



Food prices and market volatility: the variables involved



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Dear Reader,
In the last five years, food commodity markets have been affected by significantly increased prices and high volatility.

This, in many ways, is something new that is of concern because the current state of volatility will, in all likelihood, persist over time, putting pressure on the entire food system if effective solutions are not found and shared.

This is not a purely economic matter nor the exclusive concern of those involved in the food chain; in fact, this increased instability has dramatic consequences, particularly for the inhabitants of the poorest countries in the world. The World Bank has estimated that the increase in prices between 2010 and 2011 has pushed 44 million more people below the poverty threshold.

In contrast, the maintenance of balanced prices means solidity for the whole food chain, adequate remuneration of the production factors – starting with work - and the possibility of investment planning.

Given the importance of the subject, the Barilla Center for Food & Nutrition has decided to thoroughly investigate the causes, in order to understand the reasons for this discontinuity with respect to the trends recorded in the recent past, and, in particular, to analyze the factors involved and the main dynamics of correlation.

What we present here is the first of the documents that we intend to devote to this complex issue, in hopes of helping to understand its importance and the essential technical aspects, illustrated in an accessible and clear way.

Starting next year, other works will follow because we want to help keep the attention high on these important issues that affect the quality of life of billions of people in different countries around the world.

Enjoy the read,
Guido Barilla

A high-angle photograph showing two women in traditional head coverings (one yellow, one green) kneeling on a vast field of red chili peppers. They appear to be sorting or inspecting the peppers. The field is divided into sections by narrow paths of bare earth.

THE VISION OF THE BARILLA CENTER FOR FOOD & NUTRITION

TO OFFER A VARIETY OF HIGHLY SCIENTIFIC CONTRIBUTIONS AND BECOME A VALUABLE SERVICE TO THE INSTITUTIONS, THE SCIENTIFIC COMMUNITY, THE MEDIA AND CIVIL SOCIETY OVER TIME; A MEETING POINT FOR ANYONE WHO CARES ABOUT FOOD, THE ENVIRONMENT, SUSTAINABLE DEVELOPMENT AND ITS IMPLICATIONS ON PEOPLE'S LIVES.

THE FUTURE OF FOOD IS GROWING WITH US

THE BARILLA CENTER FOR FOOD & NUTRITION

The Barilla Center for Food & Nutrition (BCFN) is a center of multidisciplinary analysis and proposals which aims to explore the major issues related to food and nutrition on a global scale.

Created in 2009, BCFN intends to listen to the demands emerging from society today by gathering experience and qualified expertise on a worldwide level and promoting a continuous and open dialogue. The complexity of the phenomena under investigation has made it necessary to adopt a methodology that goes beyond the boundaries of different disciplines.

These topics under study are broken down into four areas: *Sustainable Growth for Food*, *Food for Health*, *Food for All* and *Food for Culture*. The areas of analysis involve science, the environment, culture and the economy; within these areas, BCFN explores topics of interest, suggesting proposals to meet the food challenges of the future.

FOOD FOR SUSTAINABLE GROWTH

In the field of *Food for Sustainable Growth*, the Barilla Center for Food & Nutrition focuses on the issue of the optimization of natural resources within the framework of the food and agricultural sector. More specifically, the studies conducted so far have identified some critical issues and have evaluated the environmental impact of food production and consumption, putting forward a series of proposals and recommendations for individual and collective lifestyles which may have a positive effect on the environment and on natural resources.



FOOD FOR HEALTH

In the field of *Food for Health*, Barilla Center for Food & Nutrition has decided to start its research work by analyzing the existing relationship between nutrition and health. It has studied in depth the recommendations provided by the most distinguished nutrition institutes in the world and the results of ad hoc panel discussions with some of the most accredited scientists at the international level. As a result, it has been able to provide civil society with a clear set of concrete proposals for more easily adopting a correct lifestyle and a healthy diet.





FOOD FOR ALL

In the field of *Food for All*, the Barilla Center for Food & Nutrition deals with the issue of food accessibility and malnutrition with the aim to reflect how to promote better governance of the food and agricultural sector on a global scale, in order to have a more equitable distribution of food and a better impact on social well-being, health and the environment.



FOOD FOR CULTURE

In the *Food for Culture* area, the Barilla Center for Food & Nutrition aims the relationship between man and food. In particular, BCFN has traced the most significant stages in the evolution of the man-food relationship, refocusing on the fundamental role of the Mediterranean diet.

In line with this approach, the activities of BCFN are guided by the Advisory Board, a body composed of experts from different but complementary sectors, which makes proposals, analyzes and develops the themes, and then drafts concrete recommendations.

One or more advisors have been individuated for each specific area: Barbara Buchner (expert on energy, climate change and the environment) and John Reilly (economist and expert on environmental issues) for the area *Food for Sustainable Growth*; Mario Monti (economist) for the area *Food For All*; Umberto Veronesi (oncologist), Gabriele Riccardi (nutritionist) and Camillo Ricordi (immunologist) for the area *Food for Health* and Claude Fischler (sociologist) for the area *Food for Culture*.

In its first two years of its activity, BCFN created and divulged a number of scientific publications. Driven by institutional deadlines and priorities found on the international economic and political agendas, it has reinforced its role as a collector and connector between science and research, and policy decisions and other governmental actions.

BCFN has also organized events which are open to civil society, including the *International Forum on Food & Nutrition*. This event is an important moment of confrontation with the greatest experts in the field and is now in its second edition. BCFN continues its path of analysis and sharing for a third year, making its content accessible to as many interlocutors as possible and acting as a reference point on issues of food and nutrition.

In *Food for All*, the Barilla Center for Food & Nutrition has recognized two main directions of study so far: on the one hand, access to food, food scarcity, and the related needs and the phenomena these cause; and on the other, the definition of an index of well-being able to provide timely guidance and direction for individual and collective behavior toward the conditions for objectively greater prosperity.

The document that we present concerns the in-depth study of a highly topical issue which has attracted attention globally of the policy-makers and key players in the food industry, for its consequences in terms of access to food and the economic impacts. It deals with the trend in the prices of food *commodities*, which have started to increase very rapidly, and the phenomenon of the increasing volatility of these markets which is currently being recorded. The aim of the document is to identify and examine the key factors underlying these trends, in order to understand the main relationships and effects, and in order to have a correct understanding of them and the ability to propose effective policy measures.



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An aerial photograph of a vast agricultural field, likely a vegetable or fruit nursery. The field is divided into numerous long, parallel rows of crops. The crops exhibit a variety of colors, including vibrant greens, yellows, oranges, and deep reds, suggesting different stages of growth or different varieties. Some rows are covered with a blue plastic mulch, which is visible as a grid-like pattern. The rows are separated by narrow, light-colored paths or furrows. The overall scene is a dense, organized expanse of cultivated land.

FOOD PRICES AND
MARKET VOLATILITY:
THE VARIABLES
INVOLVED

EXECUTIVE SUMMARY

1. THE NEW PHASE OF RAPIDLY RISING FOOD COMMODITY PRICES AND THE INCREASE IN VOLATILITY HAS ATTRACTED GLOBAL ATTENTION BECAUSE OF THE POSSIBLE SOCIAL AND ECONOMIC CONSEQUENCES

Since the second half of 2010, market prices of agricultural commodities have started to grow very quickly: during the period between July 2010 and February 2011, the FAO Food Price Index rose by 38%, reaching a peak level higher than the one recorded during the 2008 food crisis. In 12 months, from June 2010 to June 2011, the price of cereals alone rose by 71%.

In addition, there is an alarming increase in the volatility of prices, with rapid and very marked swings going up and down daily, even within the same session, which, of course, creates uncertainty and instability in the markets. Another worrying fact is the standard deviation, a measure of volatility, which in the last 5 years has more than doubled as compared to the previous 15 years (29.3 compared to 13.5).

In an already difficult context for current global economic conditions, the consequences of these phenomena could lead to a highly critical situation for the food security of families (particularly those with low incomes) and in the development of the food chain and the economy as a whole (especially, but not only, in developing countries).

The effects generated by the instability and uncertainty in the markets have attracted the attention of the international community as evidenced, for example, by the decision of the French Presidency to put the issue of access to food at the center of the work of the next G-20 summit in Cannes (November 3-4, 2011), paying particular attention to the issue of prices.

2. THE DYNAMICS OF PRICES ARE DETERMINED IN THE SHORT AND MEDIUM-TERM BY SEVERAL FACTORS THAT ACT WITHIN A FRAMEWORK OF COMPLEX RELATIONS THAT CAN BE ANALYZED USING A MODEL OF INTERPRETATION PROPOSED BY THE BARILLA CENTER FOR FOOD AND NUTRITION

The interpretative model proposed by the BCFN intends to offer a systemic view of the many elements, the subject of many studies and investigations, which help to define the performance of food commodity prices, with the aim of identifying and understanding the causation and possible interrelationships. We have highlighted the factors related to the demand side (demographic factors, economic growth in emerging countries, dietary habits, level of stocks

of the product) and those of the supply (agricultural production, limited natural resources, effects related to climate change, biofuel production), as well as cross-cutting factors that directly or indirectly affect prices (the level of financial speculation, the trend of exchange rates, oil and energy prices, trade policies and international geopolitical dynamics).

- The growth of the world's population (from 6.9 billion to 9.1 billion in 2050) and its progressive urbanization, the economic development in emerging countries (average annual growth in GDP has been 7.3% in Asia and 4.5% in sub-Saharan Africa over the past 5 years) and the resulting shift in food choices toward more complex food in these countries (128% increase in per capita consumption of meat in China since 1990) represent enormous challenges for the global food system, that in the medium-long term will have to try to cope with this increase in demand (according to the FAO, between 70 and 100% by 2050) which will cause increasing tensions concerning the prices of food commodities. An increase in the demand for meat and dairy products increases the demand (and prices) of the products necessary for raising animals (cereals and protein crops), and similarly, their increased price results in higher prices for livestock products.
- Several factors, including lower than expected harvests due to adverse weather events and changes concerning the use of certain crops in favor of the energy sector (biofuels), have recently made it necessary to draw on stocks accumulated over the years to meet the growing demand for food (which has grown faster than the supply) and to stabilize domestic prices. There is a strong link between the development of food stocks and changes in the prices of major agricultural commodities (wheat, corn, rice). In particular, in a sufficiently ample time span, it was observed that a reduction in the stocks-to-use cereals tends to correspond to an increase in the level of prices; on the contrary, an increase in the stocks-to-use tends to reduce the price (for example, between 1990 and 2011, the correlation for wheat was -0.73).
- Faced with the growing demand, the supply system will have to be capable of ensuring a state of market equilibrium, in order to avoid situations of instability and, therefore, of high price volatility. The most critical aspects concern the inefficiencies of the current distribution processes, wastage and losses along the food chain (losses upstream in developing countries, wastage downstream in developed countries and distortions in the distribution system), rather than the production itself (the total amount of calories produced per day is equal to 2720 kcal per person, theoretically sufficient for all). In the future, however, the challenge will be that of innovating to move toward models of agricultural production and high productivity – which has grown much more slowly over the past 20 years (+1.22% per year) as compared to the period of 1960-1990 (+1.84%) – resulting in higher quality and lower environmental impact. Scientific and technological research, both public and private, on these issues will be decisive. However, we should not underestimate the fact that the limits in the availability of natural resources (especially water and arable land) are a very important constraint to the growth of the productive capacity of world agriculture.
- The development of biofuels, which is strongly influenced by public policies of incentives, has connected the food commodity markets more directly with those concerning energy, already linked due to the price of food commodities which is strongly correlated with that of oil (correlation coefficient of 0.84 over the past 10 years). In addition, since most of the biofuels (first generation) are not economically viable without government subsidies and are produced with the same inputs intended for human consumption or raising animals (cereals, sugar cane, etc.), this generates competition between the energy sector and the food sector for the use of agricultural raw materials (in 2010, 38.4% of U.S. corn production was used to make ethanol). Therefore, changes in oil prices and, above all, the political support for biofuel production are responsible for important variations in the demand, for episodes of sharp short-term volatility and for price increases on the food

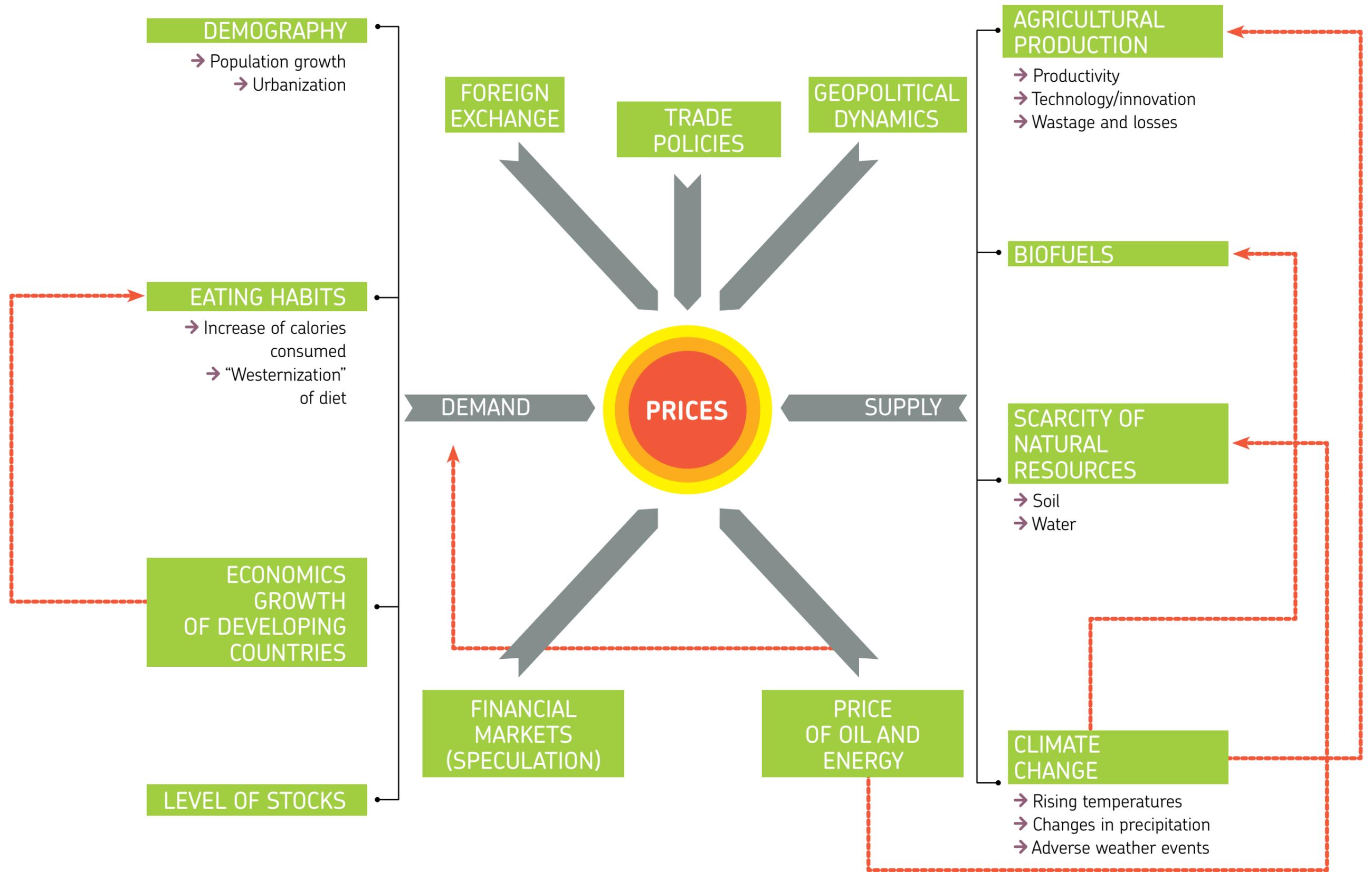
- markets. In this context, the recent development of GM varieties of corn intended only for the production of bio-ethanol presents new and more disturbing scenarios.
- It is estimated that, net of other factors, the rising temperatures and changes in rainfall have led to an 18.9% increase in cereal prices since 1980. In the future, *according to the most authoritative studies on climate change, the most likely scenario will be that of a decrease in overall agricultural productivity*. For example, with reference to cereals, a decrease is expected of up to about 1% worldwide in 2080, with peaks of around 7% in sub-Saharan Africa and Southeast Asia. The effects of climate change, in fact, may affect certain geographic areas and their ability to ensure adequate production levels on a regular basis compared to the current volumes, mainly due to rising temperatures and more severe conditions of access to water (the most significant impacts should be recorded in the equatorial belt, in the Mediterranean region and Australia). Finally, climate change is intensifying because of adverse weather events (droughts, floods, etc.) that can cause extensive crop losses.
 - *The cost of energy is one of the factors that strongly influence the operating costs in the agricultural sector*, affecting many aspects of operations, from cultivation of the fields to the logistics and distribution of finished products. In fact, the trend in oil prices directly affects the cost of fuel for the movement of tractors and agricultural machinery, fertilizer prices, the cost of energy needed for heating the stables, structures for drying fodder and greenhouses, the price of fuel for the transportation of grain, for the distribution of semi-finished and finished products, etc., thus indirectly affecting the prices of agricultural products. In particular, by analyzing the prices of fertilizers, production with a high-energy need, and sometimes directly derived from hydrocarbons, there is a very strong correlation with the prices of crops making more use of fertilizers, including cereals (the correlation between the index of cereal prices and the prices of nitrogen and phosphorus in the last 20 years was 0.91).
 - *The imposition of trade barriers/subsidies can be a distorting factor in the dynamics of supply and demand* on the international market of food commodities when these are not intended to protect farmers in developing countries, who may be heavily penalized. In the period of 2008-2010, as a result of the lowered expectations concerning future crops and with the expectations of an increase on the international prices of some important agricultural commodities, some exporting countries eliminated export subsidies (or introduced taxes on the exports) to increase their domestic supply and limit the internal effect of the global food prices. These dynamics are being proposed in recent months and are among those that are most responsible for the new, rapid increase in prices.
 - *The trend of the dollar is an important factor in these markets*, since the United States is the major exporter of agricultural commodities in the world and most prices are denominated in U.S. dollars. For example, when the dollar depreciates, the purchasing power of importing countries increases, which translates into an increase in the demand for imports, thus contributing to the imbalance between supply and demand and the inflation of international prices.
 - *Futures markets perform two important functions: they help manage the volatility of prices and contribute to the formation of prices*. However, the global financial crisis of recent years has caused “non-commercial” investors (holding long positions in *index funds* and *hedge funds* that act aggressively in the short term) to increase their investments in agricultural commodity derivatives: the increase in the share of contracts in the hands of non-commercial investors may have prompted speculation. Since the actual role of this phenomenon in determining the growth of the level of prices is widely debated and not yet clearly demonstrable, financial speculation in food commodity markets, however, may have amplified the volatility in the short term.

- *Rising food prices and the onset of geopolitical imbalances in countries with poor socio-economic conditions are related to each other*, particularly if these countries are net importers of foodstuffs. In some cases, the pressure of events in these countries can influence the subsequent dynamics of international prices: this is the case of the “Arab Spring,” which caused a surge in oil prices – influencing the food commodity prices – and a sharp increase in purchases of food at high prices from these countries attempting to control the social tensions.

3. IT IS NECESSARY TO TAKE ACTION ON STRUCTURAL FACTORS (MEDIUM-LONG TERM VISION) AND CONTINGENT FACTORS (SHORT TERM VISION)

The factors analyzed can be divided according to the actual possibility of acting upon them, both in reducing volatility and avoiding excessive price increases that would put global food security and the development of the agricultural-food sector at risk.

- *The contextual factors* are the constants on which it is not appropriate/possible to take action: population growth and urbanization, economic development of emerging countries, the trend in the currency markets, international geopolitical dynamics, and the close link between energy costs and oil prices and agricultural inputs.
- *The structural factors* of supply and demand, approachable with interventions that will produce their effects only in the medium-long term and problems that can be resolved by the processes of adapting the system to changing structural conditions, are: agricultural productivity, wastage and losses along the food chain, constraints imposed by a scarcity of natural resources, the effects of climate change, the “Westernization” of diet in many emerging areas of the planet and a generalized increase in average calorie consumption. These are decisive factors in the long term that, unfortunately, are not aligned to the cycles of politics, and therefore are often neglected.
- *The contingent factors* can determine results in the short term through appropriate technical and political solutions and interventions. The contingent factors are the levers of effective intervention in the short term, fundamental for dealing with an emergency (but not sufficient in the absence of interventions on the structural factors). Some examples are:
 - Low level of stocks of agricultural commodities → *Creation of a multilateral system of food reserves and improvement of the transparency of flows and stocks.*
 - Implementation of trade policies distorting the market by exporting and importing countries → *Reduction of the various forms of trade restraints; foremost, the bans, quotas and export duties.*
 - Incentives for the production of first generation biofuels → *Reduce support for the production of first generation biofuels that compete with food production, in favor of second generation biofuels; increase investments in new technologies and achieve greater openness in trading in this sector.*
 - Excessive speculation and “financialization” of the food commodity markets → *Regulation of the excessive financial speculation on food commodities.*





1. THE INCREASE IN
AGRICULTURAL
COMMODITY PRICES,
THE VOLATILITY OF
THESE MARKETS AND
THE CONSEQUENCES

1.1 THE GROWING GLOBAL ATTENTION REGARDING THE ISSUE

IN 2050, THE GLOBAL DEMAND FOR FOOD WILL INCREASE BETWEEN 70 AND 100%

UNTIL 2020, PRICES WILL RECORD EVEN HIGHER VALUES THAN THOSE OF THE PREVIOUS DECADE

The growth of the world population, the significant increase in income, urbanization and the increased consumption of animal protein in emergent and developing countries are some of the factors that will contribute greatly to the rising global demand for food. In fact, the most reliable predictions have estimated that the world population will reach 9 billion people in 2050, resulting in an increase in the global demand for food, estimated between 70 and 100%.

The expectations concerning these predictions, in addition to numerous, added variables whose dynamics also produce significant effects on the changes in the price of food commodities, help in putting pressure on the price of raw materials. The latest medium-term predictions made by the FAO and the OECD reveal future scenarios that are quite worrisome: it has been estimated, in fact, that until 2020, prices will record even higher values in real terms than those of the previous decade's food crisis of 2007-2008. These two international organizations estimate, for example, that the average price of grain – in real terms – will remain 20% higher in the next 10 years than in the previous decade. Similarly, the price of meat will be 30% higher. If the rate of growth of agricultural production – which is estimated to decrease an average of 1.7% per year as compared to 2.6% in the last 10 years – will not actually be able to keep pace with demand, the result will be an inevitable increase in prices.

These issues have recently been included in the international political agendas as among the most urgent and critical issues to be addressed. France has decided to put the issue of access to food at the center of its mandate for the presidency of the G-20 this year and the French President, Nicolas Sarkozy, has called the problem of the high price of commodities “one of the main dangers that threaten growth today.” In line with this, in fact, at the recent G-20 meeting of the Ministers of Agriculture,¹ a plan of action against hunger and the volatility of food prices on international markets was presented, the so-called *Action Plan on Food Price Volatility and Agriculture*, defined by the French Minister of Agriculture, Bruno Le Maire, as “a historic agreement that contains concrete measures, far from the statements made at the outset.”²

However, this was not the first meeting where the issue of access to food was discussed; the topic had already been on the agenda of the G-8 meeting in L'Aquila, at the *World Food Summit* held in Rome in 2009 and at the G-20 in Seoul in 2010. On the latter occasion, however, the centrality of the issue of *food security* was reaffirmed and defined as one of nine “key pillars” which most urgently require actions and reforms to ensure sustainable economic growth and recovery in developing and low income countries.

