Hedge Hunting the Polar Bear

The Tactical and Strategic Value of Commodity Futures on Nordic Markets

Victor Steien
MSc, Major in Finance
Stockholm School of Economics

Christian Wachtmeister
MSc, Major in Finance
Stockholm School of Economics

Abstract

Despite the fact that commodity futures have been trading for hundreds of years, it is only recently that the debate has begun about including these assets in conventional portfolios. Much of the attraction of commodities emerges from their potential to produce equity-like returns while having low or even negative correlation with equities and bonds, thus providing considerable diversification benefits. This thesis demystifies the unexplored strategic and tactical opportunities that commodity futures present to investors on the Nordic markets. On the basis of the facts we produce, the historical performance of investments in commodity futures puts forward an attractive asset class to diversify traditional portfolios of stocks and bonds. We find a positive correlation between commodity futures and inflation which has important implications for long term asset management, where the aim is not only to generate a positive return, but also to protect the assets from decline in real terms. Interestingly and in contrast to previous research, we find evidence of a small but positive correlation between Scandinavian stock markets and commodity futures. The higher correlation may be a reflection of a higher commodity dependency in these markets. Conclusively, the thesis sheds light on the risk-return characteristics of adding commodity futures to an investment portfolio. In spite of not being a perfect hedge with zero or negative correlation with stocks and bonds, commodity futures still have a lot to offer the hedge hunting investor in terms of diversification benefits and the associated increase in risk adjusted returns.

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TABLE OF CONTENTS

1. INTRODUCTION

With little obvious potential in traditional asset classes, and risk premiums declining, many investors have slowly but surely turned to embrace 'alternative' investments, such as hedge funds, private equity and commodities. The optimistic growth prospects of large developing countries like Brazil, China and India, and the accompanying need for oil, industrial metals and construction supplies, have convinced many investors that the only direction for commodity prices is up. Consequently, investment in commodities is growing at an unprecedented rate (Kat and Oomen (2006)).

While commodity futures have been trading for hundreds of years, it is only recently that the debate has begun about including these assets in mainstream portfolios (Erb and Harvey (2006)). Over the past years, commodity prices have experienced the biggest boom in half a century. Much of the attraction of commodities appears to be the fact that they seem to produce equity-like returns while having low or even negative correlation with equities, thus potentially providing considerable diversification benefits. This view is supported by recent studies such as the Gorton and Rouwenhorst (2005), finding considerable evidence that the inclusion of commodities in a portfolio can improve its risk-return characteristics. The results of this and other similar studies were widely publicized, and received attention well beyond the academic community (Basu et. al (2006)). This might be partly responsible for the renewed interest of the asset management industry in commodities. However, at the same time there have been calls for caution from academics and practitioners alike.

In a well-diversified portfolio, the overall portfolio's risk-return characteristics are primarily determined by the relationship between the various asset classes that make up the portfolio. When considering investing in a new asset class, it is therefore important to carefully analyze the relationship between the returns on that particular asset class and the return on asset classes already present in the portfolio. Erb and Harvey (2006) point out that simply adding commodities to an equity portfolio does not necessarily guarantee superior performance, thus emphasizing the need for active management. There is also the issue whether the publicity received by "bullish" studies may itself affect investor behavior and thus alter the outlook for commodity investment. Moreover, as commodity prices have increased during recent years, fears are arising concerning inflation. Since one part of inflation is caused by rising commodity prices, it is not unreasonable to assume that commodities may provide a good hedge against inflation.

1.1 Purpose and Contribution

This paper explores the strategic and tactical opportunities that commodities present to investors on the Nordic markets. Since the Goldman Sachs Commodity Index (GSCI) was launched in 1992, the arguments for why a basket of long commodity futures contracts should have positive returns have been well chronicled. A primary motivation for investing in alternative asset classes is to diversify and

thus hedge against poor performance in traditional assets classes, particularly equities (Edwards and Caglayan (2000)). Prices of raw materials often move independently of financial markets. However, even the most sophisticated investors have long ignored the diversification benefits of commodity investments because of the inherent volatility in the asset class. It is important that the increased interest for commodity futures as an investment is complemented by academic research. Given the rising interest for commodities among professional investors, there is a surprising scarcity of commodity related research performed in other markets than the United States. By taking a Scandinavian perspective on commodity investing, our study hence contributes to explore unknown territory of the academic landscape. The study is unique and it is the first covering this particular field. Commodities are important to the Scandinavian economies with their many commodity production related industries.

On the basis of the facts we produce, the historical performance of investments in commodity futures suggests that they are an attractive asset class to diversify traditional portfolios of stocks and bonds. We find a positive correlation between commodity futures and inflation which has important implications for long term asset management, where the aim is not only to generate positive return, but also to protect the assets from decline in real terms. In contrast to previous research, we find evidence of a positive correlation between Scandinavian stock markets and commodity futures. The higher correlation may be a reflection of a higher commodity dependency in these markets. Moreover, we shed light on the diversification benefits of adding commodity futures to an investment portfolio. Our analysis indicates that commodity futures yield equity like returns, i.e. the risk and return of commodity futures is comparable to those of stocks. Even though not being a perfect hedge with zero or even negative correlation to stocks and bonds, as suggested by previous research, commodity futures still have a lot to offer the strategic investor in terms of diversification benefits and the associated increase in risk adjusted returns.

Our research not only provides valuable insights to investors on the never ending quest for higher risk adjusted returns. It also sheds light on the underlying economic realities and structural differences between different economies and markets. The return characteristics of commodities and the correlation with other asset classes reflect economic circumstances of the three Scandinavian countries, which in some aspects differ from the US, where the vast majority of commodity futures related research has been performed. It is our aim and belief that this research is as valuable to the professional investor as to the scholar.

2. THEORETICAL FRAMEWORK

2.1 The Fundamentals of Commodity Futures Returns

Commodity futures are still a relatively unknown asset class. This may be because commodity futures are strikingly different from stocks, bonds, and other conventional assets. Among these differences Gorton and Rouwenhorst (2005) identify: (1) commodity futures are derivative securities; they are not claims on long-lived corporations; (2) they are short maturity claims on real assets; (3) unlike financial assets, many commodities have pronounced seasonality in price levels and volatilities. Another reason that commodity futures are relatively unknown may be more prosaic, namely, there is a lack of data.

With crude oil along with other commodities reaching all time highs, interest in commodities has risen to historic levels. Commodities have emerged from recent obscurity to the front pages of both alternative and mainstream investment publications and assets are piling into commodity linked indices and products. The economic function of corporate securities, liabilities of firms, such as stocks and bonds, is to raise external resources for the firm. Investors are bearing the risk that the future cash flows of the firm may be low occurring bad times, like recessions. These claims represent the discounted value of cash flows over very long horizons. Their value depends on decisions of management as well as market conditions and investors are compensated for these risks. Gorton and Rouwenhorst (2005) call attention to the fact that commodity futures are rather different since they do not raise resources for firms to invest. Instead, commodity futures allow firms to obtain insurance for the future value of their outputs or inputs. Investors in commodity futures receive compensation for bearing the risk of short-term commodity price fluctuations.

When a currency weakens, the Federal Reserve has a variety of tools available to manage valuation and promote stability. Likewise, central banks can massage interest rates to address economic concerns like inflation and deflation. Moreover, companies can address many near-term over- or underperformance matters through a variety of corporate actions. When a drought damages a grain crop or a hurricane destroys a key energy distribution channel, however, governments, banks, and companies often have restricted options to support short-term stability in commodity markets (Akey (2005)). While all markets face periodic crises and disruptions, financial market contracts can be filed in a drawer or a hard drive. Commodity storage and distribution is a far more complex and expensive endeavor, so the production cycles of many natural resources are designed to reduce cost-of-carry and spoilage expenses. Hence, many commodities are mined in quantities commensurate to anticipated consumption. With limited intervention capabilities and slow production responses, the market has basically one response to short-term supply and demand disruptions: Price. This results in the notorious volatility of commodities prices and investments.

2.2 The Mechanics of an Investment in Commodity Futures

According to Gorton and Rouwenhorst (2005), commodity futures do not represent direct exposure to actual commodities. Futures prices represent a bet on the expected future spot prices. Inventory decisions link current and future scarcity of the commodity and consequently provide a connection between the spot price and the expected future spot price. But commodities, and hence commodity futures, display a wide range of specific characteristics. Some are storable and some are not while some are input goods and some are intermediate goods.

A commodity futures contract is an agreement to buy or sell a specified quantity of a commodity at a future date, at a price agreed upon when entering into the contract – the future price. The future price is different from the value of a futures contract. Upon entering a futures contract, no cash changes hands between buyers and sellers – and hence the value of the contract is zero at its inception. Since the future spot price is unknown today, a futures contract is a way to lock in the terms of trade for future transactions. In determining the fair futures price, market participants will compare the current futures price to the spot price that can be expected to prevail at the maturity of the futures contract. In other words, futures markets are forward looking and the futures price will embed expectations about the future spot price. If spot prices are expected to be much higher at the maturity of the futures contract than they are today, the current futures price will be set at a high level relative to the current spot price. According to Black (1976), lower expected spot prices in the future will be reflected in a low current futures price.

There are three sources of return in commodity investing: spot return, roll return and collateral interest. Spot return arise from the changes in spot price, roll return from the term structure of future prices and finally collateral interest is the interest earned on cash or money market account used to collateralize the futures position. In the following sections, the mechanics of these three sources of return are explained further.

2.2.1 Demystifying the Sources of Return

Since anticipated trends in spot markets are taken into account when the futures prices are set, expected movements in the spot price are not a source of return to an investor in futures. Futures investors will benefit when the spot price at maturity comes out higher than expected when they entered into the contract, and lose when the spot price is lower than anticipated. Hence, a futures contract is a bet on the future spot price, and by entering into a futures contract an investor assumes the risk of unexpected movements in the future spot price. Unexpected deviations from the expected future spot price are by definition unpredictable, and should average out to zero over time for an investor in futures, unless the investor has the advantageous ability to correctly time the market.

If an investor in futures does not benefit from expected spot price movements, and is unable to outmaneuver the market, the return expectations shall be based on risk premium: the difference between the current futures price and the expected future spot price (Gorton and Rouwenhorst (2005)).

If the futures price of today is set below the expected future spot price, a purchaser of futures will on average earn money. If the futures price is set above the expected future spot price, a seller of futures will earn a risk premium.

Keynes' (1930) and Hicks' (1939) theory of normal backwardation postulated that the risk premium would on average accrue to the buyers of futures. The authors pictured a world in which commodity producers would seek to hedge the price risk of their output. For example, a grain producer would sell grain futures to lock in the future price of his crops an obtain insurance against the price risk of grain at harvest time. Speculators would provide this insurance and buy futures, but demand a futures price which is below the spot price that could be expected to prevail at the maturity of the futures contract. By backwardating the futures price relative to the expected future spot price, speculators would receive a risk premium from producers for assuming the risk of future price fluctuations. As the maturity date of the futures contract draws close, the futures price will start to approach the spot price of a commodity. At maturity, the futures contract will become equivalent to a spot contract, and the futures price will equal the spot price. If futures prices were initially set below the expected future spot price, the futures price will gradually increase over time, rewarding the long position. Whether the theory of normal backwardation is an accurate theory of the determination of the futures price is an empirical matter. However, the above discussion of the mechanics of futures markets, serves to make following important points about an investment in futures, along the lines with Gorton and Rouwenhorst (2005):

1. The expected payoff to a futures position is the risk premium. The realized payoff is the risk premium plus any unexpected deviation of the future spot price from the expected future spot price.

2. A long position in futures is expected to earn positive (excess) returns as long as the futures price is set below the expected future spot price.

3. If the futures price is set below the expected future spot price, the futures prices will tend to rise over time, providing a return to investors in futures.

4. Expected trends in spot prices are not a source of return to an investor in futures.

2.2.3 The Term Structure of Futures Prices – Contango and Backwardation

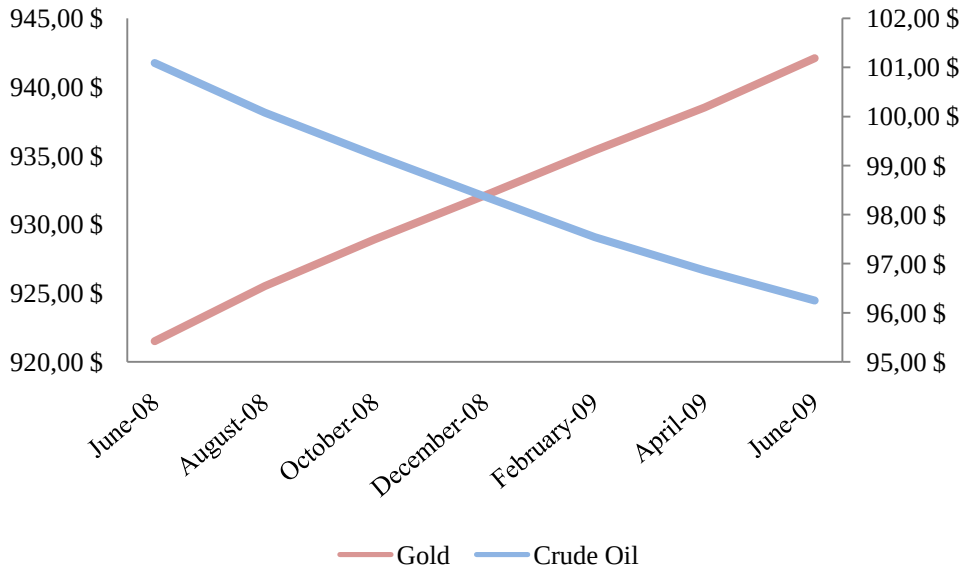
The source of return in spot prices is the most uncomplicated for commodity investors to understand. This is the directional exposure to commodities many are looking for, particularly if their interest is based on a bullish outlook (Akey (2005)). If an index has long exposure to heating oil and the price of heating oil increases, the position is profitable. Similarly, the collateral return is rather uncomplicated. A collateralized commodity futures program is unleveraged. That is, for every desired $1 in commodity futures exposure, an investor sets aside $1 in money-market funds or similar cash equivalents, hence making the futures program fully collateralized. When calculating returns to a

collateralized commodity futures program or total return index, one typically includes the collateral returns (interest on the cash equivalent) as well. As previously mentioned, the theory of normal backwardation states that the risk premium would on average go to the buyers of futures, mainly because of commodity producers hedging their sales, thus accepting a lower futures price than the expected future spot price. According to Gorton and Rouwenhorst (2005), the producers thereby insure their profit from price effects, paying a risk premium for this to speculators buying the contracts. By rolling futures contracts forward, the investor realizes this so called roll yield. However, understanding the portion of return attributable to roll yield requires a review of the concepts of backwardation and contango as they apply to the pricing of commodity futures.

When a futures contract's price is at a discount to the spot price, the futures curve is called backwardation. When the futures contract's price is at a premium to the spot price, the shape of the futures curve is called contango. Futures returns are a combination of spot price returns plus the effect of the futures price converging to the spot. In a backwardated futures market, a futures contract converges (rolls up) to the spot price as the delivery date approaches. This is the roll yield that an investor captures. The spot price can stay constant, but one will still earn returns from buying discounted futures contracts, which continuously roll up to the constant spot price. In a contangoed market, reverse occurs: an investor continuously locks in losses from the futures contracts converging to a lower spot price.

Figure 1

Term Structure of Commodity Prices as of March 31, 2008



The term structure of futures prices depicts the relation between futures prices and the maturity of futures contracts. While there are competing theories of commodity price determination, the term structure of futures prices is a market reality that investors face every day (Erb and Harvey (2006)). *Figure 1* illustrates the term structure of futures prices for crude oil and gold at the end of March 2008;

the futures price for crude oil decline as the time horizon increases, from a price of $101.09 per barrel of oil for the June 2008 futures contract to a price of $96.25 for the June 2009 futures contract. This is an example of market backwardation, in which the futures price for a commodity is lower than the current spot price. Typically, the current spot price is the futures contract with the shortest time to maturity, the nearby futures contract. In our example, the futures price for gold increases as the time horizon increases. As mentioned above, this relationship is known as contango.

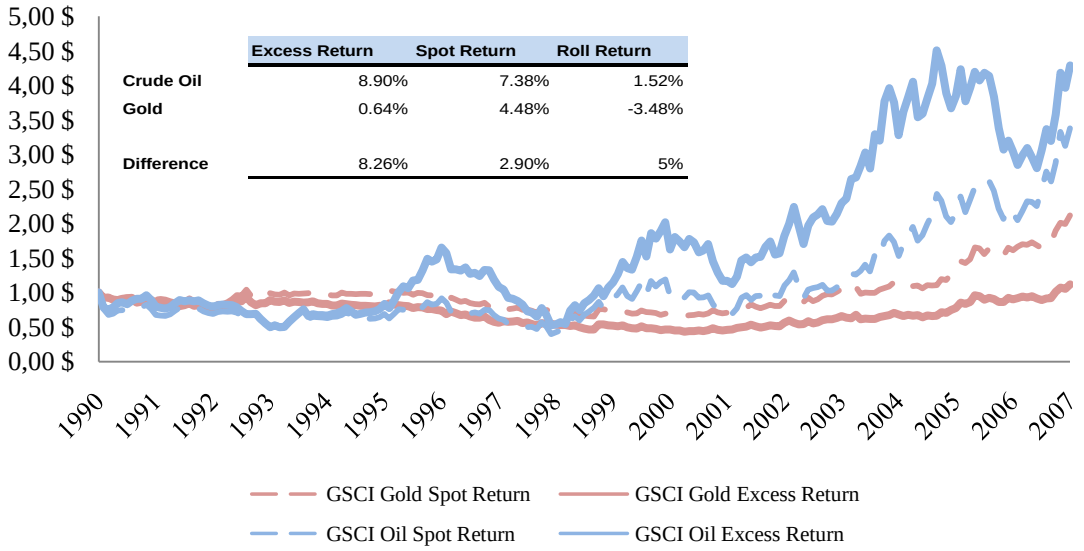
Crude oil is indeed backwardated in *Figure 1* but it is worth shedding light on the fact that crude oil is not always backwardated. Historically crude oil futures have been backwardated about 66 percent of the time. In contrast, gold has always been in contango. Fascinatingly, while gold is a standard component of many commodity futures indices, some have argued that gold is really a currency, not a commodity, and that gold futures is best thought of as financial futures (Erb and Harvey (2006)). Normally, markets dominated by big producers, like the oil market, are in backwardation. The desire to hedge the output is the strongest force in the market. In the gold futures market, on the other hand, the investor pays a risk premium to be long in gold, which is considered to be a safe asset.

An upward or downward sloping term structure of futures prices creates the possibility of a futures price "roll return". In fixed income parlance, an upward sloping yield curve produces a return attributable to the passage of time known as "rolling down the yield curve". In the example of oil futures, the futures price for June 2009 is $96.25 while the June 2008 price is $101.09. If the term structure of oil remained unchanged between June 2008 and June 2009, then the roll return from buying the June 2009 oil contract and holding the position for one year is 5 percent ($101.09/$96.25-1). For gold, assuming no change in the term structure of gold futures prices, the roll return is -2.2 percent ($921.5/$942.1-1).

In the case of index investors, the selling back of all commodity futures purchased before the time of delivery is built into the mechanical structure of the commodity index itself. For example, as of June 12, 2008 the S&P GSCI index holds WTI crude oil futures for delivery in August of 2008. During the 5^{th}-9^{th} business days of July, the index will sell those August futures and purchase contract for delivery in September of 2008. This is, as discussed above, "rolling" the futures positions and involves selling futures as their delivery time approaches and then buying new futures farther out the forward curve. In this manner the index investor maintains their investment in WTI crude oil futures at a fixed point on the forward curve, much like a bond investor seeking to maintain a constant maturity in their bond portfolio. By "rolling" their commodity futures positions in this way index investors never take physical delivery of the commodity and so cannot be adding to physical demand (Greely and Currie (2008)).

Figure 2

Excess and Spot Returns



	Excess Return	Spot Return	Roll Return
Crude Oil	8.90%	7.38%	1.52%
Gold	0.64%	4.48%	-3.48%
Difference	8.26%	2.90%	5%

Figure 2 shows that, since 1990, the geometric average excess return for crude oil futures was 8.90 percent per annum. The average excess return consists of a spot return and a roll return. The spot return is the change in the price of the nearby futures contract. Since futures contracts have an expiration date, investors who want to maintain a commodity futures position have to periodically sell an expiring futures contract and buy the next to expire contract. Hence, if the term structure of futures prices is downward sloping, an investor rolls from a higher priced expiring contract into a lower priced next nearby futures contract. This suggests that the term structure of future prices drives the roll return.

For crude oil, the spot return was 7.38 percent and the roll return was 1.52 percent. The roll return was positive because energy markets were typically in backwardation. The excess return for gold futures was 0.64 percent, the spot price return was 4.48 percent and the roll return was -3.48 percent. The roll return was negative because the gold futures market has as mentioned always been in contango. The average spot returns of crude oil and gold futures are just a reflection of a time period specific historical experience and it says nothing about the future spot returns. History is not always an appropriate guide for the future.

2.3 Speculators, Index Investors, and Commodity Prices

It is useful to address some of the questions that have been raised regarding the financial participants in the commodity futures markets. A common theme is that speculators and index investors perform very different roles in the commodity futures markets, and that these differences in economic roles imply very different influences on commodity prices. The economic roles are so different, in fact, as to make the increasingly prevalent label of “index speculator” a contradiction in terms (Greely and Currie (2008)). The role of speculators is to bring new information to the market on forward supply and demand fundamentals. Consequently, speculative buying and selling moves commodity prices to

the extent that other market participants believe it is revealing new information on forward fundamentals. However, it is important to note that the empirical evidence shows that the size of the implied commodity price changes due to speculative buying and selling are well below those sometimes suggested by market commentators (Greely and Currie (2008)).

The role of index investors is to supply a pool of stable, passive, unleveraged capital to bear commodity price risk. Unlike speculators who buy and sell on new information, the index investors buy and sell mechanically. Consequently, the buying and selling of index investors, does not "move the market" in the same manner that the buying and selling of speculators does. Instead, by allowing commodity producers to transfer their inherent commodity price risk exposure to long-term investors who are better-suited to bear it, the participation of the index investors in the commodity futures markets lowers the cost of capital to commodity producers, and by lowering costs helps to lower commodity prices over the long run.

2.3.1 Hedgers and Financial Participants

The commodity futures markets are comprised of physical and financial participants. The physical participants are commonly called commercial participants, or hedgers. They are the producers and consumers of the physical commodities, and they are part of both the commodity futures markets and the underlying physical markets for the commodities.

The financial participants generally participate in only the commodity futures markets, not the underlying physical commodities markets. The financial participants are comprised of both speculators who actively trade the commodity futures markets and commodity index investors who passively hold a commodity futures position in their portfolio as part of their overall asset allocation strategy. Commercials participate in order to hedge their inherent commodity price risk exposure, speculators to profit by anticipating commodity price movements, and index investors to earn a return for bearing commodity price risk. The commercials participate in the commodity futures markets in order to reduce their natural exposure to commodity price risk. This is why they are also known as hedgers, as they seek to hedge through commodity futures their exposure to commodity prices due to their role as producers and consumers of the physical commodities. The speculators, or active investors, trade in the commodity futures markets because they believe that they can profit by successfully anticipating movements in commodity prices.

The index investors, or passive investors, hold a commodity futures position as a part of their asset allocation strategy. Index investors seek to earn returns on these positions as a payment for bearing the commodity price risk that the physical participants want to hedge. Index investors also seek diversification and to protect their portfolios against inflation and adverse movements in equity and bond prices. In the commodity futures markets the desire of commodity producers to hedge generally exceeds that of commodity consumers. This is according to Greely and Currie (2008) because commodity production is typically concentrated among far fewer participants than is

consumption, leaving each commodity producer exposed to far greater commodity price risk than each consumer. Because of this underlying mismatch between the willingness of producers and consumers to hedge, commercials as a whole tend to be sellers of commodity futures.

Commodity indices were designed to be long-only investment vehicles in order to create a stable supply of passive buyers to balance the commercial selling. Put simply, the index investors are the buyers of the commodity futures positions that the commercials want to sell in order to hedge their natural exposure to commodity price risk. Speculators will be either long or short, buyers or sellers, depending on the direction they anticipate commodity prices will move.

2.3.3 The Commodity Pioneers of the Harvard Endowment

One of the institutions that have realized the benefits of using commodities as an ingredient in its long term investment portfolio is the Harvard University Endowment. Jack Meyer who managed the Harvard endowment from 1990 to 2005 was a pioneer in increasing the commodities allocation to circa 13 percent, arguing that even though commodity investments are generally considered risky for most investors because of their extremely high volatility, for a fully collateralized well-diversified investor like Harvard the high risk characteristic applies to a smaller extent and in fact improves the risk-return ratio of the portfolio over time through diversification. As Carl Johan Renström at the Harvard Endowment points out, commodities therefore serve primarily as a diversifying asset class with small correlation and in some cases negative correlation with other asset classes, implying that commodity investment lowers the standard deviation of the endowment portfolio enough to allow for an increased allocation to higher-returning equities without increasing overall portfolio volatility/risk. Commodities also serve as a hedge against unanticipated inflation in Harvard's portfolio, since commodity prices tend to rise elastically with increasing inflation (in the 1970s the real value of many university endowments plummeted due to lack of an inflation hedge).

The Endowment does not invest in physical commodities, due to high transaction costs, insurance costs and storage costs that make such direct investing inefficient. Rather, Harvard obtains an indexed exposure to commodities by investing in commodity-related indices linked to commodity prices, primarily the GSCI which also has the advantage of not necessarily relying on a predicted increase in commodity spot prices for returns. This way, Harvard can essentially earn a combination of a risk premium for bearing volatile commodity risk that inventory holders and producers wish to get rid of (i.e. roll-yield in a backwardated futures market) and spot commodity price hikes (often driven by the just-in-time inventory policies that cause temporary shortages of individual commodities). The GSCI is majority-weighted in commodity futures contracts that are typically in backwardation. The endowment returns from commodities have been on par with bonds and equities but with significantly less risk (Renström, 17 June 2008).

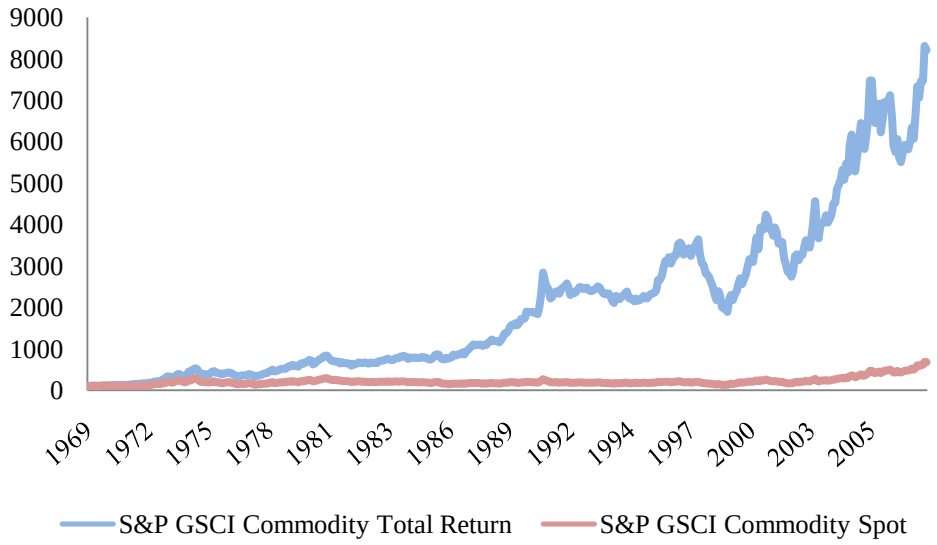
3. THE HISTORICAL RETURN OF COMMODITIES

We now turn to the empirical evidence on spot and future returns. This is illustrated in *Figure 3a*, which compares the GSCI total return index of commodity futures to the GSCI portfolio of spot commodities between 1990 and 2007. The index of commodity prices simply tracks the evolution of the spot prices, and ignores all costs associated with the holding of physical commodities (storage, insurance etc). Hence, there is an upper bound on the return that an investor in commodity prices would have earned.

Figure 3a

Commodities Performance

GSCI Spot versus GSCI Total Return Futures Index 1969-2007



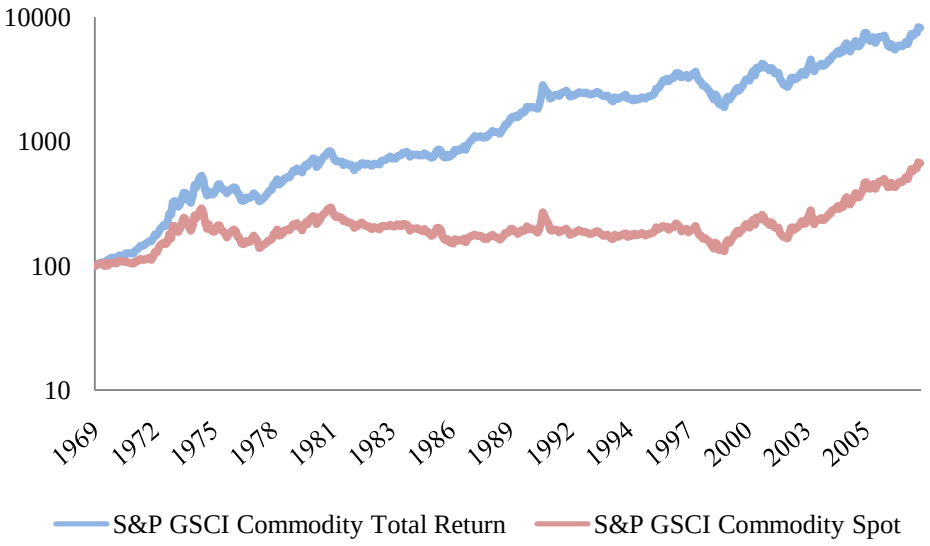
The main conclusions that we are able to draw from the examination of the figure are that:

1. There are differences between the historical performance of spot commodity prices and collateralized commodity futures returns, due to reasons described above. The historical return to an investment in commodity futures has exceeded the return to a holder of spot commodities.

2. The indices of both commodity spot and commodity futures prices have outpaced inflation.

What might be less apparent from *Figure 3a* is that the return on the futures position is highly correlated with movements in the spot. As explained in section 2.2.1, an investment in commodity futures benefits from unexpected increases in spot prices. Especially in times of high spot market volatility, the returns to spot and futures will be highly correlated (Erb and Harvey (2006)). This is illustrated in *Figure 3b*, which presents the same data as *Figure 3a*, but the scale is in logs. This facilitates identification of proportional changes in series that differ in levels. Evident from *Figure 3b* is that the two series are highly correlated.

Figure 3b
Commodities Performance (Logarithmic)
GSCI Spot versus GSCI Total Return Futures Index 1969-2007



Temporary price movements can be pronounced in spot markets attributable to the fact that many spot commodity prices exhibit seasonal price fluctuations (Gorton and Rouwenhorst (2005)). For example, heating oil prices are on average higher during the winter months, and gasoline increase during the summer driving season. Seasonality in spot prices is unlikely to influence futures returns since they represent foreseeable fluctuations that are taken into account when market participants set futures prices. There may be separate factors that drive temporary price movements in futures returns, but this is a matter falling beyond the intention of this thesis.

