

Agricultural Futures Markets and Index Fund Investment

Bachelor thesis Economics and Policy

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Chapter 1: Disturbed Agricultural Futures Markets

1.1 Introduction

In January 2011 food prices reached a new historical peak. This was the second one in a few years after the historical peak in 2008. Linked to this issue of high food prices in the last years is the increasing volatility of food prices. Since 2007 food prices seem to fluctuate more strongly than before. This means that if there is a peak in prices, price volatility may be higher also.

Especially people in poor countries suffer from high food prices. Many poor countries have to import food. Higher food prices means they can import less food for a given budget. Around 44 million people in developing countries are believed to have fallen into extreme poverty and hunger because of increasing food prices since June 2010 (World Bank, 2011). Common causes for high food prices that are named in the literature and media are high oil prices, increasing demand for biofuels, weather shocks, less support from governments for farmers leading to lower production levels, increasing demand for food products in some large countries like China and India and the influence of commodities speculators.

The increase of food prices in the last years is partly caused by the rise in wheat prices. According to FAO (2011), *“Increasing wheat prices drove international food prices up 5% last month in the biggest month-on-month increase since November 2009”*. The total amount of wheat harvested in 2010 was 5% lower than in 2009. Wheat stocks are 9% lower in 2010 than they were in 2009 (FAO, 2011). This decrease in supply of wheat has an impact on food prices. If we look at the price of wheat in the figure below we see that the price of the wheat (red line) in recent years is also more fluctuating and higher than before.

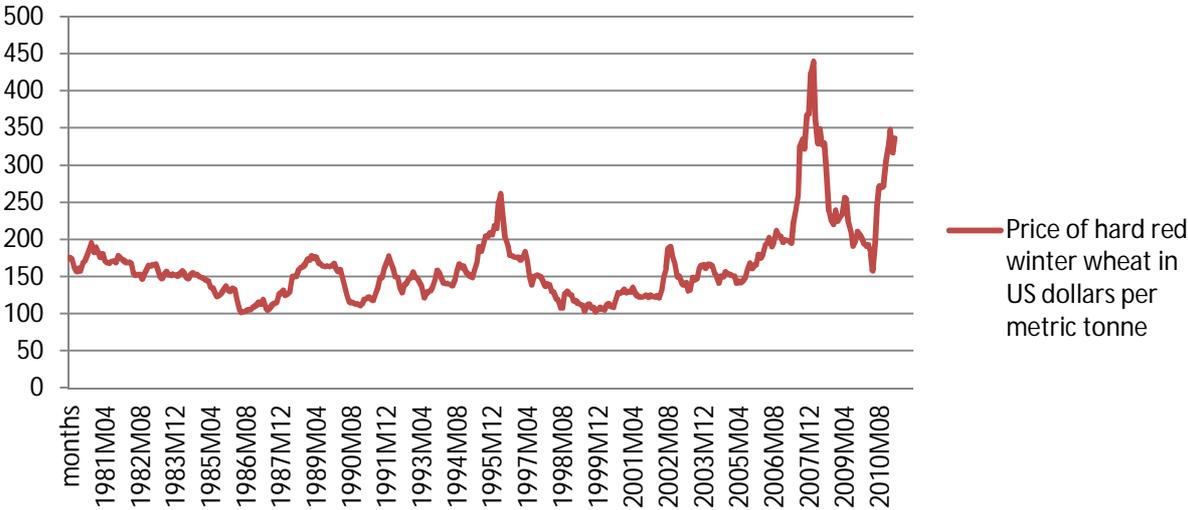


Figure 1: Price of hard red winter wheat futures between January 1980 and April 2011, IMF (2011)

Large amounts of wheat are traded via futures contracts. A futures contract is a *“commitment to make or take delivery of a specific quantity and quality of a given commodity at a specific delivery location and time in the future”* (cited from CME group, 2011). Wheat futures contracts are traded on agricultural futures markets. One large market for wheat futures is the Chicago Board of Trade

(CBOT). The Kansas Board of Trade (KCBT) is another important wheat futures market. Besides extreme price rises and volatility another problem was present during 2007-2010 at the KCBT and CBOT, i.e. non-convergence of futures and spot market prices.

Wheat futures prices theoretically should converge to the spot price of wheat as the delivery month of the contract approaches. At the delivery period the futures price equals or is very close to the spot price (Hull, 2007). That futures prices and spot prices are expected to converge when the delivery month is approaching follows from the laws of supply and demand. If futures would be above the cash price, the cash commodity would be bought and futures would be sold. The supply of futures goes up and demand for the cash commodity increases. The price of futures decreases and the price of the cash commodity increases so the prices should come in theory together (Irwin et al. 2007). At the KCBT and CBOT there have been convergence problems between 2007 and 2010. Lack of convergence is a problem because the futures market has a function in price discovery and in price risk management. If there are convergence issues these both functions are negatively influenced.

Futures markets have three primary roles. Besides price discovery and risk shifting there is also the role of facilitating finance (Hudson, 2006). These functions of futures markets are undermined by extreme price volatility, extreme high prices and lack of price convergence. More about these concepts will be discussed in the next chapters.

On agricultural futures markets hedgers (for example farmers and food processors) and speculators are active. By selling (farmers) or buying (food processors) futures contracts hedgers try to shift their price risks to traditional speculators. Speculators try to make a profit by buying in advance via a futures contract when they expect a price increase and selling forward when they expect a price decrease traditional.

1.2 Problem Statement

Recently, index fund investors (or commodity investors) have become active on agricultural futures markets besides traditional speculators. These index investors are not only active on one agricultural futures market but on several commodity markets at the same time (Gilbert, 2011). Index fund investment may disturb agricultural futures markets because these investors are less informed about the market and seek profit for the investment in the entire "commodity class" and not only in one agricultural futures market. This may lead to more price volatility, higher futures prices and higher food prices. Another problem that may occur is the lack of price convergence. There are some signals that this may have occurred in 2007-2010 on agricultural future markets in Kansas City (KCBT) and Chicago (CBOT). The question is if index fund investment can be linked to these problems and if it did disturb the functioning of agricultural futures markets during the price rises in 2007-2008 and 2009-2010.

1.3 Objective and research questions

The main objective of this thesis is to investigate whether index fund investment did disturb the functioning of agricultural futures markets. To analyse this problem we first need to know how a future market works so the first research question is: how do agricultural future markets work?

Another important aspect of the main question is index fund investment. So the next question is: what is index fund investment?

Besides extreme price rises there have been other problems on agricultural futures markets. In the third question we will investigate what problems there have been in the past. This question mainly focuses on problems in the period 2007-2010 on the agricultural futures markets of Kansas City, US (KCBT) and Chicago, US (CBOT): What problems have been observed on agricultural futures markets in the past and what are the causes?

The fourth research question is: how is investment speculation linked to these problems? To find an answer on the main question we first need to find out what theories there exist about index fund investment and the problems mentioned in the introduction.

With answers on all questions we should be able to find an answer on the main question: did index fund investment disturb the functioning of agricultural futures markets?

1.4 Structure of the thesis

This thesis exists of five chapters, including this introduction (chapter 1). The second chapter is about futures markets. To understand how futures markets work we need to know what futures contracts are, what actors participate on futures markets and how prices are determined. Other concepts that are discussed in this chapter that are related to futures markets are, for example, price convergence and liquidity on future markets. Also the role of index investment funds on agricultural futures markets will be discussed in this chapter.

In chapter 3 we discuss the problems there were on agricultural futures markets mainly during 2007-2010. We will focus on the agricultural futures markets Chicago and Kansas City, both in the USA. This chapter also discusses theories on the causes of these problems.

The relationship between the problems found in chapter 3 will be linked to index fund investment in chapter 4. We do this by comparing data from index fund participation and commodity futures prices. Also results of research about the impact of index fund investment will be included in this chapter.

Based on chapters 1 up to 4, in chapter 5 conclusions are given. The results and potential topics for future research are also discussed.