Despite growing international attention given to the issue of the level and volatility of prices of food commodities and the consequences in terms of access to food, there is still a situation of global instability today. In fact, combined with the current economic difficulty, the effects of rising food prices now represent a high risk factor for stability and security in many parts of the world.

THE INCREASE IN FOOD PRICES IS A RISK FACTOR WITH REGARD TO THE STABILITY AND SECURITY IN MANY PARTS OF THE WORLD

1.2 THE DYNAMICS OF THE PRICES OF FOOD COMMODITIES

Over the past 50 years, there have been few extremely critical periods for the prices of food commodities. The highest levels reached globally from the Sixties up to today are to be referred to two specific moments in history: the food crisis of the Seventies and the present situation of turmoil and instability, beginning in 2007 and continuing until now, with the exception of flexion in the second half of 2008 and 2009. It should be recalled that there were three other periods of sudden price increases, namely in the years 1978-1979, 1986-1987 and in 1995, but these never proved to be as critical as those mentioned above.

The monthly change in the international prices of a basket of food products is measured by the FAO Food Price Index (FFPI) which is, therefore, considered the benchmark for assessing the stability of food commodity markets. This indicator is the product of the average of the price indices of five groups of products (cereals, dairy, oils/fats, meat and sugar) that make up the five sub-indices and are calculated in the following way:

- *the price index of oils and fats* is the average price of 11 different oils (including animal and fish oils);
- *the price index of sugar* is calculated by adopting the standard established by the International Sugar Agreement;
- *the price index of meat* is calculated by taking into account the average of the four most common types of meat; the quotations include 2 poultry products, 3 beef products, 3 pork products and 1 lamb product;
- *the price index of dairy products* includes the prices of butter, skimmed powdered milk, whole powdered milk, cheese and casein;
- *the price index of cereals* is calculated by taking into account the price indices for cereals and rice.

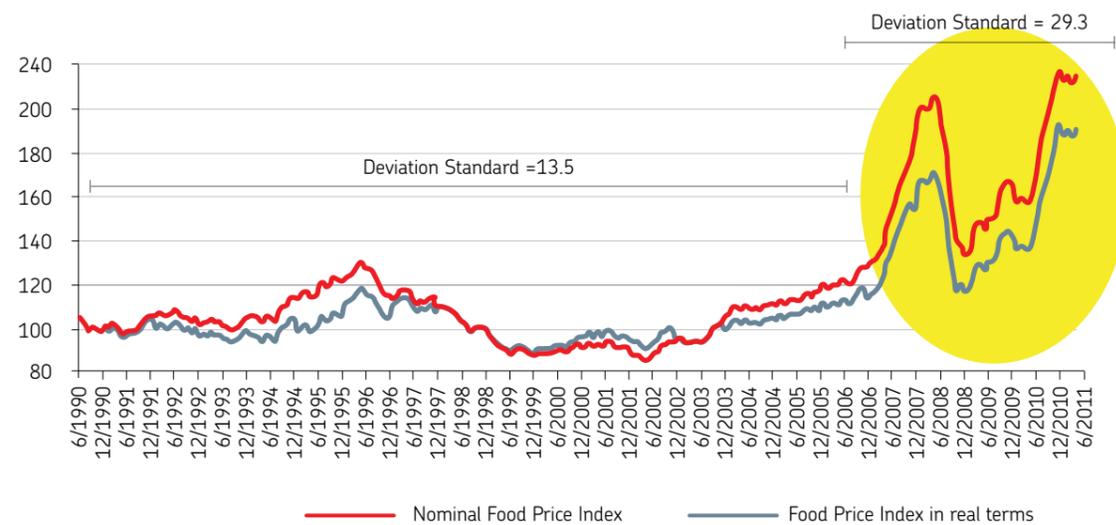
As shown in Figure 1.1., the FAO Food Price Index has followed a trend of sharp swings in recent years, both in real terms and in nominal values. In particular, compared to a substantially static period that occurred between the Eighties and 2006, since 2007, the prices of food commodities have been making huge and rapid fluctuations:

- *from March 2007 to June 2008*, we saw the first rise in prices: the nominal index increased very rapidly, registering a change of 63.1% (the real index rose by 52.9%);
- *from July 2008 to February 2009*, a sudden drop in the price level was recorded: the nominal index marked a variation of -35.9% (the real index decreased by 33%);
- *from March 2009 to January 2010*, prices started to rise again: the index, both nominal and real, grew by 25%;
- *from February 2010 to July 2010*, there was a brief period of stability;
- *from July 2010 to February 2011*, we once again saw a sharp increase in prices: the index increased by 37.8% (the real index rose by 41.9%);

THE FAO FOOD PRICE INDEX MEASURES THE PRICES OF FOOD COMMODITIES

THE FFPI HAS HAD SHARP SWINGS IN RECENT YEARS

Figure 1.1. Dynamics of the prices of food commodities – FAO Food Price Index (June 1990–June 2011)



Source: elaborations by The European House-Ambrosetti of FAO data, August 2011.

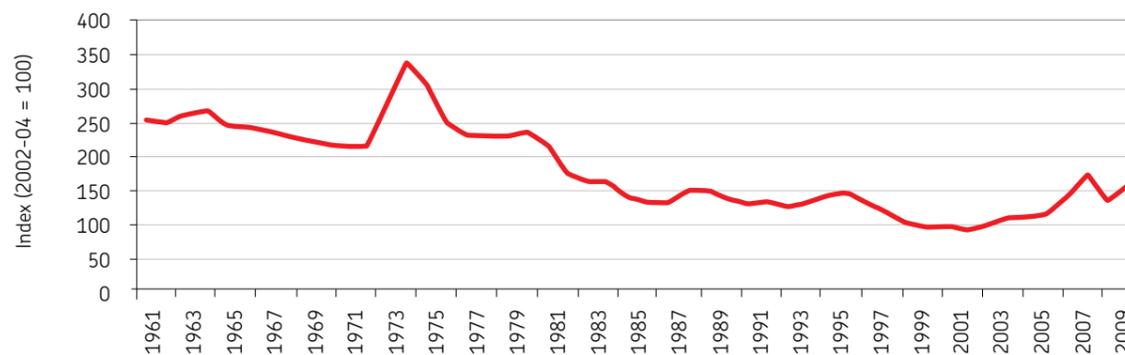
- from February 2011 to June 2011, the price level was slightly downsized: the index, both nominal and real, was down by 1.6%.

IN FEBRUARY 2011, THE INDEX REACHED A HISTORICAL RECORD, RISING TO A TOTAL OF 238 POINTS

By analyzing the dynamics of prices in recent months in detail, we see that in February 2011 the index reached a historical record, rising to a total of 238 points (nominal value). From February to June, even though there was a slight improvement of the situation, the values remained close to the maximum. In fact, the last FAO Food Price Index data (June 2011) shows a value of 234 points, down 0.3% compared to April 2011, but up 39% compared to June 2010.

Along with adverse weather phenomena, a number of other factors have had a strong negative impact on the stability of the food market, leading to the rise in prices last year; these factors include: the consequences of the earthquake in Japan, an unprecedented wave of political unrest in many countries of North Africa and the Near East, a sharp rise in oil prices and the prolonged uncertainty in financial markets and global economics.³

Figure 1.2. Dynamics of the prices of food commodities – FAO Food Price Index, real values (1961–2010)



Source: elaborations by The European House-Ambrosetti of FAO data, June 2011.

As you can see from the chart below (Figure 1.2.), however, if we take into account the real values, the highest maximum ever recorded corresponds to the serious food crisis of the Seventies, during which the FAO Food Price Index marked a value of nearly 350 points, compared to 206 points today.

After considering the dynamics of the FAO Food Price Index, it is important to analyze recent changes in the prices of the five commodities that compose it. To this end, it may be useful to consider the two most recent periods among those previously listed:

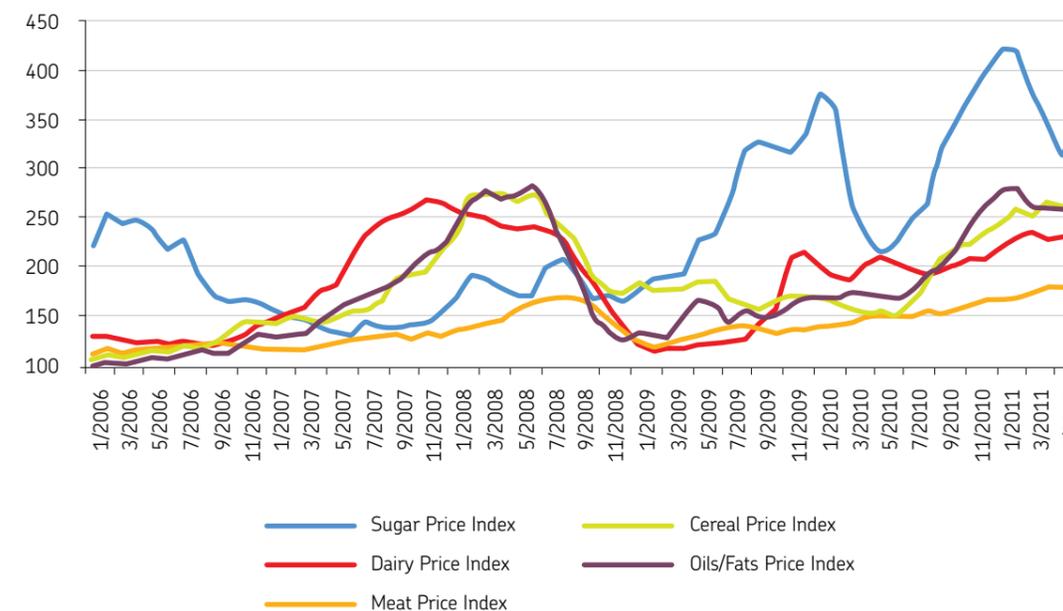
- FFPI growth from June 2010 to February 2011, sugar, oils/fats and cereal recorded an increase of prices higher than meat and dairy products; in fact, the prices of these commodities increased by 86, 66 and 71%, respectively (compared to +12% and +13% for meat and dairy products);
- subsequently, from February 2011 to June 2011, the FFPI decreased slightly. The underlying values showed a significant decrease in sugar price indices (-14%) and oils/fats (-8%), concurrent with a slight rise in meat and dairy products (+6% and +1%, respectively). These increases were still below the reversal of trend recorded by sugar, thus preventing the descent of the FFPI, even helping to curb it. The dairy products were stable.

Despite slight drops in recent months, the serious risk of another food crisis is evident if we consider the trend of the last 12 months (June 2010–June 2011), which could be summarized as follows:

- Price index of oils/fats: +52.7%;
- Price index of sugar: +59%;
- Price index of meat: +18.3%;
- Price index of dairy products: +14%;
- Price index of cereals: +71%.

THE SERIOUS RISK OF ANOTHER FOOD CRISIS

Figure 1.3. Dynamics of the prices of food commodities: meat, dairy products, cereals, oils/fats and sugar (January 2006–June 2011)



Source: elaborations by The European House-Ambrosetti of FAO data, August 2011.

According to the FAO, however, we have not yet really entered into a new food crisis. The most recent documents, in fact, refer to a “period of turbulence.”⁴ It is certain, however, that the current instability experienced in agricultural markets is creating an extremely critical situation, where any event, such as a new extensive drought in a major exporting country (such as occurred in Russia in the summer of 2010), could once again disrupt the market for food commodities.



Willard Culver/National Geographic Stock

1.3 THE PHENOMENON OF THE VOLATILITY OF THE PRICES OF FOOD COMMODITIES

In recent years, not only has there been a strong increase in food commodity prices, but there has also – and above all – been a sharp increase in volatility – remaining stable at high levels for five consecutive years – and, therefore, uncertainty and instability in the markets. Volatility is a statistical indicator used to assess the variability and uncertainty in the markets. Depending on the variables referenced, it can be traced to several technical definitions; here “volatility” refers explicitly to what extent and how quickly agricultural prices vary over time.

Not all price changes constitute a problem. It is not a matter for concern, for example, when prices show a uniform and well-established pattern, or when they follow a usual, known seasonal pattern.

In fact, stable high prices stimulate production, enabling the development of the cultivation of land that is less suitable or farther away from major waterways, facilitating remuneration and the development of rural communities, which constitute the majority of the population in developing countries.

Price changes become problematic, however, when they are large, unpredictable and sudden, because they create a level of uncertainty that increases the risk for producers, merchants, consumers and governments, with the consequent possibility that suboptimal decisions are made. Finally, the price changes related to factors that are external to the market of specific commodities (for example, corn prices affected by the price of oil) may be problematic, in that they are difficult to interpret and cause incorrect decisions.

Although it is known that, in general, many food commodity markets are characterized by a high degree of volatility, specifically it must be said that the markets for food commodities have always been characterized by high volatility for several reasons. Here are some:

- agricultural production is not constant due to *unexpected natural events*, such as weather events or infestations;
- the *elasticity of supply and demand compared to the price is low*. In particular, the offer shows a very low degree of elasticity in the short term: in fact, in order to rebalance supply and demand after a shock on the supply side, prices necessarily vary sharply, especially if the stock level is low;
- *agricultural production is a process that takes time* and producers, given the low elasticity of supply in the short term, must wait until the end of production cycles in order to better respond to price changes. This vicious cycle causes cyclical adjustments which further increase the volatility of the markets in question.⁵

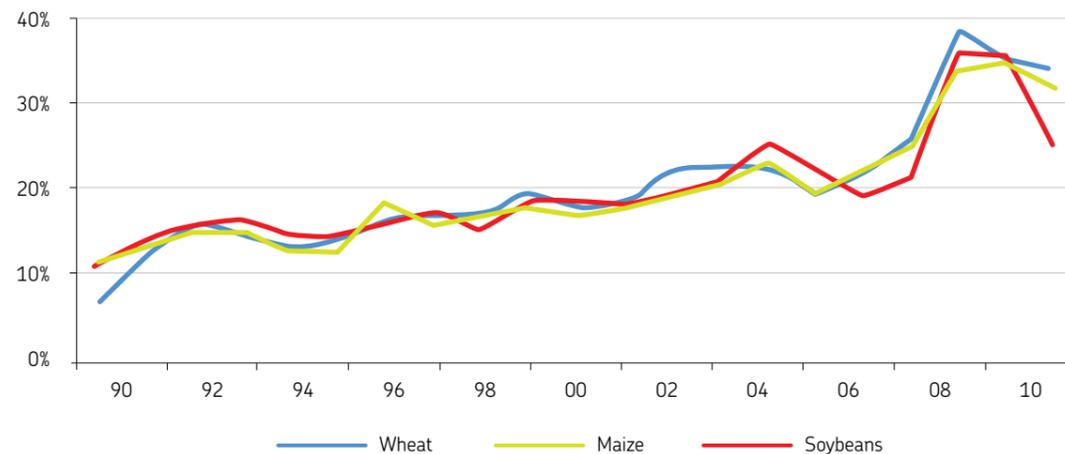
It is important to note that the volatility has reached exceptionally high levels in recent years. In this regard, as shown in Figure 1.1., the standard deviation⁶ of the prices for the period of 1992-2006 amounted to 13.5, while in 2007-2011, it more than doubled, reaching a value of 29.3.

A TREND OF UNIFORM AND CONSOLIDATED PRICES IS NOT A MATTER OF CONCERN

WHEN LARGE, UNPREDICTABLE AND SUDDEN CHANGES BECOME PROBLEMATIC AND RISKY

IN RECENT YEARS, THE VOLATILITY HAS REACHED EXCEPTIONALLY HIGH LEVELS

Figure 1.4. Annual implied volatility of wheat, corn and soybean (1990-2010)



Source: *Price Volatility in Food and Agricultural Markets: Policy Responses*, FAO, IFAD, FMI, OCSE, UNCTAD, WFP, World Bank, WTO, IFPRI and UN HLTF, May 2011.

VARIOUS CAUSES OF THE RECENT SHARP INCREASE IN VOLATILITY

The underlying causes of the recent sharp increase in price volatility can be identified in several factors: the occurrence of adverse weather events, the reduction of stock levels, the use of agricultural raw materials for biofuel production (which has developed a strong bond with the price of energy and accelerated growth of demand), the evolution of exchange rates, trade restrictions, increased financial speculation⁷ and, last but not least, the political intervention in the markets in many of the major producing countries, which has altered the dynamics and production models often adopted by farmers. Even taking into account a different indicator than the standard deviation, such as the implied volatility,⁸ there is clearly a situation of heightened volatility in the market from 2006 until today.

As is clear from the graph in Figure 1.4., since 1990 the implied volatility of soybean, wheat and corn has increased steadily, but the strongest growth has been in recent years. In conclusion, although volatility is not a new phenomenon in the agricultural sector, the dynamics of the last period are of a much higher scale than any seen so far, and determine highly risky situations for most of the subjects of the food chain. In general, this phenomenon generates negative consequences in the agricultural sector, not only as to food security, but also for the entire economy, both in developed countries and in developing countries.

The exacerbated volatility also causes tensions in the agricultural and food sectors, causing serious failures and imbalances between different actors, triggering phenomena of cyclicity in the prices and a further increase in volatility.

SUCH AN EXACERBATED VOLATILITY GENERATES NEGATIVE CONSEQUENCES FOR FOOD SECURITY AND FOR THE ECONOMY AS A WHOLE

1.4 THE IMPACT OF VOLATILITY OF FOOD PRICES ON THE ECONOMY AND ACCESS TO FOOD

The global concern for price volatility overshadows that concerning the price levels, and both make up one of the main issues related to food security.⁹

Whereas the producers often derive benefits and opportunities from a high level of the prices of food commodities, consumers – particularly those living in poor and developing countries – will suffer serious consequences.

The poorest families, in fact, spend a large portion of their budget on food and, consuming mostly unprocessed foods, are particularly affected by higher prices of food commodities. Consequently, these families are seeing that their ability to feed themselves adequately, their access to health care, education and other basic necessities are compromised.

The producers (especially small farmers), in contrast, are more disadvantaged in a scenario of low prices, which forces them to reduce investments, to produce in non-optimal conditions and to change their standard of living, because the loss of income threatens the maintenance of their family or the ability to support operating costs of their farms. The uncertainty can then be transformed into non-optimal decisions and production levels.

In general, volatility becomes a problem when it induces risk-averse behavior, leading to inefficient investment decisions, as well as when critical situations are created that producers, consumers and entire nations are not able to solve optimally.

More specifically, the impact of a high volatility in the prices of agricultural raw materials can be analyzed in two different perspectives: macroeconomic and microeconomic.

THE POOREST HOUSEHOLDS WILL SUFFER THE INCREASE OF PRICES

THE PRODUCERS ARE DISADVANTAGED BY LOW PRICES

VOLATILITY BECOMES A PROBLEM WHEN IT INDUCES RISK-AVERSE BEHAVIOR, LEADING TO INEFFICIENT INVESTMENT DECISION

1.4.1 The consequences in “macro” terms

At the macroeconomic level, the analysis of the effects of volatility in food commodity prices should start from the distinction between the long-term and short-term effects and between exporting and importing countries.

Exporting countries

The countries most at risk of negative macroeconomic impact generated by the volatility of prices are developing countries that are dependent on the export of agricultural raw materials or whose imports of food carry a significant weight in the balance of payments and public finance.



In exporting countries, where the GDP is strongly linked to agriculture, the occurrence of an exceptional reduction in food commodity prices will cause serious consequences to the national economy. In this scenario, in fact, there is an immediate, direct impact on the balance of payments, investment cuts and a reduction in the use of inputs. These three factors, in turn, lead to a negative impact on the medium-term economic growth of the country.

AN EXCEPTIONAL REDUCTION HAS SERIOUS CONSEQUENCES UPON THE ECONOMY OF EXPORTING COUNTRIES

Furthermore, an excessive increase in prices often results in protectionist reactions in the exporting countries, such as export bans aimed at reducing domestic inflation, but which result in causing distortions in the national supply chain and uncontrolled increases in the international market, which, at the end of the period, often backfire on the country that promoted the sanction.

AN EXCESSIVE INCREASE IN PRICES OFTEN RESULTS IN PROTECTIONIST REACTIONS

Importing countries

The importing countries, instead, when the prices of food undergo a great upturn, are likely to experience a worsening of balance of payments and public finances; also in this case, therefore, the whole economy is affected.

THE IMPORTING COUNTRIES ARE AFFECTED BY EXCEPTIONAL INCREASES IN PRICES

Particular attention must be given to those countries importing food that are defined as “low income,” where the negative wave may cause a rise in inflation and import costs, which, in turn, lead to a worsening of the balance of payments. In addition, having to increase exports to repay the imports, these countries face a higher risk of currency depreciation.

Finally, an increase in food commodity prices will have an impact on the fiscal measures relating to imports, food taxes and subsidies for food consumption.

1.4.2 The consequences in “micro” terms

At the microeconomic level, some studies¹⁰ have identified the main impacts generated by a situation of high volatility in the prices of food commodities, analyzing both the demand and supply and relating these to the price level.

On the demand side

As mentioned previously, on the demand side, a significantly higher level of prices is dramatic for poor families, especially for those living in developing countries. These, spending an average of three-quarters of their family budget on food, are forced to deteriorate and modify their standards of food consumption and living, worsening the already critical situation of global malnutrition. Therefore, in terms of impact, it is appropriate to make a distinction here between different socioeconomic groups and types of households.

A SIGNIFICANTLY HIGHER LEVEL OF PRICES IS DRAMATIC FOR POOR FAMILIES

A significant increase in food prices strongly affects net food consumers (consumers and nonproducers), since food represents a very large share of their spending: in such circumstances, in fact, higher prices sharply reduce the purchasing power of the families in question. Among these, the most affected are low-income urban families¹¹ who buy their food with the wages they earn (not owning or cultivating land) and those headed by females.

FRAGILITY OF URBAN FAMILIES AND THOSE WHO MAKE A LIVING BY SUBSISTENCE FARMING

Another category that is very susceptible to higher prices, in addition to net consumers of food products, is the one pertaining to families living predominantly by subsistence farming, but who are still forced to buy some goods from the outside.

WOMEN AND CHILDREN ARE AMONG THOSE WHO ARE THE MOST AFFECTED BY THE VOLATILITY OF THE PRICES

Families that experience difficulty in purchasing food, therefore, buy supplies of lower quality and in less quantity.

At this point, however, a further clarification is required: the direct impact of higher prices of commodities is generally expected to be negative, but to assess this effect, it is important to consider in which direction the prices of different foods move. If prices all move in the same direction, both the economy and the impact on welfare will be what has been described so far. In the opposite case, however, it is possible that families may take action to replace the products of their own basket and that this “substitution effect” in favor of less expensive products mitigates the effect of the increases in the prices of others.

The sharp rise in food commodity prices, in addition to generating short-term effects such as those just described (reduction of the quantity and quality of food expenditure for certain categories of people), causes medium- to long-term impacts of even greater concern.