3.1 Diversification Return – The "Free Lunch" in Finance

Booth and Fama (1992) introduced the concept of diversification return as a potential compound return driver of a commodity futures portfolio. The diversification return is in effect the difference between a portfolio's geometric return and the weighted average geometric return of a portfolio's constituents. The diversification return can under certain conditions appreciably raise the geometric return of a fixed weight, or rebalanced, commodity futures portfolio. As Erb and Harvey (2006) show, unrebalanced portfolios such as market capitalization weighted portfolios, are unlikely to benefit from a diversification return to the same extent as fixed-weight, rebalanced, portfolios. Portfolio diversification has been referred to as the one "free lunch" in finance since it allows an investor to reduce a portfolio's standard deviation of return without reducing the portfolio's arithmetic return (Campbell (2000)). The diversification return can be regarded as the one free lunch that can raise a portfolio's geometric return. The key to this is that most commodity prices are mean reverting, i.e. they tend to vary around a historical relatively stable mean. When the portfolio is rebalanced to its fixed weights, the portfolio automatically sells the commodity that has gone up in price and buys the

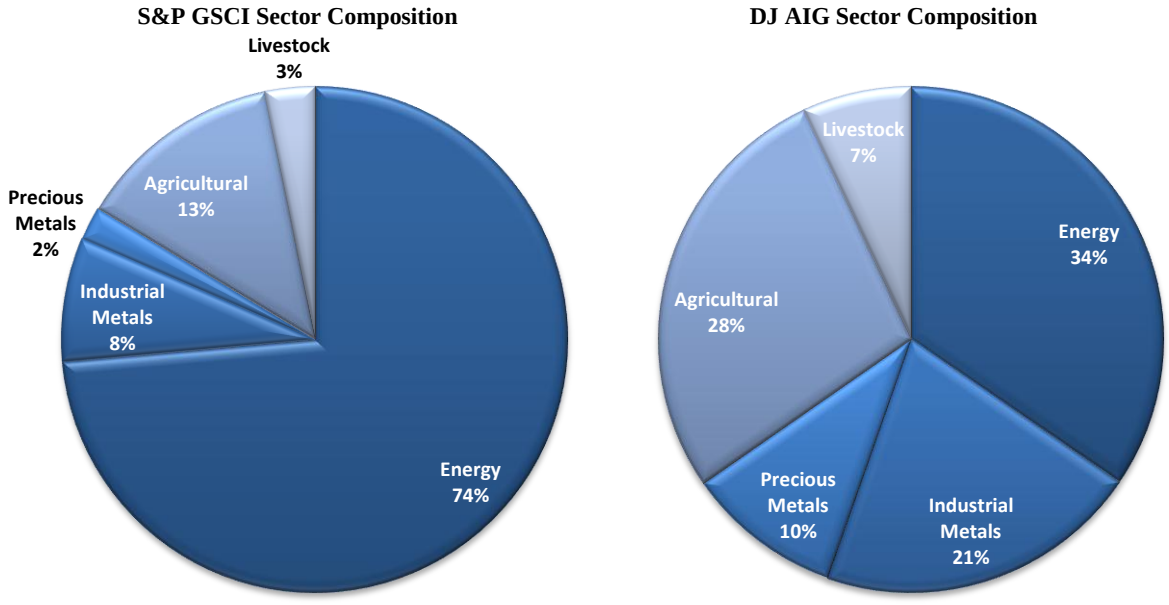
one that has performed badly. If the prices are mean reverting, the previous underperformer will now outperform and vice versa. This way, the constantly rebalanced portfolio tends to do exactly what a successful investor should do – buy low, sell high.

3.2 Commodity Indices are Strategies

Even if the message of equally weighted portfolios might be difficult to decipher, an examination of commodity futures indices might reveal some answers. The two most commonly traded indices are the S&P Goldman Sachs Commodity Index (GSCI) and the Dow Jones-AIG Commodity Index (DJ AIG). Each of these indices is intended to be a broad representation of investment opportunities in the aggregate commodity futures market. It is according to Erb and Harvey (2006) natural to expect that the return and risk of broad-based indices should be similar.

Asset weights and asset returns drive portfolio returns. The return and risk differences amongst these two commodity indices can partially be explained by the different weights of individual futures contracts in each of the indices. Different portfolio weights imply that each of these indices suggest different definitions of the aggregate commodity futures market. As visible in *Table I*, the GSCI currently invests in 24 underlying futures contracts and the DJ AIG index invests in 19 different futures contracts. The GSCI is heavily skewed towards energy exposure because its portfolio weighting scheme is based on the level of worldwide production for each commodity (S&P (2008)). In contrast, the DJ AIG index primarily focuses on futures contract liquidity data, supplemented with production data, to determine portfolio weights (Dow Jones (2008)).

Figure 4
Index Compositions as of March 2008



The composition of the indices differ from one another because there is no agreement upon which way to define the composition of the aggregate commodity futures market as there is with the aggregate equity market or the aggregate bond market. For example, the composition of the aggregate equity and bond markets is driven by market capitalization, the outstanding value of stocks and bonds. However, for every futures contract that one investor is long, there is another investor who is short the respective futures contract. The outstanding value of long and short futures contracts is exactly offsetting and consequently there is no commodity futures market capitalization. Lacking a market capitalization based portfolio weighting scheme, Erb and Harvey (2006) suggest that commodity indices can best be thought of as commodity portfolio strategies.

Table I

The Composition of Commodity Indices

	Portfolio Weights (%)	
Commodity	**S&P GSCI**	**DJ AIG**
Aluminium	2.62	7.79
Cocoa	0.20	
Coffee	0.53	2.64
Copper	3.29	7.79
Corn	3.59	6.25
Cotton	0.79	2.26
Crude Oil	38.00	12.78
Brent Crude Oil	13.58	
Feeder Cattle	0.35	
Gas Oil	5.21	
Gold	1.90	7.17
Heating Oil	5.07	3.89
Lead	0.47	
Lean Hogs	1.04	2.82
Live Cattle	1.79	4.11
Natural Gas	7.36	14.22
Nickel	0.90	2.67
RBOB		3.66
Silver	0.26	2.80
Soybeans	2.03	6.63
Soybean Oil		2.59
Sugar	0.95	2.97
Unleaded Gas	4.38	
Wheat	4.13	4.39
Kansas Wheat	0.98	
Zinc	0.56	2.56
Total	100.00	100.00
Futures Contracts	24	19

As of 31 March 2008

Furthermore, another issue complicating historical analysis of commodity index returns is that the weights of the constituents within a commodity futures index can vary substantially over time. The GSCI initially consisted of four commodity futures only: cattle, corn, soybeans and wheat. For the first decade of the index's return history, cattle represented the largest portfolio exposure. Over time new commodity futures contracts have been added to the GSCI. As *Table I* shows, cattle now represents less than 0.5 percent of the index while crude oil is the single largest portfolio constituent at about 38 percent. As returns differ from one commodity to another and portfolio composition and weights change over time, the historical index performance may not be a perfect guide to prospective index returns (Erb and Harvey, 2006). This illustrates the difficulties in finding a good proxy for the entire commodity futures markets.

In addition to these main indices, there are some alternative indices constructed to capture the overall performance of the commodities market. The Gorton and Rouwenhorst index is an equally weighted index, including the 36 most traded commodity futures contracts. It measures the monthly returns over the period between July of 1959 and December of 2004 in order to study simple properties of commodity futures as an asset class. The index is included in some parts of our analysis due to its extensive time period and a detailed description of the index is found in Appendix F.

Legendary author and investor Jim Rogers recommended us to make room for his own raw materials index in our analysis. The Rogers International Commodity Index (RICI) is a composite, US dollar-based, total return index created by Rogers, co-founder to George Soros of the Quantum Fund, in 1998. The RICI was designed to meet the need for consistent investing in a broad based international vehicle; it represents the value of a basket of commodities consumed in the global economy, ranging from agricultural to energy to metal products. The value of this basket is tracked via futures contracts on 36 different exchange-traded physical commodities, quoted in four currencies, listed on eleven exchanges in five countries. The RICI aims to be an effective measure of the price action of raw materials not just in the US but also around the world. The RICI's weightings attempt to balance consumption patterns worldwide (in developed and developing countries) and specific contract liquidity (Rogers, 31 May 2008). In spite of being an attractive index given its breadth and trading volume, the time series available are not long enough to be included in this analysis.

3.3 Comparing Returns over a Common Time Period

Knowing that individual commodity portfolio asset weights vary provides only half of the answer to understanding the return of a diversified commodity futures portfolio. The other element to explore is, of course, the returns of the individual commodity futures that make up a portfolio. The earlier exploration of individual commodity futures returns looked at the since-inception return of a number of individual commodities with one another over a common time period. Dimson, Marsh and Staunton (2002), focusing on the question of how similar or dissimilar national equity market returns have been, point out that a desirable characteristic of a good index is an ability to allow comparisons amongst the

constituents of the index over a common time period. The same argument suggests that a common time period can be useful when investigating the returns for individual commodity futures portfolios. A common time period makes it possible to investigate, through a cross-sectional examination of returns, the reasons for the possible differences in returns of the portfolio constituents. Dissimilar time period returns have a certain archival value, however, it is hard to say that they improve investor appreciation of investment opportunities. A challenge is to find an objective way to identify the broadest cross-section of individual commodity futures contracts that fully captures the current breadth of choices and simultaneously provides the longest historical time series.

3.4 Indirect vs. Direct Exposure

Indirect investment in commodity stocks is not to be regarded as a sufficient substitute for direct investment. Listed commodity stocks have their own characteristics and risks, so investors do not receive direct commodity exposure (Schweizer (2008)). Fabozzi, Fuess and Kaiser (2008) note that the major sources of varying movements between commodity stocks and the underlying commodity are: operational risk caused by human or technical failure, internal regulations, external events, the strategic position of the company, management quality, capital structure, the expectations and ratings of company and profit growth, risk sensitivity, the risk of a total loss if prices decrease below total production costs, information transparency, information credibility, and temporary mispricing due to market disequilibrium. Furthermore, Georgiev (2006) shows that these sector-specific stocks are only slightly correlated with commodity prices.

For the majority of investors, an index oriented investment will be the most efficient (Fabozzi, Fuess and Kaiser (2008)). Hence, investable commodity futures indices are the best available proxies for the risk-return profile of commodities, and most studies use these indices as benchmarks for the development of the commodity markets.

In recent years the possibilities of investing in the commodities markets have increased significantly, now making the asset class accessible even to private investors. Commodity related Exchange traded Funds (ETFs), Contracts for Difference (CFDs) and Open end certificates are now marketed directly to retail clients, allowing them to take part of the opportunities, and risks, of commodities. An example of this trend is that since March 2008 commodity certificates are traded on the Stockholm Stock Exchange (OMX).

4. HYPOTHESES

The examined theory and previous research is applied to the Scandinavian markets as the following hypotheses are established. In total, seven hypotheses are formulated and tested statistically three times, once for each individual country; Sweden, Norway and Denmark.

4.1 Inflation

Hypothesis 1: Commodities is a better hedge against inflation than stocks

A good hedge against inflation is expected to increase in value in times of rising inflation, i.e. having a positive correlation and thereby preserving purchasing power. Commodities are likely to show a positive correlation with inflation since increased commodity prices will put an increasing pressure on the general price level in the economy. The prices of many of the items included in the CPI are more or less linked directly to commodity prices. Stocks on the other hand, risk suffering from losses in the companies due to higher prices.

Hypothesis 2: Commodities is a better hedge against inflation than bonds

When nominal bond prices are set, expected inflation is taken into account. However, as inflation rises, the required nominal yield will rise which will cause the price to fall. On the other hand, increased inflation causes the prices of real assets, like commodities, to increase.

4.2 Stocks and Bonds

Hypothesis 3: Commodities have a lower correlation to local stocks than has international stocks

Commodities, being an internationally traded asset class denominated in USD, are likely to be affected by global economic events. So are the international stock markets. However, individual international stock markets are affected by common factors and hence we assume the relationship between local Scandinavian stocks to be higher with international stocks than with commodities, making commodities the better hedge.

Hypothesis 4: Correlation between commodities and stocks is larger than 0

The Scandinavian economies are all more or less dependent on commodity markets. For example Norwegian oil and gas, Swedish steel and forestry, all make these markets more exposed to commodities than for example USA. Therefore, in contrast to previous research that has found a zero or negative correlation between commodities and US stocks, we assume there to be a positive correlation, though not very large, between commodities and Scandinavian stocks.

Hypothesis 5: Correlation between commodities and bonds is larger than 0

For similar reasons as above, we expect there to be a small but positive correlation between commodities and bonds.

Hypothesis 6: Commodity futures yield equity like returns

In previous research the risk and return of commodities are found similar to equities. This is still assumed to be the case. When looking at commodity futures and stocks as entire asset classes, local stock indices for each country are used and the global commodity indices GSCI and DJ AIG.

4.3 The GSCI and DJ AIG Indices

When testing the hypotheses above, we use the GSCI and DJ AIG indices as proxies for commodities as an asset class. When determining which of the two indices to use, the one with the highest or lowest correlation is used. This depends on how the hypothesis is formulated, e.g. in Hypothesis 1, DJ AIG is used against Swedish inflation since its correlation is 0.135 compared to 0.106 for GSCI. The following hypotheses are put together in order to test the relationship between the two indices.

Hypothesis 7a: GSCI is a better hedge against inflation than DJ AIG

Given the great exposure to energy, GSCI is likely to provide a better hedge against inflation the DJ AIG. Energy, primarily petroleum, is one of the main potential drivers of inflation.

Hypothesis 7b: GSCI is a better hedge for stocks than DJ AIG

Given the high energy exposure, the GSCI is likely to be the better hedge against stocks. Rising energy prices increase the production costs of most companies and tend to decrease profits.

Hypothesis 7c: GSCI is a better hedge for bonds than DJ AIG

Given its assumed higher correlation with inflation, as argued in Hypothesis 1, GSCI is also likely to be the better hedge against bonds.

All seven hypotheses are as mentioned statistically tested and the results are discussed in section 6.5. A formal description of the applied hypothesis testing methods is found in Appendix E.

5. DATA AND METHODOLOGY

5.1 Collection of Data

To perform the analysis and test our hypotheses, data for equity, fixed income and commodities indices is used. Time series data is used to find the return characteristics, variances and correlations for the asset classes. Since this paper studies commodities investments from a Nordic perspective, we have recalculated the commodity returns into the local currencies Swedish Krona (SEK), Norwegian Krone (NOK) and Danish Krone (DKK). This means that an extra currency risk is added. The return of the commodity investment is thus not only dependent on the actual commodity return, denominated in United States Dollar (USD), but also the exchange rate. What ultimately matters is what the Nordic investor gets in each respective local currency.

The data used is mainly gathered from the Thomson Datastream database, but also from other sources such as S&P, Dow Jones, Statistics Sweden and the National Bureau of Economic Research. The dataset is as extensive as possible given access and availability. The DJ AIG index is

the limiting factor since data is not available prior to January 1991 when the index was started. Hence our quantitative analysis is based on a data sample stretching from 1991 to 2007, a period of 17 years. For some indices we have data that stretches farther back in time and have thus chosen to include this data in parts of our analyses, to shed light on differences caused by different sample periods. The monthly data from 1971 to 2007, allows us to test the robustness of the data as well as to observe long term trends.

As proxy for international stocks we use the MSCI World Index which is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of developed markets. It measures total market performance, including price appreciation and income from net-dividend payments (MSCI (2008)). As of June 2007 the MSCI World Index consisted of the following 23 developed market country indices: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The MSCI Nordic Countries Index is like MSCI World Index a free float adjusted market capitalization weighted index. The index is designed to measure the performance of the Nordic equity markets and hence include Denmark, Finland, Norway and Sweden. Country specific indices are also brought into play such as MSCI Denmark, MSCI Norway and MSCI Sweden.

OMRX Total Bond Index is a Swedish fixed income index that is designed to measure the performance of the bond market and includes Swedish Government Bonds and Swedish Mortgage Bonds of longer maturities (OMX (2008)). OMRX Treasury Bill Index is a Swedish fixed income index measuring the performance of Swedish treasury bills. It includes Swedish government treasury bills with a variety of maturities. For Norwegian Bonds we use the Datastream Index for Total All Lives Government Bonds. To measure the performance of the Danish bond market the Citigroup Weighted Government Bond Index, All Maturities, Total Return is used. It would have been preferable to use the same index for all three countries, as in the case of equities, but this was impossible due to lack of data availability.

As inflation measure we analyse the Swedish Consumer Price Index which is designed by Statistics Sweden. The Consumer Price Index covers the consumption of the entire population of the country and prices used in the index are regular prices paid by the public. Corresponding CPI indices for Norway and Denmark are employed.

The two major commodity indices, GSCI and DJ AIG, are already discussed and examined above. When data is presented for individual commodities, e.g. gold, wheat and crude oil, the respective GSCI Total Return Index is used. Finally, we partially include the equally weighted index of commodity futures created by Professor Gorton of the Wharton School, University of Pennsylvania, and Professor Rouwenhorst of Yale University. This index is claimed to give an even broader diversification across different commodities than both GSCI and DJ AIG (Gorton and Rouwenhorst (2005)) and is hence included in the periphery in some parts of our analysis. A more detailed

description of this index is located in Appendix F. The Rogers International Commodity Index would have been interesting to include, but due to its relatively recent creation in 1998, the time period available is much shorter than for the other indices and it is therefore not included in the study.

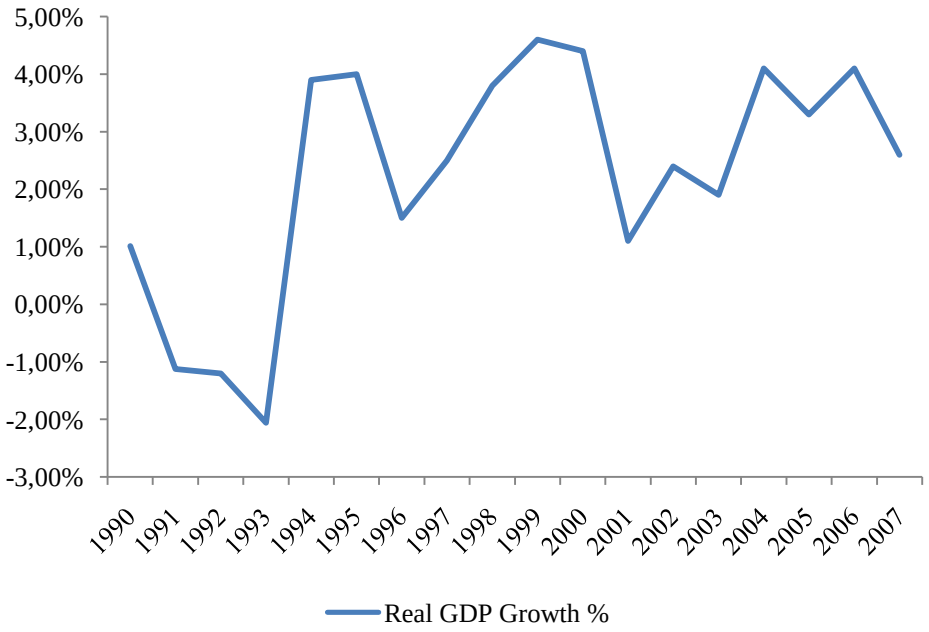
5.2 Validity of Data

All data is originating from sources considered to be reliable. Hence, we assume that there are few, if any, measurement errors. Furthermore, the extensive sample provides a large number of observations. Only the 1991 – 2007 samples contain 204 individual observations for each time series. That number of observations allows us to assume a normal distribution of the data and hence to perform the tests presented below without worries of distorted results due to faults in the underlying dataset (Gujarati (2005)).

Our analysis is based on historical data. In order to reach relevant conclusions regarding the hedging potential of commodities and its implications for portfolio optimization, we must be confident that our historical data is representative and able to generate relevant estimations for the future. The main data sample starts in 1991, a time of crisis and financial turbulence. It further includes the IT boom and crash, the following recession and finally the last years' bull market, but not the financial crisis taking place in the last half of 2008. In *Figure 5* the yearly real GDP growth in Sweden for the years covered in our data sample is depicted. The first years are characterized by a decreasing GDP, but after 1993 the growth level has varied around two or three percent annually which is rather stable. The negative GDP growth in the beginning of the sample may explain some of the results presented in following sections.

Figure 5

Real Swedish GDP Growth 1990 - 2007



The method of mean-variance optimization, as later explained, is based on mean returns, variances and covariances. It is therefore sensitive to estimation errors. Estimations of asset returns are sensitive to the choice of time period. The difficulty in choosing time periods is obtaining a time period that yields an estimated return in the approved manner. If there is a short time period, there is a risk for bias if the period is a period of under or over performance. However, if the time period is long enough, the estimations of return mean, variance and covariance will be satisfactorily accurate.

5.3 Data Analysis

The quantitative data analysis consists of studying return characteristics and correlations. Correlations are measured as the Pearson correlation coefficient. The correlation between two variables *X* and *Y* can be defined as

$$\frac{\text{cov}(X,Y)}{\sigma_X \sigma_y}$$

where σ_X and σ_Y are the standard deviations of *X* and *Y* and *cov(X,Y)* is the covariance between *X* and *Y*. The covariance between *X* and *Y* is defined as

$$E[(X-\mu_X)(Y-\mu_Y)]$$

Where μ_X and μ_Y are the means of *X* and *Y*, and *E* denotes the expected value. Although it is easier to develop intuition about the meaning of a correlation than it is for covariance, it is covariances that are the fundamental variables of our analysis. Define x_i and y_i as the percentage changes in *X* and *Y* between the end of month *i-1* and the end of month *i*:

$$x_i = \frac{X_i - X_{i-1}}{X_{i-1}}, \qquad y_i = \frac{Y_i - Y_{i-1}}{Y_{i-1}}$$

where X_i and Y_i are the values of *X* and *Y* at the end of month i. We also define the following along the lines with Hull (2006):

- $\sigma_{x,n}$: Monthly volatility of variable *X*, estimated for month *n*
- $\sigma_{y,n}$: Monthly volatility of variable *Y*, estimated for month *n*
- cov_n: Estimate of covariance between monthly changes in *X* and *Y*, calculated for month *n*.

Our estimate of the correlation between *X* and *Y* for month n is:

$$\frac{\text{cov}_n}{\sigma_{x,n}\sigma_{y,n}}$$

The hypotheses are tested statistically using t-tests and formal descriptions of the statistical procedures are found in Appendix E. Finally, the results obtained in the statistical analysis are made used of when constructing a number of efficient investment portfolios, with and without commodities. This to shed light on the diversification benefits of commodities.

5.4 Portfolio Optimization

5.4.1 Theoretical Background

The introduction of modern portfolio theory by Harry Markowitz has lead to a mathematical explanation of the expression "don't put all your eggs in one basket" (Markowitz (1952)). One of the most fundamental conclusions in Markowitz' portfolio choice theory is that rational investors should not choose assets only because of their unique properties such as the expected return and variance, but should also consider the covariation between the different assets. As the number of assets in a portfolio increases, the covariance increasingly makes up a greater part of an individual asset's contribution to the total risk of a portfolio. This is illustrated in the figure below where the variance terms make up the diagonal elements of the variance-covariance matrix.

Figure 6

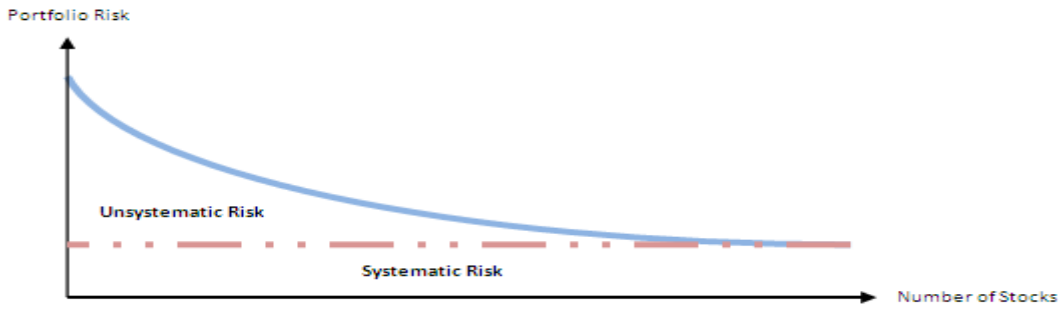
Variance-Covariance Matrix

$$\begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix}$$

For each incremental asset, 1 variance term and n-1 covariance terms are added to the matrix. As long as an asset does not correlate perfectly with the other assets in the portfolio, the total variance will be reduced. From an investment perspective, this sheds light on the benefits of diversification. The idea is that a portfolio should consist of a large amount of assets, belonging to different lines of business with the purpose of spreading the risk exposure while achieving lower correlation. The effect of diversification is common knowledge within the field of financial theory and a great number of researchers have found supporting evidence. Among these studies, Solnik (1974) shows that the risk of a well-diversified portfolio initially decreases dramatically and then converges to an undiversifiable level of risk, i.e. systematic risk.

Figure 6

The Effect of Diversification



By using the optimization procedure for a given universe of securities, an efficient frontier of risky assets may be formed. The portfolios on the frontier are efficient in the sense that they offer the

highest return for any given level of risk. The optimization model follows the Markowitz framework and models the rate of return on assets as random variables. The optimization is done by choosing the weights of each asset in the portfolio optimally as to minimize the portfolio volatility at any given rate of return on the portfolio. The Markowitz portfolio optimization can be summarized as follows (Markowitz (1952)).

1) $E(R_p) = \sum_{i=1}^{n} w_i E(R_i)$ The expected return of the portfolio, $E(R_p)$, is equal to the weighted sum of the expected returns of the constituent assets, $E(R_i)$, where w_i is the weight of each asset.
2) $\sigma_p^2 = \sum_{i=1}^{n} w_i^2 \sigma_i + \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \sigma_i \sigma_i \rho_{ij}$ The variance of the portfolio, σ_p^2, is the weighted sum of variances and adding the covariances of the constituent assets, i.e σ_i is the standard deviation of each asset and ρ_{ij} is the correlation between assets *i* and *j*. Note that $i \neq j$ and that $\rho_{ij} = 1$ for $i = j$.
3) $\sum_{i=1}^{n} w_i = 1$ All the weights of the portfolio, be long or short, must sum up to one in order to keep the budget constraint.
4) i = Swedish stocks, International stocks, Swedish Bonds, Swedish T-Bills, GSCI, DJ AIG

Given the above, the optimization problem can be formulated as follows. Let the portfolio have an expected return of $z = r^T w$ and variance of $\sigma^2 = w^T V \omega$. Then minimize $\sigma^2 = m^T V \omega$, subject to $\sum_{i=1}^{n} r_i w \geq r^*$, and $\sum_{i=1}^{n} \omega = 1$, where r^* is the minimal accepted return. Using this optimization framework in order to investigate the impact of adding commodities to an investment portfolio, we construct a number of portfolios, each with its unique set of restrictions.

5.4.2 Portfolios

The primary tool for our investigation regarding the role of commodities in a strategic asset allocation is the Markowitz's mean-variance optimization described above. Mean-variance optimization requires three sets of inputs for the asset classes that make up a given investment universe - returns, standard deviations and correlations. The mean-variance optimization results in an efficient frontier, where each point on the frontier represents the risk and return of an efficient asset allocation, maximizing the expected return for a given level of risk, or equivalently, minimize the risk for a given level of return. The asset allocations that make up an efficient frontier are a function of the three inputs. Historical returns, standard deviations and correlations are known with certainty and hence the historical efficient frontiers tell us the asset allocations that were optimal in the past (Idzorek (2006)). In our analysis historical data and the traditional Markowitz mean-variance optimization framework are brought forward to create efficient frontiers. This allows us to compare the asset allocations from efficient frontiers with and without commodities.

Each portfolio represents a portfolio held by a typical investor based in Sweden and include Swedish stocks, international stocks, Swedish Bonds, Swedish T-Bills as well as the commodity indices GSCI and DJ AIG. Although it can be argued that Swedish investors primarily hold domestic stocks, portfolio theory tells us that holding bonds and international stocks reduces the overall portfolio risk. Today's wide variety of mutual funds gives access to all world markets even to a small private investor. All returns are expressed in Swedish Kronor to give the actual returns earned by a domestic investor. Hedging the currency exposure has not been undertaken. The exact composition of the individual portfolios can be found in Appendix D.

The first portfolio is unrestricted and can take long as well as short positions. The second portfolio is a long only portfolio with the exception of the possibility to take short positions in T-Bills, i.e. a levered portfolio. The third portfolio is a long only portfolio without further restrictions. The fourth portfolio is long only, with an upper limit for each position of 30 percent of total portfolio value. The fifth portfolio is the same as the fourth, with the additional possibility of borrowing, just as the third portfolio. The sixth and final portfolio is a long only benchmark portfolio with predetermined fixed weights. All these portfolios are constructed with and without commodities.

6. EMPIRICAL RESULTS

6.1 Risk-Return Characteristics

With the purpose of providing an overview of the data, the analysis of our results begins with a glance at the performance of the indices. The focus is on monthly Swedish data and the results presented are in SEK. However, references and comparisons to the other two Scandinavian countries are also presented. Associated tables and graphs can be found in Appendices A and B.

Figure 7

Performance of Selected Asset Classes 1991 - 2007

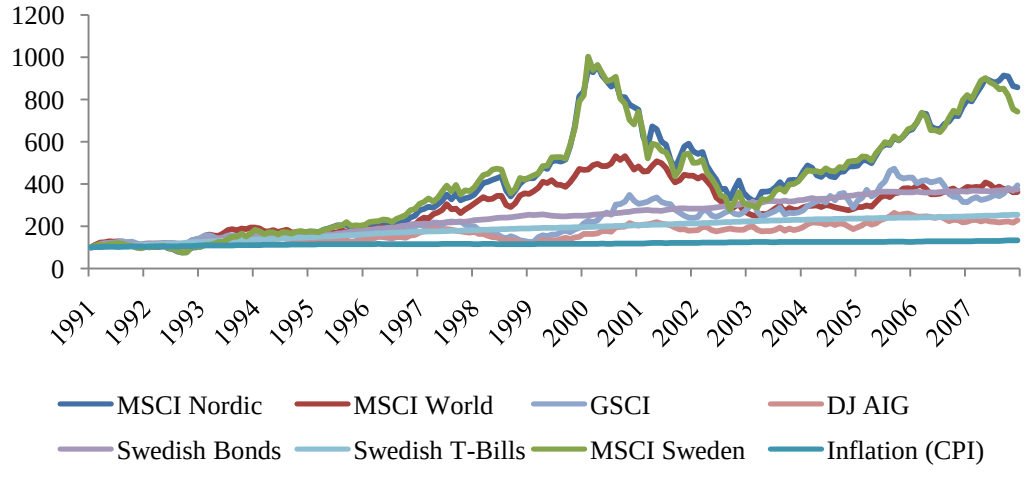


Figure 7 illustrates the performance of different asset classes, namely MSCI Nordic, MSCI World, GSCI, DJ AIG, Swedish Bonds and Swedish T-Bills, as well as the Swedish inflation, measured as the CPI. All indices are converted to SEK and rebased to 1991 = 100.

In *Table II* we can observe the descriptive statistics for the monthly returns for the equity, bond and commodity indices, as well as inflation, actual and unexpected. In addition to minimum, maximum, mean and standard deviation, also skewness and kurtosis are taken into consideration.

