DERIVATIVES AGRICULTURAL COMMODITY MARKETS: A BRIEF ANALYSIS OF THEIR STRUCTURE AND OPERATION[*]

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Resumen

El objetivo del presente trabajo es el de proporcionar una visión amplia de los principales mercados de derivados sobre commodities agrícolas existentes en la economía global hoy día, de manera que a través del estudio y descripción de sus orígenes, estructura, mecanismos de funcionamiento, principales activos subyacentes y funciones económicas llevadas a cabo por éstos, de tal manera que los usuarios e investigadores interesados puedan obtener datos e información útiles para una administración más eficiente de sus activos.

Palabras clave: derivados; materias primas agrícolas; futuros; opciones y permutas.

Abstract

The aim of this paper is to provide a brief view of the main markets of agricultural commodities derivatives that exist n the global economy today, so, through the study and description of its origins, structure, operating mechanisms, main underlying assets and economic functions carried out by them, the interested users and researchers can obtain data and information useful for a more efficient management of their assets.

Key words: derivatives; agricultural commodities; futures; options and swaps.

JEL Classification Codes: F13; G15 y G18.

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1. Introduction

The building blocks used in the analysis of agricultural commodities consist, as for other commodities, of supply, demand and inventory, with the additional considerations of perishability and quality (e.g., arabica versus robusta coffee). Some elements of vocabulary specific to agricultural commodities are recalled below.

Supply

For agricultural commodities, supply comprises three components:
1. Surplus stocks left from the previous.
2. Current year production.
3. lmports from other countries.

Demand

It essentially covers two categories:
1. Domestic use.
2. Exports.

For these two categories, further subdivisions can be considered, such as animal feed versus human food. In the first category, products are generally used as such while, in the second, food that needs to be processed will have different costs and lead to various quantities of the raw product.

Carry – over

This is defined as the remaining supply from the previous year plus current year production and any imports minus demand. It is this carry - over that links Futures prices in different crop years. In particular, when there is a decrease in demand in one crop year, carry - over to the next crop year will increase and prices will generally drop that year.

Stocks – to - use ratio

This important indicator for trading activities is defined as current year ending stocks divided by current year use. For instance, if the year's ending stocks in wheat are 540 million bushels and the year's usage totals 2.7 billion bushels, the stock – to - use ratio is 20%. This number expresses how short supplies may be: typically, it should lie between 20% and 40%. It will obviously have an impact on price volatility: in a tight market, any shock in supply while demand is steady is likely to send prices very high. This explains why the stock – to - use ratio is a key number in technical analysis rules of trading in commodity markets and option pricing as well.

According to the above, this paper is structured as follows:The first section describes the major derivatives markets grains (bean and its derivatives, corn and wheat in different varieties) and derivative contracts and the latest e-commerce modes (Analysis equally applicable to the other subsequent markets included in the paper). The second section discusses the major derivative markets agricultural products called "soft", such as cocoa, coffee, sugar and cotton. In the third section and because of the importance of the market system - global product, carried out the study of the major citrus derivatives markets and products derived there from. The fourth section describes the major derivatives markets animal products (beef, pork and its derivatives). Finally, the last section discusses and exemplifies comparing technical analysis with fundamental analysis for purposes of practical application in the derivatives agricultural commodities markets.

2. The grain markets

The US Department of Agriculture (USDA) publishes every month an updated balance sheet containing the current year exports, domestic use, carry - out from last year and expected carry - over for next year. It also contains the USDA's estimates for production in the major foreign nations that either competes with US producers, such as Brazil and Argentina which have become major competitors for soybeans, or the traditional importers, such as India, Russia, Pakistan and Egypt.

A USDA monthly report on all grains comes out during the second week of the month. If the USDA's numbers differ greatly from private reports, a price shock may occur in the market.

In addition to the monthly reports, the USDA issues two planting reports: (1) the Planting Intentions report, which comes out at the end of March, and (2) the Final Acreage report, which comes out at the end of June and shows what farmers actually planted. For instance, a decline in acreage translates into an expected decline of production; or, if the Planting Intentions report shows that farmers intend to plant less corn in the coming season, corn prices will rise relative to soybean prices. At the same time with USDA's reports, events that can impact prices may be the announcement of a large purchase by an export customer, a weather - related event such as a frost on the winter wheat crop just before harvest or the decision of a country to develop extensively the planting of a new commodity (such as coffee in Vietnam in recent years).
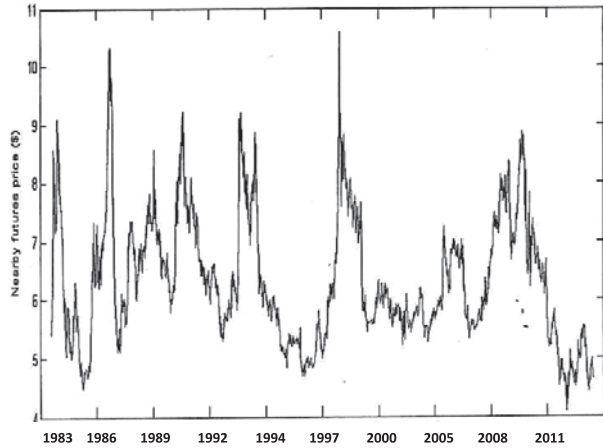
Soybeans

Soybeans were used in China more than 4,500 years ago, and first appeared in France in the middle of the 18th century. In the US, they were first used in the east and southeast of the country, with culture appearing around the end of the 19th century. At the time soybeans were mostly used as animal feed.

Soybean culture increased strongly throughout the 20th century in the US, one reason for this expansion being its similarity to corn culture. Beans are planted in the spring, generally April and May, but they can be planted as late as early July. A late - planted crop runs the risk of being caught by an early frost in the fall and may have difficulties flowering and setting pods in August. For these reasons, a late -planted crop will generally lead to a higher premium. Through the summer prices gyrate with the weather, especially at the time when pods are set. Soybeans are known as "miracle plants" because of their remarkable resilience.
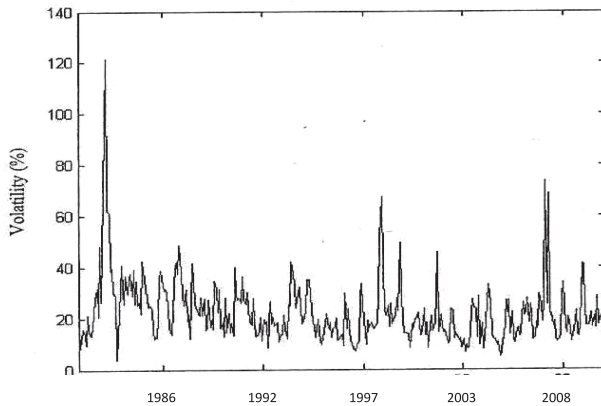
Figure 1

Soybean nearby Futures price over the period July 1984 to October 2010

Source: authors based on data from US Department of Agriculture (USDA).
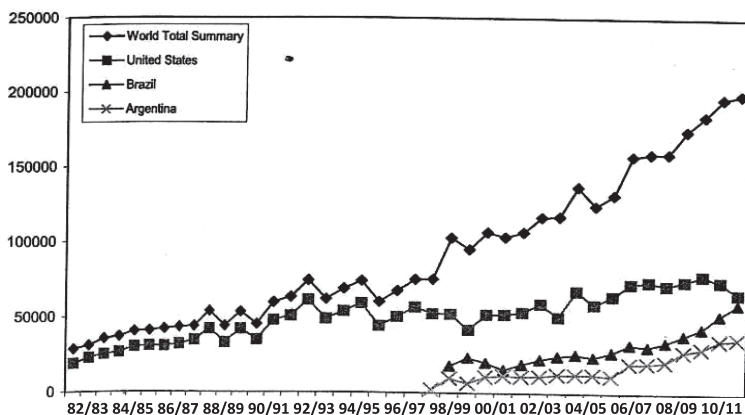
Figure 2

Soybean price volatility over the period July 1988 to October 2010

Source: authors based on data from US Department of Agriculture (USDA).