Chapter 2: Theory of Futures Markets

2.1 Introduction

In this chapter the theory about futures markets is discussed. Paragraph 2.2 starts with the specifications of a futures contract. On futures markets several market participants are active. In paragraph 2.3 we discuss what hedgers and speculators are and their roles in a futures market. In paragraph 2.4 the functions of futures markets are explained. Paragraph 2.5 explains the price determination on futures markets. In paragraph 2.6 the concept of price convergence is explained. Paragraph 2.7 discusses liquidity on futures markets. This is related to price volatility. In paragraph 2.8 index fund investment is explained.

2.2 Futures contracts

A futures contract is a *"commitment to make or take delivery of a specific quantity and quality of a given commodity at a specific delivery location and time in the future"* (cited from CME group, 2011). The person who buys the contract has a long futures position in the contract and the person who sells has a short futures position. The latter can, for example, be a farmer in an agricultural futures market. Once a transaction is made the futures contract can be sold again to a third party. The trading of futures contracts occurs at futures markets.

When a contract is formulated the details of delivery must be clear. Things that must be specified in the contract are: the asset, the contract size, how prices will be quoted, where delivery will be made, when delivery will be made and how the price to be paid will be determined (Hull, 2007).

When the asset is a commodity there may be variation in the quality of what is offered on the market. Therefore it is important that in a futures contract certain minimum requirements concerning the quality are specified. For example, in a wheat futures contract at the Kansas City Board of Trade (KCBT) it says: *"the wheat contains no more than 4 ppm of deoxynivalenol (vomitoxin)"* (cited from KCBT, 2011). Besides this requirement it is also specified how this vomitoxin value is measured when delivery takes place.

The contract size is the quantity that will be delivered under one contract. The size of the contract cannot be too small because then transaction costs become relatively too high. On the other hand the size of the contract should not be too high because then buyers who wish to buy a smaller amount might drop out.

The price of futures is quoted *"in a way that is convenient and easy to understand"* (cited from Hull, 2007: page 55). In the wheat future contracts at KCBT the price is quoted in dollars, cents and 0.25 cents per bushel (KCBT, 2011).

The majority of transactions on futures markets is not between the supplier of the commodity and the buyer of the futures contract. After this transaction the futures contract is often sold again and again between several kind of parties. Still the delivery location plays an important role especially when transport costs are high. For example, a wheat futures contract at KCBT states: *"Delivery Points: Kansas City, Mo.-Kans., Hutchinson, Kans. at a 9 cent discount, Salina/Abilene at a 12 cent discount, and Wichita at a 6 cent discount"* (cited from KCBT, 2011).

For most futures contracts the delivery period is one month. The contract should also state until what moment the contract can still be traded. This is usually a few days before the deadline of

delivery (Hull, 2007). At the KCBT delivery months can be July, September, December, March or May. After the fifteenth of this month the futures contract cannot be traded anymore (KCBT, 2011) .

2.3 Hedgers and speculators

On agricultural futures markets several market participants are active. An important role of agricultural futures markets is risk shifting. A farmer can for example plant a crop in the spring and harvest it in the fall. At the time of planting in the spring it is not known what the price of the crop will be in the fall. The uncertainty on price changes (positively or negatively) is known as price risk. On agricultural futures markets farmers are able to sell their crops in advance for future delivery. By selling their crops via a futures contract the farmer has shifted the price risk from himself to the buyer of the contract. If the price goes down during the growth season this won't make a difference for the farmer because the harvest is already sold for a determined price (Hull, 2007).

Hedge means protection. In the futures markets this means: *"a counterbalancing transaction involving a position in the futures market that is opposite one's current position in the cash market"* (cited from CME group, 2011). On futures markets hedgers reduce their price risks. On agricultural futures markets farmers can sell a future harvest in advance for a determined price. By selling the harvest for future delivery to someone else the farmer takes a short position. A farmer who owns a physical commodity, for example wheat, is said to be in a long position in the cash market. By taking an opposite position in the futures market than he would have in the cash market, the farmer creates a hedge (Hudson, 2006).

Besides farmers there are companies active on agricultural futures markets who want to buy the crop, e.g. in order to produce flour. For them a guaranteed price for a future delivery can be attractive as well. By buying a futures contract they pay a determined price and don't have the risk of higher costs at the moment of the harvest. When farmers sell a contract they are in a so called short position and an individual or company that chooses to purchase the contract for future delivery is taking a long position. A farmer and a company that want to use the product take opposite positions than they would have in the cash market thereby creating a hedge. Therefore both kind of participants are hedgers (Hudson, 2006).

Besides farmers and food processors other hedgers on agricultural futures markets are merchandisers, importers and exporters. All these parties are looking for protection against lower (merchandisers and importers) or higher prices (exporters) (CME Group, 2011).

Because the number of farms and firms seeking protection against declining prices at any specific moment is probably never the same as the number of firms seeking protection against rising prices, other market participants are needed. These participants are known as speculators (CME Group, 2011). Speculators can enter the futures markets easily and efficiently. Speculators do not want to own the underlying commodity of a futures contract. Because speculators thereby do not have a position in the cash market these trades are called uncovered (Hudson, 2006).

Speculators *"are attracted by the opportunity to realize a profit if they prove to be correct in anticipating the direction and timing of price changes"* (cited from CME Group, 2011). For example, a speculator expects a price rise. By buying futures he makes a profit when prices indeed go up. When he expects the price will drop he sells his futures and buys them again at a lower price thereby making a profit. If speculators are indeed well informed and are able to predict prices well this leads

to more market liquidity (or less price volatility). When speculators expect a price rise they buy futures. When prices are higher they want to collect their profits and sell their futures. Because of this the supply of futures increase which lowers the price again.

Traditional speculators are only active on one wheat futures market. Often they keep futures for a shorter period. They try to make profit by buying when they expect a price rise and selling when they expect a price drop. Because these traditional speculators are specialized in one market they are usually well informed. Thereby they have a function of price discovery. Also because normally a futures market has many buyers and sellers the prices of for example wheat futures are often used as "the" price for wheat (Hudson, 2006). Traditional speculators lead in theory to more market liquidity (or less price volatility) and more informed prices (Gilbert, 2011).

2.4 Functions of futures markets

Agricultural future markets have three important roles. The first of them is risk shifting. This is important for hedgers and speculators. Hedgers can shift their price risks to speculators as explained in paragraph 2.3.

Another important role of agricultural future markets is price discovery as introduced in paragraph 2.3. Speculators play an important role in this. Traditional speculators try to inform themselves as good as possible about supply, demand and indicators that indicate changes in demand and supply. Thereby speculators try to predict the price and base their transactions on this. When speculators do their job well the prices of futures are a good predictor for future spot prices. Also because future markets have often many buyers and sellers which can easily enter and exit the market the price, of for example wheat futures, is seen as "the" price of wheat (Hudson, 2006).

Besides risk shifting and price discovery an important role for agricultural futures markets is facilitating financing for hedgers. Because the farmer has a guaranteed price for its harvest for example banks will easier lend money for the investments that are required to cultivate crops. By buying the commodity in advance the processor can more easily calculate its costs for this input in the future. Thereby the futures market helps the processor to calculate future profit more easily. This means that besides a farmer also a food processor will be able to derive money more easily from a bank (Hudson, 2006).

2.5 Price determination of futures contracts

"Futures prices are determined through a bid system at a public commodity exchange" (cited from Canola Connection, 1999: page 2). The CBOT and KCBT are such markets for wheat futures contracts. On a futures market buyers and sellers of future contracts come together and find out what buyers are willing to pay and at what price sellers want to sell their contracts. At the CBOT this trading goes electronically. If indicators suggest demand is increasing or there will be a shortage of wheat, prices will go up. Prices will decrease if oversupply or decreased demand is expected.

The prices of futures are determined by supply and demand. If, for example, at a particular time more traders wish to buy March wheat futures than sell March wheat futures, the price will go up. Often there are so called daily price movement limits also at the KCBT. The purpose of these limits is to *"prevent large price movements from occurring because of speculative excesses"* (cited from Hull, 2007: page 56).