Table II

Monthly Descriptive Statistics 1991-2007 (SEK)

	Minimum	Maximum	Mean	Std. Dev.	Skewness	Std. Error	Kurtosis	Std. Error
MSCI Nordic	-17.180	26.590	1.280	6.290	0.157	0.170	1.476	0.339
MSCI World	-12.930	21.570	0.750	4.880	0.131	0.170	1.344	0.339
MSCI Sweden	-18.670	34.610	1.300	7.090	0.354	0.170	2.318	0.339
Swedish Bonds	-2.420	4.410	0.670	1.060	0.437	0.170	1.045	0.339
Swedish T-Bills	0.000	2.910	0.470	0.340	2.727	0.170	13.742	0.339
GSCI	-14.730	18.840	0.780	5.810	0.160	0.170	0.245	0.339
DJ AIG	-10.970	16.540	0.500	4.240	0.390	0.171	0.285	0.340
Agriculture	-10.550	22.650	0.280	5.360	0.378	0.170	0.618	0.339
Energy	-19.120	35.030	1.080	8.560	0.292	0.170	0.917	0.339
Industrial Metals	-14.830	18.190	0.780	5.500	0.332	0.170	0.158	0.339
Livestock	-19.730	21.070	0.280	5.210	0.026	0.170	1.377	0.339
Precious Metals	-11.070	16.890	0.630	4.510	0.434	0.170	1.329	0.339
Gold	-10.410	16.460	0.550	4.380	0.529	0.170	1.417	0.339
Wheat	-17.920	24.770	0.300	7.400	0.414	0.170	0.508	0.339
Crude Oil	-23.870	37.080	1.510	8.890	0.135	0.170	0.867	0.339
Inflation	-0.480	2.560	0.150	0.370	2.009	0.170	8.989	0.339
Unexpected Inflation	-1.730	1.750	0.000	0.410	0.047	0.170	2.240	0.339

As pointed out by previous studies, Gorton and Rouwenhorst (2005) and Erb and Harvey (2006), the returns on financial instruments sometimes deviate from a normal distribution, i.e. displaying skewness and having so called fat tails. If the distribution of a variable is not symmetrical about the median or the mean it is said to be skewed. The distribution has positive skewness if, in some sense, the tail of high values longer than the tail of low values, and negative skewness if the reverse is true. Skewness is quantified by Pearson's coefficient of skewness, the quartile coefficient of skewness or the moment coefficient of skewness. Kurtosis is a measure of the peakedness of a distribution. The usual measure is β_2 given by:

$$\beta_2 = \frac{\mu_4}{\mu_2^2}$$

μ_4 is the fourth central moment of the distribution and μ_2 is variance. It is invariant under a change of scale or origin. For a normal distribution β_2 is 3; an alternative definition of kurtosis reduces the ratio by 3 to give a value of 0 for the normal. With this adjustment, a distribution having negative kurtosis

is described as being platykurtic (flatter), and a distribution having positive kurtosis as being leptokurtic (more peaked). A distribution having kurtosis zero is described as mesokurtic (Upton and Cook (2002)). *Table II* shows that both GSCI and DJ AIG returns have a small positive skewness and also stock and bond returns are leptokurtic. In addition, commodities display relatively low kurtosis, whereas stocks and bonds have higher kurtosis.

In *Table III*, the return and standard deviations are annualized. When analyzing the return data, one observes that Nordic stocks have performed very well over the period. Its return, as well as its risk, exceeds the MSCI World index considerably. The two commodity indices GSCI and DJ AIG have performed similar to international stocks. Most surprising is perhaps the extremely strong performance of Swedish Bonds and T-Bills. The Swedish Bonds have returns in line with international stocks and commodities, but to a significantly lower risk. We doubt that this very strong risk adjusted bond performance is a realistic proxy for future performance. Hence, the Bond and T-Bill returns from year 2000 are used as estimates in the portfolio optimization performed in Section 6.6. From the year 2000 till the end of our sample period, the fiscal and monetary climate in Sweden was relatively stable and will hence probably be a better prediction for the future than the financially chaotic years of the early 1990s. When adjusting the period, the mean bond return is 5.15 percent annually with a standard deviation of 2.29 percent. The corresponding measures for T-Bills are 3.35 percent and 0.36 percent respectively.

Table III

Annualized Return and Volatility 1991-2007 (SEK)

	Mean	Std. Deviation
MSCI Nordic	16.48%	21.79%
MSCI World	9.39%	16.91%
MSCI Sweden	16.72%	24.54%
Swedish Bonds	8.39%	3.67%
Swedish T-Bills	5.77%	1.17%
GSCI	9.81%	20.14%
DJ AIG	6.12%	14.68%
Agriculture	3.37%	18.56%
Energy	13.79%	29.66%
Industrial Metals	9.74%	19.06%
Livestock	3.46%	18.04%
Precious Metals	7.79%	15.63%
Gold	6.8%	15.18%
Wheat	3.62%	25.64%
Crude Oil	19.71%	30.81%
Inflation	1.85%	1.3%
Unexpected Inflation	0.00%	1.41%

The results for Norway and Denmark, displayed in Appendix A, are very similar to those of Sweden. MSCI Norway has averaged 12.31 percent and MSCI Denmark 12.95 percent. The currency fluctuations between the Scandinavian countries are relatively small, which means that the performance of USD denominated assets are very similar across the three countries. *Figure 7* in Appendix B shows the performance of the three Scandinavian currencies relative to the US dollar. Finally, the annualized inflation is very close to two percent in all three countries. These findings reflects that the three Scandinavian economies are closely linked to each other and share many common features.

The DJ AIG is more diversified than the GSCI and it is therefore not surprising to see that it has a lower risk. The standard deviation of GSCI is 20.14 percent while 14.68 percent for DJ AIG. However, also the return is lower than for GSCI, 6.12 percent compared to 9.81 percent, given the strong performance of energy futures, towards which GSCI is heavily skewed.

Figure 8

Risk and Return for Selected Asset Classes (SEK)

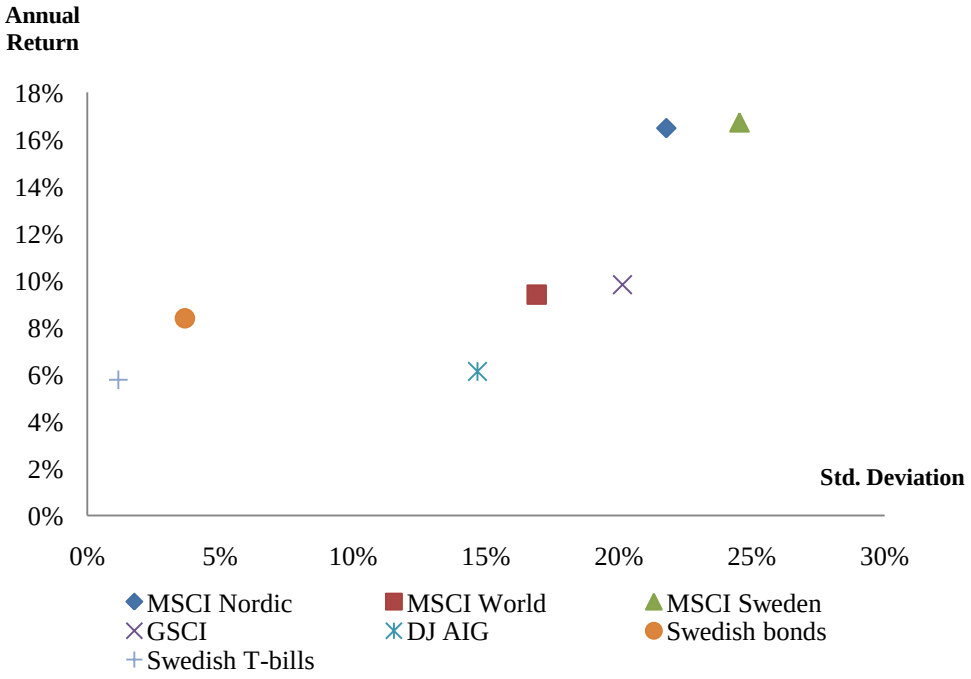


Figure 8 shows the risk-return characteristics of the asset classes plotted into a graph. The strong performance of Swedish and Nordic stocks is clearly visible, and so is the performance of bonds. According to this graph, the risk-return characteristics of the commodity indices GSCI and DJ AIG do not look too attractive. However, as previously discussed, their attractiveness does not reside in their individual risk-return ratio, but in their hedging potential.

As mentioned, our main sample stretches from 1991 to 2007, DJ AIG being the limiting factor. Still, we also examine available data starting in 1971 in order to see if our results from the main sample are representative for a longer period of time. These results are displayed in Appendix A. By adding another 20 years the sample size is more than doubled. However, we do not have data for all indices this far back, limiting our analysis. The DJ AIG is replaced with the Gorton & Rouwenhorst index, described in Appendix F. As can be observed in *Table IV*, equity returns in all three countries do not vary substantially from what is observed in the 1971 - 2007 period, while on the other hand, commodities returns are higher during this period. Measured in SEK, GSCI and Gorton and Rouwenhorst Index performed 14.04 percent and 14.84 percent respectively from 1971 to 2007. The corresponding figures for 1991 to 2007 are 9.81 percent and 6.12 percent. The figures in NOK and DKK are very similar. This difference between the two time periods is interesting and may partly have its explanation in the oil crisis during the 1970s when the price of oil increased dramatically. Another common feature observed in this longer sample is the higher inflation. In the case of Sweden it was 5.36 percent, compared to 1.85 percent for the period 1991 to 2007. The higher inflation also partly explains the higher nominal returns of commodity indices, i.e. when measured as real return the difference is smaller. The numbers for Norway and Denmark are very similar to those for Sweden.

Table IV

Annualized Monthly Returns 1971 - 2007

	Mean	Std. Deviation
MSCI Nordic	15.2%	19.06%
MSCI World	8.99%	16.73%
MSCI Sweden	16.18%	22.54%
GSCI	14.04%	15.45%
G&R Index	14.84%	20.65%
Inflation	5.36%	1.73%

To investigate the reliability of the estimations, the rolling averages of return and volatility along the lines of Buyuksahin, Haigh and Robe (2007) are brought into consideration. By looking at the rolling return and volatility over a longer period we can scrutinize trends in the return and variance and hence assess if our time period is suitable to use as an estimation for future return and variance or not. *Figure 9* shows the rolling ten year average monthly return. A decreasing trend in returns until 2003 is observable, possibly an effect of the economic crisis in the early 1990s. As visible in *Figure 5* the real GDP growth for this period was negative, and thereafter remaining positive throughout the sample period. The same trend can be observed in Norway and Denmark but it is most pronounced in the Swedish data.

Figure 9

Ten Year Rolling Average Monthly Return Sweden

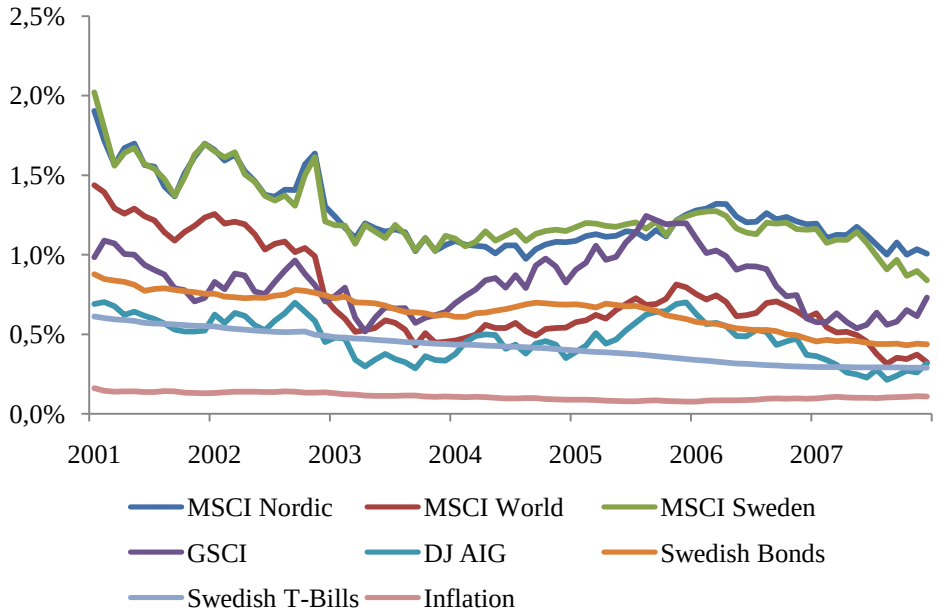
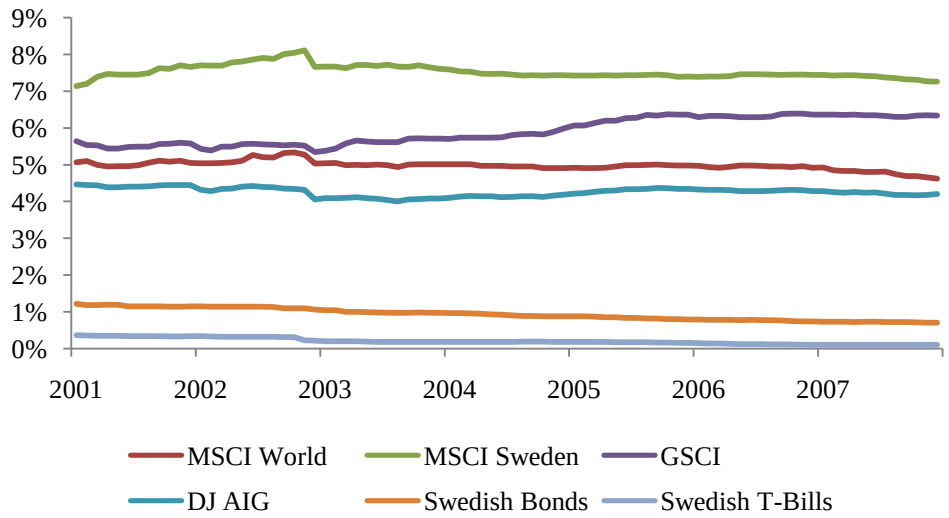


Figure 10 shows the rolling ten year volatility. Observing this graph, one can see that estimations of volatilities are less sensitive to the choice of period. The volatilities are rather constant, with the exception of a drop in late 2002, also likely to be an effect of the financial crisis 1991 – 1993 with its higher volatility falling out of the period.

Figure 10

Ten Year Rolling Monthly Volatility Sweden



To conclude, as displayed in Appendices A and B, the three Scandinavian markets behave correspondingly and the return and risk patterns are analogous. The levels of return and volatility are relatively stable, except from a trend shift around 1993, before which the nominal returns and volatility were generally higher and thereafter remained more constant.

6.2 The Correlations of Commodities with Other Asset Classes

6.2.1 Monthly Correlations

Correlation is without doubt the single most important parameter in portfolio theory, since it is used to measure the dependence between the returns on different assets or asset classes (Kat and Oomen (2006)). The rule is simple: low correlation makes good diversification and highly correlated assets or asset classes are to be avoided. As explained, one of the most attractive features of commodity futures as an investment class is its assumed low correlation with stocks and bonds. Previous studies such as Gorton and Rouwenhorst (2005) find a low or even negative correlation between the returns of commodity futures and stocks and bonds. Below we examine the correlation, measured as Pearson's linear correlation coefficient, of commodity futures returns with stocks and bonds over various investment horizons. In *Table V* the monthly correlations between a selected number of asset classes are displayed. In Appendix A, a larger correlation matrix for more assets, such as commodities sub indices, is presented.

Table V

Monthly Correlation Matrix 1991-2007 (SEK)

	MSCI Nordic	MSCI World	MSCI Sweden	GSCI	DJ AIG	Swe Bonds	Swe T-Bills	Agriculture	Energy	Industrial Metals	Livestock	Precious Metals
MSCI Nordic	1											
MSCI World	**0.741**	1										
MSCI Sweden	**0.922**	**0.684**	1									
GSCI	0.131	**0.29**	0.072	1								
DJ AIG	**0.244**	**0.468**	**0.189**	**0.886**	1							
Swedish Bonds	**0.161**	**0.202**	**0.182**	0.062	0.104	1						
Swedish T-Bills	0.076	**0.166**	0.096	0.061	0.121	**0.55**	1					
Agriculture	**0.254**	**0.495**	**0.194**	**0.365**	**0.598**	**0.123**	**0.201**	1				
Energy	0.043	0.135	-0.009	**0.95**	**0.746**	0.016	0.004	**0.142**	1			
Industrial Metals	**0.347**	**0.472**	**0.327**	**0.345**	**0.564**	-0.112	-0.058	**0.321**	**0.185**	1		
Livestock	**0.199**	**0.421**	**0.18**	**0.313**	**0.46**	**0.146**	**0.158**	**0.407**	0.125	**0.314**	1	
Precious Metals	**0.158**	**0.373**	0.1	**0.353**	**0.56**	0.104	0.059	**0.393**	**0.197**	**0.449**	**0.331**	1

Studying the monthly correlation matrix, one can, unsurprisingly, observe a strong correlation between the equity markets, e.g. the correlation between MSCI Nordic and MSCI World is 0.741. Looking at commodities, the GSCI has fairly low correlation to equity markets, bond markets and inflation. DJ AIG has a somewhat higher correlation with both equity and bond markets. The high correlation of 0.886 between GSCI and DJ AIG is not surprising given that both are broad commodity indices.

For more extensive correlation matrices, including significance levels, see Appendix A, *Tables A1, A5* and *A7*. There is a relatively high correlation between the commodity indices and international stocks. The correlation coefficient of 0.290 and 0.468 for GSCI and DJ AIG respectively, both being statistically significant, is, at a first glance, surprisingly high, especially if comparing with previous studies that find a negative or zero correlation (Gorton and Rouwenhorst (2005) and Buyuksahin, Haigh and Robe (2007)). However, this can partly be explained by an exchange rate effect. Since both international stocks and commodities are denominated in USD, the exchange rate effect for a Nordic investor is the same for both assets. Adding this extra return component increases the correlation, measured in the local currency, considerably. As visible in Appendix A, *Table A9*, the

correlation between international stocks and GSCI measured in USD is -0.028, i.e. much lower. Given the differences of the Scandinavian economies, the relation between commodities and the three Scandinavian stock markets are not the same. The Norwegian stock market has the highest correlation to commodities, especially to energy, to a large extent explained by its important oil and gas sector. Sweden has the lowest correlation and Denmark is found in between. An illustrative example is the three stock markets correlation with GSCI, which is 0.072 for Sweden, 0.178 for Denmark and 0.288 for Norway. For Swedish stocks, the Energy index, Crude Oil, Gold, GSCI and Wheat appear to be the best hedges, i.e. having the lowest correlations. In the case of Norway the asset with the lowest correlation found to the stock market is Gold with a coefficient of 0.125. The assets showing the lowest correlation with Danish stocks are Crude Oil, Wheat and the Energy index. The commodity sub-index that has the highest correlation with stocks, in all three countries, is Industrial Metals. Industrial Metals can be seen as a general indicator of the general activity level in the economy. When the economy is in a boom state and production goes up, so does the demand for industrial metals to use in cars, TVs, construction etc.

6.2.2 Correlations over Different Holding Periods

The correlations for monthly, quarterly and yearly data are not the same. It is reasonable to expect that since commodities returns are quite volatile, examining correlation over longer holding periods may reveal patterns in the data that are obscured by short-term price fluctuations (Gorton and Rouwenhorst (2005)). *Table VI* contains monthly, quarterly and yearly correlations, observed as monthly overlapping return data, for GSCI and DJ AIG and three equity indices as well as inflation. The main trend is that correlations increase with the holding period, though this is not always the case, such as for inflation.

Table VI

Monthly, Quarterly and Yearly Correlations 1991 - 2007

		MSCI Nordic	MSCI World	MSCI Sweden	Inflation
Monthly Correlation					
GSCI	Pearson Correlation	0.131	**0.290**	0.072	0.106
	Sig. (2-tailed)	0.063	0.000	0.306	0.13
DJ AIG	Pearson Correlation	**0.244**	**0.468**	**0.189**	0.135
	Sig. (2-tailed)	0.000	0.000	0.000	0.055
Quarterly Correlation					
GSCI	Pearson Correlation	**0.174**	**0.342**	**0.156**	**0.284**
	Sig. (2-tailed)	0.016	0.000	0.030	0.000
DJ AIG	Pearson Correlation	**0.289**	**0.509**	**0.274**	**0.264**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
Yearly Correlation					
GSCI	Pearson Correlation	**0.409**	**0.429**	**0.408**	0.009
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
DJ AIG	Pearson Correlation	**0.458**	**0.547**	**0.456**	**0.165**
	Sig. (2-tailed)	0.000	0.000	0.000	0.022

As the positive correlation of commodity futures with stocks tends to increase with the holding period, and following the analysis of Gorton and Rouwenhorst (2005) this suggests that the diversification benefits of commodities should be lower at longer horizons. On the other hand, the positive correlation between commodity futures and inflation is larger on a quarterly horizon but then again lower on a yearly basis. Just like asset return and volatility, correlation between different assets is not constant over time. With the intention of discovering how the correlation between different asset classes change over time, the 10 year rolling monthly correlation is calculated.

Figure 11

Ten Year Rolling Correlation GSCI and DJ AIG with MSCI Sweden

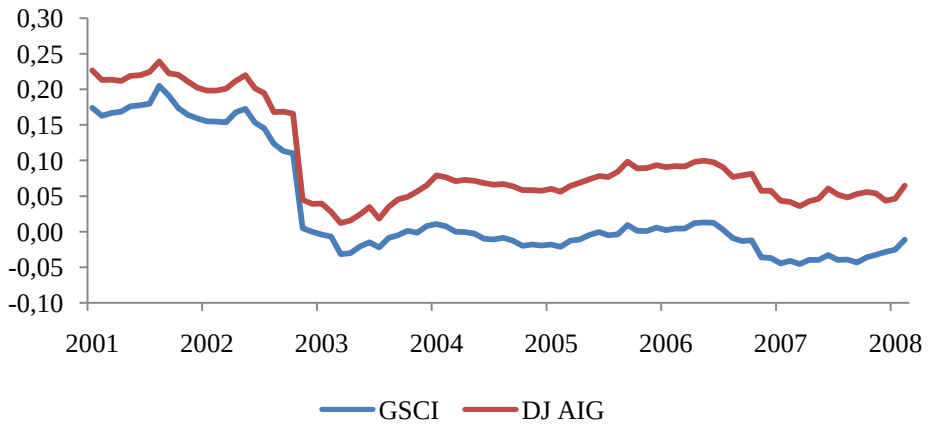
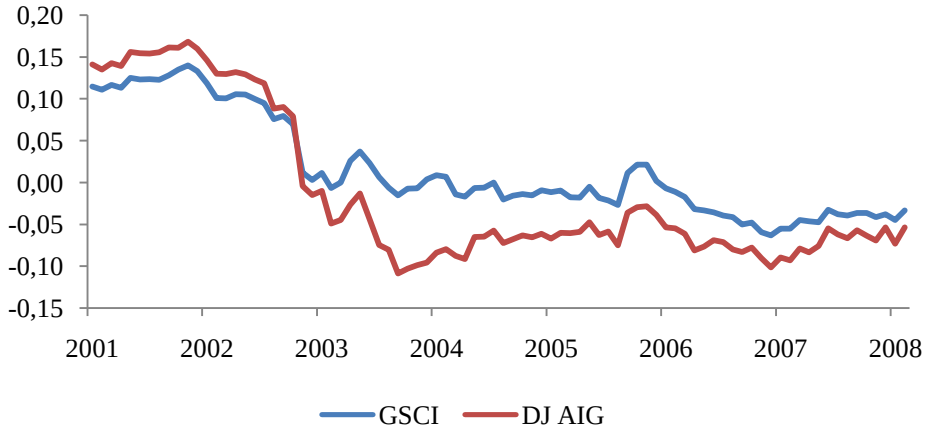


Figure 11 shows the 10 year rolling monthly correlation for GSCI and DJ AIG with Swedish stocks. We can see that before 2003, the correlation is much higher than during later years. This sharp drop may be an effect of the turbulent financial markets in the beginning of the 1990s. When these years fall out of the 10 year sample in 2003 the correlation decreases dramatically and remains relatively stable at a low level. This effect is most clearly observed in the Swedish data, but a similar drop, however weaker, can also be seen in Norway and Denmark.

Figure 12

Ten Year Rolling Correlation GSCI and DJ AIG with Swedish Bonds



Performing the same analysis for bonds, a similar trend shift around 2003 is observed, as displayed in *Figure 12*. Before this point in time the correlation is positive but afterwards it is mainly negative. For Norway and Denmark, the trend is also a decreasing correlation, though not as sharply around 2003. By studying the rolling correlation over time, it is clear that correlations between assets are not constant implying that the choice of time period directly affects the outcome of the analysis.

6.2.3 Correlations for Altering Sample Periods

Since we know that correlations vary over time, we are interested to know if the results from our main data sample, stretching from 1991 to 2007, are representative for a longer time period. In order to do this we analyze the correlations for available indices from a period extending from 1971 to 2007. Adding 20 years to the sample more than doubles its size. The results for all three countries are displayed in Appendix A.

Table VII

Monthly Correlations 1971 – 2007

		MSCI Nordic	MSCI World	MSCI Sweden	G&R Index	GSCI
MSCI Nordic	Pearson Correlation	1				
	Sig. (2-tailed)					
MSCI World	Pearson Correlation	**0.648**	1			
	Sig. (2-tailed)	0.000				
MSCI Sweden	Pearson Correlation	**0.923**	**0.578**	1		
	Sig. (2-tailed)	0.000	0.000			
G&R Index	Pearson Correlation	**0.232**	**0.399**	**0.159**	1	
	Sig. (2-tailed)	0.000	0.000	0.001		
GSCI	Pearson Correlation	0.087	**0.225**	0.015	**0.782**	1
	Sig. (2-tailed)	0.068	0.000	0.754	0.000	

In all three countries, the correlations in the 1971 – 2007 sample are close to those of the 1991 – 2007 sample, although there are some smaller deviations. For example the GSCI correlation with MSCI World is 0.225 compared to 0.290 in the main sample and the correlation with Swedish stocks is 0.015 and 0.072 respectively, i.e. not any dramatic changes. This further indicates that our data is robust and that the main sample period is representative even though it is limited to 17 years.

Finally, an extra robustness test is performed. As observed above in the 10 year rolling values, there is a trend shift around late 2002. This can be observed for return and standard deviation as well as correlations. To see what impact this has, a new correlation matrix based on data from 1993 to 2007 is calculated, i.e. the two first years of the original sample are excluded. The results from this are exhibited in *Table VIII* as well as Appendix A, *Tables A3* and *A4*. This is only done for Sweden, which is the country that shows the greatest trend shifts around 1993.

Table VIII

Monthly Correlation Selected Asset Classes (SEK) 1993 – 2007

		MSCI Nordic	MSCI World	MSCI Sweden	GSCI	DJ AIG	Swedish Bonds	Swedish T-Bills
MSCI Nordic	Pearson Correlation	1						
	Sig. (2-tailed)							
MSCI World	Pearson Correlation	0.723	1					
	Sig. (2-tailed)	0						
MSCI Sweden	Pearson Correlation	0.915	0.669	1				
	Sig. (2-tailed)	0	0					
GSCI	Pearson Correlation	0.045	0.184	-0.011	1			
	Sig. (2-tailed)	0.546	0.013	0.879				
DJ AIG	Pearson Correlation	0.133	0.367	0.064	0.873	1		
	Sig. (2-tailed)	0.075	0	0.391	0			
Swedish Bonds	Pearson Correlation	0.043	0.11	0.056	0.02	0.001	1	
	Sig. (2-tailed)	0.567	0.141	0.451	0.787	0.993		
Swedish T-Bills	Pearson Correlation	-0.006	0.045	0	0	0.016	0.549	1
	Sig. (2-tailed)	0.94	0.551	0.995	0.999	0.836	0	

When comparing the 1993 – 2007 data with the 1991 – 2007 data we can observe some changes in the correlations. For example the correlation between MSCI Sweden and commodities is 0.072 (GSCI) and 0.189 (DJ AIG) in the entire sample and when taking away the two first years the corresponding figures are -0.011 and 0.064. The correlations with Swedish Bonds are at first 0.062 (GSCI) and 0.104 (DJ AIG) and after subtracting two years 0.020 and 0.001 respectively. While the correlations between commodities and stocks and bonds decrease, the correlation between commodities and inflation increases from 0.106 (GSCI) and 0.135 (DJ AIG) to 0.208 and 0.147 respectively. Even though we can observe a trend, none of these differences are statistically significant, based on hypothesis testing comparing two correlation coefficients as described in Appendix E. Since the exclusion or inclusion of these two years does not significantly change our results for Sweden it will not do so for the other countries either since the effect of these years is less pronounced there.

Furthermore, the results for our main sample, 1991 – 2007, are closer to those of the long 1971 – 2007 sample, suggesting it to be a better proxy for long term performance of the various asset classes. Hence, we can conclude that our results are robust since we have three sub-periods, i.e. 1971 – 2007, 1991 – 2007 and 1993 – 2007, and covering three separate countries, that all yield similar results.

6.3 Commodities and Industry Sectors

Different industry sectors have different exposure to the commodities markets. It is therefore likely that stocks from different industries have different levels of correlation with commodities. *Table IX* shows the correlation between a number of Swedish sector stock indices and commodity sub-indices. Industrial Metals is the commodity sub-index that generally shows the highest correlation with the sector stock indices.

Table IX

Monthly Correlations 1991 - 2007

	Cons. Disc.	Cons. Staples	Energy	Financials	Health Care	IT	Industrials	Materials	Telecoms	Utilities
GSCI	0.027	0.092	**0.166**	-0.012	-0.146	0.009	0.057	0.031	-0.027	-0.098
DJ AIG	0.023	0.094	0.142	0.039	-0.109	0.046	0.130	0.088	0.052	-0.006
G&R Index	0.061	0.040	0.091	0.082	-0.017	0.097	**0.175**	0.076	**0.175**	0.017
Agriculture	-0.003	0.047	-0.097	-0.009	-0.060	0.015	0.043	0.028	0.095	-0.045
Energy	0.025	0.107	0.131	-0.044	**-0.166**	-0.018	0.016	0.007	-0.078	-0.111
Industrial Metals	0.056	-0.078	0.135	**0.161**	0.114	**0.201**	**0.273**	**0.161**	**0.312**	**0.170**
Livestock	0.045	-0.148	-0.002	0.072	0.099	0.137	0.100	0.048	0.064	-0.010
Precious Metals	-0.156	0.059	0.087	-0.003	0.076	-0.125	-0.002	-0.025	-0.026	0.107
Gold	**-0.179**	0.072	0.086	-0.028	0.054	-0.151	-0.028	-0.032	-0.066	0.087
Wheat	-0.056	-0.018	-0.110	-0.117	-0.114	-0.029	-0.043	0.006	0.019	-0.062
Crude Oil	0.044	0.102	**0.182**	-0.073	-0.121	-0.008	-0.012	-0.028	-0.063	-0.070

The overall correlation is relatively low. An important implication of this is, as previously mentioned, that investing in commodity related stocks is not necessarily a sufficient substitute for investing in the commodity itself. For example, the correlation between energy stocks and energy commodities is only 0.131. As Schweizer (2008) points out there are many other factors, external as well company specific, that determine the price of stocks, thus making commodity related stocks an insufficient substitute to direct commodity investments. Finally we note that the results for Denmark and Norway are similar to those of Sweden. This is displayed in Appendix A, *Table A30 - A31*.

6.4 Commodities and Inflation

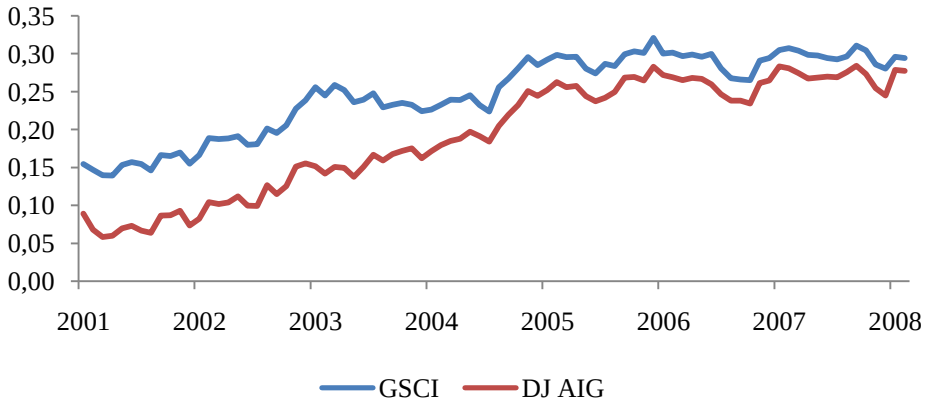
6.4.1 Actual Inflation

After all, investors do not only want to make money. What matters in the long run is to gain purchasing power i.e. to outperform inflation. Unlike stocks and bonds, commodity prices are not discounted future cash flows. Therefore it is reasonable to assume that the relation between commodity futures returns and inflation is fundamentally different as well. In times of strong economic growth, there will be an upward pressure on commodities, producer and consumer prices, as well as interest rates (Kat and Oomen (2006)). The increasing commodity prices and higher interest rates will reduce growth potential of company profits and also reduce the present value of future cash flows, i.e. the stock and bond returns will fall. However, commodities will still perform well. Given this view, higher inflation is likely to have a negative impact on stock and bond returns but a positive impact on commodities.