Figure 3

World soybean production

Source: authors based on data from US Department of Agriculture (USDA).

South American soybeans

Prior to the 1970s, the US was the only place to buy soybeans and soybean products, and was responsible for more than three - quarters of world production. In the 1960s, because of a feed shortage in proteins, soybean - growing skills were passed on to Brazil and Argentina, through firms Iike Archer Daniels Midland. Today, these two countries combined produce almost as many soybeans as the US, with 36% of world production against 45% for the US. Their combined production 5 years ago represented only about one - half of US production. Total South America soybean production from 1995 to 2010 underwent a four - fold increase, with Paraguay entering the market in the mid 1990s.

Plantations in Brazil are producing as much as 50 bushels an acre, these yields being on a par with US yields. Moreover, Brazil has more than 100 million acres of uncultivated grasslands in the center and north of the country that are ideal for bean crops. In the near future, the Brazilian government envisions this area being fully cultivated. Nowdays, these regions mostly lack of an adequate

transportation system for mass - production. These 100 million acres exceed the size of the US Corn Belt. Imports of soybeans to the European Community mostly arrive in the ports of Rotterdam and Saint - Nazaire (France),[1] as the EU is the world's largest soybean importer. Figures 3, 4 and 5 illustrate the Brazilian boom in soybean production and exports.

As a percentage of total supply, the US exports more than the other two producers (30% versus 20%), but consumption represents roughly the same proportion in all three countries (around 60%). Thus, exports alone explain the fact that the ending stock percentage in the US accounts for a smaller part of total supply: 10% compared with 20% in the other two countries.

Note that, over the last 5 years, Brazil has exported much more and consumed less in percentage terms with no significant change in ending stock percentage.

Soybean acreage in the US increased from 1.8 million in 1924 to 72.7 million in 2010.

Figure 4

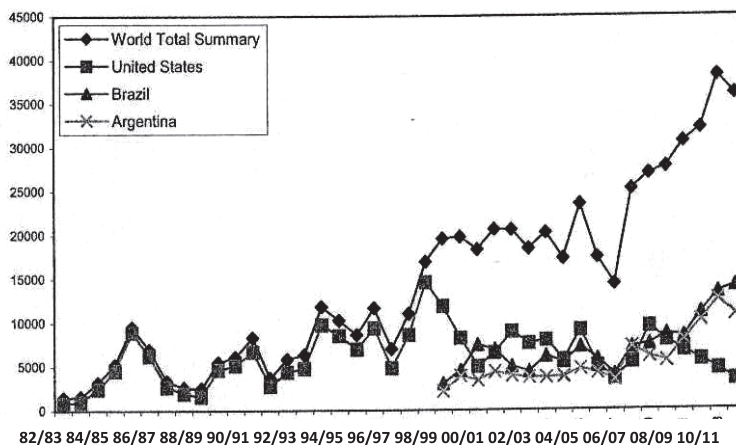Soybean world exports and the Brazilian boom-
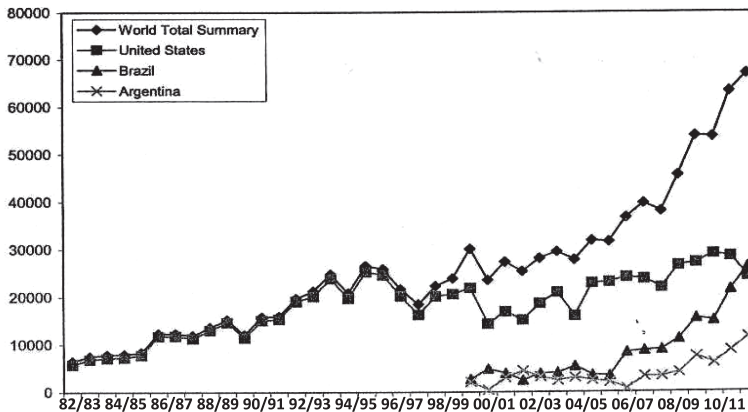
Source: Authors based on data from US Department of Agriculture (USDA).

[1] Saint Nazaire is home to a major soybean – processing center operated by the US commodity company Cargill.

Figure 5

Soybean ending stocks

Source: authors based on data from US Department of Agriculture (USDA).

Cultivation takes place in most central and eastern states, from Wisconsin to Alabama, with Iowa and IIinois predominating, each having more than 10 million acres under culture. Today, soybean represents the number one US export crop. An extensive study of soybean inventory and its relation to price volatility over the last 15 years can be found in the articles by German and Nguyen (2010) and Richter and Sorensen (2010).

Historically, soybeans were mainly prized for their seeds, which were processed into different types of food products. Today, soybeans account for more than one-half of the total fats consumed in the US. Indonesian consumers are turning to that source of proteins and fats, with a sharp increase in their imports over the past decade. Soybeans are also traded under the form of soybean meal and soybean oil; the three forms constitute what is called the "soybean complex".

Soybean meal and oil

 Soybeans are crushed to produce meal and oil. The crush spread is the expected gross margin of soybean processing. It is a very popular agricultural spread and traded by the simultaneous purchase (sale) of soybean Futures and the sale (purchase) of soybean oil and soybean meal Futures. Meal makes up 75% - 80% of the content of a bean and is used for animal feed as a direct competitor with corn. It has a higher quality protein than corn and, as such, exhibits a premium over corn. Factors affecting meal prices include: the availability of meal from crushing operations; the price of fish meal, produced from anchovy fished off the Pacific coast of South America; the price of corn and the size of livestock herds. Soybean oil is mostly used for cooking. Its competitors range from India's groundnut oil to Canada's canola oil, as well as sunflower oil and palm oil, mostly produced in Indonesia and Malaysia. An important product extracted from soybean oil is lecithin, used in many food preparations as an emulsifier.

   If meal demand is high and oil demand is not, processors promptly turn to crushing and allow oil stocks to build up in anticipation of future demand. This explains why trading the spread between meal and oil is very popular in this industry.

    Options on this spread are highly traded between participants in this market. Each month the US Census Bureau and the National Oil Processor Association (NOPA) release estimates of the crush rate and the stock of meal and oil.

Figure 6

Soybean nearby Futures price

06/07/11 26/07/11 10/08/11 26/08/11 13/09/11 28/09/11 14/10/11 29/10/11 16/11/11 03/12/11
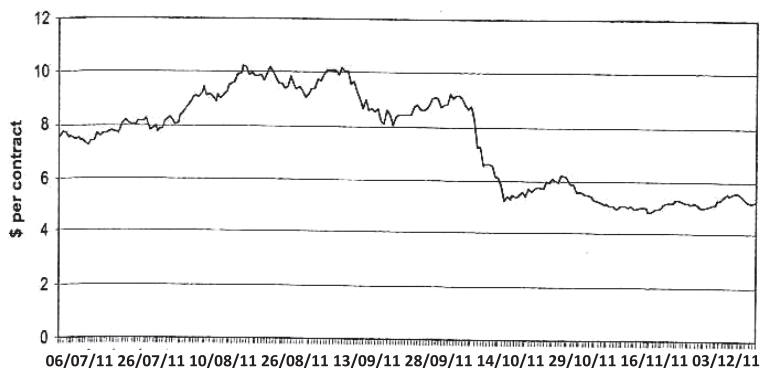
Source: authors based on data from the Chicago Board of Trade (CBOT).