At a social/nutritional level, the subjects that are most affected by the volatility of the prices of food commodities are women and children, especially within the first 1000 days of life, in which the type of diet has major implications on their psycho-physical development.

It is, therefore, clear that the consequences can be tragic and irreversible: a large number of children cease to receive adequate nutrition and education, there are severe losses in terms of human and labor capital, poverty and malnutrition increase globally and the mortality rate increases dramatically.

The joint development of these phenomena creates serious problems of sustainability in the future of developing countries which will see their economic growth, often driven by agriculture, severely affected. But at the same time, a prolonged decline in prices causes the impoverishment of the less developed agricultural areas, areas that cannot benefit from subsidies like those of developed countries. This phenomenon has certainly been one of the causes of the massive migration of rural populations to urban areas in developing countries.

With reference to developed countries, the effects of volatility and high prices are less extensive.

Although many families spend about half of the family budget for food expenditures, these nations have a greater ability to “adjust” the expense according to the contingencies, orienting toward different kinds of food. In addition, most developed countries have protection mechanisms that ensure adequate assistance to those at risk.

On the supply side

On the supply side, however, a high level of prices generates net benefits for producers of food commodities and is an incentive to increase production. The profitability of farms, however, is affected, especially if the increase in feed costs is not entirely transferred to the consumers.

Low or volatile prices, in fact, create considerable problems for farmers and others in the food chain who risk losing their productive investments if the drop in prices occurs during the implementation of investments whose profitability depends on how high the prices are. A classic example is that of farmers who have already planted their crops and find themselves facing a drop in prices: in this situation, the poor small farmers who have difficulty getting access to credit may encounter special problems in financing a new seeding just in order to stay in business. This type of problem can be particularly severe and difficult to solve, for example, for women owners of small plots of land, who constitute the majority in many countries.

THE CONSEQUENCES ON THE FAMILIES ARE LESS EXTENSIVE IN DEVELOPED COUNTRIES

THE INCREASE IN PRICES FAVORS THE NET PRODUCERS

THE VOLATILITY PUTS THE RETURN ON THE INVESTMENTS AT RISK

It is also important to consider that many farmers in developing countries (and even some developed countries) do not operate on a scale that is large enough to set aside income for the following seasons: consequently, both the welfare of their family and the very existence of the farm are at risk in a situation of excessive volatility. Uncertainty may also result in suboptimal long-term investment decisions.

After having considered the negative impacts deriving from rising prices in the agricultural sector, we must also consider some important opportunities of such a scenario. Considering the fact that agriculture is the main source of income for most of the rural population in most developing countries, a situation of permanently higher prices could help alleviate rural poverty, but only on the condition that the farmers are fully integrated in the market. The breadth of these opportunities is then tied to the size of the farm and access to the other resources (seeds, fertilizers, machinery, etc.), allowing farmers to take advantage of the rising prices.

Moreover, in areas where agriculture is a necessary condition for growth and rural development, increased agricultural production and productivity growth generate important multiplier effects on secondary/non-agricultural rural activities and employment.

A SITUATION OF CONSTANTLY HIGHER PRICES COULD HELP ALLEVIATE RURAL POVERTY



© Corbis

A close-up, top-down view of a large quantity of fresh green pea pods. The pods are vibrant green, elongated, and slightly curved, filling the entire frame. Some pods show signs of being recently harvested, with small stems and leaves still attached. The lighting is even, highlighting the texture of the pea skins.

2. THE FACTORS THAT DETERMINE THE EVOLUTION OF THE PRICES OF FOOD COMMODITIES AND THEIR VOLATILITY

2.1 THE INTERPRETATIVE MODEL OF THE BCFN

In the previous chapter, the historical trend and the current scenario of the prices of food commodities were discussed in detail. Also described were the consequences – on household food security (particularly those with low incomes) and on the economic and political stability of countries (particularly developing ones) – of the phenomenon of increased volatility and sudden price increases that we have been seeing recently.

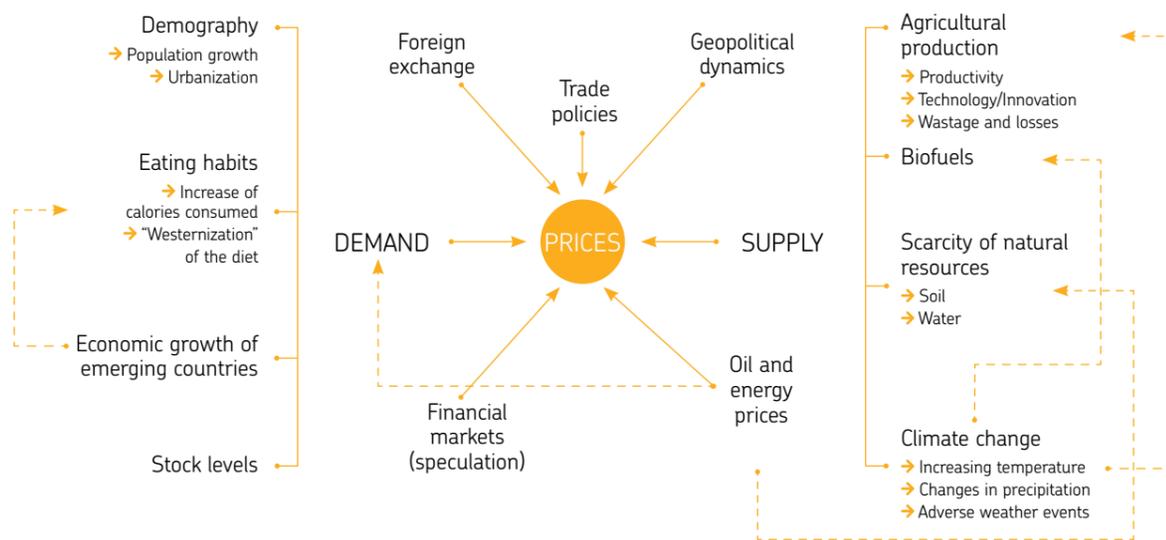
SEVERAL FACTORS AFFECTING THE LEVEL AND VOLATILITY OF FOOD PRICES

In this second chapter, the main factors behind these trends will be identified and examined, in order to understand the main relationships and effects.

To this end, the BCFN developed the interpretative model shown in Figure 2.1.

Offering a systemic view of the many elements that help to define the performance of food commodity prices, this model shows the factors related primarily to the demand side (product stock levels, demographic factors, economic growth in emerging countries, food choices) and that of the offer (agricultural production, scarcity of natural resources, production of biofuels and effects related to climate change).

Figure 2.1. Interpretative model of the factors affecting the level and volatility of food prices



Source: elaborated by The European House-Ambrosetti, 2011.

There are endogenous factors to which transversal exogenous factors can also be associated, that directly or indirectly have an effect on food commodity prices. Among these, the proposed interpretative model takes into account the financial markets and the exchange rate, the price of oil and energy, international trade policies and geopolitical dynamics.

The need to outline this model in a graphical representation has imposed the choice of placing the various factors on the side of the demand, the supply or among the transversal factors. However, we realize the limitations of this simplification, since we are aware of the fact that in reality many of these factors have much more complex interactions in the relation of the demand/supply of food commodities. In addition, it must also be said that there are many interconnections between the factors themselves, which we have therefore tried to highlight by means of dotted lines.

In the next few paragraphs, we will attempt to locate and describe the relationships between each of the variables identified and the evolution of the prices of food commodities and their volatility.¹

All the elements identified and represented in the interpretive model described above can also be divided according to type of effects generated on the prices and their time horizon. In the following paragraphs, in addition to seeking to thoroughly understand the relationships between identified variables and prices, we will also try to clarify whether the impact generated is more about the increase in price volatility in the short term and/or the increase of the level of prices in the medium-long term.

From these estimates, it also follows that the effects of some factors can only be changed in the medium to long term and can be answered in the process of adapting the system to changing structural conditions of the supply and demand. This is the case, for example, of the population and economic growth in emerging countries, which induces a significant increase in demand for food, of urbanization, the rising temperature caused by climate change and the progressive accentuation of the scarcity of natural resources.

As will be discussed in more detail in Chapter 3, in referring to these issues it is necessary to process a very wide range of changing attitudes and lifestyles and of adaptation to and mitigation of climate change, as well as investments and innovations that increase agricultural productivity.

On the contrary, there are factors on which action can be taken in the short term, such as the management of the reserves of basic food commodities, incentives for biofuel production, the excesses of financial speculation on markets of agricultural commodities and trade policies.

FACTORS RELATED TO THE DEMAND AND SUPPLY AND CROSS-CUTTING FACTORS

TYPES OF EFFECTS GENERATED ON THE PRICES AND THEIR TIME HORIZON

FACTORS THAT CAN BE MODIFIED ONLY IN THE MEDIUM TO LONG TERM AND FACTORS TO DEAL WITH IN SHORT TERM

2.2 DEMOGRAPHIC TRENDS, ECONOMIC GROWTH IN THE EMERGING COUNTRIES AND CHANGES IN FOOD CHOICES

The growth of the world population and its gradual urbanization, the economic development in emerging countries and the resulting shift in food choices to more complex food products represent enormous challenges for the global food system, that in the medium-long term will have to try to cope with a steady increase in demand, which will most likely cause increasing tensions on prices of food commodities. For example, according to medium-term projections made by the OECD and the FAO,² in the 2010-2020 decade, the prices of cereals and those derived from the breeding of cattle will be 20 and 30% higher, respectively, than those of the past decade.³

Prices of meat and dairy products, on the one hand, and cereals and vegetable oils, on the other, influence each other through a series of direct and indirect relationships. Therefore, changes in demand for meat and dairy products also affect the demand (and prices) of the crops needed for breeding livestock. Conversely, since cereals and vegetable oils are the major cost items for breeding livestock, an increase in the price of these commodities results in an increase in the price of meat.

The increase in available income, migration from rural to urban areas and changes in food choices in emerging countries are phenomena that explain a rise in the demand for food by these economies, which are appearing increasingly on international markets at the expense of their own production.

It is important to note that the increase in per capita income of such an important portion of the world's population does not reflect directly only on an increase in consumption, but also on a diversification of demand and a minor sensitivity to price changes. The minor flexibility of demand is one of the factors underpinning the increase in prices because it reduces the magnitude of the substitution effect, providing for an increase in the price of a particular commodity and leading consumers to buy goods with similar features at lower prices.

Some data on the phenomena mentioned above can help to better understand the scope of these challenges.

Most developing countries have experienced strong economic growth in recent years. Asia, especially China and India, is experiencing sustained economic growth, with the area's real GDP up 7.3% on an annual basis between 2006 and 2011. Sub-Saharan Africa has achieved a growth rate of its real GDP of 4.5% over the same period. This strong growth, combined with the influence it exerts on consumption, is a key factor for understanding the gradual change in world food demand.

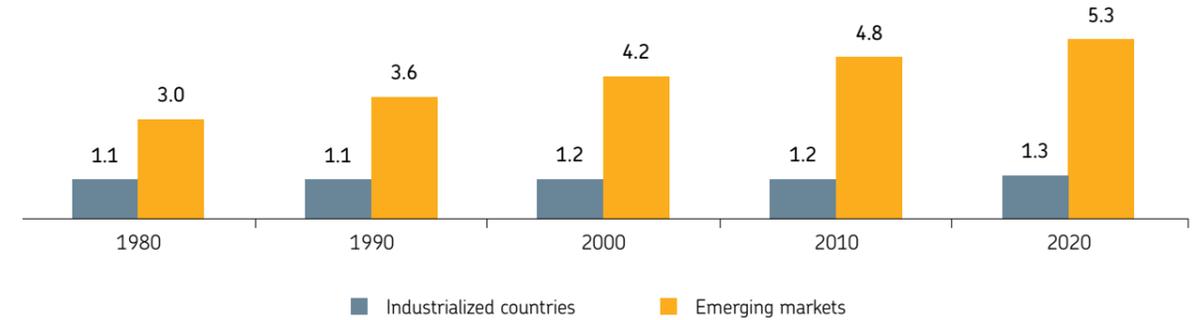
With regard to population growth, according to estimates by the FAO, in 2050 the world population will have increased by one third, reaching 9.1 billion compared to 6.9 billion today, and consequently the demand for food could increase between 70 and 100%.⁴ Even in the near future, as has already happened in the recent past (Figure 2.2.), the

THE GROWTH IN PER CAPITA INCOME INCREASES CONSUMPTION AND A DIVERSIFICATION OF DEMAND

THE WORLD POPULATION WILL HAVE INCREASED BY ONE THIRD IN 2050

increase will mainly involve the population of emerging countries (markets), which already account for 60% of the world population. Between 1980 and 2010, the population of these countries has grown at an average annual rate of 6%, compared to 2.5% in industrialized countries.

Figure 2.2. Resident population in industrialized countries and in emerging markets (1980-2020, billion)



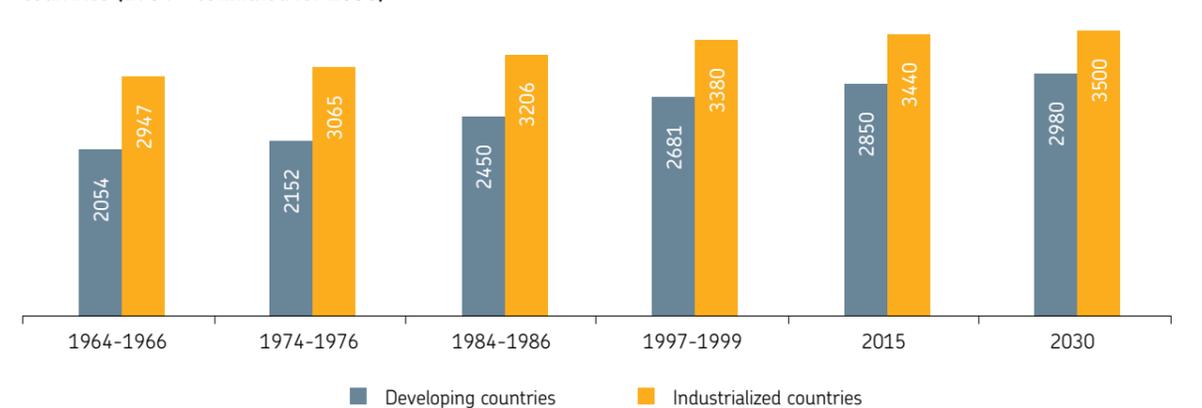
Source: elaboration by The European House-Ambrosetti of USDA (United States Department of Agriculture) data, 2010.

Another demographic phenomenon that is having a major impact on the demand for food is the urbanization⁵ underway in developing countries, in that migration from the countryside to the cities generally follows a change in eating habits toward a more diversified diet.

The increase in per capita income and urbanization are two factors that lead to the gradual change in the composition of the food basket of emerging countries, with the transition from a diet consisting mainly of cereals to a diet rich in fruits, vegetables, meat and fish. Urban consumers, especially in Asia, are experiencing an increasingly Western diet, reducing the consumption of traditional foods.

Figure 2.3. shows the average daily caloric intake in developing countries and in industrialized countries in the period 1964-2030. In developing countries, the trend of growth is more than double that of industrialized countries (average 0.55% per year compared to 0.24%), due to the so-called "Westernization of the diet," or the gradual replacement of poor foods with foods derived from more complex processing.

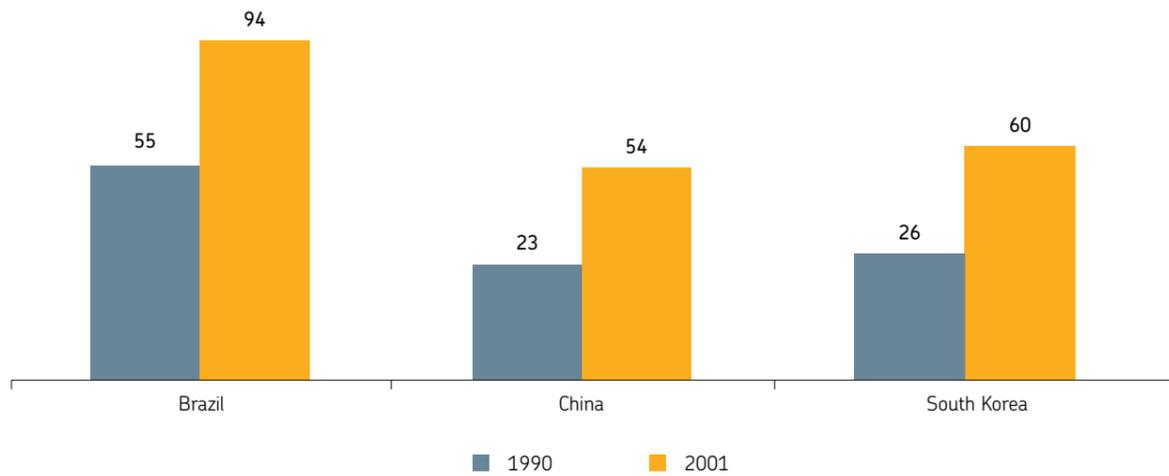
Figure 2.3. Per capita food consumption (kcal per day) in developing countries and developed countries (1964 - estimated for 2030)



Source: elaboration by The European House-Ambrosetti of FAO data, 2010.

INCREASE IN PER CAPITA INCOME AND URBANIZATION ALTER THE COMPOSITION OF THE FOOD BASKET OF EMERGING COUNTRIES

Figure 2.4. Consumption of meat per capita (kg), China, Brazil, South Korea in 1990 and in 2011



Source: elaboration by The European House-Ambrosetti of FAPRI (Food and Agriculture Policy Research Institute) data, 2011.

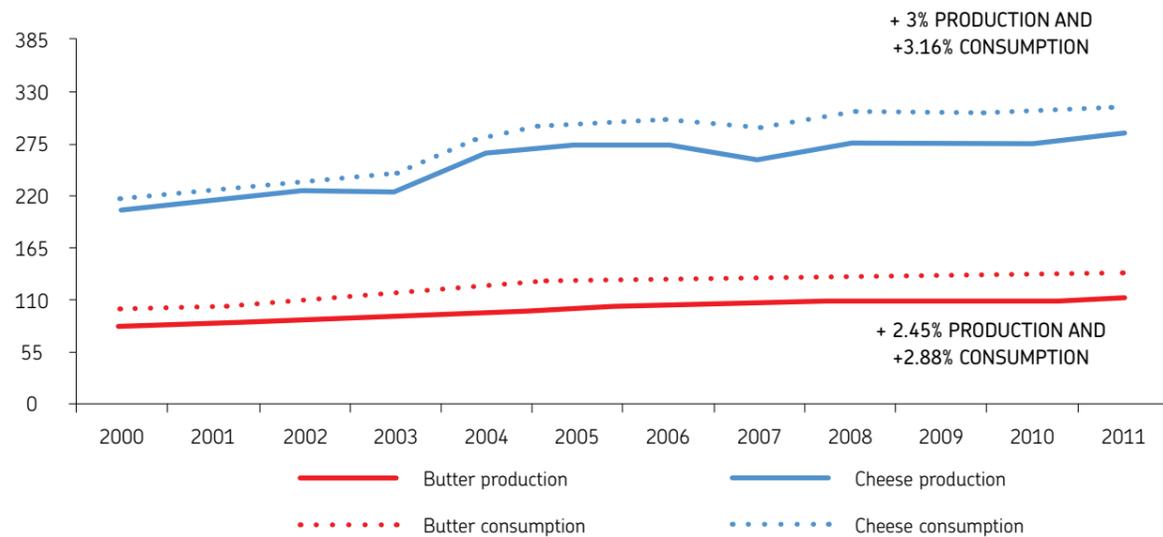
THE DIVERSIFICATION OF THE DIET LEADS TO AN INCREASE IN THE CONSUMPTION OF FARMING PRODUCTS

More specifically, the diversification of the diet leads to an increase in the consumption of products with higher calorie and protein content, such as meat and dairy products.⁶ Moreover, in these countries, a steady increase in the production and consumption of dairy products may also be observed. Figure 2.5. shows the case of China with regard to butter and cheese.

With the increased consumption of meat and dairy products, the demand for grain required for livestock nutrition is growing. This increase is exponential: to produce 1 kg of chicken, it takes about 2 kg of grain; for 1 kg of pork, about 4 kg of cereal; and for 1 kg of beef, between 7 and 8 kg of grain.

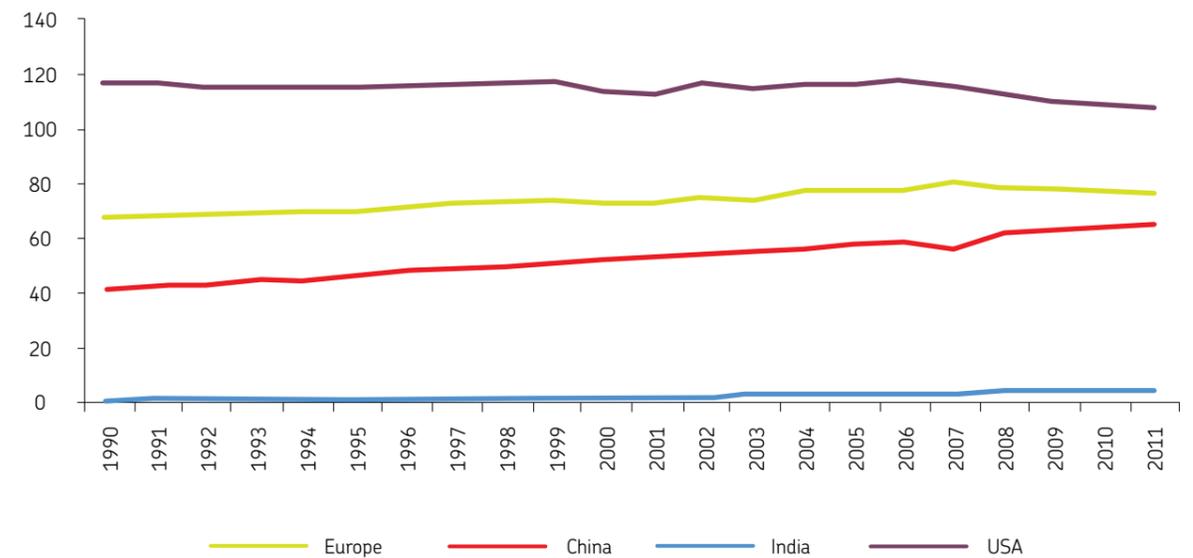
Per capita consumption of meat in China has now reached European levels (Figure 2.6.).

Figure 2.5. Production and consumption of butter and cheese in China (2000-2011, thousands of tons)



Source: elaboration by The European House-Ambrosetti of FAPRI, *World Agricultural Outlook data 2011*.

Figure 2.6. Per capita consumption of meat in China, Europe, India and the USA (kg)



Source: elaboration by The European House-Ambrosetti of FAPRI, *World Agricultural Outlook data 2011*.

