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Haute école de gestion
Genève

Why can crude oil traders take advantage of a Super-Contango while agricultural traders cannot? When the same market principles apply, why traders of different commodities cannot take advantage in a similar manner?

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by

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Declaration

This Bachelor Project is submitted as part of the final examination requirements of the Haute Ecole de Gestion de Genève, for the Bachelor of Science HES-SO in International Business Management.

The student accepts the terms of the confidentiality agreement if one has been signed. The use of any conclusions or recommendations made in the Bachelor Project, with no prejudice to their value, engages neither the responsibility of the author, nor the advisor to the Bachelor Project, nor the jury members nor the HEG.

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Geneva, June 4th 2018

Loris BELTRAMELLO

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Executive Summary

Trading is a very competitive and low margin business regardless of the type of commodity traded. There are multiple ways for traders to make profits and capture value along the supply chain especially when there is a disruption in the supply and demand.

In 2009, crude oil saw its price decrease by 78.6% while the price of the futures contract was abnormally high compared to the spot price. Oil traders saw the arbitrage opportunity and took advantage of the situation in order to reap the profits. This phenomenon is well known within the industry under the name of Super-Contango. It happened again 6 years later in 2015. On the other hand, despite the fact that the same principles apply in the grain trading business, the Super-Carry phenomenon is not as well known.

This paper aims to investigate and demonstrate the reasons that prevent the agricultural market from having a Super-Carry. The thesis seeks to compare oil traders and agricultural traders in terms of storage management, market structure, market opportunity, the supply chain and the commodity itself.

The first part of the research focuses on the large trading companies in both industries and the collection of possible information in their financial report. The purpose of this analysis is to estimate the inventory management in order to define how many days the companies are holding their stocks. The results showed that agricultural companies intentionally keep their inventory longer. Agricultural firms were reducing their storage capacity and the tendency that oil companies rent their tanks while silos and warehouse are owned by the grain traders.

The second part of the study focuses on the market structure as general, seasonality implies many parameters. Analysis demonstrates that the overall storage capacity divided by the daily production is much more important for grain than crude oil. The observations showed that seasonality creates a supply and demand predictability in the grain market. This predictability allows traders to anticipate and speculate not on the flat price but on the basis[1].

[1] The basis is the price difference between spot and futures contract (spot – contract +1M)

Indicators suggest that Super-Carry has occurred. However, it is not considered as attractive or potentially profitable as Super-Contango. Therefore, only the professionals are aware of it and not the public.

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1. Introduction

Firstly, the author would like to describe how this research paper is structured and organized. The purpose of the introduction is to explain and define the theoretical principles that are involved in this bachelor thesis; mainly the working and the meaning of a forward curve, the definition of the Super-Contango, the historical facts concerning the two previous Super-Contangos, under what circumstances they occurred and the problem statement that he is trying to resolve. The literature review is also part of the introduction as it includes and gathers existing research papers, recent articles and statements from trading companies on the subject. The literature review has been split between oil and agriculture.

The analysis part includes the methodology used in order to conduct the research and the study of the collected data. The first part of the analysis is based on the financial report published by the most relevant companies within their industry using the turnover ratio. The turnover ratio was then compared between companies and the industry in order to understand the different patterns between the crude and agricultural business. Qualitative data has been collected as well through discussions with professionals working in the sector who agreed to give their opinions on why a Super-Carry does not exist and for what reasons.

Based on these discussions with professionals, secondary quantitative data has been collected from reliable sources such as EIA, USDA and Index Mundi in order to compare the overall production compared to the overall storage capacity.

Furthermore, the cost to store grains has been explained in detail in order to understand how the cost of carry is computed and what kind of cost has to be taken into account compared to oil which seems to involve less parameters. In addition, the market structure and seasonality are defined in order to understand what this implies for traders.

Finally, the discussion part summarises the findings of this research paper, the overall results and the conclusion of the stated problem. It states the current situation and the coming trends and changes, what the changes are for trading companies and how they can react in order to stay attractive as part of the producer-consumer transaction.

1.1 Basics of forward curve

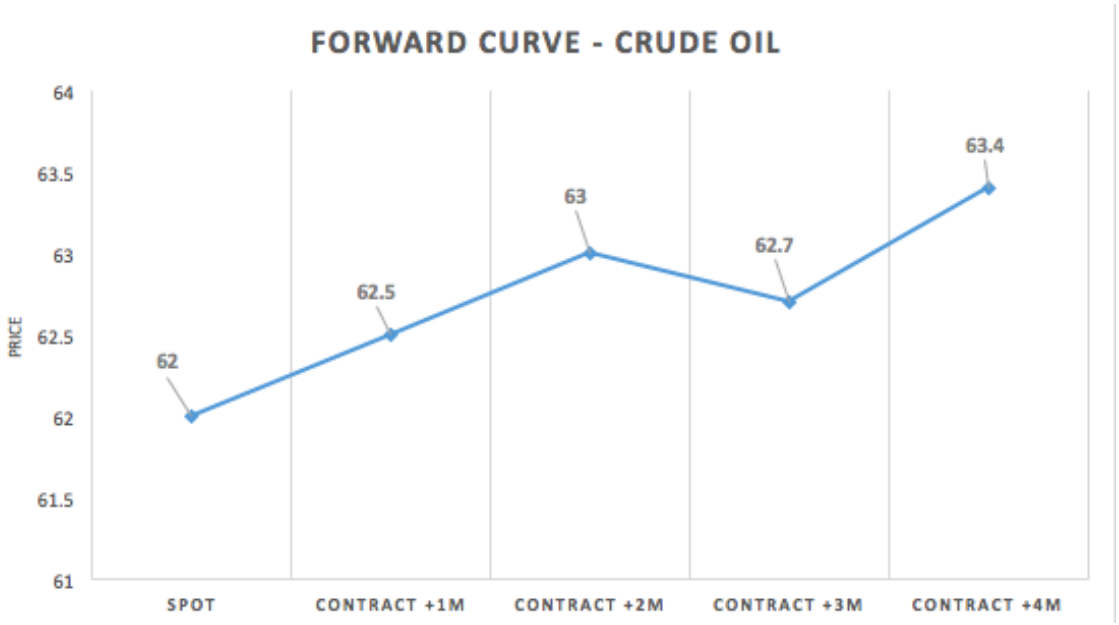
In order to understand this research paper, it is essential to define and introduce the concept of the forward curve as an important part of the work involves the use of forward and futures contracts.

Futures contracts are essential for traders. As commodity trading is a very low margin business, the need to hedge is mandatory in order to avoid price risk and lock-in their margin made on the transaction.

A forward curve reflects a series of futures/forward contracts arranged together representing the day's tradable price for a future specified delivery date. It is very important to specify that the forward curve is not a price forecast, it represents the current price for future delivery, thus it is a market indicator for today.

As an example, below is a typical forward curve for WTI Crude oil.

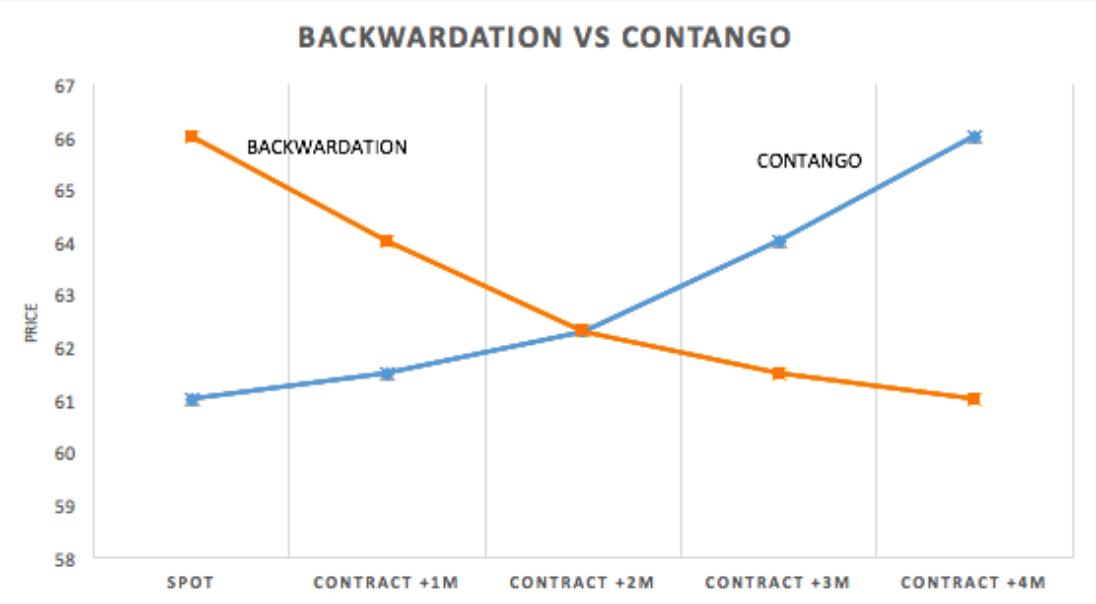
Table 1 – Crude oil forward curve example



The first column represents the spot price, meaning the price for physical delivery today, the second column is the current price for delivery in 1 month after the spot, the third is the current price for delivery 2 months after the spot and so on.

When the forward curve is an upward curve we will call it "Contango", on the contrary, a downward curve is called "Backwardation".

Table 2 – Forward curve in Contango and Backwardation



As mentioned above, the forward curve does not represent a price forecast. However, it is a great tool that gives an insight into the market current supply and demand. The basic principle is the following: when the curve is Contango, the supply>demand, the market is oversupplied. In the opposite case the market is undersupplied, supply<demand when the curve is in backwardation. The two terms are used for all commodities except agricultural commodities, a trader working with corn for instance will use “Carry” (Contango) and “Inverse” (Backwardation).

Generally, the forward curve should be in Contango if there is no oversupply or undersupply, buying the goods at the spot price is less expensive than buying the goods +1 months this is because the future price incorporates the cost of carry.

The cost of carry represents the charge that the seller has to pay in order to hold the physical commodity until the date of delivery. It includes the cost of storage, the insurance and the interest rate.

1.2 Characteristics of a Super-Contango

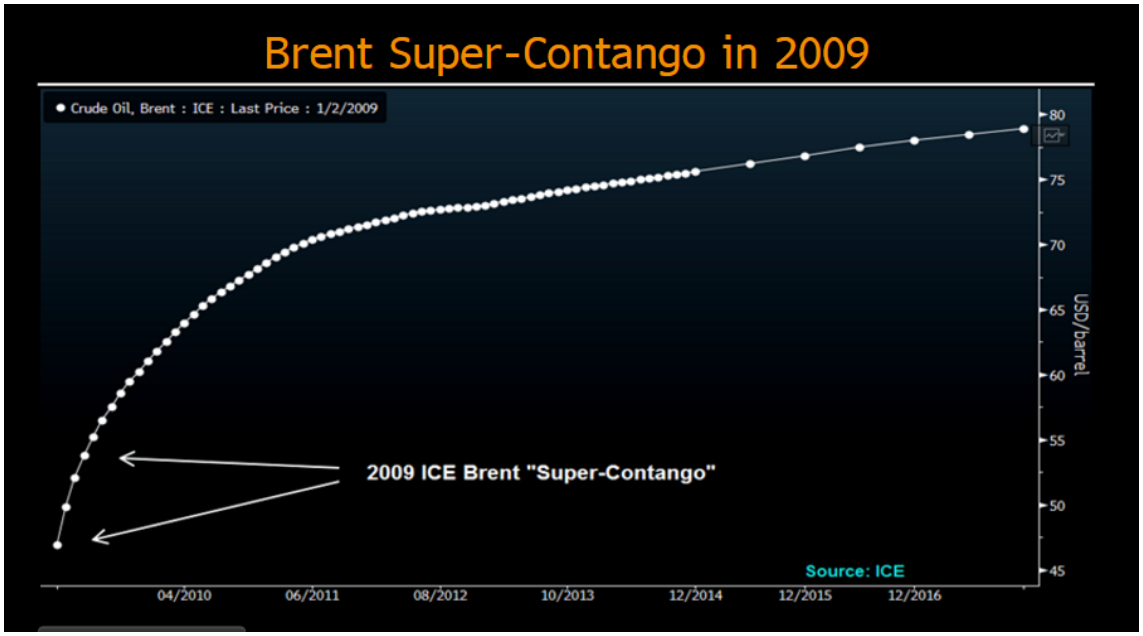
The difference between a Contango and a Super-Contango needs to be defined for the purpose of this research. Basically, it becomes a Super-Contango at the point where the future price is much higher than the spot price to a greater extent that can be explained

by the cost of carry. In other words, when the basis[2] is not covered by the cost of carry. Thus, for a Super-Contango, we have an arbitrage opportunity, which would allow the trader to make profits by selling forward, buying at the spot price and store until the delivery expiry. The very basic concept seems easy, and thus, the first thought is the fact that everybody will do it and the arbitrage opportunity will quickly disappear. However, not everybody can make money out of it. In order to better understand this phenomenon we will analyse the two most recent and documented historical Super-Contango, which occurred in 2009 and 2015 in the crude oil market.

1.3 2009 Super-Contango

On the 22th of January 2009, the oil (WTI) was traded on the New York Mercantile Exchange at $38.81. Under normal conditions, the cost to store a barrel (including insurance, interest rate and rent) would cost around $0.90 cents. Thus, we would expect the price of the June futures contract to be around $43.31 cents per barrel (5x.90+38.81). However, that contract was settled at $52.12 which is $8.83 above the cost of carry. In other words, the traders that had the storage capacity and the liquidity could make a profit of $8.83 per barrel in five months by buying at the spot price, selling the June contract and storing the commodities until delivery. (FITZ-GERALD, Keith, 2009)

Figure 1 – Brent future curve in 2009



Source: Bloomberg, 2016.

[2] The basis is the price difference between spot and futures contract (spot – contract +1M)

This graph shows the forward curve for Brent crude oil on 1st of February 2009. We can easily observe how the price of the futures contract is abnormally high compared to the spot price and the spread[3] is also very wide.

This gap between the spot and the futures contract is explained according to Goldman Sachs analysts by three reasons: a supply gut, a higher cost of financing in the future, and the belief that the demand will catch up the supply very soon. In fact, the supply was expected to be adjusted by the Organisation of the Petroleum Exporting Countries (OPEC) following their intention to introduce production cuts.

According to a Bloomberg article, the global recession caused this basis difference, a lower demand in the oil global consumption causing the benchmark price to decrease by almost 75%.

Super-Contango creates such an arbitrage opportunity that most traders cannot let pass such an opportunity to make profits. This leads to unexpected phenomena such as hoarding at sea, meaning that traders rent a super tanker, load it, park it offshore and wait for future contract's expiry.

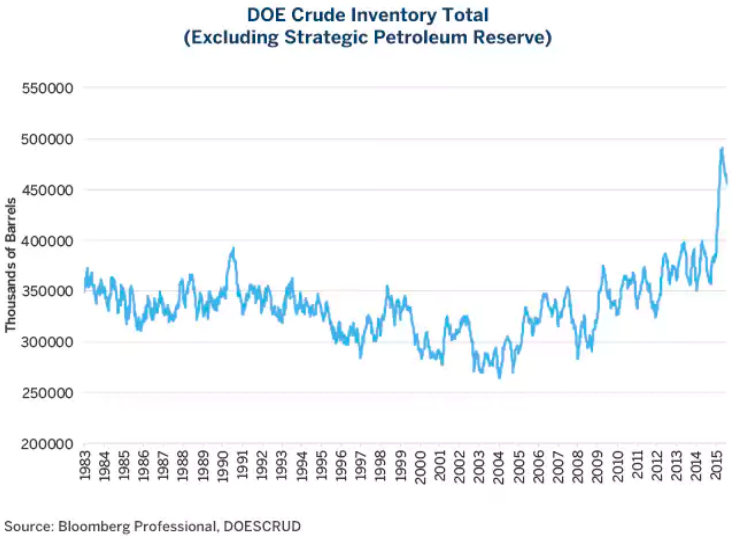
The demand for super tankers obviously increased and the rate to rent them increased about 50% from January 2009 to February 2009.