Corn

Corn was first cultivated in Central America about 5000 B.C., when it was mainly used for human food. The cereal was brought to Europe and North America, but remained poorly grown until the 19th century. As strains of the plant were further developed, it led to a high - yield plant that could grow under different conditions and in different climates. Plants were also modified to increase their content of proteins, above all in the amino acid tryptophan, a lack of which in populations that mainly depended on corn led to skin disease.

Corn must be planted no later than mid - June and, even then, it may be too late as late - planted corn will need to flower and be pollinated in the high heat of the summer in late July to mid - August. Late - planted corn is also vulnerable to early frosts in the fall. If corn is to be planted late, farmers have the option to switch to a variety that has a shorter growing season. Today, corn represents about 70% of the world coarse grain markets. The five leading producers in 2003 were the US (38%), China (20%), Brazil (7%), EU (7%) and Mexico (3%). The main consumers in 2003 were the US (32% of world consumption, equivalent to about 88% of production), China (20%) and the EU (7%). Yields in the US or

EU countries are about three times those of Brazil and Mexico. In recent years, China has aggressively increased its corn production so that from a net importer it became a net exporter of corn. Production in Ukraine has increased markedly in the past years, with a 16.7% increase from 2001/2002 to 2002/ 2003, and a 50% increase in 2003/2004 relative to the previous year (Source: USDA).

The main competitors of corn as animal feed are wheat, sorghum and soybean meal.

One of the drawbacks of corn is its low content of essential amino acids, which is much higher in soybean. Corn production has been subject to scientific controversy in recent years. Use of Genetically Modified (GM) seeds that bear insecticide-producing genes or other modified features has prompted an ethical debate; some GM corns have for instance been qualified as improper for human food by the US Environmental Protection Agency (e.g., Aventis's Star Link product).

As was the case for the first known Central American populations, some in South America still use corn for human consumption. In Europe and the US, it is mainly used for forage. In Northern America, 75% of the corn produced is on average used for animal feed; this variety is called "dent corn". About 8% is transformed into vegetable oil or wheat for incorporation in food preparations, and 6% is used for food (in particular, sweet corn which possesses a higher quantity of sugar). Moreover, corn is used in alcohol distilleries, and in the production of alcohol for engines. Due to the major increase in crude oil prices in 2000, the use of corn for ethanol production increased considerably. Over 5% of US corn is currently used for the production of ethanol and other alternative fuels, and about 95% of North America's ethanol is made from corn. Programs on ethanol production from corn will therefore have a constant influence over corn prices, such as the $300m program announced at the end of 2000 by the US to expand ethanol production.

The corn that is traded on the Chicago Board Of Trade (CBOT) is animal feed, not the sweet corn bought in the supermarket. The competitors of feed corn are wheat, sorghum and soybean meal. Foreign competition in production is primarily China, South Africa and Argentina.

Electronic trading and new Futures on grains

In February 2002 the Minneapolis Grain Exchange (MGEX), which was established in 1881, launched corn and soybean derivatives: Futures and options contracts, respectively written on the National Corn Index (NCI) and National Soybean Index (NSI), started trading while the MGEX launched at the same time its new electronic trading platform MGEXpress.[2] NCI and NSI Futures and options trade exclusively on the MGEXpress. They were the first cash - settled grain and oil seed Futures and options and represent the industry's first exclusively electronically traded contracts as well.

The NCI and NSI are indexes composed of country elevator bids. As such, they tend to track prices where grain is originated - the cash market - more closely than corn and soybean contracts traded at the CBOT, which are based on delivery to a few major elevators.

The indexes are calculated by Data Transmission Network (DTN), an electronic commerce and information services company which collects bids from roughly 1,500 elevators and, in turn, calculates the indexes. These indexes are based on bids in the country and, hence, tend to correlate closely with cash prices, making the Futures contracts an effective tool for risk management. The indexes also reflect a broad spectrum of cash market participants, which precludes the possibility of index manipulations; for instance, the single largest bidders for corn and soybeans represent respectively 3.3% and 3.6% of the index and more than 90% of US elevators are represented. The contract size is 5,000 bushels for both NCI and NSI Futures.

Wheat

A grass similar to wheat was cultivated in the Middle East earlier than 8000 B.C. Its culture, in the area called the "Fertile Crescent", at that time most probably constituted the birthplace of agriculture. Wheat is the oldest commodity contract and started trading around 1850 on the CBOT. It is used as food for both humans and animals. For many nations, wheat is the staple diet and is certainly a major part of the US diet.

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[2]   OM Technology, a company based in Stockholm, provides the technological expertise behind MGEXpress.

World wheat production reached a maximum in 2008 with 609 million tonnes (note that a tone is the metric unit equivalent of 1.1 US tonnes), which was mainly due to large craps in the major producing countries: the US, former Soviet Union and China. US production has been unstable, with small crops in 2010 and 2011. Total trade projected for 2012/2013 is up 2% since 2010 to 99.5 million tonnes.

<div align="center">Table 1</div>

Different kinds of wheat in the US			
Wheat	Ratio of total production (%)*	Farmer price (crop 2011, $)	Domestic us/export (million bushels)*
Hard red winter	45.5	3.2-4.4	520.4/510
Hard red spring	21.4	3.5-4.5	246.5/260
Soft red winter Soft	16.2	3.0-3.8	250.6/135
white	12.8	3.2-4.0	116.5/180
Durum	4.1	3.6-4.5	85/40

* Projected for 2012/2013. Source: USDA.

Kinds of wheat

Wheat is traded on three US exchanges: the CBOT, the Kansas City Board of Trade (KCBOT) and the MGEX. Chicago wheat is a soft winter wheat. It is planted in the fall and harvested in the late spring and early summer. It is grown primarily in Tennessee, Arkansas, Missouri, southern Illinois, Indiana and Ohio. lt is low-grade wheat used as animal feed and as flour for cheap bread and pizza dough. It is often exported to Third World countries because of its low price.

Kansas City wheat is the largest crop. It is a hard, red, winter wheat and is grown in Texas, Oklahoma, Kansas, eastern Colorado and southern Nebraska. It represents prime bread and pizza dough wheat. About one - half of this crap is exported. Like Chicago wheat, it is planted in the fall and harvested in the spring and summer. Chicago wheat and Kansas City wheat account for 60% - 75% of the wheat grown in the US. Minneapolis wheat is grown in the northern states of Montana, the Dakotas, northern Nebraska and Minnesota. It is the highest grade

of wheat, planted in the spring and harvested in the fall. It is used for pastry and is not exported.

In the US, specifically in Texas, the harvest generally begins in June and continues north through the summer until it is completed in September in Minnesota. Storage facilities exist to store approximately one - half of it; the rest gets sold immediately. This situation produces a temporary oversupply, depressing the market until all the wheat can be used or sold abroad. So, every year, wheat gets depressed during the summer harvest. When the harvest is complete, the selling pressure comes off the market and the price gradually rises each fall until supplies become available from the southern hemisphere around December.