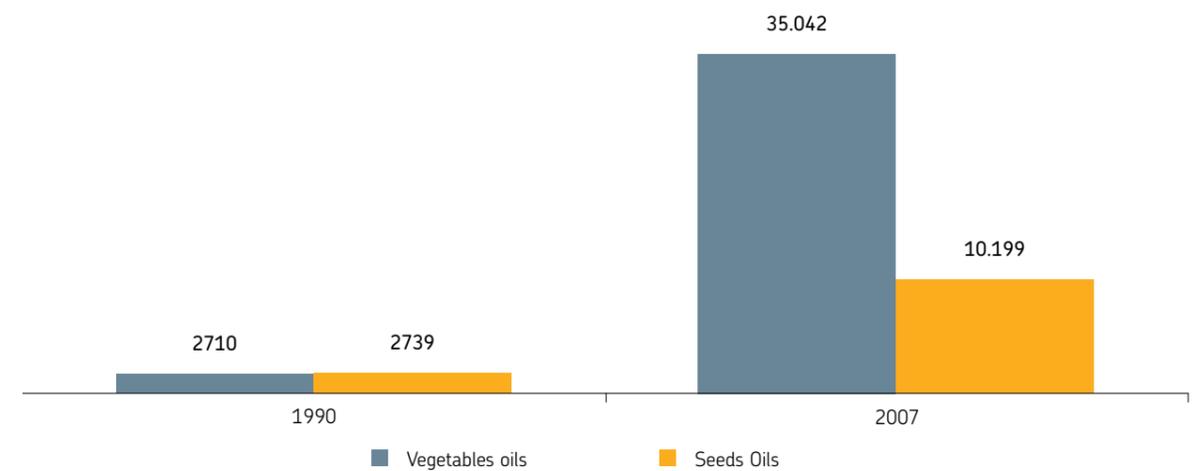
It is interesting to note that, for this reason, China has become one of the world's largest importers of soybeans and vegetable oils, used as protein supplements in livestock feed. In fact, between 1990 and 2007, the import of oil seeds and vegetable oils for breeding increased 16.2 and 8.9%, respectively, on an annual basis.

India, too, has recorded a 72% increase in the importing of seed oil since 1990.

The changes in food consumption patterns that are occurring globally in recent years will be increasingly clear-cut in the future. For example, while the per capita consumption of rice in Southeast Asia is expected to decline by 4% between 2000 and 2050, consumption of fruits, vegetables and dairy products will grow by 70% and that of eggs, meat and fish will double, due to growing income (an average +6.1% on an annual basis).

CHINA HAS BECOME ONE OF THE WORLD'S LARGEST IMPORTERS OF SOYBEANS AND VEGETABLE OILS BECAUSE OF INCREASE OF CONSUMPTION OF MEAT

Figure 2.7. Chinese imports of seed oils and vegetable oils (1990-2007, thousands of tons)



Source: elaboration by The European House-Ambrosetti of FAO data, 2007.

2.3 STOCK LEVELS

THE LEVEL OF STOCKS INDICATES THE SUPPLY CAPACITY AND FUTURE AVAILABILITY OF RAW MATERIALS

THE RELATIONSHIP BETWEEN THE LEVEL OF FOOD STOCKS AND PRICES

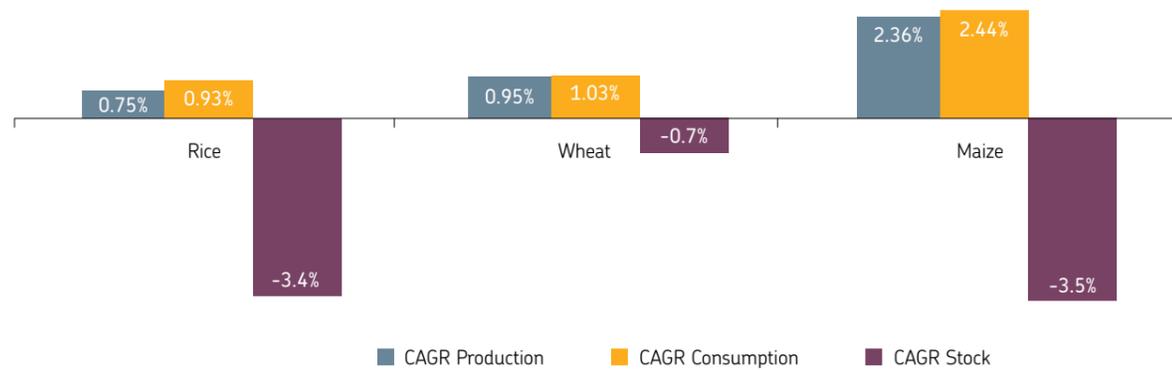
Stocks of food commodities represent the share of the crop to be stored and not for immediate consumption. The main structures for conserving grain are silos, which can guarantee the conditions necessary for the maintenance of the chemical and nutritional characteristics of the raw materials stored there.

The level of stocks of major food commodities can be considered a valid indicator to assess the ability of current offerings and, above all, the future availability of these raw materials. Since ancient times, inventory management has always been crucial to the prosperity of the population: a far-sighted policy of accumulating during periods of good harvest meant there would be sufficient availability of food in times of famine.⁷

Therefore, the level of stock value has a precautionary measure, on the one hand, against the volatility of the crops and, on the other, concerning the level of prices. A good level of stocks allows for supporting the offer in times of crisis by introducing new volumes into the market, thus helping to keep prices stable. In times of plenty, however, it is preferable to allocate shares of the harvest to storage in order to avoid waste and prices that are too low. To interpret the behavior of prices in commodity markets and identify the causes of their performance, it is important to understand what the relationship is between the level of food stocks and prices.

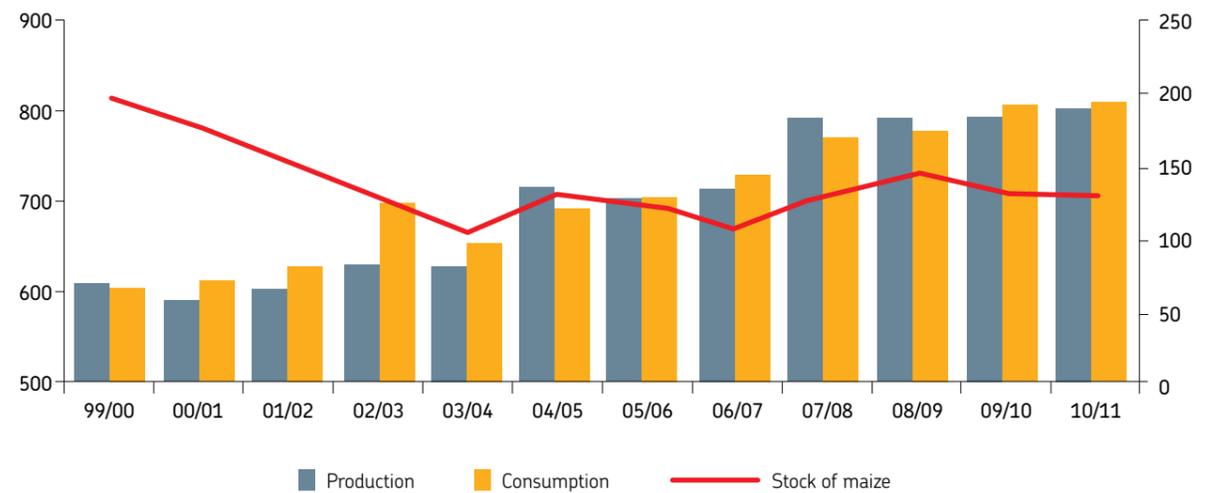
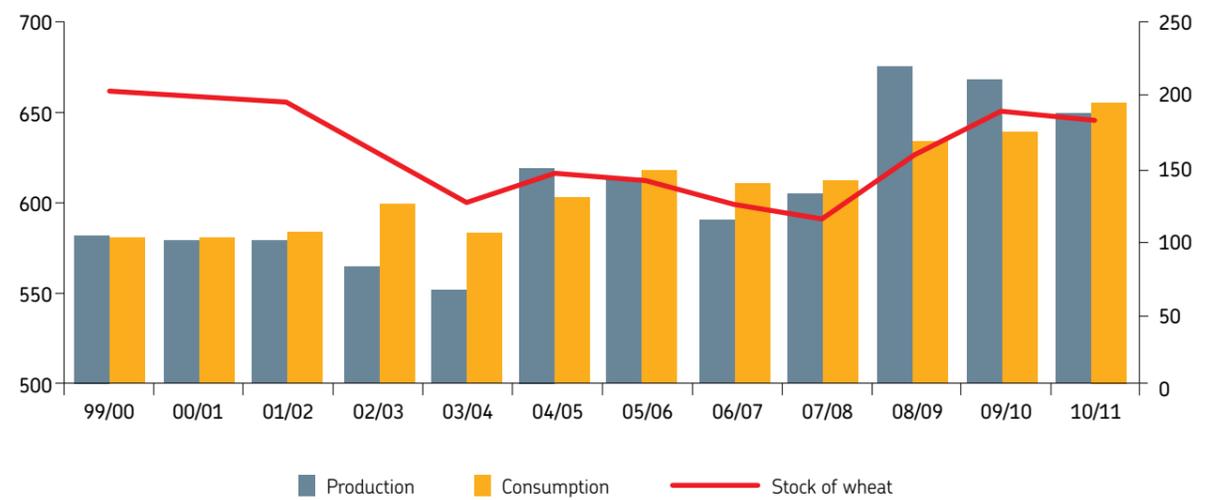
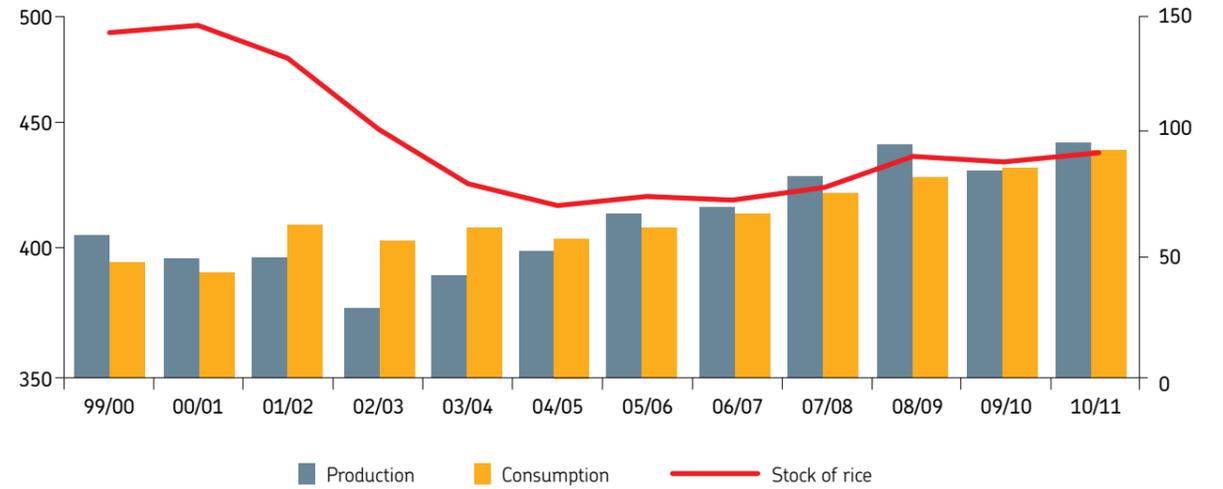
Figure 2.8. shows that between 2000 and 2011, the annual growth rate of production and consumption worldwide has been unbalanced. Consumption grew on average more than production and to meet the growing demand, stocks were used that, as shown, are in decline.

Figure 2.8. Average annual rate of change of production, consumption and stock levels of rice, wheat and corn (Worldwide, 2000-2011)



Source: elaboration by The European House-Ambrosetti of FAPRI data, 2011.

Figure 2.9. Global stocks in relation to production and consumption of rice, wheat and maize (1999-2011, millions of tons)



Source: elaboration by The European House-Ambrosetti of FAPRI data, 2011.

THE DIMINISHED STOCKS ARE USED TO MEET THE GROWING DEMAND

The decrease in stocks is a fact given by which markets⁸ formulate their predictions about the future level of prices and physical availability. Based on these estimates, states should amend their trade policies by operating through tariffs, subsidies, or drawing on reserves as needed.⁹ The phenomenon of the reduction of stocks in recent years is also due to the dismantling of contingency plans in support of the prices in some OECD countries and the degree of accuracy of the information on stored volumes in the producing and consuming nations. From the graphs in Figure 2.9., we can see that for all commodities considered, a period of strong imbalance in favor of consumption can be seen between 2001 and 2004, when stocks fell to levels that were insufficient to withstand the crisis of 2007-2008. The delta between production and consumption has been gradually oriented toward a slow process of rebuilding the stocks, although the latest observations indicate a further reduction. It is useful now to consider how the prices of the progress of reserves behaved: Figure 2.10. shows, in the case of wheat, the correlation between the ratio of stocks-to-use¹⁰ and the price of wheat between 1990 and estimates for 2012.

Figure 2.10. Correlation between stocks-to-use ratio and price levels of wheat (1990-2012)



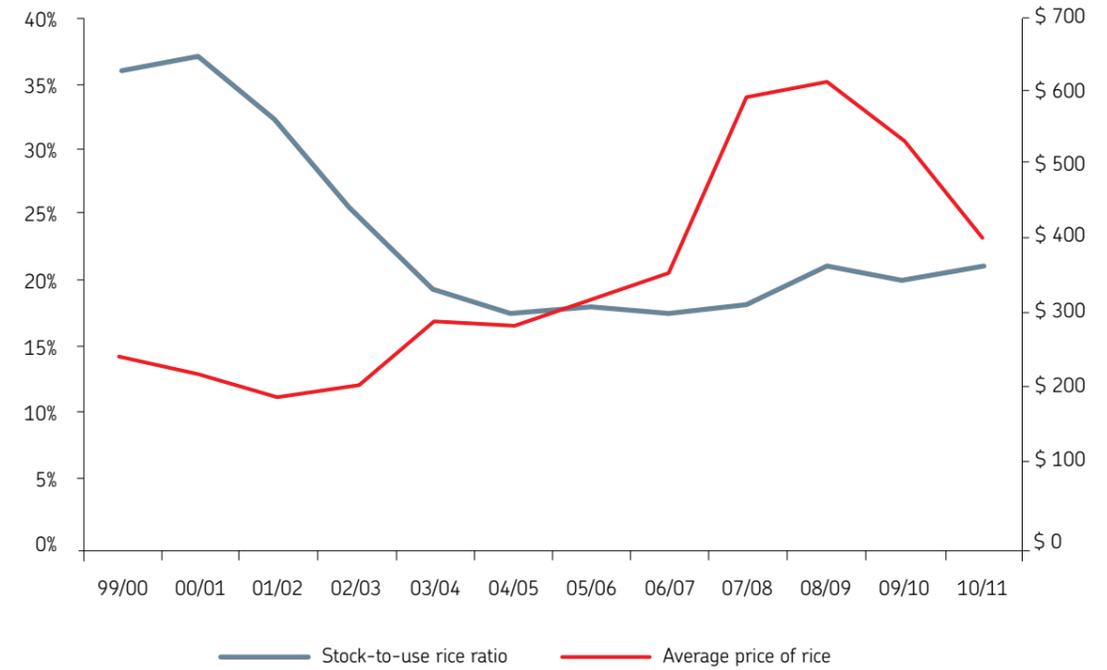
Source: elaboration by The European House-Ambrosetti of FAPRI data, 2011.

THERE IS A STRONG LINK BETWEEN STOCK LEVELS AND PRICE DEVELOPMENTS

A reduction in stocks (which in the graph is represented by a negative slope of the stocks-to-use curve) corresponds to an increase in the price level, as shown in the shocks of 1995-1996 or 2008-2009; on the contrary, with an increase in stocks (which corresponds to the positive slope in the graph of the stock-to-use curve), the price tends to decrease, as in the 1996-2002 period. The correlation index shows how there is a strong negative correlation between the two series (-0.73), which suggests the presence of a strong link between stock levels and price developments.

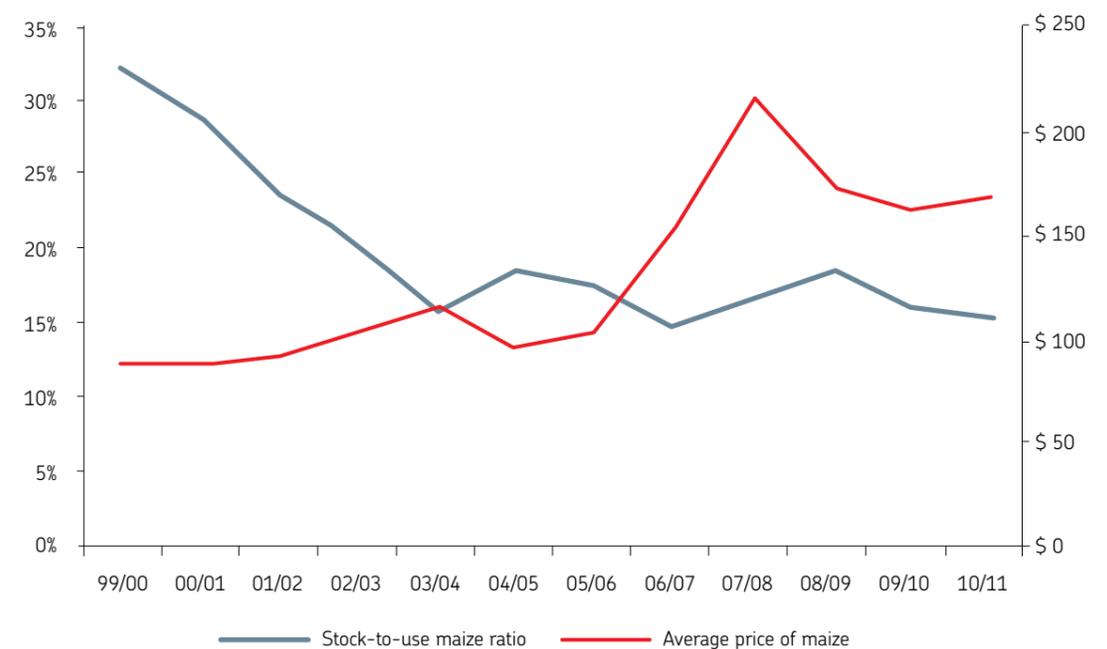
The same relationship can also be observed with regard to rice and maize.

Figure 2.11. Correlation between stocks-to-use ratio and the price levels of rice (1999-2011)



Source: elaboration by The European House-Ambrosetti of FAPRI data, 2011.

Figure 2.12. Correlation between stocks-to-use ratio and the price levels of maize (1999-2011)



Source: elaboration by The European House-Ambrosetti of FAPRI data, 2011.

2.4 AGRICULTURAL PRODUCTION AND SCARCITY OF RESOURCES

In the previous paragraphs, we have analyzed the main variables that influence the dynamics of the demand for food in the world, in both the short and medium-long term. Among these are the phenomena related to the evolution of demographic scenarios, changes in eating habits and the development of emerging countries.

The scenario presented here, therefore, outlines a future characterized by a strong growth in demand for food globally.

In contrast, therefore, the supply must show an ability to compensate for this growth in demand: from a purely economic point of view, the more the supply will be able to modulate and adjust to reach a state of equilibrium, the more it will be possible to avoid situations of instability and, therefore, of extreme price volatility.

Currently, the inefficiency of the economic dynamics inherent to the food commodities market from the supply side is due to several factors, but not to an insufficient agricultural production: in fact, it has been estimated that the total amount of calories produced per person per day is equal to 2720 kcal.¹¹

So, from a technical-quantitative point of view, the world today is able to produce enough food for everyone, but, as unfortunately demonstrated by the 925 million undernourished people in the world, there are great inefficiencies in the market. These include, for example, issues related to market access, the waste of food both in the phases of production and in those of consumption,¹² the inefficiency of the models and processes of food distribution, and the eating habits of the industrialized countries.

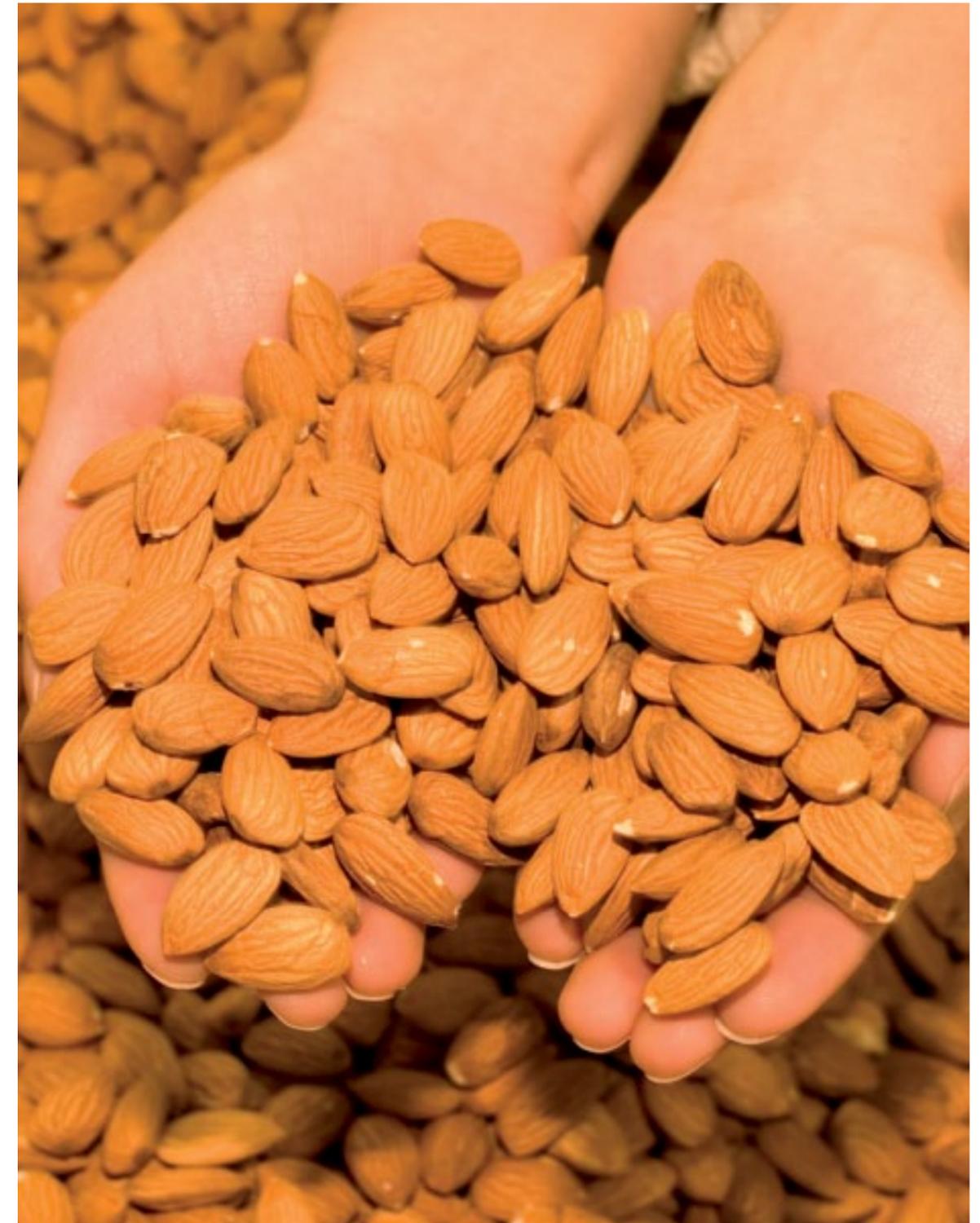
Among the factors listed above, the main cause of imbalances on the supply side is the inadequacy of food distribution processes, that seem to favor the commercialization and monetization of food products rather than the enhancement of the availability and access to food by all sections of the population. Just think of the paradox of the many countries that have always played a significant role in world agricultural production in which a high number of undernourished people is recorded.