In *Table X* below, we can see that whereas all equity indices have a slightly negative correlation with inflation, measured as change in CPI, both GSCI and DJ AIG have a positive correlation. This means that commodities tend to perform well during periods of rising inflation, especially relative to stocks and nominal bonds, and thus provide hedging possibilities against inflation. In this study the focus is on Swedish inflation whereas the commodity market is global and normally denominated in USD. However, the Swedish consumer price index is made up of various items, of which many are more or less dependent on the price of commodities, may it be energy, food or others. Hence it is logical to assume that in times of rising commodity prices, the constituting items of the CPI will increase in price, hence driving inflation.

Figure 13

Ten Year Rolling Correlation GSCI and DJ AIG with Inflation



In *Figure 13*, showing the 10 year rolling correlation between GSCI and DJ AIG to the Swedish inflation, one cannot observe the same breaking point in 2003 as for both stocks and bonds. However the correlation is clearly higher the period following this point in time than the period preceding it. During the entire sample, the correlation between commodities and inflation is positive. However, the correlation coefficient is not statistically significant, as seen in *Table X*.

Table X

Selected Asset Classes Correlation with Swedish Inflation 1991 -2007

	MSCI Nordic	MSCI World	MSCI Sweden	GSCI	DJ AIG	Swe Bonds	Swe T-Bills	Agriculture	Energy	Ind. Metals	Livestock	Prec. Metals
Inflation	-0.092	-0.069	-0.080	0.106	0.135	0.071	**0.186**	0.011	0.108	-0.102	0.012	-0.029
	0.190	0.326	0.257	0.130	0.055	0.312	0.008	0.878	0.123	0.146	0.865	0.681
Unexpected Inflation	-0.078	**-0.138**	-0.083	0.083	0.070	**-0.170**	**-0.408**	-0.105	0.120	-0.037	-0.089	-0.031
	0.267	0.049	0.238	0.239	0.318	0.015	0.000	0.135	0.088	0.603	0.207	0.656

A surprising finding is the low correlation to gold. Gold has traditionally been regarded as a safe haven from inflation. In Appendix A, *Table A2*, we see that the observed correlation between gold and inflation is -0.028. Though close to zero, it has not the positive correlation that one expects from an ideal inflation hedge. When studying the longer sample, starting in 1971, we find similar results as above. The correlation with stocks is close to zero, sometimes even negative. The correlation with commodities from 1971 to 2007 is statistically significantly positive and in the same range as for the shorter sample.

Table XI

Selected Assets Correlation with Swedish Inflation 1971 - 2007

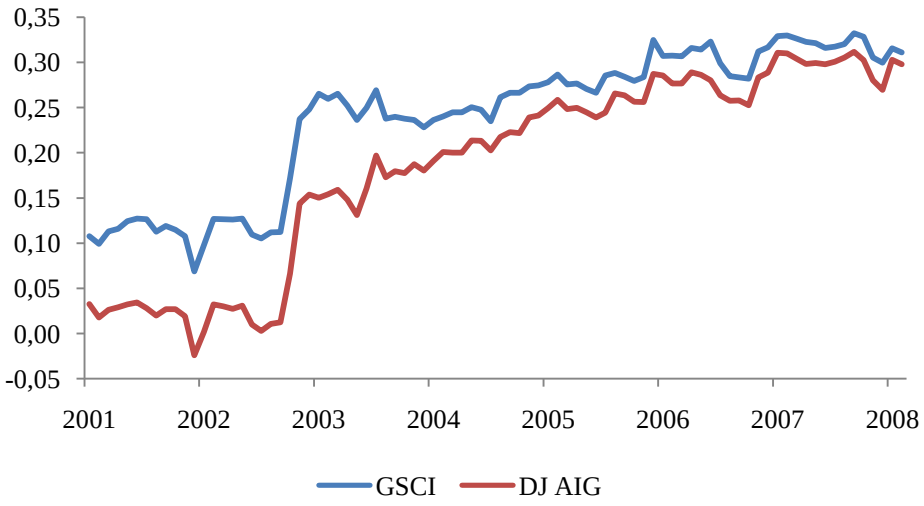
		MSCI Nordic	MSCI World	MSCI Sweden	GSCI	G&R Index
Inflation	Pearson Correlation	-0.040	0.002	-0.041	**0.142**	**0.163**
	Sig. (2-tailed)	0.398	0.965	0.387	0.003	0.001

6.4.2 Unexpected Inflation

Actual inflation can be decomposed in two components: expected inflation and unexpected inflation. Unexpected inflation is hence the difference between expected and actual inflation. Expected future inflation will already be incorporated in today's asset prices. Therefore, what really matters is not how commodity returns respond to actual inflation, but to unexpected inflation (Gorton and Rouwenhorst (2005)). However, it is not easy to measure the unexpected inflation. There are two principal methods of doing this. First, unexpected inflation can be calculated as the difference between actual inflation and the T-Bill rate, serving as proxy for expected inflation (Fama and Schwert (1977)). Second, the change in inflation rate can be used as a proxy for unexpected inflation. This implicitly assumes that today's inflation is the best predictor of future inflation (Kat and Omen (2006)). In this paper, the first method is used. From *Table XII* in the following section, we can see that the monthly correlation is positive whereas the quarterly and yearly is negative.

Figure 14

Ten Year Rolling Correlation GSCI and DJ AIG with Unexpected Inflation



In *Figure 14* the 10 year rolling correlation for GSCI and DJ AIG with unexpected inflation is displayed. For the entire period, there is a positive correlation. As in the case of actual inflation, the correlation is positive, though not statistically significant. Again, we can observe a sharp shift in the level of correlation in late 2002.

6.4.3 Inflation Post 1993

As shown in *Figure 13* and *Figure 14*, the 10 year rolling correlation between commodities and inflation, expected and unexpected, is higher for the period after 2002. As previously done with returns and correlation for stocks and bonds, the post 1992 correlations is calculated, paving the way to identify what effect the two first years have on the results. The results are visible in *Table XII* below.

Table XII

Monthly Correlations Selected Asset Classes with Inflation (SEK) 1993 – 2007

		MSCI Nordic	MSCI World	MSCI Sweden	GSCI	DJ AIG	Swedish Bonds	Swedish T-Bills
Inflation	Pearson Correlation	-0.131	-0.14	-0.16	0.208	0.147	-0.05	0.15
	Sig. (2-tailed)	0.08	0.059	0.031	0.005	0.048	0.505	0.043
Unexpected Inflation	Pearson Correlation	-0.131	-0.156	-0.165	0.209	0.138	-0.244	-0.357
	Sig. (2-tailed)	0.078	0.036	0.026	0.005	0.064	0.001	0

As indicated by the graphs, the correlation is higher for this period. However the difference is not statistically significant and the rest of our analysis is based on the original 1991 – 2007 sample.

6.5 Hypothesis Testing

After analysing the data we perform formal hypothesis testing in order to verify the validity and statistical significance of the analysis. The hypotheses and results are presented below.

6.5.1 Inflation

Table XIII

Hypothesis 1 and Results

Hypothesis 1: Commodities is a better hedge against inflation than is Stocks	Country	Result	Comment
1a: DJAIG is a better hedge against inflation than Stocks	Sweden	Confirmed	H0 rejected at 5% level
1b: GSCI is a better hedge against inflation than Stocks	Norway	Confirmed	H0 rejected at 5% level
1c: GSCI is a better hedge against inflation than Stocks	Denmark	Not confirmed	H0 not rejected

The correlation between commodities and inflation is higher than the correlation between stocks and inflation. This makes commodities a better hedge against inflation than stocks. In the case of Sweden and Norway our hypothesis is statistically confirmed since we can reject the null hypothesis at a 5 percent level. In the case of Denmark, the correlation between commodities and inflation is also higher, but the difference is not statistically significant.

Table XIV

Hypothesis 2 and Results

Hypothesis 2: Commodities is a better hedge against inflation than is Bonds	Country	Result	Comment
2a: DJ AIG is a better hedge against inflation than Bonds (Sweden)	Sweden	Not confirmed	H0 not rejected
2b: GSCI is a better hedge against inflation than Bonds (Norway)	Norway	Not confirmed	H0 not rejected
2c: GSCI is a better hedge against inflation than Bonds (Denmark)	Denmark	Not confirmed	H0 not rejected

In all three countries, the correlation between commodities and inflation is higher than the correlation between bonds and inflation, suggesting commodities to be the better hedge. However, the difference is not large enough in any country to make it statistically significant.

6.5.2 Stocks and Bonds

Table XV

Hypothesis 3 and Results

Hypothesis 3: Correlation between commodities and local stocks < local and intl. stocks	Country	Result	Comment
3a: GSCI is a better hedge against local stocks than are international stocks	Sweden	Confirmed	H0 rejected at 5% level
3b: GSCI is a better hedge against local stocks than are international stocks	Norway	Confirmed	H0 rejected at 5% level
3b: GSCI is a better hedge against local stocks than are international stocks	Denmark	Confirmed	H0 rejected at 5% level

In all three Scandinavian countries, the correlation between local stocks and international stocks is higher than local stocks and commodities. This implies that commodities are a better hedge and a good diversifier in a portfolio consisting of local stocks. The null hypothesis can be rejected at a 5 percent level in all three cases.

Table XVI

Hypothesis 4 and Results

Hypothesis 4: Correlation between Commodities and Stocks is larger than 0	Country	Result	Comment
MSCI Sweden; GSCI	Sweden	Not confirmed	Positive correlation not significant
MSCI Sweden; DJ AIG	Sweden	Confirmed	Positive correlation significant at 5% level
MSCI Norway; GSCI	Norway	Confirmed	Positive correlation significant at 5% level
MSCI Norway; DJ AIG	Norway	Confirmed	Positive correlation significant at 5% level
MSCI Denmark; GSCI	Denmark	Confirmed	Positive correlation significant at 5% level
MSCI Denmark; DJ AIG	Denmark	Confirmed	Positive correlation significant at 5% level

The correlation between stocks and commodities, both GSCI and DJ AIG, is positive in all three countries. In all cases except the MSCI Sweden and GSCI correlation, all positive correlations are statistically significant at a 5 percent level. These findings are interesting since they contradict many US research papers that find a negative or zero correlation between stocks and commodities, e.g. Gorton and Rouwenhorst (2005) and Buyuksahin, Haigh and Robe (2007),

Table XVII

Hypothesis 5 and Results

Hypothesis 5: Correlation between Commodities and Bonds is larger than 0	Country	Result	Comment
Swedish Bonds; GSCI	Sweden	Not confirmed	Positive correlation not significant
Swedish Bonds; DJ AIG	Sweden	Not confirmed	Positive correlation not significant
Norwegian Bonds; GSCI	Norway	Confirmed	Positive correlation significant at 5% level
Norwegian Bonds; DJ AIG	Norway	Confirmed	Positive correlation significant at 5% level
Danish Bonds; GSCI	Denmark	Not confirmed	Positive correlation not significant
Danish Bonds; DJ AIG	Denmark	Not confirmed	Positive correlation not significant

In all three countries, the correlation between bonds and commodities is positive. However, it is only in the case of Norway that the difference from zero is statistically significant. Commodities are fundamentally different from financial assets like bonds so it is likely that their returns should have a low correlation. Bond prices are primarily driven by longer-term economic prospects, while

commodity prices are primarily determined by current economic activity (Kat and Oomen (2006)). Like the previous hypothesis, our results here are different from previous studies that indicate a negative correlation between commodities and bonds, e.g. Gorton and Rouwenhorst (2005) and Kat and Oomen (2006).

Table XVIII

Hypothesis 6 and Results

Hypothesis 6: Commodity futures (GSCI/DJ AIG) yield equity like returns (MSCI Index)	Country	Result	Comment
Commodity futures (GSCI) yield equity like returns (MSCI Sweden)	Sweden	Confirmed	H0 no rejected at 5% level
Commodity futures (DJ AIG) yield equity like returns (MSCI Sweden)	Sweden	Confirmed	H0 no rejected at 5% level
Commodity futures (GSCI) yield equity like returns (MSCI Norway)	Norway	Confirmed	H0 no rejected at 5% level
Commodity futures (DJ AIG) yield equity like returns (MSCI Norway)	Norway	Confirmed	H0 no rejected at 5% level
Commodity futures (GSCI) yield equity like returns (MSCI Denmark)	Denmark	Confirmed	H0 no rejected at 5% level
Commodity futures (DJ AIG) yield equity like returns (MSCI Denmark)	Denmark	Confirmed	H0 no rejected at 5% level

Previous research suggests that long-only portfolios of commodity futures have had average returns similar to stocks, e.g. Bodie and Rosansky's (1980) and Gorton and Rouwenhorst (2005). Based on our data, we cannot reject the hypothesis that the return from stocks is equal to the returns of commodity futures, measured as GSCI. The three Scandinavian stock indices all have yielded higher results than commodities during the period, but the difference is not statistically significant. The same is true for DJ AIG. Over the sample period DJ AIG has produced a lower yield than the stock indices, but the difference is not statistically significant.

6.5.3 The GSCI and DJ AIG Indices

Table XIX

Hypothesis 7a and Results

Hypothesis 7a: GSCI is a better hedge against Inflation than DJ AIG	Country	Result	Comment
GSCI is a better hedge for Inflation than DJ AIG	Sweden	Not Confirmed	H0 no rejected at 5% level
GSCI is a better hedge for Inflation than DJ AIG	Norway	Not Confirmed	H0 no rejected at 5% level
GSCI is a better hedge for Inflation than DJ AIG	Denmark	Not Confirmed	H0 no rejected at 5% level

A good hedge against inflation has a high correlation with the inflation since the asset price must go up to compensate for the higher inflation in order not to lose purchasing power. The correlation between GSCI and DJ AIG with inflation is quite similar, the small difference is not large enough to make it statistically significant and we cannot reject the null hypothesis.

Table XX

Hypothesis 7b and Results

Hypothesis 7b: GSCI is a better hedge for Stocks than DJ AIG	Country	Result	Comment
GSCI is a better hedge for Stocks than DJ AIG	Sweden	Not Confirmed	H0 no rejected at 5% level
GSCI is a better hedge for Stocks than DJ AIG	Norway	Not Confirmed	H0 no rejected at 5% level
GSCI is a better hedge for Stocks than DJ AIG	Denmark	Not Confirmed	H0 no rejected at 5% level

In order to be a good hedge for stocks, an asset should have a low or even negative correlation with stocks. When comparing our two commodity indices, the correlation with stocks is higher for DJ AIG than GSCI in all three countries. However, it is only in Sweden that the difference is statistically significant.

Table XXI

Hypothesis 7c and Results

Hypothesis 7c: GSCI is a better hedge for Bonds than DJ AIG	Country	Result	Comment
GSCI is a better hedge for Bonds than DJ AIG	Sweden	Not Confirmed	H0 no rejected at 5% level
GSCI is a better hedge for Bonds than DJ AIG	Norway	Not Confirmed	H0 no rejected at 5% level
GSCI is a better hedge for Bonds than DJ AIG	Denmark	Not Confirmed	H0 no rejected at 5% level

The difference between the correlation of GSCI and DJ AIG with bonds is very small in all three countries. Therefore no conclusion can be drawn about which of the two indices is the best hedge for bonds.

Decisively, the formal hypothesis testing allows us to draw stronger conclusions from our quantitative analysis and in most cases our theories are confirmed, though sometimes with a lack of statistical significance.

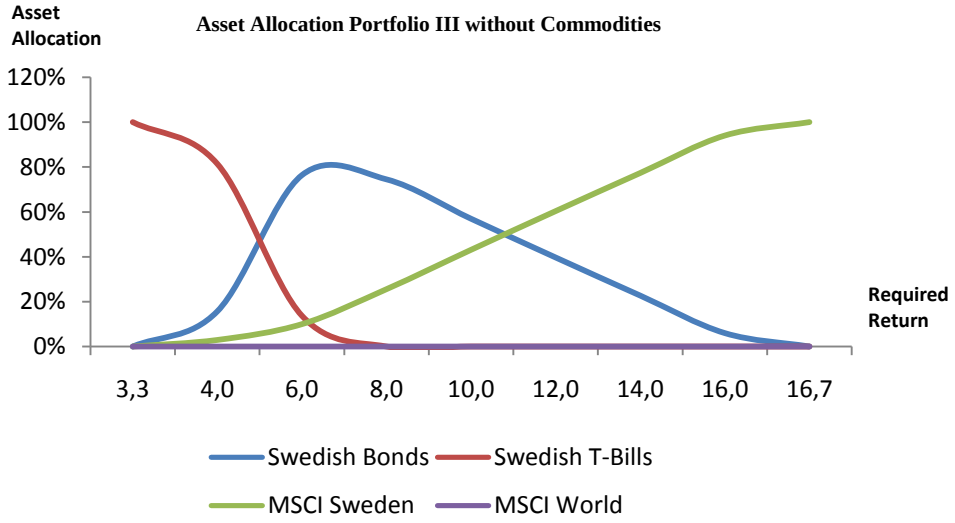
6.6 Portfolio Optimization

The return patterns analyzed above are used to create mean-variance efficient portfolios according to the Markowitz framework, described in Section 5.3.1. Per a given level of expected return, the optimal asset allocation in order to minimize the standard deviation is calculated. The assets available are Swedish stocks, international stocks, Swedish Bonds, Swedish T-Bills, GSCI and DJ AIG. First, an optimal mean-variance portfolio without commodities is constructed. Second, commodities may be added to the portfolio in order to make a comparison on the risk and return levels.

This is illustrated by using Portfolio III, which is a long only portfolio, i.e. it is only allowed to take positive positions. The minimum individual position is consequently 0 percent and the maximum is 100 percent, while the sum of all positions, of course, always add up to 100 percent. When no commodities are allowed, the optimal asset allocation, consisting of Swedish stocks, international stocks, Swedish Bonds and Swedish T-Bills, is as displayed in *Figure 15*.

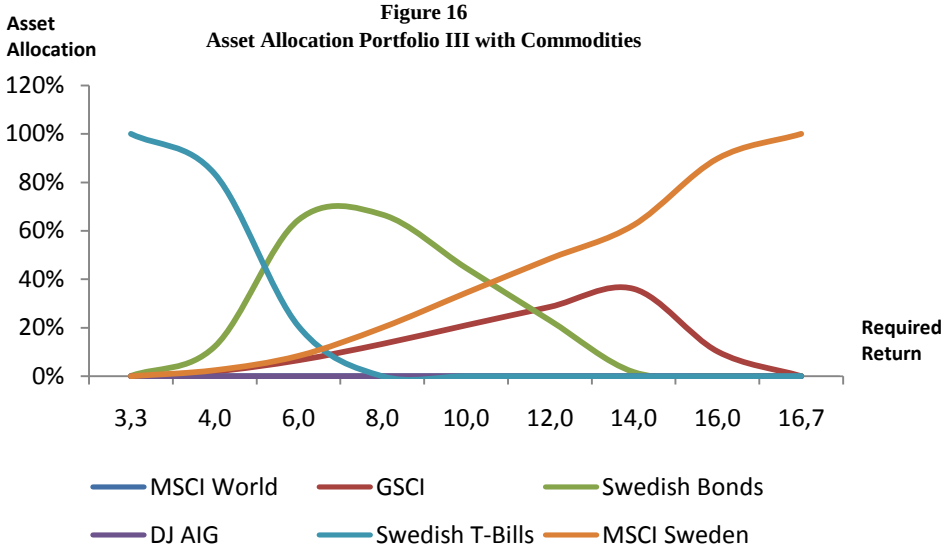
Figure 15

Asset Allocation Portfolio III without Commodities



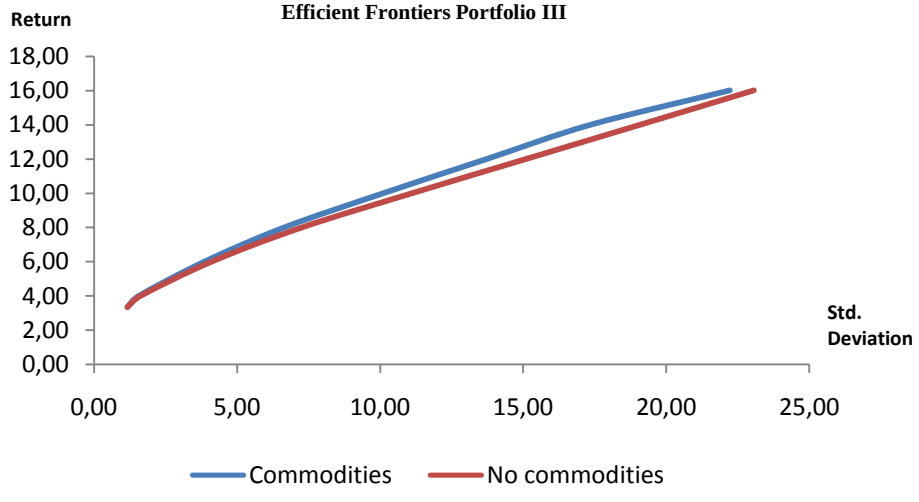
The optimal asset allocation varies as the required return, and hence the accepted risk level, increases. In the next step commodity indices, GSCI and DJ AIG, are added to the investment universe. As visible in *Figure 16*, when adding commodities to the available investment opportunities, the optimal asset allocation changes as follows.

Figure 16
Asset Allocation Portfolio III with Commodities



The optimal asset allocation now includes commodities and the proportional allocation to commodities is increasing with the required return. *Figure 17* shows the efficient frontiers of the portfolio with commodities and of the portfolio without commodities. It clearly illustrates the effect on the risk adjusted returns caused by the inclusion of commodity futures in the portfolio.

Figure 17
Efficient Frontiers Portfolio III



From observing the graph, we can conclude that the portfolio with commodities dominates the one without commodities. Appendix D contains further graphs and tables regarding the portfolios and their compositions. In all cases, adding commodities to the portfolio will decrease the risk per any given level of return, i.e. the efficient frontier shifts up. A summary of the risk and return characteristics for each portfolio is presented in *Table XXII* below.

Given the return and standard deviation, a Sharpe ratio is calculated. The Sharpe ratio for the *No commodities* and the *Commodities* portfolios are compared. The Sharpe ratio is computed using the following formula:

$$Sharpe\ Ratio = \frac{r_p - r_{rf}}{\sigma_p}$$

Where r_p is the return of the portfolio, r_{rf} is the risk free return and σ_p is the standard deviation of the portfolio. In all cases the Sharpe ratio increases by the inclusion of commodities, i.e. the Commodities portfolios always dominate the No Commodities portfolios. The greatest effect is, unsurprisingly, in the unrestricted portfolio, where the diversification benefits of commodities can be used most extensively. The smallest change is in the Benchmark portfolio where the commodities weight is fixed at 10 percent.

Table XXII

Risk and Return for Efficient Portfolios

Portfolio	Return (%)	Std. Deviation	Sharpe Ratio	Δ Sharpe Ratio
Unrestricted portfolio				0.24
No Commodities	10.00	9.42	0.82	
Commodities	10.00	8.10	1.06	
Long only. levered				0.05
No Commodities	10.00	9.43	0.71	
Commodities	10.00	8.83	0.75	
Long only. unlevered				0.06
No Commodities	10.00	11.12	0.60	
Commodities	10.00	10.12	0.66	
Long only. unlevered. no pos >30%				0.09
No Commodities	8.00	8.40	0.55	
Commodities	8.00	7.23	0.64	
Long only. levered. no pos >30%				0.09
No Commodities	8.00	8.40	0.55	
Commodities	8.00	7.23	0.64	
Benchmark portfolio				0.03
No Commodities	10.50	13.55	0.53	
Commodities	10.62	13.08	0.56	

All portfolios with commodities dominate those without commodities and the proportional allocation of the different asset classes differ across the portfolios. What drive these allocation changes are returns and correlations. We have seen that historically stock and commodity returns have had a low correlation and therefore a portfolio that invested in both stocks and commodity futures has a lower level of volatility than either stocks or commodity futures separately. Consequently, a mixed portfolio of stocks, bonds and commodity futures can be more efficient, have a higher ratio of return to risk, than a standalone stocks and bonds portfolio.

7. CONCLUDING REMARKS

Commodities is an asset class that has gone from relative obscurity into the limelight in recent time. There are two principal reasons for this increased focus on commodities. Firstly, we have seen a bull market in commodities, attracting the attention of investors. Secondly, commodities have an assumed low correlation with stocks and bonds, making it an attractive portfolio component. The price of commodities is a function of demand, which has increased due to the rising economic activity in many emerging markets such as China, India and Latin America, and supply, which often is limited and difficult to adjust in the short run. Small changes in production output may have great marginal effects on price, thereof the notorious volatility of commodities (Akey (2005)). The paradox is, however, that though in itself being a relatively risky asset, commodities may reduce the overall risk of a portfolio due to its relatively low correlation to traditional asset classes like stocks and bonds. Recent research claims that commodities have a zero or even negative correlation with these asset classes. Moreover, commodities have been suggested as a hedge against inflation, i.e. having a positive correlation. The primary purpose of this paper is to examine commodity futures and its characteristics from a Scandinavian perspective; to investigate whether the potential benefits of commodity futures investments suggested by previous research is applicable in this part of the world. This is done by taking the perspective of a Scandinavian investor, with significant exposure to its local stock and bond market and whose returns will ultimately be measured in the local currency. Below we outline our most important findings.

Firstly, when investigating the relationship between commodity futures and inflation, we find a positive correlation. This is true for both expected inflation and unexpected inflation. Further, commodity futures have a higher correlation with inflation than both stocks and bonds. The positive correlation between commodity futures and inflation implies that commodity futures work as a hedge against inflation, i.e. when inflation goes up, so does the return of your commodity futures, hence protecting your purchasing power. This has very important implications for long term asset management, where the aim is not only to generate positive returns, but also to protect the assets from decline in real terms. By adding commodity futures to the portfolio an investor is better shielded from inflation than if only holding stocks and bonds. On this point our findings are in line with most previous research, e.g. Gorton and Rouwenhorst (2005), Erb and Harvey (2006) and Kat and Oomen (2007).

Secondly, we examine the correlation between commodity futures and stocks and bonds. Local Scandinavian stocks have lower correlation to commodity futures than to international stocks, meaning that an investor holding local stocks have greater diversification benefits to gain from adding commodity futures, rather than international stocks, to his or her portfolio. In contrast to previous studies, e.g. Gorton and Rouwenhorst (2005) and Kat and Oomen (2007), who find a zero or negative correlation between commodity futures and stocks, we find evidence of a positive correlation between

Scandinavian stock markets and commodity futures. The correlation is still relatively low, especially compared to the correlation between stocks and bonds for example, but not as low as previously argued. The same results are found for bonds, i.e. we find a positive correlation between commodity futures and bonds. However, the trend is not as strong as for stocks. Finally, our analysis indicates, in line with previous studies, e.g. Erb and Harvey (2006), that commodity futures yield equity like returns, i.e. the risk and return of commodity futures is comparable to those of stocks.

Thirdly, we show the diversification benefits of commodity futures in an investment portfolio. By constructing six portfolios, each with its own set of asset allocation restrictions, and optimizing the asset allocation to minimize risk per any given level of return, it is clear that the portfolio including commodities always dominate the corresponding portfolio without commodities. Hence, even though not being a nearly perfect hedge with zero or negative correlation to stocks and bonds, as suggested by previous research, commodities have a lot to offer the strategic investor in terms of diversification benefits and the associated increase in risk adjusted returns. An interesting question that arises following these findings is how to explain the higher correlation between commodity futures and stocks and bonds in the Scandinavian markets, compared to for example the United States, where the majority of all commodity futures related research has been performed. The higher correlation may be a reflection of a higher commodity dependency in these markets. Norwegian oil and gas, Swedish steel and forestry and Danish agriculture, for example, all have an important impact on the economy and also ultimately the stock markets, hence a higher correlation is reasonable. An illustrative example is Norway, where high oil prices tend to fuel not only the oil producing companies, but the entire off-shore and oil services industry as well as shipping and other related businesses, ultimately affecting the entire economy.

To conclude, commodity futures returns have a good potential to provide diversification benefits in both stock and bond portfolios. The correlation with stocks and bonds is low over most horizons. Commodity futures perform better in periods of unexpected inflation, when stock and bond returns generally disappoint and diversify the cyclical variation in stock and bond returns. On the basis of the facts we have produced, the historical performance of investments in commodity futures suggests that they are an attractive asset class for the hedge hunting investor aiming to diversify traditional investment portfolios of stocks and bonds.

7.1 Discussion of the Results and Suggestions for Further Research

Given our extensive data sample, the main sample stretching over 17 years and an additional sample of 37 years, covering three separate countries, including several commodity, equity and fixed income indices, we are convinced that our findings are well representative. The consistent results for the different time periods suggest a good level of robustness. Furthermore, the majority of our findings are statistically significant, making us confident with the validity of our conclusions. Equally important,

our conclusions fit from an economic, not only statistical, perspective. Even though our data sample is extensive, studying an even longer time period would pave the way to identify changes in the pattern of return, volatility and correlation over time. In addition, it would make sense to apply this study on other geographical areas where stock markets can be assumed to be more or less correlated with commodities.

The results are supported by some of the leading academics and investors in the commodities field, to whom we have presented our results and conclusions. As Cam Harvey of Duke University draws attention to, the higher correlation is driven by the higher commodity exposure of these countries, and therefore some of the hedging effect is lost (Harvey, 23 May 2008). Also Gary Gorton of Wharton School, University of Pennsylvania, who himself found a negative correlation between commodities and stocks and bonds, agrees that a more commodity related economy could result in higher correlation (Gorton, 28 May 2008). Scandinavia is not the only region whose equity markets have proven to have a higher correlation with commodities. Michael Haigh, Commodities Derivatives Trading at Société Générale, draws the parallel to Australia, where the main stock index, comprised of many commodity stocks, is also highly correlated (Haigh, 23 May 2008).

In this research paper, GSCI and Dow Jones AIG indices are used as proxies for the commodities markets since they are the two most traded and widely used indices. As previously indicated, these are not the only definitions of the aggregate performance of commodities markets, and it would be appealing to further elaborate and bring more indices into attention. Furthermore, extra robustness tests could be undertaken. An idea would be to perform an analysis for the largest firms only, and an analysis for the smaller firms only, testing the assumption that large companies are not as heavily related to the commodities market. An alternative would be to look at companies that are dual-listed; if the companies are broadly diversified world-wide, then the local economic situation is likely to matter less.

It is sometimes believed that investing in the stocks of commodity producing companies is a good way to gain exposure to commodities. It has even been argued that the stocks of such companies are a substitute for commodity futures. In this paper we could see that there was a relatively low correlation between stocks from a particular sector and the corresponding commodities index, e.g. between energy stocks and energy commodities. It would be interesting to examine this argument by comparing the performance of commodity related stocks and the associated commodities on a more detailed level than on sector by sector basis.