The speed and efficiency at which price changes occur depend on the market structure. Attributes of the market structure are the number of buyers and sellers, the commodities homogeneity, the number of substitutes for the commodity, the transparency of price information, the ease of commodity transfer and the artificial restrictions on the market process (Schnepf, 2006).

The number of buyers and sellers influences the price competitiveness. More market participants means mostly that there will be more price competitiveness. At the CBOT and KCBT there are relatively a lot of market participants.

Homogeneity in terms of quality has an impact on the price differences between products and markets. More product differentiation will mean more price differences. With specific quality requirements for the wheat at the CBOT and KCBT this commodity is very homogenous at these markets.

When there are more substitutes for a commodity the buyer has more options which will lead to more price sensitivity. In theory there are substitutes for the red hard winter wheat futures traded at the CBOT and KCBT but in practise for example bread producers will probably not easily switch to another kind of wheat. This has also to do with the fact that the demand for food products is very price inelastic.

More transparency of price information leads to less possibilities for price manipulation. For example an open auction has much more transparency than private contracts. Prices at the CBOT and KCBT are public.

When a commodity can easily be transported buyers and sellers can more easily switch to other markets. This means that the commodity has greater mobility and this leads to less spatial price differences. The lower the transportation costs the lower spatial price differences (Schnepf, 2006).

Besides the above mentioned factors for the speed and efficiency at which the price is determined the price itself is influenced by the amount of supply and demand for futures contracts. Things that have an impact on supply and demand for wheat (futures) in the United States are crop size and crop conditions in the U.S. and other wheat-producing countries, the level of surplus or shortfall, agricultural and economic policies, worldwide demand for wheat, domestic flour milling demand and the strength of the U.S. dollar (KCBT, 2011). More about the factors that influence the demand and supply of wheat will be discussed in Chapter 3.

2.6 Price convergence

The cash price of a commodity is defined as “the price paid for immediate delivery at a given location” (cited from Canola Connection, 1999: page 2). Often cash prices are linked to a place where the commodity is stored. For example, there is a cash price for Kansas wheat. Besides this cash price there is also the price for futures. For Kansas wheat this is the Kansas City Board of Trade (KCBT) wheat futures price (O’Brien, 2010).

There is normally a difference between the cash price and the futures price of a commodity. This is the case because there always will be costs to hold a commodity until the delivery period of a futures contract is reached. These costs can be storage, insurance and interest costs. The total of these are costs are known as cost of carry (Irwin et al., 2009). Besides the cost of carry there can be a difference between the futures price and spot price because there can be appointments for delivery included in the futures contract, for example about the point of delivery or about the transport costs of the commodity. Also transaction costs can influence the futures price and spot price differently. The total difference between the futures price and the spot price is known as the basis.

Futures prices are expected to converge to the spot prices as the delivery month of the contract approaches. When it is the delivery period the future price equals or is very close to the spot price (Hull, 2007). The difference between the futures price and spot price decreases when the delivery month is near because the cost of carry decreases as well.

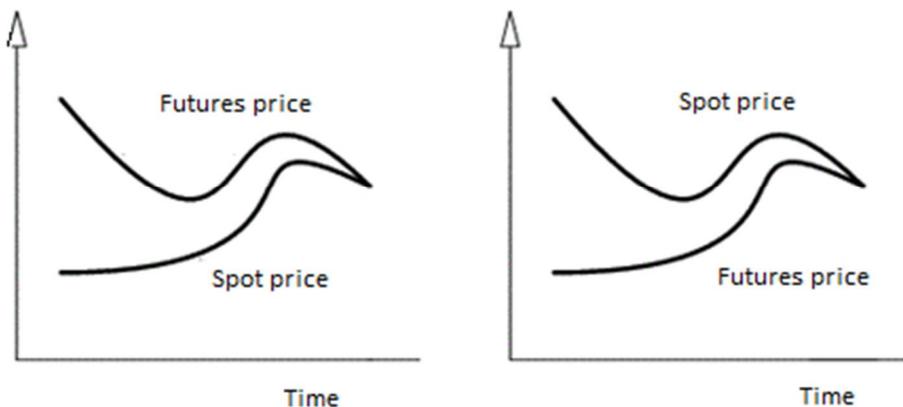


Figure 2: Price convergence when delivery month of the futures contract is approached, Hull (2007)

That futures prices and spot prices are expected to converge when the delivery month is reached follows from the laws of supply and demand. If futures would be above the cash price, the cash commodity would be bought and futures would be sold. The supply of futures goes up and demand for the cash commodity increases. The price of futures decreases and the price of the cash commodity increases so the prices should come in theory together (Irwin et al. 2007). In practise there will often be a small difference between cash prices and futures prices even in the delivery month. This is because perfect markets are very rare (Canola Connection, 1999).

2.7 Market liquidity and price volatility

“Market liquidity refers to the ability to buy or sell a future without causing a significant change in the market price” (cited from Fagan and Gencay, 2008: page 1). Liquidity is an important component on a futures market. When there is not enough market liquidity hedgers and speculators cannot trade efficiently and share risk on a futures market. For example, somebody wants to sell a futures contract but nobody wants to buy. Unless the market price will change the party that wants to sell cannot trade the futures contract. An essential requirement for market liquidity is that there are enough market participants that are willing to buy and that there are enough market participants that are willing to sell (Nieh et al. 2008).

An indicator to measure market liquidity is the amount of open interest. The open interest is defined as the *“total number of futures or options (puts and calls) contracts traded that have not been closed out or liquidated an offset on delivery”* (cited from CME Group, 2011: page 64). This means it refers to the amount of futures that market participants want to buy or sell but have not been yet actually traded.

Related to market liquidity is price volatility. Price volatility means the amount of variation of a price in a time period. As mentioned in paragraph 1.1 prices of wheat (futures) have fluctuated strongly last years which means a high price volatility. If prices on futures markets fluctuate strongly this undermines the function of risk shifting the futures market has, which makes the futures market less attractive for hedgers. When there are for example farmers who want to sell wheat futures but there are less speculators willing to buy wheat futures liquidity is reduced. When it becomes harder for farmers to sell their futures contracts they will more easily sell their contracts for lower prices. Also when there are too many buyers prices will rise faster. This means that less market liquidity leads to more price volatility.

2.8 Index fund investment

There is a distinction between traditional speculators and commodity investment which we call index fund investment in this thesis. The role of (traditional) speculators is already explained in paragraph 2.3. In this paragraph we explain what index fund investment is. If we are using the concept of index fund investment in this thesis we mean commodity index fund investment¹.

Index investment funds can invest in several commodity futures markets at the same time. This investment index is a quantitative weighted average of the prices of several commodity futures markets. Some of these future markets can be agricultural futures markets but other kind of commodity futures markets can be included as well, for example energy futures markets (Irwin and Sanders, 2009). Index commodity investment is a relative new phenomenon. While traditional speculators have been acting on futures markets for much longer index investment investors emerged the past two decades. The investment of an index fund in an agricultural futures market can be relatively large in relation to the total size of the market (Gilbert, 2011). While we assume traditional speculators lead to more market liquidity (or less price volatility) and more informed prices it is rather unclear what index investment funds (positively or negatively) contribute to agricultural futures markets.

¹ There also exists stock index fund investment. This kind of investment works similar as commodity index fund investment but means investing in share markets.

Just like traditional speculators index investment funds don't want to own or use the underlying commodity of a futures contract. Besides that index investment funds are active on several commodity futures markets another important difference with traditional speculators is that they often keep futures contracts for a longer time. Traditional speculators can shift from purchasing to selling within minutes while index investment funds keep their futures contracts until the delivery period is approached. When holding too many futures contracts that approach delivery period the index investment funds sell them and buy contracts of which the delivery period is further away. This happens on a predetermined basis (Stoll and Whaley, 2009).

Goldman-Sachs is a company that has a commodity index investment fund which keeps commodity futures contracts. They only keep contracts for which the delivery period is further away. These commodities are energy, metals, agricultural and livestock products. Because of rising prices of all these commodities this fund has had high returns last years.

