recent time horizon. Novy-Marx (2012) reports that the first option generates returns of 1.21% and the second option generates a return of 0.77% which can be considered to be a significant difference. Novy-Marx (2012) also examines the reasons behind momentum profits and reports that the momentum is not driven by that loser stocks keep on losing and winner stocks keep on winning but more because of a company's performance 7 to 12 months before the portfolio is comprised. The results obtained in the study are based on the idea that the portfolio should be comprised 7 months prior to the formation period since the momentum does not describe the meaning behind strategy accurately enough. This statement by Novy-Marx (2012) is based on the definition of momentum which appoints that "momentum is a tendency of an object in motion to stay in motion". The results presented in the study by Novy-Marx (2012) are not in line with the traditional momentum since the time horizon is different. He concludes that the performance of the momentum by using the time horizon presented is especially good for large-cap stocks that are more liquid than small-cap stocks.

Since this paper examines a commodity futures strategy which includes momentum it is significant to examine previous studies which also include different asset classes than stocks for the evaluation of the momentum performance. Asness, Moskovitz and

Pedersen (2013) use a time period of 1972 to 2011 in eight different markets to examine asset classes such as commodities and currencies. The results provided in this study appoint that momentum strategy generated excess returns of 12.4% for commodities on average and 3.0% for currencies on average.

4.1.2. Momentum returns on different geographical areas

Since the original momentum studies and most of the more recent studies are mainly based on U.S. markets it is relevant to examine the momentum profitability in different geographical areas to gain more robust evidence on the global momentum profitability. Chordia and Shivakumar (2002) appoint that the momentum profitability can be explained by certain macroeconomic variables which are able to capture time-varying profitability. They examine a possible explanation for momentum strategy profitability by investigating the effects of common factors and firm-specific details.. Their results show that the momentum profitability can be the related to common macroeconomic factors in relationship with business cycle which have indeed an explanatory effect on the strategy profitability. These variables are dividend yield, default spread, yield on 3-month T-bills and the spread of term structure. Furthermore, they appoint that the profitability of momentum strategies is positive only on time periods when the economy is reviving. On the other hand in time periods of recession the strategy profitability turns into negative.

Asness, Moskovitz and Pedersen (2013) appoint a robust result that the momentum anomaly can be found in eight different global markets which supports more the fact that momentum is one of the strongest anomalies which has existed in financial markets. Rouwenhorst (1998) examines the geographical existence of momentum profitability in different geographical areas by examining 12 European countries during the time period of 1980 to 1995. In this study Rouwenhorst (1998: 283) examines momentum data from Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the U.K by constructing a momentum portfolio based on the methods by Jegadeesh and Titman in 1993. The results found by Rouwenhorst (1998) suggests that momentum is profitable in Europe since the returns are in the range of 0.77%

to 1.35% per month. The study by Rouwenhorst (1998) also states that the results are not based on data snooping and that the momentum portfolio outperforms the contrarian portfolio by approximately one percent per month which can be considered to be quite significant difference.

Nijman, Swinkels and Verbeek (2004) investigate the momentum existence in European markets by examining a time period of 1990 to 2000. The motivation for this study is also to highlight the fact that most of the momentum studies only consider U.S. markets and that the momentum robustness for different geographical areas has not been challenged. They examine the momentum performance by using a portfolio-based regression approach to explain the momentum returns for diversified portfolios. This approach makes it possible to examine multiple effects simultaneously which enables to observe the most significant effects from the point of view of the expected excess returns. Their findings suggest that the anomaly is mostly driven by individual momentum effects. They also find that industry momentum also explains part of the momentum returns.

4.1.3. Momentum and markets changes

Recent studies have investigated the effects of market changes to momentum strategy. It has been noticed that momentum is highly effected by the state of the markets (Cooper, Gutierrez & Hameed 2004: 1345). The purpose of their paper is to examine the cross section of stock returns by examining the overreaction theories of short-term momentum and long-term reversal. They examine two market states: “UP”, which is defined as when the lagged three-year market return is negative. “DOWN” is defined as when the lagged three-year market return is negative. Cooper et al. (2004: 1359) appoint that momentum profits are much higher when markets are in a positive state compared to the situation when markets are in a negative state.

There is also evidence that short-term momentum and long-term reversal effects are not related to each other and should be considered as separate effects (George and Hwang 2004: 2145-2146). The profits of momentum strategy are higher when markets are in a stable situation compared to a situation when markets are rising or going downwards

(Asem & Tian 2010: 1549). According to these previous studies it is safe to say that the state of the markets is effecting the efficiency of momentum strategy and should be considered when creating a momentum strategy. Daniel and Moskovitz (2016) examine the momentum profitability during the recent recessions. In their research they find out that momentum has produced significantly negative returns after market crashes. This effect which includes high negative returns during a recession period is called a momentum crash. These negative returns vary from -24.98% (in October of 2001) to -49.19% (in January of 2001). These negative returns are driven by the situation where markets start to recover and the badly performed stocks begin to generate high positive returns which leads into bad performance of the momentum stocks.

Grobys (2014) examines the momentum profitability during the most recent recessions globally. The results provided in this article appoint that the strategy was profitable globally during years 1993 to 2013 but during the recessions it generated significantly negative returns. The most negative returns were observed during the financial crisis of 2007 to 2009. According to Grobys (2014) these results are supported by the study by Daniel and Moskovitz (2016) where they state that momentum crashes are driven by the loser portfolio since the up- and down-beta differential gets highlighted in bear markets.

Barroso and Santa-Clara (2015) examine the momentum performance by examining the possible predictability of momentum strategies. In their paper they examine the past recessions and the relationship between them and momentum since momentum has experienced significant crashes during these recessions. They perform an analysis by examining the variance of daily returns that is realized and find that the risk related to momentum crashing is highly predictable. Their results appoint that the risk management related to momentum leads into significant economic gains. Their methodology includes scaling a long-short portfolio based on its realized volatility from the recent past 6 months and by targeting a constant volatility strategy. The strategy results in Sharpe ratio of 0.97 for the risk-managed version of the momentum strategy but even more significant outcome is the drop in excess kurtosis which drops from 18.24 to 2.68 when compared to the un-managed momentum strategy. Also the left skewness drops from -2.47 to 0.42.

The results obtained by them are robust since they also examine the international evidence related to the strategy.

4.2. Contrarian

Contrarian strategy can be described as an investing strategy that focuses on going long on the assets that have been generating negative excess returns in the recent past and by going short on the assets that have been generating positive excess returns in the recent past. The strategy is based on the idea that the assets that have been generating significant positive excess returns are overvalued and therefore not having a potential of growing in the value and on the other hand the assets that have been generating negative returns are undervalued and since hold more potential in generating positive returns in the future. Furthermore, the strategy can be described as going against the current market trend which generally suggests that the winner assets are being the most bought in the markets and on the other hand the loser assets are the most sold assets in the markets. The contrarian strategies have been proven to be effective on a longer time period compared to momentum. Due to this the contrarian strategies that are observed in this thesis focus on the longer term return aspect of examinations of contrarian strategies. Contrarian anomaly is often referred as long-term reversal. (Chan 1988.)