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APPENDIX A

Table A1

Monthly Correlations Selected Asset Classes (SEK) 1991 – 2007

		MSCI Nordic	MSCI World	MSCI Sweden	GSCI	DJ AIG	Swedish Bonds	Swedish T-Bills	Agriculture	Energy	Industrial Metals	Livestock	Precious Metals	Gold	Wheat	Crude Oil
MSCI Nordic	Pearson Correlation	1														
	Sig. (2-tailed)															
MSCI World	Pearson Correlation	0.741	1													
	Sig. (2-tailed)	0														
MSCI Sweden	Pearson Correlation	0.922	0.684	1												
	Sig. (2-tailed)	0	0													
GSCI	Pearson Correlation	0.131	0.29	0.072	1											
	Sig. (2-tailed)	0.063	0	0.306												
DJ AIG	Pearson Correlation	0.244	0.468	0.189	0.886	1										
	Sig. (2-tailed)	0	0	0.007	0											
Swedish Bonds	Pearson Correlation	0.161	0.202	0.182	0.062	0.104	1									
	Sig. (2-tailed)	0.021	0.004	0.009	0.378	0.139										
Swedish T-Bills	Pearson Correlation	0.076	0.166	0.096	0.061	0.121	0.55	1								
	Sig. (2-tailed)	0.277	0.018	0.171	0.385	0.085	0									
Agriculture	Pearson Correlation	0.254	0.495	0.194	0.365	0.598	0.123	0.201	1							
	Sig. (2-tailed)	0	0	0.006	0	0	0.079	0.004								
Energy	Pearson Correlation	0.043	0.135	-0.009	0.95	0.746	0.016	0.004	0.142	1						
	Sig. (2-tailed)	0.539	0.053	0.902	0	0	0.823	0.953	0.043							
Industrial Metals	Pearson Correlation	0.347	0.472	0.327	0.345	0.564	-0.112	-0.058	0.321	0.185	1					
	Sig. (2-tailed)	0	0	0	0	0	0.111	0.413	0	0.008						
Livestock	Pearson Correlation	0.199	0.421	0.18	0.313	0.46	0.146	0.158	0.407	0.125	0.314	1				
	Sig. (2-tailed)	0.004	0	0.01	0	0	0.037	0.024	0	0.075	0					
Precious Metals	Pearson Correlation	0.158	0.373	0.1	0.353	0.56	0.104	0.059	0.393	0.197	0.449	0.331	1			
	Sig. (2-tailed)	0.024	0	0.153	0	0	0.141	0.401	0	0.005	0	0				
Gold	Pearson Correlation	0.116	0.343	0.062	0.358	0.552	0.113	0.061	0.389	0.206	0.426	0.329	0.988	1		
	Sig. (2-tailed)	0.098	0	0.381	0	0	0.106	0.387	0	0.003	0	0	0			
Wheat	Pearson Correlation	0.178	0.329	0.099	0.294	0.43	0.091	0.165	0.824	0.122	0.198	0.321	0.25	0.259	1	
	Sig. (2-tailed)	0.011	0	0.16	0	0	0.198	0.018	0	0.083	0.004	0	0	0		
Crude Oil	Pearson Correlation	0.043	0.123	0.015	0.859	0.677	-0.033	-0.01	0.12	0.913	0.195	0.115	0.202	0.208	0.102	1
	Sig. (2-tailed)	0.538	0.079	0.826	0	0	0.637	0.882	0.089	0	0.005	0.102	0.004	0.003	0.145	

Table A2

Monthly Correlation Selected Asset Classes with Inflation (SEK) 1991 – 2007

		MSCI Nordic	MSCI World	MSCI Sweden	GSCI	DJ AIG	Swedish Bonds	Swedish T-Bills	Agriculture	Energy	Industrial Metals	Livestock	Precious Metals	Gold	Wheat	Crude Oil
Inflation	Pearson Correlation	-0.092	-0.069	-0.08	0.106	0.135	0.071	0.186	0.011	0.108	-0.102	0.012	-0.029	-0.028	0.069	0.056
	Sig. (2-tailed)	0.19	0.326	0.257	0.13	0.055	0.312	0.008	0.878	0.123	0.146	0.865	0.681	0.69	0.324	0.429
Unexpected Inflation	Pearson Correlation	-0.078	-0.138	-0.083	0.083	0.07	-0.17	-0.408	-0.105	0.12	-0.037	-0.089	-0.031	-0.032	-0.05	0.077
	Sig. (2-tailed)	0.267	0.049	0.238	0.239	0.318	0.015	0	0.135	0.088	0.603	0.207	0.656	0.652	0.48	0.273

Table A3

Monthly Correlation Selected Asset Classes (SEK) 1993 – 2007

		MSCI Nordic	MSCI World	MSCI Sweden	GSCI	DJ AIG	Swedish Bonds	Swedish T-Bills	Agriculture	Energy	Industrial Metals	Livestock	Precious Metals	Gold	Wheat	Crude Oil
MSCI Nordic	Pearson Correlation	1														
	Sig. (2-tailed)															
MSCI World	Pearson Correlation	0.723	1													
	Sig. (2-tailed)	0														
MSCI Sweden	Pearson Correlation	0.915	0.669	1												
	Sig. (2-tailed)	0	0													
GSCI	Pearson Correlation	0.045	0.184	-0.011	1											
	Sig. (2-tailed)	0.546	0.013	0.879												
DJ AIG	Pearson Correlation	0.133	0.367	0.064	0.873	1										
	Sig. (2-tailed)	0.075	0	0.391	0											
Swedish Bonds	Pearson Correlation	0.043	0.11	0.056	0.02	0.001	1									
	Sig. (2-tailed)	0.567	0.141	0.451	0.787	0.993										
Swedish T-Bills	Pearson Correlation	-0.006	0.045	0	0	0.016	0.549	1								
	Sig. (2-tailed)	0.94	0.551	0.995	0.999	0.836	0									
Agriculture	Pearson Correlation	0.141	0.396	0.072	0.28	0.534	0.02	0.127	1							
	Sig. (2-tailed)	0.058	0	0.333	0	0	0.79	0.088								
Energy	Pearson Correlation	-0.011	0.055	-0.055	0.954	0.743	0.005	-0.022	0.072	1						
	Sig. (2-tailed)	0.878	0.464	0.465	0	0	0.942	0.771	0.335							
Industrial Metals	Pearson Correlation	0.298	0.437	0.276	0.279	0.526	-0.165	-0.139	0.263	0.13	1					
	Sig. (2-tailed)	0	0	0	0	0	0.026	0.062	0	0.081						
Livestock	Pearson Correlation	0.112	0.329	0.077	0.221	0.357	0.06	0.015	0.312	0.059	0.242	1				
	Sig. (2-tailed)	0.133	0	0.304	0.003	0	0.421	0.841	0	0.433	0.001					
Precious Metals	Pearson Correlation	0.06	0.282	-0.004	0.252	0.486	0.037	-0.016	0.314	0.113	0.375	0.218	1			
	Sig. (2-tailed)	0.425	0	0.962	0.001	0	0.623	0.831	0	0.132	0	0.003				
Gold	Pearson Correlation	0.011	0.247	-0.047	0.261	0.481	0.055	-0.007	0.314	0.125	0.353	0.223	0.986	1		
	Sig. (2-tailed)	0.878	0.001	0.534	0	0	0.466	0.928	0	0.094	0	0.003	0			
Wheat	Pearson Correlation	0.101	0.236	0.009	0.23	0.374	0.004	0.093	0.807	0.072	0.159	0.244	0.183	0.196	1	
	Sig. (2-tailed)	0.176	0.001	0.903	0.002	0	0.96	0.211	0	0.333	0.033	0.001	0.014	0.008		
Crude Oil	Pearson Correlation	-0.002	0.055	-0.017	0.856	0.671	-0.043	-0.008	0.058	0.906	0.145	0.06	0.122	0.13	0.062	1
	Sig. (2-tailed)	0.974	0.464	0.819	0	0	0.566	0.916	0.439	0	0.051	0.424	0.103	0.08	0.407	

Table A4

Monthly Correlations Selected Asset Classes with Inflation (SEK) 1993 – 2007

		MSCI Nordic	MSCI World	MSCI Sweden	GSCI	DJ AIG	Swedish Bonds	Swedish T-Bills	Agriculture	Energy	Industrial Metals	Livestock	Precious Metals	Gold	Wheat	Crude Oil
Inflation	Pearson Correlation	-0.131	-0.14	-0.16	0.208	0.147	-0.05	0.15	0.018	0.223	-0.067	-0.038	0.059	0.067	0.087	0.181
	Sig. (2-tailed)	0.08	0.059	0.031	0.005	0.048	0.505	0.043	0.808	0.003	0.369	0.614	0.428	0.369	0.247	0.015
Unexpected Inflation	Pearson Correlation	-0.131	-0.156	-0.165	0.209	0.138	-0.244	-0.357	-0.056	0.238	0.006	-0.053	0.071	0.077	0.028	0.192
	Sig. (2-tailed)	0.078	0.036	0.026	0.005	0.064	0.001	0	0.451	0.001	0.939	0.479	0.341	0.305	0.709	0.01

Table A5

Monthly Correlations Selected Asset Classes (NOK) 1991 – 2007

		MSCI Nordic	MSCI World	MSCI Sweden	GSCI	DJ AIG	Swedish Bonds	Swedish T-Bills	Agriculture	Energy	Industrial Metals	Livestock	Precious Metals	Gold	Wheat	Crude Oil
MSCI Nordic	Pearson Correlation	1														
	Sig. (2-tailed)															
MSCI World	Pearson Correlation	0.761	1													
	Sig. (2-tailed)	0														
MSCI Norway	Pearson Correlation	0.703	0.603	1												
	Sig. (2-tailed)	0	0													
Norwegian Bonds	Pearson Correlation	0.122	0.144	0.182	1											
	Sig. (2-tailed)	0.083	0.04	0.009												
GSCI	Pearson Correlation	0.158	0.283	0.288	0.15	1										
	Sig. (2-tailed)	0.024	0	0	0.033											
DJ AIG	Pearson Correlation	0.271	0.46	0.354	0.149	0.883	1									
	Sig. (2-tailed)	0	0	0	0.034	0										
G&R Index	Pearson Correlation	0.392	0.633	0.385	0.115	0.692	0.885	1								
	Sig. (2-tailed)	0	0	0	0.103	0	0									
Agriculture	Pearson Correlation	0.259	0.473	0.248	0.085	0.322	0.554	0.668	1							
	Sig. (2-tailed)	0	0	0	0.23	0	0	0								
Energy	Pearson Correlation	0.072	0.137	0.211	0.122	0.952	0.754	0.494	0.11	1						
	Sig. (2-tailed)	0.305	0.051	0.003	0.082	0	0	0	0.119							
Industrial Metals	Pearson Correlation	0.376	0.469	0.338	-0.014	0.308	0.541	0.607	0.277	0.155	1					
	Sig. (2-tailed)	0	0	0	0.848	0	0	0	0	0.028						
Livestock	Pearson Correlation	0.226	0.42	0.192	0.132	0.293	0.426	0.606	0.367	0.117	0.293	1				
	Sig. (2-tailed)	0.001	0	0.006	0.06	0	0	0	0	0.097	0					
Precious Metals	Pearson Correlation	0.182	0.352	0.161	0.099	0.283	0.497	0.562	0.319	0.14	0.396	0.282	1			
	Sig. (2-tailed)	0.009	0	0.022	0.159	0	0	0	0	0.047	0	0				
Gold	Pearson Correlation	0.139	0.32	0.125	0.101	0.286	0.486	0.538	0.313	0.148	0.371	0.28	0.985	1		
	Sig. (2-tailed)	0.049	0	0.075	0.15	0	0	0	0	0.035	0	0	0			
Wheat	Pearson Correlation	0.176	0.304	0.176	0.045	0.259	0.388	0.428	0.814	0.096	0.161	0.286	0.186	0.194	1	
	Sig. (2-tailed)	0.012	0	0.012	0.523	0	0	0	0	0.172	0.022	0	0.008	0.006		
Crude Oil	Pearson Correlation	0.063	0.114	0.196	0.087	0.852	0.671	0.43	0.077	0.909	0.151	0.096	0.131	0.136	0.07	1
	Sig. (2-tailed)	0.368	0.107	0.005	0.217	0	0	0	0.277	0	0.031	0.172	0.063	0.053	0.324	

Table A6

Monthly Correlations Selected Asset Classes with Inflation (NOK) 1991 - 2007

		MSCI Nordic	MSCI World	MSCI Norway	Norwegian Bonds	GSCI	DJ AIG	G&R Index	Agriculture	Energy	Industrial Metals	Livestock	Precious Metals	Gold	Wheat	Crude Oil
Inflation	Pearson Correlation	-0.106	-0.101	-0.109	0.062	0.145	0.115	0.046	-0.068	0.166	-0.028	0	0.135	0.128	-0.081	0.178
	Sig. (2-tailed)	0.133	0.151	0.121	0.382	0.039	0.102	0.519	0.334	0.018	0.695	0.999	0.054	0.069	0.253	0.011

Table A7

Monthly Correlations Selected Asset Classes (DKK) 1991 -2007

		MSCI Nordic	MSCI World	MSCI Denmark	Danish Bonds	GSCI	DJ AIG	G&R Index	Agriculture	Energy	Industrial Metals	Livestock	Precious Metals	Gold	Wheat	Crude Oil
MSCI Nordic	Pearson Correlation	1														
	Sig. (2-tailed)															
MSCI World	Pearson Correlation	**0.774**	1													
	Sig. (2-tailed)	0														
MSCI Denmark	Pearson Correlation	**0.7**	**0.667**	1												
	Sig. (2-tailed)	0	0													
Danish Bonds	Pearson Correlation	0.017	**0.15**	**0.169**	1											
	Sig. (2-tailed)	0.806	0.033	0.016												
GSCI	Pearson Correlation	**0.203**	**0.317**	**0.178**	0.079	1										
	Sig. (2-tailed)	0.004	0	0.011	0.261											
DJ AIG	Pearson Correlation	**0.312**	**0.481**	**0.282**	0.072	**0.894**	1									
	Sig. (2-tailed)	0	0	0	0.304	0										
G&R Index	Pearson Correlation	**0.425**	**0.644**	**0.368**	0.049	**0.718**	**0.892**	1								
	Sig. (2-tailed)	0	0	0	0.484	0	0									
Agriculture	Pearson Correlation	**0.283**	**0.479**	**0.238**	0.09	**0.345**	**0.56**	**0.667**	1							
	Sig. (2-tailed)	0	0	0.001	0.203	0	0	0								
Energy	Pearson Correlation	0.119	**0.181**	0.113	0.057	**0.957**	**0.778**	**0.538**	**0.147**	1						
	Sig. (2-tailed)	0.09	0.01	0.109	0.418	0	0	0	0.037							
Industrial Metals	Pearson Correlation	**0.396**	**0.476**	**0.32**	-0.121	**0.329**	**0.546**	**0.607**	**0.276**	**0.187**	1					
	Sig. (2-tailed)	0	0	0	0.087	0	0	0	0	0.007						
Livestock	Pearson Correlation	**0.243**	**0.42**	**0.186**	0.108	**0.307**	**0.424**	**0.594**	**0.355**	**0.146**	**0.286**	1				
	Sig. (2-tailed)	0	0	0.008	0.125	0	0	0	0	0.037	0					
Precious Metals	Pearson Correlation	**0.217**	**0.365**	**0.186**	0.069	**0.317**	**0.514**	**0.565**	**0.324**	**0.186**	**0.399**	**0.274**	1			
	Sig. (2-tailed)	0.002	0	0.008	0.328	0	0	0	0	0.008	0	0				
Gold	Pearson Correlation	**0.176**	**0.335**	**0.144**	0.081	**0.321**	**0.503**	**0.539**	**0.317**	**0.196**	**0.373**	**0.27**	**0.986**	1		
	Sig. (2-tailed)	0.012	0	0.04	0.252	0	0	0	0	0.005	0	0	0			
Wheat	Pearson Correlation	**0.2**	**0.317**	0.108	0.088	**0.283**	**0.402**	**0.438**	**0.818**	0.129	**0.169**	**0.285**	**0.201**	**0.209**	1	
	Sig. (2-tailed)	0.004	0	0.124	0.209	0	0	0	0	0.066	0.016	0	0.004	0.003		
Crude Oil	Pearson Correlation	0.115	**0.164**	0.126	0.014	**0.865**	**0.705**	**0.484**	0.121	**0.914**	**0.19**	**0.133**	**0.185**	**0.192**	0.109	1
	Sig. (2-tailed)	0.104	0.019	0.073	0.845	0	0	0	0.085	0	0.007	0.059	0.008	0.006	0.123	

Table A8

Monthly Correlations Selected Asset Classes with Inflation (DKK) 1991 – 2007

		MSCI Nordic	MSCI World	MSCI Denmark	Danish Bonds	GSCI	DJ AIG	G&R Index	Agriculture	Energy	Industrial Metals	Livestock	Precious Metals	Gold	Wheat	Crude Oil
Inflation	Pearson Correlation	-0.019	-0.038	-0.103	-0.074	0.019	0.007	-0.03	-0.11	0.066	-0.046	-0.087	-0.007	-0.005	-0.149	0.022
	Sig. (2-tailed)	0.787	0.586	0.145	0.293	0.791	0.915	0.675	0.117	0.351	0.512	0.218	0.917	0.946	0.034	0.754

Table A9

Monthly Correlation Selected Asset Classes and Commodities (USD) 1991 – 2007: Part 1/3

		MSCI World	MSCI Nordic	MSCI Sweden	MSCI Norway	MSCI Denmark	MSCI Finland	Swedish Bonds	Swedish T-Bills	GSCI	DJAIG	CRB	Agriculture	Energy	Industr. Metals	Livestock	Precious Metals	Aluminiu	Cocoa
MSCI World	Pearson Correlation	1																	
	Sig. (2-tailed)																		
MSCI Nordic	Pearson Correlation	0.65	1																
	Sig. (2-tailed)	0																	
MSCI Sweden	Pearson Correlation	0.596	0.933	1															
	Sig. (2-tailed)	0	0																
MSCI Norway	Pearson Correlation	0.51	0.639	0.476	1														
	Sig. (2-tailed)	0	0	0															
MSCI Denmark	Pearson Correlation	0.454	0.587	0.447	0.442	1													
	Sig. (2-tailed)	0	0	0	0														
MSCI Finland	Pearson Correlation	0.494	0.774	0.596	0.433	0.34	1												
	Sig. (2-tailed)	0	0	0	0	0													
Swedish Bonds	Pearson Correlation	0.076	0.307	0.3	0.304	0.343	0.14	1											
	Sig. (2-tailed)	0.265	0	0	0	0	0.04												
Swedish T-Bills	Pearson Correlation	0.018	0.275	0.26	0.293	0.316	0.119	0.959	1										
	Sig. (2-tailed)	0.792	0	0	0	0	0.081	0											
GSCI	Pearson Correlation	-0.028	0.049	-0.019	0.234	0.043	0.033	0.151	0.17	1									
	Sig. (2-tailed)	0.556	0.3	0.68	0	0.357	0.558	0.027	0.013										
DJAIG	Pearson Correlation	0.13	0.177	0.133	0.38	0.176	0.097	0.224	0.226	0.883	1								
	Sig. (2-tailed)	0.065	0.012	0.058	0	0.012	0.17	0.001	0.001	0									
CRB	Pearson Correlation	0.065	0.12	0.049	0.273	0.097	0.147	0.12	0.123	0.679	0.811	1							
	Sig. (2-tailed)	0.188	0.016	0.325	0	0.05	0.01	0.08	0.072	0	0								
Agriculture	Pearson Correlation	0.003	0.058	0.008	0.16	0.027	0.114	0.041	0.035	0.5	0.376	0.722	1						
	Sig. (2-tailed)	0.949	0.217	0.866	0.001	0.566	0.044	0.554	0.612	0	0	0							
Energy	Pearson Correlation	-0.058	-0.002	-0.07	0.228	0.044	0.003	0.141	0.166	0.922	0.804	0.405	-0.021	1					
	Sig. (2-tailed)	0.318	0.976	0.226	0	0.445	0.952	0.039	0.015	0	0	0	0.722						
Industrial Metals	Pearson Correlation	0.182	0.225	0.177	0.29	0.18	0.119	0.082	0.142	0.252	0.427	0.418	0.236	0.051	1				
	Sig. (2-tailed)	0	0	0.001	0	0	0.036	0.229	0.038	0	0	0	0	0.383					
Livestock	Pearson Correlation	0.068	0.083	0.059	0.105	0.065	0.082	0.024	0	0.433	0.106	0.361	0.192	0.006	0.095	1			
	Sig. (2-tailed)	0.145	0.076	0.207	0.025	0.168	0.147	0.731	0.996	0	0.134	0	0	0.917	0.068				
Precious Metals	Pearson Correlation	0.073	0.149	0.103	0.223	0.083	0.082	0.212	0.203	0.29	0.392	0.457	0.263	0.164	0.363	0.089	1		
	Sig. (2-tailed)	0.133	0.002	0.035	0	0.09	0.149	0.002	0.003	0	0	0	0	0.004	0	0.07			
Aluminium	Pearson Correlation	0.208	0.274	0.293	0.272	0.211	0.157	0.025	0.071	0.143	0.317	0.241	0.048	0.085	0.853	-0.005	0.144	1	
	Sig. (2-tailed)	0.003	0	0	0	0.003	0.025	0.721	0.313	0.042	0	0.001	0.498	0.227	0	0.943	0.04		
Cocoa	Pearson Correlation	-0.061	-0.024	-0.005	0.112	0.075	-0.085	0.066	0.088	0.065	0.086	0.29	0.087	0.072	0.052	-0.027	0.168	-0.056	1
	Sig. (2-tailed)	0.301	0.686	0.938	0.057	0.202	0.149	0.339	0.196	0.27	0.223	0	0.142	0.226	0.376	0.643	0.004	0.427	

Table A10

Monthly Correlations Selected Asset Classes and Commodities (USD) 1991 – 2007: Part 2/3

		MSCI World	MSCI Nordic	MSCI Sweden	MSCI Norway	MSCI Denmark	MSCI Finland	Swedish Bonds	Swedish T-Bills	GSCI	DJAIG	CRB	Agriculture	Energy	Industr. Metals	Live-stock	Precious Metals	Aluminiu	Cocoa
Coffee	Pearson Correlation	0.102	0.086	0.058	0.084	0.065	0.11	-0.104	-0.091	-0.004	0.062	0.244	0.26	-0.041	0.07	-0.052	0.041	0.055	0.066
	Sig. (2-tailed)	0.068	0.122	0.3	0.131	0.246	0.051	0.127	0.183	0.945	0.378	0	0	0.482	0.207	0.354	0.466	0.438	0.266
Copper	Pearson Correlation	0.173	0.198	0.146	0.28	0.156	0.107	0.051	0.1	0.269	0.429	0.44	0.233	0.076	0.946	0.092	0.354	0.594	0.095
	Sig. (2-tailed)	0.001	0	0.005	0	0.003	0.06	0.457	0.144	0	0	0	0	0.188	0	0.077	0	0	0.108
Corn	Pearson Correlation	0.028	0.044	0.017	0.095	0.032	0.048	0.047	0.023	0.353	0.306	0.589	0.777	-0.067	0.123	0.229	0.134	0.029	0.007
	Sig. (2-tailed)	0.546	0.349	0.712	0.042	0.492	0.398	0.489	0.741	0	0	0	0	0.25	0.018	0	0.006	0.686	0.904
Cotton	Pearson Correlation	0.1	0.131	0.158	0.072	0.089	0.08	0.081	0.053	0.124	0.187	0.291	0.339	0.052	0.143	0.006	0.085	0.073	0.147
	Sig. (2-tailed)	0.055	0.011	0.002	0.169	0.088	0.158	0.234	0.437	0.017	0.008	0	0	0.374	0.006	0.901	0.101	0.299	0.013
Crude Oil	Pearson Correlation	-0.119	-0.029	-0.066	0.186	0.019	-0.056	0.105	0.142	0.878	0.715	0.368	-0.064	0.924	0.033	-0.012	0.181	0.106	0.078
	Sig. (2-tailed)	0.059	0.651	0.295	0.003	0.77	0.378	0.123	0.037	0	0	0	0.316	0	0.6	0.849	0.004	0.134	0.219
Gold	Pearson Correlation	0.041	0.075	0.017	0.202	0.059	0.04	0.235	0.226	0.265	0.384	0.461	0.184	0.179	0.341	0.055	0.977	0.126	0.152
	Sig. (2-tailed)	0.437	0.158	0.751	0	0.268	0.483	0.001	0.001	0	0	0	0	0.002	0	0.299	0	0.072	0.01
Grains	Pearson Correlation	0.014	0.042	-0.008	0.124	0.024	0.106	0.047	0.035	0.463	0.344	0.687	0.921	-0.024	0.163	0.266	0.199	0.012	0
	Sig. (2-tailed)	0.771	0.372	0.867	0.008	0.603	0.06	0.495	0.612	0	0	0	0	0.674	0.002	0	0	0.87	0.997
Heating Oil	Pearson Correlation	-0.056	0.008	-0.059	0.206	0.026	0.024	0.099	0.127	0.875	0.754	0.403	-0.029	0.944	0.069	0.03	0.169	0.104	0.057
	Sig. (2-tailed)	0.338	0.886	0.31	0	0.658	0.678	0.148	0.063	0	0	0	0.616	0	0.235	0.61	0.003	0.141	0.332
Live Cattle	Pearson Correlation	0.062	0.089	0.068	0.111	0.07	0.077	-0.001	-0.008	0.383	0.038	0.294	0.169	-0.035	0.119	0.915	0.058	0.023	-0.028
	Sig. (2-tailed)	0.187	0.059	0.15	0.018	0.137	0.177	0.983	0.911	0	0.593	0	0	0.544	0.022	0	0.233	0.741	0.632
Live Hogs	Pearson Correlation	0.071	0.045	0.024	0.079	0.029	0.055	0.058	0.025	0.297	0.154	0.288	0.12	0.048	0.045	0.83	0.1	-0.014	-0.021
	Sig. (2-tailed)	0.165	0.381	0.635	0.124	0.571	0.332	0.394	0.712	0	0.028	0	0.019	0.407	0.385	0	0.05	0.845	0.717
Natural Gas	Pearson Correlation	0.012	0.012	-0.046	0.115	0.029	0.009	0.221	0.188	0.659	0.606	0.375	0.067	0.663	0.03	-0.047	0.116	-0.02	-0.128
	Sig. (2-tailed)	0.875	0.88	0.557	0.14	0.71	0.91	0.004	0.015	0	0	0	0.392	0	0.7	0.542	0.137	0.8	0.099
Nickel	Pearson Correlation	0.287	0.322	0.325	0.307	0.235	0.221	0.109	0.143	0.166	0.339	0.261	0.003	0.103	0.678	-0.019	0.241	0.484	-0.126
	Sig. (2-tailed)	0	0	0	0	0.002	0.003	0.148	0.056	0.027	0	0	0.97	0.171	0	0.8	0.001	0	0.092
Silver	Pearson Correlation	0.128	0.161	0.115	0.249	0.067	0.113	0.073	0.068	0.231	0.264	0.44	0.223	0.055	0.336	0.09	0.861	0.124	0.16
	Sig. (2-tailed)	0.008	0.001	0.018	0	0.174	0.047	0.285	0.322	0	0	0	0	0.343	0	0.067	0	0.078	0.006
Soybeans	Pearson Correlation	-0.045	0.058	0.02	0.116	0.077	0.045	0.007	-0.002	0.412	0.337	0.673	0.701	-0.015	0.197	0.293	0.213	0.071	0.048
	Sig. (2-tailed)	0.334	0.214	0.665	0.013	0.099	0.433	0.922	0.982	0	0	0	0	0.794	0	0	0	0.317	0.417
Sugar	Pearson Correlation	-0.017	0.054	0.03	0.142	0.018	0.021	-0.012	0.022	0.224	0.111	0.308	0.459	-0.023	0.208	-0.034	0.209	0.111	0.078
	Sig. (2-tailed)	0.723	0.272	0.541	0.004	0.716	0.709	0.856	0.747	0	0.116	0	0	0.685	0	0.486	0	0.115	0.187
Unleaded Gasoline	Pearson Correlation	-0.063	0.038	-0.005	0.238	0.052	0.018	0.094	0.132	0.85	0.712	0.368	-0.043	0.874	0.167	-0.031	0.11	0.096	0.098
	Sig. (2-tailed)	0.331	0.562	0.941	0	0.422	0.784	0.172	0.053	0	0	0	0.512	0	0.01	0.635	0.089	0.172	0.13
Wheat (CBOT)	Pearson Correlation	0.026	0.032	-0.021	0.111	-0.005	0.142	0.055	0.052	0.422	0.266	0.561	0.827	0.014	0.131	0.213	0.171	-0.012	-0.031
	Sig. (2-tailed)	0.579	0.5	0.647	0.017	0.918	0.012	0.425	0.446	0	0	0	0	0.803	0.011	0	0	0.868	0.595
Zinc	Pearson Correlation	0.162	0.23	0.258	0.246	0.188	0.084	0.146	0.18	0.088	0.244	0.229	0.055	0.012	0.672	0.067	0.197	0.458	-0.033
	Sig. (2-tailed)	0.021	0.001	0	0	0.007	0.233	0.038	0.01	0.213	0	0.001	0.433	0.863	0	0.344	0.005	0	0.641

Table A11

Monthly Correlations Selected Asset Classes and Commodities (USD) 1991 – 2007: Part 3/3

		Coffee	Copper	Corn	Cotton	Crude Oil	Gold	Grains	Heating Oil	Live Cattle	Live Hogs	Natural Nickel	Silver	Soybeans	Sugar	Unleaded Gasoline	Wheat (CBOT)	Zinc
Coffee	Pearson Correlation	1																
	Sig. (2-tailed)																	
Copper	Pearson Correlation	0.075	1															
	Sig. (2-tailed)	0.179																
Corn	Pearson Correlation	0.054	0.096	1														
	Sig. (2-tailed)	0.331	0.064															
Cotton	Pearson Correlation	0.031	0.167	0.192	1													
	Sig. (2-tailed)	0.577	0.001	0														
Crude Oil	Pearson Correlation	-0.029	0.062	-0.123	0.043	1												
	Sig. (2-tailed)	0.653	0.325	0.052	0.495													
Gold	Pearson Correlation	0.029	0.336	0.033	0.078	0.213	1											
	Sig. (2-tailed)	0.598	0	0.539	0.141	0.001												
Grains	Pearson Correlation	0.061	0.158	0.849	0.198	-0.082	0.118	1										
	Sig. (2-tailed)	0.272	0.002	0	0	0.195	0.025											
Heating Oil	Pearson Correlation	-0.071	0.098	-0.082	0.033	0.873	0.183	-0.02	1									
	Sig. (2-tailed)	0.22	0.092	0.158	0.57	0	0.002	0.729										
Live Cattle	Pearson Correlation	-0.05	0.103	0.214	-0.02	-0.051	0.017	0.237	-0.011	1								
	Sig. (2-tailed)	0.37	0.047	0	0.705	0.425	0.742	0	0.844									
Live Hogs	Pearson Correlation	-0.036	0.052	0.085	0.039	0.033	0.081	0.158	0.058	0.461	1							
	Sig. (2-tailed)	0.525	0.322	0.095	0.458	0.598	0.125	0.002	0.32	0								
Natural Gas	Pearson Correlation	-0.096	0.036	0.089	0.006	0.345	0.122	0.084	0.509	-0.109	0.045	1						
	Sig. (2-tailed)	0.218	0.645	0.255	0.934	0	0.116	0.281	0	0.159	0.562							
Nickel	Pearson Correlation	0.066	0.447	0.041	0.016	0.072	0.211	0.021	0.133	0.003	-0.014	0.082	1					
	Sig. (2-tailed)	0.382	0	0.582	0.837	0.341	0.005	0.776	0.076	0.967	0.85	0.294						
Silver	Pearson Correlation	0.047	0.327	0.144	0.061	0.08	0.739	0.172	0.067	0.057	0.111	0.012	0.234	1				
	Sig. (2-tailed)	0.401	0	0.003	0.244	0.207	0	0	0.251	0.244	0.03	0.88	0.002					
Soybeans	Pearson Correlation	0.088	0.193	0.721	0.249	-0.062	0.143	0.754	0.007	0.266	0.139	0.085	0.054	0.17	1			
	Sig. (2-tailed)	0.115	0	0	0	0.325	0.007	0	0.9	0	0.006	0.278	0.475	0				
Sugar	Pearson Correlation	0.018	0.196	0.165	0.029	-0.009	0.142	0.18	-0.02	-0.011	-0.046	0.068	-0.021	0.184	0.141	1		
	Sig. (2-tailed)	0.743	0	0.001	0.58	0.884	0.007	0	0.732	0.818	0.372	0.381	0.777	0	0.004			
Unleaded Gasoline	Pearson Correlation	-0.019	0.184	-0.086	0.009	0.826	0.126	-0.055	0.815	-0.034	-0.011	0.413	0.137	0.015	-0.074	0.005	1	
	Sig. (2-tailed)	0.768	0.004	0.184	0.885	0	0.052	0.4	0	0.604	0.865	0	0.068	0.813	0.256	0.939		
Wheat (CBOT)	Pearson Correlation	0.035	0.142	0.577	0.121	-0.024	0.122	0.901	0.023	0.185	0.154	0.058	-0.003	0.137	0.483	0.154	0.001	1
	Sig. (2-tailed)	0.534	0.006	0	0.02	0.706	0.021	0	0.686	0	0.003	0.456	0.972	0.005	0	0.002	0.983	
Zinc	Pearson Correlation	0.094	0.525	0.048	0.007	0.021	0.16	0.019	-0.008	0.054	0.072	-0.001	0.467	0.245	-0.058	0.112	0.048	0.029	1
	Sig. (2-tailed)	0.18	0	0.495	0.919	0.764	0.022	0.785	0.909	0.446	0.309	0.986	0	0	0.407	0.113	0.495	0.683	