Chapter 3: Problems on Agricultural Futures Markets and General Causes

3.1 Introduction

Prices of food commodity futures have fluctuated strongly in recent years. Paragraph 3.2 discusses theories of commodity price volatility and causes that are often mentioned in the literature. We link these causes to the volatility of wheat futures prices. Paragraph 3.4 is about the rise of food commodity prices and its causes between 2007-2008 and we try to link this to the rise in food commodity futures prices between 2007 and 2008. In paragraph 3.5 we discuss price convergence issues and their causes.

3.2 Price volatility of commodity futures and causes

Prices of food commodities are correlated with each other (Stoll and Whaley, 2009). This means that there are some causes that affect all commodities, including wheat. Especially wheat futures prices have dealt with an increased price volatility between 2007 and 2010. In the long run price volatility of commodities is determined by supply and demand fundamentals. Because the demand and supply of most food products are very price inelastic the price of food products can fluctuate strongly when demand or supply changes. This means that many changes in demand and supply of wheat can strongly influence the price of wheat (futures) and thereby increase price volatility. Factors that influence the demand and supply of commodities such as wheat are inventories, macroeconomic factors, inflation, exchange rates and interest rates, global economic activity, oil price volatility, global weather patterns, irrational speculation and agricultural policies (IMF, 2009). Next we discuss the factors that might have increased price volatility of wheat futures between 2007 and 2010.

The IMF (2009) concludes that rising volatility of the inflation of the US dollar has played a large role in the increase of volatility of food commodity prices. According to the IMF inflation volatility of the US dollar has increased from 0.5% to 2.3% between 1995 and 2009. If we look at the variation of the inflation rate in figure 3 we see that from 2008 onwards inflation fluctuates even more than before. Also we see often the same pattern as the variation of wheat prices in figure 3 and the same two relative high peaks in both graphs². It seems thereby that the increase in variation of the US dollar inflation also increased the wheat price variation. This suggests that increase in US dollar inflation increased price volatility of wheat futures between 2007 and 2010.

² The inflation rate data is based on consumers prices and is therefore “delayed” compared to data of commodity (futures) markets where prices change more easily than prices for consumers, for example in retail. Besides, the red line is the price of wheat futures. This price goes in front of cash prices.

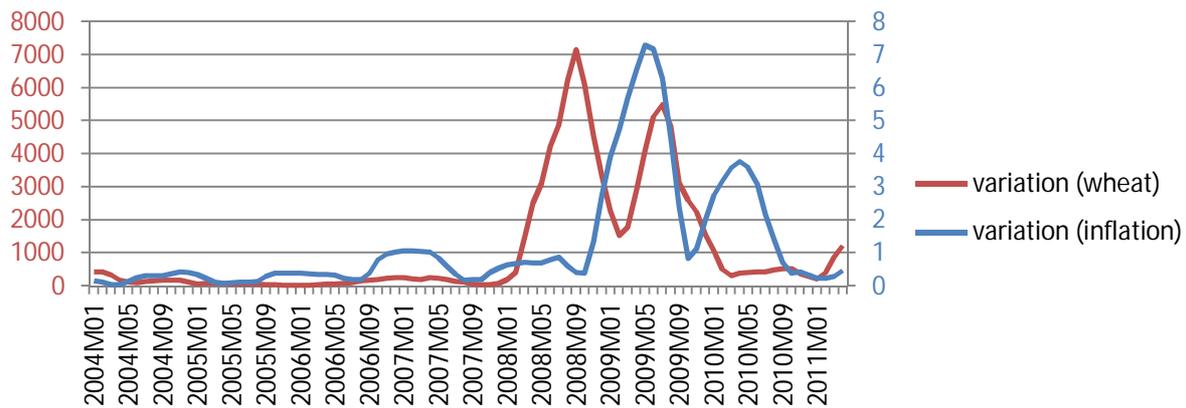


Figure 3: Variation of the US dollar inflation rate and variation of the price of US hard red winter wheat futures between January 2004 and April 2011, IMF (2011)

The second important cause of the increased price volatility of food named by the IMF (2009) is the rise in volatility of the US dollar exchange rate. The volatility of this exchange rate has increased from 3-5% in the mid-1990s to 10% in 2010. When the exchange rate of the US dollar changes the price for importing countries changes. This affects the demand for US wheat from importing countries. Relatively a lot of US wheat is exported so when demand from foreign countries fluctuates strongly because of fluctuating exchange rates demand and price of wheat on US markets will also fluctuate more.

Besides rising volatility of the US dollar inflation rate and stronger US dollar exchange rate volatility there are other causes for the increase of food price volatility. These are global economic activity (recession increases price volatility), global stock market volatility and weather effects. The effects on food price volatility of these causes are rather small (IMF, 2009).

According to the IMF rising volatility of the US dollar inflation has played the most important role in the increase of food commodity price volatility. Based on figure 3 we have concluded that this is also an important cause for the increase of wheat futures price volatility between 2007 and 2010. Volatility of the exchange rate of the US dollar plays a less important in the increase of futures price volatility. Global activity, global stock market volatility and weather effects are least important but also affect the volatility of food commodity futures prices. Possible causes that have been researched but that have not a significant impact on the volatility of food prices are inventories, oil price volatility and policy variables (IMF, 2009).

3.3 High prices of commodity futures and causes

The prices of food commodities started to increase sharply in 2007. In 2009 and 2010 commodity prices started to rise again. Also the price of wheat peaked in 2008, then decreased rapidly followed by another steady and increased in 2009 and 2010 which seems to lead to a new peak in 2011 as we can see in figure 4. This paragraph explains the general causes for high food commodity prices which also affected wheat futures prices between 2007 and 2010.

The World Bank (2008) concludes that higher energy prices have played a major role in the increase of food prices in 2007. This seems a logical explanation. To produce fertilizer and chemicals a lot of

energy is used. The price of fertilizer and chemicals plays an important role in the production costs of wheat. When the production costs become higher the price of wheat will increase. Higher energy prices also led to higher transportation costs, made the production of biofuels more attractive and encouraged policy support for biofuel production.

If we look to the patterns of the crude oil price graph and the wheat price graph in figure 4 we see indeed that often the price of wheat increases after an increase in oil price and that the price of wheat decreases after a decrease in oil price. It seems thereby that this plays an important role in the raises of wheat prices between 2007 and 2010.

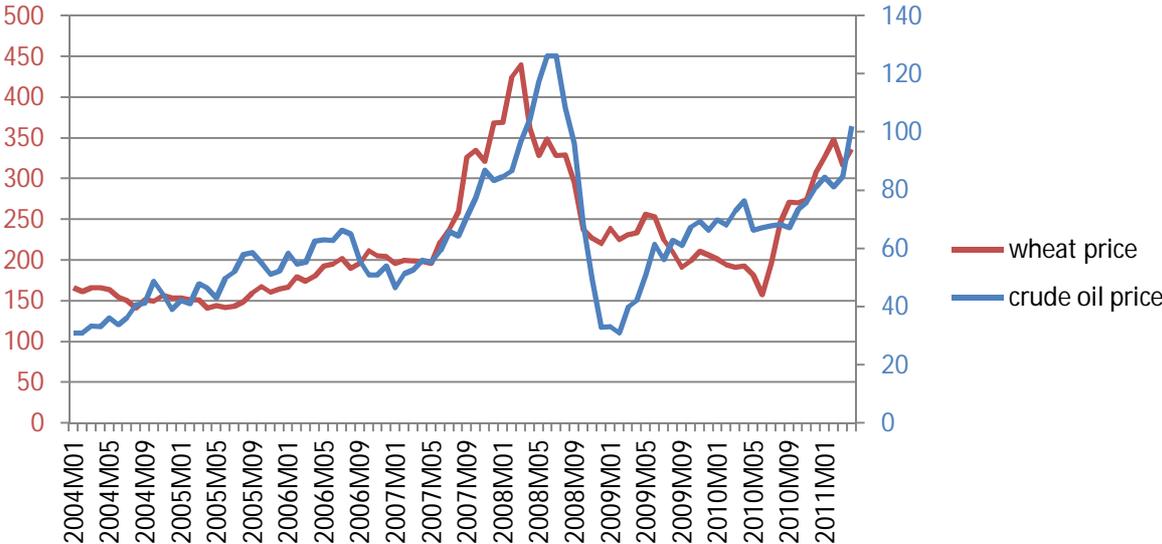


Figure 4: Price of crude oil in US dollars per barrel and price of hard red winter wheat futures in US dollars per metric tonne between January 2004 and April 2011, IMF (2011)