De Bondt and Thaler (1985) examine the performance and behavior of various portfolios over extended time periods from the point of view of market overreaction. They also test if the overreaction hypothesis has predictive power in the markets. They test the performance of the recent past loser and winner portfolios and do they overreact in the financial markets. They appoint that in the stock markets the overreaction hypothesis predictions are true for the assumption that the past loser portfolios are able to outperform the past winner portfolios. The returns for the loser portfolios thirty-six months after the formation of the portfolios were 25% higher than for the winner portfolios. Furthermore, they appoint that the profitability of the loser portfolios was strongly driven by the January effect.

Lakonishok, Shleifer and Vishny (1994) examine the possible explanations behind the positive performance of value strategies by examining the contrarian anomaly in the financial markets. They examine how the so called “glamour” stocks perform against value stocks. The definition of a glamour stock is that it has been performing well in the recent past which leads the stock being overpriced (Lakonishok et al. 1994: 1542). Furthermore, value stocks are stocks that have been performing badly which leads into overreaction in the markets and to overselling of them since leading into underpricing (Lakonishok et al. 1994: 1542). In this case the assumption is that the value stocks outperform against “glamour” stocks. In their contrarian strategy model they define the contrarian model by stating that the model predicts the differences in expected future growth rates are linked to past growth of the stocks which leads into overestimations in actual future growth differences for the value and glamour stocks. The results obtained in their study suggest that a significant number of value strategies have been able to generate significant positive excess return. Furthermore, they appoint that the patterns related to past, expected and actual future growth rates follows the principles of the contrarian strategy model.

Lakonishok et al. (1994) continue by stating three main findings from their empirical research. First, they find that the performance of the strategy which includes buying the recent past out-of-favor (loser) stocks has been significantly better than strategies including buying glamour stocks over the time period of 1968 to 1990. Second, they suggest an explanation for the positive performance of the value strategies. Their suggested reason for the performance is behind the actual future growth rates of earnings, cash flow, etc. of the glamour stocks compared to value stocks were significantly lower than these values had been in the past. The third finding is due to the risk related to the value strategies. Their findings suggest that the risk of value strategies compared to glamour strategies can be considered to be approximately the same. This suggest that the reward of bearing fundamental risk cannot be considered to be an explanation for the higher average returns on value stocks than on glamour stocks.

Lo and MacKinlay (1990) examine the profitability of contrarian strategies by examining the stock market overreaction as the possible reason for the profitability. They appoint that the cross-sectional interaction of returns of securities can be described as a significant factor in stock price dynamics. Their results suggest that although stock returns are generally positively cross-autocorrelated, which compensates the serial correlation that is negative, in individual asset returns with positive autocorrelation in global indices. This leads into the assumption that stock market overreaction does not have to be the only reason behind the significant returns of contrarian strategies. Their empirical evidence appoints that less than half of the expected profits from these strategies can be explained by market overreaction. Furthermore, the returns from the strategies are mostly due to the cross-effects amidst securities.

4.3. Commodity strategies

Since commodity futures have become even more mainstream asset class it is relevant to examine a possibility of equipping some commonly used market anomalies in commodity futures strategies to examine how they work in commodity markets. Since many of the previous studies have proven, the commodity futures can have equity like returns and the correlation between stocks has noticed to be very low thus making it is compelling to examine how certain signals which have been profitable in equity markets work when combined with commodity futures strategies. (Gorton & Rouwenhorst 2006.)

Erb and Harvey (2006) examine the tactical and strategic value of commodity futures by investigating the historical returns of commodities, the term structure of futures prices and momentum. They suggest that the historical returns for the commodity futures cannot be considered equity-like but they might hold value in portfolio diversification. Furthermore, the term structure of futures prices and momentum strategy in commodity markets based on historical evidence appoints that they have gained excess returns. Erb et al. (2006) provide information that a momentum strategy with 12 month ranking period and 1 month holding period in GSCI-index is able to produce positive and significant returns. However, they argue that there are no existing proofs that these profits will exists in the future.

Miffre and Rallis (2007) investigate 16 momentum strategies in commodity futures markets which include buying the best previous past performance commodity futures and selling the worst previous past performance commodity futures. The time period examined in this paper is from January 1979 to September 2004. The ranking and holding periods examined in the paper range from 1 month to 12 month for the momentum strategies. They also compare the momentum strategies against contrarian strategies which include the opposite actions than the momentum strategies. The ranking and holding period for contrarian strategies were 2 to 5 years. The purpose of this paper was to examine if the short-term price continuation and the long-term reversal exist in commodity futures markets which were originally found in equity markets by Jegadeesh and Titman (1993, 2001) and De Bondt and Thaler (1985). The findings of the article appoint 13 profitable momentum strategies in the commodity futures markets. Furthermore the findings show that contrarian strategies do not work in the commodity futures markets. Miffre and Rallis (2007) show that momentum strategies generate on average returns of 9.38% annually. The results also suggest that the returns are not only related to compensations for the risk but they are based on to the propensity of commodity futures markets as being either backwardated or contangoed. These findings suggest that the momentum strategies tend to buy backwardated and sell contangoed contracts. Furthermore, the returns for the contrarian strategies in commodity futures were between -5.12% to -0.72%.

Shen, Szakmary and Sharma (2007) examine momentum strategies related to commodity futures likewise as Miffre and Rallis (2007). They investigate momentum strategies in commodity futures markets by using a research design which is typically used to examine momentum in stock returns. They appoint that one of the benefits of the futures as asset class is that taking a short position is as easy taking a long position. This is because there are no limitations on taking a short position and the transaction costs are the same as for long position. This makes the applying of momentum strategies in commodity futures markets much easier compared to stock markets which supports the importance of investigating commodity futures returns. The findings of the study by Shen et al. (2007) suggest that the excess returns are significantly positive for short and intermediate time periods in the markets examined. Furthermore, the returns are found to be similar to equity returns and cannot be explained by data-snooping biases.

Rallis, Miffre and Fuertes (2010) continue to examine the commodity futures returns by examining a combination of momentum and term structure signals. They create a double-sort strategy which combines these two signals by buying the backwardated "winner" commodity futures whose prices can be expected to appreciate and by shorting contangoed "loser" commodity futures whose prices are expected to depreciate. They also expand the methodology by Erb and Harvey (2006) by adding the sensitivity of term structure profits to the roll-return definition, the frequency of rebalancing of the long-short portfolios and the date of portfolio formation. Rallis et al. (2010) furthermore examine an in-depth analysis of the risk, performance and trading costs of single signal strategies such as momentum-only, term structure-only and double-sort strategies. The findings of the paper suggest that the combination of momentum and term structure in one strategy is able to reach even higher profits compared to individual strategies which consist only one signal. The average annual return of the strategy is 21.02% compared to the returns of the individual strategies returns of 10.14% and 12.66%. The robustness tests performed in the study suggest that the exceptionally higher performance of the double-sort strategy is not based on lack of liquidity or data mining, the results are only robust to alternative specification of the risk-return relationship. The second significant finding in the paper is that the commodity-based relative-strength portfolios can be considered as attractive additions for diversified portfolios since their correlations with more traditional asset classes are significantly low. These findings appoint that commodity futures have some tactical value in portfolio comprising since they have been proven to be significantly profitable and have some diversification benefits.

