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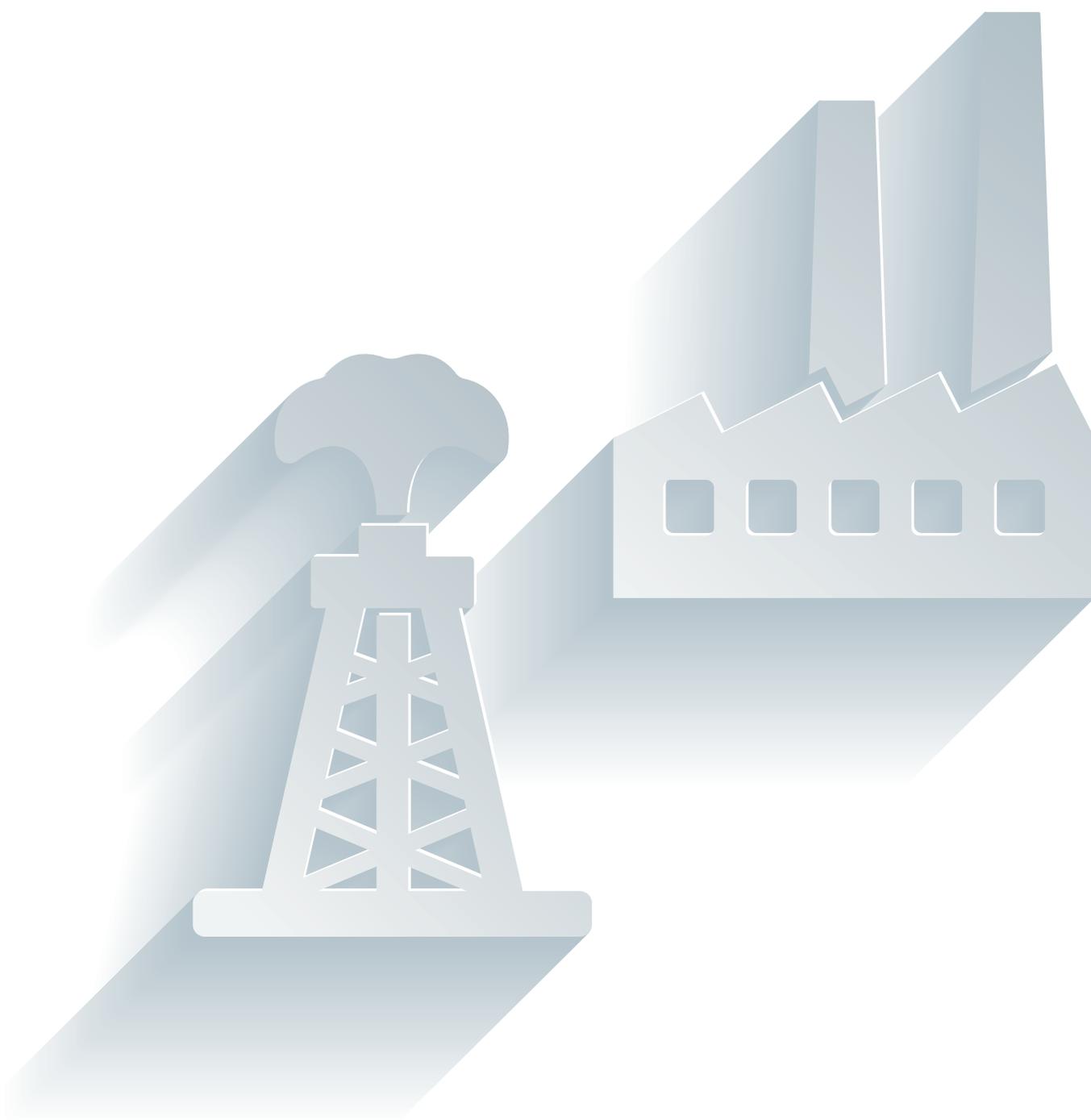
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# Sources of return in the commodity market

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*This article surveys sources of return in the commodity market seen from an investor's point of view. The purpose is to review some of the scientific articles that identify and explain sources of return. The purpose is also quantitatively to isolate identified sources of return and describe their properties.*

### **Background**

Sources of return with respect to the equity market have for many years been the subject of comprehensive research. In addition, the focus of attention has in recent years been on sources of return in other asset classes including the commodity market, for instance Asness et al (2012). This has resulted in several analyses, theoretical and practical, which also relate to sources of return across asset classes. Hence, the sources of return are regarded as reward (at least partial) of specific generic risks across asset classes.

The purpose of the article is to review part of the research relating to sources of return in the commodity market known from the analysis of the equity and fixed-income market. The purpose is also a quantitative description of sources of return using CMCI indices of the individual commodity futures which are characterised by a broad coverage of the forward curve. By far the majority of research papers solely use price data from the ultra short end of the forward curve.

The following sources of return will be described: Value, Momentum, Carry and Low Risk. Also, sources of return relating to the commodity market will be described: Hedge Pressure and Seasonality.

### **1. Sources of return**

Risk factors, risk premiums or sources of return are considered return or reward for assuming a specific risk.

We prefer the designation sources of return instead of risk premiums because several sources of return in the equity market – Quality or Low Risk – are related to investor behaviour. The return on these cannot be directly related to an assumed expected, higher risk and is factually related to a lower realised risk compared with the market.

The existence of a given source of return should in our view be based on a theoretical foundation – primarily in a risk/reward approach and hence a rational understanding of why a given source of return may occur. Secondly, behaviour-related explanations may apply, but no matter the explanation, the understanding of the basic economic foundation is important. Only in this way, can a potential trading strategy, seeking excess returns via utilisation of sources of return, be realised on an ongoing basis, and the properties and interaction between the return drivers be understood.