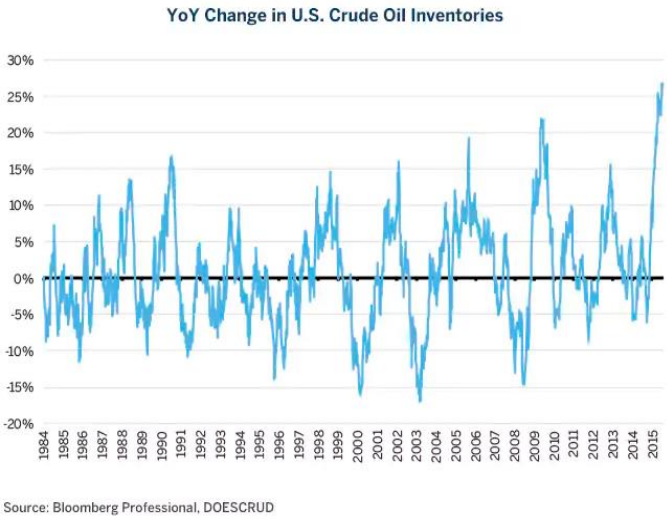
[3] The spread is the price difference between two future contracts (contract +1M – contract +2M)

1.4 2015 Super-Contango

In August 2015, despite Americans are driving more than they did last year. US crude oil inventories were at their highest level since 1983, as well as the year on year change of crude oil inventory passing the 25% of increase.

Figure 2 & 3 – Us crude oil inventory & Yearly change of US crude oil inventories





Source: CMEGROUP, 2015.

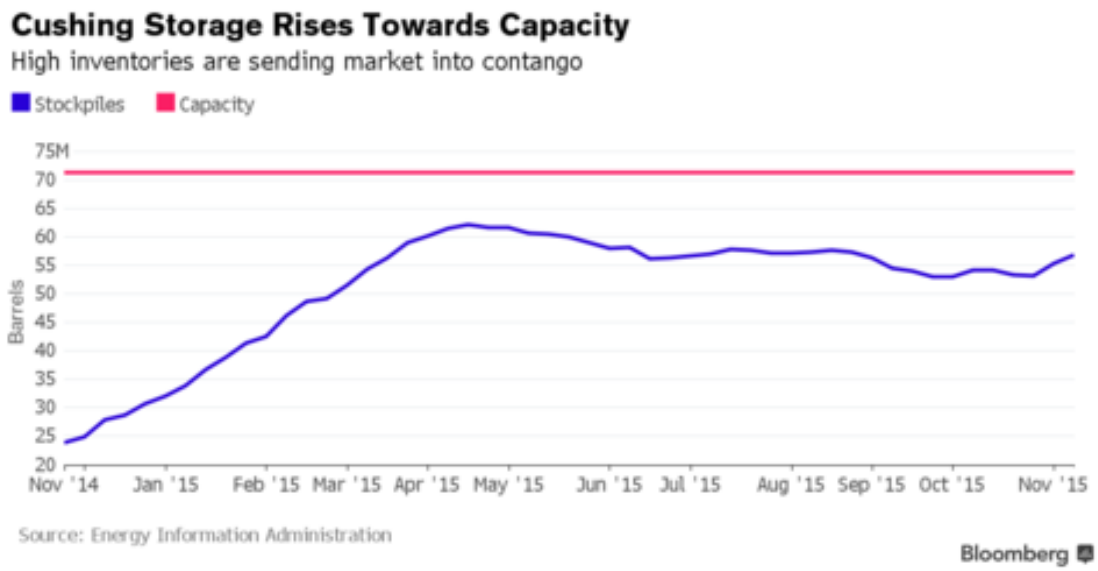
This abnormal inventory level could be explained by a lower demand of crude oil. However, Americans had been driving about 5% more miles than they had the previous year. Thus, the consumption/demand was not decreasing but increasing, as a result, the refined product such as gasoline inventory was decreasing. This gap between gasoline and crude oil is due to the fact that US refineries are running at almost full capacity (96-98%). A high level of crude oil inventory and a low level of gasoline can also be translated into a wide crack spread[4].

Cushing is a city in Oklahoma, it is well known as a major physical trading hub for crude oil and the biggest oil field storage in the USA, currently the storage capacity is about 85M Barrels. According to CME rulebook, Cushing is the delivery point for WTI futures contracts and thus the pricing point as well. It has easy access for supplier and refiners, it is a huge transhipment point with several important oil pipelines converging there.

[4] Oil term used for the differential between the price of crude oil and the refined petroleum product

If we look at the inventory level during 2014-2015, we notice that the stockpiles are not only increasing in mid-2015. They are almost reaching the full storage capacity of the tankers. What does that mean? It means that the discount on direct/spot oil delivery is widening because the storage option is no longer possible and crude oil holders have no other choice than to sell it.

Figure 4 - Cushing storage utilization



Source: Bloomberg, 2015.

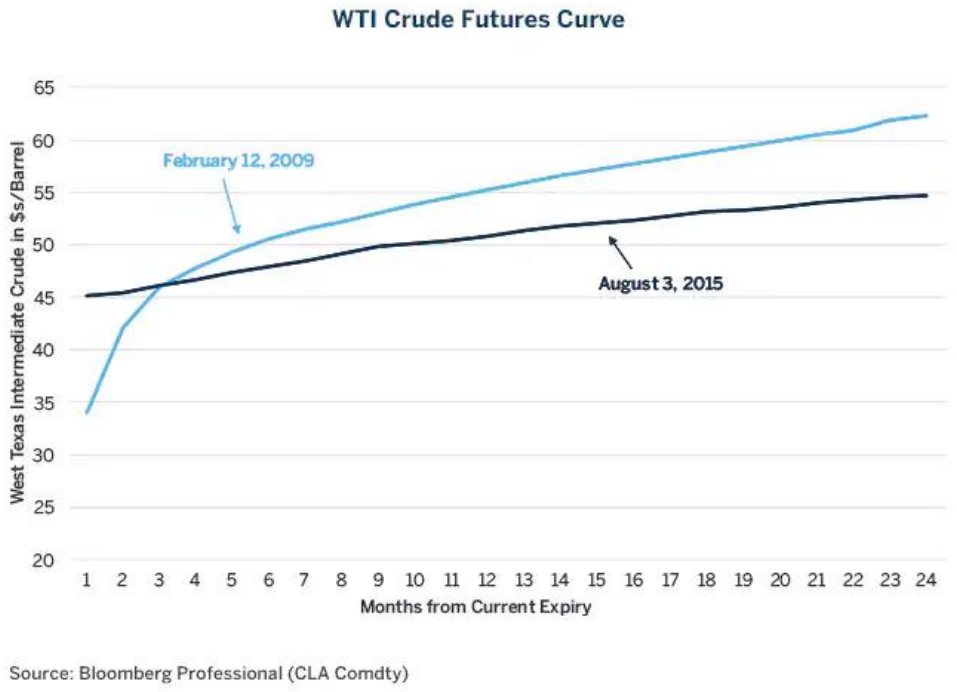
The Cushing WTI spot price closed at a $1.70 discount to the WTI January contract on Nymex on Monday 23.11.2015. With this kind of spread offshore storage became profitable. According to the Bloomberg article written by Mark Shenk, the cost of storage on land per barrel per month is about $0.45 to $0.50, the offshore cost of storage is around $1 to $1.25 depending on the vessel used.

1.5 Comparison and learnings

The overall purpose of covering the last two historical Super-Contangos is to compare them and understand what are the similar and different patterns in order to define the practical definition of Super-Contango.

From a general point of view, in 2009, we had a decrease in demand mainly due to the financial crisis and an increase in supply. Whereas in 2015, it was more a concerns of overproduction and high level of inventories.

Figure 5 – WTI future curve in 2009 and 2015



Source: CME group, 2015.

In this graph we have the forward curves of 12.02.2009 and 03.08.2015 showing the next two years of future contracts. The curve in 2015 is less steep than it was in 2009 especially for the first 6 months' contract. This is mainly due to the fact that people were confident that the price would soon increase again due to an announcement from OPEC about production cuts. On the other hand, 2015 curves seem to be a stable increasing straight line which means that people did not except a huge decrease in supply or increase in demand in the near future.

Furthermore, we know that when the market is bearish it means that the supply is more important than the demand, and thus, if the forward curve is in Contango, we assume that the spot price will be lower than it is usually. In case of Super-Contango, we expect the price to be at the lowest point. The following graph shows the historical price per barrel of WTI crude oil price for the past 10 years.

Figure 6 - WTI historical price 10 years

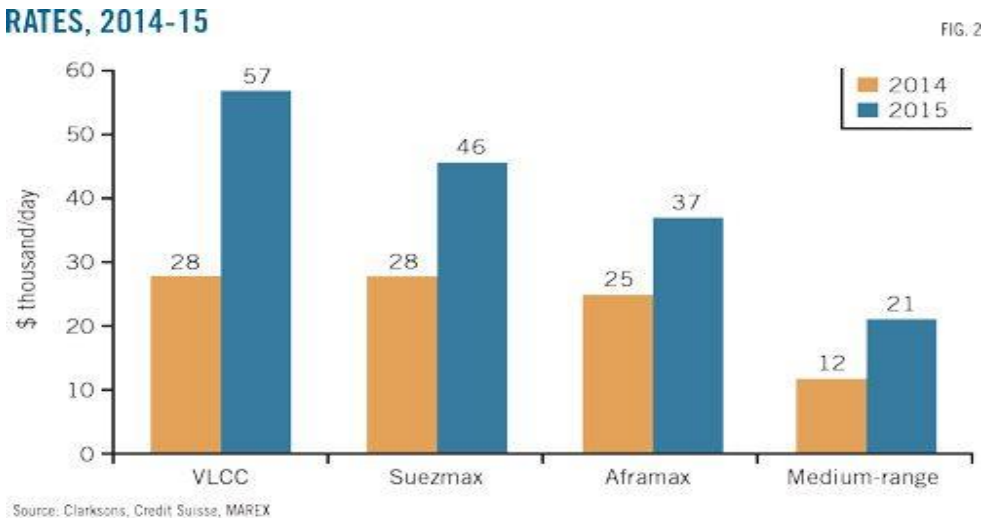
Source: Macrotrends, 2018.

Between 2008 and 2017 we can observe two bottom peaks which occurred in 2008-2009 and 2015-2016. It exactly follows the same time period of the two Super-Contangos at the beginning of 2009 and towards the end of 2015. The price collapsed from $141.47 per barrel on 10.07.2008 to $30.28 on 23.12.2008. It represents a price decrease of 78.6% in a time frame of approximately 5 months. The second bottom peak the price went from $61.01 on 23.06.2015 to $28.46 on 19.01.2016, which represents a price decrease of 53.4% in the time frame of approximately 7 months. As a result, the price decrease was more important in 2009 than in 2015. We can also note the fact that the price recovered faster and higher in 2009 than in 2015.

As stated above, the Super-Contango in 2009 was much more impressive than 2015, and so was the collapse of the WTI crude oil price. What we can observe and retain from the historical price related to forward curves is the following: When the price of a commodity collapses brutally and then recovers, the forward curve should be in Contango, the more the decrease in price the steeper the Contango will be.

Another trend observed in both 2009 and 2015 is the fact that tankers were used as storage facilities as they became a viable option when the land storage capacity was almost full. Furthermore, we faced a significant negative basis in 2009 and 2015, which enabled traders to accept higher carrying costs and still make a profit. In 2009, around 100 million barrels of oil were hoarded at sea[5]. In 2015, on a smaller scale several million barrels were stored on sea. The vessels used for offshore oil storage are usually VLCC as they are the biggest crude oil carriers and can transport/store up to 2 million barrels per vessel. (SAUL, Jonathan, 2015).

Figure 7 – Tanker freight rate



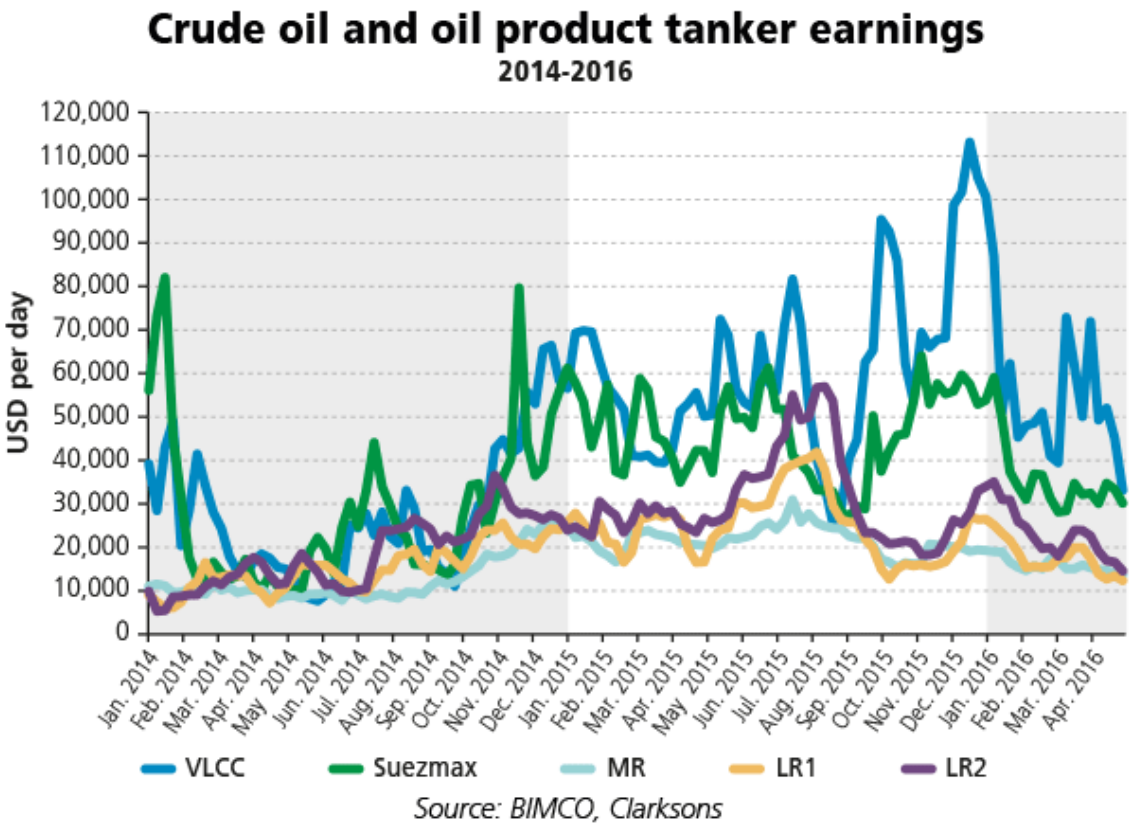
Source: ogi.com, 2016.

In this graph we see the increase of oil tanker freight from 2014 to 2015. This is mostly explained by the decrease in crude oil price increasing oil trades. For instance, China increased their export of refined oil by 22% from 2014. It can also be explained by the fact that trading companies are using VLCC as crude oil storage in order to take

[5] Reuters, 2015

advantage of the Contango which would also explain why the difference is more important for VLCC than Suezmax or Aframax. (RANA, Rajesh, 2016)

Figure 8 – Tanker earnings in 2014-2016



Source: BIMCO, 2016.

This graph also clearly illustrates the increase in VLCC earnings from 2014 to 2016. The increase is impressive in 2015, this price increase might be the consequence of VLCC demand for offshore storage.

1.6 Statement of the problem

In 2015, the crude oil market went through a Super-Contango. The Brent future curve moved from Contango in May to Super-Contango in November 2015. This phenomenon is well reflected in the forward curve, where supply is abnormally higher than demand which decreases the price. The forward curve is a fundamental tool for traders as it indicates whether they should buy and store a commodity or sell it. In 2015, it allowed traders with massive crude storages to buy a significant amount of crude oil at low prices and sell it when the supply and demand had been brought into line.

They thus made a lot of money. On the other hand, we do not hear about Super-Carry. Why is this the case? Sometimes agricultural commodities show similar attributes such as maize which is at very low price. Its forward curve seems to indicate a supply that is, currently, set to high.