Fuertes, Miffre and Fernandez-Perez (2015) examine a commodity strategy that combines momentum, term structure of interest rates and idiosyncratic volatility into a triple-sort strategy. The strategy presented in the paper consists of buying commodity futures with good past performance, high roll-yields and low idiosyncratic volatility, and simultaneously shorting commodity futures with bad past performance, low roll-yields and high idiosyncratic volatility. Their ambition is to examine how the strategy performs against other combinations of such strategies and do the signals used in the strategy overlap each other. Their results suggest that the profits of the strategy are significantly higher than profits from strategies which only use one of the signals mentioned or a combination of two signals. The Sharpe ratio for the triple-sort strategy over a time period of 1985 to 2011 is 0.69 which is much higher than the Sharpe ratio of long-short portfolios based on individually examined signals which is 0.37. Furthermore, they test the robustness of the strategy by appointing that the strategy outperforms double-sort strategies and that the profitability cannot be explained by risks in liquidity or transaction costs. They continue that the profitability of the strategy is not based on overreaction occurring in short terms or subsequent mean reversion. The findings also appoint that the strategy has a role in diversifying risks in equities but it does not work as an inflation hedge.

Asness, Ilmanen, Israel & Moskowitz (2015) examine value investing by investigating a 5-year reversal factor in commodity markets. The results suggest that this style of value investing in commodity futures is able to generate positive Sharpe ratio of 0.11. They also point that the momentum factor in commodity markets is able to generate a Sharpe ratio of 0.56.

Bianchi, Drew and Hua Fan (2015) examine the profitability of a commodity futures strategy which combines momentum and reversal signal into a commodity strategy. Their motivation for the paper is behind the arising profitability of commodities. They suggest that unlike other double-sort strategies their second sort does not require added information other than the commodity futures returns. The strategy is combined by taking long positions in medium-term winners that are long-term losers and by shorting medium-term losers that are long-term winners. They use a holding period of one month since commodity futures have a monthly or bimonthly expiring dates. The results provided in this study appoint that a double-sort strategy which combines momentum and reversal generates significantly higher profits than various single-sort commodity strategies. The strategy generates an excess return of 20.24% per annum. The average profit of single-sort strategies is 11.14% annually. Bianchi et al. (2015) tests the robustness of the strategy by examining seasonality effects and sample adjustments in commodity futures and suggests that they strategy holds even after these factors examined. They also discuss about factors which cannot explain the profitability for the strategy. These factors consist of standard risk factor, term structure, volatility in the markets, investor sentiment, data mining and transaction costs. Furthermore, it seems that the strategy profitability can be explained at least partly by global funding liquidity. They also suggest that the strategy works as a portfolio diversification tool.

Fernandez-Perez, Frijns, Fuertes and Miffre (2018) examine a commodity strategy that is based on the relationship between skewness of commodity futures returns and expected returns. The fundamental of the strategy is to take a long position in commodity futures contracts that are most negatively skewed and short position in commodity futures that are most positively skewed. They use time-series approach to examine does the daily skewness of commodity futures have any indications on the expected returns by taking long position on 20% of commodities that are most negatively skewed and short position on the 20% commodities that are most positively skewed. This strategy yielded excess returns of 8.01% per annum and the alpha for the long-short skewness-based portfolio is 6.21% annually. Fernandez-Perez et al. (2018) conclude that the traditional risk factors related to commodity futures do not explain these excess returns yielded from the strategy which appoints that skewness cannot be considered as an explaining factor for the fundamentals of backwardation and contango in commodity investing.

5. DATA DESCRIPTION AND METHODOLOGY

The first section in this chapter presents the dataset which is used in the empirical part of this study. The dataset consists of 26 individual commodity futures data and GSCI-index which is used as the benchmark index in this study. The second section introduces the methodology of this study. Methodology part includes the description of the momentum and contrarian strategies examined in this thesis. Furthermore, all the formulas used in the momentum and contrarian strategy profitability examinations are introduced. The last part of the methodology presents the multifactor model that is used to examine the sensitivity of the strategies to bond, equity and commodity returns.

5.1. Data

The dataset used in this thesis is collected from Datastream online and consists data of the daily settlement prices of 26 commodity futures. The commodity futures contracts which are used in this thesis are: cocoa, coffee, corn, cotton, concentrated orange juice, oats, soybean meal, soybean oil, soybeans, sugar, wheat, gasoline, Brent crude oil, natural gas, feeder cattle, lean hogs, live cattle, copper, gold, aluminum, palladium, platinum, silver, zinc, tin and lumber. The data is collected for a time period of January 2000 until December of 2018.

Table 1 shows the composition of the GSCI-index which states for the Goldman Sachs Commodity Index. In this paper the GSCI-index is used as a benchmark index and tool of comparison for the individual commodity momentum and contrarian strategies. The index includes 24 commodities. This includes 6 energy futures (Crude Oil, Brent Crude Oil, Unleaded Gas, Heating Oil, Gas Oil and Natural Gas), 5 industrial metal futures (Aluminum, Copper, Lead, Nickel and Zinc), 2 precious Metals (Gold and Silver), 8 agricultural futures (Wheat, Red Wheat, Corn, Soybeans, Cotton, Sugar, Coffee and Cocoa) and 3 livestock futures (Live Cattle, Feeder Cattle and Lean Hogs). The historical performance of the GSCI-index is compared to the momentum and contrarian portfolio performances. By doing this we can examine how the passive buy-and-hold strategy performs against active portfolio management strategies.

By examining the composition of the GSCI-index, it can be noticed that the GSCI portfolio contains significant amount of energy sector commodities. The composition of the GSCI-index has varied over the time period examined in this paper. However, the heavy emphasis of the energy sector in the index has been constant. The buy-and-hold strategy for the GSCI-index has provided quite insignificant excess returns over the time period of January 2000 to December 2018. The annual returns for the long-only GSCI is 1.00%. **Table 2** presents the annualized excess returns for the GSCI-index.

Table 1. The composition of GSCI-Index.

	Portfolio weight
Commodity	GSCI
Aluminum	3,628 %
Brent Crude Oil	16,89 %
Chicago Wheat	3,029 %
Cocoa	0,365 %
Coffee	1,012 %
Corn	4,978 %
Cotton	1,593 %
Feeder Cattle	1,252 %
Gas Oil	4,634 %
Gold	4,209 %
Heating Oil	3,876 %
Kansas Wheat	1,121 %
Lead	0,867 %
Lean Hogs	2,216 %
Live Cattle	4,062 %
LME Copper	4,428 %
Natural Gas	3,898 %
Nickel	0,685 %
RBOB Gasoline	4,584 %
Silver	0,520 %
Soybeans	3,662 %
Sugar	2,487 %
WTI Crude Oil	24,70 %
Zinc	1,304 %
	100 %

Table 2. The returns of GSCI-index January 2000-December 2018

Index	Mean	Standard Deviation	t-Statistic	Skewness	Kurtosis	Sharpe Ratio
GSCI	0,0100	0,2246	0.1590	-0,4049	1,2397	0,0446

The mean and the standard deviation are annualized. The Sharpe ratio is measured as the ratio of mean and standard deviation.