In the following the focus will be on the sources of return which are characterised as "alternative" (accessed non-conventionally), and which are in several articles seen as generic across asset classes.

The commodity risk premium per se with return driving macro factors such as growth, inflation and interest-rate development - will not be included in these considerations.

Section 1 surveys general theoretical considerations for an explanation of the central elements, driving risk premiums and the forward curve in the commodity market whereas the individual sources of return – based on section 1 – will be examined in section 2.

Section 3 describes the data whereas results of the research are presented in section 4. Section 5 investigates the properties of the sources of return in combination.

### 2. Theoretical considerations

With good help from Dagys, S (2011) and Erb & Harvey (2006), we will go through theories about the pricing of commodity futures. In brief, Keynes' Normal Backwardation theory describes a given futures price as being a sum of expected spot price and a risk premium. In a world of risk-averse players, commercial players will be willing to hedge their underlying production at an expected future spot price below the futures price and in return have the risk on future price fluctuations transferred. This involves a regular premium by being long in futures, which has on several occasions been demonstrated not continuously to be the case for all commodities. Subsequently, these thoughts were expanded to the Hedge Pressure theory whereby negative as well as positive risk premiums may occur, depending on whether the commercial players are net sellers or buyers of futures (purchase of futures for hedging purposes will be the case for producers using commodities in their production). Both approaches, which can be named the Insurance approach, are based on risk transfer between buyer and seller of futures and deliver a set of explanations of risk premiums in the market and partly also of the structure of the forward curve of a given commodity.

Theory of Storage explains the shape of the forward curve via the introduction of the Conve-

nience Yield of a future in combination with the spot price. Convenience Yield is regarded as the "additional payment" a given producer, who uses the commodity as input, is willing to pay to be sure to have the input physically or for very short delivery to avoid a production stop or a production decline. Hence, Theory of Storage explains the relation between the spot price and the futures price via the arbitrage determined by the interest rate during the maturity of the future, storage costs and Convenience Yield. In case of abundance of the commodity, Convenience Yield is zero (the forward curve is rising – contango). In case of scarcity, it is high (the forward curve is inverse – backwardation). The theory explains the forward curve and relates it to the inventory situation.

#### *Roll yield / price return and sources of return*

The total return on commodity futures is generated from price movements in the futures contract (price return) and the return associated with the ongoing shift of contracts close to maturity to contracts with longer maturity (roll yield) and the yield return on the collateral. It is a well-known fact that roll yield is a dominant factor for the generation of return. One example is natural gas for which the price has since early 1998 increased by an average of 5.1% p.a. whereas excess return has declined by 5.7% (in terms of the CMCI index for natural gas). The costs involved in continuous maintenance of a long position in natural gas, which is in permanent contango, have been so considerable that the result for an investor has been negative although the price increase has been significant. Therefore, the forward curve has a very strong influence on the return on commodities.

Investor is rewarded for assuming a specific market risk. As investors we will basically not care how we receive our return as long as we receive

payment for participating in the risk transfer. Hence, we regard roll yield and price return as return types and not as independent sources of return. We believe that in the description and analysis of sources of return, the return is important - not the specific occurrence.

The distinction between roll yield and price return can, however, not be underestimated, cf. above. And this distinction is very important when the underlying sources of return and drivers of the forward curve are applied in practical trading strategies in the commodity market.

### 3. Review of sources of return

#### *Value*

Value is well known in the equity market where the source of return relates to investment in equities which on selected key figures have a lower valuation than the market average. Some consider Value in the equity market, cf. Borg (2013), as an anomaly, and the explanation of the occurrence of a Value source of return is attributed to investor behaviour. Others explain the return on Value on equities as pure reward of a higher default risk on low-value equities.

A great deal of research papers focus on Value in the commodity market, i.e. the excess return on comparatively "cheap" commodity futures. The problems with commodity futures are that there is no specific book value or an expected cash flow which can form the basis of an evaluation as to whether a given commodity future has a low valuation. Theory of Storage as well as the Insurance approach provides a basis of identification as to which commodity futures can over a given period of time be expected to yield a higher return than others. Hence, the "cheap" commodity future is determined to be the commodity with a high expected return/high risk premium.

Via Convenience Yield, introduced in the arbitrage between the futures and the spot price, Theory of Storage connects a market situation of scarcity to an increased flattening or inversion of the forward curve whereby investors with long positions can expect a higher excess return via roll yield.

Convenience Yield can also be described as the value of an option for the owner of the physical commodity deriving from the possibility of benefiting from short-term price increases. An increase in the expected volatility leads to a higher value of the option and an increasing Convenience Yield. Hence, Convenience Yield is connected to higher volatility, leading to a higher expected return as risk reward obtained through roll yield.

With reference to Deaton & Laroque, Gorton, Hayashi & Rouwenhorst (2008) describes a theoretical basis of ranking "cheap" vs "expensive" commodity futures. In a market with a tight inventory situation, fluctuations in price are expected to increase over a period of time until the market conditions return to normal. The reward for participating in the risk transfer via entering into a long position must therefore increase to attract investors. Likewise, the willingness among hedgers to pay more for security of future price has enhanced. The consideration of a "cheap" commodity future is connected to an expected "above-normal" excess return, and cheap commodity futures are thereby related to the inventory level/risk of critical scarcity. A Value premium on commodities based on Theory of Storage and the Insurance approach is here considered a risk/reward.

Neither Convenience Yield nor "critical scarcity" can be observed directly. Therefore, several research papers (Blitz et al (2013), Gorton, Hayashi & Rouwenhorst (2008) etc.) use the forward curve as an expression of the degree of scarcity in the market. Scarcity can be read from the prices

which are quoted in the market and scarcity will result in futures for short delivery being traded up relative to longer maturities. Other approaches assess the price level relative to the historical price level, for instance Asness et al. (2012), who assesses "cheap/expensive" via the price of the commodity relative to its price five years earlier and obtain positive results in a kind of mean reversion which can in practice be observed in the market. In our view, the theoretical basis of such an implementation is missing.