According to the World Bank another important factor that increased food commodity prices in 2007 and 2008 has been the decline in value of the US dollar. "The U.S. dollar depreciated about 35 percent against the euro from January 2002 to June 2008" (cited from World Bank, 2008: page 15). If we look at the inflation rate of the US dollar in figure 5 and the exchange rate per euro in figure 6 we see that the decrease in the dollar value (increase in inflation rate and decrease in exchange rate) in 2007-2008 is related to the increase of the wheat price in 2007-2008. The increase in dollar value goes hand in hand with the price decrease of wheat in 2008. In 2010 we see again a decrease in exchange rate and an increase in inflation rate (or a decrease in dollar value) and an increase in wheat price in 2010.

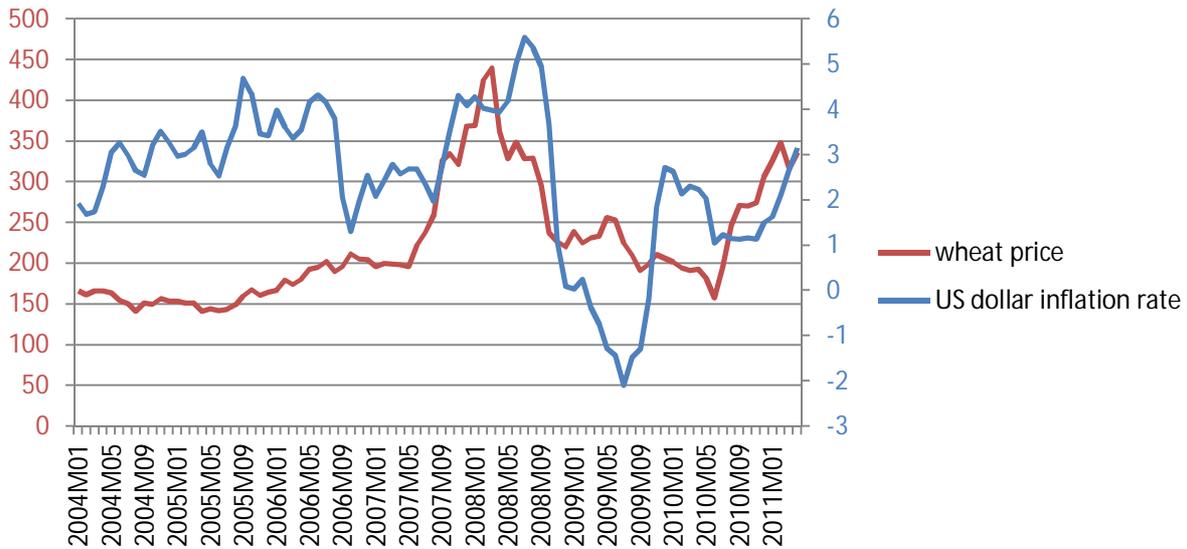


Figure 5: US dollar inflation rate (%) between January 2004 and April 2011

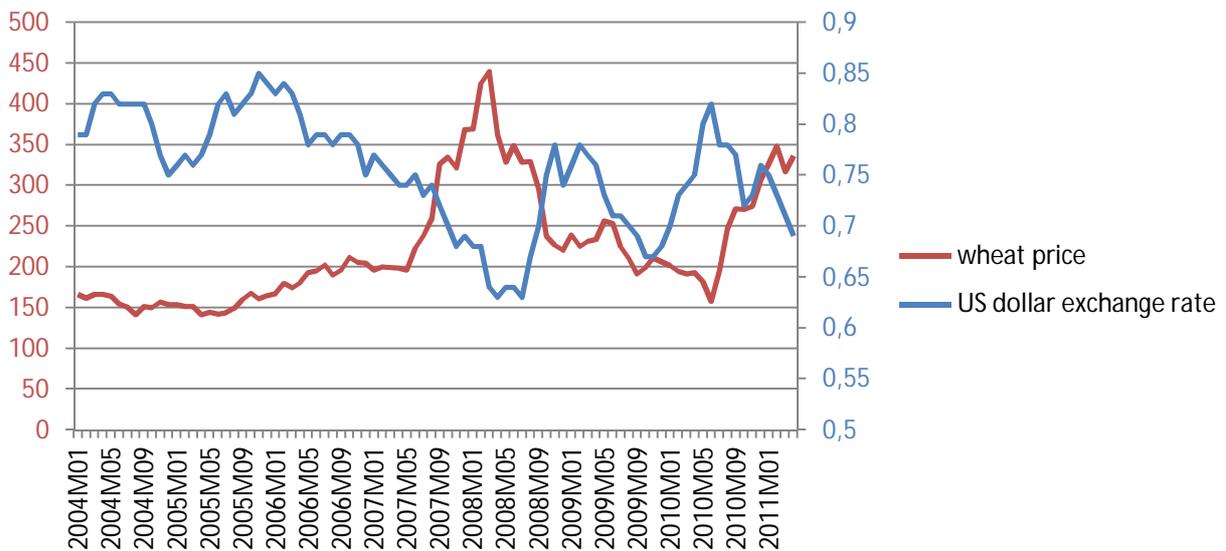


Figure 6: Exchange rate US dollar per Euro between January 2004 and April 2011

According to the World Bank (2008) the increase in oil price and a decrease in the US dollar value has led to higher food commodity prices in 2007 and 2008. If we look to the patterns of the oil price, the inflation rate and exchange rate of the US dollar and compare this to the wheat price we can conclude this also has been the case for the raises in wheat futures prices between 2007 and 2010.

3.4 Price convergence issues and causes

Between 2007 and 2010 another problem occurred on the Chicago futures markets for wheat, soy and corn. This was a lack of convergence between the futures prices and the cash prices. Also at the KCBT wheat futures market this problem occurred but the differences between the cash and futures prices were the largest for Chicago wheat. Irwin et al. (2009) have done research to the causes of poor convergence performance of CBOT wheat, corn and soy beans futures contracts.

As main cause of the lack of convergence of CBOT wheat futures is named the low storage costs there were for owners of an expired futures contract. Until July 2008 owners of such contract (or parties that are in the long position in the futures market) received a warehouse receipt. This allowed them to store the wheat at the CBOT for 4.5 dollar cents per bushel per month. The average of storage rates for wheat elsewhere were around 7.0 dollar cents per bushel per month in mid-2008. This meant that it was relatively attractive to own expiring wheat futures contracts and the warehouse receipt that goes with it at the CBOT which led to a difference between expiring futures contract prices and cash prices. The price of wheat futures was relatively high compared to the cash price at the CBOT. In figure 7 we can see this difference.