Table A12
Monthly Correlations Selected Asset Classes (SEK) 1971 -2007

		MSCI Nordic	MSCI World	MSCI Sweden	GSCI	G&R Index
MSCI Nordic	Pearson Correlation	1				
	Sig. (2-tailed)					
MSCI World	Pearson Correlation	**0.648**	1			
	Sig. (2-tailed)	0				
MSCI Sweden	Pearson Correlation	**0.923**	**0.578**	1		
	Sig. (2-tailed)	0	0			
GSCI	Pearson Correlation	**0.232**	**0.399**	**0.159**	1	
	Sig. (2-tailed)	0	0	0.001		
G&R Index	Pearson Correlation	0.087	**0.225**	0.015	**0.782**	1
	Sig. (2-tailed)	0.068	0	0.754	0	
Inflation	Pearson Correlation	-0.04	0.002	-0.041	**0.142**	**0.163**
	Sig. (2-tailed)	0.398	0.965	0.387	0.003	0.001

Table A13
Monthly Correlations Selected Asset Classes (NOK) 1971 -2007

		MSCI Nordic	MSCI World	MSCI Norway	GSCI	G&R Index
MSCI Nordic	Pearson Correlation	1				
	Sig. (2-tailed)					
MSCI World	Pearson Correlation	**0.664**	1			
	Sig. (2-tailed)	0				
MSCI Norway	Pearson Correlation	**0.61**	**0.476**	1		
	Sig. (2-tailed)	0	0			
GSCI	Pearson Correlation	**0.097**	**0.211**	**0.219**	1	
	Sig. (2-tailed)	0.041	0	0		
G&R Index	Pearson Correlation	**0.244**	**0.383**	**0.29**	**0.775**	1
	Sig. (2-tailed)	0	0	0	0	
Inflation	Pearson Correlation	-0.023	-0.021	-0.061	0.056	0.048
	Sig. (2-tailed)	0.623	0.658	0.193	0.241	0.311

Table A14
Monthly Correlations Selected Asset Classes (DKK) 1971 -2007

		MSCI Nordic	MSCI World	MSCI Denmark	GSCI	G&R Index
MSCI Nordic	Pearson Correlation	1				
	Sig. (2-tailed)					
MSCI World	Pearson Correlation	**0.686**	1			
	Sig. (2-tailed)	0				
MSCI Denmark	Pearson Correlation	**0.582**	**0.514**	1		
	Sig. (2-tailed)	0	0			
GSCI	Pearson Correlation	**0.148**	**0.259**	0.087	1	
	Sig. (2-tailed)	0.002	0	0.066		
G&R Index	Pearson Correlation	**0.288**	**0.421**	**0.162**	**0.789**	1
	Sig. (2-tailed)	0	0	0.001	0	
Inflation	Pearson Correlation	-0.067	-0.043	**-0.124**	**0.17**	**0.122**
	Sig. (2-tailed)	0.157	0.369	0.009	0	0.01

Table A15
Monthly Descriptive Statistics (SEK) 1991 – 2007

					Skewness		Kurtosis	
	Minimum	Maximum	Mean	Std. Deviation	Statistic	Std. Error	Statistic	Std. Error
MSCI Nordic	-17.18	26.59	1.28	6.29	0.157	0.17	1.476	0.339
MSCI World	-12.93	21.57	0.75	4.88	0.131	0.17	1.344	0.339
MSCI Sweden	-18.67	34.61	1.3	7.09	0.354	0.17	2.318	0.339
Swedish Bonds	-2.42	4.41	0.67	1.06	0.437	0.17	1.045	0.339
Swedish T-Bills	0	2.91	0.47	0.34	2.727	0.17	13.742	0.339
GSCI	-14.73	18.84	0.78	5.81	0.16	0.17	0.245	0.339
DJ AIG	-10.97	16.54	0.5	4.24	0.39	0.171	0.285	0.34
Agriculture	-10.55	22.65	0.28	5.36	0.378	0.17	0.618	0.339
Energy	-19.12	35.03	1.08	8.56	0.292	0.17	0.917	0.339
Industrial Metals	-14.83	18.19	0.78	5.5	0.332	0.17	0.158	0.339
Livestock	-19.73	21.07	0.28	5.21	0.026	0.17	1.377	0.339
Precious Metals	-11.07	16.89	0.63	4.51	0.434	0.17	1.329	0.339
Gold	-10.41	16.46	0.55	4.38	0.529	0.17	1.417	0.339
Wheat	-17.92	24.77	0.3	7.4	0.414	0.17	0.508	0.339
Crude Oil	-23.87	37.08	1.51	8.89	0.135	0.17	0.867	0.339
Inflation	-0.48	2.56	0.15	0.37	2.009	0.17	8.989	0.339
Unexpected Inflation	-1.73	1.75	0	0.41	0.047	0.17	2.24	0.339

Table A16
Annualized Monthly Return and Standard Deviation (SEK) 1991 – 2007

	Mean	Std. Deviation
MSCI Nordic	16.48%	21.79%
MSCI World	9.39%	16.91%
MSCI Sweden	16.72%	24.54%
Swedish Bonds	8.39%	3.67%
Swedish T-Bills	5.77%	1.17%
GSCI	9.81%	20.14%
DJ AIG	6.12%	14.68%
Agriculture	3.37%	18.56%
Energy	13.79%	29.66%
Industrial Metals	9.74%	19.06%
Livestock	3.46%	18.04%
Precious Metals	7.79%	15.63%
Gold	6.80%	15.18%
Wheat	3.62%	25.64%
Crude Oil	19.71%	30.81%
Inflation	1.85%	1.30%
Unexpected Inflation	0.00%	1.41%

Table A17
Monthly Descriptive Statistics (NOK) 1991 – 2007

					Skewness		Kurtosis	
	Minimum	Maximum	Mean	Std. Deviation	Statistic	Std. Error	Statistic	Std. Error
MSCI Nordic	-18.86	20.39	1.17	6.53	-0.171	0.171	0.409	0.34
MSCI World	-13.36	13.45	0.65	4.97	-0.202	0.171	-0.072	0.34
MSCI Norway	-24.95	16.16	0.97	6.18	-0.599	0.171	1.171	0.34
Norwegian Bonds	-4.14	3.6	0.03	1.16	-0.166	0.171	1.518	0.34
GSCI	-13.12	18.28	0.73	5.65	0.188	0.171	0.243	0.34
DJ AIG	-10.59	11.98	0.38	4.01	0.217	0.171	-0.288	0.34
G&R Index	-10.04	12.64	0.78	3.54	0.205	0.171	0.208	0.34
Agriculture	-11.09	14.01	0.16	5.11	0.102	0.171	-0.137	0.34
Energy	-21	31.57	1.07	8.41	0.338	0.171	0.7	0.34
Industrial Metals	-15.89	14.26	0.71	5.37	0.195	0.171	-0.113	0.34
Livestock	-17.71	13.89	0.16	5.12	-0.234	0.171	0.304	0.34
Precious Metals	-10.87	14.24	0.55	4.13	0.194	0.171	1.051	0.34
Gold	-10.53	15.51	0.47	3.99	0.343	0.171	1.233	0.34
Wheat	-18.95	23.39	0.18	7.21	0.26	0.171	0.221	0.34
Crude Oil	-23.28	33.57	1.51	8.63	0.172	0.171	0.539	0.34
Inflation	-0.84	1.57	0.17	0.31	0.279	0.171	3.289	0.34

Table A18
Annualized Monthly Return and Standard Deviation (NOK) 1991 – 2007

	Mean	Std. Deviation
MSCI Nordic	14.96%	22.61%
MSCI World	8.09%	17.22%
MSCI Norway	12.31%	21.40%
Norwegian Bonds	0.41%	4.03%
GSCI	9.08%	19.56%
DJ AIG	4.66%	13.91%
G&R Index	9.76%	12.25%
Agriculture	1.97%	17.69%
Energy	13.61%	29.14%
Industrial Metals	8.87%	18.61%
Livestock	1.97%	17.75%
Precious Metals	6.83%	14.30%
Gold	5.85%	13.81%
Wheat	2.18%	24.99%
Crude Oil	19.73%	29.89%
Inflation	2.11%	1.07%

Table A19
Monthly Descriptive Statistics (DKK) 1991 – 2007

	Minimum	Maximum	Mean	Std. Deviation	Statistic	Std. Error	Statistic	Std. Error
MSCI Nordic	-18.82	21.27	1.16	6.69	-0.121	0.171	0.454	0.34
MSCI World	-14.98	13.22	0.63	5.03	-0.314	0.171	0.079	0.34
MSCI Denmark	-14.12	13.87	1.02	5.1	-0.199	0.171	0.294	0.34
Danish Bonds	-3.02	4.51	0.6	1.08	-0.02	0.171	0.962	0.34
GSCI	-15.39	20.48	0.71	5.81	0.162	0.171	0.483	0.34
DJ AIG	-10.58	14.06	0.36	4.12	0.194	0.171	0.038	0.34
G&R	-10.02	12.79	0.75	3.5	0.122	0.171	0.219	0.34
Agriculture	-10.95	15.23	0.14	5.11	0.122	0.171	-0.181	0.34
Energy	-20.41	36.93	1.06	8.63	0.399	0.171	1.207	0.34
Industrial Metals	-16.06	16.61	0.69	5.38	0.269	0.171	0.215	0.34
Livestock	-19.71	14.04	0.14	5.05	-0.318	0.171	0.609	0.34
Precious Metals	-10.68	14.88	0.53	4.19	0.212	0.171	0.744	0.34
Gold	-10.01	16.15	0.45	4.04	0.359	0.171	0.935	0.34
Wheat	-18.79	24.71	0.16	7.27	0.32	0.171	0.363	0.34
Crude Oil	-25.03	39	1.51	8.89	0.291	0.171	1.166	0.34
Inflation	-0.34	0.8	0.17	0.24	0.111	0.171	-0.266	0.34

Table A20
Annualized Monthly Return and Standard Deviation (DKK) 1991 – 2007

	Mean	Std. Deviation
MSCI Nordic	14.79%	23.17%
MSCI World	7.84%	17.43%
MSCI Denmark	12.95%	17.67%
Danish Bonds	7.42%	3.76%
GSCI	8.90%	20.11%
DJ AIG	4.43%	14.27%
G&R	9.44%	12.11%
Agriculture	1.70%	17.69%
Energy	13.53%	29.88%
Industrial Metals	8.58%	18.64%
Livestock	1.65%	17.50%
Precious Metals	6.57%	14.51%
Gold	5.58%	13.99%
Wheat	1.94%	25.19%
Crude Oil	19.69%	30.80%
Inflation	2.06%	0.82%

Table A21
Monthly Descriptive Statistics (USD) 1991 – 2007

	Minimum	Maximum	Mean	Std. Deviation	Skewness Statistic	Skewness Std. Error	Kurtosis Statistic	Kurtosis Std. Error
MSCI World	-13.92	9.95	0.63	3.67	-0.692	0.17	1.155	0.339
MSCI Nordic	-19.65	21.13	1.22	6.35	-0.051	0.17	0.59	0.339
MSCI Sweden	-22.48	22.81	1.23	7.1	-0.097	0.17	0.661	0.339
MSCI Norway	-27.9	16.62	0.99	6.52	-0.39	0.17	1.126	0.339
MSCI Denmark	-13.48	13.22	1.08	4.97	-0.265	0.17	0.156	0.339
Swedish Bonds	-12.03	9.43	0.65	3.29	-0.031	0.17	0.609	0.339
Swedish T-Bills	-14.08	8.22	0.45	3.17	-0.373	0.17	1.418	0.339
GSCI	-14.41	16.88	0.69	5.42	0.106	0.17	0.321	0.339
DJAIG	-7.64	10.07	0.39	3.52	0.099	0.171	0.02	0.34
CRB	-6.11	8.24	0.41	2.63	0.234	0.17	-0.057	0.339
Agriculture	-10.57	15.34	0.16	4.33	0.102	0.17	0.366	0.339
Energy	-22.14	34.68	1.01	8.53	0.33	0.17	0.86	0.339
Industrial Metals	-12.89	21.33	0.68	4.94	0.501	0.17	1.034	0.339
Livestock	-15.76	10.81	0.16	3.98	-0.474	0.17	0.638	0.339
Precious Metals	-11.03	15.58	0.53	3.91	0.549	0.17	1.123	0.339
Aluminium	-16.55	14.67	0.22	4.76	0.232	0.171	0.381	0.34
Cocoa	-24.93	35.15	0.06	8.34	0.899	0.17	2.27	0.339
Coffee	-30.89	54.23	0.4	11.67	1.189	0.17	2.869	0.339
Copper	-19.18	31.34	1.16	6.67	0.597	0.17	1.745	0.339
Corn	-17.15	22.73	-0.23	6.49	0.146	0.17	0.593	0.339
Cotton	-16.63	24.93	-0.12	7.15	0.443	0.17	0.69	0.339
Crude Oil	-23.27	36.72	1.44	8.84	0.196	0.17	0.622	0.339
Gold	-9.46	16.86	0.46	3.82	0.707	0.17	1.484	0.339
Grains	-13.22	17.53	0.16	5.52	0.164	0.17	0.141	0.339
Heating Oil	-21.75	35.7	1.09	8.98	0.406	0.17	1.218	0.339
Live Cattle	-21.02	10.12	0.39	3.88	-0.793	0.17	4.079	0.339
Live Hogs	-25.87	22.38	-0.21	7.07	-0.111	0.17	1.115	0.339
Natural Gas	-37.63	53.07	-0.28	16.56	0.564	0.188	0.83	0.374
Nickel	-27.48	35.15	1.65	9.84	0.389	0.182	0.834	0.361
Silver	-23.46	18.42	0.85	7.04	0.076	0.17	0.491	0.339
Soybeans	-19.58	20.73	0.77	6.21	0.091	0.17	0.876	0.339
Sugar	-22.51	23.26	0.84	8.19	0.101	0.17	0.251	0.339
Unleaded Gasoline	-24.15	39.99	1.56	9.66	0.387	0.17	1.414	0.339
Wheat (CBOT)	-16.48	21.47	0.19	6.82	0.383	0.17	0.213	0.339
Zinc	-17.02	28.07	0.48	6.63	0.728	0.171	1.809	0.34

Table A22
Annualized Monthly Return and Standard Deviation (USD) 1991 – 2007

	Mean	Std. Deviation
MSCI World	7.87%	12.72%
MSCI Nordic	15.62%	21.98%
MSCI Sweden	15.87%	24.60%
MSCI Norway	12.58%	22.58%
MSCI Denmark	13.48%	16.78%
Swedish Bonds	8.14%	11.41%
Swedish T-Bills	5.55%	11.00%
GSCI	8.66%	18.78%
DJAIG	4.82%	12.18%
CRB	5.00%	9.10%
Agriculture	1.96%	15.00%
Energy		
Industrial Metals	8.49%	17.13%
Livestock	1.95%	13.78%
Precious Metals	6.61%	13.53%
Aluminium	2.67%	16.49%
Cocoa	0.68%	28.87%
Coffee	4.94%	40.41%
Copper	14.86%	23.12%
Corn	-2.67%	22.48%
Cotton	-1.40%	24.78%
Crude Oil	18.66%	30.61%
Gold	5.66%	13.22%
Grains	1.97%	19.14%
Heating Oil	13.86%	31.10%
Live Cattle	4.77%	13.43%
Live Hogs	-2.54%	24.50%
Natural Gas	-3.30%	57.38%
Nickel	21.63%	34.09%
Silver	10.65%	24.38%
Soybeans	9.71%	21.51%
Sugar	10.54%	28.39%
Unleaded Gasoline	20.42%	33.48%
Wheat (CBOT)	2.30%	23.62%
Zinc	5.96%	22.96%

Table A23

Monthly Descriptive Statistics (SEK) 1971 - 2007

					Skewness		Kurtosis	
	Minimum	Maximum	Mean	Std. Deviation	Statistic	Std. Error	Statistic	Std. Error
MSCI Nordic	-19.98%	26.59%	1.19%	5.50%	0.01	0.116	2.062	0.231
MSCI World	-22.93%	27.69%	0.72%	4.83%	0.122	0.116	3.689	0.231
MSCI Sweden	-21.73%	34.61%	1.26%	6.51%	0.178	0.116	2.145	0.231
G&R Index	-11.68%	21.70%	1.10%	4.46%	0.857	0.116	2.958	0.231
GSCI	-16.92%	25.52%	1.16%	5.96%	0.359	0.116	1.361	0.231
Inflation	-0.48%	2.81%	0.44%	0.50%	1.14	0.116	2.519	0.231

Table A24

Annualized Monthly Return and Standard Deviation (SEK) 1971 – 2007

	Mean	Std. Deviation
MSCI Nordic	15.20%	19.06%
MSCI World	8.99%	16.73%
MSCI Sweden	16.18%	22.54%
GSCI	14.04%	15.45%
G&R Index	14.84%	20.65%
Inflation	5.36%	1.73%

Table A25

Monthly Descriptive Statistics (NOK) 1971 - 2007

					Skewness		Kurtosis	
	Minimum	Maximum	Mean	Std. Deviation	Statistic	Std. Error	Statistic	Std. Error
MSCI Nordic	-18.86%	20.39%	1.08%	5.65%	-0.266	0.116	1.053	0.231
MSCI World	-21.63%	14.97%	0.61%	4.83%	-0.359	0.116	1.113	0.231
MSCI Norway	-29.85%	25.92%	1.03%	7.12%	-0.232	0.114	1.188	0.228
GSCI	-18.11%	26.78%	1.04%	5.86%	0.326	0.116	1.615	0.231
G&R Index	-10.27%	22.49%	0.98%	4.31%	0.665	0.116	2.654	0.231
Inflation	-0.84%	2.95%	0.43%	0.43%	0.902	0.114	2.952	0.228

Table A26

Annualized Monthly Return and Standard Deviation (NOK) 1971 – 2007

	Mean	Std. Deviation
MSCI Nordic	13.80%	19.59%
MSCI World	7.56%	16.74%
MSCI Norway	13.03%	24.67%
GSCI	13.24%	20.31%
G&R Index	12.44%	14.92%
Inflation	5.33%	1.51%

Table A27

Monthly Descriptive Statistics (DKK) 1971 - 2007

					Skewness		Kurtosis	
	Minimum	Maximum	Mean	Std. Deviation	Statistic	Std. Error	Statistic	Std. Error
MSCI Nordic	-21.39%	21.27%	1.07%	5.83%	-0.232	0.116	1.239	0.2314609
MSCI World	-24.29%	15.34%	0.59%	5.01%	-0.49	0.116	1.456	0.2314609
MSCI Denmark	-14.12%	18.42%	1.00%	5.04%	0.006	0.116	0.56	0.231203
GSCI	-16.48%	22.87%	1.03%	6.02%	0.307	0.116	0.984	0.2314609
G&R Index	-10.22%	21.44%	0.96%	4.40%	0.569	0.116	1.669	0.2314609
Inflation	-0.88%	2.46%	0.42%	0.47%	1.17	0.116	2.328	0.231203

Table A28

Annualized Monthly Return and Standard Deviation (DKK) 1971 – 2007

	Mean	Std. Deviation
MSCI Nordic	13.60%	20.21%
MSCI World	7.36%	17.34%
MSCI Denmark	12.63%	17.45%
GSCI	13.03%	20.86%
G&R Index	12.16%	15.26%
Inflation	5.10%	1.62%

Table A29

Monthly Sector Correlation Matrix Sweden 1991 - 2007

		Consumer Discr.	Consumer Staples	Energy	Financials	Health Care	IT	Industrials	Materials	Telecoms	Utilities
GSCI	Pearson Correlation	0.027	0.092	**0.166**	-0.012	-0.146	0.009	0.057	0.031	-0.027	-0.098
	Sig. (2-tailed)	0.735	0.282	0.047	0.878	0.069	0.911	0.481	0.705	0.744	0.224
DJ AIG	Pearson Correlation	0.023	0.094	0.142	0.039	-0.109	0.046	0.13	0.088	0.052	-0.006
	Sig. (2-tailed)	0.777	0.269	0.091	0.626	0.177	0.566	0.106	0.278	0.534	0.941
G&R Index	Pearson Correlation	0.061	0.04	0.091	0.082	-0.017	0.097	**0.175**	0.076	**0.175**	0.017
	Sig. (2-tailed)	0.454	0.638	0.275	0.309	0.838	0.231	0.029	0.348	0.036	0.829
Agriculture	Pearson Correlation	-0.003	0.047	-0.097	-0.009	-0.06	0.015	0.043	0.028	0.095	-0.045
	Sig. (2-tailed)	0.968	0.58	0.248	0.909	0.456	0.851	0.594	0.734	0.257	0.579
Energy	Pearson Correlation	0.025	0.107	0.131	-0.044	**-0.166**	-0.018	0.016	0.007	-0.078	-0.111
	Sig. (2-tailed)	0.757	0.209	0.117	0.586	0.038	0.824	0.839	0.93	0.356	0.167
Industrial Metals	Pearson Correlation	0.056	-0.078	0.135	**0.161**	0.114	**0.201**	**0.273**	**0.161**	**0.312**	**0.17**
	Sig. (2-tailed)	0.492	0.364	0.106	0.045	0.158	0.012	0.001	0.045	0	0.035
Livestock	Pearson Correlation	0.045	-0.148	-0.002	0.072	0.099	0.137	0.1	0.048	0.064	-0.01
	Sig. (2-tailed)	0.576	0.082	0.98	0.373	0.223	0.09	0.216	0.552	0.449	0.906
Precious Metals	Pearson Correlation	-0.156	0.059	0.087	-0.003	0.076	-0.125	-0.002	-0.025	-0.026	0.107
	Sig. (2-tailed)	0.052	0.493	0.298	0.973	0.348	0.122	0.976	0.755	0.755	0.185
Gold	Pearson Correlation	**-0.179**	0.072	0.086	-0.028	0.054	-0.151	-0.028	-0.032	-0.066	0.087
	Sig. (2-tailed)	0.026	0.399	0.305	0.725	0.508	0.06	0.728	0.692	0.433	0.282
Wheat	Pearson Correlation	-0.056	-0.018	-0.11	-0.117	-0.114	-0.029	-0.043	0.006	0.019	-0.062
	Sig. (2-tailed)	0.489	0.832	0.188	0.146	0.156	0.719	0.598	0.937	0.821	0.441
Crude Oil	Pearson Correlation	0.044	0.102	**0.182**	-0.073	-0.121	-0.008	-0.012	-0.028	-0.063	-0.07
	Sig. (2-tailed)	0.587	0.231	0.029	0.368	0.135	0.923	0.88	0.729	0.455	0.384

Table A30

Monthly Sector Correlation Matrix Norway 1991 - 2007

		Consumer Discr.	Consumer Staples	Energy	Financials	Health Care	IT	Industrials	Materials	Telecoms	Utilities
GSCI	Pearson Correlation	0.03	0.049	**0.171**	-0.03	0.158	0.032	-0.017	0.145	-0.082	-0.064
	Sig. (2-tailed)	0.712	0.547	0.034	0.721	0.058	0.732	0.83	0.073	0.33	0.432
DJ AIG	Pearson Correlation	0.091	0.107	**0.187**	0.04	**0.214**	0.102	0.079	**0.178**	-0.068	0.017
	Sig. (2-tailed)	0.262	0.185	0.02	0.627	0.01	0.273	0.327	0.027	0.417	0.837
G&R Index	Pearson Correlation	0.109	0.086	**0.165**	0.033	**0.268**	**0.203**	0.119	0.149	0.052	0.044
	Sig. (2-tailed)	0.176	0.289	0.04	0.69	0.001	0.028	0.139	0.064	0.538	0.585
Agriculture	Pearson Correlation	0.088	0.087	0.119	-0.019	**0.211**	0.147	0.083	0.055	0.038	-0.014
	Sig. (2-tailed)	0.274	0.283	0.141	0.82	0.011	0.114	0.304	0.499	0.655	0.865
Energy	Pearson Correlation	-0.003	0.018	0.147	-0.058	0.113	-0.032	-0.026	0.136	-0.103	-0.101
	Sig. (2-tailed)	0.967	0.826	0.068	0.485	0.179	0.733	0.748	0.091	0.218	0.213
Industrial Metals	Pearson Correlation	0.143	0.077	**0.18**	**0.165**	**0.297**	**0.259**	**0.162**	0.113	0.159	**0.255**
	Sig. (2-tailed)	0.076	0.344	0.025	0.046	0	0.005	0.045	0.163	0.057	0.001
Livestock	Pearson Correlation	-0.032	0.092	-0.044	-0.058	0.106	0.102	0.047	0.04	-0.019	-0.048
	Sig. (2-tailed)	0.689	0.254	0.589	0.487	0.204	0.275	0.557	0.619	0.822	0.554
Precious Metals	Pearson Correlation	-0.022	0.042	0.024	**0.169**	0.067	0.094	0.071	0.038	-0.083	0.135
	Sig. (2-tailed)	0.789	0.603	0.764	0.041	0.424	0.314	0.377	0.638	0.325	0.094
Gold	Pearson Correlation	-0.057	0.021	0.013	**0.163**	0.042	0.083	0.052	0.03	-0.113	0.116
	Sig. (2-tailed)	0.482	0.794	0.875	0.049	0.615	0.376	0.521	0.709	0.177	0.149
Wheat	Pearson Correlation	0.022	-0.031	0.045	-0.116	**0.18**	0.146	-0.023	0.017	0.04	0.031
	Sig. (2-tailed)	0.788	0.702	0.574	0.163	0.031	0.117	0.78	0.83	0.635	0.705
Crude Oil	Pearson Correlation	0.052	0.022	**0.167**	-0.046	0.096	-0.004	-0.019	0.116	-0.047	-0.112
	Sig. (2-tailed)	0.523	0.79	0.038	0.582	0.252	0.969	0.816	0.15	0.577	0.164

Table A31

Monthly Sector Correlation Matrix Denmark 1991 - 2007

		Consumer Discr.	Consumer Staples	Energy	Financials	Health Care	IT	Industrials	Materials	Telecoms	Utilities
GSCI	Pearson Correlation	0.038	-0.008	0.036	0.04	0.089	0.086	**0.173**	-0.012	0.01	-0.009
	Sig. (2-tailed)	0.641	0.925	0.848	0.619	0.271	0.306	0.032	0.891	0.9	0.914
DJ AIG	Pearson Correlation	0.122	0.043	0.21	0.114	**0.161**	**0.171**	**0.251**	0.029	0.035	0.074
	Sig. (2-tailed)	0.131	0.596	0.266	0.157	0.045	0.04	0.002	0.73	0.664	0.38
G&R Index	Pearson Correlation	**0.164**	0.076	0.272	0.149	**0.195**	**0.271**	**0.288**	0.092	0.146	0.093
	Sig. (2-tailed)	0.042	0.345	0.146	0.063	0.015	0.001	0	0.275	0.069	0.267
Agriculture	Pearson Correlation	0.052	0.064	0.218	0.019	0.13	0.162	**0.161**	0.061	0.02	0.13
	Sig. (2-tailed)	0.518	0.429	0.248	0.811	0.107	0.053	0.046	0.466	0.809	0.12
Energy	Pearson Correlation	-0.005	-0.023	-0.008	-0.004	0.061	0.022	0.11	-0.039	-0.028	-0.042
	Sig. (2-tailed)	0.955	0.772	0.966	0.958	0.449	0.798	0.172	0.641	0.728	0.618
Industrial Metals	Pearson Correlation	**0.236**	0.076	0.001	**0.175**	0.065	**0.299**	**0.256**	0.035	**0.225**	0.081
	Sig. (2-tailed)	0.003	0.348	0.994	0.029	0.418	0	0.001	0.678	0.005	0.337
Livestock	Pearson Correlation	0.075	-0.024	0.271	0.01	**0.167**	0.097	**0.179**	0.097	0.004	0.052
	Sig. (2-tailed)	0.353	0.77	0.147	0.898	0.038	0.246	0.025	0.252	0.964	0.536
Precious Metals	Pearson Correlation	0.13	0.117	0.158	**0.174**	0.142	0.102	**0.167**	0.085	0.05	0.01
	Sig. (2-tailed)	0.106	0.146	0.404	0.031	0.079	0.223	0.038	0.313	0.535	0.901
Gold	Pearson Correlation	0.113	0.094	0.136	0.141	0.11	0.08	0.153	0.1	0.03	0.016
	Sig. (2-tailed)	0.16	0.244	0.473	0.079	0.174	0.338	0.058	0.236	0.708	0.852
Wheat	Pearson Correlation	-0.056	-0.021	0.094	-0.133	0.023	0.096	0.05	0.004	0.028	0.07
	Sig. (2-tailed)	0.486	0.795	0.622	0.099	0.774	0.25	0.534	0.967	0.728	0.404
Crude Oil	Pearson Correlation	0.05	-0.013	0.038	0.016	0.06	0.127	0.117	-0.049	0.048	0.011
	Sig. (2-tailed)	0.537	0.871	0.844	0.848	0.458	0.128	0.147	0.558	0.557	0.892