Blitz et al (2013), Kang et al (2013), Gorton & Rouwenhorst (2006), Fuertes et al (2012) and many others inspect Value and finds positive significant returns in Long/Short strategies which isolate the source of return.

### *Hedge Pressure*

The Hedge Pressure premium is directly related to the Insurance approach, cf. above where the risk premium of taking up positions in commodities is related to the need for hedging among commercial players. If there is a heavy demand for hedging among commercial players ("hedgers"), this will result in a larger-than-anticipated risk premium to the players who are willing to meet this demand. In other words: In case of a strong need for hedging, commercial players are willing to sell futures "cheaper" to attract non-commercial buyers ("speculators"). Vice versa, if non-commercial players primarily have long commodity positions. This leads to a higher expected return to attract non-commercial players to enter into long positions.

Basu and Miffre (2013) explains the theory and the empirical testing well and, in the isolation of the Hedge Pressure premium, obtains positive results that support the theory. Their testing of the theory is made by calculating a Hedge Pressure degree as the ratio between long positions and the sum of short and long positions which are

reported to the CFTC of the groups "commercials" and "non-commercials". If the Hedge Pressure degree is low for commercial players, the need for hedging among these is strong leading to expectations of a higher risk premium for investors who meet this need through long positions. If the Hedge Pressure degree is high for non-commercial players, the majority of non-commercial players hold long positions, and expectations are that the risk premium is increased to attract players to enter into long positions. A positive excess return is hence related to the risk transfer between buyer and seller of futures and the variation in demand after risk transfer.

As opposed to Basu & Miffre, Gorton, Hayashi & Rouwenhorst (2008), among others, do not achieve any results through investigation of Hedge Pressure, and generally there seems to be no consensus about Hedge Pressure as indicator of future performance.

### *Momentum*

Momentum in commodities is well-documented empirically in research papers by Gorton & Rouwenhorst (2006), Miffre & Rallis (2007), Erb & Harvey (2006), Asness et al. (2013), Schmidt (2009), Kang et al (2013), among others, and is considered a continued source of return.

The reason why Momentum arises in commodities, is explained by some (for instance Kang et al (2013)) as being determined by the same investor behaviour that is known from explanations of Momentum in the equity market, cf. Borg (2013): underreaction to news, overreaction to news, herd instinct etc.

On the opposite, Schmidt (2006) relates Momentum to the fact that commodity futures are based on a physical market and that the physical inventory adjustment given a supply or demand shock will, needless to say, take place over a long period

of time with dynamic adjustments to the demand as well as the supply side. Therefore, Momentum is a natural part of the commodity market. It is found that commodities, with a high risk of critical scarcity, show trend properties to a higher degree than commodities with a lower supply risk. Hence, it is demonstrated that gold, without any risk of critical scarcity, does not show any trend properties whereas oil and copper with a high risk of critical scarcity show significant trend properties.

On this background, investors, holding long positions in commodities with scarcity, may expect to see positive Momentum, but also that volatility of this long position remains above normal for a long period of time while the market adjustment takes place. A higher expected return on commodities with positive Momentum is therefore associated with a higher expected risk, and vice versa for commodities with negative Momentum. The isolated return on Momentum is thus explained as a risk / reward.

We must expect a certain correlation with Value since Value is based on partially the same consideration. Dynamics are, however, different: Commodities, which are "cheap", will show considerable Momentum, but with price increases, the Basis will change in relative terms since the long end of the forward curve will typically "catch up with" the short end of the curve after a period of time. Therefore, considerable variation can be expected with respect to which commodities are included positively in the Momentum portfolio and which are included in the most attractive Value portfolio.

### *Carry*

The source of return is attributed to the extra relative risk premium which should presumably go to investors as reward for taking up long futures positions given that long-term contracts

involve higher risk, cf. Barclays Research (2011) and Kang et al (2013). The basis of the source of return is directly related to the Carry or Term premium which is well-known from the fixed income market. The basis of the source of return is the Insurance approach where the return on futures is seen as the expected spot price plus a risk premium, and the risk premium must be larger for long-term vs short-term contracts. In both research papers the premium is quantitatively supported by stable positive returns and is seen as a continuous source of return.

### *Seasonality*

Seasonality is an important dynamic factor in the pricing in the commodity market. Sørensen (1999) demonstrates a strong Seasonality of grain products. Brooks et al (2013) also demonstrates by repetition of an investigation of Fama and French with supplementary data significant Seasonality in the forward curve (which implicitly leads to Seasonality in prices).

Seasonality is associated with a given recurrent event, for instance shift from old to new harvest year, winter vs summer conditions for energy, inventory accumulation on natural gas up to the heating season etc. The Seasonal premium occurs when in periods of seasonal events greater uncertainty can be expected and hence the expected reward of investors who hold long positions must be above normal. We are not familiar with research papers isolating and calculating a seasonal source of return on commodities.

### *Low Risk*

Low Risk is thoroughly investigated in the equity market (and the credit market), and consensus points to a persistent source of return in the equity market documented over a considerable number of years. Also consensus points to an anomaly associated with investor behaviour.