In this regard, in fact, it is estimated that about 75% of the countries that show signs of malnutrition in the population are food exporters in the world.¹³ One example is India which, despite its 238 million people living in conditions of malnutrition, had exported some 60 million tons of grain produced in the country in 2000.

Nevertheless, even if today the production of agricultural raw materials can be considered theoretically sufficient to cover the world's food needs,¹⁴ serious doubts and concerns arise about the potential development of the agricultural scenario and food in the future. Will the world's agricultural production, given the constraints of the increasing scarcity of natural resources globally, be able to keep pace with the strong growth in the demand for food? How much will agricultural productivity have to grow?

The limitation in the availability of natural resources, with particular reference to inputs such as water and arable land, represents a significant constraint to the growth of the productive capacity of world agriculture.

THE CONSTRAINT OF LIMITED NATURAL RESOURCES



Phil Schermeister/National Geographic Stock

TODAY, THE WORLD IS ABLE TO PRODUCE FOOD FOR EVERYONE

NEVERTHELESS, THE PROCESSES OF FOOD DISTRIBUTION ARE INADEQUATE

WILL THE GLOBAL AGRICULTURAL PRODUCTION BALANCE THE STRONG GROWTH IN DEMAND?

The scarcity of water, today and tomorrow

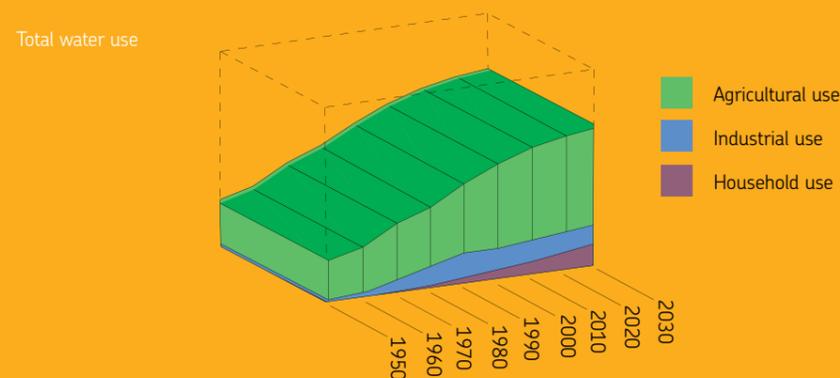
Overall, our planet has approximately 1.4 billion km³ of water. It is estimated, however, that only less than 45,000 km³ of water (equal to 0.003% of the total) are theoretically useable and only 9-14,000 (representing approximately 0.001% of the total) are actually available for human use because of sufficient quality and affordability. At present, agriculture irrigation alone employs about 70% of the world consumption of freshwater.¹⁵

The current water demand, already very high, will grow steadily in the future, causing a progressive scarcity, especially in some areas of the planet, and serious consequences to the agricultural/food sector. As can be seen in Figure 2.13., in fact, it is estimated that in 2030, agriculture will still represent the sector with the greatest absorption of the global water resources.¹⁶ Data relating to access to water for the future is not reassuring in that, because of population growth, the high cost of irrigation techniques that often exceeds the financial capacities of the small farmers of many developing countries, the persistence of inefficient irrigation practices and the increasing competition for water use, it is

estimated that somewhere between 15 and 35% of current water withdrawals for irrigation will not be sustainable in the future.¹⁷ Considering that the yield of cultivated land is 2-3 times higher in land which is irrigated (about 20% of the total arable world area) – providing 40% of world production – compared to those areas that use only the rainfall water supply (80% of the land), it is even more evident just how critical the phenomenon of water scarcity is.

The relationship between water and agricultural production is, therefore, one of the most difficult challenges for the future of mankind, in that it will be of paramount importance to avoid a further deterioration of an already critical and unacceptable situation of malnutrition and thirst in the world. Considering the great problem of water scarcity (which already affects more than 1.2 billion people and will affect more than 1.8 billion in 2025), it is essential to undertake a thorough analysis aimed at identifying a pattern of structural growth which must be pursued with international and intersectoral approaches, especially in relation to the future sustainability of agricultural production.

Figure 2.13. The removal of water as to type of use: the future prospects



Source: WBCSD, *Facts and Trends – Water*.

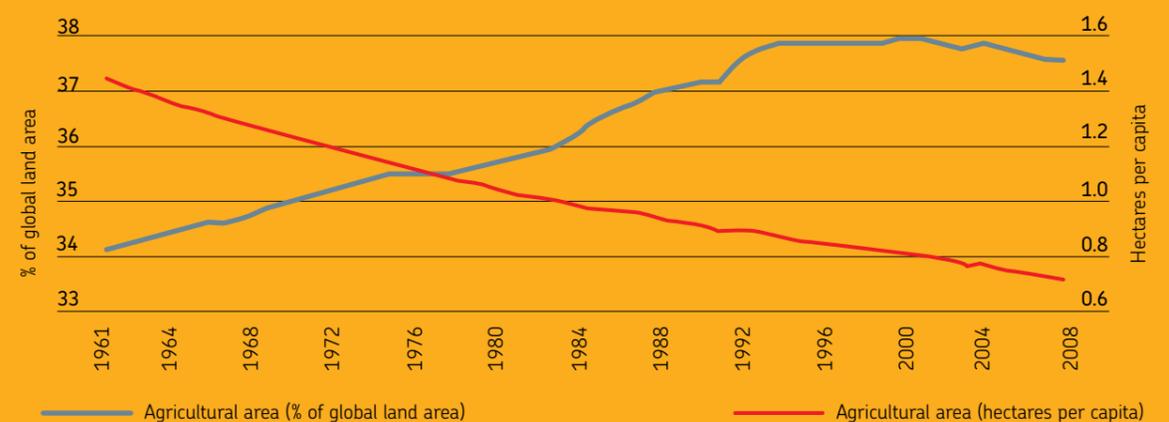
Land degradation

Soil degradation is a degenerative process of the function and the long-term productivity of the ecosystems.¹⁸ It is an impoverishment of the soil in terms of fertility, which is manifested mainly through phenomena such as desertification, erosion (gradual exporting of soil), the salinization and the presence of contaminants. The process of soil formation and regeneration is very slow and, for this reason, soil is considered an essentially non-renewable resource. The main causes of land degradation include: logging and deforestation, the extraction of nutrients of agricultural land, urban conversion, irrigation and pollution. In addition, the degradation of arable land is also caused by inadequate land management, depletion through intensive exploitation of the land and inadequate irrigation techniques.

Some studies,¹⁹ that observed the phenomenon over a period of 20 years, claim that land degradation is increasing and is gradually spreading to many parts of the world. Currently, this phenomenon affects more than 20% of all arable land, 30% of

the forests and 10% of the grasslands. Furthermore, according to other scholars,²⁰ every year 20,000-50,000 km² of land become unusable, with losses 2-6 times higher in Africa, Latin America and Asia than in North America and Europe. In conclusion, therefore, as can be seen in the graph in Figure 2.14., the share of agricultural land has undergone a dramatic downsizing, creating a significant impact on the entire food chain. The main repercussions will increasingly affect agricultural productivity; it is important to remember how erosion, desertification and salinization have direct impacts on agricultural yields. Following such phenomena, in fact, the productivity of some areas is reduced by 50%. For example, in Africa, the continent most severely hit by the phenomenon,²⁴ losses vary in range from 2 to 40%, with an average loss estimated at 8.2%, calculated upon the entire territory. On a global level, then, the repercussions of the phenomenon have caused a loss of productivity ranging from 1-8%, equal to an annual loss of 400 billion dollars,²² or approximately 70 dollars per person.

Figure 2.14. The share of agricultural land has peaked



Source: FAO, <http://faostat.fao.org/site/377/default.aspx>

**AGRICULTURAL
PRODUCTIVITY IS
INCREASING LESS
RAPIDLY THAN IN
THE PAST**

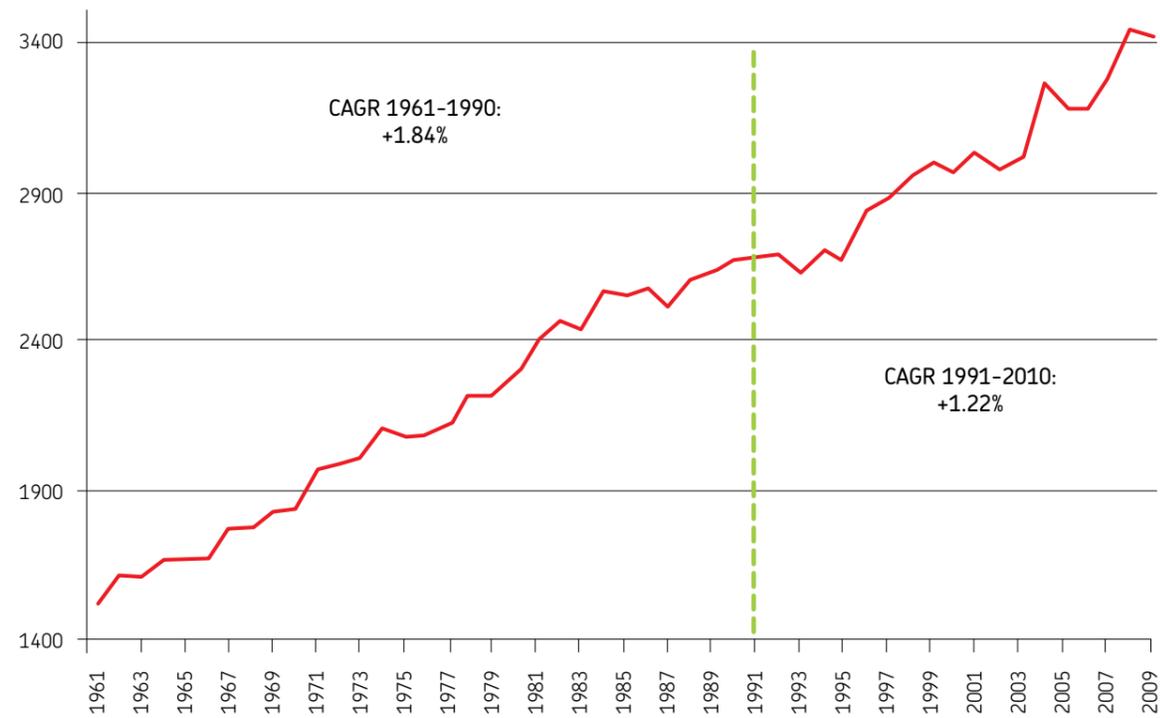
Therefore, the growth in agricultural productivity, or the yield of land used for agricultural purposes, will be of fundamental importance, both through the use of new technologies and through the spreading of best practices and agricultural technologies, also in less developed countries.

In general, over the past 50 years, agricultural productivity has continued to grow globally, even if at decreasing rates. The reason for this slowdown can be identified in the order of the effects of so-called “green revolution,” where the introduction and widespread use of innovative agricultural techniques (with particular reference to pesticides and chemical fertilizers) led productivity to make a great “leap forward” in the late Sixties/Seventies.

As can be seen clearly from the graph in Figure 2.15., for example, the yield from land planted with cereals has risen without interruption since 1960, albeit according to two different speeds. From the Sixties to the Nineties, in fact, the average annual rate of growth was 50% higher than in the next twenty years; today’s agricultural productivity, however, is growing less rapidly than in the past and, above all, less rapidly than the growth of the demand.

Also, in the coming years, a similar slowdown is predicted, caused by the lack of relevant technological advances that, therefore, represents the real challenge to ensuring adequate global agricultural production in the near future.

Figure 2.15. Global yield of cereals²³ (1961-2010)



Source: elaboration by The European House-Ambrosetti of The World Bank data, July 2011.



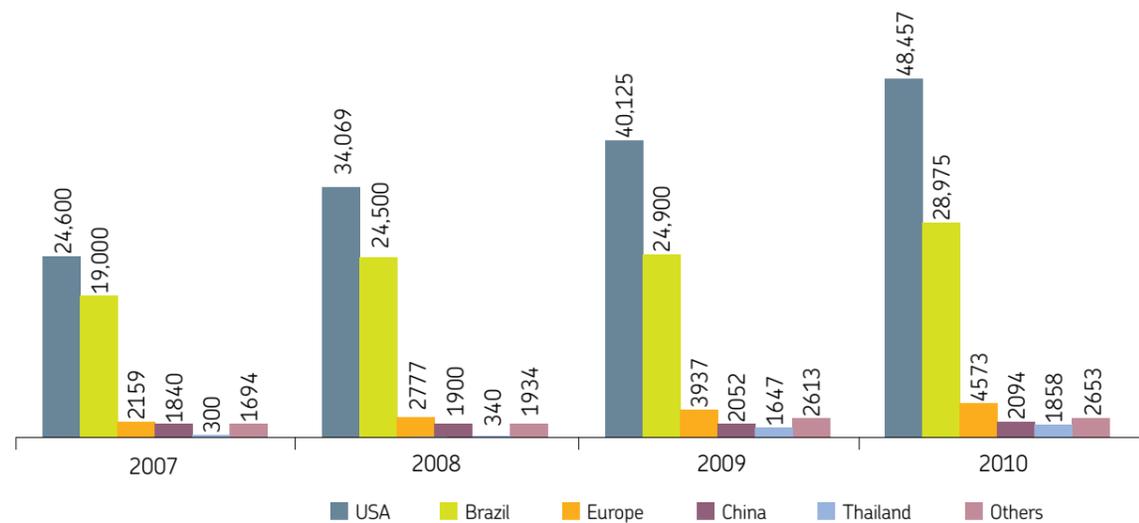
2.5 PRODUCTION OF BIOFUELS

THE PRODUCTION OF BIOFUELS HAS INCREASED RAPIDLY

The objectives of energy security and the issue of the exhaustion of fossil sources of energy,²⁴ both in Western countries and in those that are emerging and developing. Among the sources of “green” energy, the share of production and consumption of biofuels²⁵ has increased rapidly in recent years and is expected to continue to grow in the foreseeable future. The global production of biofuels has increased, in fact, in a few years from 49.6 billion liters in 2007 to the current 88.6 billion liters in 2010.²⁶

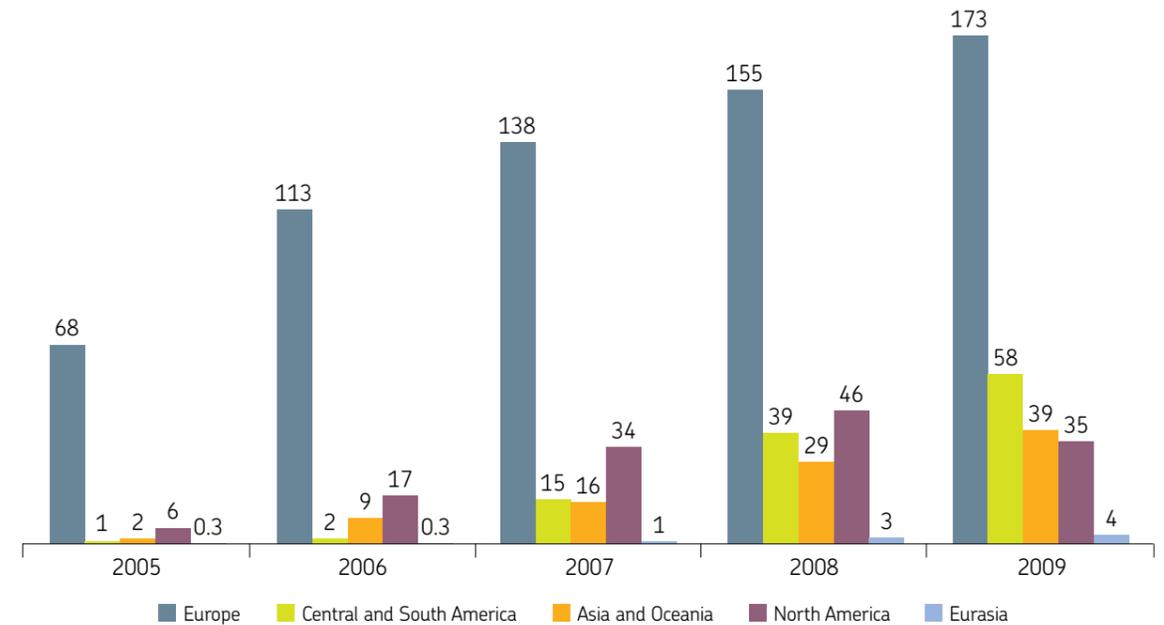
This growth was mainly driven by national and international energy policies (such as mandates on the share of biofuels and targets for renewable energy production), subsidies, tax breaks and protection measures.²⁷ In addition, the use of biofuels does not require special technological developments in the engineering of modern engines, and is an easy alternative to fossil fuels. As can be seen from Figures 2.16. and 2.17., the scenario of the global production of biofuels is divided into two main areas: on the one hand, there are the two major producers of ethanol, Brazil and the United States; and on the other, European Union countries, where, instead, the production of biodiesel is concentrated, made from raw material (vegetable oils) coming from the European Union, Brazil and Southeast Asia. Biofuels can be divided into those of the first and second generation.

Figure 2.16. World production of ethanol: the main producing countries (2007-2010, millions of gallons)



Source: elaboration by The European House-Ambrosetti of USDE (United States Department of Energy) data, 2010.

Figure 2.17. Worldwide production of biodiesel by macro-regions (2005-2009, thousands of barrels/day)



Source: elaboration by The European House-Ambrosetti of USDE data, 2009.

According to a definition of the International Energy Agency (IEA), first-generation biofuels are typically ethanol from sugar cane, roots or maize, and biodiesel. The raw materials used in the production of first generation biofuels are derived from the fermentation of foods high in sugar content, such as sucrose, roots (in the case of biodiesel), oils from oilseeds or tropical fruits and animal fats, which can also be consumed as food or feed for animals.

Second-generation biofuels are, conversely, non-food products from organic substances, such as cellulose, hemicellulose or lignin. Therefore, they have more sustainable production characteristics than those of the first generation.

However, their production is currently far more complex and costly and in the near future, their share of the total will remain relatively low: in fact, it is estimated that in 2020, second-generation ethanol production will represent only 2.8% of the total.²⁸

It can be argued, then, that today the growing production of biofuels competes directly with the use of raw materials in the food and feed sectors.

In this regard, it has been found that, among the agricultural commodities, the production of biofuel impacts particularly on the demand for wheat, corn, sugar and seed oils. In fact, in the period 2008-2010, the production of bio-ethanol was primarily made with raw cereals and sugar cane, whereas that of biodiesel was made from vegetable oils (90% of biodiesel production is obtained by processing vegetable oils, just as ethanol is produced with 55% from raw wheat and 35% from sugar cane).²⁹

Some data is useful to frame the scope of the phenomenon.

The widespread use of corn for ethanol production in the United States determines important implications on a global scale, accounting for one third of world production and two thirds of the volumes exported.

It is estimated that in 2010, the U.S. spent 38.4% of its total production of corn to produce ethanol.

THE FIRST AND SECOND GENERATION BIOFUELS

THE PRODUCTION OF BIOFUELS COMPETES WITH THE PRODUCTION OF FOOD

IN THE U.S., THERE IS WIDESPREAD USE OF CORN (MAIZE) FOR ETHANOL PRODUCTION

IN EUROPE, MAINLY
VEGETABLE OILS
ARE USED

Between 2004 and 2007, the use of corn for food consumption grew at a rate of 1.5% per year, while the share for the production of ethanol increased by 36% in the same period.

The same is true for the production of biodiesel, for which, for example, in Europe, a total of 8.6 million tons of vegetable oils are used (about 3% of world production). The industrial use of vegetable oils rose 15% per year in the period 2004-2008: a considerably higher trend than the rate of growth of production for food of the same asset, amounting to 4.2% during the same period.

Beyond the numbers related to the increasing shares of some agricultural products absorbed by the biofuel industry, the problem of new kinds of energy can not only be limited to the amount of crops used to produce fuel, but must be extended also to the amount of land that can be allocated or reassigned exclusively to production for the biofuel industry, in a logic of trade-offs in land use.

Between 2001 and 2007, the United States witnessed an expansion of 23% of the areas for the cultivation of corn, in response to the increased demand for ethanol production. This led to a 16% decrease of the areas for the cultivation of soybeans, which reduced production, leading to a 75% increase in relative prices.

While in the U.S., corn crops are grown for industrial purposes at the expense of soybean crops, in Europe and other exporting countries, seed oil is increasingly a substitute for wheat. The expansion of biodiesel production in Europe has, thus, become one of the primary causes of the slowdown in the cultivation of corn and wheat crops. In addition, prices for raw canola oil rose from \$660/metric ton in 2004 to over \$1000/metric ton in 2010.

The rising prices of seed oils is leading to substantial changes in the composition of agricultural crops, in favor of rapeseed, sunflower seed and, especially in Southeast Asia, palm oil. Since 2010, the world's largest exporters of wheat have increased the areas for the cultivation of oil seeds by 36% (8.4 million hectares), while those intended for the cultivation of wheat fell by 1%.

Biofuels will have more and more weight in the world production of cereals, sugar cane and vegetable oils.

In 2020, for the production of ethanol, 12% of the global production of raw cereals will be used (compared to 11% between 2008 and 2010) and 33% of the sugar production (compared to 21% today).

16% of the global production of vegetable oils will be used to produce biodiesel (compared to 11% today).

Also, during the period 2010-2020, 21% of the global production of raw grains will go toward the production of biofuels, 29% of that of vegetable oils, and finally, 68% that of sugar.³⁰

It is not certain, though, that these estimates will be confirmed, as there are no certainties about the future of biofuel production since economic sustainability is basically determined by government aid and political support, as well as by policies adopted by countries on issues of environmental sustainability and energy (procurement policies, international agreements, research funding, environmental commitment, etc.), the dynamics of oil prices (the price of which is greater when there are more market incentives to develop alternative forms of energy), and technology that will be available in relation to the production and use of biofuels (cost of production, environmental impact of facilities, security, efficiency, etc.).