Therefore, we obtain a regular seasonal pattern in prices that are exhibited by observed price trajectories. The fundamentals facts that produce this pattern are clear: if the price approaches the bottom third of the historical trading range for wheat during the months of May, June or July, it is likely that this will be the low for the year. The combination of approaching historical low prices in the right seasonal time frame can be a buying signal for technical analysis speculators. These observations are part of the elements that constitute the technical analysis rules often used in the trading of agricultural commodity Futures, by Commodity Trading Advisors (CTAs) in particular.

Figure 7

Wheat nearby Futures price
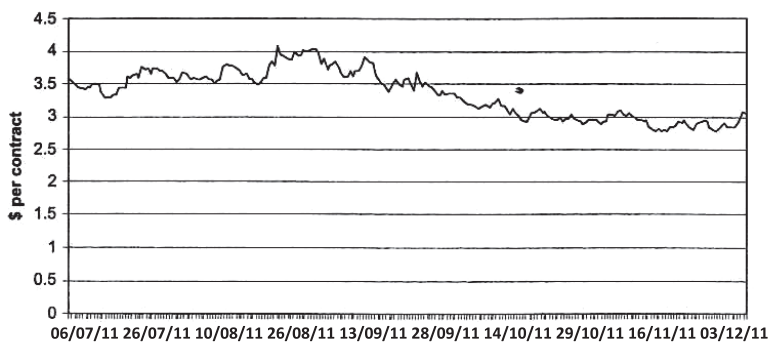
Source: authors based on data from the Chicago Board of Trade (CBOT).

Note that 75% of the wheat grown in the US is winter wheat that is planted in the fall. It germinates, sprouts, and then is covered with snow and lies dormant for the rest of winter. In late winter or early spring, it begins to grow once more and is ready to harvest by early summer.

Global wheat

World wheat production reached a maximum of 609 million tonnes in 2008, which was mainly due to bumper crops in the major producing countries: the US, Russia and China. The forecast for global production in 2012 is 548 million tonnes; this low value comes from a number of factors, not least of which has been variable US production over the past few years.

The competitors of the US in wheat production are most EU countries, along with Argentina, Canada and Australia. The main customers are Egypt, Morocco, Pakistan, India, Russia and China. Wheat is grown in almost every part of the globe, including Saudi Arabia.

Global wheat stocks have been decreasing since 2010. Ending stock forecast for 2012 and the stock – or – use ratio have reached their lowest values in a long time, stocks being depleted by 128 million tones. At the same time global consumption has slightly increased. Such conditions will make 2012 the sixth consecutive year that global consumption has exceeded production. Ending stocks in the US were at their peak in 2009 and 2010, reaching close to 40%, but have been decreasing ever since, and should end the year 2012 around 23%. China has seen its production fall in the past 3 years and has been using its own stocks to meet demand. India also had to face a small decrease in its stocks, due to rising consumption.

Wheat is a hard-to-kill grass and the only danger to the wheat crop is the loss of yield and quality in the case of too much rain at the end of the crop cycle when it is time to harvest (see Grandmill, 2001).

3. Soft commodities: Coffee, Cotton and Sugar.

The soft group is an odd mix. It is often referred to as "tropics" because these commodities are grown primarily in tropical or sub tropical regions. In most cases, they are grown in developing countries where information is often difficult to obtain.

Cocoa

Cocoa beans grow on trees and, hence, changes in production occur over very long cycles. New trees take approximately 7 years to mature and fruit, which makes grain production easy to forecast.

If prices get too low, cocoa farmers abandon marginal growth. This is what happened in the early 1990s when prices reached $795 a ton, down from $4,500 in 1976; the seventh consecutive year of overproduction was 1991. After the lows of 1992, the market rallied between then and 1998 with prices reaching $1,787.

Since early 2000, cocoa production has been expanding as a result of the additional trees that were planted as prices began to rise in the early 1990s. The Ivory Coast, by far the biggest cocoa - growing nation, has achieved record high production levels recently. Cocoa statistics are released every year by the International Cocoa Organization (ICCO) at its annual conference in London, where the headquarters of lCCO are located.

Measuring demand is difficult. Cocoa grind statistics are released country by country, but more cocoa is being ground in the production countries and shipped afterwards. As with other commodities, the stock – to – use figure is the most important one.

Because of the key role of London in cocoa trading, cocoa is also priced in sterling on the world market, in contrast to most other commodities.

Figure 8

Cocoa nearby Futures price
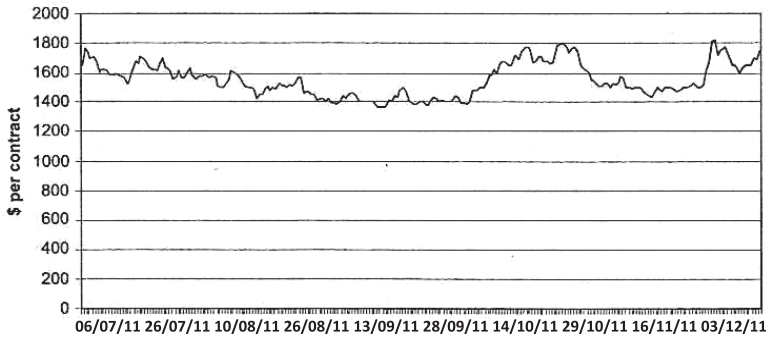
Source: authors based on data from the Chicago Board of Trade (CBOT).

Coffee

This tropical crop is grown in so many different varieties that the Coffee, Sugar and Cocoa Division of the New York Board of Trade (NYBOT) has established a scale that determines the ratio at which the different types of coffee can be delivered against the contract traded on that exchange. The main difference, however, is between African coffee, which is arabica coffee, and Latin America, which is robusta. The London coffee contract is arabica and the New York contract is robusta. The US almost exclusively imports robusta coffee, probably because US consumers have gotten used to its taste. Coffee is the second largest US import (it was the largest until the 1960s) - one of the reasons the coffee market has become subject to dramatic price volatility. It is interesting to note, for instance, that the development of the Starbucks coffee chain, which is now present in most towns of the US and 65 countries by the end of 2011, has given rise to an estimated increase of 10% in world coffee consumption.

Coffee grows as bushes. It takes 3 - 5 years for new bushes to mature sufficiently to produce fruit. Brazil is by far the largest robusta producer, followed by Colombia, Ecuador, Costa Rica and other Latin American countries.

The international Coffee Organization (lCO) is a consortium of producing and consuming nations. For years, the US, as the largest consuming nation, blocked a program meant to buy surplus production from farmers. Now some countries, most notably Brazil, have established their own price support programs independently; but these programs may collapse if they prove to be difficult or unpopular.

Overproduction of coffee (mediocre coffee in particular) in the world explains the consistent decline of coffee prices since 2008, as depicted in Figure 9. This phenomenon is occurring despite the sharp increase in US coffee drinking.

The Coffee Quality Program (CQP), promoted by the ICO with the aim of checking that coffee meets minimal standards before being sold on the markets, is not really effective. African producers, however, are trying to bridge the gap between robusta and arabica prices, the former having recently reached an all time low. African producing countries, regrouped in the African Coffee Organization, are determined to improve the quality of the robusta coffee they produce and promote a "robusta gourmet" – type coffee.

Figure 9

Arabica nearby Futures price
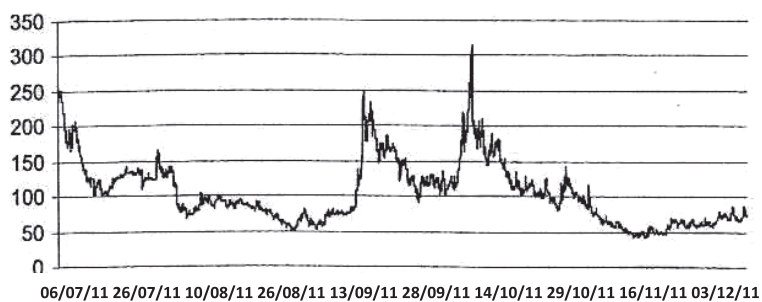
Source: authors based on data from the Chicago Board of Trade (CBOT).