Low Risk has also, although to a considerably lower extent, been investigated in the commodity market. Blitz et al (2013) investigates the Low Risk premium in the commodity market with methods known from the equity market and concludes that a risk-adjusted Long/Short portfolio yields a significant return. The point of departure for e.g. Dhume (2012) is analogue to Gorton et al (2008) that high volatility will be associated with a high expected return and given that historically high volatility is expected for a certain period of time (again the physical dynamics in the market), the risk premium must, all other things being equal, be higher. Empirically, Dhume (2012) supports this approach. Fuertes, Miffre & Fernandez (2013) investigates an approach according to which the idiosyncratic risk of the individual commodity futures is being identified, and subsequently long positions are held in commodities with lowest specific risk and short positions in the commodities with highest specific risk. Fuertes, Miffre & Fernandez (2013) conclude that no payment to Low Risk can be demonstrated in the commodity market. The theoretical (and intuitive) basis of a Low Risk premium in the commodity market is hence not unambiguous.

#### 4. Data and Research

The simple quantification of the individual sources of return is based on monthly data from end-February 1998 to end-January 2014. The basis is a universe of 25 commodities: Energy: WTI, Brent, heating oil, gas oil, petrol, natural gas. Industrial metals: copper, aluminium, zinc, nickel, lead. Precious metals: gold, silver. Crops: corn, wheat, soy beans, soy meal, soy bean oil, cane sugar, white sugar, cotton, cocoa, coffee. Livestock: live cattle, lean hogs. Price and return data for commodities are expressed by the UBS CMCI index. In relation to determination of Carry the CMCI Tenor index is used and for certain commodities the S&P GSCI index is used to express the short end of the forward curve.

The above commodities have been chosen since these are included or used to be included in the UBS Bloomberg CMCI index and hence represent a certain market size/value and liquidity.

The CMCI index technology (Constant Maturity Commodity Index) is characterised by exposure throughout the entire forward curve. The CMCI index on the individual commodities are composed by Constant Maturity sub-indices – Tenor Index - for maturities 3, 6 months, 12 months but also 2 years and 3 years depending on the liquidity throughout the forward curve for the individual commodity. The CMCI Tenor Index expresses synthetic futures with a fixed maturity, and listed futures, which are daily rebalanced around the maturities, are the basis of the individual indices. The advantage of using the CMCI index is a liquidity-adjusted exposure over the entire forward curve. Hence, we obtain a more correct expression of investor's opportunities which are not only limited to the short end of the curve and therefore also a more neutral expression of the sources of return.

Generic Futures on commodities with short and long maturities (varying for the individual commodities up to 12 months) are used to express the forward curve – or the Basis. Basis is calculated annualised.

For expression of Hedge Pressure, weekly data from U.S. Commodity Futures Trading Commission (CFTC) are used for commercial and non-commercial and for both classifications the number of contracts long and short.

#### *Calculation methodology*

Calculations in section 4 are made with equal-weight portfolios. The naive view is that all commodities have "equal right" irrespective of the liquidity etc.

All calculations have been made on the excess return index (ER) and the price index (PR) with a view to an illustration of which return type is the driver of the individual sources of return.

The basis of the calculations is that initially USD 100 is provided as collateral and subsequently a long position with a nominal principal of USD 50 and a short position with a nominal principal of USD 50 are entered. Gain/loss is accumulated on an ongoing basis, and each month a long position and a short position are taken up with 50% of the accumulated principal. The net exposure is therefore always zero and the gross exposure is 100% (except Low Risk – see later).

No yield return is calculated on the principal.

Calculations are generally before trading costs – yet, returns are referred after trading costs (estimate: 0.15%) for certain sources of return. All investment decisions are made at the end of the month with a holding period for next month.

Data are in USD and have been collected from Bloomberg.

### 5. Implementation and results

#### *Commodity index*

We construct a simple long-only commodity index (in the following called the commodity index) which will be applied in the isolation of the Seasonality source of return. Since we take the naive point of departure that all commodities have "equal rights", the index is also equally weighted by the 25 commodities with monthly rebalancing. The index is in no way comparable with the well-known commodity index but designed to match the "reality" of this article. Properties are shown in the table below.

Table 1. Equal-weighted commodity index

Return p.a.	Standard deviation	Sharpe ratio
6.22%	14.5%	0.43

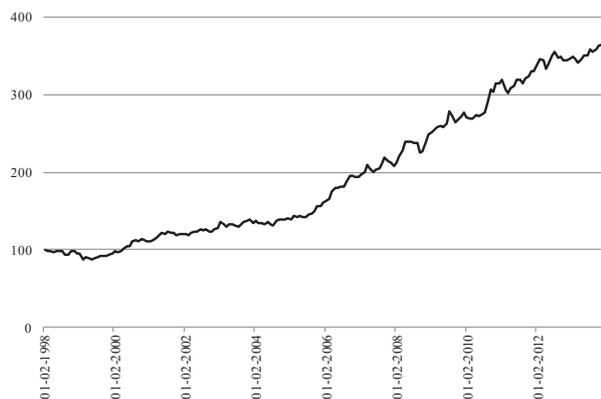
#### *Value*

At the end of each month, all 25 commodities are ranked on the annualised Basis. We generate an equal-weight portfolio with 30% of the commodities (8) with the largest Basis: Short portfolio – the "expensive" commodities. Likewise, we generate an equal-weight portfolio with 30% of the commodities (8) with the lowest Basis: Long portfolio – the "cheap" commodities. And finally a Long/Short portfolio is generated as the Long minus Short portfolio. These positions are kept for one month, and subsequently a new ranking is made and new portfolios are composed.

Results hereof are shown in table 2 and chart 1. Also in chart 1b, 3 portfolios are shown, dividing the universe in thirds (portfolios 1, 2 and 3). The conclusion is that the universe ranked according to Value shows the expected positive properties. The "cheap" commodities yield a very considerable excess return. The Long/Short portfolio, which isolates Value, shows a relatively stable generation of returns at 8.5% p.a. and a Sharpe ratio of 1.1, supporting that Value in commodities can be regarded as a persistent source of return.