APPENDIX B

Figure B1
Ten Year Rolling Average Monthly Return Sweden

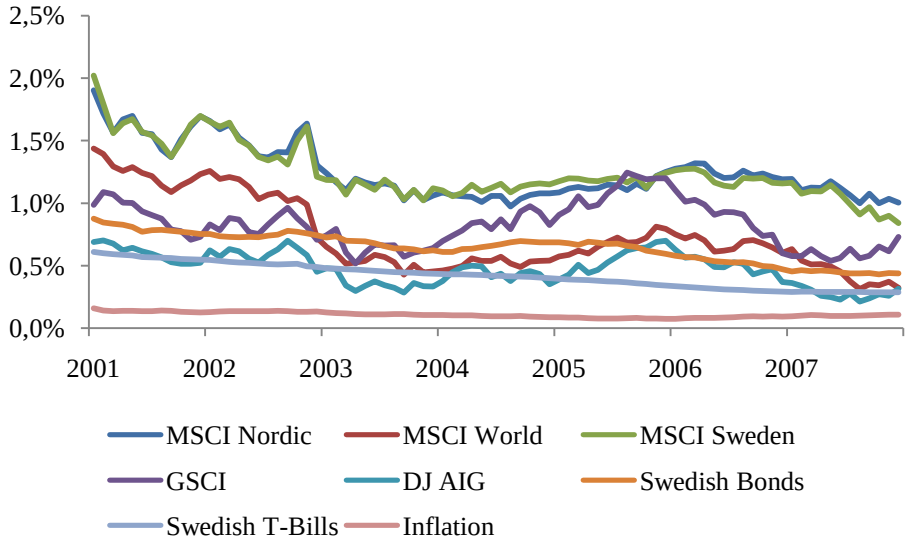


Figure B2
Ten Year Rolling Average Monthly Volatility Sweden

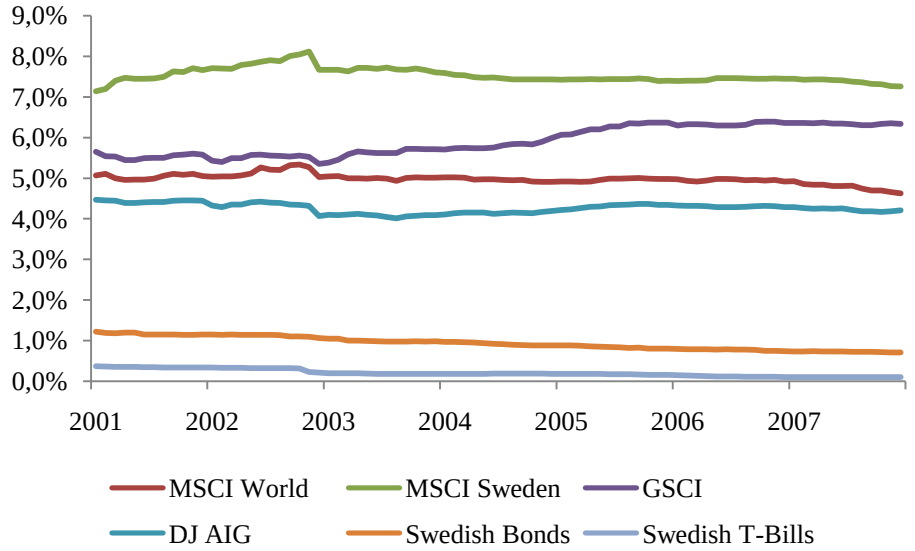


Figure B3
Ten Year Rolling Average Monthly Return Norway

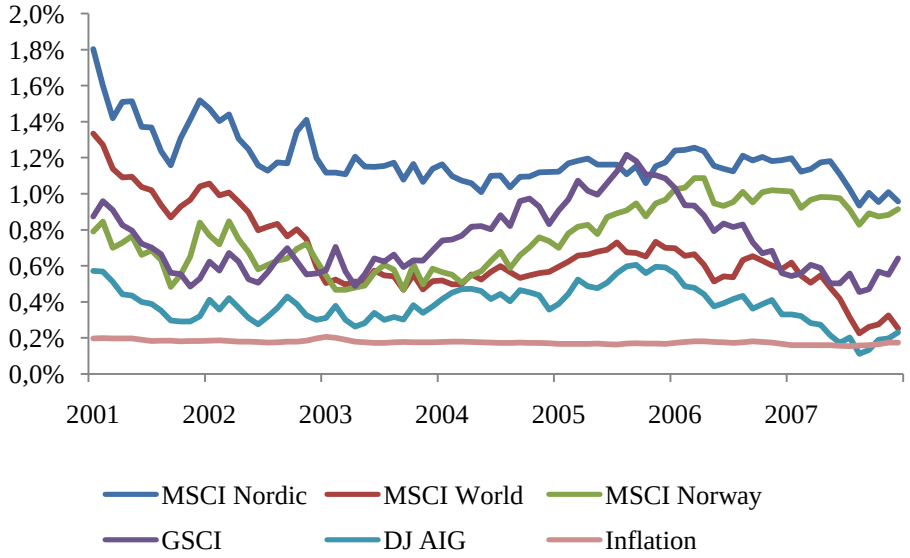


Figure B4
Ten Year Rolling Average Monthly Volatility Norway

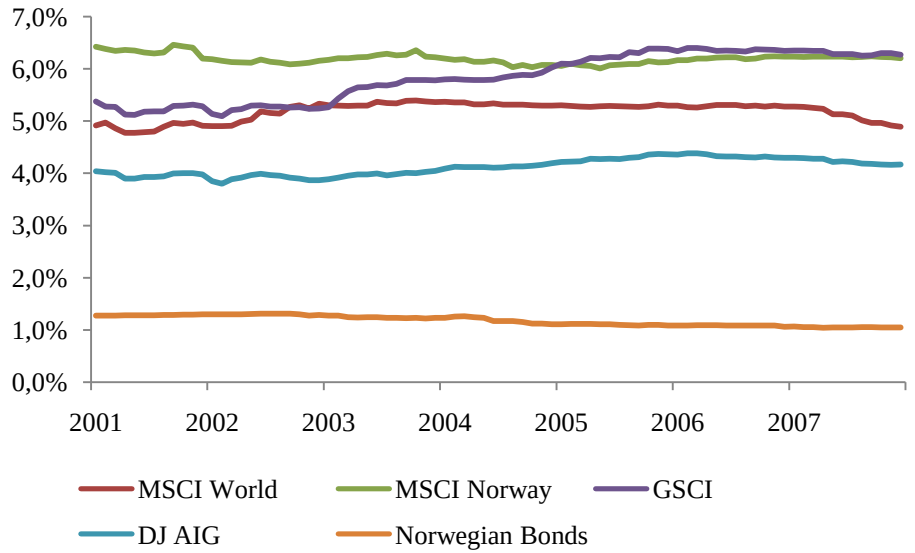


Figure B5
Ten Year Rolling Average Monthly Return Denmark

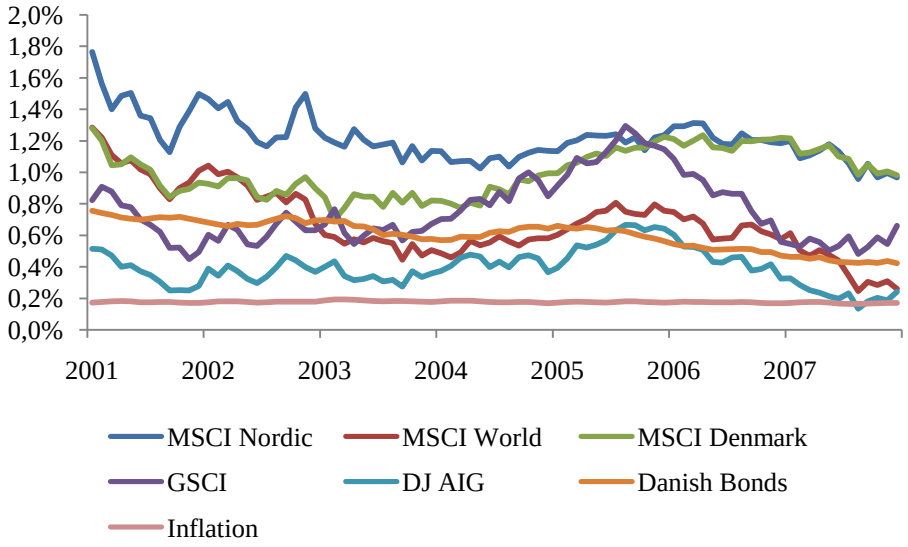


Figure B6
Ten Year Rolling Average Monthly Volatility Denmark

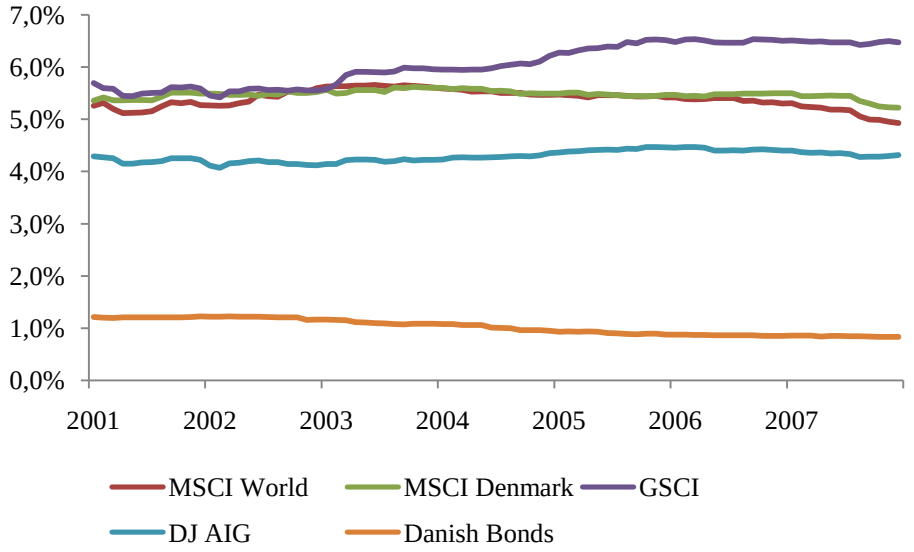
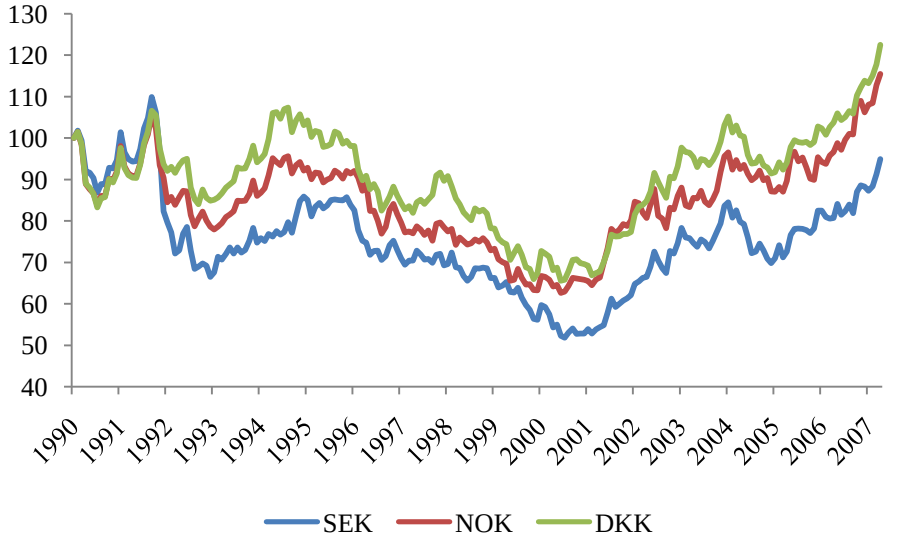


Figure B7
Swedish Krona, Norwegian Krone and Danish Krone against US Dollar



APPENDIX C

Figure C1
Ten Year Rolling Correlation with MSCI Sweden 2001 – 2007

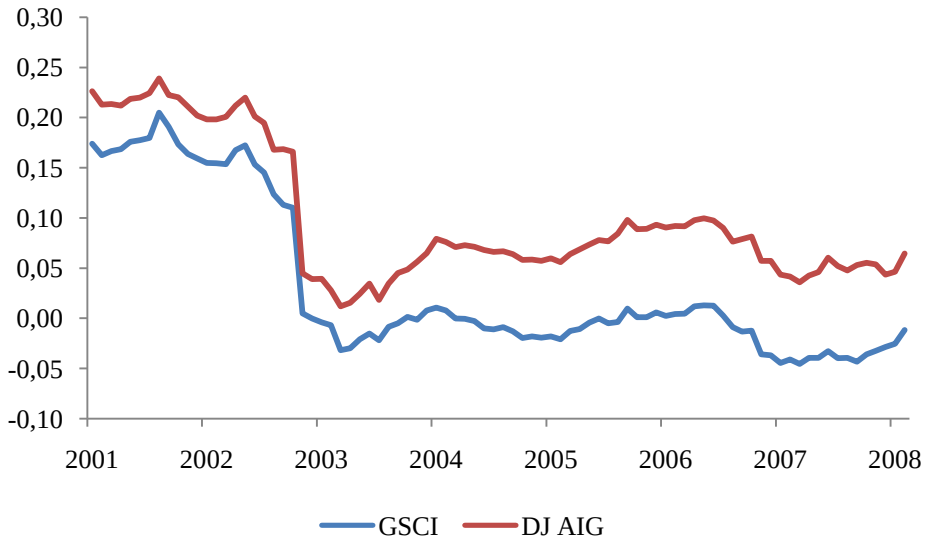


Figure C2
Ten Year Rolling Correlation with Swedish Bonds 2001 – 2007

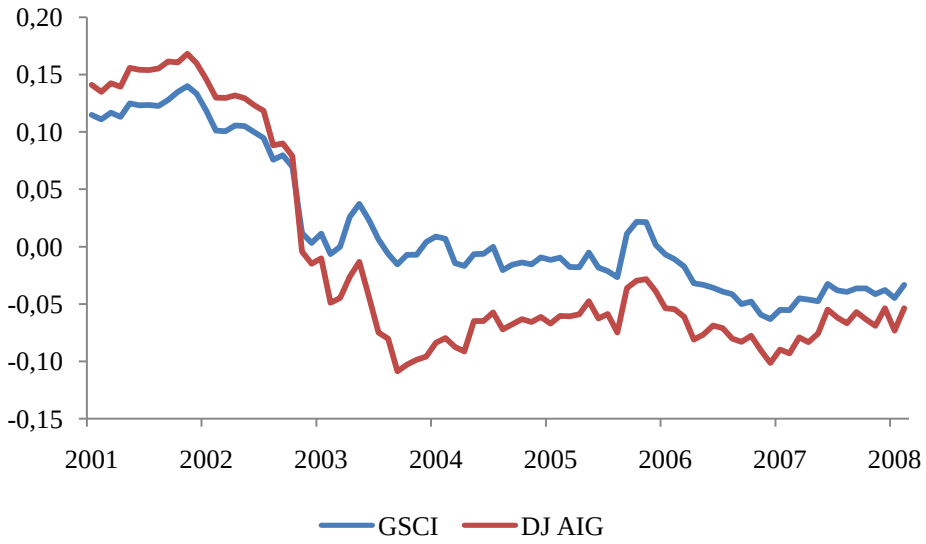


Figure C3
Ten Year Rolling Correlation with Swedish Inflation 2001 – 2007

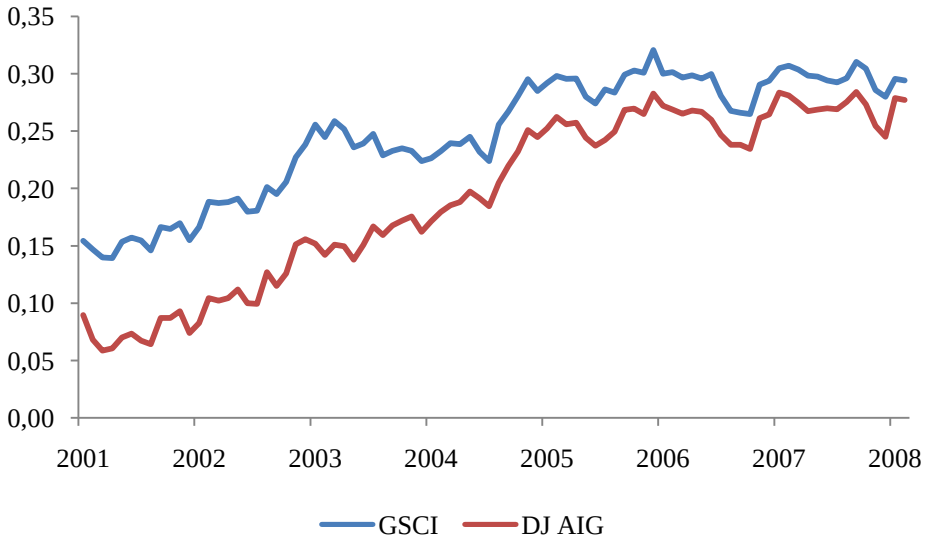


Figure C4
Ten Year Rolling Correlation with MSCI Norway 2001 – 2007

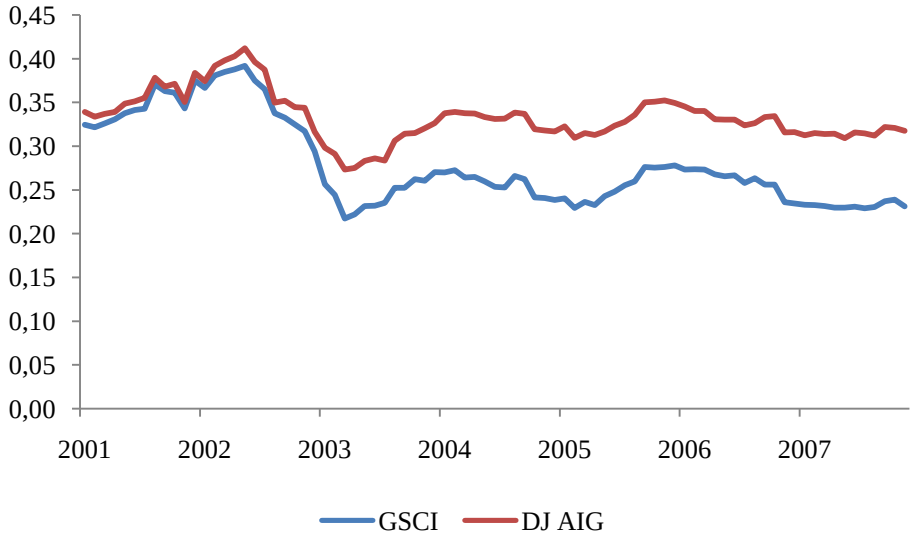


Figure C5
Ten Year Rolling Correlation with Norwegian Bonds 2001 -2007

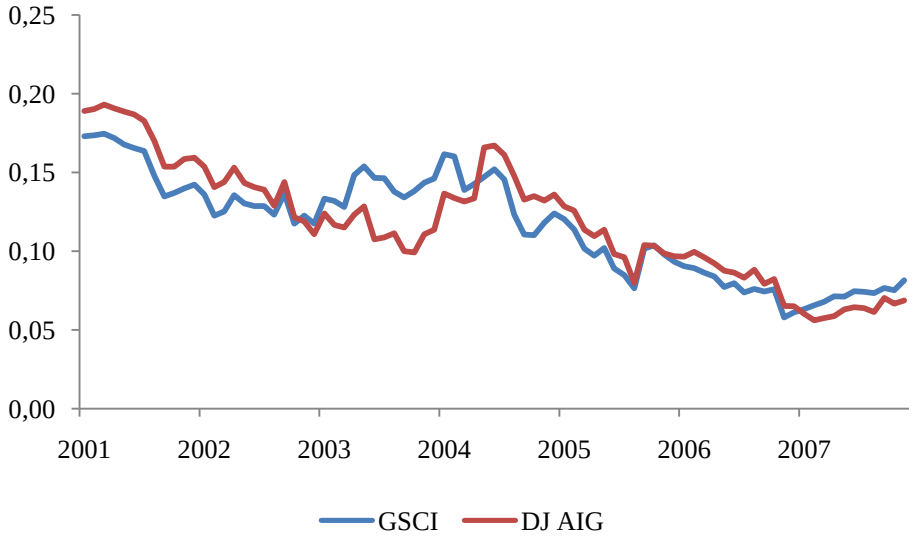


Figure C6
Ten Year Rolling Correlation with Norwegian Inflation 2001 - 2007

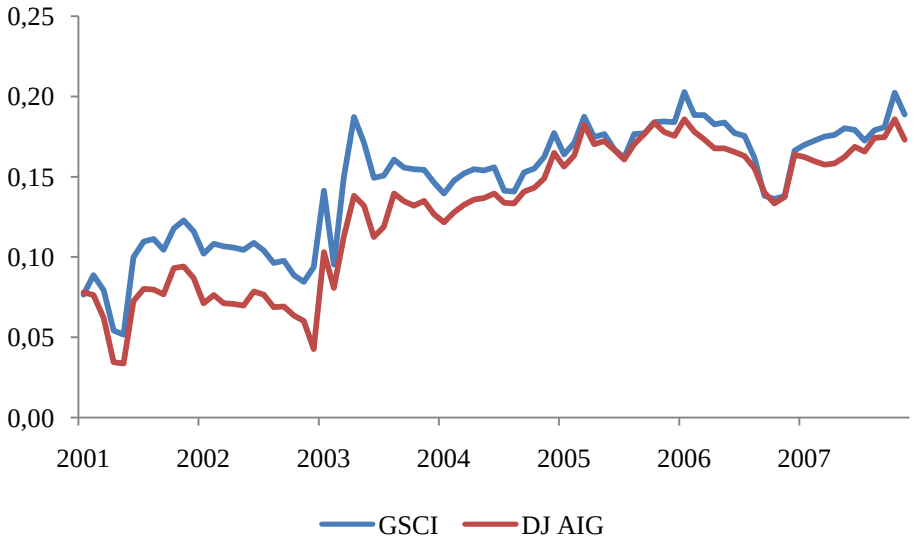


Figure C7
Ten Year Rolling Correlation with MSCI Denmark 2001 – 2007

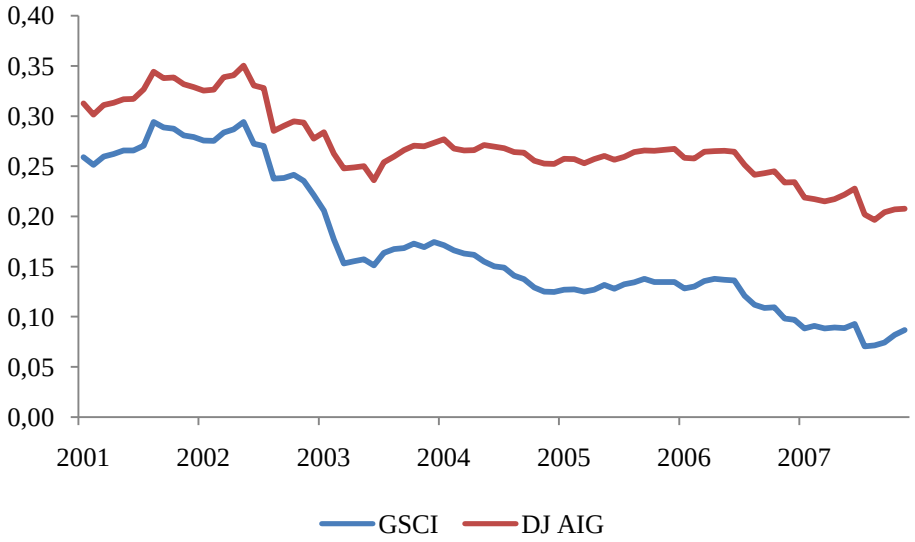


Figure C8
Ten Year Rolling Correlation with Danish Bonds 2001 – 2007

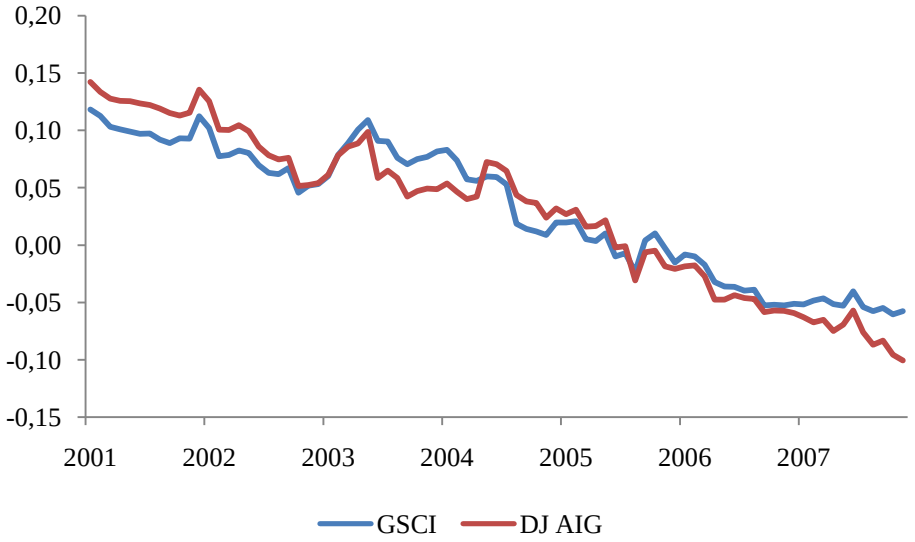
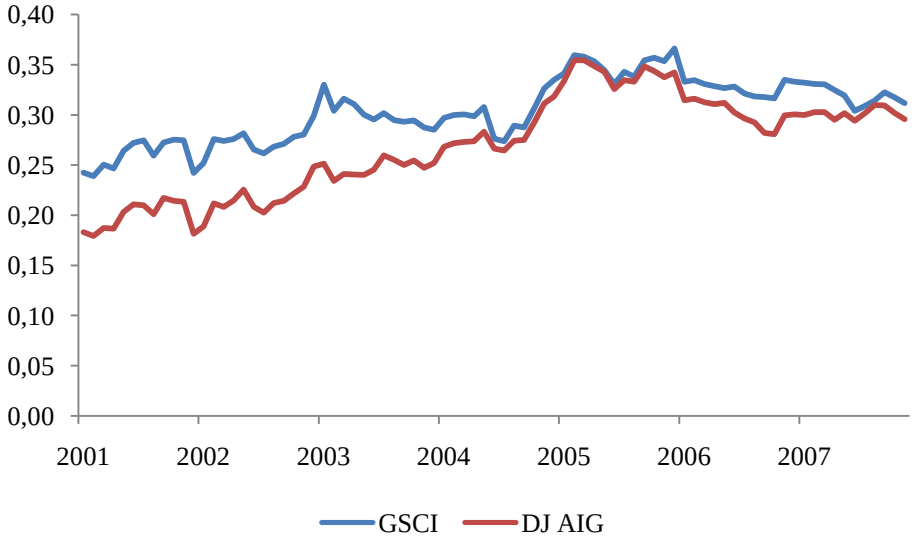


Figure C9
Ten Year Rolling Correlation with Danish Inflation 2001 – 2007



APPENDIX D

Table D1 – Asset Allocation Constraints Portfolio I

Portfolio	MSCI Sweden	MSCI World	Swedish Bonds	Swedish T-Bills	GSCI	DJAIG
Commodities						
Maximum allocation	-	-	-	-	-	-
Minimum allocation	-	-	-	-	-	-
No Commodities						
Maximum allocations	-	-	-	-	0	0
Minimum allocation	-	-	-	-	0	0

Figure D1 - Efficient Frontiers Portfolio I

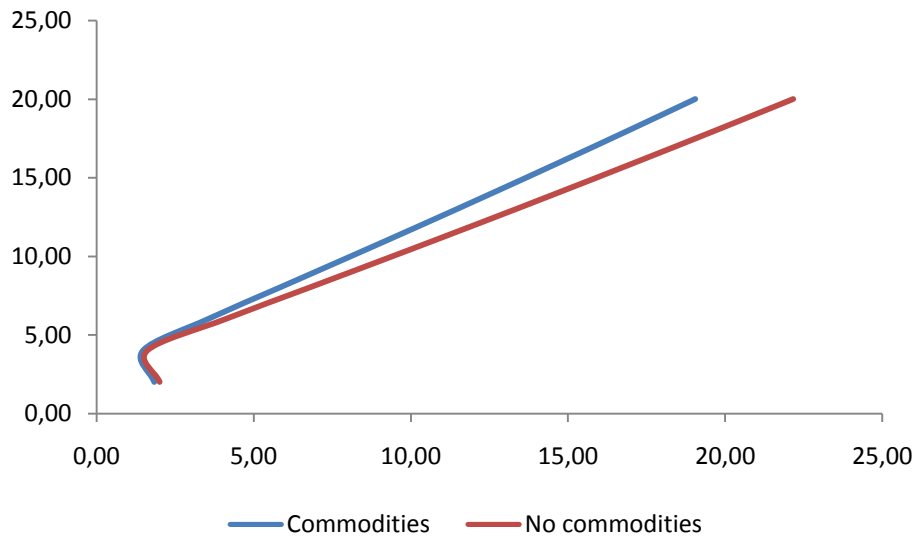


Figure D2 – Asset Allocation Portfolio I with Commodities

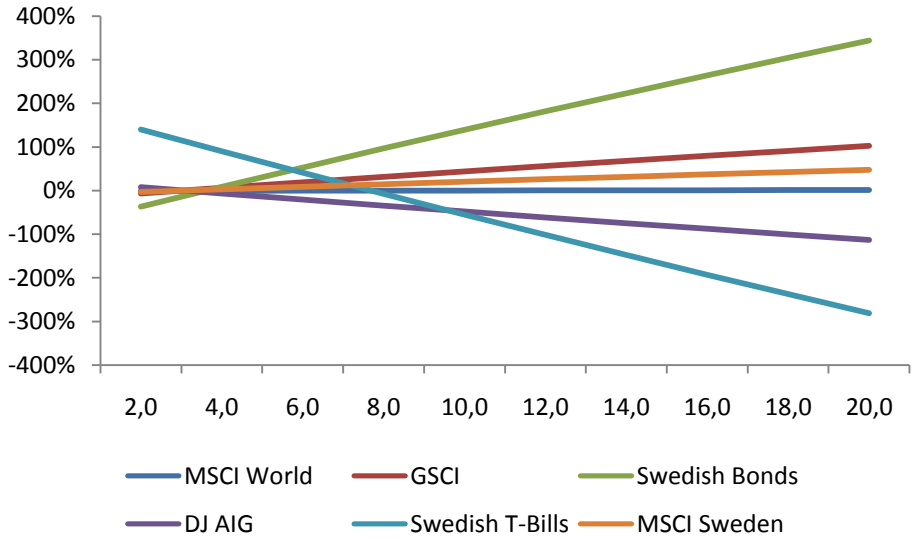


Figure D3 – Asset Allocation Portfolio I without Commodities

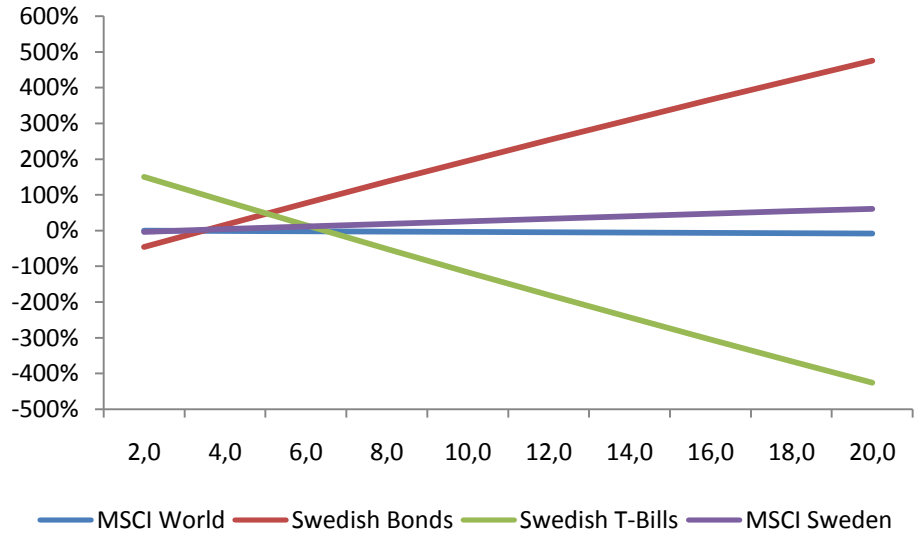


Table D2 – Asset Allocation Constraints Portfolio II

Portfolio	MSCI Sweden	MSCI World	Swedish Bonds	Swedish T-Bills	GSCI	DJAIG
Commodities						
Maximum allocation	-	-	-	-	-	-
Minimum allocation	0	0	0	-	0	0
No Commodities						
Maximum allocations	-	-	-	-	0	0
Minimum allocation	0	0	0	-	0	0