5.2. Methodology

In this section the methodology for the empirical part of this thesis is presented. This includes the construction of the momentum and contrarian portfolios, the equations which are used to examine the profitability of the strategies and finally the multifactor model is presented and the sensitivity of the strategies to equity, bond and commodity returns.

5.2.1. Momentum strategy

Since there are several different ways to construct momentum portfolios for a momentum strategy it is significant to select an amount of strategies which is rational to examine from a standpoint of individual investor. The two main variables which effect the constructing of the momentum portfolios are ranking period and holding period. This thesis examines combinations of ranking periods of 1, 3, 6 and 12 months and also holding periods of 1, 3, 6 and 12 months. The selection of these time periods is due to the momentum profitability during short-term time periods based on previous momentum studies by Jegadeesh and Titman (1993, 2001). This portfolio formation can be considered as a rational way for an individual investor to perform a momentum strategy with relatively low costs.

The momentum portfolios are constructed using similar methodology as Miffre and Rallis (2007). This includes sorting every 26 commodity futures contracts into quantiles at the end of each month based on their average return over the previous R months, which is the ranking period. Then the portfolios are formed by taking the winner and loser quantiles over a certain holding period. The first quantile is considered as the "winner" portfolio and ninth quantile is considered to be the "loser" portfolio for a certain month.

The motivation behind using several commodity futures in this thesis is to examine how a portfolio, consisting of different commodity futures contracts performs against an index of commodities. The expectation is that by using individual commodities we are able to achieve more benefits from diversification which leads into lower levels of risk. This is because it is expected that the combination of various commodity futures based on the previous performance is able to reach higher returns and lower levels of standard deviations.

The returns for the commodity futures returns are calculated by using a methodology similar to many previous studies such as Miffre and Rallis (2007) by using the following equation:

$$(12) \qquad R_t = \ln\left(\frac{SP_t}{SP_{t-1}}\right),$$

where R_t is the return for the strategy and SP_t is the settlement price on the futures contract on day t. The ln denotes a natural logarithm which is a logarithm for to the base, where the e is a mathematical constant equal to 2.718 approximately.

In this thesis the performance of a momentum and contrarian investing strategies are measured by using the Sharpe ratio (SR). The Sharpe ratio is considered to be one of the most commonly known reward-to-risk ratios. SR is calculated by subtracting the risk-free rate from the rate of return of the portfolio and by dividing this result by the portfolio volatility. A greater the number of the SR indicates a better risk-adjusted performance of the portfolio. The SR equation is the following:

$$(13) \qquad Sharpe\ ratio = \frac{E(r_i) - r_f}{\sigma_i},$$

where r_i is the return for the strategy examined, r_f is the risk-free return and σ_i is the volatility of the strategy.

5.2.2. Construction of momentum portfolios

Since the construction of momentum portfolios is based on the previous performance of an asset it is necessary to examine the group of assets in the dataset. The momentum strategy is based on the pattern of investing in the assets that have performed best in the time period examined and short selling the assets that have performed the worst. This is because the momentum theory suggests that the assets that have been performing the best continue to produce higher excess returns in the future, thus continuing their positive trend. The portfolios which are formed have to be rebalanced under certain time periods since it is highly unlikely that the strategy would produce excess returns everlastingly.

In this thesis there are various holding periods and ranking periods which are examined. The main reason why there is not only one combination under examination is that this way it is possible to test how sensitive the strategies are to these choices of ranking and holding periods. However, there is an endless amount of holding and ranking periods which could be examined but the sixteen strategies that are chosen in this thesis describe the most accurately the ones that could be put into use in practice by individual investors or investing managers.

The momentum strategies are constructed similarly as Erb et al. (2006). In the beginning we calculate the logarithmic returns for a certain ranking period and divide the commodity futures into nine quantiles that are based on the previous R months returns. The ranking periods observed are 1, 3, 6 and 12 months. At the end of every month, we take the long position in the commodity futures contracts which have performed the best during the time period examined and short position in the commodity futures contracts that have performed the worst during the time period examined. The performance of the strategy is examined over H months, which denotes the holding period. These holding periods range from 1, 3, 6 and 12 months. The strategy which is obtained is called the R-H momentum strategy.

The regression model which is used to calculate the profitability of momentum strategies in commodity futures markets is based on the study by Miffre and Rallis (2007). They use the following multifactor model to calculate the profitability of the strategies after taking account on the risk:

(14) $$R_{pt} = \alpha + \beta_B(R_{Bt} - R_{ft}) + \beta_M(R_{Mt} - R_{ft}) + \beta_C(R_{Ct} - R_{ft}) + \varepsilon_{Pt},$$

where R_{pt} is the return of the winner, loser, or momentum portfolio, R_{Bt}, R_{Mt} and R_{Ct} are the returns on Datastream government bond index, the S&P500 composite index and GSCI (Goldman Sachs Commodity Index), R_{Ft} is the risk-free rate and ε_{Pt} is the error term.

5.3. Construction of the contrarian portfolios

The ideology behind contrarian strategy is similar as the ideology of the momentum strategy from the point of view of trend following. The contrarian strategy is based on examining the previous performance of a certain asset and building the strategy around this past data. The contrarian strategy expects that the assets state will turn from backwardation into contango during the holding period which would turn the previous loser assets into winner assets. In this thesis the contrarian strategy is examined by using long-term time periods in investing strategies which are typical when examining contrarian strategies. This effect is also called a long-term reversal. The contrarian strategy in this thesis consists of long investing in the commodity futures that have performed the worst over the previous R months and short investing in the commodity futures that have the best performance over the previous R months.

In this thesis several ranking periods and holding periods are being examined to show how sensitive the different portfolios are for these factors in contrarian strategies. The ranking periods that are used are 2 years, 3 years and 5 years. Similarly, the holding periods that are used are 2 years, 3 years and 5 years. The strategies obtained are called R-H contrarian strategies. The contrarian portfolios are formed similarly as the momentum portfolios. This is done by ranking the commodity futures each month into quantiles based on their performance during the previous R months. The first quantile consists of the commodity futures that have performed the worst over the previous R months and the ninth quantile consists of the commodity futures that have performed the best during the previous R months. These factors are motivated by the previous studies which suggest that contrarian strategies are mostly profitable on longer term due to the long term reversal effect. Furthermore, these holding and ranking periods are used by Miffre and Rallis (2007) who examine the possibility of utilizing contrarian strategy in commodity markets.

6. EMPIRICAL RESULTS

In this section the results obtained in this thesis are introduced. First, the profitability of individual commodities over the time period of January 2000 to December 2018 is presented. Second, the profitability of the momentum strategies in commodity markets are examined. The performance of the strategies examined in this thesis are examined during the financial crisis of 2007-2009. Furthermore, the results for the contrarian strategy profitability are examined. In the end of this section the results from the multifactor model are presented.