Chart 1: Value

a. Long / short portfolio



b. Portfolios 1, 2 and 3

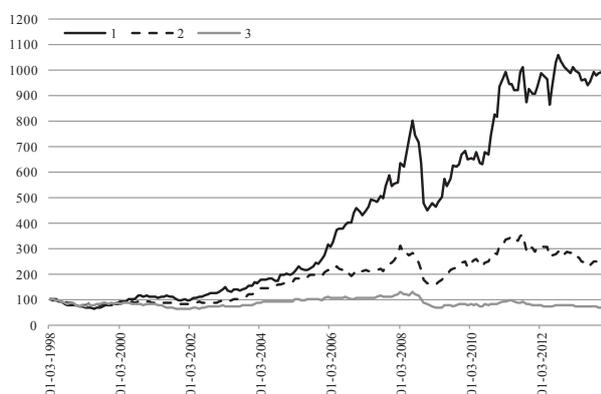


Table 2. Results - Value

	Return, p.a. %	Std. dev. %	Sharpe ratio
Long	14.9	18.3	0.81
Short	-2.6	14.8	-0.16
Long/Short, ER	8.5	7.7	1.1
Long/Short, PR	-0.1	7.5	-0.02

The return on Value is exclusively generated by roll yield - there is no (average) return from price development. No systematic test of robustness

has been made. We have, however, analysed on longer holding periods up to nine months of the equal-weight portfolios before a new ranking and find that the volatility of the 8 "cheapest" is higher than the 8 "most expensive", supporting the theoretical basis of the source of return.

There is a rather considerable turnover in the portfolios and therefore we have calculated return after costs. The return after costs is reduced to 7.6% p.a. and Sharpe ratio to 1.

Hedge Pressure

Hedge Pressure is seen as a Value premium and we focus on non-commercial Hedge Pressure. CFTC data are only available for 16 of the 25 commodities. We rank the 16 commodities according to non-commercial Hedge Pressure which is measured as non-commercial market participants' long positions over an average of 16 weeks divided by the average of the same group's total open interest over 16 weeks. We generate an equal-weight Long portfolio of the 30% (5) commodities with the highest Hedge Pressure and likewise an equal-weight Short portfolio with the 30% lowest ranking commodities. We have decided to hold the two portfolios for 12 months before a new ranking is made, cf. Basu and Miffre's considerations of holding periods. Results of Long / Short portfolios are shown in table 3 and chart 2.

Table 3: Results - Hedge Pressure

	Return, p.a. %	Std. dev. %	Sharpe ratio
Long	11.7	18.7	0.63
Short	-0.8	16.4	-0.05
Long/Short, ER	6	8.1	0.74
Long/Short, PR	1.2	8	0.15

A return of 6% p.a. and a Sharpe ratio of 0.74 on the Long/Short portfolio, isolating Hedge Pres-

sure are realised. The performance is less stable with a maximum draw down just below 20%.

Short holding periods give positive results, but a holding period of 12 months is better, and we have – quite arbitrarily – chosen this holding period. Also, we have isolated the premium based on the positions of commercial players, i.e. long low Hedge Pressure and short high Hedge Pressure for commercial players, and the result is positive but somewhat weaker than for non-commercial players.

Chart 2: Hedge Pressure



The result is very much like Basu and Miffre and supports that a source of return can be isolated linked to Hedge Pressure and its predictions as to which commodities can be expected to yield a higher return.

Since several research papers do not find an empirical basis for the theory and the results are rather dependent on the period of the ranking and the holding period, we are cautious. Yet, we find that an attractive and persistent positive return is obtained and furthermore that the intuition behind Hedge Pressure is straightforward. The most issue is whether the source of return Hedge Pressure actually deviates from other sources of

return. As opposed to Value, Price Return yields poor, yet positive results indicating that other risk sources are rewarded in Hedge Pressure.

In the isolation of Hedge Pressure relatively few changes are made in the portfolios. Trading costs are therefore of less importance.

### Low Risk

Every month, the commodities are ranked according to two years' standard deviation on the individual commodities' price indices, representing the short end of the forward curve which is characterised by highest volatility. An equal-weight long portfolio is generated from the 30% commodities with the lowest volatility and likewise an equal-weight short portfolio is generated from the 30% commodities with the highest volatility. The Long / Short portfolio does not show any specific properties over the period analysed.

If Long as well as Short portfolio is risk-adjusted to the same level as the market, we see, as shown in table 4 and chart 3, a positive, yet less stable return of 6.9% p.a. with a Sharpe ratio of 0.64 and a maximum draw down of just above 30%. The risk adjustment implies that the Long / Short portfolio is risk neutral, but also that the net exposure is not zero as for the other sources of return.

Table 4: Results - Low Risk

	Return, p.a. %	Std. dev. %	Sharpe ratio
Long	8.6	13.4	0.64
Short	3.6	18.7	0.2
Long/Short, ER	6.9	10.8	0.64
Long/Short, PR	10.6	10.5	1.01

The positive result may indicate that a systematic undercompensation of the risk by entering into long positions in more volatile commodity futures. The same result is obtained by Blitz (2013). Price return is an important driver of the return which indicates an independent source of return. We have certain reservations against the results; partly this is not a scientific analysis; partly we miss a theoretical basis for the source of return, and finally the intuition behind a Low Risk premium on the commodities is not clear-cut.

Chart 3: Low risk



The turnover of the long / short portfolio isolating Low Risk is low. Trading costs are therefore not significant.