Sugar

The year 2011 was disastrous for sugar, with spot prices of 6 cents per pound at the beginning of 2012, a number which is barely the production cost of the most efficient producers in the state of Sao Paulo (Brazil) and way below the cost of 40 cents per pound characterizing some old sugar-producing entities. The explanation for this drop is essentially oversupply. During 2010/11, the world production had generated large stocks, totaling between 3 and 6 million tonnes according to estimates. The season 2011-12 followed the same pattern, with an excess supply totaling between 2 and 3 million tonnes. Brazil again had a remarkable harvest, with the production of cane sugar increasing by 6% over the previous year. With potential exports of 13.5 million tonnes (out of its production of 24 million tonnes), Brazil dominates all its world competitors. India has become a structural exporter, while Australia and Thailand are following the same path. Only if consumption of sugar in China approaches Western levels would a number of the order of 20 million tonnes (Chalmin, 2012) be reached and push prices up, but this is not the case yet.

In June 2011 a meeting took place in Bangkok between Brazil, Australia, South Africa, Guatemala and Thailand - countries representing 25 million tonnes of exports. Not much was decided, except for a complaint directed to the World Trade Organization (WTO) against the sugar export policy of the EU. The complaint which Brazil filed, along with Australia and Thailand, argued that the close - on $2bn in annual export subsidies the EU pays to sugar beet and sugar cane farmers encourages over production, which floods the world, drives down market prices and hurts the economies of poor nations that depend on the crop. According to the agency Oxfam, EU subsidies depress prices by 23%, depriving developing countries of hundreds of millions of dollars in revenues from sugar crops. Indeed, the EU exports about five million tonnes of sugar a year.

In August 2011 the WTO declared the EU sugar subsidy program to be in violation of international trade agreements. In July 2011 the EU agriculture commissioner proposed extensive changes to EU sugar subsidies, including cutting support prices and exports. The WTO decision could planned hasten reductions in

sugar subsidies in the EU and, more generally, help developing nations by reducing farm subsidies in the rich nations by 20%.

Figure 10

Sugar production, consumption and price
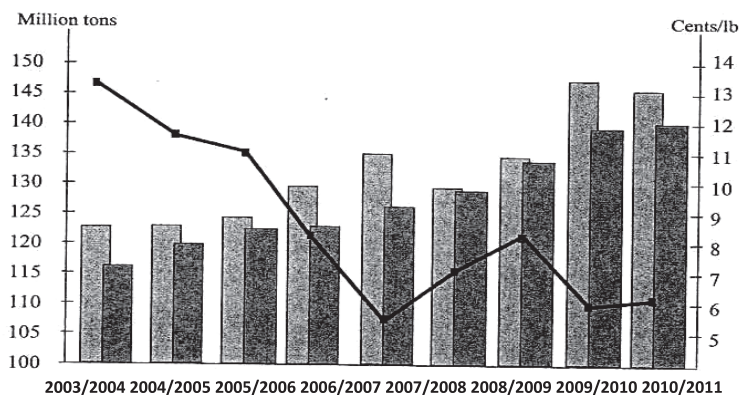
Source: authors based on data from US Department of Agriculture (USDA).

Cotton

This is another hot weather crop. In the US, cotton is grown from Georgia through Arizona and California. California cotton is among the best quality cotton in the world. Cotton is also grown in Latin America and Asia. Cotton exporters include such nations as Kazakhstan, Pakistan and Australia. China also produces a large quantity of cotton and alternates from being an importer to an exporter depending on its crop size and domestic usage.

Cotton prices in the US are mostly affected by world prices, but they are also subject to such government programs as the "Step I: Export Subsidy Program". This program is variously applied as it must be voted on each year by Congress.

Because cotton is such an important US crop, the USDA produces a very complete report that includes supply and demand figures for the US and for

Table 2

|	2006/07	2007/08	2008/09	2009/10	2010/01	2001/02*
Sugar production: Consumption, exports and imports (in million tonnes).						
World production	**130.9**	**136.5**	**130.5**	**134.9**	**147.3**	**144.6**
Brazil	18.3	20.1	17.1	20.4	23.8	24.8
India	17.4	20.2	20.5	20.5	22.1	19.9
European Union	17.8	19.5	18.5	16.2	18.7	17.1
China	9.0	7.5	6.8	8.3	10.6	10.1
United States of America	7.6	8.2	8.0	7.2	7.6	8.1
Thailand	5.4	5.7	5.1	6.4	7.3	7.7
Mexico	5.0	5.0	5.2	5.2	5.2	5.5
Australia	5.0	5.4	4.2	4.7	5.4	5.1
Cuba	3.8	4.1	3.5	3.7	2.0	2.0
Russian Federation	1.3	1.5	1.6	1.6	1.6	1.8
Ukraine	2.0	1.7	1.7	1.8	1.6	1.4
World consumption	**124.2**	**127.4**	**130.2**	**134.8**	**137.7**	**139.3**
India	17.0	17.3	17.8	19.8	20.8	21.5
European Union	14.3	14.5	14.1	14.1	14.4	14.4
China	8.9	8.5	8.7	9.4	9.9	10.3
Brazil	9.1	9.1	9.3	9.5	9.8	10.1
United States of America	9.1	9.0	9.3	9.1	9.1	8.8
Russian Federation	5.0	6.1	6.8	7.0	6.3	6.0
Mexico	4.5	4.6	4.6	5.2	5.2	5.3
Ukraine	2.0	1.9	2.1	2.0	2.4	2.2
World exports	**37.4**	**41.4**	**37.7**	**41.2**	**45.7**	**45.1**
Brazil	8.8	11.3	7.7	11.6	14.0	14.3
Thailand	3.4	4.1	3.4	4.2	5.1	5.8
European Union	5.3	6.1	6.6	4.8	5.6	4.9
Australia	4.1	4.1	3.1	3.6	4.2	3.9
Cuba	3.1	3.4	3.0	3.1	1.4	1.3
World imports	**36.0**	**36.1**	**38.6**	**37.7**	**39.2**	**37.2**
Russian Federation	5.4	5.2	5.7	4.9	3.9	3.8
United States of America	1.7	1.5	1.4	1.4	1.6	1.4
Japan	1.5	1.7	1.5	1.4	1.5	1.4
China	0.5	0.7	1.1	1.4	0.6	0.6
Indonesia		1.7	1.8	1.7	1.8	1.9

Source: USDA.
*Estimated.

the world. Cotton is used primarily for clothing fiber and is increasingly being consumed in developing countries as their economies improve.

The Cotlook A Index - the major cotton index - averaged 68 cents per pound in 2010/11, a 6 - year high. Higher prices are boosting the world cotton area by an estimated 8% in 2011/12. The harvest has begun in the northern hemisphere without incident, and the world yield is forecast to climb to a record 663 kg per hectare in 2010/11, up 26 kg from the previous season. As a result, world production is forecast to go up 13%, from 20.5 million tonnes in 2010/11 to a record 23.1 million tonnes.