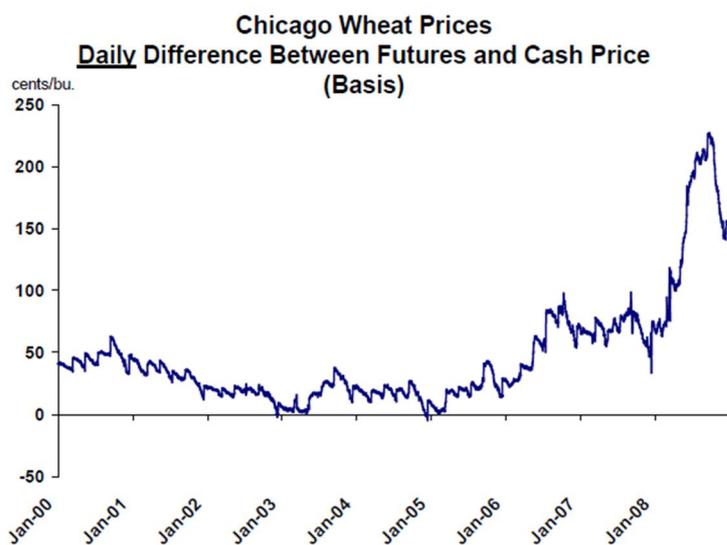


Figure 7: The difference between the Chicago wheat futures price and the Chicago wheat cash price between January 2000 and January 2009, Permanent Subcommittee on Investigations (2009)

Per July 2008 the warehouse receipt for wheat storage was replaced by a shipping certificate which means that parties don't have a guaranteed place at the CBOT to store wheat. Also the price to store wheat at the CBOT has increased. This means that for parties who are in the long position in the futures market but don't want to "use" the commodity (for example speculators) it is less attractive to keep expiring wheat futures contracts. This puts a downwards pressure on the price of expiring wheat futures contracts and since this price was higher than the cash price this should lead to better price convergence between the wheat futures price and the wheat cash price. If we look at figure 7 we see indeed that since mid-2008 the basis goes down which means there is more price convergence.

Still the basis is higher in 2009 than it was before 2008. CBOT soy beans and corn futures have had similar convergence problems in 2008 as CBOT wheat futures. After the price of storage for soy beans and corn at CBOT had been increased in conformity with commercial storage prices CBOT soybeans and corn futures prices converged better than CBOT wheat futures. This suggests there is another reason for lack of price convergence of CBOT wheat futures. Irwin et al. (2009) conclude that this has to do with the fact that delivery locations are no longer in the main commercial flow of wheat which puts downwards pressure on the cash price of Chicago wheat. In the next chapter we discuss if convergence issues, increased price volatility and increased prices on agricultural futures markets can be linked to index fund investment.

Chapter 4: Disturbed Agricultural Futures Markets and Index Fund Investment

4.1 Introduction

In this chapter we will link the problems on agricultural futures markets mentioned in chapter 3 to index fund investment. Paragraph 4.2 is about price volatility on agricultural futures markets and its relationship with index fund investment. Paragraph 4.3 discusses if index fund investment has increased prices on agricultural futures markets. In paragraph 4.4 it is discussed whether index fund investment is a cause of price convergence issues on agricultural futures markets.

4.2 Price volatility of commodity futures and index fund investment

Between 2007 and 2010 there was more price volatility of food commodity futures than before. In paragraph 3.2 we have concluded that an increase in inflation rate volatility increased price volatility on wheat (futures) markets. In this paragraph we will discuss if index fund investment has increased price volatility of Chicago wheat futures.

An increase in futures price volatility can be caused by reduced market liquidity. An indicator for reduced market liquidity is a lower open interest (Bessembinder and Seguin, 1993) as also explained in chapter 2. If we look at the participation of index funds at the CBOT in terms of purchased wheat futures contracts in figure 9 we see an increase and higher levels from January 2004 onwards. If we look at the total open interest of wheat futures and options at the CBOT (figure 8, blue line) we see that this graph has more or less the same pattern as the graph of index fund participation (figure 9) from January 2004 onwards. This suggests that index investment funds played a role in the increase in open interest at the CBOT from January 2004 onwards. Because the amount of open interest is an indicator for market liquidity it suggests index fund investment has increased market liquidity by increasing the open interest. A higher market liquidity should in theory lead to less price volatility (chapter 2). This suggests index fund investment should have indirectly decreased price volatility of wheat futures at the CBOT.

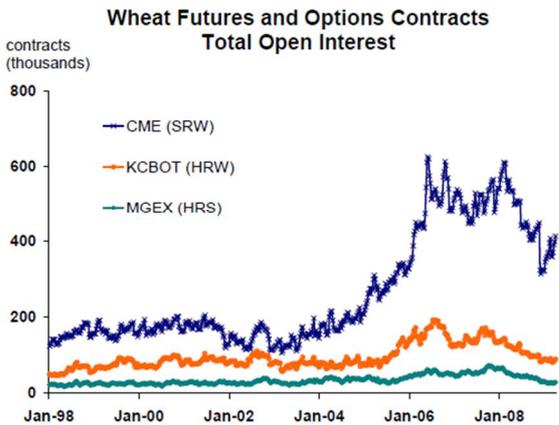


Figure 8: Total open interest (thousands of contracts) of wheat futures contracts and options contracts, Permanent Subcommittee on Investigations (2009)



Figure 9: Index fund purchases of Chicago wheat futures contracts (thousands of contracts), Permanent Subcommittee on Investigations (2009)

Moreover, if we look at the increase of index fund investment participation at the CBOT in figure 8 we see that the participation increased already rapidly from January 2004 onwards while the increase of wheat price volatility started only halfway 2007 onwards as we have seen in chapter 3. It seems thereby that index fund investment has no impact on the price volatility of wheat futures. This is also a conclusion of Power and Turvey (2010), who did quantitative research on the impact of index traders on commodity futures markets and did not find any empirical evidence for the statement that greater index trader volume did increase price volatility for storable commodity futures.

4.3 High prices of commodity futures and index fund investment

In this paragraph we discuss if index fund investment contributed to the price increases of food commodity futures between 2007-2008. As we have seen in figures 8 and 9 the participation of index fund investment has increased a lot at the CBOT from 2004 onwards. Index fund investment has been responsible for almost half of the total open interest of wheat futures at the CBOT at certain moments. This suggests demand for wheat futures has increased from 2004 onwards and therefore that the presence of index fund investment drives up the price of wheat futures.

In figure 10 we see the index fund participation in agricultural futures markets for Chicago wheat, Kansas wheat, corn and soybeans. Index funds invest relatively a lot in corn futures. If we look at the index fund participation in 2008 in Chicago wheat futures, corn futures and soybeans we can see a peak, especially in the participation in corn futures. We also see this peak in the prices of wheat, soybeans and corn futures in figure 11, but at a later period. The hypothesised relationship between index fund participation and food price spikes is therefore not convincing. For example, the index fund participation in corn futures (yellow line) and soybeans futures (green line) seems to decrease already while the prices of corn (orange line) and soybeans (green line) are still increasing.

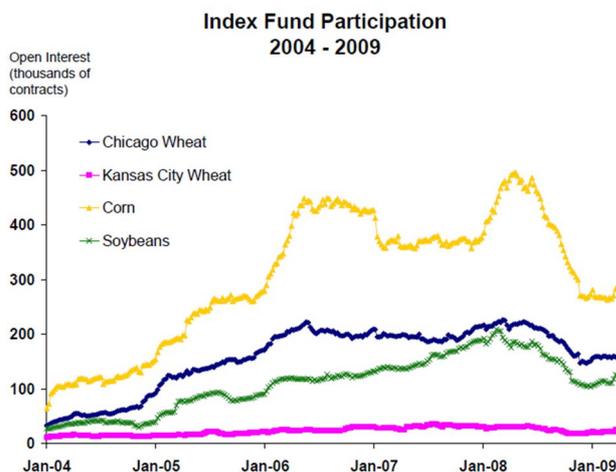


Figure 10: Index Fund Participation in terms of open interest between January 2004 and March 2009, Permanent Subcommittee on Investigations (2009)

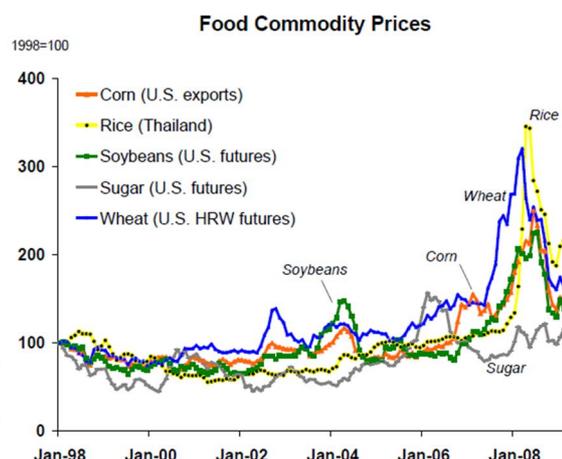


Figure 11: Food Commodity Prices (Index) between January 1998 and March 2009 (1998=100), Permanent Subcommittee on Investigations (2009)

If we look at the participation of index fund investment in figure 12 as part of the total interest we see that its share in the total open interest has hardly changed from January 2006 onwards on the futures markets for corn (yellow) and soybeans (green). According to these graphs this means index fund investment has not lead to the price peaks of corn and soybeans futures in 2008. The share in total open interest on the Chicago wheat futures market is relatively large (around 50%) from 2005 onwards but also does not show a peak in 2008. This means we can conclude index fund investment is not responsible for the raise of agricultural futures prices in 2007-2008.