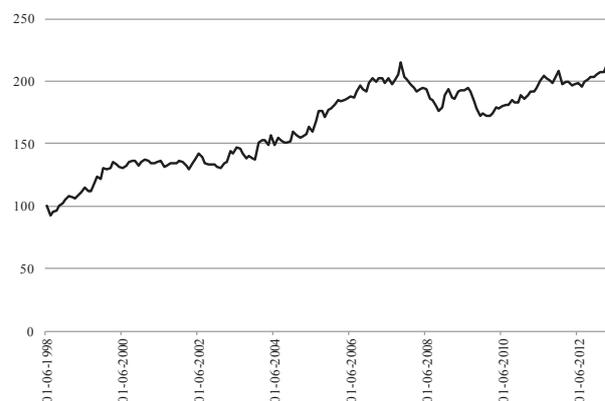
### Momentum

The commodities are ranked every month after the price development in the preceding year, yet recent month's observation has been deducted. The same principle is used in several articles investigating Momentum on equities. Subsequently, an equal-weight Long portfolio of the 30% highest-ranking commodities and a corresponding equal-weight Short portfolio of the 30% lowest-ranking commodities are generated. In addition, a Long / Short portfolio is generated according to the above principles. The portfolios are rebalanced on a monthly basis following a new ranking.

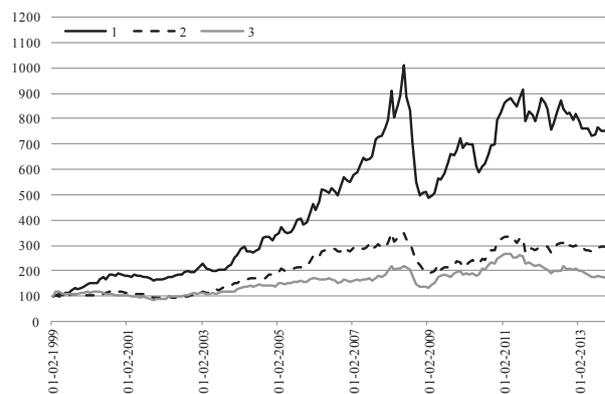
Results hereof are shown in table 5 and chart 4. Also in chart 4b, 3 portfolios are shown, dividing the universe in thirds (portfolios 1, 2 and 3). It is seen that commodities with positive Momentum yield a significant excess return. The Long / Short portfolio, which isolates Momentum, shows a return of 5.3% p.a. and a Sharpe ratio of 0.63, supporting that Momentum in commodities can be regarded as a persistent source of return. It is seen that the return is somewhat unstable, challenged in recent years and with a maximum draw down of just below 20%. The return is almost exclusively driven by roll yield.

Chart 4: Momentum

#### a. Long / short portfolio



#### b. Portfolios 1, 2 and 3



As mentioned, a certain correlation with Value must be expected. As opposed to Value, the return is, however, more unstable, indicating that Momentum is (also) driven by another factor.

Table 5: Results - Momentum

	Return, p.a. %	Std. dev. %	Sharpe ratio
Long	14.7	19.3	0.76
Short	3.3	15.8	0.21
Long/Short, ER	5.3	8.5	0.63
Long/Short, PR	0.5	8.9	0.05

Momentum is very sensitive to partly the holding period and partly the period over which the commodities are ranked. The same applies to Momentum in equities. Selection of other periods reduces as well as improves the risk-adjusted return, but the return is still positive.

Momentum on equities is characterised by high-frequency trade, and the costs involved may result in a considerable deduction in the return. Therefore, we have also calculated Momentum after costs, reducing the return to 4.7% p.a. and the Sharpe ratio to 0.57.

### Carry

For each commodity a long position in CMCI Tenor 6m and a corresponding short position in the shortest possible tenor are entered into, to the effect that the total net exposure for each commodity is zero. For commodities with monthly maturities (applies to all commodities within energy and industrial metals) the SP GSCI index has been chosen, which due to index technology rolls over contracts with the shortest maturities on an ongoing basis. For other commodities the UBS CMCI Tenor 3m has been chosen as representation of a positioning at the short end of the forward curve. The return on these positionings for each commodity is weighted equally. Results hereof are shown in table 6 and chart 5

Table 6: Results - Carry

	Return, p.a. %	Std. dev. %	Sharpe ratio
Long/Short, ER	1.5	1.3	1.14
Long/Short, PR	-1.0	1.7	-0.56

Carry shows a stable return of 1.5% p.a. and a Sharpe ratio of 1.14. The results support the existence of a specific persistent source of return (cf. Barclays Research (2011)). The attractive Sharpe ratio can partly be attributed to the "diversification effect" deriving from the equal weighting of less correlated commodities. On an individual basis, Sharpe ratios are less attractive and varying. By using the CMCI indices a "purer" expression of the source of return is obtained since we continuously have the same exposure to maturity.

Chart 5: Carry



The result is thus not disturbed by the fact that other risk factors may come into play during the period of time which passes while the long leg "rolls" all the way down the curve before prolongation. This does not imply that roll yield is not important, on the contrary the return is, as expected, generated by roll yield alone.

### Seasonality

We identify Seasonality on the basis of a proprietary qualitative analysis of the individual com-

modities, supported by quantitative analyses, always provided that the qualitative analysis will take precedence. In our analysis, each commodity is allotted three months during a calendar year with a positive Seasonal score and three months with a negative Seasonal score.

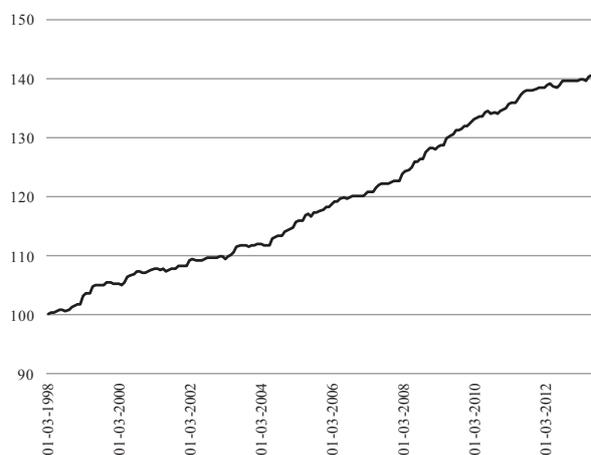
We form a long index where each commodity is overweighted by up to 50% in case of a positive Seasonal score and correspondingly underweighted by up to 50% in case of a negative Seasonal score. The overweight for commodities with a positive Seasonal score in a given month is fully financed by the underweight on commodities with a negative Seasonal score. We isolate the Seasonal premium by taking up a short position in the commodity index described above to the effect that the net exposure is zero and the gross exposure 100% on an ongoing basis. Results hereof are shown in table 7 and chart 6.