Why are corn traders not storing physical corn in order to take advantage of the current situation of the market and sell it later when the price will rise? What are the reasons differentiating agricultural commodities from crude oil?

1.7 Literature review

1.7.1 Crude oil

Futures markets are an essential part of the financial world and are extensively used directly by companies such as producers, traders and consumers for risk management reasons or indirectly for over-the-counter swap and forward contracts. (Wang, Wu, Yang 2015)

In addition, futures markets are also used as source of price indicators for resource allocation decisions. (William and Wright, 1991)

When there is a bias in the relation between spot and future prices, the possible resource misallocation and mismanagement of risk appears. Cash-and-carry[6] represents a significant role in the futures and spot markets for storable goods. As demonstrated by Jarrow and Larsson (2012) “an important implication of cash-and-carry arbitrage for the utility of future prices in decision making is that the absence of arbitrage also implies informal market efficiency. At the same time, there is an intimate link between cash-and-carry arbitrage theory of storage”.

The theory of storage was first developed in 1933 by Holbrook Working, then the theory was improved and continued by Breenan in 1958, Deaton and Larroque in 1992.

The theory of storage is a pattern observed in the commodities market, it relates the inventory to the forward curve tendency. When the inventory level of a commodity is high and buyers are keeping their inventory at low level, the futures curve tends to be in Contango, the basis reaches the entire cost of carry and the volatility of spot and futures

[6] A strategy combining the purchase (long) of a physical position in an asset and the sale (short) of the futures contract on that same underlying asset. It seeks to exploit the pricing inefficiencies between the physical market and the futures market. The aim is to make a profit without taking any risk.

prices tend to be low. By contrast, when the supplies are low and consumers increase their inventory to ensure availability of the goods, the forward curve tends to be in Backwardation and the volatility of the spot and near futures prices rise compared to long-term futures prices.

“The size of the spread between the future and spot price (also known as basis) accounting for the convenience yield act as a trigger for arbitrage trade”. When an arbitrage opportunity emerges, traders buy or sell the commodity and take the opposing position in futures market.

An arbitrageurs will act to exploit an arbitrage opportunity by selling or buying futures contracts while simultaneously buying or selling the physical product which means the movement in or out of the storage. (Pirrong 2012)

1.7.2 Agricultural

Cargill made a profit in 2012, during the huge harvest shortfall, which created extreme price fluctuations and allowed them to speculate on the price of wheat, soybean and corn. They bought futures at favourable prices and sold them when the prices rose. From this statement we understand that when the supply collapses and the price increases, agricultural traders can benefit from it.

According to Katlheen Masterson from NPR news, grain farmers are acquiring their own grain bins. Private storages have been increasing rapidly since 2012, allowing farmers to choose at what price and time they want to sell their harvest which affects their profits and makes the traders’ life misery.

The biggest agricultural companies are reducing their costs and enhancing savings (Bloomberg October 2017). “About 40 senior managers and executives in the agricultural industry quit their positions at trading houses such as ADM and Louis Dreyfus. Agriculture accounts for 43% of all job change in commodities this year”.

Miroslaw Marcinak, a consultant at InfoGrain, said “The industry, which for a century has been dominated by the “ABCD” quartet of ADM, has been forced to make wide-ranging changes. Firms turned to asset sales, trading in niche markets or even processing meat to generate more cash. Executives are putting more pressure on traders to deliver profits”.

We have experienced high prices in the agricultural market over the last decade, triggered by the fast-expansion and development of certain emerging countries, especially China. However, this is not going to happen again anytime soon said Gonzalo

Ramirez Martiarena, Louis Dreyfus' CEO, "Consumption keeps growing fast but production grows even faster".

Apparently, we are entering a long-term period of oversupply in agricultural commodities, which will involve lower prices and thus, lower margins for producers and traders.

As a result, the barriers preventing traders from taking advantage of a possible Super-Carry are the following: farmers are becoming more "modern" and store their own production; the grain market has become less volatile than it used to be; supply is not expected to decrease and demand is not expected to increase anytime soon, which means that the price is not likely to increase in the short term. Large companies had taken advantage of price fluctuations in 2012 by speculating on the futures market.

2. The analysis

2.1 The methodology

The research method used is principally exploratory and is composed mainly of interviews, company annual reports, articles, and descriptive analysis of the collected data.

First the author collected data from the annual reports of the relevant companies within their industry, three of which trade crude oil and petroleum principally and three which focus on the agribusiness. The principal reason was to extract the yearend inventory in their balance sheet as well as the cost of sales from the income statement.

He then analysed this information with the help of the inventory turnover ratios, which indicate how important the inventory is and how long the company keeps its inventory before turning it into sales. The next step was a comparison between the ratios from agricultural firms and the ratios from oil companies, which showed the different patterns from the two industries, including which sector stores its produce longer than the other.

In addition, it was also interesting to compare the evolution of these ratios over the years in order to understand the changes and the challenges that trading companies are up against.

The annual report of these companies also disclose additional information to the balance sheet and the income statement. One can find their daily production for instance, their

overall storage capacity, the number of bulk warehouses owned. This information enabled the author to understand the evolution of these companies.

Furthermore, the author had the opportunity to discuss with some professionals working for agricultural trading companies such as Cargill and Bunge. The purpose of these discussions was to understand if the trading companies have important storage capacity and if they use this storage capacity to store commodities and wait for an increase in price. The author did not look for concrete answers but it allowed him to have some clues and adapt his research according to the findings from these discussions.

Finally, the author had planned to look at expired contracts and their historical price on the Chicago Mercantile Exchange to reproduce previous forward curves in order to observe weather or not the forward curve of an agricultural commodities has been in Super-Carry by exceeding the cost of carry. Unfortunately, The CME[7] Group website does not provide the desired data, however, it is possible to buy this data by creating a CME DataMine account. Once this account has been created it is possible to obtain complete historical data for one specific commodity and it costs $2'000 for each purchase. The author had hoped to identify a Super-Carry for Corn, Soybean and Wheat but it would have cost $6000 to access the necessary data, which unfortunately is not affordable for a student. He is sure that large companies have the resources to access this kind of data.

2.2 The ratios

Investors and analysts use multiple tools, concepts and techniques in order to compare company's strengths and weaknesses. The ratio analysis is an instrument that uses quantitative data from numbers found in the financial statements of companies and thus can be done by anyone with access to it. Fortunately, more and more companies are being transparent and publish their financial statements. It is really important to analyse these ratios over the years in order to define the trend and not only for a certain period of time.

The commonly used ratios are divided into four categories: activity, liquidity, solvency and profitability. Because we want to compare the activity of an oil and agricultural trader, we are looking for an activity ratio, which measures how efficiently a company utilizes their assets. In our case we would like to know how long companies are keeping their inventory, we are thus using the inventory turnover ratio. (LAN, Joe, 2012)

[7] Chicago Mercantile Exchange & Chicago Board of Trade, online trading platform for derivatives.

2.3 The inventory turnover ratio

The inventory turnover ratio shows how effectively the inventory is managed by dividing the COGS[8] (cost of goods sold) by the average inventory. It measures how many times the average inventory is sold during the years. (MY ACCOUNTING COURSE, 2018)

The formula is as follows:

$$\text{Inventory Turnover Ratio} = \frac{\text{Cost of Goods Sold}}{\text{Average Inventory}}$$

Usually companies seek the highest inventory turnover ratio otherwise it means that the company is overbuying inventory compared to their sales and thus wasting resources by storing non sellable inventory. By keeping a high ratio of inventory turnover, the company manages their inventory effectively. The benchmark for this ratio depends on which industry the company is in. Beware, an unusual high ratio can also be a sign that the firm's ratio is too lean and thus could not support an increase in demand from their clients.

Nevertheless, the inventory turnover ratio cannot be assessed in the same way for trading firms as for other firms. Storing goods and selling them 6 months later does not mean that the company manages their inventory badly; it could mean that the company speculates on the price or the basis of the commodity which could fluctuate negatively or positively.

Goods that increase their value over time are not very common, it can be the case for wine makers for instance. However, for most manufactured goods, the goods will not be sold at a higher price but a lower price. For instance, for a smartphone maker, keeping their phone stored will cost them money. In addition, the smartphone will lose value as the technology evolves and becomes obsolete. Finally, the raw material fluctuation represents only a fraction of the phone price and will almost not affect the overall price.

Furthermore, commodities are very liquid markets, it is easy to find a buyer or/and a seller, thus, there is no point in keeping inventory for long periods of time for reasons other than speculation or to capture an arbitrage opportunity.

[8] Costs related to the purchase and the direct production of the goods

As a result, for most businesses a high ratio of turnover inventory is good. On the contrary, a low ratio of turnover inventory for commodities firms could demonstrate their ability to make money from holding a certain amount of stock.

2.4 The company selection

For this analysis ratio activity, the author chose to select only six trading firms, three in the agricultural area and three in the crude oil area. He preferred having only a few companies in order to compare companies of similar size and influence. The interest is in the big players in the oil and agricultural industry because small companies are less likely to take advantage of a Contango or Carry. Only large and reputed companies will have sufficient liquidity to invest and store those commodities during a certain amount of time. Even though they do not have the liquidity, they easily have access to massive credit lines from the banks which would not be possible for small trading firms.

They are mostly public as it is mandatory for them to publish their financial report. The author wish he could have access to data from certain companies such as Vitol or Cargill, but they do not disclose such information as they are private companies. Trading firms that trade a wide range of commodities have been avoided, such as Glencore which trade metals, minerals, agriculture and energy. The selected companies are specialized and focus their activity in either the agricultural or the oil business.

2.4.1 Agricultural firms

Without surprise, the traders analysed are the three transnational giants that dominate the raw material of the global food system, and part of the well-known ABCD group which includes ADM, Bunge, Cargill and Louis Dreyfus. In 2011, they accounted for about 75% to 90% of the grain traded around the world, the figures are not precise due to the fact that Cargill and Louis Dreyfus are privately owned companies and do not disclose their figures. Cargill is not part of the analysis because the company does not publish their financial data. (KATHLEEN Masterson, 2012.)

ADM is an American public company which was founded in 1902 and listed in the New York Stock Exchange since 1924. Their revenue in 2017 was 60.828 billion and they employ 31’000 people. The headquarters are located in Chicago, Illinois, United States. Soybeans, soybean meal and corn are their main product source of revenue. They also trade other commodities such as wheat, oilseeds, oats, rice, barley. The processing of corn, oilseeds and wild flavour is also part of their activities. ADM is the perfect candidate

as they only trade and process agricultural commodities. (ARCHER DANIEL'S MIDLAND COMPANY, 2017)

Bunge is an American public company which was founded in 1818 and has been listed on the New York Stock Exchange since 2001. Their revenue in 2017 was 45.794 billion and they employ 31'000 people. The headquarters are located in White Plains, New York, United States. Bunge is an important trader of dry milled corn in north and South America. They also trade oilseeds primarily soybeans, sunflower seeds, rapeseed, canola, and grains primarily wheat and corn. They are also present in other segments such as the production of sugar and bioenergy, the milling process of rice, corn, wheat flours and the production of fertilizer. (BUNGE, 2017)

Louis Dreyfus Company is originally a French company which was founded in 1851 in Alsace It is one of the world's largest family owned companies, in fact it is more precisely a "private company with limited liability", the headquarters are today located in Rotterdam, Netherland. They have 19'000 employees worldwide, their revenue in 2017 was 43.0 billion. Louis Dreyfus are present in 11 different commodities "platforms": Oilseeds, grains, coffee, cotton, sugar, rice, dairy, finance, juice, freights, metals, they also produce, process and refine commodities. (LOUIS DREYFUS COMPANY, 2017)

Surprisingly, they disclose their financial statement even though the company is private, and thus it was possible to select them for the analysis. Compared to Bunge and ADM they are also in the metal industry, but it represents only a fraction of their activities. Thus, they are still a company that mainly trades agricultural goods.

2.4.2 Oil firms

The selection of oil firms was much more difficult, the author would have liked to analyse the biggest crude oil traders such as Vitol, Mercuria or Gunvore. Unfortunately, as private companies they do not disclose their financial statements so he turned to oil and gas companies. Their revenue is more based on the refined oil product than crude oil, but crude oil and the refined product are very much correlated.

ExxonMobil is an American public oil and gas company that was founded in 1999 after the merger of Exxon and Mobil. The two former companies were both American. Their main activities were the sales of gasoline and the management of their convenience store at the gas stations. The headquarters are located in Irving, Texas, United States, they are listed on the New York stock exchange. Their revenue in 2017 was 327.162 billion and they employ nearly 70'000 people. ExxonMobil was ranked among the world's

five biggest oil companies in 2015. They mainly deal with crude oil, natural gas, oil products, and petrochemicals. (EXXONMOBIL, 2017)

Trafigura is a Singaporean private oil company that was founded in 1993, they are the world's second largest crude oil traders and are also important metal traders. Their head office is located in Geneva, Switzerland and they have a registered office in Singapore. Their revenue in 2017 was 136.4 billion, the oil and petroleum products represent 69% of their revenue meaning that the company is specialized in this area. They only employ 3'935 people, which is fairly low compared to their competitors. The commodities that Trafigura deals with are crude oil, refined petroleum products and non-ferrous metals[9]. Non-ferrous metals activities represent 31% of their revenue. The company is private but as Louis Dreyfus, they are transparent and disclose their financial report, they have been included in the ratio computation as well. (TRAFIGURA GROUP PTE. LTD., 2017)

British Petroleum (BP) is a British public limited oil and gas company that was founded in 1908 under the name of Anglo-Persian oil company, it became British Petroleum in 1959. The company's shares are traded on the London stock exchange, Frankfurt stock exchange and New York stock exchange. Their headquarters are located in London, United Kingdom. Their revenue in 2017 was 240.208 billion and they employ 74'000 people. BP is very similar to ExxonMobil in terms of activities, BP are an important player mainly in the crude oil, gas and refined oil products. (BP, 2017)

2.5 Company analysis

The inventory turnover ratio is useful for looking at the trend and the evolution over a certain period of time which in our case will be 6 years. The author would have liked to have the ratio for previous years and after the financial crisis of 2008. Unfortunately, most annual reports start in 2012-2013. It would have been interesting to see the yearend inventory of the oil company for the year 2008 (when the Super-Contango happened). Firstly, the ratio compares the three companies within the same industry and secondly it compares the two industries by taking the average ratio from each company.

2.5.1 Oil companies over 6 years

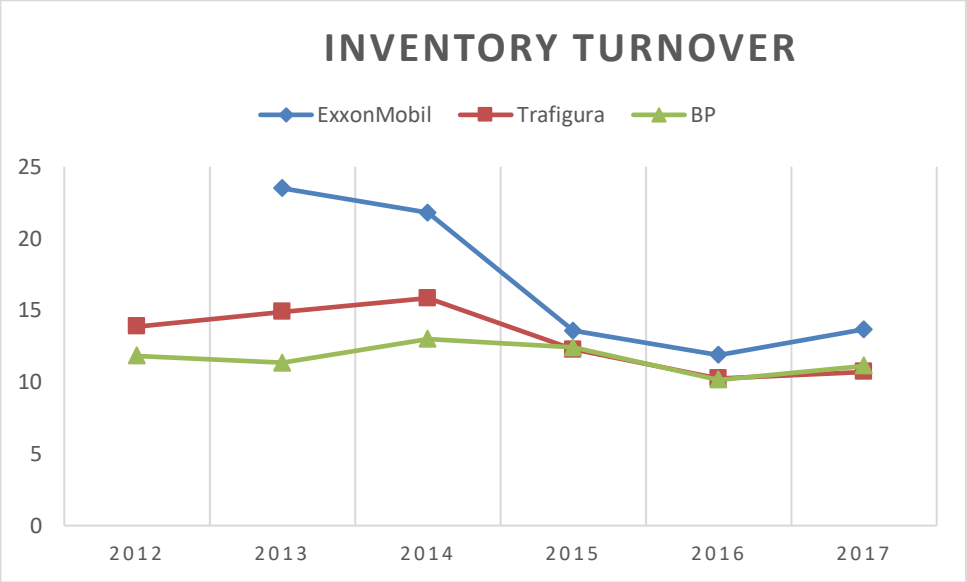
The pattern for oil companies is very similar. This can be explained by the fact that these companies are dealing with the same commodities; mainly crude oil and refined petroleum products. Thus, their inventory retention will be very much related to the

[9] The non-ferrous metals do not include Iron (e.g. copper, aluminium,..)

market of these goods. ExxonMobil reduced its yearly inventory turnover from 23.5 in 2013 to 11.9 in 2016, in 3 years they have doubled the holding time of their inventory. It can be explained by the decrease in price of mid/end 2015 and the Super-Contango that occurred the same year. ExxonMobil kept their inventory in order to take advantage of the arbitrage opportunity.