Expectations of rising stocks and lower imports by China in 2011/12 caused the Cotlook A Index to fall from 75 cents per pound in January 2011 to 52 cents per pound in August 2011. World cotton consumption in 2004 will be stimulated by lower prices, as cotton is currently price-competitive with polyester. Mill use is forecast to go up 400,000 tonnes, nearly 2%, to a record of 21.6 million tonnes in 2011/12.

Figure 11

Cotton nearby Futures price
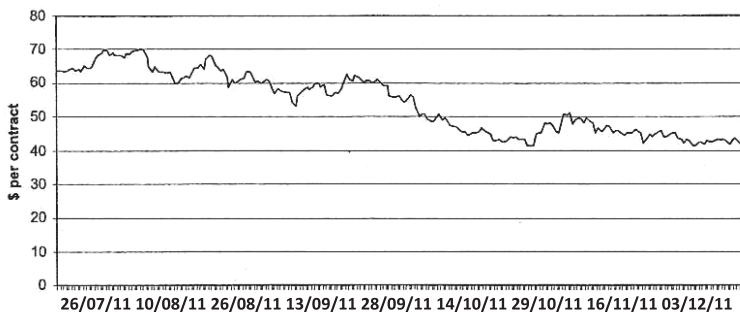
Source: authors based on data from the Chicago Board of Trade (CBOT).

The shortfall between production and consumption in China is expected to shrink by 1 million tonnes from more than 2.2.million tonnes in 2010/11. However, depleted stocks, including government reserves, need to be replenished.

Chinese imports are expected to decline from more than 1.9 million/tonnes in 2010/11 to 1.5 million tonnes in 2011/12.

Despite record consumption, world ending stocks are projected to increase from 7.8 million tonnes last season to 9.2 million tonnes in 2010/11. Market fundamentals suggest that the season average Cotlook A Index will decline to 52 cents per pound in 2011/12, 16 cents (24%) below the average in 2010/11.

Figure 11

World cotton supply and distribution			
	2010/11	2011/12	2012/13*
Production	20.485	23.08	22.04
	94.09	106.0	101.2
Consumption	21.256	21.63	21.98
	97.63	99.4	101.0
Exports	7.280	3.56	6.95
	33.44	30.1	31.9
Ending stocks	7.761	9.21	9.26
	36.65	42.3	42.5

* Projected; the first number is in million tonnes, the second in million bales.
Source: USDA.

4. Citrus and orange juice

Citrus represents a very important group in world fruit production. It constitutes roughly one - quarter of total fruit volume, but there is a high variability in production. All the main producing countries have reduced their output: Brazil by 9%, the US by 7%, China by 13% and Spain by 3%. These four countries account for 53% of world production, and in the total list, the first ten countries account for 71%.

The international citrus market is divided into two types of products: fresh fruit and juices. One - third of world citrus production is transformed into juices. Brazil (the state of Sao Paulo) and the United States (state of Florida) are the principal regions in the world for citrus juices (particularly, orange juice) and account for 75% of transformed citrus volume. Italy and Mexico for orange juice, Argentina for lemon juice and Cuba for grapefruit juice complete the world offer. The EU has slightly reduced its imports in the recent past, while the US has increased its imported volumes and no significant change has happened in Asia. The price of frozen concentrate orange juice (i.e., the reference product) remains stable between $1,000 and $1,200 per ton (free on board) in Europe, despite a sharp decline in the Brazilian crop for the season 2003/04, the worst since 1989. This is due to the high level of inventory and the expectation of a record harvest in Florida.

Table 4

Concentrate orange juice in Brazil (in thousands of tonnes)					
	2008	2009	2010	2011	2012 (estimated)
Beginning inventory	346	263	151	240	92
Production	1,197	978	1,354	1,005	1,260
Exports	1,265	1,078	1,250	1,135	1,195
Consumption	15	15	15	18	18
Ending inventory	263	141	240	92	139

Source: USDA.

A recent and fundamental evolution in juice consumption is the shift in interest to "not – from - concentrate" orange juice. The market share of such juice in the US is today at 52% and should increase at a rate of 3%-5% per year. Accord with that, many plants in Florida are transforming their capacity to production of not-from-concentrate orange juice.

Frozen Concentrate Orange Juice (FCOJ) was first traded in an organized way around 1947. Innovations in packaging and transportation permitted the

emergence of an international market. In 1966 the NYBOT launched FCOJ Futures contracts, and options on Futures appeared in 1985. Both instruments translated the impact of the weather on the commodity price and, in turn, its risk: production in Florida is very sensitive to frost while orange trees in Brazil languish in a dry climate.

The quality of orange juice is measured by two criteria: "brix" and the acidity (brix represents the fraction of sugar in the juice). The taste of the fruit is determined by the sugar – to - acid ratio.
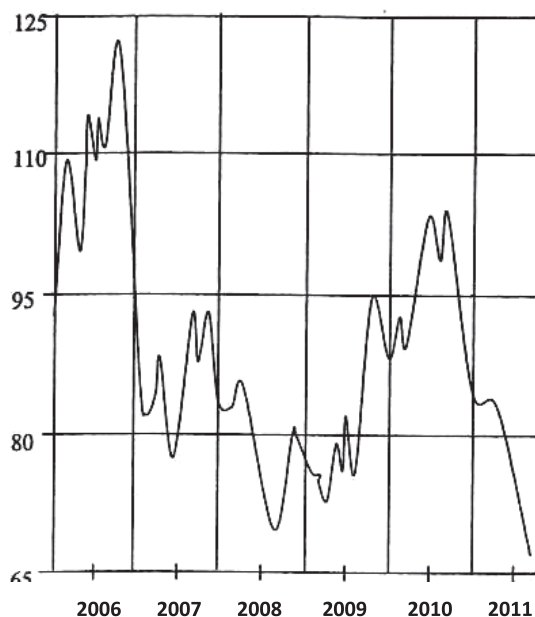
Table 5

Orange juices (in thousands of tonnes) and the main exporting countries.						
	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13*
World production	2,416.9	2,489.3	2,199.9	2,604.2	2,142.7	2,602.3
Brazil	1,360.0	1,197.0	978.0	1,354.0	1,005.0	1,260.0
United States of America	879.0	1,071.7	966.7	992.8	898.3	1,108.9
Spain						
Israel	45.3	52.0	58.0	58.0	56.0	58.0
Italy	14.5	74.0	52.0	40.0	44.0	35.0
South Africa	25.0	40.0	38.0	38.4	45.3	37.0
Australia	15.8	23.5	20.8	27.4	23.7	23.1
Mexico	17.6	23.1	13.0	26.1	13.5	18.1
	45.3	41.0	40.5	34.0	13.0	20.0
Main exporting countries						
Brazil	1,295.0	1,265.0	1,075.0	1,250.0	1,135.0	1,195.0
Untied States of America	106.8	103.5	87.2	128.89	73.3	125.0
Spain	56.6	73.7	59.0	55.0	56.0	57.0
Italy	28.0	38.0	43.0	16.1	18.0	20.0
Mexico	45.0	37.8	37.9	0.7	9.9	16.9

Source: USDA.

Figure 12

Price of orange juice in Chicago (in cents per pound)

Source: authors based on data from the Chicago Board of Trade (CBOT).

Table 6

FCOJ Futures contract specification

Trading unit	15.00 pounds (±3%)
Trading hours	12:30 p.m. to 2:45 p.m.
Traded months	January, March, May, July, September, November
Symbol	OJ
Tick	0.05 cent per pound or $7.5 per trading unit
Last trading day	The 14th business day prior to the month's last business day
Quality	Grade A, with a minimal brix degree of 62.5
Delivery location	Defined locations in Florida, New Jersey, Delaware and California.