Table 7: Results - Seasonality

	Return, p.a. %	Std. dev. %	Sharpe ratio
Long/Short, ER	3.2	1.5	2.11
Long/Short, PR	3.5	1.6	2.23

The return is very stable with an attractive Sharpe ratio and indicates that it may be an advantage to isolate a persistent Seasonal premium on commodities. Part of the return can be attributed to the "diversification effect" deriving from the weighting and monthly rebalancing of 25 less correlated commodities. On an individual basis, Sharpe ratios are however generally at rather reasonable levels.

Chart 6: Seasonality



Value includes an important element of Seasonality, but price return dominates the return of Seasonality. This is as opposed to Value and indicates a separate risk reward for the event risk Seasonality.

## 6. Correlation and portfolio properties

In this section we see how sources of return correlate mutually and against the commodity index and equities.

The sources of return are re-calculated to a volatility target of 5% (for the individual sources of return a simplified ex post gearing is made until the volatility target is attained) and is shown in chart 7. The same chart also shows the development of a simple equal-weight portfolio of the volatility-adjusted sources of return with monthly rebalancing.

Table 8 shows correlations over the entire time period (June 2000 to December 2013) and two selected time periods; partly to October 2008; partly from November 2008 and ahead.

It is noted that the correlations are at relatively low levels and that there are no unambiguous variations between the two time periods, which indicates that it may be independent sources of return. It is particularly worthy of note that Seasonality does not have any correlation whatsoever. It is also seen that the correlation to

equities and the commodity index is relatively low. Momentum and Value breach the picture and correlate at medium level which is in direct opposition to what is typically ascertained for equities. Fuertes et al (2012) also finds a positive correlation of 0.44.

Table 8: Correlation tables

June 2000 - January 2013

	Momentum	Value	Hedge Pressure	Carry	Low Risk	Seasonality	Commodity index	Equity index
Momentum	1							
Value	0.52	1						
Hedge Pressure	0.15	0.10	1					
Carry	-0.19	-0.17	-0.16	1				
Low Risk	0.16	0.10	-0.06	0.10	1			
Seasonality	-0.07	-0.01	-0.07	0.05	0.06	1		
Commodity index	0.24	0.27	-0.04	-0.25	0.44	-0.09	1	
Equity index	0.07	0.19	-0.07	-0.06	0.32	-0.04	0.58	1

October 2008 - January 2013

	Momentum	Value	Hedge Pressure	Carry	Low Risk	Seasonality	Commodity index	Equity index
Momentum	1							
Value	0.37	1						
Hedge Pressure	0.18	0.06	1					
Carry	0.18	0.18	-0.16	1				
Low Risk	0.26	0.43	0.09	-0.23	1			
Seasonality	-0.22	-0.11	-0.16	0.16	-0.09	1		
Commodity index	0.08	0.38	-0.09	0.44	0.44	-0.24	1	
Equity index	0.12	0.31	-0.13	-0.16	0.32	-0.22	0.79	1

June 2000 to October 2008

	Momentum	Value	Hedge Pressure	Carry	Low Risk	Seasonality	Commodity index	Equity index
Momentum	1							
Value	0.58	1						
Hedge Pressure	0.12	0.10	1					
Carry	-0.26	-0.25	-0.15	1				
Low Risk	0.15	0.06	-0.11	0.14	1			
Seasonality	-0.04	0.00	0.01	0.03	0.06	1		
Commodity index	0.29	0.24	-0.02	0.46	0.46	-0.10	1	
Equity index	0.04	0.19	-0.06	-0.03	0.34	0.01	0.54	1

The correlation indicates either that both sources of return are to a high extent a reward of the same risk type or that we have not succeeded satisfactorily isolating Value and Momentum. The qualitative considerations above indicate that there "should" be a reward of various risk types. We believe that it is the expression of the sources of return which must be subject to further investigation.

In chart 8, the average monthly returns for the sources of return are shown in various business cycles: expansion, slowdown, downturn and recovery (data from OECD). Momentum is expected to be up against challenges in the phases which are characterised by transition between downturn and expansion, which is also evident. Hedge Pressure is expected to yield the best returns over these periods since the demand for hedging is expected to be heaviest here, which picture is evident from chart 8. We would expect to see the same picture for Value, but the recovery phase is weakest for Value, which can partly be explained by the fact that the period will be characterised by major movements in the forward curve driven by the short end. Low Risk does not give an unambiguous picture and shows the poorest performance in slowdown and downturn. The expectation will be positive returns in these periods which underline our reservations.

Carry is expected to be challenged in recovery where the forward curve is boosted by movements at the short end. Likewise, Carry is expected to be challenged in the expansion phase with a typically high risk tolerance which however does not match the quantitative assessment. The qualitative assessment of the fact that Momentum and Value only partially remunerate the same risk types is emphasised by their different performance in the cyclical phases.

Performance and risk of the equal-weight portfolio of sources of return have, cf. table 9, very attractive properties which are a result of the fact that the individual sources of return yield positive returns and that the correlation between the sources of return is rather limited.