Nevertheless, the further increase in the volume of biofuels could contribute greatly to the increase in food commodity prices. The link between biofuel production and the prices of agricultural products was estimated by the FAO, which calculated the effects on prices of agricultural products due to a greater or lesser use of biofuels, drawing up two alternative scenarios:

THE PRODUCTION OF
BIOFUELS COULD CONTRIBUTE
SIGNIFICANTLY TO THE
GROWTH OF THE PRICES OF
AGRICULTURAL PRODUCTS

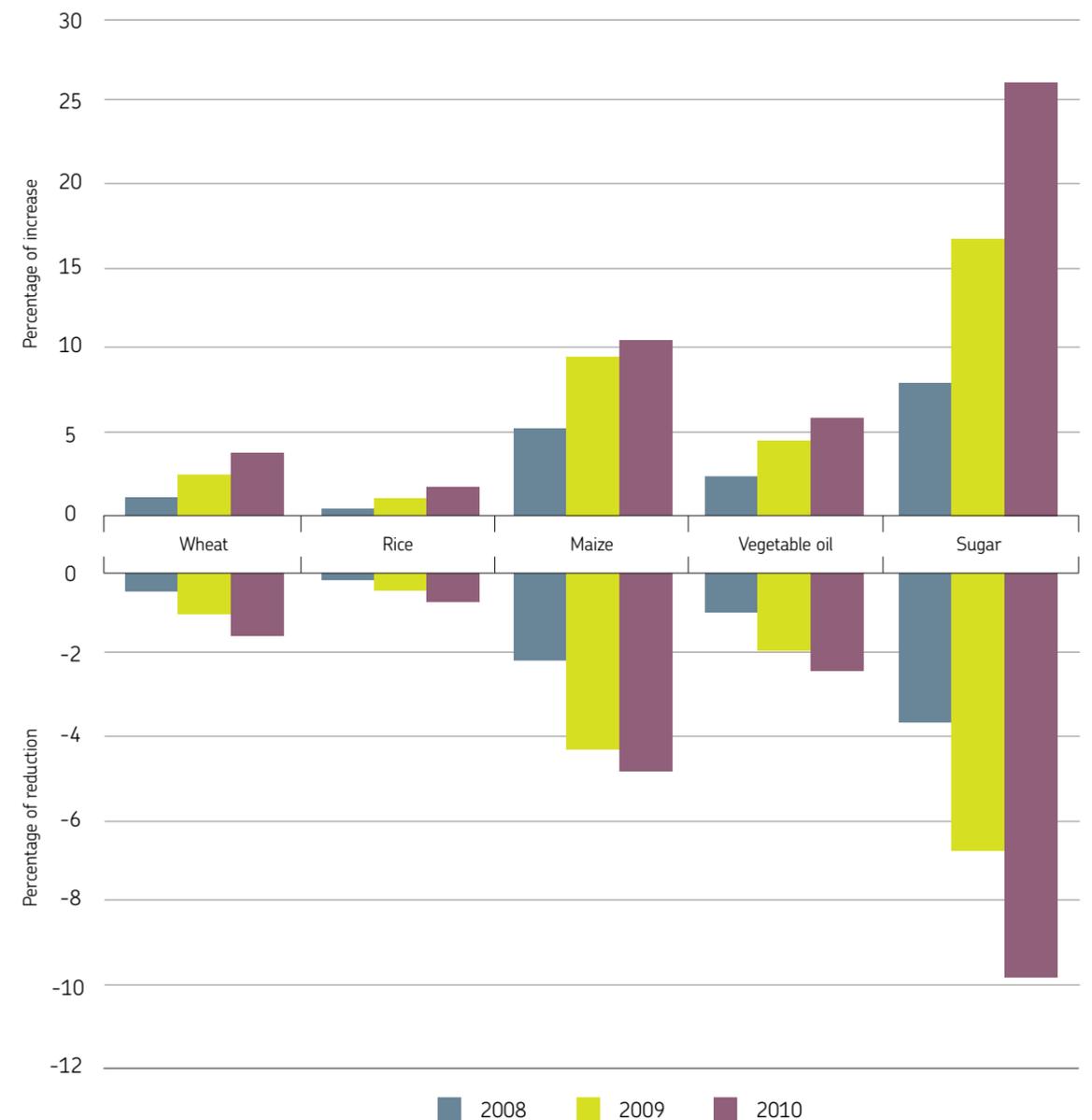
- 30% increase in the demand for wheat, sugar and vegetable oils for biofuel production;
- 15% reduction of the demand for wheat, sugar and vegetable oils for biofuel production.

The results of this estimation are shown in Figure 2.18., where it can be seen that the greatest effects in terms of price changes are those related to sugar and corn.

The link between biofuel production and price of raw materials with which it is produced seems to be confirmed by the data presented in Figures 2.19. and 2.21., showing the relationship between the production of ethanol and biodiesel with the price of their commodities (corn and rapeseed oil) in the United States and Europe.

THE LINK BETWEEN
BIOFUEL PRODUCTION
AND THE PRICE OF RAW
MATERIALS WITH WHICH
IT IS PRODUCED

Figure 2.18. Effects of a 30% increase in the demand for agricultural products for biofuels and of a 15% reduction of the same demand concerning the prices of agricultural products in the period 2008-2009-2010



Source: *The State of Food and Agriculture in 2008*, FAO, 2008.

Figure 2.19. shows the degree of correlation (Pearson's index equal to 0.9) between the development of ethanol production and the evolution of corn prices.

The strong growth in ethanol production drives up the price increase of corn, which is the primary element for the production of that biofuel.

Since the United States is the largest producer of corn, such a massive change in land use (+35% increase annually in ethanol production) has resulted in a surge in the price level, thus contributing to the price crisis of 2007-2008.

In addition, the effect exerted on corn is reflected on the entire grain segment, in that these are connected by a high degree of substitutability in the production of animal feed.

If we analyze the case of biodiesel production and the price of canola, there was again a clear increase in the price of rapeseed oil between 2000 and 2007 (275%), which occurred simultaneously with the introduction and rapid development of biodiesel production.

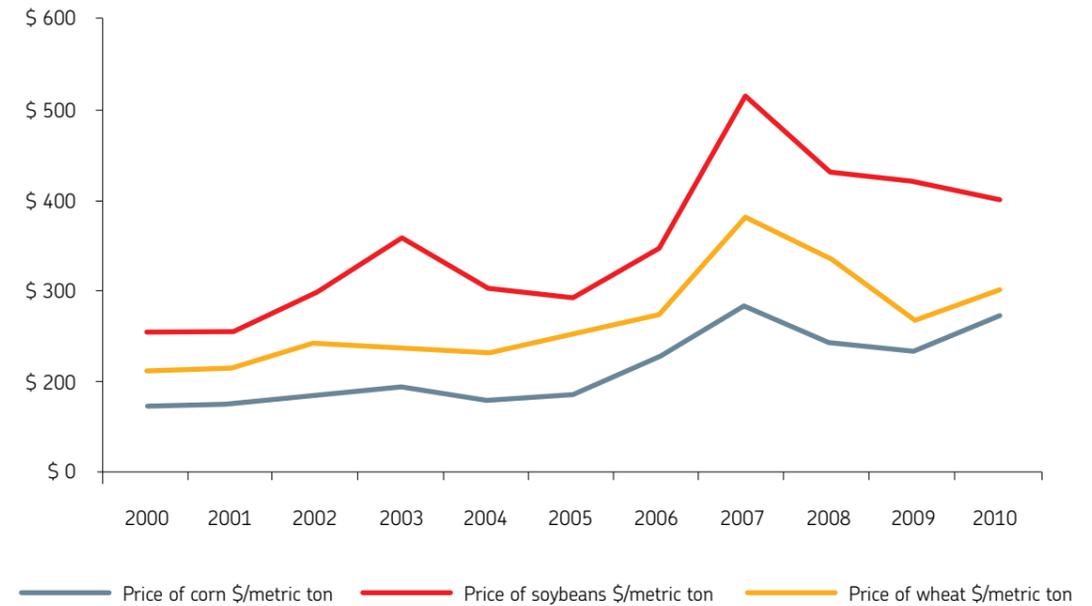
In Europe, there have been two important facts: the production of rapeseed has increased dramatically with the introduction of biodiesel production (+78% between 2000 and 2007, with an annual growth rate of 7%) and the share of the production of rapeseed for the production of biodiesel has doubled (in 2010, 84% of the production of rapeseed oil in Europe was allocated for this purpose, compared with 41% in 2005).

Figure 2.19. Correlation between ethanol production (million gallons) and the price of corn (\$/metric ton) in the U.S. (2000-2011)



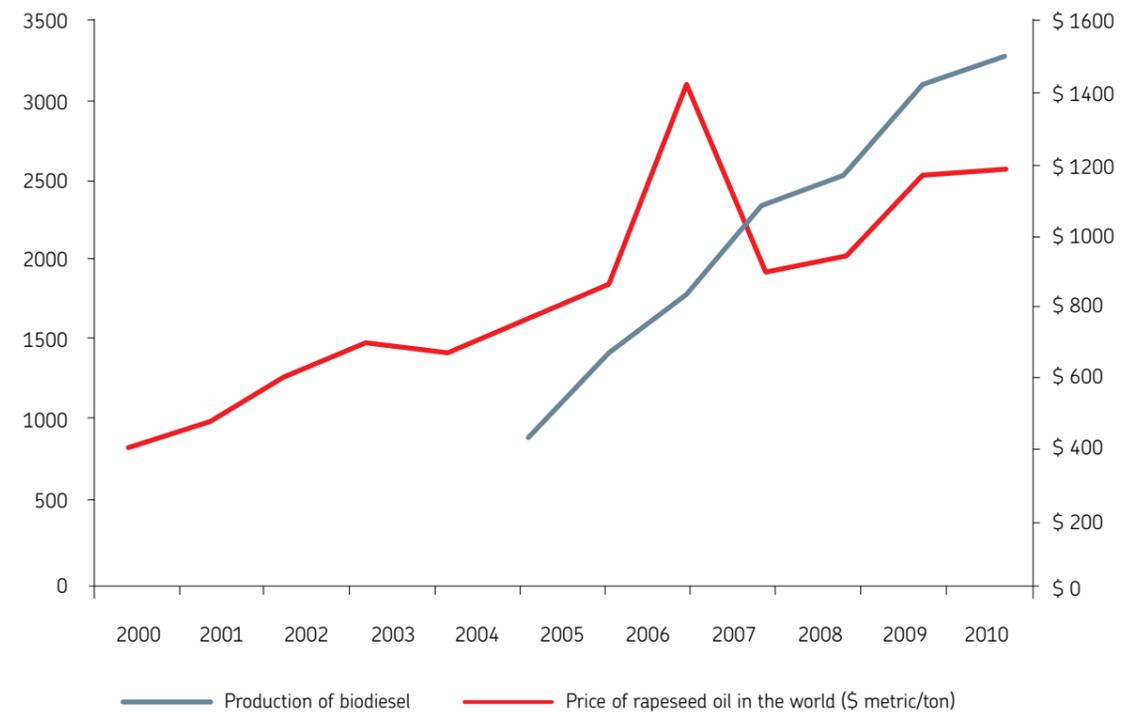
Source: elaboration by The European House-Ambrosetti of FAPRI data, 2010.

Figure 2.20. Trend in the price of corn, soybeans and wheat (2000-2010)



Source: elaboration by The European House-Ambrosetti of FAPRI data, 2010.

Figure 2.21. Correlation between production of biodiesel in Europe (million gallons) and price of rapeseed oil in the world (\$/metric ton)



Source: elaboration by The European House-Ambrosetti of FAPRI data, 2010.

China and the case of cassava

The cassava root has long been an important ingredient and the base of some human food and animal feed.

In 2010, 98% of the volume of cassava exports from Thailand (the world's biggest exporter) was destined to a single nation, China, and for a single purpose, to produce biofuel.

The Chinese government, concerned about the possible repercussions on the growth of prices and possible shortages in their own territory, in fact, banned the use of cereals for biofuel production in 2007. Thus, Chinese scientists developed a process to obtain fuel from cassava, a root that can ensure a good energy return. In addition to expanding the domestic cultivation, China started to buy large quantities from Cambodia, Laos and, especially, Thailand. Since 2008, the amount of cassava exports from Thailand has quadrupled and the

price has doubled because of the demand from China.

In 2009, the proportion of cassava used for ethanol production rose to 52%, as compared to 10% in 2008.

Since cassava is not an essential component of the Asian diet (contrary to that of some African countries), China considered that the production of fuel from this root would not affect the trend of food prices, at least in its territory.

However, problems related to this policy are emerging rapidly. Since cassava was typically used as feed for farm animals, the new demand for the biofuel production is causing an increase in the final price of meat and dairy products.

In addition, stimulated by the price of this commodity, the countries of Southeast Asia are displacing other food crops such as rice and cereals with cassava to support the growth of the Chinese demand.

Jatropha, a new plant for energy

Jatropha is a plant native to South America, where it has been used as an antiseptic medicine since antiquity.

In the sixteenth century, when Portuguese traders landed on the coast of South America, they discovered the Jatropha plant and began to carry it along the trade routes in Asia and Africa, using it in the fields to defend their crops from wild animals, since it is toxic.

Currently, Jatropha can be found growing from the rainforests of Brazil to the Fiji Islands.

The vegetable oil of Jatropha, obtained by squeezing the inedible seeds, was widely used in the nineteenth century as oil for illumination. Thanks to this peculiarity, it was widespread in the markets of the time, only to be later abandoned in favor of paraffin.

Jatropha seeds contain between 30 and 38% oil, are not edible but can be used directly as a common oil or as fuel (after simple filtration) in specifically-designed diesel engines, or transformed into biodiesel and used in all diesel engines without any specific modifications.

Jatropha has often been identified as a source of sustainable development for the people of the poorest countries: in

fact, it allows for producing a fuel of high quality, low viscosity, second only to palm oil (whose cultivation, instead, requires significant amounts of water).

This plant does not compete with food production because it is not edible, requires low amounts of water, does not subtract drinkable water for human use and grows in arid zones where few other crops would be possible anyway. In addition, for the fact that it can be grown in arid areas, Jatropha could also reduce desertification and soil erosion.

Cultivation on an industrial scale is currently still in its infancy, covering a total area of 900,000 hectares. More than 85% of the plantations are in Asia, particularly in: Myanmar, India, China and Indonesia. Africa holds 12% of the production, split between Madagascar and Zambia, and the remainder is located in South America, mainly in Brazil.

It is thought that in 2015, the cultivation of Jatropha worldwide will reach a share of 12.8 million/ha.

The FAO estimates that Indonesia will become the largest producer in Asia with 5.2 million/ha, that Ghana and Madagascar will reach 1.1 mil/ha and Brazil 1.3 mil/ha.²¹



2.6 CLIMATE CHANGE

CLIMATE CHANGE THREATENS THE FUTURE SUSTAINABILITY OF AGRICULTURAL PRODUCTION

IN 30 YEARS, CEREAL PRICES HAVE INCREASED BY 18.9%, JUST FOR THE EFFECTS OF CLIMATE CHANGE ALONE

The phenomenon of climate change is recognized as a serious threat to the future sustainability of agricultural production globally. Climate change acts through a dual effect: on the one hand, it is estimated that rising temperatures in the medium to long run will result in a reduction in agricultural productivity and, therefore, contribute to the increase in food commodity prices; and second, the intensification of adverse weather events – that cause unpredictable losses of crops – will impact on the increase in price volatility in the short term.

A recent study³² quantified the impact of global warming on the production and prices of cereals over the past 30 years. It is estimated that – net of other factors such as competition for land use and the increasing demand – rising temperatures and changes in rainfall have led to an increase in cereal prices by 18.9% from 1980 until today. In other words, in the absence of the phenomenon of climate change, the prices of agricultural commodities would now be about 20% lower. Since 1980, climate change has, in fact, reduced world production of cereals by 3%: for wheat and maize, the negative impact was 5.5 and 3.8%, respectively, while for other crops (such as soybean and rice) the drop in yield in some areas was offset by increases in other areas. The countries most affected were Russia (where there has been a 15% reduction in wheat production), Turkey and Mexico. Other studies have estimated the possible impact that climate change could have on the world production of cereals in the future. Especially in the poorest parts of the world, in which the ability to adapt to climate change is lower, there has been a sharp decline in cereal production, while in other areas – such as in developed countries and Latin America countries – the data suggests that an increase of cereal production is also due to the phenomenon of carbon fertilization.

Figure 2.22. Estimated impact of climate change on global cereal production (estimates from 1990 to 2080, percentage change)

REGION	VARIATION 1990-2080 %
World	from -0.6 to -0.9
Developed countries	from 2.7 to 9
Developing countries	from -3.3 to -7.2
Southeast Asia	from -2.5 to -7.8
South Asia	from -18.2 to -22.1
Sub-Saharan Africa	from -3.9 to -7.5
Latin America	from 5.2 to 12.5

Source: elaboration by The European House-Ambrosetti of IFPRI (International Food Policy Research Institute) data and Tubiello F.N., G. Fischer, 2007.

Unfavorable weather conditions (drought, floods, extreme events) and other unexpected natural disasters had a considerable effect on the grain harvest in the period 2005-2010. The impact on production has been manifested by an increase in the level of uncertainty present in the markets and a sharp rise in prices and market volatility. While these natural events have always been an obvious risk factor for food production, a worsening is expected, both in terms of frequency and severity due to the ongoing climate change.

In particular, in the last two years, the poor harvests due to adverse weather events – such as the droughts in the summer of 2010, first in Russia and then in Argentina, and the heavy rains in Canada and Australia in early 2011 – have partially contributed to the current peak in the level of food prices. For example, the phenomenon of the “Niña”³³ raged during the first months of 2011, resulting in colder winters in the Northern Hemisphere and droughts in the southern United States and an increase in rainfall in Indonesia, Malaysia and Australia. The impact could result in a reduction of the production of the plantations in major producing countries of food commodities, such as in the case of soybeans in Argentina and Brazil, and of coffee in Colombia.

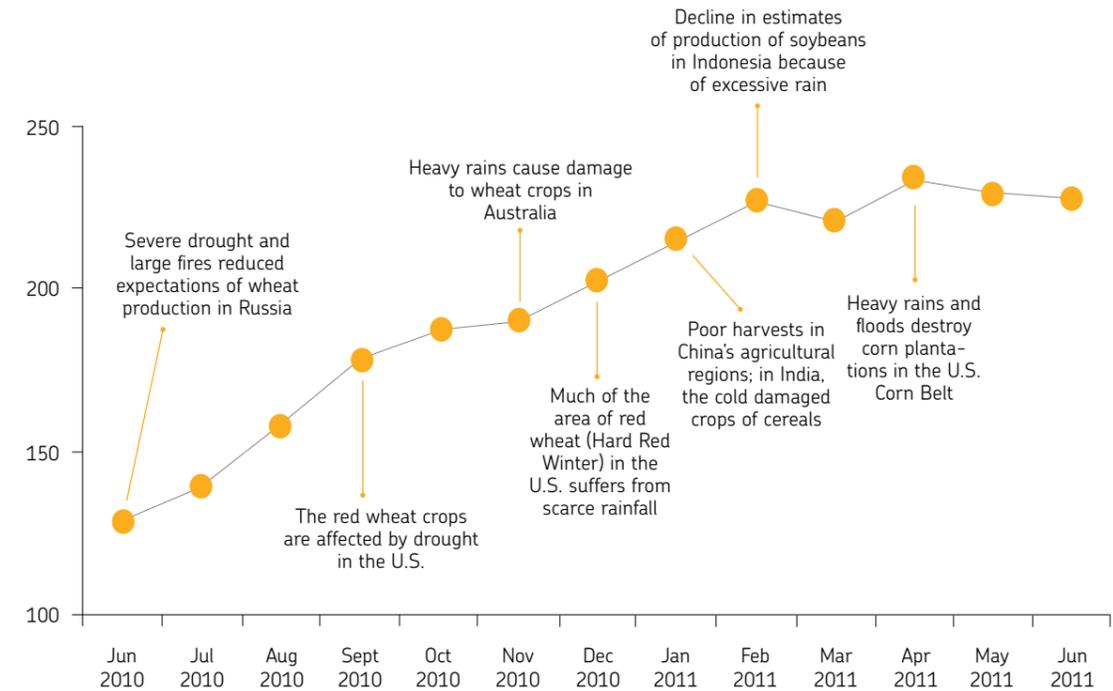
Figure 2.23. shows how, in the last year, a significant increase in cereal prices (approximated by the FAO Cereal Price Index) has been basically accompanied by the occurrence of adverse weather conditions that had a negative impact on agricultural production. A series of adverse events concentrated in just 12 months dramatically reduced expectations on the increase of global production and inventory levels in 2010, thus contributing to raising the level of prices.

In light of ongoing climate change, the producers, consumers and policy-makers must, therefore, make suitable choice to support agricultural productivity.

CLIMATE CHANGE WILL BE RESPONSIBLE FOR A DECLINE IN THE GLOBAL PRODUCTION OF CEREALS

MORE FREQUENT AND INTENSE ADVERSE WEATHER EVENTS ARE TRIGGERING RISING PRICES

Figure 2.23. Development of prices of cereals (FAO Cereal Price Index, October 2005 = 100) and major weather events (June 2010-April 2011)



Source: elaboration by The European House-Ambrosetti of USDA and FAO data, 2011.

THE EX-ANTE
POLICIES AIM FOR THE
DIFFERENTIATION OF
CROPS

THE EX-POST POLICIES
ARE AIMED AT
REDUCING ECONOMIC
LOSSES AND A DROP IN
WELL-BEING

THE INTERVENTIONS
BY GOVERNMENTS
WILL BE CRUCIAL

In literature, some hypotheses have been formulated for the establishment of a system of appropriate measures and policies for the problem of climate change. The policies to follow can be of two types:³⁴ ex-ante measures or actions to anticipate and mitigate the effect of adverse weather events, and ex-post measures.

The ex-ante policies are mainly focused on the differentiation of crops trying to accommodate the changes in climate in a given period of time. One of the main ex-ante measures, difficult to achieve due to high costs and loss of productivity, is the flexibility of the crops. In addition, many countries (including Russia) have a productivity gap which is still very high compared to Europe, the U.S. and Brazil, which could be filled through the development of good farming practices.

It has proven to be easier to implement ex-post policies, aimed at reducing the economic losses and drop in well-being caused by adverse weather events. Some of these strategies involve the reduction of liquidity and stock reserves, the use of bank or informal loans, and the sale of key assets.

Unfortunately, not all of these strategies can be adopted by farmers and, in general, they fail to ensure food security and access to food.

In the more advanced countries, on the one hand, farmers may adopt social security systems or have recourse to financial markets to insure against the risks of production or receive financial assistance from the government to guarantee a sufficient level of supply in the domestic markets. On the other hand, consumers are less sensitive to price changes due to reductions in productivity caused by changes in the climate, although allocating a smaller share of their income to purchase food.

In poor countries, instead, the effects of sudden reductions in agricultural productivity are much more dramatic because of the lack of preventive or insurance measures. Moreover, from the point of view of the consumers, even small increases in the price level can result in serious social problems.

Consequently, in the absence of state intervention or a social security system, ex-ante policies can prevent the risk of significant losses in periods of poor harvests, but do not constitute a basis for generating income in favorable times. In fact, to defend themselves from weather variability, farmers cultivate less risky products (less sensitive to climate change) which are also less profitable (such as oats and barley, typically used as animal feed and highly resistance to climate change).

In general, the ex-post policies (such as, for example, the liquidation of key assets or land) bring about beneficial effects on the consumption in the short term, but end up reducing the production capacity in the long run.

Climate change, therefore, generates the need for adaptive responses by farmers, from whom interventions are required for any change in fundamental factors (such as the level of local rainfall and temperature fluctuations), in order to ensure a sufficient supply and to maintain or gradually change the current level of prices.

At the same time, interventions are required from national governments, which should act to promote, on the one hand, the adoption of policies for adaptation to climate change to contain the phenomenon³⁵ and, on the other, the spreading of good farming practices that mitigate the negative effects of climate change.

A study by the IFPRI³⁶ estimates that without government intervention to support policies aimed at mitigating negative effects and without crop flexibility, the price of rice will rise 31.2% by 2050, while that of corn by as much as 100.7%.