Source: authors based on data from the Chicago Board of Trade (CBOT).

5. Livestock markets

Unlike grain markets, where almost one - half of the use is exports, livestock markets are much more domestic. Although exports have become more important, they only represent 10%-15% of total use. The advance of agribusiness is noticeable in the livestock markets. Producers now sell their production directly to packers and this may lead to the demise of livestock Futures markets. For the time being, cattle and hogs are still auctioned on the open market.

Cattle

The USDA releases its "cattle – on - feed" report every month; this shows the supply and demand numbers of cattle on feed, their placement and marketing. Cattle on feed means the total number of cattle in feedlots, placements mean the number of cattle placed in feedlots and marketing is the number of cattle marketed by these feedlots.

Each month, the USDA also releases a "cold storage" report that includes pork, beef and orange juice in cold storage throughout the country. At the end of January, the USDA releases its annual cattle inventory report, which is not only the best indicator of supply in the coming year, but also of increasing or decreasing production in the long term. However, the total number of calves (and their ages) is not enough to describe supply: the price of feed (corn) makes a big difference since animals are fed longer if corn is cheap. In contrast, when the price of corn approaches $4, the market is flooded with large numbers of animals. Over the last 14 years, the cattle price has plunged whenever corn prices reached $3.25 or higher.

The demand for cattle is more elastic than the supply (e.g., when the public at large experiences the feel-good factor a preference for beef is observed).

Studies show that when the number of available cattle is tight, producers tend to try to hold their cattle in order to get a higher price. Likewise, when supply looks like becoming plentiful, they will try to sell their cattle while prices are still good.

To trade feeder cattle, one has to watch the feeder cattle market, the cattle market and the corn market at the same time. As a result of such an amount of necessary information, there is a lack of liquidity in the cattle market.

Hogs

The cycle for hogs is significantly shorter than the cycle for cattle. Hogs are taken to the market when they weight around 230 lb, i.e., at the age of 6 months. The USDA's quarterly Hogs and Pigs Report is filled with important details regarding the nation's hog supply. As mentioned earlier, another important report is the monthly "cold storage" report.

Pork bellies

Pork bellies are the flanks and ribs of hogs and are largely used to make bacon. They may be stored up to 1 year when frozen and represent the underlying of the Chicago Mercantile Exchange (CME) contract. The hog Futures contract represents 40,000 lb of carcass and (unsurprisingly) is cash - settled based on an index of prices collected by the USDA. The belly Futures contract represents 50,000 lb of frozen bellies; each point move (one - hundredth of a cent) represents $5 per contract. There is a 300 - point limit in the belly market which is known for numerous limit moves. The reason usually given for that high volatility is the high percentage of speculators - as opposed to hedgers - in this market.

6. Technical analysis in agricultural commodity markets

(A) Some reminders of fundamental analysis

We recap here the main components of the fundamental analysis.

(1)Supply and demand characteristics.
Total supply is defined by the beginning stocks carried over from the previous year's production plus imports:

- Beginning stocks are in general published by the USDA and analogous publications.
- Production is the crop estimate for the current year and is a key number to figure out. Sources of information on this key number, production, are the USDA weekly Crop Progress report as well as news collected from information providers worldwide. For instance, those who closely followed the political upheaval which has been brewing in the Ivory Coast for more than a year and which culminated in November 2004 with the massive departure of French producers were certainly able to benefit from the sharp rise in cocoa prices at the end of November 2004. Last but not least, major agrifood and agribusiness companies such as Nestlé, Cargill or Louis Dreyfus Corporation locate their own staff in major producing countries in order to have real - time information on what the fields, trees and future crops look like.
- Imports are relevant at the level of a country or a region. From a worldwide perspective of prices in a given commodity market, they play no role.

(2) Ending stocks (01' carry-over stocks).

These are defined by total supply, i.e., production plus beginning stocks plus imports, minus demand, including the raw commodity used in the crush process. Obviously, in the case of agricultural commodities, there are no underground

reserves as in the case of oil and natural gas. An interesting piece of information, however, is represented by commodities "in transit". There is a weekly report produced in the US by the Commodity Futures Trading Commission (CFTC) which publishes the changes in terms of volume of corn, wheat, soybeans and oats which are in the elevators licensed to deliver on the CBOT. This information is particularly relevant for those willing to trade the first nearby Futures contract.

(3) Weather

Weather is a key component of fundamental analysis for agricultural commodity markets. Given the location in both hemispheres of major producing countries of soybean, corn, coffee, etc., each calendar quarter represents either a planting season (winter in the US), a crop development season (summer in the southern hemisphere for Brazilian coffee) or a harvest season. Besides the major TV and radio channels, other sources of information are available such as the weekly USDA Weather Bulletin or private companies' publications.

To conclude this section, we observe that, just like in equity markets, large volumes in commodity markets will move prices and volatility (German and Ané, 2006). In practice, these large volumes go together with news arrival on one of the quantities discussed above and constitute an important signal both for fundamental and technical analysts.

(B) Technical analysis

In agricultural commodity markets, the "locals" in the pits together with the major agrifood companies and crush spread traders represent the major players; banks and other financial institutions are practically not present, while they do intervene in metals and energy markets. Moreover, the trading sessions are short, lasting for a few hours (from 10:30 a.m. to 2:10 p.m. New York time) and it is quite risky to keep open positions from one day to another. These open positions are mostly held by hedgers. For the other market participants, technical analysis is a particularly popular tool. Without trying to be exhaustive on this subject to which dozens of books are dedicated, we provide below some minimal elements of this approach.

The technical approach to investment in commodity markets relies on the premise that prices move in trends which are determined by the changing attitudes of investors toward a number of factors, including the ones defining a fundamental approach to the markets as listed above. According to Perfetti (2002), "technical analysis is the ability to identify trend changes at an early stage and to maintain an investment position until the weight of the evidence indicates that the trend has reversed." It is important to observe that technical analysis does not try to forecast trends in the economy or to assess the attitudes of investors toward those changes. It aims to identify turning points in the market's assessment.

Charts

The bar chart is the first basic tool of the technical analyst. It consists in representing every day with a bar (vertical line) where the top represents the day's high and the base the day's low. Most professionals subscribe to a service which updates the charts in real time. In any given price chart, analysts will try to identify patterns. The first goal is to determine the trend of the market, uptrend or downtrend, as well as changes in the trend.

*Trend-determining techniques*

The trend line is the most basic and the most popular of all chart tools. It can be either an uptrend line or a downtrend line. In an uptrend (respectively, downtrend) the market tends to show higher lows and higher highs. In a rising (or bull) market, the trend line is obtained by drawing a straight line between higher lows; the more points connected, the more conclusive the trend is. When an uptrend line is broken, this is viewed as a negative signal and long positions should be liquidated. But it may be that the market returns to the preceding trend, and a new trend line should be drawn using the new significant high.

Channels

In the "best" trends, prices trade within a channel. A channel is identified by constructing a parallel line to the major trend line:

Figure 13

Representation of a channel
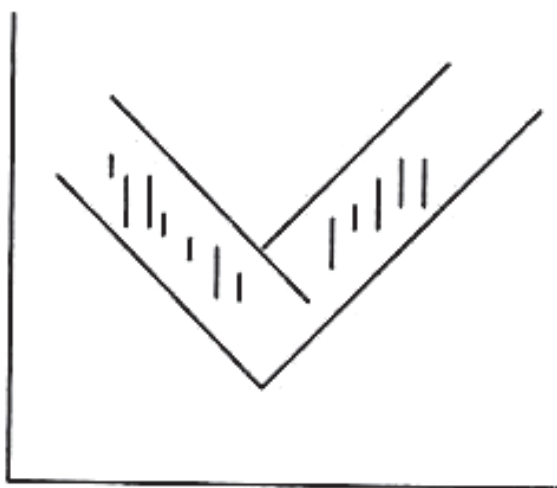
Source: authors.