Table 3 presents the historical excess returns for the individual commodities used in this thesis. Based on the geometric means, the returns of the individual commodities examined in this paper have been positive over the time period of January 2000 to December 2018. Overall we can see that the returns of the individual commodities has fluctuated significantly over the time period examined. Furthermore, we can see that the differences in different commodities have been quite diverse during the sample period which is examined. The rather high values of standard deviation and lack of statistical significance in the sample suggest that the individual commodities cannot be considered as a stable long-term investment. However, the time period examined in this thesis also contains the financial crisis of 2007 to 2009 which could hold some explanations for the quite low returns of individual commodity futures.

Table 3. Historical excess returns January 2000 – December 2018

Commodity	Arithmetic	Geometric mean	Standard Deviation	t-Statistic	Skewness	Kurtosis	Sharpe Ratio
Brent crude oil	0,0933	0,0480	0,3108	1,2200	-0,1625	-0,5404	0,1412
Soybeans	0,0751	0,0329	0,2734	1,1577	1,0559	1,4335	0,1288
Wheat	0,0891	0,0385	0,3161	1,3579	1,0126	1,1483	0,1434
Gold	0,0966	0,0842	0,1679	1,1302	-0,7011	0,7807	0,5718
Cocoa	0,1129	0,0592	0,3238	1,8149	0,5694	0,6982	0,2237
Corn	0,0780	0,0291	0,2942	1,0706	1,5899	4,3509	0,1169
Feeder cattle	0,0427	0,0263	0,1576	1,0794	0,1210	-0,4507	0,1677
Live cattle	0,0469	0,0282	0,1746	1,2769	0,1469	-0,6481	0,2336
Cotton	0,0707	0,0124	0,3143	0,9386	0,5882	0,2809	0,0354
Sugar	0,0967	0,0375	0,3419	1,1051	1,5889	2,4155	0,0917
Natural gas	0,1665	0,0036	0,5456	1,3591	2,8496	10,1037	0,0044
Lean hogs	0,0781	0,0054	0,3696	1,0815	0,9602	3,0774	0,0374
Copper	0,0987	0,0588	0,2639	1,3171	1,4479	3,9964	0,1446
Silver	0,1046	0,0586	0,2997	1,5534	0,9325	1,3642	0,2085
Coffee	0,0365	-0,0035	0,3147	0,5011	0,6000	0,0254	-0,0108
Gasoline	0,0855	0,0428	0,3063	1,1302	0,0434	1,0306	0,1374
Aluminium	0,0262	0,0040	0,2019	0,5042	0,2387	-0,4123	0,0193
Zinc	0,0805	0,0367	0,2673	1,1079	0,9663	0,7913	0,0904
Soybean Oil	0,0655	0,0334	0,2610	1,0747	0,6795	-0,1558	0,1269
Orange Juice Conc.	0,0697	0,0058	0,3184	0,9644	0,4137	-0,5324	0,0163
Oats	0,1188	0,0540	0,3613	1,4903	0,4537	0,5531	0,2082
Lumber	0,0514	0,0088	0,3261	0,6865	0,2273	-1,1937	0,0312
Platinum	0,0614	0,0372	0,2312	1,0390	0,1116	-0,4990	0,1508
Palladium	0,1248	0,0722	0,3619	1,3463	0,6180	-0,1462	0,1436
Soybean meal	0,0849	0,0357	0,2894	1,2902	0,4223	-0,4742	0,1472
Tin	0,0979	0,0530	0,2468	1,3943	0,4132	-1,1301	0,1668

The arithmetic mean, geometric mean and standard deviation are annualized.

6.1. Momentum strategies

Table 4 presents the summary statistics for the short-term momentum strategies with holding periods of 1 to 12 months and ranking periods of 1 to 12 months. The rows in this table represent the various ranking periods used in this thesis and the columns represent the holding periods. From table 4 we can see that the winner portfolios constantly beat the loser portfolios regardless of the ranking or holding period. The results are in line with the study results by Miffre and Rallis (2007). The momentum strategies created in this study are all generating positive annualized excess returns. From the 16 strategies 12 are statistically significant at the 10% level. The average annualized return for the 12 strategies that are statistically significant, one can earn a 6.63% excess return by exercising the momentum strategy that buys the recent past winner commodities and sells the recent past loser commodities. Furthermore, the momentum strategy in commodity futures can be considered to be significantly better performing than a long-only commodity strategy that has generated a 1.00% annualized excess return over the time period of 2000 to 2018.

These results are similar as the results obtained by Jegadeesh and Titman (1993) who suggest that momentum strategies perform in equity markets and the results by Miffre and Rallis (2007) who appoint that momentum strategies are profitable in the commodity markets. Furthermore, Erb and Harvey (2006) suggest that the momentum strategy which consists of a holding period of 1 month and ranking period of 12 months is able to produce excess returns, which is also in line with the results obtained in this paper. Due to these results it is safe to say that the momentum anomaly is able to generate significant excess returns and it still exist in the commodity markets like Miffre & Rallis (2007) and Fuertes, Miffre & Fernandez-Perez (2015) suggest.

The profitability of the momentum strategies examined in this paper is constantly driven by the loser portfolios. The winner portfolios formed in this paper generate an average of -0.18% negative returns which can be considered to be quite insignificant. However the loser portfolios formed in this paper generate an average return of -6.35% which is the main cause of the profitability of the strategies observed. Furthermore, all the loser portfolios observed are generating negative returns consistently across all the 8 profitable momentum strategies which is the most significant driver of the momentum strategy profitability. This result is in line with the observations by Hong, Lim and Stein (2000: 277) who suggest that the momentum profitability is mainly driven by the losers in every category they examine.

The reward-to-risk ratios which are calculated as the ratio of the annualized mean and annualized standard deviation are reported in table 4. The ratios for the winner portfolios are generally quite low or even negative. This result suggests that winner portfolios generally do not generate significant excess returns. The ratios for the loser portfolios are generally significantly negative which is in line with the suggestion that the loser commodity futures are not able to generate positive excess returns but are the main driver of the momentum strategy positive returns. The ratios for the momentum portfolios are ranging from 0.17 to 0.75. This result suggests that the momentum portfolios are able to generate positive risk-adjusted results by utilizing the momentum strategy.