2015 does not have the lowest ratio compared to 2016 because the inventory turnover ratio takes the average inventory which is computed with the beginning and ending inventory of the years. The Super-Contango in 2015 occurred at the end of the year, thus, the high inventory is at the end meaning that it is also covers the beginning of 2016.

Table 3 – Inventory turnover ratio oil companies



ExxonMobil is not the only company showing an interesting reaction to the Super-Contango of 2015, all three companies held their inventories for a longer period of time. For the years 2015, 2016 and 2017, the patterns seem to be almost perfectly aligned, especially if we compare Trafigura and BP. They have almost the same inventory turnover for three consecutive years. This graph also shows how the competition between oil firms is tight and the fact that they need to capture value anywhere they can.

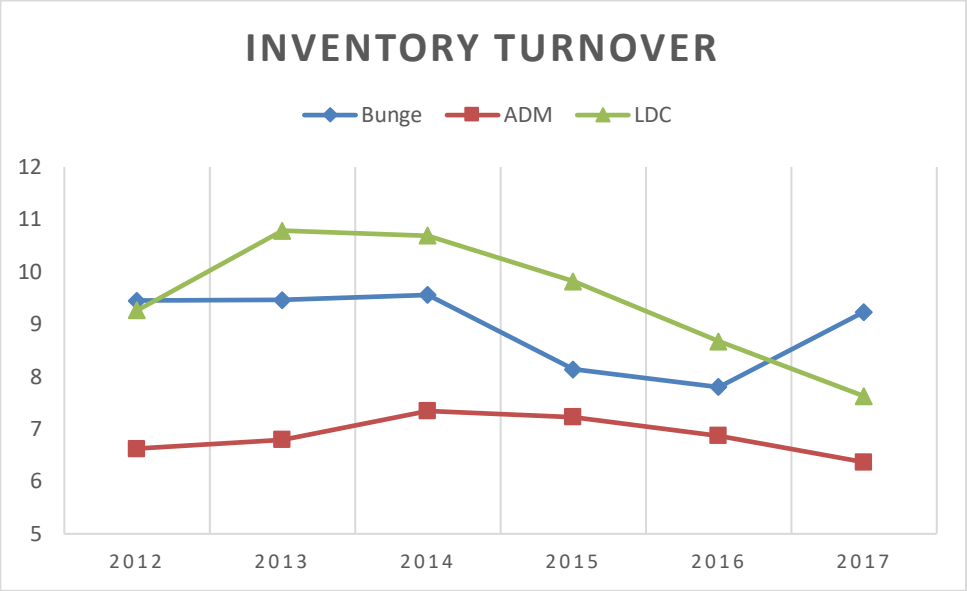
2.5.2 Agricultural companies over 6 years

It is much more difficult to see a pattern in the agricultural companies. This is most likely due to the fact that the range of products that can be traded and processed in this area is much wider than the oil industry which makes each company different from the other. In addition, it is more difficult to explain an increase or decrease in holding inventory; we

do not know the details of their inventory and whether it concerns corn, wheat, soybean or other agricultural commodities.

The slight trend that can be observed is the decrease of the turnover ratio since 2014, meaning that they are holding their inventory for a longer period of time.

Figure 4 – Inventory turnover ratio agricultural companies



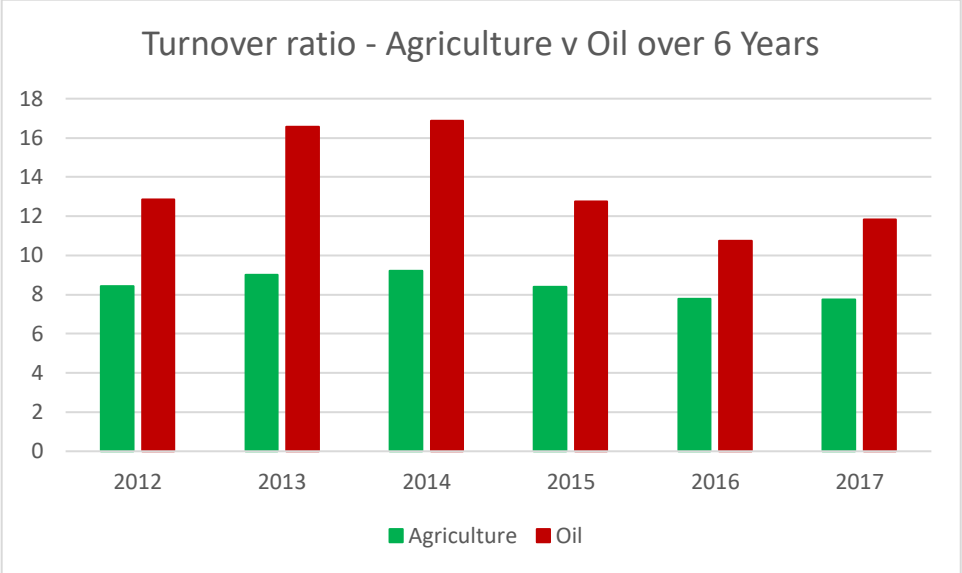
ADM had a stable inventory turnover during these six years. Either they were not adapting to market trend, which is unlikely for this type of company or they were applying their storage the same way for different commodities according to the market opportunity. For instance, in 2014 they stored rice for a longer period of time, in 2015 it was wheat, etc.

As stated above, it is very difficult to find the correct explanation for any increase or decrease of the inventory turnover ratio because agricultural companies are storing and trading multiple commodities.

2.5.3 Comparison between the two sectors

The primary reason for this ratio analysis is to compare whether or not oil companies hold inventories longer than agricultural companies. In order to provide a general picture, the average of the three companies was compared over the 6 years. Agricultural companies tend to have a much lower ratio than the oil companies, which means that they keep their inventories longer.

Table 5 – Inventory turnover ratio sector comparison



The average of the green columns is 8.4 which transformed into days represents 45 days to sell their yearly average inventory. The average of the red columns is 13.6 which transformed in days represent 28.2 days to sell their yearly average inventory. Even during the year 2015 and 2016, oil companies have a higher inventory turnover ratio. Although the forward curve of oil was in Contango and oil traders were storing crude oil for months.

Another difference that must be observed is the fact that the turnover ratio is stable in agriculture over the years. Whereas it fluctuates a lot in the oil industry, from 2014 to 2016 the ratio decreases approximately 36%.

Oil companies rely almost only on crude oil and oil products which are very much correlated. They do not trade a wide range of commodities which oblige them to follow only one market. When this market is bearish and the forward curve is in Contango, oil inventories will be kept for a longer period and thus, the ratio will be low. On the other hand, if the market is bullish and the forward curve is in backwardation. The inventories will be kept for a shorter period of time during the year and thus the ratio will be higher.

The agricultural companies can choose which commodities they want to store, trade and invest in. Most agricultural commodities can be stored in the same storage facility so it does not make any difference to them which commodity needs to be stored. For instance, if in 2012 the wheat market was bearish, they could store it and sell it later. In 2013 if it was no longer the case for wheat, they could store another commodity such as corn because the market was bearish that year, and the following year they could switch to

soybean instead of corn within their storage facilities. The possibility to substitute the commodity they are handling might be the reason for this stable inventory turnover ratio.

2.5.4 Additional findings from the financial statements

As mentioned in the point 2.5 under the company selection, the author intentionally chose to analyse few companies in order to go beyond their balance sheet and income statement. He also read their annual report and collect relevant information concerning their inventory management, their storage capacity evolution and other information. The comparison will not be conducted under this point because each financial report is different from one company to another. However, the evolution within the same company might be relevant.

Bunge communicate through their annual report some interesting numbers concerning their storage capacity and the number of warehouses they own at the end of the year as well as their daily production.

Table 6 – Bunge production, storage capacity and warehouse facilities

Years	Daily production in Mt	Storage capacity in Mt	Warehouse/storage facilities
2017	145,697	15,474,260	182
2016	146,236	17,354,480	174
2015	150,499	18,669,158	185
2014	147,115	18,634,343	194
2013	139,819	19,031,629	220
2012	138,296	19,198,418	208

This table shows the persistent decrease of capacity storage which is expressed in metric tons from 2012 to 2017. The number of warehouses owned by the company also declined except in 2017, when they increased their storage facilities by 8. However, it is highly likely that they replaced large warehouses by smaller warehouse because even they had more storage facilities their capacity diminished from the previous year. From 2012 to 2017 the storage capacity of Bunge was reduced by 3,724,158 metric tons which represents a 19.4% decrease. (Bunge, 2017)

On the other hand, the daily production which is also expressed in metric tons has slightly increased since 2012.

These numbers tell us a great deal about the current shift in market structure that agricultural traders are experiencing. They are actually producing more and thus invest

in backward integration which is the producers' activity. On the other side, they are reducing their storage capacity because producers are investing in their own warehouses. The producers progressively capture trader's activities and thus, can take advantage of the market seasonality.

In addition, the author found statements within the annual report which provided some interesting clues concerning the use of derivatives and the management of physical commodities according to an inverse or carry market.

"The group uses futures and options contract mostly to hedge trading inventories and open commitments in commodities and securities." (p79 - LDC financial report 2017)

The main use of derivatives is for hedging. It allows traders to offset their position and thus eliminate their exposition to flat price fluctuation but by doing so, the traders take on a basis risk. The other use of derivatives can be for speculation purposes.

"Controlling our own origination, warehousing and logistics allows us to efficiently navigate both inverse and carry market". (p47 – LDC financial report 2017)

This statement clearly confirms the use of physical facilities such as warehousing in order to capture value and take advantage of either inverse or carry market. Although it is not supported by figures or any details, agricultural companies also look at forward curves as oil traders do.

Bunge included a table in their financial report which summarises the volume of economic derivatives and an interesting statement.

"Agricultural commodity derivatives are used to manage our inventory and forward purchase and sales contracts." (p90 – Bunge Annual report 2017)

Figure 9 – Bunge volume of economic derivatives

(US$ in millions)	DECEMBER 31, 2017 LONG	2017 (SHORT)	2016 LONG	2016 (SHORT)	UNIT OF MEASURE
Interest rate					
Swaps	$ 713	$ (1,611)	$ 569	$ (500)	$ Notional
Futures	$ -	$ (2)	$ 5	$ -	$ Notional
FRAs	$ -	$ (1,424)	$ 979	$ (68)	$ Notional
Currency					
Forwards	$ 9,784	$ (9,668)	$ 6,126	$ (8,889)	$ Notional
Swaps	$ 192	$ (148)	$ 157	$ (129)	$ Notional
Futures	$ -	$ (58)	$ -	$ -	$ Notional
Options	$ 521	$ (471)	$ 268	$ (126)	Delta
Agricultural commodities					
Forwards	23,438,004	(30,055,331)	25,960,476	(35,672,883)	Metric Tons
Swaps	65,045	(5,279,181)	1,442,144	(3,326,874)	Metric Tons
Futures	4,520,267	-	-	(6,914,908)	Metric Tons
Options	828,296	-	-	(334,494)	Metric Tons
Ocean freight					
FFA	-	(3,617)	-	(3,165)	Hire Days
FFA options	892	-	-	(467)	Hire Days
Natural gas					
Swaps	3,519,668	-	1,351,351	-	MMBtus
Futures	2,691,350	-	3,930,000	-	MMBtus
Energy - other					
Forwards	5,534,290	-	6,048,869	-	Metric Tons
Futures	1,394	-	1,777	-	Metric Tons
Options	-	-	-	(1,285)	Metric Tons
Swaps	223,600	-	215,100	-	Metric Tons

Source: BUNGE, 2017. Annual Report

Bunge is using derivatives in order to manage their purchases and sales contracts. However, when we compare the balance between sales and purchases (short and long) we observe that their short position is more important than their long position. In other words, they are selling more forward contracts than those they are buying. We can assume that their physical position is long, they have bought commodities in a spot contract and then sold them using forward contracts. It might be due to the fact that the basis is attractive enough to buy physical and sell forward.

Most of the hedging should done with futures as they are more liquid that forward contracts and thus easier to offset traders' positions. For example, the common traders' position on the futures market was short in 2016. They were short 6,914,908 metric tons because they were supposed to be long physical and thus they had to hedge their physical commodities. However, for December 2017, their position in the futures market was long, which could be due to speculation during that period or because they increased their swap position.

2.6 Overall Storage capacity

The author had the opportunity to discuss his research with a trader from Bunge, Mr. Jean-Baptiste HERMANN. His opinion concerning the Super-Contango in crude oil is that it occurred because there were not enough oil tanks to store all the crude oil available on the spot market. It had never happened in agricultural commodities because there is much more available storage capacity for grains than for oil. As a result, the author has decided to compare the overall capacity with the daily production of oil and grains in order to determine the importance of the gap in term of storage capacity. This research based on storage capacity will be limited to the United States; they have the most developed, complete and efficient information entities which are EIA (U.S. Energy Information Administration) for oil and USDA (United States Department of Agriculture) for grains, they provide daily news, reports, statistics, analysis and graphs.

2.6.1 Oil storage

The production of crude oil in the USA is approximately 10,000,000[10] barrels per day. The aggregate USA crude oil tank farm represents a capacity of 478,988,000[11] barrels excluding strategic petroleum reserves and pipeline fills. EIA included two tables in their report. One concerning “working storage capacity” which represents the difference in volume between the maximum safe fill and the residual oil at the bottom of the tank. The second table is the “net available shell storage capacity” which is the “designed” capacity which will always be greater than or equal to the working storage capacity. The number has been taken from the working storage capacity as it represents the reality. Thus, the overall storage represents about 48 days of production.

2.6.2 Grain storage

We expect the aggregate grain storage capacity to be really significant. Warehouses and silos must be able to store the harvest which takes place once a year until the stock liquidation during the year, as the demand evolves.

In 2017, the grain storage capacity in USA represented 24,690,405,000[12] bushels according to USDA. The four biggest States in terms of storage capacity are Illinois, Iowa, Minnesota and Nebraska.

[10] EIA, Working and Net Available Shell storage Capacity

[11] EIA, Weekly U.S. Field Production of crude oil

[12] USDA, 2017

Concerning the production, the author did not find the total grain production for 2017, as a result, he took the most common grains and computed them. The grain sector includes mainly wheat, corn, barley, rice and oats. The production is commonly expressed in metric tons rather than in bushels.

The following table shows the production in metric tons for the main commodity under the grain category in the USA for the year 2017. The metric tons have been converted in bushels as well.

Table 6 – US grain production in 2017

Commodity	Yearly Production Mt	Yearly Production in Bushels
Corn	370 960 000.00	14 604 046 020.00
Soybean	119 518 529.71	4 391 553 000.00
Wheat	47 371 000.00	1 740 585 812.70
Rice	5 659 000.00	124 759 558.98
Barley	3 090 000.00	141 923 700.00
Oat	717 000.00	41 597 735.86
Total	547 315 529.71	21 044 465 827.54

The yearly production of grains is 21,044,465,827[13] bushels. It represents an average daily production of 58,456,849 bushels. The storage capacity can support at least one year of grain harvest, more precisely, the grain storage could stock 422 days of daily average production.

There is a real gap in terms of storage capacity between oil and agriculture. Oil aggregate storage capacity represents only 48 days of production whereas grains storage capacity represents about 422 days of average production. As a result, during an oversupply period, tanks could reach their capacity very quickly. Thus, put pressure on the spot price which would increase the basis because they have nowhere to store oil and therefore must sell it. On the other hand, it is less likely that grain storage is ever completely full.