2.7 COST OF ENERGY AND THE PRICE OF OIL

The security of the supply of raw materials for energy production today is at the heart of the agenda of global policymakers. In particular, attention is focused on the level of oil reserves, which has a market dominated by large fields, 500 of which accomplish 60% of world production.³⁷

The debate on the actual availability of oil in the coming decades presents different and contradictory scenarios. On the one hand, recent investigations envisage a progressive reduction in the capacity of the global oil reserves: in 2008, 580 out of 651 of the largest oil producers reported that they had passed the peak of productivity and are now extracting an average of 6% less oil on an annual basis. Confirming this trend of decline in oil extraction, an independent study conducted by the University of Uppsala in Sweden³⁸ estimated a reduction in world oil production from 84 million barrels per day in 2007 to 76 million barrels per day in 2030.

On the other hand, there are surveys that mitigate the risk of exhaustion in the short term of the reserves of fossil fuels and the advent of new oil crises. Energy scenarios for 2035 outlined by the International Energy Agency (IEA), estimate that global production will not reach the peak by that date, whereas – if an energy path aimed at containing greenhouse gases in the atmosphere is pursued – a weaker demand for oil will cause the production peak to be reached shortly before 2020 (to 86 million barrels per day), to then give way to a sustained reduction.³⁹

The recent global economic crisis – which drove oil prices to 132 dollars a barrel in July 2008 – has prompted the largest importers to review their energy plans according to the logic of conservation, savings and a greater use of alternative sources, which, combined with doubts about the strength of economic recovery, has prevented prices from returning once again to the maximum reached in 2008.

Even though the global recession has, in fact, contributed to the decline in oil prices, a strong upward pressure has come from rising demand in emerging countries, thus increasing the gap between demand and supply.

In any case, since the demand for oil is growing at a rate higher than the production, both the International Energy Agency and the Energy Information Administration (EIA) estimate that the price of oil in 2030 will amount to around 190 dollars per barrel nominally (as opposed to the current value of between 115 and 120 dollars).

The cost of energy is one of the factors markedly influencing operating costs in the agricultural sector.

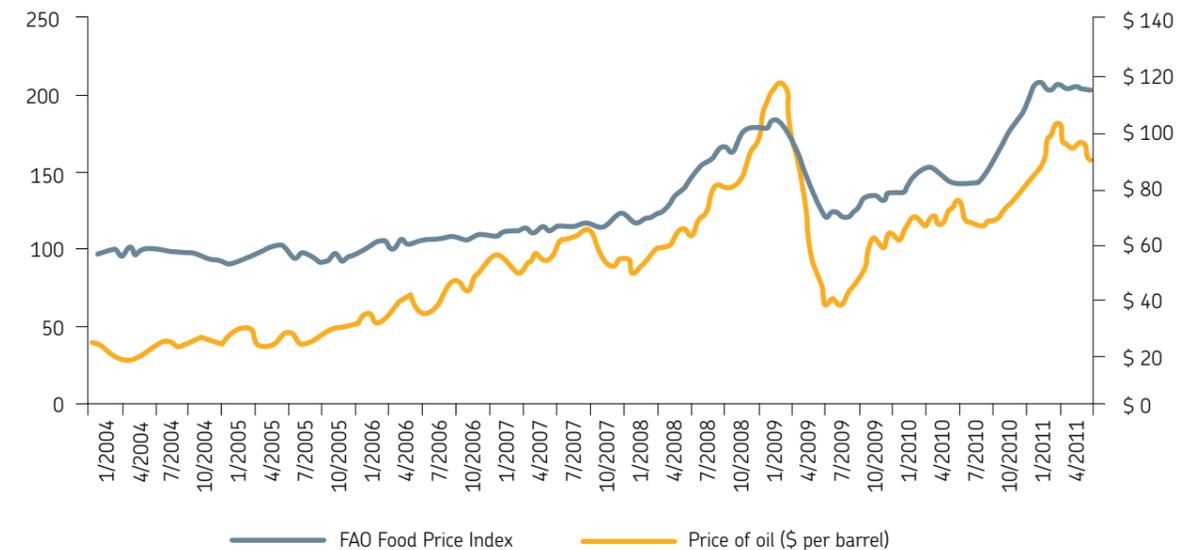
In particular, the increase in oil prices impacts on a range of activities related to the entire production cycle of the agricultural chain, from cultivation in the fields to the logistics and distribution of finished products.

The effects are transmitted – directly and indirectly – onto the cost:

- of the fuel for the movement of tractors and agricultural machinery for operations of sowing, fertilizing, weeding, watering, mulching and harvesting;
- of fertilizers, the price increase of which has a significant influence on crop production costs (particularly cereals, which require more use of fertilizers);
- of the fuel for heating the stables, the places for drying fodder for animal feed and for the greenhouses;
- of the services related to agriculture (increase in the cost of electricity bills);
- of the fuel for the transportation of the grain (trucks, trains, ships, etc.) for the distribution of semi-finished and finished products.

Proof of this, as seen in Figure 2.24., is the high degree of the correlation between the FAO Food Price Index and the price of oil on a monthly basis (correlation index = 0.84).

Figure 2.24. Correlation between the price of oil and food prices (January 2004–April 2011)



Source: elaboration by The European House-Ambrosetti of FAO and IMF data, 2011.

In general, one can see how the two peaks recorded between 1960 and 2010 by the FAO Food Price Index adjusted for inflation (1971-1973 and 2001-2009) coincide with the first oil crisis of 1973 and with the beginning of the global financial crisis that began in 2007, respectively. In those moments in history, the price increase can, therefore, also be explained by the rising prices of oil and the depreciation of the dollar.⁴⁰

In this paper, we have tried to highlight, in particular, the importance of the link between the cost of fertilizer and the trend in oil prices, with the consequent repercussions on the price of agricultural commodities.

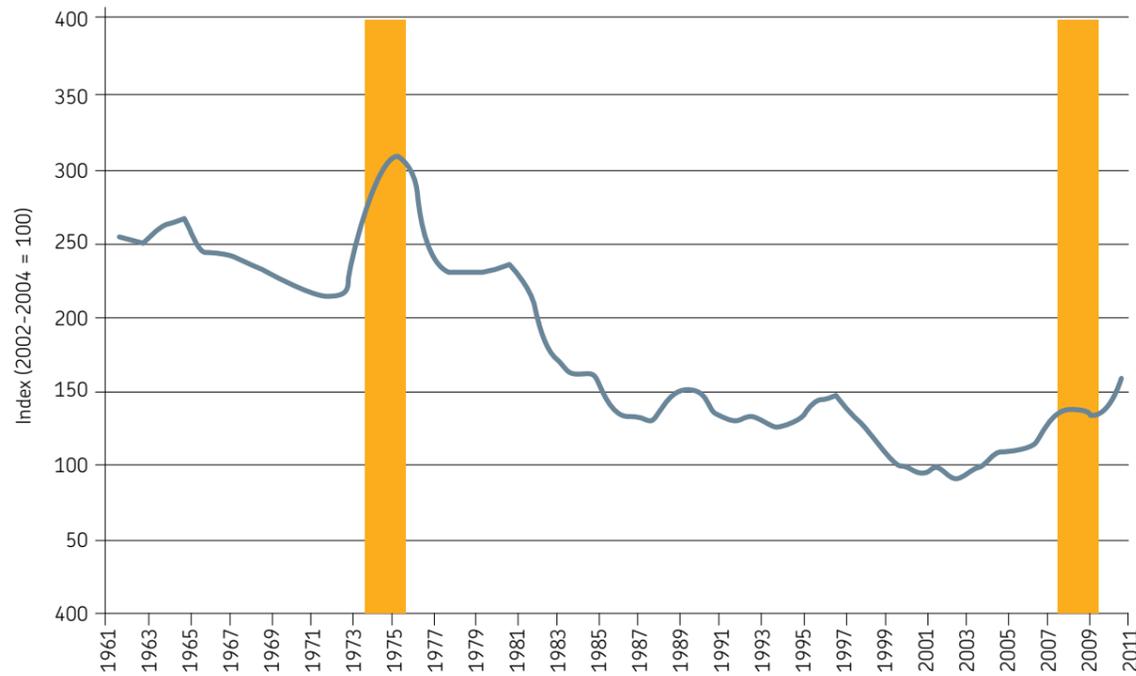
Globally, the consumption of fertilizers (nitrogen, phosphorus and potassium) increased between 2006 and 2010 at an average annual compound rate of 2%, reaching 175.3 million tons in the last year.

About half of the global demand for fertilizers is for crops of wheat (15% of the total demand in 2010), corn (14.6%), rice (14%) and soybeans (5.8%). In particular, the consumption of fertilizers for the cultivation of soybeans and corn showed a trend of 3 and 2.3%, respectively, in the period of 2006-2010.

THE INCREASE IN OIL PRICES AFFECTS MANY ACTIVITIES OF THE PRODUCTION CYCLE

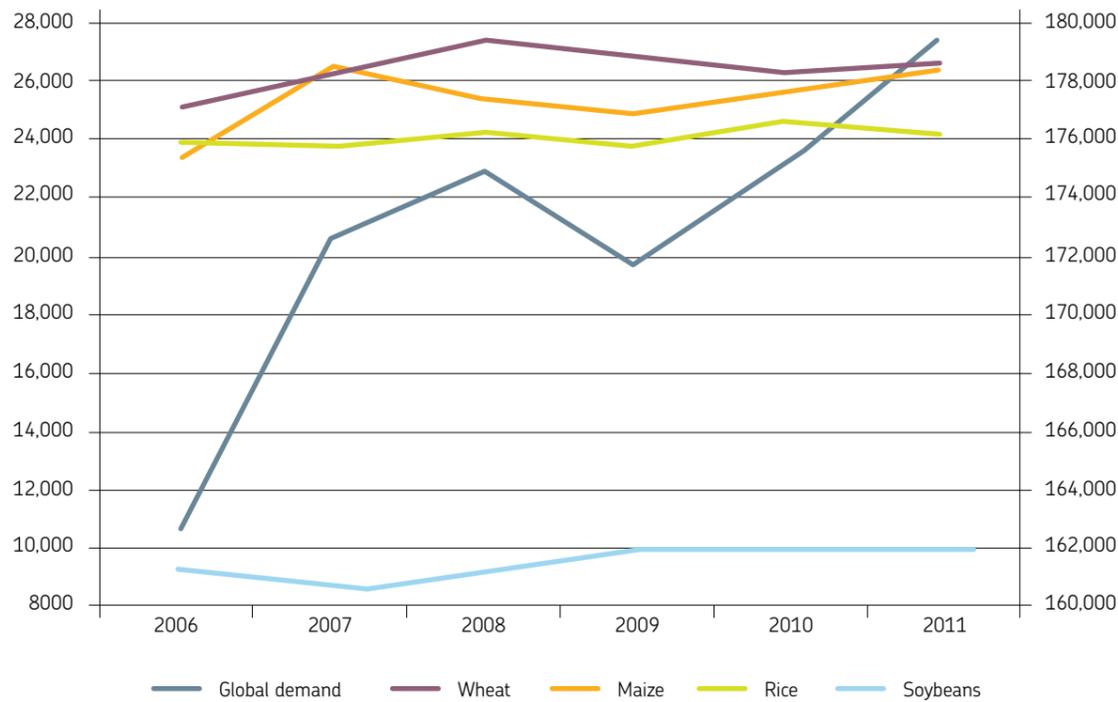
THE PRICE OF OIL DIRECTLY AFFECTS THE COST OF FERTILIZERS

Figure 2.25. Performance of the FAO Food Price Index, 1961–2011 (2002–2004 = 100, values adjusted for inflation)



Source: elaboration by The European House-Ambrosetti of FAO data, 2011.

Figure 2.26. Trend in global demand of fertilizers and the intended use (2006–2011, thousand of metric tons)

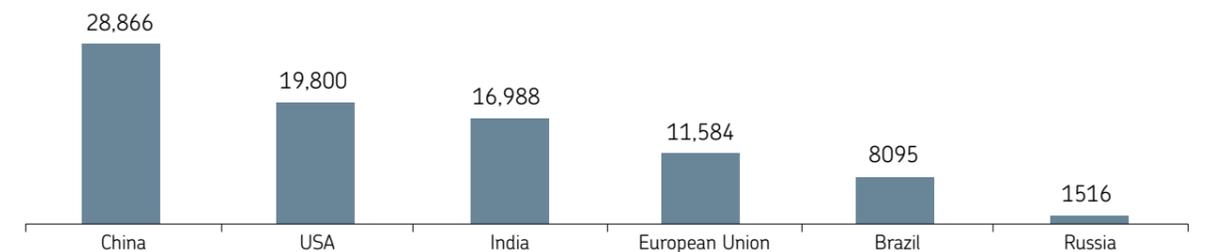


Source: elaboration by The European House-Ambrosetti of FAPRI data, 2011 (estimated for the year 2011).

Among the largest users of fertilizers, there are emerging economies such as China (28.8 million tons, 16.5% of the global demand in 2010), India (9.7%) and Brazil (4.6%), alongside the United States (11.3%) and the European Union (6.6%). In terms of uses, between 2006 and 2010, the demand for fertilizers in Brazil grew overall to an average annual rate of 5.7% (10.6% for wheat and 7.4% for soybeans); in comparison, the annual growth rate in the United States was 3.2% (6.5% for rice and 3.7% for corn).

In the U.S., 50% of fertilizers is intended for crops of corn, while in European countries, its use for crops of wheat prevails (39% of the total); among the BRICS, rice accounts for about one third of the demand for fertilizers in India (39%) and China (32%), as well as Brazil, which uses 43% of the fertilizer for its soybean plantations.

Figure 2.27. Major global consumer of fertilizers (2010, thousands of metric tons)



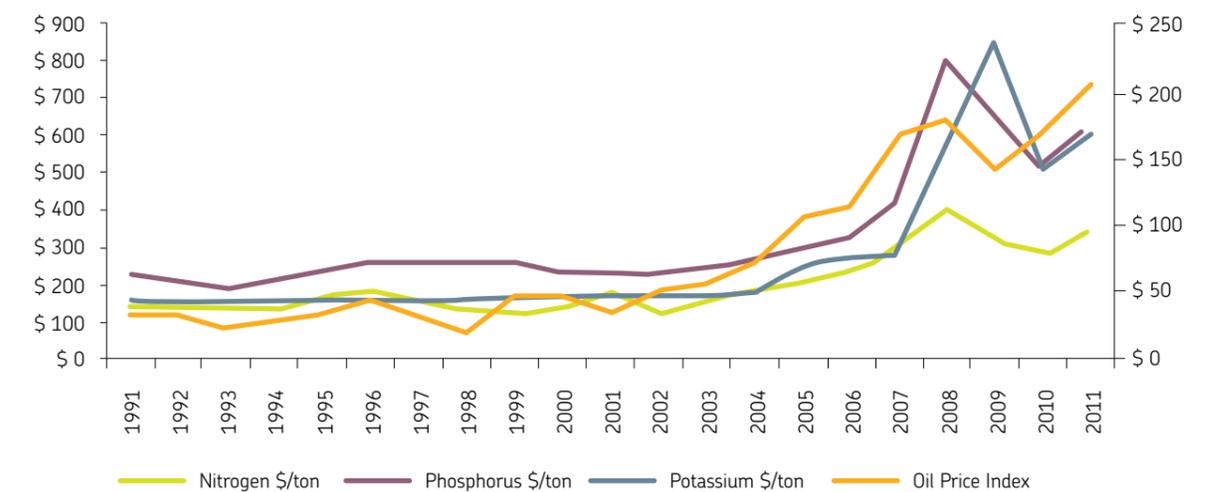
Source: elaboration by The European House-Ambrosetti of FAPRI data, 2011 (estimates for the year 2011).

The fact that many fertilizers are obtained directly from the processing of natural gas or oil also explains the close connection between the increase in food commodity prices and rising oil prices, as can be seen from Figure 2.28. Even though fertilizers such as potassium and phosphorus are not directly derived from fossil fuels, a large amount of energy is needed for their extraction, thus aligning the level of prices for those products to that of oil.

Therefore, the high cost of fertilizers affects the final price of agricultural products (and, indirectly, of food). Figure 2.29. shows the correlation between the average annual price of oil (Oil Price Index), the price index of cereals (FAO Cereal Price Index) and prices of the main nutrients (nitrogen and phosphorus).

THE COST OF FERTILIZERS AFFECTS THE FINAL PRICE OF AGRICULTURAL PRODUCTS

Figure 2.28. Trend in oil prices and the main fertilizers (1991–2011, \$/ton)



Source: elaboration by The European House-Ambrosetti of USDA and FAO data, 2011.

THE TREND IN OIL PRICES ALSO AFFECTS THE PRODUCTION COSTS OF BIOFUEL

The degree of correlation between the index of cereal prices and prices in real values of nitrogen and phosphorus is very high (correlation coefficient = 0.91), since by its very nature, the cultivation of cereals requires the widespread use of these elements.

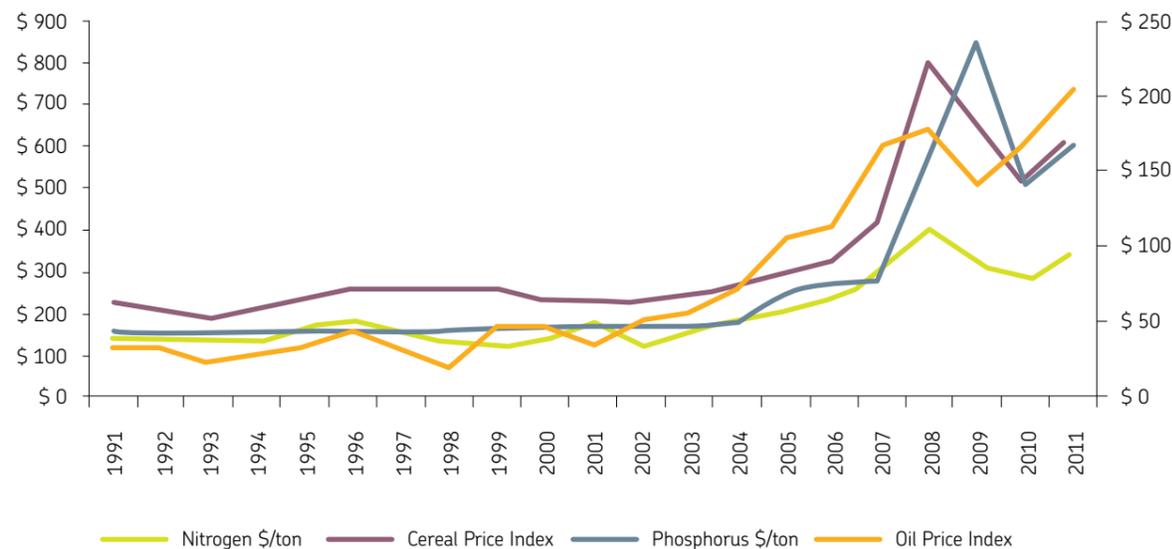
A similar consideration can also be made in the case of the Oil Price Index: the correlation of the price of nitrogen and phosphorus with the price of oil is equal to 0.93 and 0.88, respectively.

Also, the production of biofuels (as seen in Paragraph 2.5) is closely tied to the price of oil. Biomass is, in fact, one of the possible alternatives to alleviate dependence on fossil fuels for energy production, since it can be carried in a liquid state and used as a fuel in substitution of oil. Biofuel production triggers a chain reaction linked to the price of oil: when the price of oil increases, it becomes more advantageous to invest in biofuel production. In turn, growth in biofuel production drives the demand for crops used for that purpose (corn, sugar cane, rapeseed, soybean, etc.), thus amplifying the phenomenon of the shift from food crops for human and animal use to those of agricultural products aimed at the production of biofuels and, at the same time, the change in the mix of crops.

For example, if we consider bio-ethanol production, the increase in the demand for this fuel increases the demand for corn and results in an increase – in a direct way – in the very price of the ethanol and the corn. However, the effects are transmitted in an indirect way on the rest of the food chain, because the variation in the price of corn leads to adjustments in other markets/agricultural sectors (such as that of wheat, which competes with corn for the use of the land, and of livestock products), then creating a systemic variation in prices of agricultural products and foodstuffs.

Finally, it seems opportune to consider the link between the trend in oil prices, the wealth of the major producing countries (especially those belonging to the OPEC⁴¹) and impacts on the global demand for cereals. When oil prices rise, nations with a high concentration of oil reserves are, in fact, able to significantly affect the demand by buying huge quantities of food and to increase their reserves, either for reasons of speculation, or, as happened in the case of the Arab Spring (see Paragraph 2.11), to deal with civil unrest triggered by rising food prices.

Figure 2.29. Impact of oil prices and the main fertilizer additives on cereal prices according to FAO data (1991-2011)



Source: elaboration by The European House-Ambrosetti of USDA data 2011, Oil Price Index 2011 and FAO, 2011.

2.8 TRADE POLICIES

Trade barriers and non-commercial barriers (e.g., fictitious nature of qualitative restrictions, or excessive controls), agricultural policies and subsidies may be a distorting factor in the dynamics of supply and demand in the market for food commodities. On the supply side, for example, in recent years the major cereal producing countries (China, European Union, the United States and India) have often been oriented toward the reduction of quantities traded in international markets. This choice has led to a significant reduction in world food supply, which has helped to increase both the volatility and the level of market prices. In addition, this type of political intervention is largely unpredictable and, consequently, leads to the increase in the level of uncertainty in the markets.

Also, other policies create the conditions of restriction of international trade flows. Consider, for example, all those activities aimed at protecting their own domestic market (customs duties, quotas on imports and/or exports) or, conversely, to support the global scenario (export subsidies, agreements).

The imposition of taxes/subsidies on imports (taxes/subsidies on imported goods) or on exports (payments/taxation of the domestic producers who sell goods abroad) generally is not intended to influence the terms of trade⁴² of the country. The reasons for such government interventions, in fact, are often linked to concerns about income distribution, the protection of areas considered particularly important, or the equilibrium of the balance of payments.⁴³ What characterizes tariffs and subsidies is that they establish a difference between the prices at which goods are traded on the international market and their prices within the country that imposes them.

It is, therefore, clear how these policies, implemented primarily in response to high food prices, are aimed at generating direct benefits for the domestic market, but at the same time, given the strong interrelationship between the markets, have the ability to generate short-term effects and imbalances on world prices.