Table 4. Summary statistics of momentum strategy returns

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	Winners	Losers	Momentum	Winners	Losers	Momentum	Winners	Losers	Momentum	Winners	Losers	Momentum
Panel A: Ranking period of 1 month												
Mean	-0,0345	-0,0822	0,0477	0,0032	-0,0520	0,0552	0,0157	-0,0475	0,0632	0,0304	-0,0396	0,0700
	(-0.95)	(-2.38)	(0.79)	(0.14)	(-2.32)	(1.36)	(0.88)	(-2.93)	(2.02)	(2.37)	(-3.50)	(3.09)
Standard deviation	0,1606	0,1565	0,2773	0,0992	0,0995	0,1806	0,0764	0,0711	0,1363	0,0537	0,0490	0,0965
Reward-to-risk ratio	-0,2148	-0,5253	0,1721	0,0322	-0,5232	0,3059	0,2058	-0,6674	0,4637	0,5659	-0,8077	0,7249
Panel B: Ranking period of 3 month												
Mean	-0,0087	-0,0704	0,0617	0,0023	-0,0606	0,0630	0,0005	-0,0650	0,0655	0,0170	-0,0444	0,0614
	(-0.23)	(2.08)	(-2.19)	(0.10)	(-2.79)	(1.61)	(0.03)	(-4.07)	(2.13)	(1.36)	(-4.15)	(2.89)
Standard deviation	0,1646	0,1514	0,2720	0,0970	0,0974	0,1746	0,0780	0,0715	0,1374	0,0540	0,0475	0,0937
Reward-to-risk ratio	-0,0531	-0,4652	0,2268	0,0241	-0,6224	0,3606	0,0063	-0,9090	0,4767	0,3149	-0,9339	0,6551
Panel C: Ranking period of 6 month												
Mean	-0,0295	-0,0804	0,0509	-0,0215	-0,0800	0,0585	-0,0114	-0,0744	0,0630	0,0055	-0,0507	0,0562
	(-0.76)	(-2.19)	(0.79)	(-0.89)	(-3.71)	(1.44)	(-0.59)	(-5.00)	(2.05)	(0.41)	(-4.78)	(2.57)
Standard deviation	0,1691	0,1642	0,2911	0,1059	0,0968	0,1843	0,0835	0,0665	0,1379	0,0580	0,0468	0,0962
Reward-to-risk ratio	-0,1744	-0,4895	0,1748	-0,2030	-0,8263	0,3175	-0,1366	-1,1193	0,4568	0,0956	-1,0825	0,5845
Panel D: Ranking period of 12 month												
Mean	-0,0094	-0,0838	0,0744	0,0007	-0,0665	0,0672	0,0021	-0,0635	0,0655	0,0089	-0,0553	0,0641
	(-0.24)	(-2.43)	(1.21)	(0.03)	(-3.18)	(1.61)	(0.10)	(-4.00)	(1.98)	(0.65)	(-5.03)	(2.86)
Standard deviation	0,1673	0,1558	0,2794	0,1621	0,1425	0,2810	0,0874	0,0694	0,1445	0,0571	0,0478	0,0971
Reward-to-risk ratio	-0,0560	-0,5375	0,2663	0,0043	-0,4670	0,2393	0,0237	-0,9142	0,4535	0,1550	-1,1568	0,6603

The mean and standard deviation are presented as annualized. The Sharpe ratio, is calculated as the ratio of the annualized mean and annualized standard deviation. T-ratios for the significance of the mean are in parentheses. The definition of returns assumes that the contracts are held up one month before maturity, at which date the position is rolled over to the second nearest contract and held up to one month before to the maturity

Figure 2 appoints the development of the commodity strategies that are profitable at the 10% significance level. The figure appoints the profitability of a certain strategy as a cumulative return by percentage. We can see from the figure that the commodity futures have experienced quite significant deviation in their annual returns but have still been able to generate excess returns over the time period of January 2000 to December 2018. The most significant finding is that we can see from the graph that all the momentum strategies examined in this paper that are profitable at the 10% level were able to beat the Goldman-Sachs Commodity Index by a significant margin over the time period examined. This suggests that momentum strategies in commodity markets are able to generate positive excess returns by benefiting technical analysis when compared to a passive long-only commodity strategy.

The figure 2 can be used as a proxy for the future profitability for the commodity futures returns in the future. The figure suggests that the commodity futures do have similar deviation in their returns but are able to generate positive returns on the long term. Furthermore, the fact that long and short position in futures trading are equally easy to take it makes the momentum strategy attractive investing strategy for a trader that is willing to utilize technical analysis and active portfolio management. These results appoint that the past performance of commodity futures can be used as a proxy for the future profitability of a commodity momentum strategy

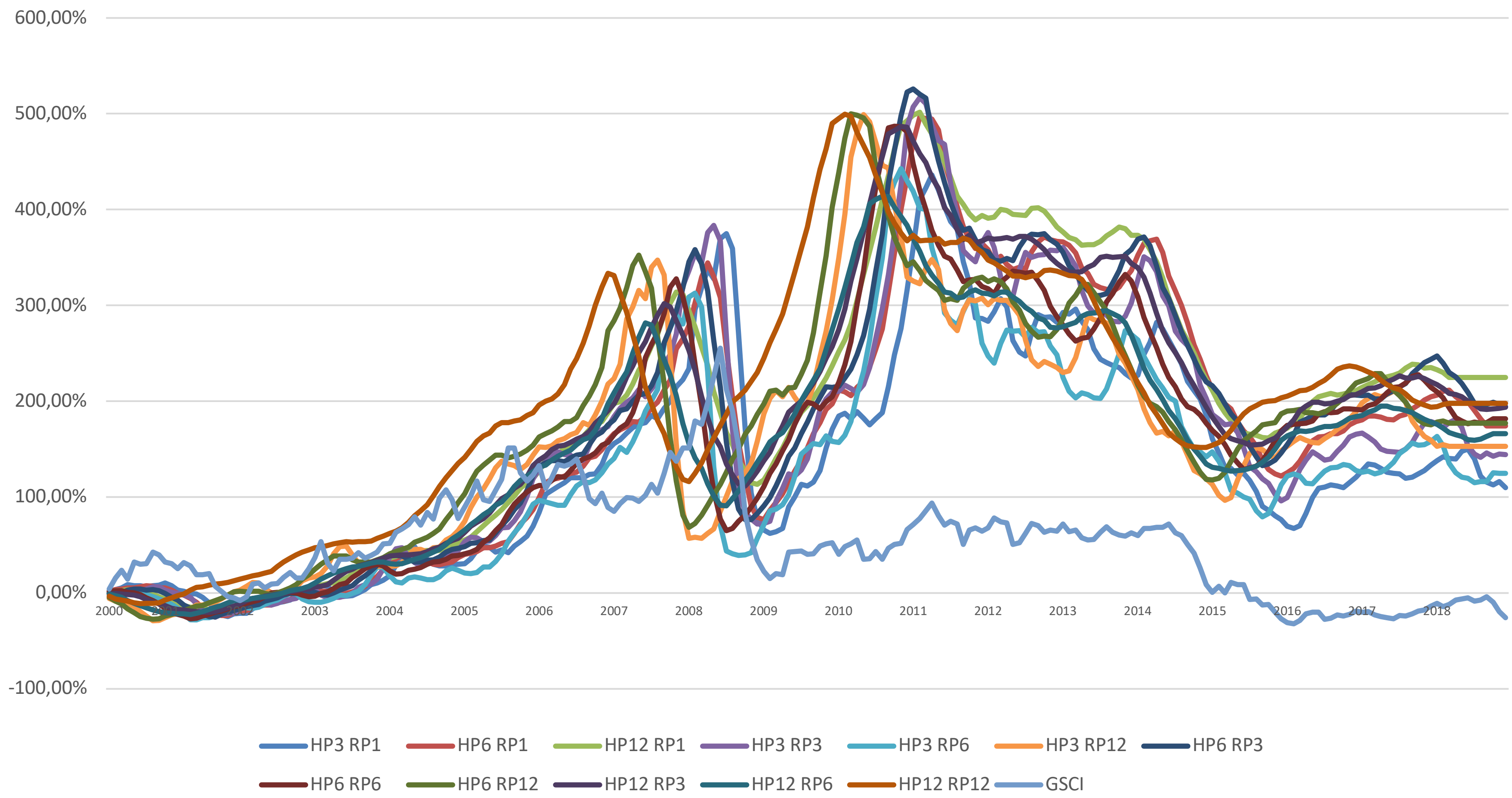

Figure 2. The development of the momentum strategies and GSCI returns during January 2000 to December 2018.