2.7 Perishability & offshore storage

Hoarding at sea occurs in the oil industry because onshore storage is full and it becomes a viable option to use tankers as storage facility. It has been possible to put oil in VLCC[14] and leave it for 6 months in the middle of the sea. This practice has been possible

[13] IndexMundi, 2018

[14] Very Large Crude Carriers

because when crude oil is stored in a proper tanker, it does not deteriorate and does not need continuous maintenance, which is surely not the case for agricultural goods. One of the hypothesis is the fact that perishable goods cannot be stored for a long period. It would prevent agricultural traders from buying spot and storing the goods while waiting for a price increase.

However, grains such as corn can be stored for up to 5 years according to Mr. Jean-Baptiste HERMANN if correctly maintained. In order to store corn, it is necessary to move it to avoid moisture as well as to provide a good ventilation system. For these reasons it would be not possible to store agricultural goods on a vessel for a long period of time. Dry bulk vessel are not designed for long-term grain maintenance and thus there would be a high rate of deterioration.

As a result, storing agriculture goods on a vessel is not an option. The grains would deteriorate and lose too much value to be profitable. Furthermore, as seen in the previous point there is enough onshore storage for grain and it is less expensive than offshore storage. As a result, there is not point to use offshore storage for grains.

2.8 Costs of storing grains

Storing grains is much more complex than storing crude oil. There are more components and variables that must be taken into account. It makes it harder to anticipate the cost of carriage. As a result, the arbitrage opportunity becomes trickier to notice, especially for the people that are neither grain traders nor farmers. The cost of storing grains can be divided into different components:

The storage facility cost occurs for both the oil and grain industry; the storage facility can be privately owned or rented. However, it seems that oil companies tend to rent the storage whereas agricultural traders would own them. For instance, Trafigura in 2017 had 2,572.2[15] million USD of storage rented while Bunge owned 182 storage facilities in 2017 which represents a storage capacity of 15,474,260[16] metric tons.

The interest on inventory is also a carrying cost that concerns every commodity, it is the interest due on money committed to stored inventory. For example, if the farmer had a loan he would pay interest on the money borrowed, by selling the goods immediately after the harvest. The loan could be reimbursed sooner and thus, less interest would be due to the banks. But if the farmer decides to keep the goods stored, he could reimburse

[15] Trafigura's Annual Report 2017, p78

[16] Bunge's Annual Report 2017, p16

the loan only when he would sell the goods. It also represents an opportunity cost if the money is not borrowed. All the money that represents the stock could be invested and used for other activities. It could be seen as a hidden cost of storage but it is always taken into account for the computation of the carrying cost. (EDWARDS, William, 2015)

Extra drying is a cost that occurs when storing corn. Historically, about 50% of the harvested corn would de dried and then be stored [17]. Commonly the corn producers will dry the corn that they planned to store into the summer to about 13% to 13.5% moisture. The corn quality N° 2[18] can go up to 15%-15.5% moisture at harvest. The extra cost to remove additional moisture must be taken into the computation of the cost of storing corn. (EDWARDS, William, 2015)

Extra shrinkage is also a cost that must not be forgotten, because corn is sold based on its weight, for instance 56 lbs per bushel for quality N°2. By removing all the additional moisture it also reduces the weight of the quantity stored and thus, the number of bushels that it represents. A shrink factor of 1.25% is used for farm storage. The extra shrink cost is computed as follows: the shrink factor is multiplied by the additional percentage of moisture removed multiplied by the current corn price. (EDWARDS, William, 2015)

Aeration is mandatory for all dried grains. The cost estimate for aeration to match outdoor temperature would cost around 0.2 to 0.3 percent per bushels under good management. These costs concern already dried grains. (EDWARDS, William, 2015)

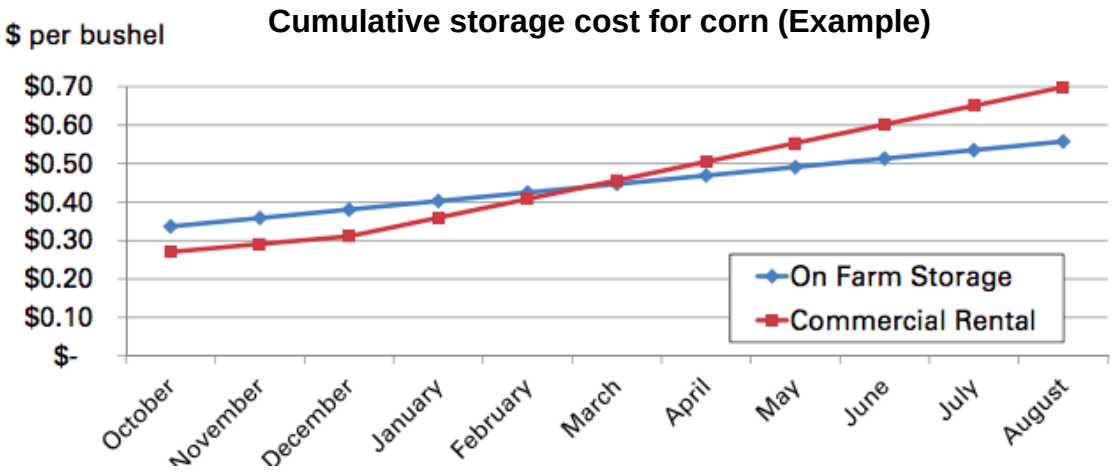
Quality deterioration is rather variable depending on: the quality of the storage facility itself, the quality of the grain stored, and how the management of the grain is conducted if the grains are stored commercially. These costs would be included in the storage facility charge.

According to William Edwards, an economist who wrote a research paper published by Iowa State university extension and outreach. The purpose of this analysis was to determine whether or not farmers should sell at harvest or store. As he stated, some costs only occur when the goods are moved and stored in the storage facility and some costs are cumulative. Furthermore, there would be a difference between on farm storage and commercial rental storage as shown in the graph bellow.

[17] KyGrain.info

[18] Quality N°2 is the standardize corn quality sold on the futures market

Figure 10 – Example of cumulative storage cost



Source: extension.iastate, 2015

The above figure shows that commercial rental becomes more expensive in the long term. This makes it more difficult for people who do not own on farm storage to take advantage of a carry forward curve. Buy the commodity and stock them is not sufficient, you need to own the storage in order to take advantage of the arbitrage opportunity and capture the basis. The people most likely to own storage facilities are the producers and traders. (EDWARDS, William, 2015)

2.9 Seasonality and market structure

Most agricultural commodities have their seasonality: wheat, soybean and corn are harvested once or twice a year in the United States. The soybean is planted from April to June and it is harvested from late September to the end of November. “Winter Wheat” is planted from mid-August to October, it is harvested between May and July. “Spring Wheat” is planted from April to May and corn planting begins in April until June and is harvested in October to the end of November. (KOWALSKI, Chuck, 2018)

The harvest period represents an important supply of the commodity concerned after the harvest, the inventories are full and it occurs every year. On the other hand, before the harvest the inventories that have to last for the rest of the year must be used up. It makes the supply and demand very predictable in the agricultural market. The only exception is the weather factor which could affect the harvest and thus this “predictability” of the market.

Oil also has its seasonality in the USA but it is much less accentuated than agricultural goods. Seasonality in the oil market is due to the fact that Americans drive their vehicles more during the summer and thus it increases the consumption for this period of time.

They also drive during the rest of the year so it is simply an increase in demand whereas the harvest of commodities represent 50%-100% of the yearly supply.

Even though the oil and agriculture market have their own seasonality, they are very different. Oil has a demand seasonality while grains have a supply seasonality. Furthermore, the oil seasonality is much less important than the agriculture seasonality.

We thus could expect the forward curve to be in carry after the harvest because the supply exceeds the demand and the inverse before the harvest because the demand exceeds the supply.

According to Jean-Baptiste Hermann grain producers have become healthier over the last years which has enabled them to acquire their own storage capacity. He describes it as a threat for a trading company such as Bunge. Initially storing the grains after the harvest was the role of the traders but the producers are taking this part of the supply chain. This phenomena could be one of the reasons for not having Super-Carry where the traders would make huge profits; many producers possess their own warehouse as a result after the harvest they have two choices: either they sell it at the spot price or they sell at the future price and store the grains until then.

However, he said that Bunge is performing what they call “Ex-harvest purchase”. It means that they analyse which commodity would be the most profitable to buy after the harvest and to store until the future delivery to their customers. It proves that agricultural companies are proceeding to cash and carry as well even though we are not hearing about any “Super-Carry”.

In fact, agricultural traders have “Super-Carry” very often. It is just not a big deal because the basis exceeds the cost of carry by a small amount because many producers and traders are storing the goods at “Ex-harvest”.

Now the question is why oil producers are not building their own tank in order to catch the arbitrage opportunity instead of having the traders capturing all the market opportunity for themselves. The author believes it is mainly because the market is less predictable and the producers are not speculators. If the forward curve is in backwardation, the oil producers are better-off directly selling the petroleum right after the extraction from the ground and storage facility would be useless. Oil producers would make their tanks profitable only under a Super-Contango; it would not be attractive enough for a producer to finance a storage facility in order to use it only once or twice for the last decades when Super-Contango occurred. In the other hand, farmers are almost always better off storing a certain amount of their harvest because the price is most likely

to increase along the year as the stocks are being emptied. After the harvest the forward curve is most likely in Carry except under poor harvest which can happen time to time such as the drought which hit the USA in 2012.

2.10 Different industries, different market opportunities

It seems that when the markets experience important variation and disruption it creates market opportunities for traders. The profit made in 2009 has already been described in the introduction. During most of this research, the investigation has been conducted in order to understand why agricultural traders are facing an oversupply in grains and whether it represents opportunities to make profits. On the other hand, the droughts in 2010 (Wheat, Russia) and in 2012 (Corn & Soybean, USA) created attractive market opportunities for trading arms within ABCD. The volatility has been profitable but because most agriculture companies recently invested billions in processing facilities. The decrease in volume due to the drought was negative for the overall performance of these firms.

2.10.1 Speculate on basis

The grain futures market is in some way predictable due to the market seasonality contrary to WTI and Brent futures. Due to the predictability agricultural traders can speculate with a certain idea of how the market is going to evolve. In general commodity traders do not speculate on the flat price and for this reason they hedge in order to eliminate any price risk. However, in a predictable market, it is more interesting for agricultural traders to speculate on either the basis or the spread. The basis is more predictable than the price and also less volatile which is easier to anticipate for agricultural traders.

The basis formula is straightforward; it is the spot (cash) price minus the futures price; The basis can be either positive or negative. If the basis is negative, the basis is said to be at a carry; by contrast, if the basis is positive it is inverted. For instance, if the spot price of a commodity is at 10 and the nearest futures contract of the underlying asset is traded at 12, the basis in going to be -2. When the basis increases in value, the basis is said to be strengthening, when it decreases in value we say that the basis is weakening.

A long basis position occurs when the trader buys a certain amount of a commodity and sells it on the futures market. By doing so, the trader eliminates the price risk: However, he undertakes a basis risk. The purpose of having a long position on the basis is to buy

when the basis is low and sell when the basis is high. There are two possible ways to structure a long-the-basis: (LORTON, Sherry and WHITE, Don, 2010.)

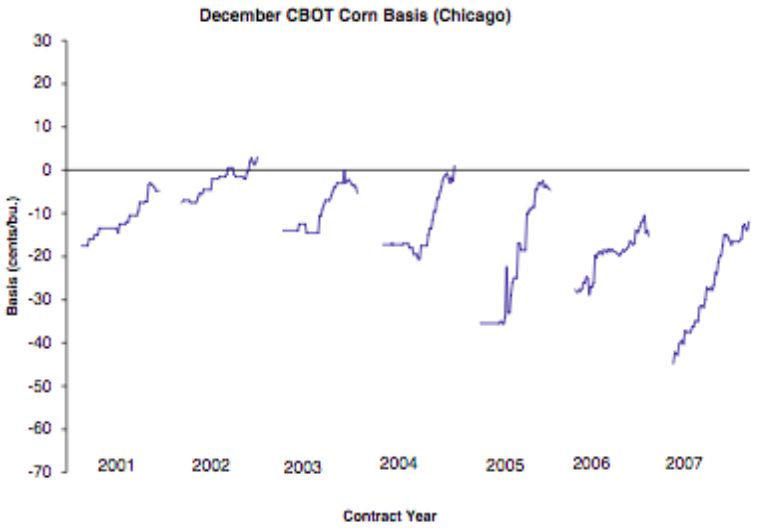
- Buy and carry cash grain inventory: it is the process of buying physical grains at the spot price, selling the nearest future and cancelling the position once the basis has strengthened. Because the goods are physically acquired, the cost of carrying the grain has to be taken into account too.
- Make a forward purchase: the principle is similar to the first strategy but instead of buying the goods at the spot price. The purchase of goods is made through a forward contract and thus the delivery is settled in the future. The short position is taken in the futures market too. When the sales are made, the short position is cancelled. This method eliminates the cost of carry because grains are not held for any time.

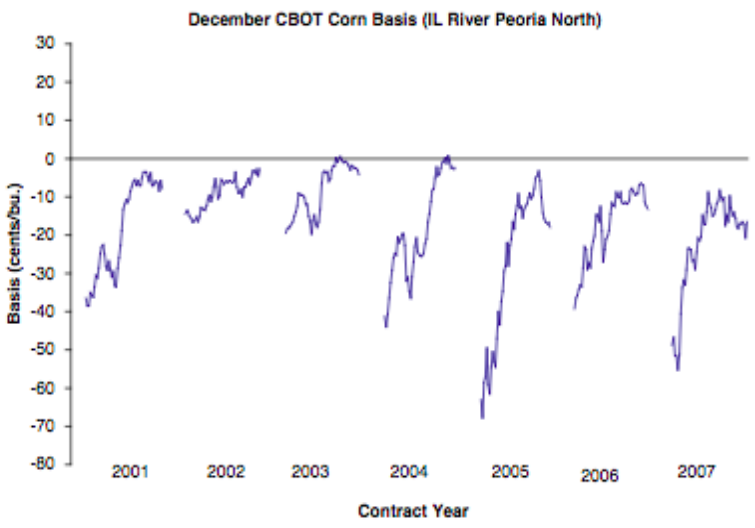
Short the basis is the other alternative to take advantage of the basis. It is the contrary of the long position and thus, it is the done by selling and buying futures. The purpose of having a short position on the basis is to sell at high basis and then sell it at low basis. The benefits are made from the decline in the basis, when it weakens. (LORTON, Sherry and WHITE, Don, 2010)

- Making forward sales: It is exactly the same principle of forward purchase in the opposite direction. A forward sales contract is sold and a long position is taken on the futures market in the same time. The seller then waits until finding another purchase contract with a lower basis in order to fulfil the forward sales agreement, and at the same time, the futures position is cancelled.
- “Price later grains” is complex because it includes the selling price of a later contract. The contract gives the right to the grain traders and thus, he can sell it but it allows the farmer to remain unpriced on the commodity until a date in the future. This method allows the trader to benefit from the money until the pricing from the farmer. Basically traders first sell the goods and then pay it to the farmers, and the entire transaction is hedged.

Basis predictability can be determined by studying the local basis patterns based on the previous basis evolution for a specific contract and understand the characteristics of the local market. The following series of graphs show the basis evolution for a specific futures contract for corn and soybean between 2001 and 2007 for the cash price in Chicago and in Peoria, Illinois.