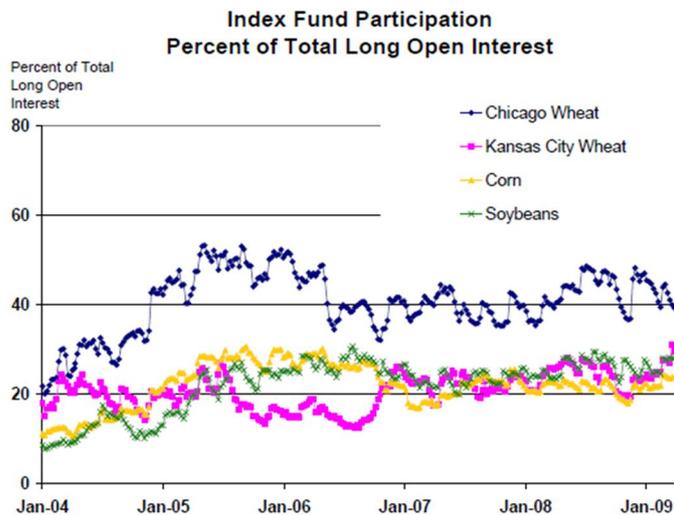


Figure 12: Index fund participation between January 2004 and March 2009, Permanent Subcommittee on Investigations (2009)

Tang and Xiong (2010) have done a study based on the correlation between commodity futures returns and stock, bond, US dollar and crude oil returns. Since 2004 correlation between commodity futures returns and stock, bond, US dollar and crude oil returns has increased significantly. This is confirmed by statistical tests. For example, *“the correlation of daily soybean and crude oil futures returns before 2004 moved in a narrow range between .10 and 0.20, but after 2004 increased steadily to a peak of about 0.60 in 2009”* (cited from Irwin and Sanders (2010)). The correlation between stock, bond, US dollar and crude oil returns and commodity futures returns that are included in major index funds (such as the one from Goldman-Sachs mentioned in chapter 2) has increased significantly more than the correlation between these returns and commodities returns that are not in such funds. This suggests index fund investment has an impact on the price of commodity futures.

Irwin and Sanders (2010) commented on the study done by Tang and Xiong (2010). Statistically there is a difference in correlation between commodities that are included in indices and commodities that are not included. In 2009 the difference in correlation with equity index, bond index, dollar index, and crude oil returns is 0.05, -0.03, -0.06 and 0.15 respectively. The composition of non-index commodities however can be criticised. Included in this control group among others are rough rice, oats, lumber, orange juice and pork bellies. The markets for rough rice, oats, lumber and orange juice are very illiquid and the market for pork bellies is not very active with almost zero open interest. Another important point for critics is the fact that there have been other periods in history in which commodity futures markets have shown more or less correlation with other markets. Since index fund investment emerged the past two decades there must at least also be general causes for this.

Irwin, Sanders and Merrin (2009) have compared the increase in prices between 2006 and 2008 on commodity futures markets with index fund participation, commodity futures markets without index fund participation and commodity markets without futures markets. They could not find empirical

evidence that prices have increased more on commodity futures markets with index fund participation than on commodity markets without index fund participation.

Several studies have discussed the possible connection between index fund investment and the “bubble” in (food) commodity prices in 2007-2008. Gilbert (2009, 2010), Einloth (2009) and Tang and Xiong (2010) did find empirical evidence that index fund investment influences commodity futures prices. However, according to Irwin and Sanders (2010) the data and methods used in these studies can be criticised, which reduces the value of the results. The list of studies in which no (statistically or economically) evidence was found is much longer. It seems thereby that index fund investment is not responsible for the raise in food commodity futures prices in 2007 and 2008.

4.4 Price convergence issues and index fund investment

Index fund investment has played relatively the most important role on the Chicago wheat futures market as we have seen in figure 12. As explained in chapter 3 lack of price convergence was present the most at the Chicago wheat futures market. This suggests index fund investment could be a cause of convergence issues.

The U.S. Senate Permanent Subcommittee on Investigations (2009) has written a report about index fund investment and the functioning of wheat markets in the US. According to the committee index funds have increased demand for futures contracts of which the delivery month is further away. This has increased the wheat futures price and the difference in price between futures and cash prices. Higher wheat futures prices means supply comes from further distances and hedgers are attracted to store and deliver their wheat in Chicago. This puts downwards pressure on the cash price of Chicago wheat because supply increases but costs for delivery are increasing which are part of the basis. According to the committee convergence performance is better when demand in the cash market is high. When demand in the cash market is normal or low prices are present in cash and futures markets convergence performance is low. The committee concludes this has to do with the presence of index fund investment at the Chicago wheat futures market.

Looking at the participation of index fund investment at the Chicago wheat futures market in figure 13 (blue line) we see this participation stays relatively constant from 2006 onwards. In the beginning of 2006 lack of convergence starts to increase as we can see in figure 14. At that moment the participation of index fund investment hardly increases anymore. This supports the statement that index fund investment is not responsible for the convergence issues at agricultural futures markets. Another increase in convergence issues at the Chicago wheat futures market starts in January 2008. Before that moment also the participation of index fund investment increases although relatively less. Besides this is a small increase it also starts to decrease already early 2008 while the lack of convergence is still increasing rapidly. This also supports the statement that index fund investment is not responsible for the convergence issues at agricultural futures markets.

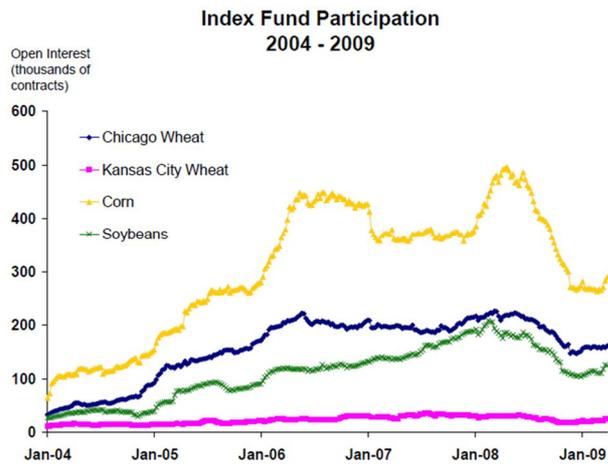


Figure 13: Index Fund Participation in terms of open interest between January 2004 and March 2009, Permanent Subcommittee on Investigations (2009)

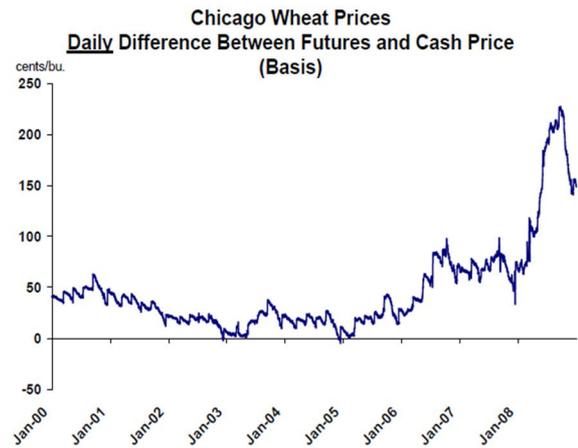


Figure 14: The difference between the Chicago wheat futures price and the Chicago wheat cash price between January 2000 and January 2009, Permanent Subcommittee on Investigations (2009)

Irwin et al. (2009) have also searched for a link between index fund investment and convergence issues at the CBOT. According to Irwin et al. (2009) patterns of index fund participation and lack of convergence are often not similar. This is based on data from the Chicago futures markets for wheat, corn and soybeans.