6.2. Multifactor model results

The multifactor regression results are presented in **table 5**. In this multifactor model the purpose is to examine if the 12 momentum strategies that are profitable at the 10% level gain their profitability as a compensation for risk. The table 5 presents the sensitivity of each strategy for bond, stock and commodity futures market returns. Furthermore, the α presents the excess returns of each strategy.

From the regression analysis we can see that the momentum strategies examined in this thesis have a relationship with the Goldman-Sachs Commodity Index fluctuations and the momentum strategies do follow the same pattern in general. Furthermore, the bond and equity market risks do not have a significant effect on the commodity futures profitability. The adjusted R-squares measured in this analysis are quite low which suggest that the model is able to explain the variation in the independent variables which confirms the result that the commodity strategy profitability's obtained in this thesis cannot be considered as a compensation for risk.

The average excess return of the momentum strategies annually is 5.46%, ranging from low 3.72% for the 1-3 strategy to a high of 6.74% for the 12-12 strategy. The 12 strategies that are able to gain positive excess returns in table 4 have positive α in table 5.

Table 5. The static risk model

	Holding period of 3 month	Holding period of 6 month	Holding period of 12 month
	Momentum	Momentum	Momentum
Panel A: Ranking period of 1 month			
α	0,0372	0,0491	0,0661
	(0,5591)	(1,7285)	(2,8093)
βB	0,0084	0,0093	0,0363
	(0,0588)	(0,0800)	(0,3811)
βM	0,3323	0,2428	0,0546
	(3,2374)	(4,2501)	(1,1531)
βC	0,1013	0,2687	0,0962
	(1,5388)	(7,8613)	(3,4179)
$\bar{R}^2$	8,02 %	27,37 %	4,58 %
Panel B: Ranking period of 3 month			
α	0,0514	0,0530	0,0636
	(0,7388)	(0,8153)	(1,3855)
βB	0,1636	0,2547	0,0245
	(0,9888)	(1,7515)	(0,3207)
βM	0,1422	0,0998	0,0189
	(1,3724)	(1,4111)	(0,4274)
βC	0,0652	0,0004	-0,0379
	(1,2708)	(0,0089)	(-1,2114)
$\bar{R}^2$	0,71 %	0,67 %	-0,35 %
Panel C: Ranking period of 6 month			
α	0,0459	0,0508	0,0601
	(0,6324)	(0,7886)	(1,2899)
βB	0,2071	0,2673	0,0007
	(1,2212)	(1,8407)	(0,0085)
βM	0,1276	0,0964	0,0164
	(1,2425)	(1,3199)	(0,3478)
βC	0,0784	-0,0003	-0,0447
	(1,4923)	(-0,0079)	(-1,3152)
$\bar{R}^2$	0,56 %	0,67 %	-0,15 %
Panel D: Ranking period of 12 month			
α	0,0563	0,0544	0,0674
	(1,2366)	(0,7795)	(1,3845)
βB	0,1807	0,2645	0,0360
	(0,9817)	(1,7318)	(0,4458)
βM	0,0895	0,0600	-0,0055
	(0,9650)	(0,7460)	(-0,1097)
βC	0,0768	0,0046	-0,0326
	(1,3987)	(0,0977)	(-0,9005)
$\bar{R}^2$	0,04 %	0,18 %	-0,65 %

The table presents the coefficient estimates from table 1. α measures the abnormal performance of a certain strategy. βB, βM and βC measures the sensitivity of the strategy returns to the excess returns on Datastream government bond index, the S&P500 composite index and GSCI. The t-ratios are in parenthesis. To make the comparison more convenient, α is annualized. $\overline{R^2}$ is the adjusted R-square.

In **table 6** the reward-to-risk ratios are presented for the momentum strategies examined in this paper during the financial crisis of 2007 to 2009. These results show that the momentum strategies consistently produce negative returns over the crisis period. This result appoints that the commodity futures experienced the market crash similarly as stocks during the latest financial crisis. Furthermore, the crisis affected the profitability of commodity futures significantly which also causes the average annualized profitability of the strategies much lower as the similar strategies performed by Miffre and Fuertes (2007).

Table 6. The reward-to-risk ratios for the momentum strategies during 2007-2009

Panel A: Ranking period of 1 month	
H = 1	-0,3602
H = 3	-0,4431
H = 6	-0,6108
H = 12	0,1812
Panel A: Ranking period of 3 month	
H = 1	0,4192
H = 3	-0,3175
H = 6	-0,3317
H = 12	-0,5110
Panel A: Ranking period of 6 month	
H = 1	-0,4015
H = 3	-0,2238
H = 6	-0,2394
H = 12	-0,5134
Panel A: Ranking period of 12 month	
H = 1	-0,3590
H = 3	-0,1727
H = 6	-0,2140
H = 12	-0,3910

6.3. Portfolio diversification and inflation hedging

In this section the correlations between the momentum strategy returns and asset classes such as bonds, equities and commodities are examined. The possibility of the momentum strategies in inflation hedging is also examined. **Table 7** appoints the correlations between these traditional asset classes with the commodity momentum strategies. Also the correlation with inflation is examined.

Table 7. Diversification and inflation hedge

	U.S. Bonds	U.S. Equity	Commodities	Inflation
Panel A: Ranking period of 1 month				
H = 3	0,00	0,07	0,21**	0,17*
H = 6	-0,16	0,28**	0,47**	0,45**
H = 12	-0,07	0,24**	0,28*	0,18*
Panel B: Ranking period of 3 month				
H = 3	0,02	0,10*	0,08	-0,01
H = 6	0,10*	0,06	-0,01	-0,15*
H = 12	0,02	0,02	-0,09*	-0,23*
Panel C: Ranking period of 6 month				
H = 3	0,03	0,08	0,09*	0,00
H = 6	0,10*	0,05	-0,02	-0,15*
H = 12	0,01	0,02	-0,11*	-0,23*
Panel D: Ranking period of 12 month				
H = 3	0,03	0,05	0,09*	-0,02
H = 6	0,11*	0,01	-0,01	-0,16*
H = 12	0,04	-0,02	-0,08	-0,22*

The table presents the correlations between returns of momentum strategies and the returns of three traditional asset classes. H is the holding period of the strategy. * and ** indicate the level of significance at 1% and 10% level by using the Pearson correlation test.