 A classical view in technical analysis is that when a market trades above the upper channel line in an uptrend, there are good chances that the market is entering in an accelerated phase - usually because of some news arrival about supply or demand.

Support and resistance

 "Support" and "resistance" represent two of the most important wards in technical trading. Support is an area where buying interest was observed in the past, hence is expected to develop again. Resistance is a symmetric notion: it represents a

level market prices having difficulties to go beyond, hence the name. Support and resistance levels can be drawn graphically by using a horizontal line on the bar chart connecting the low points in the case of support and the top points in the case of resistance.

Figure 14 shows the evolution of wheat prices during the period 29 November to 6 December 2011. Looking at the price chart on 6 December, the technical analyst will draw a support line at 300 and a resistance line at 304. He recognizes a buying signal when the market breaks the 304 resistance level.

Figure 14

**Intraday wheat prices from 29 November to 6 December 2011**
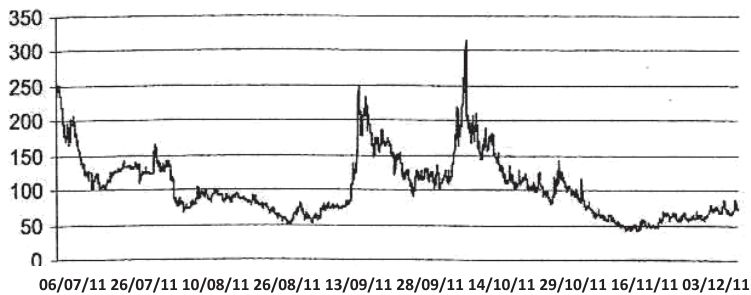
Source: authors based on data from the Chicago Board of Trade (CBOT).

Flags

As indicated by the name, a flag indicates a market trend where the price trajectory is included in a slanted rectangle, upward or downward sloping, and signals a pause after a significant move. When the flag is passed, prices return (in principle) to the same drift as the one prevailing before the flag, and in bigger volumes - since market participants do not in general like trendless markets:

Figure 15

Representation of a flag
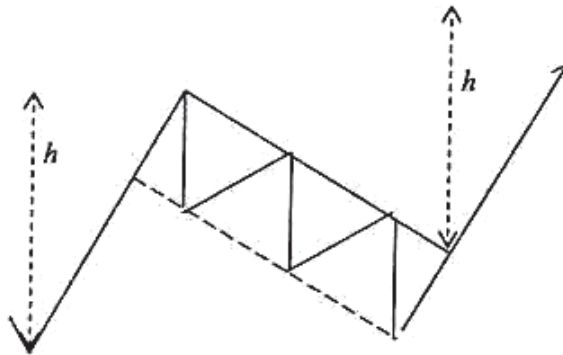
Source: authors.

Figure 16 exhibits a bearish flag because of its inverted shape. The market entered the flag a downward trend; the lower side of the flag represents a support line. When it is broken in September 2011, the technical analyst recognizes a selling signal. Everyone, including non - technical analysts, can visualize on this graph the extreme volatility of agricultural commodity markets.

Elliott waves and Fibonacci series

Ralph Elliott published the results related to his famous waves in 1939. His "theory" relies on the observation that natural cycles have been observed since the beginning of the universe, in the planets' trajectories, in the immutable alternation of nights and days. These cyclical evolutions have to be transmitted to financial markets since prices have to reflect the current psychology of market players.

Figure 16

Corn prices over the period October 2010 to December 2011

Source: authors based on data from the Chicago Board of Trade (CBOT).

Fibonacci sequence

This is named after the mathematician Leonardo Fibonacci, who lived in the 13th century and introduced the sequence:

$$1, 2, 3(1 + 3), 5(2 + 3), 8(3 + 5), 13, 21, 34, 55,$$

The ratio between two consecutive numbers is equal to 0.618 and 1.618, depending on which order it is computed; moreover is called the gold number.

$$1.618 = \frac{1 + \sqrt{5}}{2}$$

The relation between Elliott's considerations on the repetition of natural cycles and Fibonacci's sequence is based on the "observation" that many natural phenomena occur according to this proportion: for instance, out of the 89 petals

in a sunflower, 55 are oriented in the direction of the wind, 34 in the opposite direction; both 34 and 55 belong to Fibonacci's sequence! Assuming that the same rules apply to financial markets, the same ratios are used to build the retracements lines.

Figure 17 depicts the intraday evolution of soybean prices over the period 30 November to 3 December 2011. On 3 December at 12:00 a.m., the technical analyst draws the extreme lines of support and resistance at 520 and 538.5, as well as the middle line 529.3. Moreover, he draws two other lines related to the Fibonacci ratios: the Fibonacci ratio 0.618 multiplied by 18.5 and leading to the horizontal line at the level 520 + 11.3 = 531.4; and (1 - 0.618) x 18.5 leading to the level 520 + 7 = 527. When this 527 line is reached, the technical analyst may decide to get out and take his profits or wait until the market reaches the middle line 529.2. In all cases, consolidation will occur at one of the three levels 527, 529.2 or 531.4 (according to Fibonacci).

Figure 17

Intraday soybean prices from 30 November to 3 December 2011
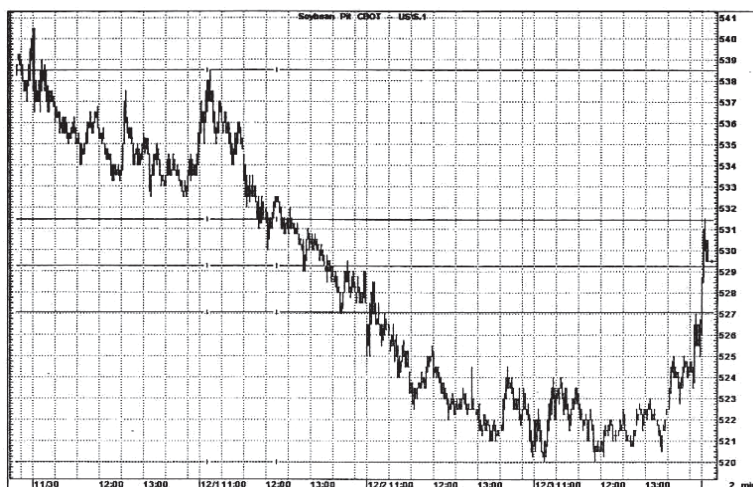
Source: authors based on data from the Chicago Board of Trade (CBOT).

7. Conclusions

The analytic disciplines that apply to financial markets, such as principal components, stochastic process characterization, Elliott waves and Fibonacci series, flags and charts and arbitrage relationships, can be apply to agricultural commodity markets. In addition, the fundamentals of agricultural economics give us strong indications for quantitative characterization. However, analytic disciplines are more useful for characterization of specific instances and specific issues of derivatives agricultural commodities markets. Despite the difficulty in modeling, the quantitative characterization of both term structures and strike structures of volatility is considerably enhanced by the use of formal techniques.

Derivatives agricultural commodities markets are strongly influenced by the separate economics of spot price movements and the arbitrage relationships for forward curve slope movements. These are in constant tension, and relative strengths change both over time and simultaneously across different tenors of the agricultural commodity curve.

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