The portfolio of sources of return is also moderately correlated to equities and commodity indices. Over the entire period, the correlation to equities and commodity index is 0.15 and 0.21, respectively. Calculations are made before costs, and the weighted portfolio will in a practical implementation be burdened heavily by costs accumulated up from the underlying six sources of return and from the ongoing equal weighting of the strategies.

Table 9: Equal-weight portfolio of sources of return

Return p.a.	Std. dev.	Sharpe ratio
5.9%	2.2%	2.54

Chart 7: Long/Short – 5% volatility target

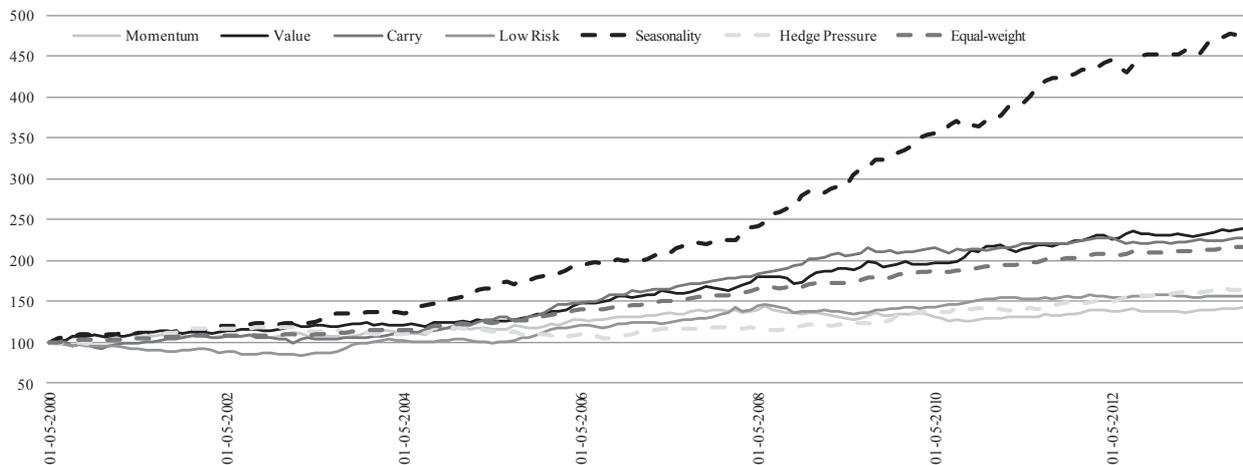
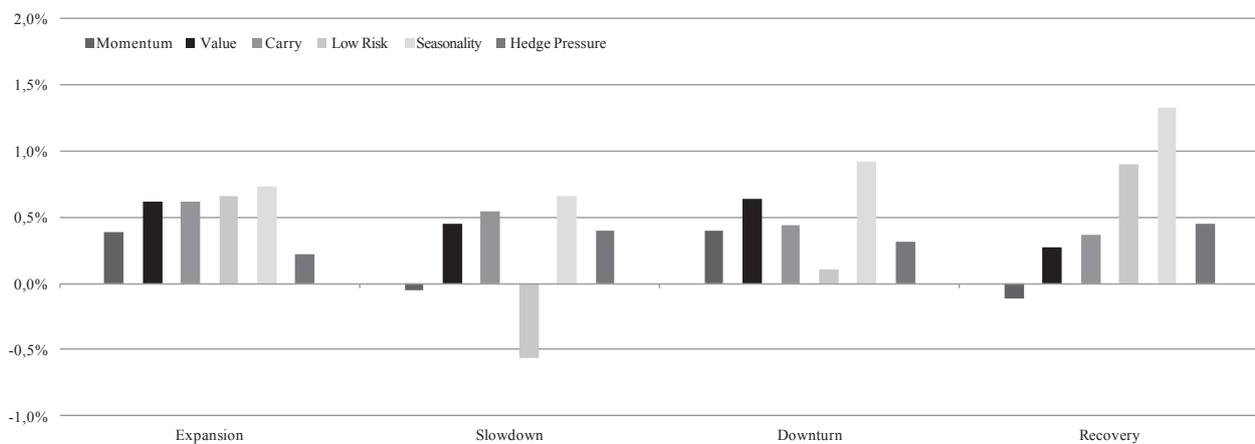


Chart 8: Sources of return over the business cycle



### 7. Conclusion

The article reviews a minor part of the literature relating various sources of return known from the equity and the fixed income market to the commodity market. In addition, specific sources of return Seasonality and Hedge Pressure relating directly and partially to the commodity market have been examined. The focus of attention is on risk/reward explanations of the sources of return, and in addition these have been analysed

through the use of index components covering the full forward curve. The conclusion is that in the literature a number of persistent sources of return have been identified and these can be explained by the risk transfer between buyer and seller in the futures market (except Low Risk). The conclusion of our quantitative analysis is that the return on the identified sources of return is positive and is seen as a reward of independent risk types – except Value and Momentum. Given that the sources of return are based on common sense

and well-functioning theoretical frameworks, and the risk-adjusted returns are generally attractive, there is a solid basis that the strategies based hereon can be expected to yield positive, stable and persistent returns.

The concept generic sources of return can in relation to commodities be regarded as somewhat challenged. The behaviour-related reasons behind for instance Momentum and Value in the equity market are not seen to apply to the commodity market. The risk transfer is the core of the explanation of sources of return in the commodity market, because the commodity market consists of various players with their own motives for being in the futures market. In the equity/fixed

income market the players are also different, but considerably more homogeneous and basically have the same motives for their presence in the market – therefore a behaviour-related approach to explanation of the sources of return is of higher importance.

*None of the information in this white paper should be regarded as investment advice. Investors are advised to contact a personal advisor with respect to investment, tax issues, etc. before buying and selling. Past performance is not a reliable indicator of future performance and price development. Performance and/or price development may be negative.*

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