The U.S. Senate Permanent Subcommittee on Investigations (2009) concludes the major cause of lack of convergence is the attendance of index fund investment at the Chicago wheat futures market. The reasoning seems logical but if we look at the participation of index fund investment on agricultural futures markets and convergence issues as done in this chapter we cannot discover any relationship. The explanation of Irwin et al. (2007) mentioned in chapter 3 is confirmed by trends in convergence issues and the difference in storage costs at the CBOT and other places. It seems thereby index fund investment is not responsible for convergence issues on agricultural futures markets.

Chapter 5: Conclusions and Discussion

5.1 Summary and Conclusions

Since 2007 food prices seem to fluctuate more strongly than before. In 2008 and 2011 food prices reached a historical high peak. Especially people in poor countries suffer from high food prices. Also on agricultural futures markets in the US prices fluctuated more and reached higher peaks. Recently index investment funds have become active on agricultural futures markets. In this chapter we first give answers on the research questions and at the end of this paragraph we give an answer on the main research question: Did index fund investment disturb the functioning of agricultural future markets?

The first research question is answered in chapter 2. How do agricultural futures markets work? The answer on this question is derived from the literature. On a futures market futures contracts are traded. We have defined a futures contract as a *“commitment to make or take delivery of a specific quantity and quality of a given commodity at a specific delivery location and time in the future”* (cited from CME group, 2011). On a futures market several market participants are active. Hedgers try to shift their price risk to speculators by taking an opposite position in the futures market than their position in the cash market. Besides risk shifting the futures markets has a function in price discovery and facilitating finance.

Traditional speculators are active in one commodity futures market and are in theory liquidity providers. An indicator to measure market liquidity is the amount of open interest. We have defined the open interest as the *“total number of futures or options (puts and calls) contracts traded that have not been closed out or liquidated and offset on delivery”* (cited from CME Group, 2011: page 64). Related to market liquidity is price volatility. Price volatility means the amount of variation of a price in a time period. In theory more market liquidity (so more open interest) leads to less price volatility.

Prices of futures are determined by supply and demand. If indicators suggest demand is increasing or there will be a shortage of wheat (futures), prices will go up. Prices will decrease if oversupply or decreased demand is expected. Futures prices and spot prices are expected to converge when the delivery month of the futures contract is reached. The difference between futures and spot prices is known as the basis. The basis is mostly determined by the cost of carry. These costs are for example storage and insurance costs.

In chapter 2 also the second research question is answered: what is index fund investment? In contrast to traditional speculators index investment funds are active in several commodity futures markets at the same time. Besides agricultural futures markets they can also be active in for example, energy futures markets. Index funds keep futures contracts for a certain period, sell them and buy new futures contracts of which the delivery period is further away. This all happens on a predetermined basis. Index investment funds can relatively be large in relation to the total market size.

The third research question is: What problems were observed on agricultural futures markets in the past and what are the causes? In chapter 3 this question is answered. We discussed findings from literature and used graphs on aggregate data to answer this question. We have distinguished three problems: high price volatility, high prices and lack of price convergence.

According to the IMF (2009) rising volatility of the US dollar inflation has played the most important role in the increase of agricultural commodity price volatility. To compare the volatility of the US dollar and the volatility of wheat futures prices we calculated the variation in prices and we put the results in a graph. Based on this figure we conclude that rising volatility of the US dollar inflation is an important cause for the increase of wheat futures price volatility between 2007 and 2010.

To explain the high commodity futures prices between 2007 and 2010 we used the causes that the World Bank (2008) has named for the food price peak in 2008. According to the World Bank (2008) the increase in oil price and a decrease in the US dollar value have led to higher food commodity prices in 2007 and 2008. Based on the analysis of graphs of the US dollar inflation rate and exchange rate, the crude oil price and the price of wheat futures we conclude that a high oil price and a low US dollar value has led to higher levels of wheat futures prices between 2007 and 2010.

Irwin et al. (2009) explained the price convergence issues at the CBOT. Low storage costs for expiring futures contracts owners led to a difference between the cash prices and futures prices for wheat, soy and corn. Besides this is an economically logical explanation we have also seen that after an increase of storage costs convergence issues indeed decreased.

The last research question is answered in chapter 5: How is index fund speculation linked to these problems? In this chapter we have compared results from several studies and we have compared these results to the results of analysing graphs.

There is not much research done on the relationship between index fund investment and price volatility on futures markets. In theory index investment funds increase the amount of open interest and thereby increase the market liquidity. This means index fund investment are expected to lead to less price volatility instead of an increase in price volatility. Recent literature suggests that there is no empirical evidence for the hypothesis that greater index trader volume increased price volatility for storable commodity futures. Based on analysing graphs of index fund participation on the CBOT wheat futures market and the price volatility of wheat futures we also conclude index fund investment has not been responsible for the increase of price volatility of wheat futures.

Based on the pattern of index fund participation and the price of corn, soybeans and wheat futures we conclude that index fund investment is not responsible for the price peak in 2008. There are a few studies in which a positive relationship between index fund investment and prices is found but the majority of studies conclude that index fund investment has no impact on prices. It seems thereby index fund investment is not responsible for high agricultural futures prices.

Between 2007 and 2010 agricultural futures markets in Kansas City and Chicago had to deal with high prices, strongly fluctuating prices and price convergence issues. In the last decades index fund investment emerged on these markets. However, index fund investment seems not to be the cause for these problems. Rising US dollar inflation volatility is responsible for an increase of agricultural futures prices. An increase in oil price and decrease in US dollar value is responsible for an increase of agricultural futures prices. Finally, low storage costs seem to have been the main cause for convergence issues on agricultural futures markets.

5.2 Discussion and topics for future research

About the impact of index fund investment on commodity futures markets has been written a lot and at this moment still articles are published. In this thesis we have tried to compare the results of these studies complemented with a raw data analysis using graphs. Sometimes studies are also based on other commodity futures markets, for example energy markets. An important assumption we have implicitly made is that other commodity futures markets are comparable to agricultural futures markets. Although agricultural futures markets are much smaller in terms of value than for example energy futures markets this seems a reasonable assumption because index funds invest in proportion to the value of the market. Also we have seen that commodity futures markets are more and more correlated with each other. A major difference is that supply of agricultural products comes only at harvesting times, whereas for other products supply is often continuous.

Because problems on the wheat futures markets of Chicago and Kansas City were relatively large we have often used data from these markets in this thesis. As wheat price we have used the price of red hard winter wheat futures (Kansas City wheat). This price is often used as the leading price of wheat because it's a very liquid market with a large trade volume. Index fund participation is relatively the largest on the Chicago wheat futures market. We have compared index participation on the Chicago wheat market with the price of Kansas City wheat but the price of red soft winter wheat futures (Chicago wheat) is similar so this is not problematic.

It is interesting to see that index fund investment plays a relatively much larger role on the Chicago wheat futures market than on the Kansas City wheat futures market. For some reason index funds invest more in red soft winter futures. This could be a potential topic for future research.

Another interesting topic is the trend following behaviour of speculators (Gilbert, 2010). This probably will be hard to measure but increased following behaviour of speculators might lead to increased price volatility or higher prices on agricultural futures markets.

For quantitative researchers it might be interesting to investigate the exact (increased?) relationship between wheat futures price and crude oil prices, US dollar inflation rate and US dollar exchange rate using econometrics. In several figures we have seen there is a clear correlation which even seems to increase but this could be econometrically tested.

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