Figure 11 & 12 – Corn basis December contract (Chicago & Peoria)





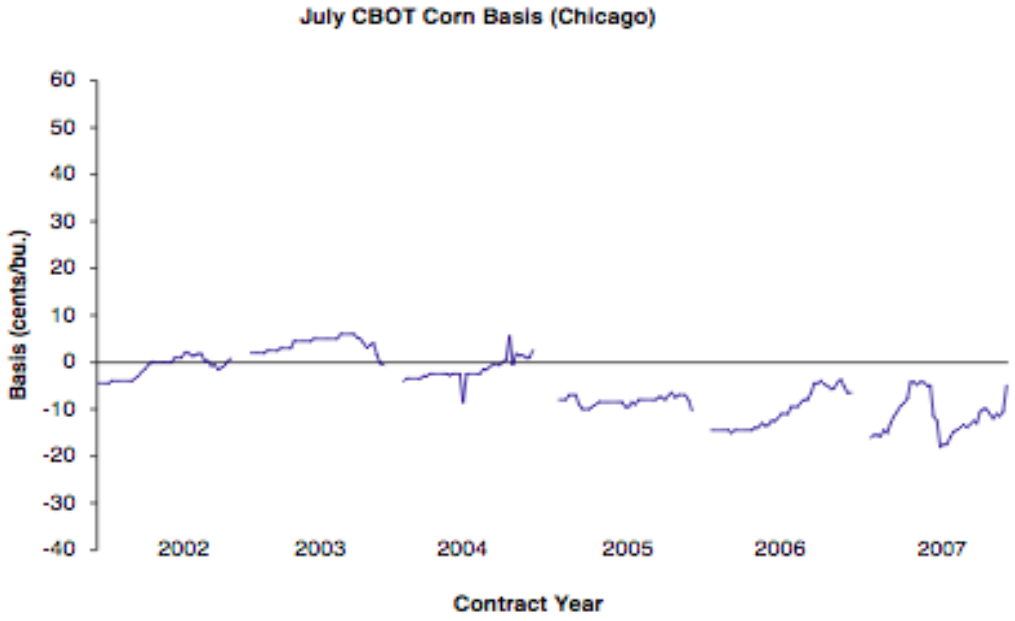
Source: IRWIN, Scott, GARCIA, Philip, GOOD, Darrel, KUNDA, Eugen, 2008. Researchgate

These two graphs show the corn basis based on the futures December contract over the years. The basis pattern is distinct and remarkable and seems to be consistent over the seven years, the basis tends to strengthen during the year. As a result, it demonstrates a form basis predictability. At the beginning of the year, the basis is always at carry and it then approaches a neutral basis when it gets closer to the end of the year, i.e. closer to the expiry date.

There is also a basis difference between Chicago and Peoria North. The location differential of $0.25/bushels is subtracted from the cash price in Peoria North which makes sense because the future market is the CBOT (Chicago Board of Trade). The delivery point of the futures contract once it reaches expiry is in Chicago. For this reason the basis in Peoria is lower because the corn has to be moved to Chicago in order to honour the futures contract. There is more demand for corn in Chicago.

This pattern indicates strong incentives for traders to have a long basis position with the futures December contract at the beginning of the year. Then, cancel their long basis position at the end of the year once the basis has strengthened.

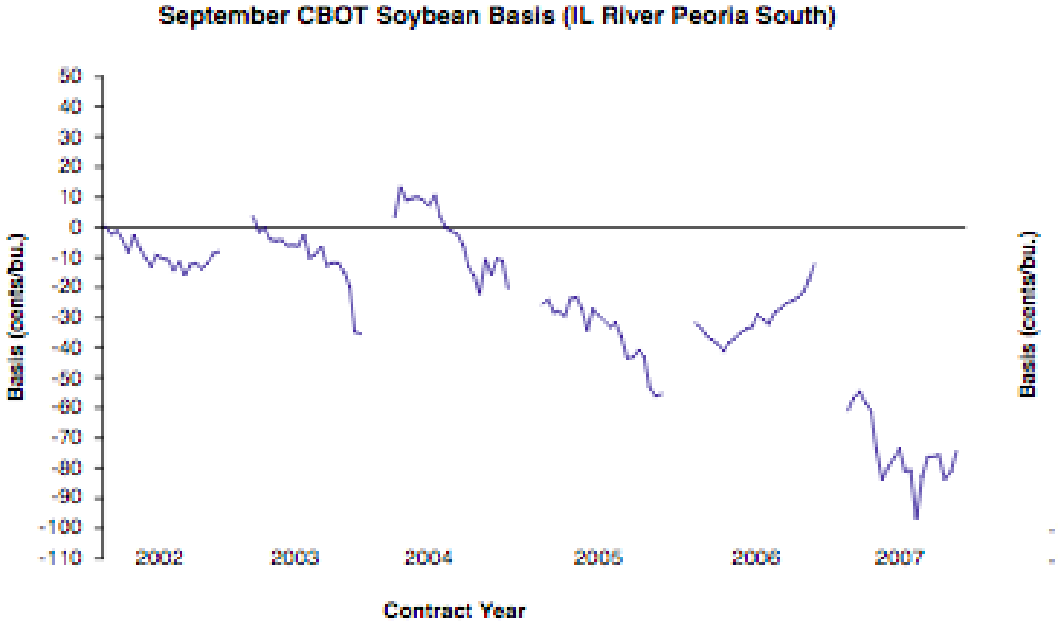
Figure 13 – Corn basis July (Chicago)



Source: IRWIN, Scott, GARCIA, Philip, GOOD, Darrel, KUNDA, Eugen, 2008. Researchgate

This graph illustrates the basis for the futures July contract. The basis fluctuation seems to be more flat than the December's future. There is no distinct pattern according to the year from 2002 and 2007. The basis position for the July contract seems to be more uncertain.

Figure 14 – Soybean basis September (Peoria)

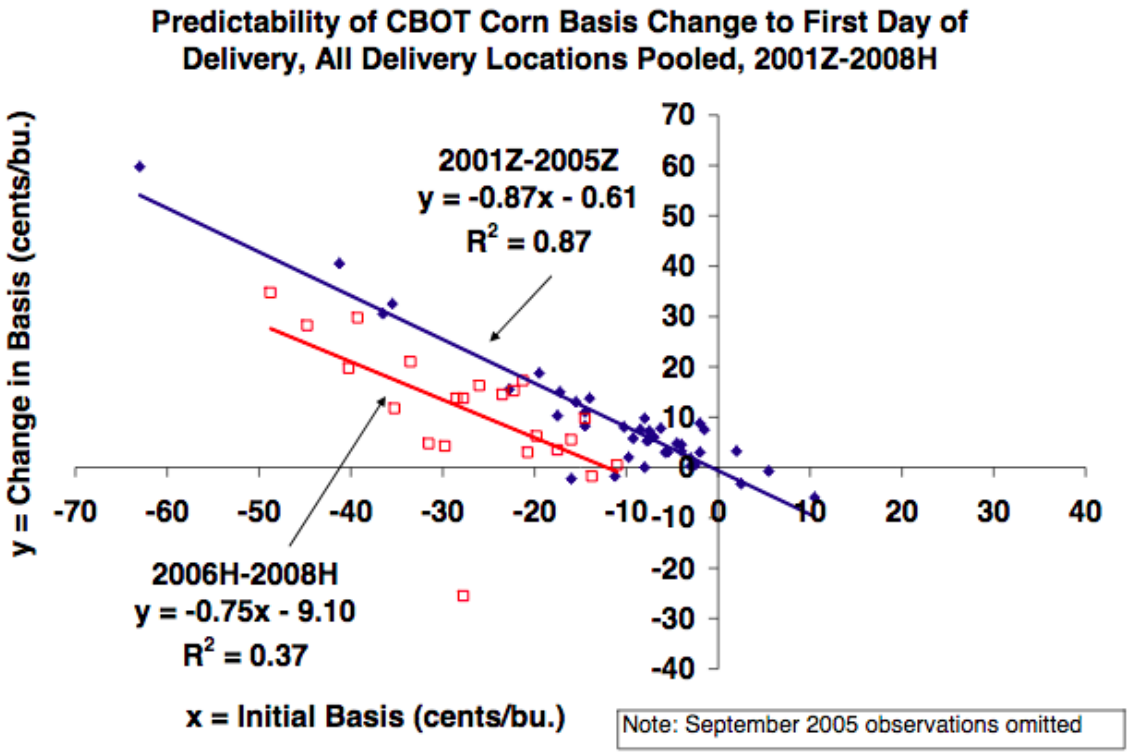


Source: IRWIN, Scott, GARCIA, Philip, GOOD, Darrel, KUNDA, Eugen, 2008. Researchgate

This graph shows the basis evolution for the September Soybean contract. It demonstrates a basis weakening during the year. The predictability can also be a decrease in the basis, in this case traders are most likely to short the basis.

In the graphs below, the horizontal axis measures the basis of the first day after the previous contract expires. The vertical axis measures the basis change from the first day after the previous contract expires and its first day of delivery.

Figure 15 - Corn basis change from first day to expiry



Source: IRWIN, Scott, GARCIA, Philip, GOOD, Darrel, KUNDA, Eugen, 2008. Researchgate

As a general trend the Corn basis is most likely to be negative on the first day of the contract after the previous contract has expired. The change in the basis is most likely to change positively from the first day to the last day of the nearest futures contract. 87% of the change in basis (y) is explained by the initial basis (x) from the end of the year 2001 to the end of the year 2005. The predictability is much less significant from the year 2006 to 2008.

3. Discussion

3.1 Findings

To conclude this research, the collection of data and its analysis, the results show the following findings:

According to theory a Contango becomes a Super-Contango at the point where the futures price is much higher than the spot price to a greater extent that can be explained by the cost of carry which is the case for the two historical Super-Contangos. However, the basis in 2009 exceeded the cost of carry by approximately $8 per barrels which is enormous. It seems that people are referring to Super-Contango not only when the basis exceeds but at the point where the margin of the arbitrage opportunity is very significant. The belief of market price recovery is also a parameter that helps to increase the gap between the futures price and the spot price. As observed in 2009 with the OPEC supply cut.

The turnover ratio of the companies demonstrates to us that oil traders have similar trends regarding their inventory turnover management. On the other hand, agricultural traders adapt different strategies during the years and manage their inventory differently from one company to another. It is mainly explained by the fact that there are many commodities handled within ABCD and they do not have the same amount of each commodity managed. As a result, they do not only answer to the one market. In addition, the turnover ratio showed that agricultural traders keep their inventory for a longer period of time than oil traders before selling it.

Agricultural firms have been decreasing their storage capacity over the last years but in 2017 the number of storage facilities increased while the capacity decreased. Traders are looking for smaller warehouses and silos in order to become closer to consumers. Traders are less interested in being close to producers because they are becoming autonomous in terms of storage activities.

Grain storage capacity is much more significant than oil storage capacity. In the USA, warehouses and silos can handle about 422 days of daily average production of grains while oil tanks can only accumulate 48 days of daily average production. Oil storage is very restricted; if the supply was to overcome the demand, the oil tanks would quickly fill up. If it was no longer possible to store the oil, the remaining choice would be to sell at spot price which would create pressure on the spot price and it would decrease. In such a case the asset might be undervalued.

Contrary to expectation, grain can be stored for up to 5 years if stored in appropriate conditions and people that take care of the goods in order to avoid moisture. Thus, the assumption that grains are too perishable to be stored for several months until the price increases has been rejected. However, it leads us to the fact that costs involved in storing grains are numerous and much more complex to anticipate and to compute than the cost of storing crude oil. It is indeed a factor that could make the process of buying spot and selling forward costlier and more complicated to anticipate the final profits. Furthermore, research has shown that renting warehouses for commercial purposes has higher cumulative storage costs in the long run. Therefore, the key learning is that cash-and-carry in agriculture is reserved for people owning the silos and warehouses.

Annual reports indicate that oil traders mainly rent their storage facilities while grain traders own their storage facilities. This makes sense due to the seasonality and the market structure of both industries. The uncertainty that rules the oil market prevents traders from acquiring such assets while the seasonality of agriculture almost ensures the need to store every year after the harvest and thus, grain traders are "safe" in acquiring silos and warehouses.

During the research indicators show that Super-Carry does exist and it probably occurs more frequently that Super-Contango. However, the arbitrage opportunity will never compete with the one that happened in oil because grain players are much better equipped in terms of storage and this is probably why we do not hear about Super-Carry, it is a common phenomenon in agriculture while it is not in crude oil.

In addition, the observations showed that a disruption in the market creates many opportunities for traders to make profits. For instance, the drought in 2012 and the fact that trading companies were happy about it. Agricultural traders are in a predictable market which allows them to speculate not on the flat price but on the basis with a certain level of confidence which is not possible in the oil market because there is no predictability and most transactions are back-to-back transactions.

3.2 Regulations

Oil and grains are both strategic commodities. Governments seek to hold a certain amount of "strategic commodities" in case of emergencies; to secure the supply and to counter important price fluctuations. However, betting and speculating on the price of agricultural commodities might be restricted by national regulations to ensure a more stable price and food security for developing countries.

Commodities traders have been criticized in many ways. For example for being responsible for the increase in food prices. According to Mr. Eric Aboussouan, there are no international regulations that could prevent agricultural traders from storing physical goods in order to wait for a higher price.

However, it seems that some countries might implement laws and regulations that could affect agricultural traders' activities. For instance, in Switzerland, citizens voted in February 2016 on the popular initiative about "Pas de spéculations sur les denrées alimentaires" (no speculation on food items). The initiative was rejected with 59.9% negative votes. Such regulations would prevent people from using financial instruments on agricultural commodities for speculative purposes. Thus, there is no current regulation that prevents traders from taking advantage of a Super-Carry for the time being, but it might be the case in the future. (SDC ANALYSIS & POLICY DIVISION, 2014)

3.3 Ethical issues

Oil is probably the commodity whose the price fluctuation has the most impact and consequences as it is used in so many ways. It affects people that have a personal car but the most important aspect is the fact that other commodities are generally transported by vessel which will used bunkers, a crude oil product. As a result, if the oil price fluctuates it would have an indirect effect on other commodities.

The agribusiness is a delicate business in terms of the impact and consequences that the price could have on the human being; especially with respect to emerging countries which have very limited budgets to feed themselves. The consequences are more direct than oil and thus agricultural firms are more likely to be blamed for such consequences.

3.3.1 The North American drought

Between the years 2012 and 2013, the United States endured the worst drought since 1930. The blistering heat destroyed approximately 45% of the corn and 35% of the soybean crop which led to an overall food price increase of 6% in the month of July. This overall price increase was due to extreme weather which is unavoidable and difficult to forecast. It is one of the reasons why agricultural commodities can be very volatile even though they are said to be predictable due to seasonality.

The misery caused by this drought was positive for the traders and allowed them to make a profit as it created high prices, price volatility, dislocation and arbitrage opportunities.

Glencore spoke about this drought as “good” for them. It does not surprise anyone that a crisis is a revenue generator for agricultural traders because it also occurred during the financial crisis.

But it is not without criticism and ethical issue concerns. A global food trader at UN said: “fine position to make money from a crisis because they have pushed for an international economic system that relies on them.” and Oxfam’s head of economic justice policy said: “for too long our leaders have stood by complacently, while up to a billion of people go hungry worldwide.”

3.3.2 The Russian export ban

During 2010, Russia experienced a heat wave which was recorded as the highest temperature in July for the past 130 years. The result of this extreme weather was drought and fires which decimated the grain crop . The Russian drought has become famous due the impact on international grain price increases.

The impact of the drought destroyed approximately 13.3 million acres of crop and affected 25,000 farms. The overall harvest loss is estimated at approximately one third compared to the previous year. (OXFAM RESEARCH REPORTS, 2011)

In response to this phenomena, the Russian government decided to implement an export ban in mid-august 2010. The ban rendered null and void any existing contracts that Russian exporters had with international buyers; the Russian exporters were exempted from any liability of the contracts as it was considered as a force majeure. The objective of this policy was to protect domestic supply.

The international clients of Russian exporters were mainly Egypt, Turkey, Azerbaijan, Pakistan, Syria and Iran. These countries were significantly affected by the export ban. For instance, Russian grains represent 50% of the imports in Egypt; with the forward contract cancelled, Egypt had to find new exporters and buy it at the market price which was higher. (OXFAM RESEARCH REPORTS, 2011)

According to Mr. Eric Aboussouan, the export ban and the price increase that followed had significant impact on the middle-east countries and created difficulties among poor people to feed themselves: This could have been one of the trigger elements of the Arab Spring.