From table 7 we can see that the correlations of momentum strategies with these three asset classes are generally quite low and insignificant. This result combined with the results obtained in table 5 suggest that the momentum strategies in commodity markets do have portfolio diversification benefits. However, the results regarding the tests of commodity strategies benefits in inflation hedging are quite controversial. The panel A suggests that the momentum strategies utilizing ranking periods of 1 month have a positive correlation with inflation suggesting that they have potential in inflation hedging. However, the commodity strategies that utilize ranking periods of 3, 6 and 12 months have a negative correlation with inflation which suggests the opposite.

6.4. Contrarian strategies

This section presents the performance of commodity strategies that follow the contrarian investing perspective. The strategy buys the commodity futures that have performed the worst over a certain ranking period and sells the commodity futures that have the best performance over a certain ranking period. The expectation of the strategy is that the commodity futures contracts that have been profitable in the recent past are being overvalued and their value will decrease and on the other hand the commodity futures contracts that have not been profitable in the recent past are undervalued and will turn into profitable.

The results presented in **table 8** appoint similar observations as the study results by Miffre and Rallis (2007). The contrarian strategies utilized in the commodity futures markets are not able to produce positive excess returns in any combination of holding and ranking period examined in this paper. Furthermore, the standard deviations of the strategies indicate that the returns of various strategies examined are quite volatile which leads into low Sharpe ratios for every strategy. Based on these results the contrarian anomaly that was detected in stock markets by De Bondt and Thaler (1985) cannot be found in commodity markets. Furthermore, most of the results obtained in table 7 are not statistically significant. The returns from contrarian strategy are not able to reach positive even though the returns for individual commodity futures during the time period examined have been generally positive.

By examining these results obtained we can state that although the holding periods examined in this paper are up to five years, the past loser commodity futures are not able to turn profitable during this time period. This result appoints that the commodity futures are not changing from a state of backwardation to contango during this examination period. However, these results suggest that the past loser commodity futures keep on losing on their value and the past winner commodity futures are able to continue their raise in value. Miffre and Rallis (2007) suggest that the lack of price reversals in commodity futures markets is possible in commodity markets since the markets do not change state from backwardation to contango or vice versa.

Table 8. Summary statistics of contrarian strategy returns

	Holding period of 2 years			Holding period of 3 years			Holding period of 5 years		
	Winners	Losers	Contrarian	Winners	Losers	Contrarian	Winners	Losers	Contrarian
Panel A: Ranking period of 2 years									
Mean	0,0168	0,0892	-0,0669	0,0042	0,0731	-0,0646	-0,0130	0,0458	-0,0565
	(0,9199)	(4,8951)	(-2,0237)	(0,3172)	(5,4913)	(-2,6755)	(-1,2675)	(4,4724)	(-2,9431)
Standard deviation	0,1581	0,1522	0,2924	0,1144	0,1105	0,2123	0,0880	0,0853	0,1660
Reward-to-risk ratio	0,1066	0,5857	-0,2287	0,0365	0,6619	-0,3043	-0,1479	0,5368	-0,3401
Panel B: Ranking period of 3 years									
Mean	0,0178	0,0924	-0,0688	-0,0005	0,0669	-0,0635	-0,0141	0,0360	-0,0484
	(1,0073)	(1,0114)	(1,0026)	(1,0062)	(1,0099)	(1,0027)	(1,0054)	(1,0082)	(1,0035)
Standard deviation	0,1717	0,1610	0,3144	0,1280	0,1179	0,2327	0,0826	0,0928	0,1712
Reward-to-risk ratio	0,1036	0,5737	-0,2187	-0,0040	0,5673	-0,2729	-0,1704	0,3875	-0,2830
Panel C: Ranking period of 5 years									
Mean	0,0105	0,0555	-0,0429	-0,0009	0,0361	-0,0359	-0,0021	0,0310	-0,0322
	(1,0093)	(1,0110)	(1,0074)	(1,0087)	(1,0102)	(1,0075)	(1,0086)	(1,0099)	(1,0075)
Standard deviation	0,1547	0,1320	0,2754	0,1464	0,1103	0,2451	0,0839	0,0855	0,1638
Reward-to-risk ratio	0,0677	0,4207	-0,1557	-0,0064	0,3275	-0,1464	-0,0249	0,3627	-0,1965

The mean and standard deviation are annualized. The reward-to-risk ratio, measured as the Sharpe ratio, is measured as the ratio of the annualized mean and annualized standard deviation. T-ratios for the significance of the mean are in parentheses.

7. CONCLUSIONS

This thesis examines 16 short-term momentum and 9 long-term contrarian strategies in commodity futures markets. The methodology of the thesis relies on the research by Miffre and Rallis (2007) who examine the short-term continuation and long-term reversal effects in commodity futures markets over a time period of 1979 to 2004. The motivation behind examining commodity future strategies is based on the absence of short selling restrictions and the possible negative correlation with other asset classes. The empirical results obtained in this thesis appoint that 12 out the 16 momentum strategies examined are able to produce statistically significant positive excess returns. Although De Bondt and Thaler (1985) appoint that contrarian strategies are able to generate excess returns in equity markets, the results of this thesis suggest that the profitability of the strategy does not exist in commodity markets likewise as Miffre and Rallis (2007) argue.

The average return of the relative strength momentum commodity strategies examined in this thesis is 6.63% annually. For the same time period the Goldman Sachs Commodity Index produces a 1.00% return annually which suggest that the active portfolio management is able to produce superior returns when compared to the passive long-only strategy. Furthermore, the profitability of the momentum strategies is tested for the possibility of the profits being compensation for the risk. The results from the static risk model suggest that this is not true for the commodity markets. Furthermore, it is relevant to notice that even though the time period examined in this thesis contains the financial crisis of 2007-2009, the average annual returns for the momentum strategies in commodity markets are significant and positive. The 9 contrarian strategies examined in this thesis, only produce negative returns for ranking and holding periods of 2, 3 and 5 years. The returns are also generally statistically insignificant at the 10% level.

One of the main findings in this thesis is related to the correlations between the momentum strategy returns and the returns of bonds, equities and commodities. The correlations between these asset classes is found to be relatively low which strengthens the possibility of commodity futures having potential in portfolio diversification. However, the possibility of inflation hedging examined in this thesis suggest controversial results. Based on these results the benefits in inflation hedging cannot be considered as robust.

Based on the previous studies and this thesis the momentum strategies are able to generate significant excess returns. However, the reasons behind momentum profitability are not certain. Furthermore, the profitability that has existed in the past is not guaranteed to continue to exist in the future. Although, it is safe to say that commodity futures do offer benefits for investors seeking for a better portfolio diversification and excess returns. Furthermore, it can be stated that the technical analysis benefiting from active portfolio management is able to generate returns that are higher than a long-only investment in commodity markets. For the future studies related to commodity futures profitability and diversification benefits there are many possible factors which could be examined. For example, the possibility of reaching an effective inflation hedge and even better returns by examining other market anomalies that have not been tested in other asset classes could be examined.

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