Figure D4 - Efficient Frontiers Portfolio II

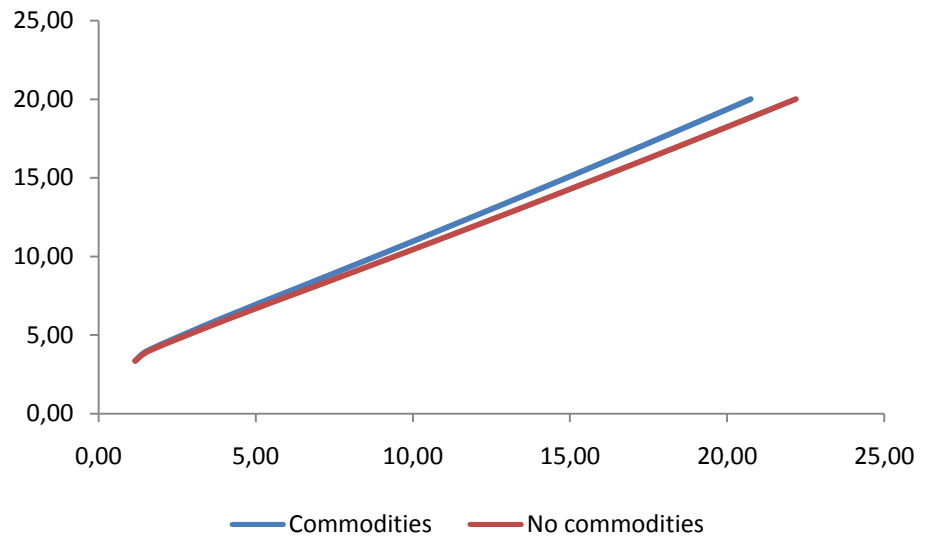


Figure D5 – Asset Allocation Portfolio II with Commodities

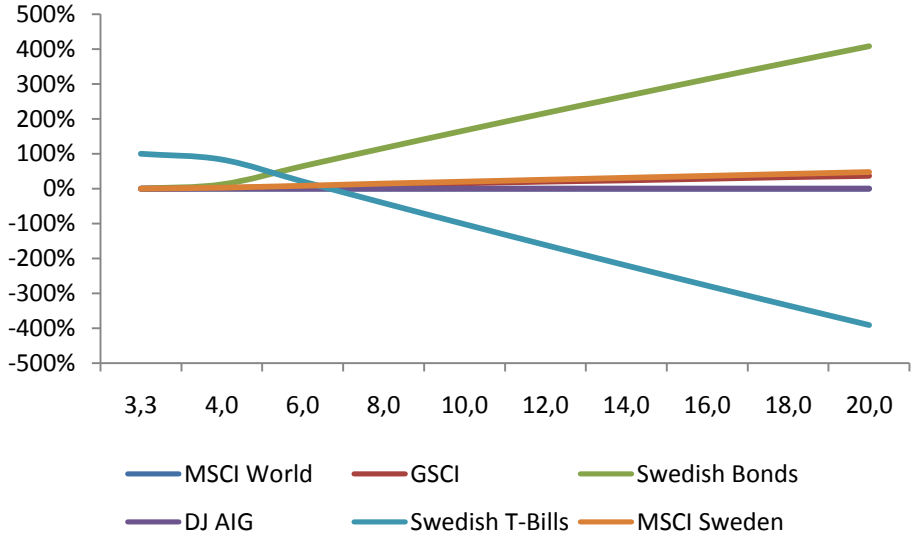


Figure D6 – Asset Allocation Portfolio II without Commodities

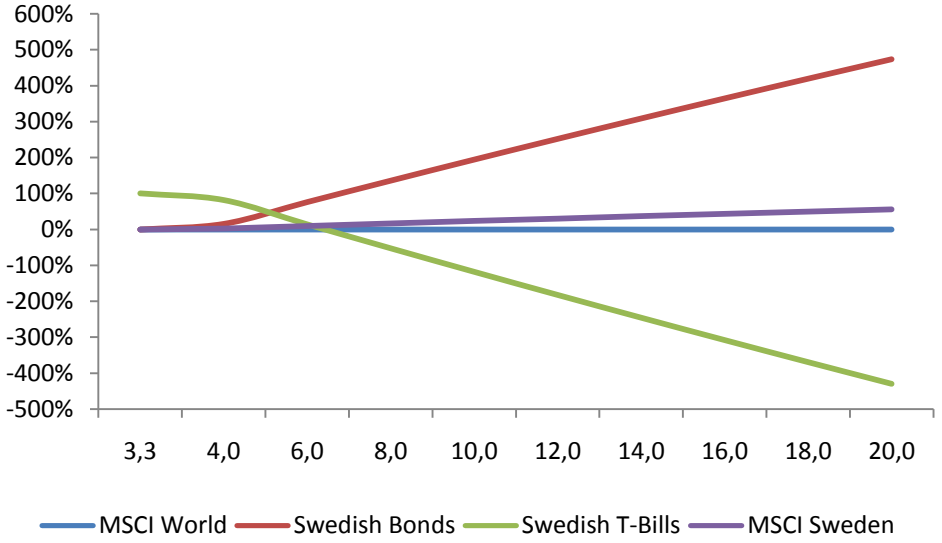


Table D3 – Asset Allocation Constraints Portfolio III

Portfolio	MSCI Sweden	MSCI World	Swedish Bonds	Swedish T-Bills	GSCI	DJAIG
Commodities						
Maximum allocation	-	-	-	-	-	-
Minimun allocation	0	0	0	0	0	0
No Commodities						
Maximum allocations	-	-	-	-	0	0
Minumum allocation	0	0	0	0	0	0

Figure D7 – Efficient Frontiers Portfolio III

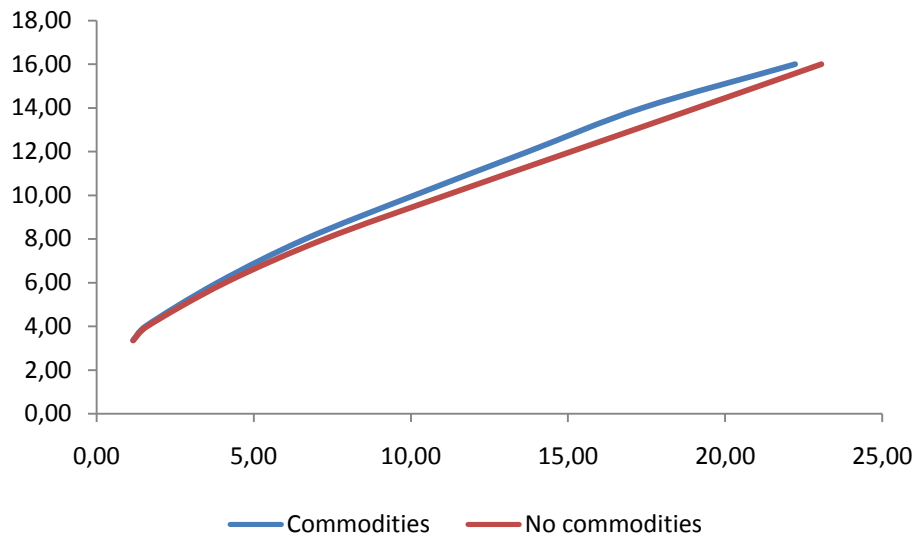


Figure D8 – Asset Allocation Portfolio III with Commodities

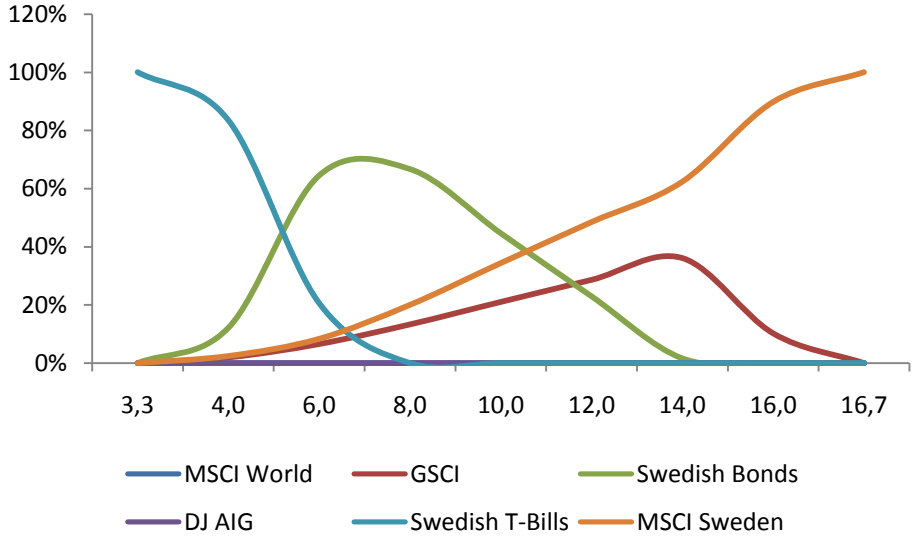


Figure D9 – Asset Allocation Portfolio III without Commodities

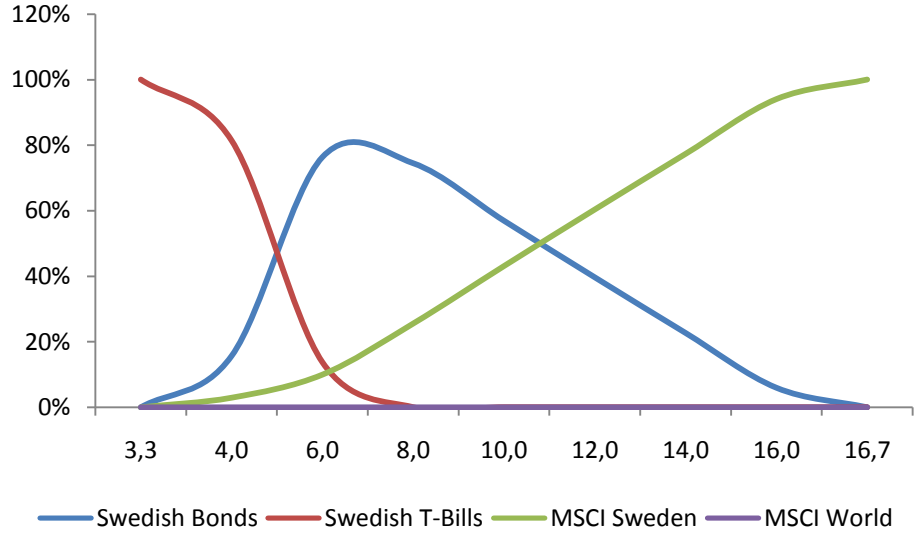


Table D4 – Asset Allocation Constraints Portfolio IV

Portfolio	MSCI Sweden	MSCI World	Swedish Bonds	Swedish T-Bills	GSCI	DJAIG
Commodities						
Maximum allocation	30%	30%	30%	30%	30%	30%
Minimun allocation	0	0	0	0	0	0
No Commodities						
Maximum allocations	30%	30%	30%	30%	0	0
Minumum allocation	0	0	0	0	0	0

Figure D10 – Efficient Frontiers Portfolio IV

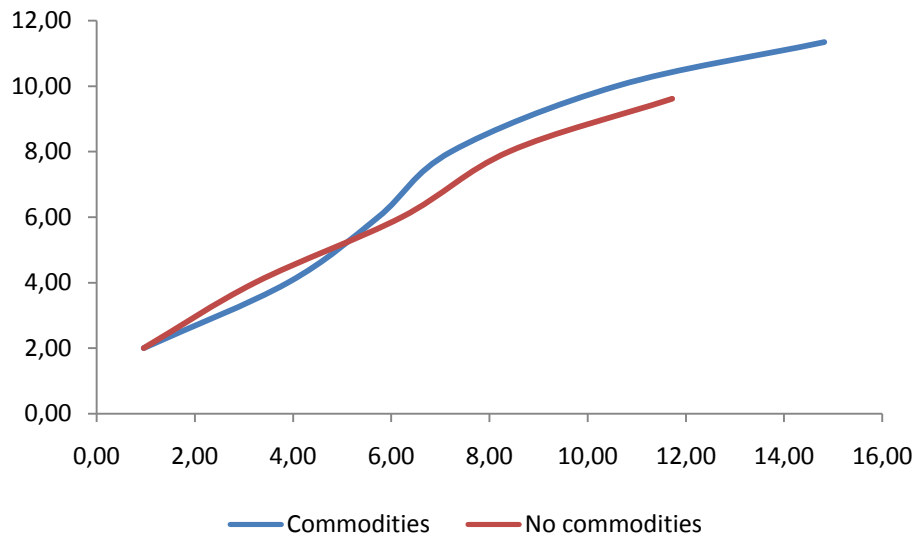


Figure D11 – Asset Allocation Portfolio IV with Commodities

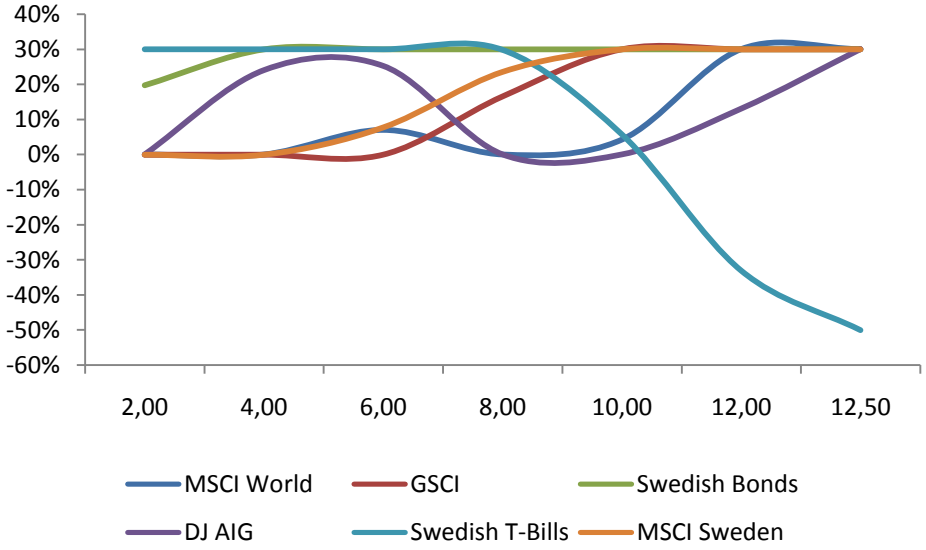


Figure D12 – Asset Allocation Portfolio IV without Commodities

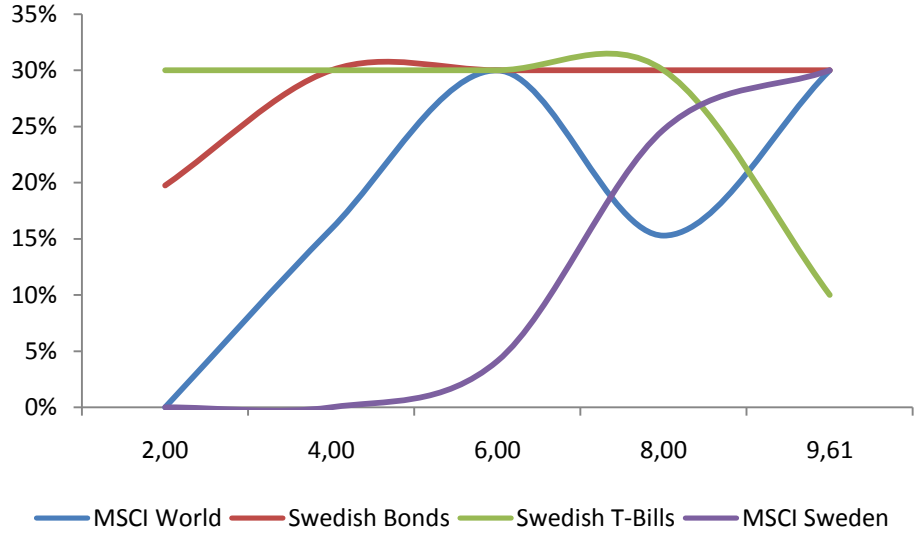


Table D5 – Asset Allocation Constraints Portfolio V

Portfolio	MSCI Sweden	MSCI World	Swedish Bonds	Swedish T-Bills	GSCI	DJAIG
Commodities						
Maximum allocation	30%	30%	30%	30%	30%	30%
Minimum allocation	0	0	0	-	0	0
No Commodities						
Maximum allocations	30%	30%	30%	30%	0	0
Minimum allocation	0	0	0	-	0	0

Figure D13 – Efficient Frontiers Portfolio V

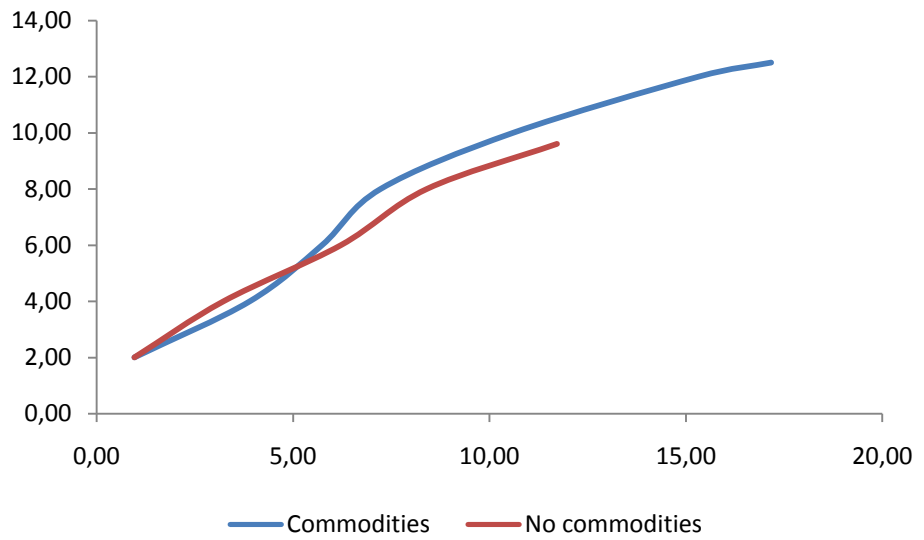


Figure D14 – Asset Allocation Portfolio V with Commodities

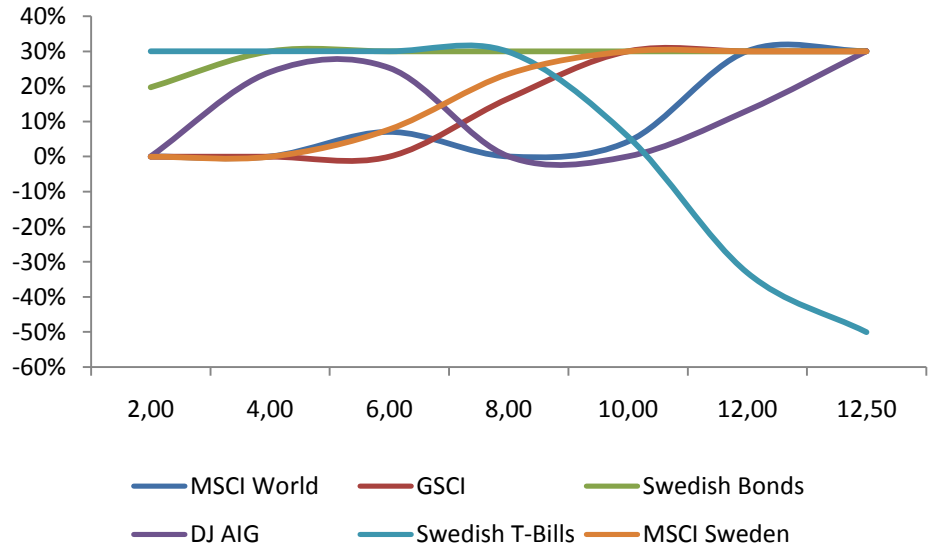


Figure D15 – Asset Allocation Portfolio V without Commodities

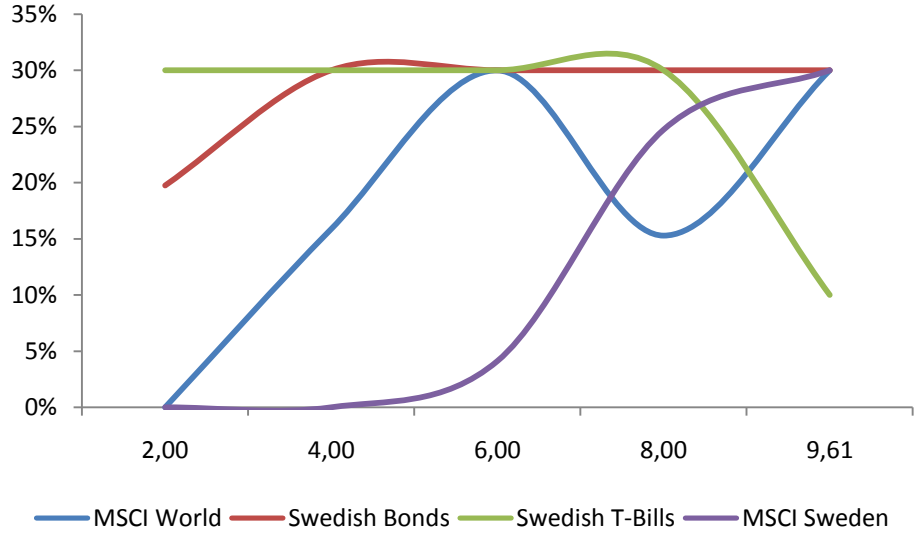


Table D6 – Asset Allocation Constraints Portfolio VI

Portfolio	MSCI Sweden	MSCI World	Swedish Bonds	Swedish T-Bills	GSCI	DJAIG
Commodities						
Maximum allocation	45%	45%	37.5%	17.5%	10%	0%
Minimum allocation	17.5%	17.5%	0%	0%	10%	0%
No Commodities						
Maximum allocations	50%	50%	40%	20%	0%	0%
Minimum allocation	20%	20%	0%	0%	0%	0%

Figure D16 – Efficient Frontiers Portfolio VI

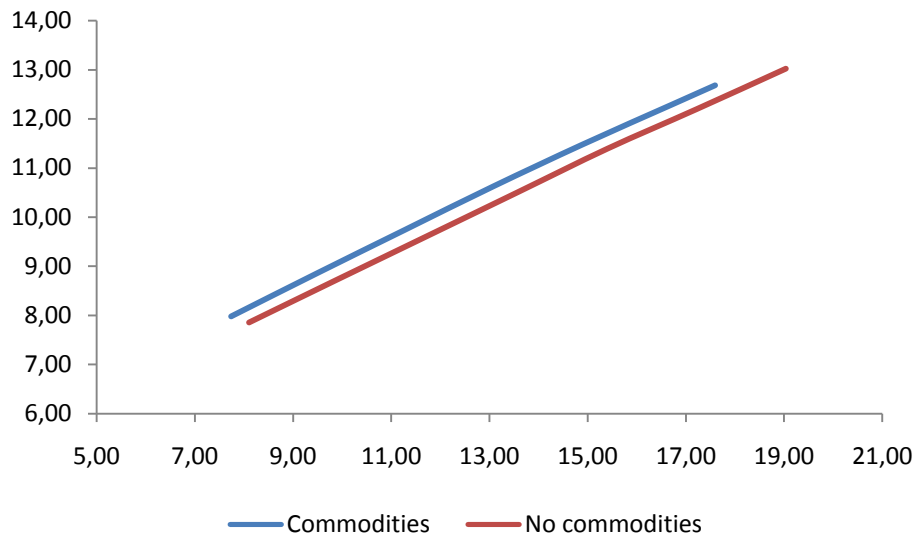


Figure D17 – Asset Allocation Portfolio VI with Commodities

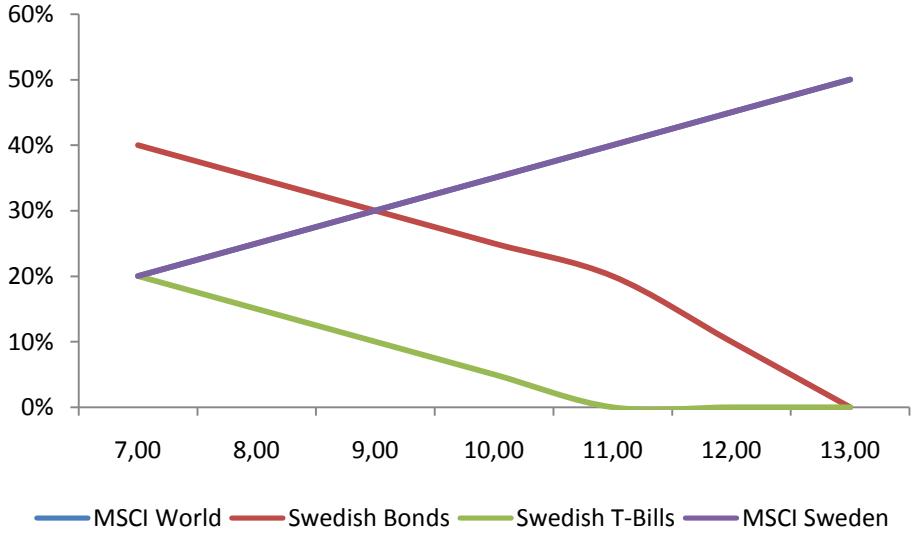
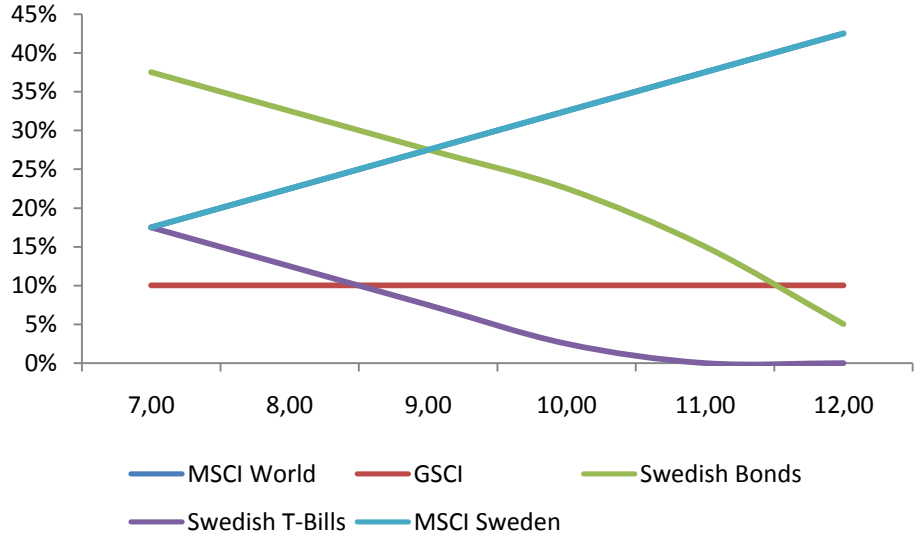


Figure D18 – Asset Allocation Portfolio VI without Commodities



APPENDIX E

E1. Hypothesis Testing with Correlations

E1.1 Testing Departures from Zero

To test if a correlation significantly different from zero, one can use a t-test. The t-statistic is calculated:

$$z = \frac{r_{x,y}}{\sqrt{\frac{1 - r_{x,y}^2}{N - 1}}}$$

Where $r_{x,y}$ is the correlation coefficient between the variables x and y, and N is the number of observations. If the observed t-statistic is larger than the critical t-value, the null hypothesis can be rejected.

E1.2 Testing Departures from Non-Zero Values

To test whether a correlation coefficient derived from a sample is significantly different from some value other than zero we use a similar method. To correct for the skewness under the null hypotheses we must use Fisher's r to z transformation, where the transformed value is normally distributed. The correlation coefficient, r, is transformed to a new value, called z or r'. This is used to conduct the test according to formulae below where $z_{r_{x,y}}$ represents the transformed value.

Fisher's r to z transformation

$$z_{r_{x,y}} = \frac{1}{2}\log_e\left(\frac{1 + r_{x,y}}{1 - r_{x,y}}\right)$$

Test statistic

$$z = \frac{z_{r_{x,y}} - z_\rho}{\sqrt{\frac{1}{N - 3}}}$$

If the test statistic is larger than the critical value, the null hypothesis can be rejected

E1.3 Comparing Correlations

This is a test to compare different correlations with one another. In this case, the null hypothesis states that the two correlation coefficients are equal. Due to the skewed sampling distributions of the correlations Fisher's r to z transformation must again be used. To test the hypothesis we must first convert both correlations, according to the formula presented above, and then use:

$$z = \frac{z_{r_1} - z_{r_2}}{\sqrt{\left(\frac{1}{n_1 - 3}\right) + \left(\frac{1}{n_2 - 3}\right)}}$$

As for the tests above, the null hypothesis can be rejected if the observed value is larger than the critical value.

APPENDIX F

F1. The Gorton and Rouwenhorst Index

F1.1 Construction of an Equally Weighted Index

The Gorton and Rouwenhorst index is an equally-weighted index, constructed using data from the Commodity Research Bureau (CRB) and the London Metals Exchange. The CRB data covers all commodity futures in existence today. Commodity futures contracts that were introduced, but later discontinued, most often due to lack of liquidity, are not included in the index (Gorton and Rouwenhorst (2005)).

The index is constructed in steps. First, for each month, price (excess) returns on each commodity future is calculated, using the nearest contract not expiring in that month. Then the total returns is calculated, assuming that the futures position is fully collateralized and earns interest based on the total return of 30 day Treasury Bills. Second, using the monthly returns for each futures contract, the index is constructed by adding the monthly returns together each month and dividing by the number of commodities in the index that month. *Table F1* shows the commodity futures contracts included in the index as well as their introduction dates.

F1.2 Portfolio Return Calculations

When calculating the return of the index the following method has been applied. For simplicity it is assumed that all futures contracts exist at all times. Further, suppose *N* commodity futures each exist for *T* months, and that R_{it} is one plus the return on a collateralized commodity future i during month *t*. The arithmetic average return on a monthly rebalanced portfolio over the *T* months is:

$$\overline{R}_{AR} = \frac{1}{NT}\sum_{i}\sum_{t} R_{it} = \frac{1}{T}\sum_{t}\left[\frac{1}{N}\sum_{i} R_{it}\right]$$

The geometric average return on a monthly rebalanced portfolio over the *T* months is given by:

$$\overline{R}_{GR}^{T} = \left[\prod_{t}\left(\frac{1}{N}\sum_{t} R_{it}\right)\right]^{\frac{1}{T}}$$

The arithmetic average return on a buy-and-hold portfolio over the *T* months is given by:

$$R_{ABH}^{T} = 1 + \frac{1}{T}\sum_{\tau}\left[\frac{\sum_{i}\prod_{t=1}^{\tau} R_{it}}{\sum_{i}\prod_{t=1}^{\tau-1} R_{it}} - 1\right]$$

where

$$\prod_{t=1}^{\tau-1=0} R_{it} \equiv 1$$

The geometric average on a buy-and-hold portfolio over the *T* months is given by:

$$\overline{R}_{GBH}^{T} = \left[\frac{1}{N}\sum_{i}\left(\prod_{t} R_{it}\right)\right]^{\frac{1}{T}}$$

Finally, these returns are annualized by subtracting one and multiply by 1200 (i.e.12 months x 100).

Table F1

Futures Contracts Included in the Gorton and Rouwenhorst Index

Name	Quotes Start	Index Inclusion Date	First Contract Year	Sector
Copper	07/01/59	07/01/59	1959	Industrial Metals
Cotton	07/01/59	07/01/59	1960	Industrial Materials
Cocoa	07/01/59	07/01/59	1960	Softs
Wheat	07/01/59	07/01/59	1959	Grains
Corn	07/01/59	07/01/59	1959	Grains
Soybeans	07/01/59	07/01/59	1959	Grains
Soybean Oil	07/01/59	07/01/59	1959	Grains
Soybean Meal	07/01/59	07/01/59	1959	Grains
Oats	07/01/59	07/01/59	1959	Grains
Sugar	01/04/61	01/31/61	1961	Softs
Pork Bellies	09/18/61	09/30/61	1962	Animal Products
Silver	06/12/63	06/30/63	1963	Precious Metals
Live Cattle	11/30/64	11/30/64	1965	Animal Products
Lean Hogs	02/28/66	02/28/66	1966	Animal Products
Orange Juice	02/01/67	02/28/67	1967	Softs
Platinum	03/04/68	03/31/68	1968	Precious Metals
Lumber	10/01/69	10/31/69	1970	Industrial Materials
Feeder Cattle	11/30/71	11/30/71	1972	Animal Products
Coffee	08/16/72	08/31/72	1973	Softs
Gold	12/31/74	12/31/74	1975	Precious Metals
Palladium	01/03/77	01/31/77	1977	Precious Metals
Zinc	01/03/77	01/31/77	1977	Industrial Metals
Lead	02/01/77	02/28/77	1977	Industrial Metals
Heating Oil	11/14/78	11/30/78	1979	Energy
Nickel	04/23/79	04/30/79	1979	Industrial Metals
Crude Oil	03/30/83	03/31/83	1983	Energy
Unleaded Gas	12/03/84	12/31/84	1985	Energy
Rough Rice	08/20/86	08/31/86	1981	Grains
Aluminum	06/01/87	06/30/87	1987	Industrial Metals
Propane	08/21/87	08/31/87	1987	Energy
Tin	07/03/89	07/31/89	1989	Industrial Metals
Natural Gas	04/04/90	04/30/90	1990	Energy
Milk	01/11/96	01/31/96	1996	Animal Products
Butter	09/05/96	09/30/96	1997	Animal Products
Coal	2007-12-01	7/31/01	2001	Energy
Electricity	2004-11-03	4/30/03	2003	Energy

As of 31 December 2004