3.3.3 Ethical issues and Super-Carry

The question that must be asked is whether ethical issues could prevent agricultural traders from taking advantage of the market opportunity that would offer a Super-Carry.

It certainly does not affect whether traders would capture a market opportunity; as the head of Glencore's food trading business said, arbitrage opportunity is good for the company because it represents potential profits. (THE GUARDIAN, 2013)

Traders are not NGO's. They are in a very competitive business; they manage their activities as efficiently as possible. However, we assume that because agriculture is a sensitive subject in term of ethics, a Super-Carry might be not disclosed in the newspapers because of the possible scandals. Let's imagine the headlines of the newspaper: "Traders are storing wheat waiting for higher price", what would be the reaction considering that millions of people are starving?

3.4 The new business model ahead

According to the biggest agricultural traders, the traditional business model in the supply chain of grain has gone. Cargill relied for many years on their extensive network of warehouses, silos and ports to maintain their competitive advantage within the USA. They used to finance the farmers and in return agreed to buy the commodities during the growing season just after the harvest. They bought the crops, stored them in storage facilities and then sold them internationally when the market appreciated. It represented an important part of the margin for these trading firms. However, things have changed and this supply chain process does not exist anymore. The reason for this shift is mainly that producers have become healthier as outlined under "seasonality and market structure". It enables them to decide when they should sell their harvest to traders. Furthermore, the accessibility to knowledge has been more affordable for producers and consumers such as data on commodity prices, forecasts, crop yield reports published by USDA and trade flows. Historically, this knowledge was only accessible to the traders' and part of their added value to the supply chain. "There is no secret anymore in the agriculture business" said Mr. Van Den Akker, president of Cargill's supply chain division.

Even though this shift in the supply chain could explain why agricultural traders have found it more difficult to catch arbitrage opportunities in recent years. It would only be the cause for recent years.

As a result, it raises new questions, such as how agricultural traders can offer value to the supply chain for today and tomorrow? Apparently traders are still buying crops from

farmers. ADM for instance has created “destination marketing” which consists of bringing the commodities closer to the buyers. This is reflected in Bunge’s 2017 annual report. For instance, they increased the number of storage facilities but their overall storage capacity decreased because they bought smaller silos and warehouse which were located in more strategic locations. Trading firms are also offering more service to farmers concerning the harvest and ways of optimize the cultivation with the help of digital tools for instance. (MEYER, Gregory and TERAZONO, Emiko, 2018)

During the discussion with Jean-Baptise Hermann (Bunge) and Eric Aboussouan (Cargill) both told the author that their companies are no longer doing backward integration and do not acquire the production part of the supply chain. However, those big companies are increasing the physical activities such as wheat milling and corn processing.

4. Conclusion

Throughout this study, we observed that the overall storage capacity compared to the overall production plays an important role in determining the cause of the Super-Contango in oil. The oil storage capacity is very limited compared to agriculture storage capacity. This difference in storage could be explained by the seasonality and the difference in market structure. After each harvest most of the crops are stored and not directly sold because the demand does not match the supply at this moment.

“Super-Carry” probably occurred more than “Super-Contango”. The reason that we talk about Super-Contango is because it is not common in the oil market. In addition, the tight storage capacity forced the oil producers to sell at the spot price because they had no other choice which put pressure the spot price. Contrary to oil producers, farmers have acquired on-farm storages. This allows them to decide whether they should sell or store their harvest. This could prevent traders from benefiting from arbitrage opportunities over the last years.

We also observed that agricultural traders tend to keep their inventories for a longer period of time before selling according to the inventory turnover ratio results. There are two possible reasons for trading companies to keep their inventory intentionally longer:

- The arbitrage opportunity between the spot market and the futures market: companies are making riskless profits by buying a commodity at cash price, storing it and selling it using a forward or futures contract.
- Speculation on the basis: because it is difficult to predict the price evolution of a commodity, traders are more likely to speculate on the basis which is in some way predictable in the agriculture market. In order to adopt a long basis position, the traders will buy the commodity spot, store it and sell the future of the underlying asset. For this reason, traders are led to stock for a certain significant period commodity.

However, despite the findings, the research for this study has been restricted for various reasons. For instance, the price to acquire the historical data of the expired future on the CME website has been a barrier to analyse and compute a possible historical “Super-Carry”.

The research could have been more scientifically conducted with deeper data analysis when testing the hypothesis, proving findings and showing the final results.

However, this would have required access to a wider range of data together with more academic as well as professional experience in the field. Therefore, the author believes that the research question has been answered from a Bachelor level perspective as the author studied all types of possibilities proving the phenomenon to ensure all the perspectives and points of view have been covered.

5. Bibliography

ADM, 2018. ADM. adm.com [online]. 2018. [viewed 25 March 2018]. Available from: https://www.adm.com/

AGRICULTURE AND FORESTRY, 2018. Bushel Equivalents Per Tonne. agric.gov.ab.ca[online]. 2018. [viewed 24 March 2018]. Available from https://www.agric.gov.ab.ca/app19/calc/crop/bushel2tonne.jsp

ARCHER DANIEL'S MIDLAND COMPANY, 2017. 2018 Letter to Stockholders Proxy Statement, 2017 Form 10-K. assets.adm.com [online]. 2017. [viewed 25 March 2018]. Available from: https://assets.adm.com/Investors/Shareholder-Reports/2017/2017-Annual-Report_032917.pdf

ARCHER DANIEL'S MIDLAND COMPANY, 2016. 2017 Letter to Stockholders Proxy Statement, 2016 Form 10-K. assets.adm.com [online]. 2016. [viewed 25 March 2018]. Available from: http://www.annualreports.com/HostedData/AnnualReports/PDF/NYSE_ADM_2016.PDF

ARCHER DANIEL'S MIDLAND COMPANY, 2015. 2016 Letter to Stockholders Proxy Statement, 2015 Form 10-K. assets.adm.com [online]. 2015. [viewed 25 March 2018]. Available from: http://www.annualreports.com/HostedData/AnnualReportArchive/a/NYSE_ADM_2015.pdf

ARCHER DANIEL'S MIDLAND COMPANY, 2014. Letter to Stockholders Proxy Statement, Form 10-K. assets.adm.com [online]. 2014. [viewed 25 March 2018]. Available from: https://assets.adm.com/Investors/Shareholder-Reports/2014/2014-ADM-Annual-Report.pdf

ARCHER DANIEL'S MIDLAND COMPANY, 2013. Chairman's letter, Proxy Statement, Form 10-K. assets.adm.com [online]. 2013. [viewed 25 March 2018]. Available from: https://assets.adm.com/Investors/Shareholder-Reports/2012.5/2013-ADM-Annual-Report.pdf

BP, 2018. BP at a glance. bp.com [online]. 2018. [viewed 25 March 2018]. Available from: https://www.bp.com/en/global/corporate/what-we-do/bp-at-a-glance.html

BP, 2017. A year of strong delivery and growth: Annual Report and Form 20-F. bp.com [online]. 2017. [viewed 25 March 2018]. Available from: https://www.bp.com/content/dam/bp/en/corporate/pdf/investors/bp-annual-report-and-form-20f-2017.pdf

BP, 2015. Annual Report and Form 20-F. bp.com [online]. 2015. [viewed 25 March 2018]. Available from: https://www.bp.com/content/dam/bp/pdf/investors/bp-annual-report-and-form-20f-2015.pdf

BP, 2013. Building a stronger, safer BP: Annual Report and Form 20-F. bp.com [online]. 2013. [viewed 25 March 2018]. Available from: https://www.bp.com/content/dam/bp/pdf/investors/bp-annual-report-and-form-20f-2013.pdf

BUNGE, 2017. Annual Report: At home everywhere helping feed the world since 1818 by connecting people, markets, countries and cultures. bunge.com [online]. 2017. [viewed 13 March 2018]. Available from: https://www.bunge.com/2017ar.pdf

BUNGE, 2016. Annual Report: Mapping growth. bunge.com [online]. 2016. [viewed 13 March 2018]. Available from: https://www.bunge.com/2016ar.pdf

BUNGE, 2015. Annual Report: Solid performance, strategic progress. bunge.com [online]. 2015. [viewed 13 March 2018]. Available from: https://www.bunge.com/sites/default/files/2015ar.pdf

BUNGE, 2014. Annual Report: Unlocking value. bunge.com [online]. 2014. [viewed 25 March 2018]. Available from: https://www.bunge.com/sites/default/files/2014ar.pdf

BUNGE, 2013. Annual Report: Striking the right balance. bunge.com [online]. 2013. [viewed 13 March 2018]. Available from: https://www.bunge.com/sites/default/files/bunge_2013ar.pdf

BUNGE, 2012. Annual Report: Fundamentals. bunge.com [online]. 2012. [viewed 13 March 2018]. Available from: https://www.bunge.com/sites/default/files/bg_2012_ar.pdf

CMEGROUP, 2018. Agriculture Conversion Calculators. cmegroup.com [online]. 2018. [viewed 24 March 2018]. Available from: http://www.cmegroup.com/tools-information/ag-calculator.html

CMEGROUP, 2015. “Super-Contango” and the Bottom in Oil Prices. cmegroup.com [online]. 6 August 2015. [viewed 10 March 2018]. Available from: http://www.cmegroup.com/education/featured-reports/super-contango-and-the-bottom-in-oil-prices.html

CMEGROUP, 2009. Chapter 200: Light Sweet Crude Oil Futures. cmegroup.com [online]. 2009. [viewed 10 March 2018]. Available from: http://www.cmegroup.com/rulebook/NYMEX/2/200.pdf

CUNTY, Georges, 2014. Corn futures curves – 1982-2014 [video recording]. YouTube [online]. 9 April 2014. [viewed 24 March 2018]. Available from: https://www.youtube.com/watch?v=gl7kjc7HOCc

DE SOUSA Agnieszka and HOFFMAN Andy, 2017. There's So Much Pain in Agriculture That Traders Are Leaving. Bloomberg.com [online]. 17 October 2017. [viewed 17 November 2017]. Available from: https://www.bloomberg.com/news/articles/2017-10-17/there-s-so-much-pain-in-agriculture-that-traders-are-leaving

EDWARDS, William, 2015. Ag Decision Marker: Cost of Storing Grain. extension.iastate.edu [online]. May 2015. [viewed 25 March 2018]. Available from: https://www.extension.iastate.edu/agdm/crops/pdf/a2-33.pdf

EXXONMOBIL, 2017.2017 Financial & Operating Review. exxonmobil.com [online]. 2017. [viewed 25 March 2018]. Available from: http://cdn.exxonmobil.com/~/media/global/files/summary-annual-report/2017-financial-and-operating-review.pdf

FITZ-GERALD, Keith, 2009. Four ways to capitalize on "Super Contango". seekingalpha.com [online]. 22 January 2009. [viewed 24 March 2018]. Available from: https://seekingalpha.com/article/115939-four-ways-to-capitalize-on-super-contango?page=3

INDEXMUNDI, 2018. United States Corn Production by Year. indexmundi.com [online]. 2018. [viewed 24 March 2018]. Available from: https://www.indexmundi.com/agriculture/?country=us&commodity=barley&graph=production

INDEXMUNDI, 2018. United States Corn Production by Year. indexmundi.com [online]. 2018. [viewed 24 March 2018]. Available from: https://www.indexmundi.com/agriculture/?country=us&commodity=corn&graph=production

INDEXMUNDI, 2018. United States Milled Rice Production by Year. indexmundi.com [online]. 2018. [viewed 24 March 2018]. Available from: https://www.indexmundi.com/agriculture/?country=us&commodity=milled-rice&graph=production

INDEXMUNDI, 2018. United States Oats Production by Year. indexmundi.com [online]. 2018. [viewed 24 March 2018]. Available from: https://www.indexmundi.com/agriculture/?country=us&commodity=oats&graph=production

INDEXMUNDI, 2018. United States Wheat Production by Year. indexmundi.com [online]. 2018. [viewed 24 March 2018]. Available from: https://www.indexmundi.com/agriculture/?country=us&commodity=wheat&graph=production

IRWIN, Scott, GARCIA, Philip, GOOD, Darrel, KUNDA, Eugen, 2008.Recent Delivery Performance of CBOT Corn, Soybean, and Wheat Futures Contracts. University of Illinois. researchgate.net [online]. 22 April 2008. [viewed 20 April 2018]. Available from: https://www.researchgate.net/publication/227364756_Recent_Convergence_Performance_of_CBOT_Corn_Soybean_and_Wheat_Futures_Contracts

JARROW, Robert A., 2010. Convenience yields. Review of Derivatives Research.13: 25-43.

JARROW, Robert A. and LARSSON, Martin, 2012. The meaning of market efficiency. USA: Mathematical Finance.

KATHLEEN Masterson, 2012. Storing Grain Can Aid Farmers In Commodity Pricing. NPR.org [Online]. 6 February 2012. [viewed 12 December 2017]. Available from: https://www.npr.org/2012/02/06/146453132/corn-storage-helps-farmers-in-commodities-market

KOWALSKI, Chuck, 2018. Learn about corn crop planting and harvest seasons. thebalance.com [online]. 2 May 2018. [viewed 25 March 2018]. Available from: https://www.thebalance.com/corn-planting-and-harvest-seasons-809309

KOWALSKI, Chuck, 2018. Learn about wheat planting and harvest seasons. thebalance.com [online]. 3 May 2018. [viewed 25 March 2018]. Available from: https://www.thebalance.com/wheat-planting-and-harvest-seasons-809321

KOWALSKI, Chuck, 2018. A commodity investor's guide to soybeans. thebalance.com [online]. 12 January 2018. [viewed 25 March 2018]. Available from: https://www.thebalance.com/soybean-planting-and-harvest-seasons-809258

LAN, Joe, 2012. 16 Financial Ratios for Analyzing a Company's Strengths and Weaknesses.aaii.com [online]. 2012. [viewed 25 March 2018]. Available from: http://www.aaii.com/journal/article/16-financial-ratios-for-analyzing-a-companys-strengths-and-weaknesses.touch

LAWRENCE, Felicity, 2011. The global food crisis: ABCD of food – how the multinationals dominate trade. The Guardian.com [online]. 2 June 2011. [viewed 19 Novembre 2017]. Available from: http://www.theguardian.com/global-development/poverty-matters/2011/jun/02/abcd-food-giants-dominate-trade

LOUIS DREYFUS COMPANY, 2017. Annual Report and Audited Consolidated Financial Statements: Realizing our Potential. ldc.com [online]. 2017. [viewed 25 March 2018]. Available from: http://www.ldc.com/files/1815/2161/8350/LDC-AR-2017.pdf

LOUIS DREYFUS COMPANY, 2016. Annual Report and Audited Consolidated Financial Statements: A new perspective. ldc.com [online]. 2016. [viewed 25 March 2018]. Available from: http://www.ldc.com/files/6414/9121/7174/LDC-AR-2016.pdf

LOUIS DREYFUS COMPANY, 2015. Audited Consolidated Financial Statements. ldc.com [online]. 2015. [viewed 25 March 2018]. Available from: http://www.ldc.com/files/7214/5854/5230/LDC-FR-2015.pdf

LOUIS DREYFUS COMPANY, 2013. Audited Consolidated Financial Statements. ldc.com [online]. 2013. [viewed 25 Marche 2018]. Available from: http://www.ldc.com/files/8514/1805/5342/LDC-FINANCIAL_REPORT-2013-A4.pdf

LORTON, Sherry and WHITE, Don, 2010. *The Art of Grain Merchandising*. Silver Edition.

MACROTRENDS, 2018. WTI Crude Oil Prices – 10 Year Daily Chart. macrotrends.net [online]. 2018. [viewed 25 March 2018]. Available from: http://www.macrotrends.net/2516/wti-crude-oil-prices-10-year-daily-chart

MEYER, GREGORY, 2013. Bunge, Cargill, Dreyfus and ADM face new challenges. ft.com [online]. 18 September 2013. [viewed 25 March 2018]. Available from: https://www.ft.com/content/dc1a8b88-1fd7-11e3-aa36-00144feab7de

MEYER, Gregory and TERAZONO, Emiko, 2018.Cargill executive calls time on traditional supply model. ft.com [online]. March 2018. [viewed 10 April 2018]. Available from: https://www.ft.com/content/695648a0-2c8c-11e8-9b4b-bc4b9f08f381?accessToken=zwAAAWOCLjOAkc9pVkigLIwR6NObS7xLnwjzgQ.MEUCIQDYunM1YuysPWaSvjRp4DuAMM-0HuKEaLdCPb21koJIkgIgYaJXlRwNXLbnrHQAKFZXI7xbP6gGNYM9UTrTivkSBQc&sharetype=gift

MY ACCOUNTING COURSE, 2018. Inventory Turnover Ratio. myaccountingcourse.com [online]. 2018. [viewed 10 March 2018]. Available from: https://www.myaccountingcourse.com/financial-ratios/inventory-turnover-ratio

OXFAM RESEARCH REPORTS, 2011. The impact of Russia's 2010 grain export ban. oxfam.org [online]. 28 June 2011. [viewed 24 March 2018]. Available from: https://www.oxfam.org/sites/www.oxfam.org/files/rr-impact-russias-grain-export-ban-280611-en.pdf

PIAZZA, Vincent, KRAUSER, Daniel and DOSANJH, Gurpal, 2016. Floating U.S. crude storage: Economics and drivers. bloomberg.com [online]. 13 March 2016. [viewed 25 March 2018]. Available from: https://www.bloomberg.com/professional/blog/floating-u-s-crude-storage-economics-and-drivers/

PIRRONG, Craig, 2012. Commodity Price Dynamics: A Structural Approach. Cambridge University Press. ISBN 9781139018142.

PIRRONG, Craig, [no date]. Commodity forward curves: models and data. bauer.uh.edu [online]. [no date]. [viewed 24 March 2018]. Available from: https://www.bauer.uh.edu/spirrong/Pirrong_Geneva_Slides_2.pdf

PRATEEK, Agarwal, 2017. Theory of Storage. intelligenteconomiste.com [online]. 26 December 2017. [viewed 24 March 2018]. Available from: https://www.intelligenteconomist.com/theory-of-storage/

RANA, Rajesh, 2016. Oil tanker freight-rate volatility increases. ogj.com [online]. 7 April 2016. [viewed 25 March 2018]. Available from: https://www.ogj.com/articles/print/volume-114/issue-7/transportation/oil-tanker-freight-rate-volatility-increases.html

REFERENCE FOR BUSINESS, 2018. Groupe Louis Dreyfus S.A. – Company Profile, Information, Business Description, History, Background Information on Groupe Louis Dreyfus S.A. referenceforbusiness.com [online]. 2018. [viewed 25 March 2018]. Available from: http://www.referenceforbusiness.com/history2/66/Groupe-Louis-Dreyfus-S-A.html

SAND, Peter, 2016. Tanker shipping: Signs of weakness are appearing, but still money to be made. bimco.org [online]. 6 May 2016. [viewed 25 March 2018]. Available from: https://www.bimco.org/news/market_analysis/2016/0506_tankersmoo_2016-02

SAUL, Jonathan, 2015. Oil traders to store millions of barrels at sea as prices slump. reuters.com [online]. 13 January 2015. [viewed 25 March 2018]. Available from: https://www.reuters.com/article/us-oil-tankers-storage/oil-traders-to-store-millions-of-barrels-at-sea-as-prices-slump-idUSKBN0KM23K20150113

SAWE, Benjamin E, 2017. Biggest Oil Companies in The World. worldatlas.com [online]. 25 April 2017. [viewed 25 March 2018]. Available from: https://www.worldatlas.com/articles/biggest-oil-companies-in-the-world.html

SDC ANALYSIS & POLICY DIVISION, 2014. Agricultural commodity trade, food prices and regulation: International debate and relevance for Switzerland. eda.admin.ch [online]. 24 November 2014. [viewed 24 March 2018]. Available from: https://www.eda.admin.ch/dam/deza/en/documents/aktuell/agenda/traverse-summary-agricultural-trade_EN.pdf

SHENK, Mark, 2015. Crude Storage Tanks Nearing Their Brim Spur 'Super Contango'. worldoil.com [online]. 25 November 2015. [viewed 25 March 2018]. Available from: http://www.worldoil.com/news/2015/11/25/crude-storage-tanks-nearing-their-brim-spur-super-contango

SHENK, Mark, 2015. Crude Storage Tanks Nearing Their Brim Spur "Super Contango". bloomberg.com [online]. 25 November 2015. [viewed 24 March 2018]. Available from: https://www.bloomberg.com/news/articles/2015-11-24/crude-storage-tanks-nearing-their-brim-spur-super-contango-

SHOCKLEY, Jordan, 2017. Determining the Economic Cost for Drying and Storing Corn this Season. kygrains.info [online]. 25 August 2017. [viewed 25 March 2018]. Available from: https://www.kygrains.info/blog/2017/8/25/determining-the-economic-cost-for-drying-and-storing-corn-this-season

STANFORD UNIVERSITY, 1933. Wheat Studies of the Food Research Institutes. ageconsearch.umn.edu [online]. 1933. [viewed 24 March 2018]. Available from: http://ageconsearch.umn.edu/record/142876/files/wheat-1933-03-09-06.pdf

THE GUARDIAN, 2013. Is it ethical to bet on food prices?. the guardian.com [online]. 31 August 2012. [viewed 24 March 2018]. Available from: https://www.theguardian.com/money/2012/aug/31/ethical-bet-food-prices

THE GUARDIAN, 2012. Glencore food chief says US drought is "good for business". The guardian.com [online]. 21 August 2012. [viewed 24 March 2018]. Available from: https://www.theguardian.com/business/2012/aug/21/glencore-us-drought-good-for-business

TRAFIGURA, 2018. Trafigura. trafigura.com [online]. 2018. [viewed 25 March 2018]. Available from: https://www.trafigura.com/

TRAFIGURA BEHEER B.V., 2013. Advancing trade: Annual Report. trafigura.com [online]. 2013. [viewed 25 March 2018]. Available from: https://www.trafigura.com/media/1397/trafigura-beheer-bv-annual-report-2013-1.pdf

TRAFIGURA GROUP PTE. LTD., 2017. Annual Report. trafigura.com [online]. 2017. [viewed 25 March 2018]. Available from: https://www.trafigura.com/media/364892/trafigura-2017-annual-report.pdf

TRAFIGURA GROUP PTE. LTD., 2015. Annual Report. trafigura.com [online]. 2015. [viewed 25 March 2018]. Available from: https://www.trafigura.com/media/3321/2015-trafigura-annual-report.pdf

UNITED STATES DEPARTMENT OF AGRICULTURE - NATIONAL AGRICULTURAL STATISTICS SERVICE, 2018. Corn Yield and Soybean Production Up in 2017, USDA

Reports: Winter Wheat Seedings and Grain also reporter. nass.usda.gov [online]. 12 January 2018. [viewed 25 March 2018]. Available from: https://www.nass.usda.gov/Newsroom/2018/01_12_2018.php

UNITED STATES DEPARTMENT OF AGRICULTURE - NATIONAL AGRICULTURAL STATISTICS SERVICE, 2018. Iowa Ag News – Storage Capacity. nass.usda.gov [online]. 12 January 2018. [viewed 25 March 2018]. Available from: https://www.nass.usda.gov/Statistics_by_State/Iowa/Publications/Crop_Report/2018/IA_Grain_Storage_01_18.pdf

U.S. ENERGY INFORMATION ADMINISTRATION, 2018. Petroleum and Other Liquids: Weekly U.S. Field Production of Crude Oil. eia.gov [online]. 16 May 2018. [viewed 25 March 2018]. Available from: https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=wcrfpus2&f=w

U.S. ENERGY INFORMATION ADMINISTRATION, 2017. Working and Net Available Shell Storage Capacity. eia.gov [online]. 30 September 2017. [viewed 25 March 2018]. Available from: https://www.eia.gov/petroleum/storagecapacity/storagecapacity.pdf

WILLIAMS, Jeffrey C. and WRIGHT, Brian D, 1991.Storage and Commodity Markets. Cambridge University Press.

Appendix 1: Inventory turnover ratio – Data

Crude oil	Comany	Year	Beginning inventory (US $ in millions)	Ending inventory (US $ in millions)	Average inventory	COGS (US $ in millions)	Inventory turnover	Inventory turnover in day
	Exxon mobil							
		2017	10877	12871	11874	162345	13.67230925	26.69629493
		2016	12037	10877	11457	136098	11.87902592	30.72642508
		2015	12384	12037	12210.5	165590	13.56127923	26.91486503
		2014	12117	12384	12250.5	266831	21.78123342	16.75754504
		2013		12117	12117	284681	23.49434679	15.53565219
	Trafigura	2017	11537	13926	12731.5	136420	10.71515532	34.06390192
		2016	7614	11537	9575.5	98097	10.24458253	35.62858701
		2015	7812	7614	7713	94636	12.26967458	29.74814024
		2014	7856	7812	7834	124153	15.84797039	23.03134036
		2013	9629	7856	8742.5	130134	14.8852159	24.52097453
		2012	7362	9629	8495.5	117794	13.86545818	26.32440956
	BP	2017	17655	19011	18333	203945	11.12447499	32.81053715
		2016	14142	17655	15898.5	161296	10.14535963	35.97703911
		2015	18373	14142	16257.5	201830	12.41457789	29.40091909
		2014	29231	18373	23802	309282	12.99395009	28.08999554
		2013	28293	29231	28762	325878	11.33015785	32.21490865
		2012	26973	28293	27633	326700	11.82282054	30.8724977

Agribusiness	Comany	Year	Beginning inventory (US $ in millions)	Ending inventory (US $ in millions)	Average inventory	COGS (US $ in millions)	Inventory turnover	Inventory turnover in day
	Bunge	2017	4466	5074	4770	44030	9.23060797	39.54235748
		2016	5554	4773	5163.5	40269	7.7987799	46.80219275
		2015	5554	4466	5010	40762	8.13612774	44.86163584
		2014	5796	5554	5675	54240	9.55770925	38.18906711
		2013	6590	5796	6193	58587	9.460197	38.58270606
		2012	5773	6590	6181.5	58418	9.45045701	38.62247081
		2017	8831	9173	9002	57322	6.36769607	57.320575
	ADM	2016	8243	8831	8537	58662	6.87150053	53.11794688
		2015	9374	8243	8808.5	63682	7.22960777	50.48683301
		2014	11441	9374	10407.5	76433	7.34403075	49.70022765
		2013	13836	11441	12638.5	85915	6.7978795	53.69321422
		2012	12415	13836	13125.5	86936	6.62344292	55.10729157
	LDC	2017	6165	4833	5499	41939	7.62665939	47.85843725
		2016	5060	6165	5612.5	48684	8.67420935	42.07876304
		2015	6013	5060	5536.5	54370	9.82028357	37.16796947
		2014	5759	6013	5886	62919	10.6896024	34.14532971
		2013	5711	5759	5735	61854	10.7853531	33.84219291
		2012	6125	5711	5918	54819	9.26309564	39.40367391

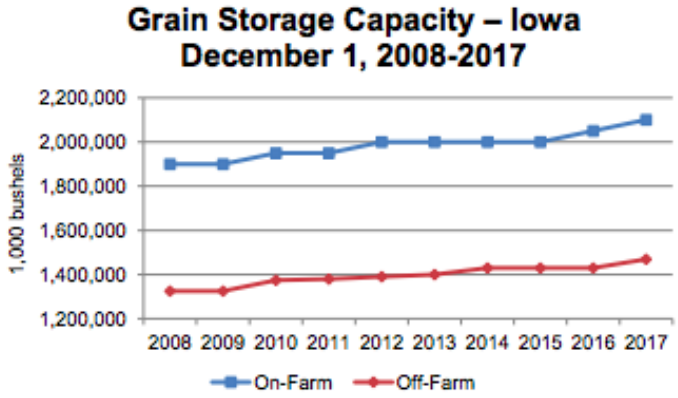
Appendix 2: US Working storage capacity for crude oil

Commodity	PAD Districts					U.S. Total	Ending Stocks	Utilization Rate[1]
	1	2	3	4	5			
Refineries								
Crude Oil[2]	13,122	18,801	70,526	3,866	36,499	142,814	94,580	66%
Fuel Ethanol	150	190	308	121	44	813	545	67%
Hydrocarbon Gas Liquids[3]	1,179	10,465	21,869	436	2,142	36,091	13,300	37%
Propane/Propylene (dedicated)[4]	406	3,401	3,919	53	195	7,974	3,105	NA
Motor Gasoline (incl. Motor Gasoline Blending Components)	8,781	28,283	52,176	6,567	27,209	123,016	72,886	59%
Distillate Fuel Oil	4,474	12,953	29,540	3,709	10,125	60,801	32,197	53%
Kerosene and Kerosene-type Jet Fuel	1,124	4,020	10,731	628	6,726	23,229	13,331	57%
Residual Fuel Oil	1,485	2,724	10,363	765	6,060	21,397	8,338	39%
Asphalt and Road Oil	1,083	8,821	4,416	2,115	1,373	17,808	9,687	54%
All Other[5]	13,952	27,840	86,306	6,835	36,233	171,166	101,719	59%
Total[6]	45,350	114,097	286,235	25,042	126,411	597,135	346,583	58%
Bulk Terminals (Including Fuel Ethanol Plants)[7]								
Fuel Ethanol	12,914	15,238	8,733	405	4,367	41,657	22,306	54%
Hydrocarbon Gas Liquids[3]	13,861	59,485	335,664	6,190	7,648	422,848	88,269	21%
Propane/Propylene (dedicated)[4]	9,904	25,858	108,530	1,023	3,291	148,606	22,998	NA
Motor Gasoline (incl. Motor Gasoline Blending Components)	84,678	52,047	61,934	4,095	24,778	227,532	122,929	54%
Distillate Fuel Oil	79,535	34,312	39,522	2,589	14,072	170,030	68,295	40%
Kerosene and Kerosene-type Jet Fuel	13,099	6,733	6,947	552	7,805	35,136	17,033	48%
Residual Fuel Oil	16,643	881	32,989	-	4,833	55,346	26,694	48%
Asphalt and Road Oil	12,607	14,931	5,922	2,263	4,606	40,329	20,534	51%
All Other[8]	10,090	3,740	25,850	7	5,171	44,858	20,994	47%
Total	243,427	187,367	517,561	16,101	73,280	1,037,736	387,054	37%
Crude Oil Tank Farms (excludes pipeline fill)[2]								
Crude Oil (Excluding SPR)	7,927	153,392	270,680	19,795	26,165	477,959	210,385	44%
Cushing, Oklahoma	--	77,505	--	--	--	77,505	33,556	43%
Strategic Petroleum Reserve	-	-	713,500	-	-	713,500	664,291	93%

Source: U.S. EIA, 2017

Appendix 3: US grain storage capacity by states

State	On-Farm Storage Capacity		Off-Farm Storage Capacity		Total Storage Capacity	
	2016	2017	2016	2017	2016	2017
	(1,000 bushels)	(1,000 bushels)	(1,000 bushels)	(1,000 bushels)	(1,000 bushels)	(1,000 bushels)
Illinois	1,470,000	1,470,000	1,500,000	1,500,000	2,970,000	2,970,000
Iowa	**2,050,000**	**2,100,000**	**1,430,000**	**1,470,000**	**3,480,000**	**3,570,000**
Kansas	380,000	380,000	1,075,000	1,100,000	1,455,000	1,480,000
Minnesota	1,550,000	1,550,000	760,000	760,000	2,310,000	2,310,000
Missouri	530,000	540,000	265,000	275,000	795,000	815,000
Nebraska	1,180,000	1,180,000	923,000	930,000	2,103,000	2,110,000
North Dakota	900,000	900,000	455,000	455,000	1,355,000	1,355,000
South Dakota	710,000	710,000	405,000	410,000	1,115,000	1,120,000
Wisconsin	375,000	375,000	360,000	360,000	735,000	735,000
United States	13,385,000	13,450,000	11,074,805	11,240,405	24,459,805	24,690,405



Source: USDA, 2018