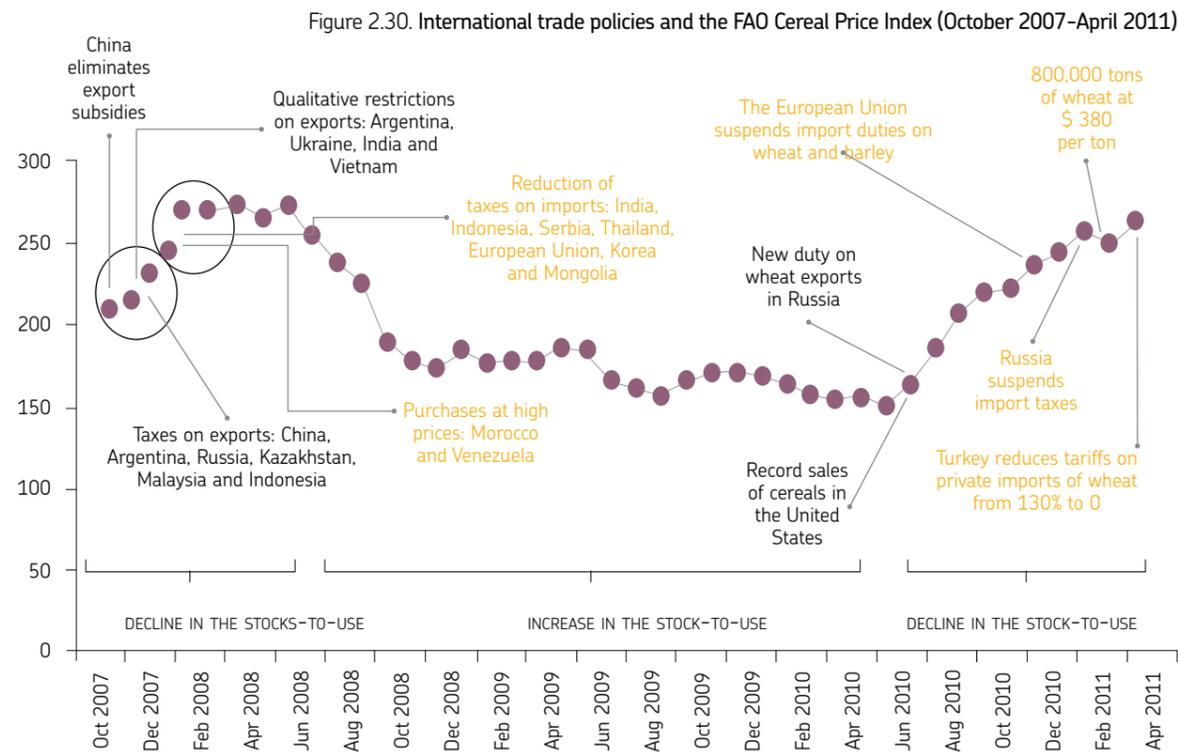
Moreover, these policies often generate large unpredictable fluctuations in income for farmers, causing, in a chain reaction, further imbalances in the supply. Low prices bring benefits to the demand (although often not passed on to consumers and, thus, fueling only speculation opportunities) but depress agricultural production.

In order to understand the relationship between the adoption of certain trade policies and price developments, Figure 2.30. shows the trend of the Cereal Price Index between October 2007 and April 2011 and some of the trade policy actions implemented by the main importers and exporters of cereals.

In the fall of 2007, following a lowering of expectations of future harvests and the increase in international prices, some exporting countries changed the direction of their trade poli-

SOME TRADE POLICIES CAN HAVE DISTORTING EFFECTS ON THE PRICES OF FOOD COMMODITIES

LOCAL POLICIES CAN LEAD TO IMBALANCES IN GLOBAL MARKETS



Source: elaboration by The European House-Ambrosetti of research data by the USDA and the Cereal Price Index (FAO).

THE RESPONSE OF EXPORTING COUNTRIES TO THE INCREASE IN PRICES

cies in order to discourage exports and promote trade and domestic consumption. The objective was to increase the domestic supply and limit the internal effect of the global increase in food prices.

An example⁴⁴ of these trade policies is the elimination of export subsidies, which took place in China, where tax refunds on the added value of exported grain and products were eliminated. Other policies concerning the introduction of export taxes:

- China, after eliminating the reimbursement of value added tax, imposed an export tax on cereals;
- Argentina has raised taxes on the export of wheat, corn, soybean flour and soybean oil;
- Russia and Kazakhstan have increased taxes on the export of wheat;
- Malaysia and Indonesia have imposed taxes on exports of palm oil.

Other measures of this type are represented by quantitative restrictions on exports (export volume ceilings) and by absolute prohibitions (for example, Ukraine, Serbia and India have banned exports of wheat).

THE PROTECTIVE POLICIES OF IMPORTING COUNTRIES

In early 2008, importing countries also began to adopt protective policies in order to defend themselves against the global increase in food prices. Their goal was to ensure a sufficient level of stocks in order to contain the increase of domestic prices. In this case, too, some policies for this purpose can be listed.

Some countries have reduced customs duties on imports:

- India (flour);
- Indonesia (soybeans and wheat);
- European Union (cereals);
- Serbia (wheat).

Countries such as Morocco and Venezuela also bought commodities at high prices and subsidized their distribution to consumers.

These trade policy interventions have led to a general increase in the demand for food commodities, which has had an impact on already rising prices.

Conversely, policies aimed at restricting exports by exporting countries, in order to reduce inflation on food prices, have continued to reduce the world supply. In this way, importers have had fewer resources available and have been forced to pay ever higher prices to ensure a sufficient level of domestic stocks.

This imbalance between supply and demand was one of the causes of the peak in food prices that lasted until April 2008. Also, in the second period of the sharp increase in prices (June 2010–April 2011), many countries adopted adaptive agricultural and trade policies, including:

- the *establishment of export restrictions*: Russia, the seventh largest exporter of wheat in the world in 2010, on August 4, 2010 imposed a duty on exports of wheat due to poor harvests and rising prices;
- the *reduction or suspension of import barriers*: the European Union has reduced taxes on imports of wheat and barley and Turkey has canceled the tax on wheat imports by the private sector;
- *subsidies to the consumption of certain goods*: Algeria, the world's largest importer of wheat, has purchased large quantities of wheat at high prices, to then sell them internally at lower prices.

The phenomenon of Algeria, in part dictated by internal unrest, was also caused by the increasing difficulty of access to food and is known as "Aggressive Buying Practices."⁴⁵

Under conditions of uncertainty about the future supply and global food prices, importing countries are finding that they have to ensure the right level of food resources by negotiating for larger quantities with exporting the countries. When Russia, for example, imposed restrictions on imports of wheat, in a period of rising prices, importers began to negotiate larger quantities. This suggests that, in balanced conditions, importers negotiate sufficient quantities in a short time span; whereas when instability and uncertainty increase, the time interval increases.

A further example of the negative impact of the restrictions of the markets comes from the ongoing negotiations of the Doha Round. It is estimated that an agreement to reduce barriers to international trade on food products would generate an increase of about 40 billion of dollars in annual exports for the benefit of developing countries.

However, while on the one hand, openness to international trade in all countries is a desirable choice, necessary for alleviating the distorting effects of subsidies and protectionist measures, on the other, it is not in itself sufficient, but must be accompanied by parallel policies of an economic and social nature to limit the risks of such an opening, especially for the most vulnerable populations.

During the 2007–2008 food price crisis, the economies most affected in terms of access to food were, in fact, the most open ones, precisely because of the absence of sufficient economic and social safety nets. Therefore, a thorough review of trade, agricultural and social policies at local, national and international levels is of fundamental importance.

AFTER THE 2008 CRISIS, WE HAVE BEEN SEEING DISTORTING TRADE POLICIES ONCE AGAIN

DURING THE FOOD PRICE CRISIS OF 2007–2008, THE ECONOMIES MOST AFFECTED IN TERMS OF ACCESS TO FOOD WERE, IN FACT, THOSE THAT WERE THE MOST OPEN

The case of price of rice between 2007 and 2008

The case of rice was the focus of policymakers in Asia in the period between 2007 and 2008. A series of events and internal policy decisions led to a record increase in the price of this cereal, causing serious problems of access to food in the countries of Southeast Asia.⁴⁶

The origin of the rice price crisis stemmed from government concerns about the inflationary expectations on the prices of the major food commodities. In July 2007, Vietnam, the second largest exporter of rice, allowed rice exports because of the paucity of stocks.

A few months later, the Indian Finance Minister announced a freeze on non-Basmati rice exports (the best quality rice) to encourage domestic consumption and replenishment of stocks.

In the following months, the importing countries (in this case, mainly China, the Philippines, Bangladesh and Egypt) recorded purchases at high prices.

In March 2008, the Thai Minister of Commerce announced that prices reached a total of \$1,000/ton, triggering aggressive buying policies by importing countries.

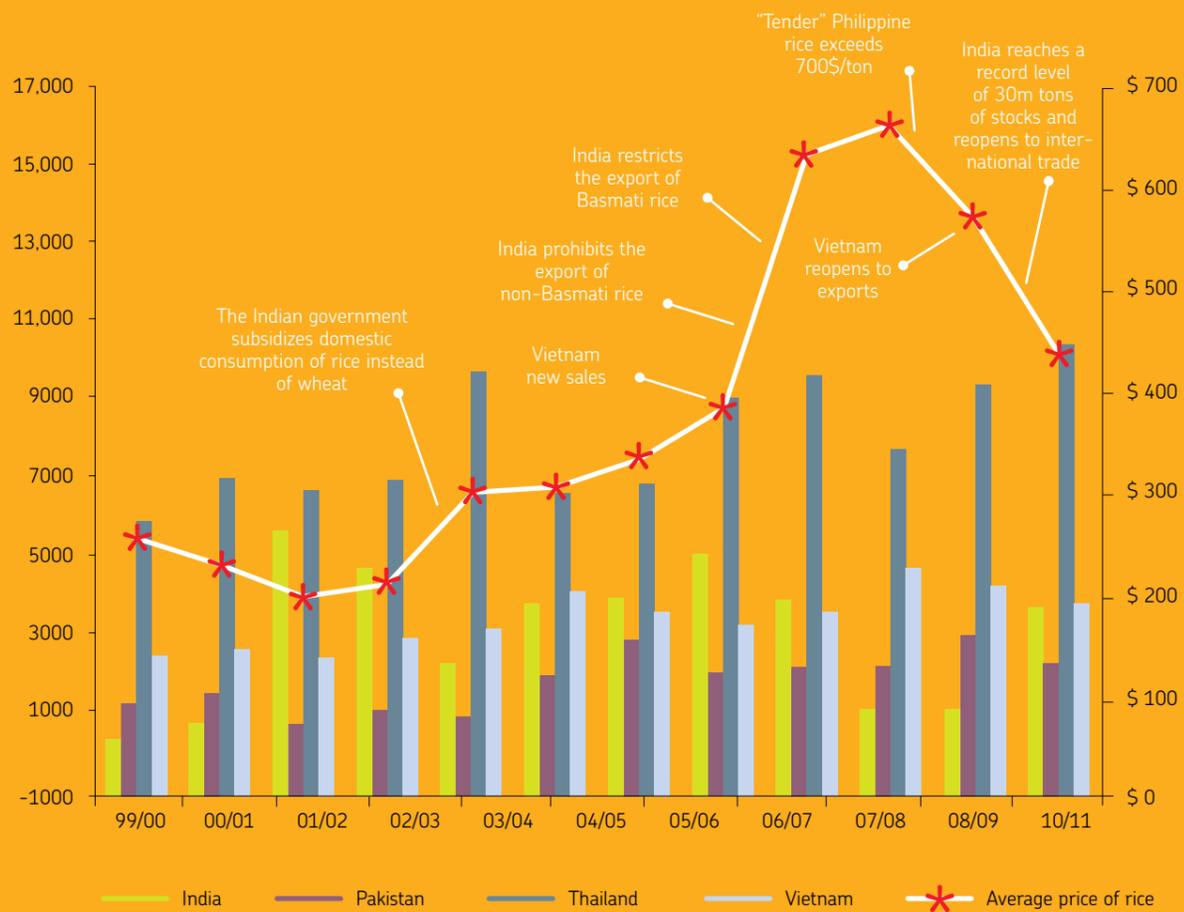
The crisis ended only when both India and Vietnam reached a predetermined share of strategic reserves and lifted restrictions on exports.

The case of rice suggests a reflection: until the time when the global supply of

major food commodities rises to an optimal level (able to match the demand at balanced prices), importers will be concerned to ensure the availability of food in their primary markets by adopting "aggressive" purchasing policies, while exporters will be concerned to limit the risk of the increase in domestic prices through "conservative" export policies (export duties or quotas). When the global offering will attest to balanced levels, importers will not feel the need to purchase extra volumes for precautionary purposes and prices will begin to fall. Minor purchases will reduce the global demand for imports and the price level, as occurred just after the 2008 crisis.

In addition, it is opportune that market prices always be sufficiently profitable to stimulate agricultural production, both in relation to production costs and in relation to competing crops.

Figure 2.31. Volume of exports and the level of rice prices (1999-2011)



Source: elaboration by The European House-Ambrosetti of FAPRI data.

2.9 FOREIGN EXCHANGE

THE U.S. DOLLAR IS THE PREVAILING CURRENCY OF EXCHANGE IN GLOBAL AGRICULTURAL TRADE

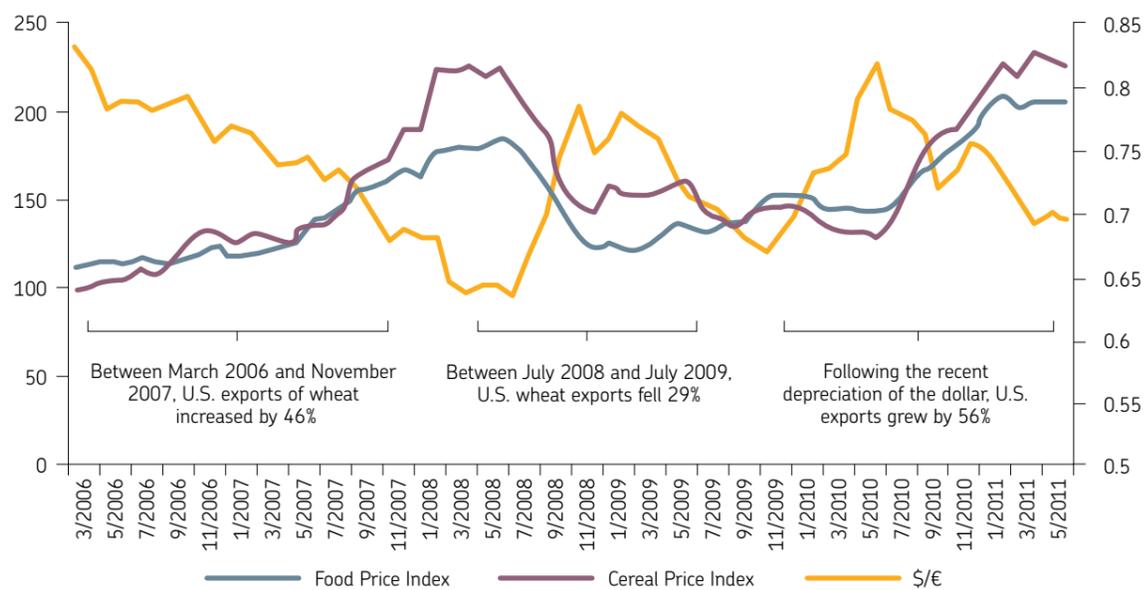
THE DEPRECIATION OF THE DOLLAR: INCREASING DEMAND AND RISING FOOD PRICES

In global agricultural trade, the currency of exchange is still primarily the U.S. dollar. Recently, the dollar has depreciated significantly against other currencies. The price of the dollar has encouraged the import of food commodities for those countries that have benefited from the appreciation of their national currency.

This situation, thanks to strong growth in emerging economies, has triggered an increased demand for food from these countries and, subsequently, a rise in food prices in the medium term by agricultural producers. Consider, for example, that in March 2011, the U.S. exported 8.5 million tons of wheat, more than double the average of the last five years.

In particular, since the United States is the major exporter of agricultural commodities in the world and many prices are denominated in dollars, the depreciation of the dollar leads to an increase in the purchasing power of importing countries, which translates into an increase in the demand for imports, contributing to the imbalance between international supply and demand and an inflation of the prices. Figure 2.32. clearly shows the

Figure 2.32. Exchange rate €//\$ and Cereal and Food Price Index (March 2006-June 2011)

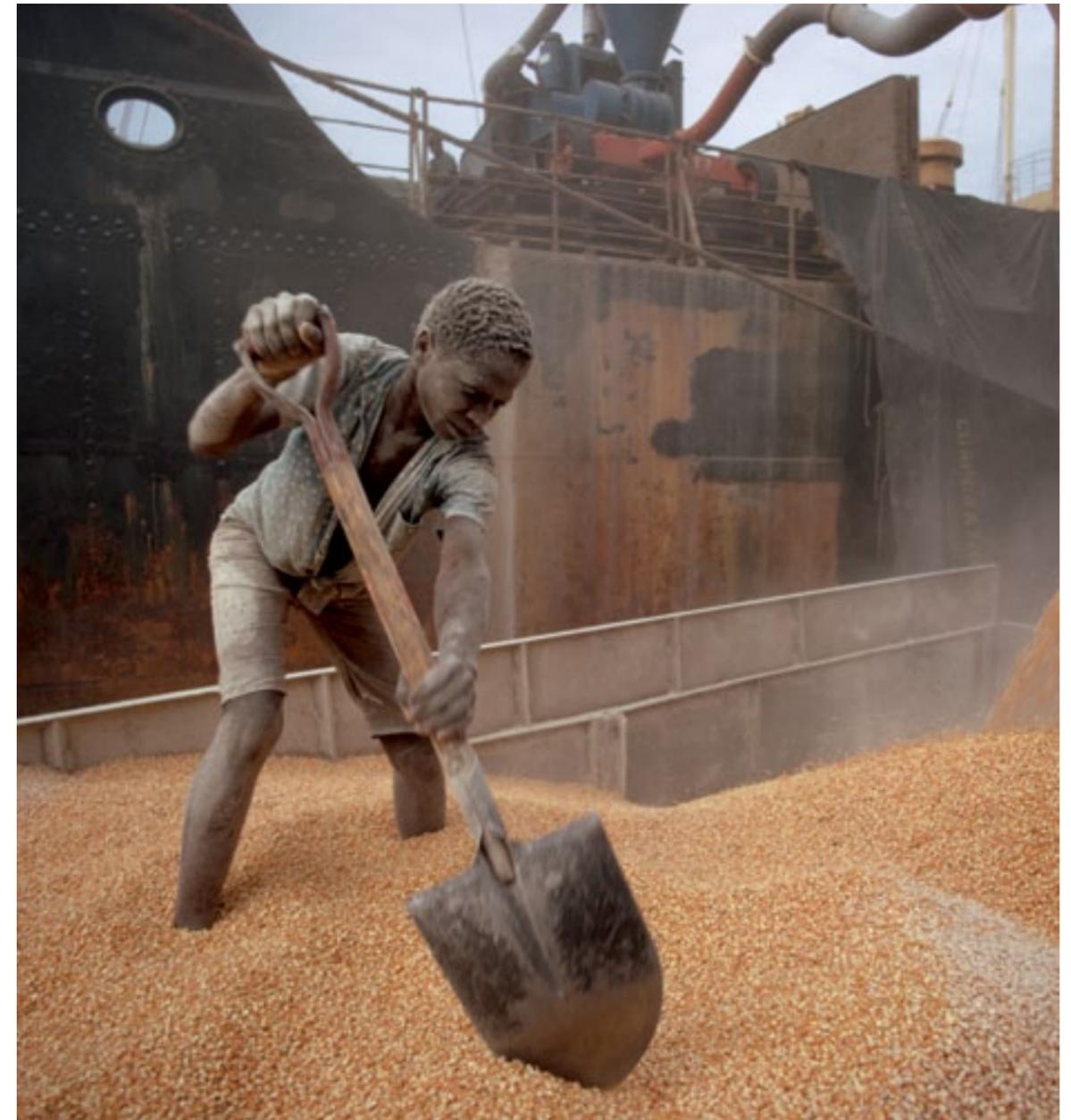


Source: elaboration by The European House-Ambrosetti of USDA, OECD and FAO data.

inverse relationship between the trend of the dollar currency and the index of the prices of all agricultural commodities and that of cereals⁴⁷ between March 2006 and June 2011, the period that saw the alternation of devaluation and revaluation of the dollar.

Moreover, one can not disregard the impact of the huge volume of liquidity injected by the Federal Reserve into the global economic system over the past decade, through the policies of quantitative expansion. The lower cost of money, in fact, tends to drive up food prices and trigger speculation, seeing that food can be considered a perfect commodity in an unbalanced market. Furthermore, this liquidity has been directed toward the emerging countries, such as China, where the inflationary impact is greater because of the fixed exchange rate.

THE LOWER COST OF MONEY TENDS TO DRIVE UP WORLD FOOD PRICES AND TRIGGER SPECULATION



Emory Kristof/National Geographic Stock

2.10 SPECULATION IN FOOD COMMODITY MARKETS

The market for agricultural commodities has been affected in recent years by a growing use of often complex and articulated financial instruments, such as the so-called “futures” or “forward” contracts, that have come to represent an important aspect for the potential impacts on the food sector.

A future can be defined as a derivative instrument consisting of a forward contract relating to a purchase/sale of goods (goods, raw or semi-finished materials) or an underlying financial activity (shares, exchange rates, interest rates, etc.), where the time of delivery is deferred and the various elements of the contract (such as quantity, quality specifications, place and date of delivery, etc.) are standardized, with the exception of the price.⁴⁸

Implying a formal obligation to buy or sell a specific quantity of a commodity at a specific price and at any given time, this type of agreement is a significant defense for farmers and operators, or a “hedge” against the risk of price fluctuations. For the producer of food commodities (such as wheat, for example), the advantage of a futures contract is the security of a fixed price even before the harvest or before seeding.

On the other hand, we must take into account that only 2% of the contracts are concluded with the physical delivery of the goods, because they are generally negotiated before the deadline. Consequently, these contracts attract a growing number of financial speculators and investors, also because – especially in periods of rising inflation – these are able to offer an attractive profit when stocks and bonds are unattractive investments.

Speculation in the commodity market plays an important role in the macro-economic equilibrium and allows the transfer of the price risk from those who are more risk averse to the investors who are more able and inclined to risk (the so-called “speculators”).

Very often, the “positions” taken on the market are quickly reversed, and it therefore becomes important to distinguish between two types of investors: on the one hand, the so-called traders (commercial investors with a high risk aversion) and, on the other, the non-commercial operators (no commercial interest and high risk inclination). Belonging to the latter category are both the mutual funds,⁴⁹ that diversify their portfolio to include commodity futures, which operate on a long-term logic, and the aggressive speculators focused more on making profits from short-term changes in futures prices.

The joint action of these individuals contributes to the effective functioning of the market through the amount of transactions carried out: the speculation is not necessarily harmful for insurance purposes, since it can provide liquidity for the hedgers (those who practice the coverage against the risks of fluctuations in market prices or hedging), given that speculators take risks that commercial distributors are not willing to take.

Producers, users and traders, therefore, have the possibility of using the information generated by the derivatives market for a more efficient allocation of goods.

FUTURES CONTRACTS REPRESENT A “HEDGE” AGAINST THE RISKS OF PRICE FLUCTUATION

SPECULATORS AND FINANCIAL INVESTORS ARE VERY ATTRACTED TO FUTURES CONTRACTS

TWO TYPES OF INVESTORS: THE TRADERS AND NON-COMMERCIAL OPERATORS

An indicator of the level of speculation within the market may be offered by the growth of the Commodity Index Fund,⁵⁰ as well as by the ratio between the number of non-commercial investors and the totality of actors on the market. This index increased between 2006 and 2008, and in the case of corn, went from an average of 0.29 in 2005 to 0.49 in the first five months of 2008.⁵¹

To appreciate the extent and the evolution of speculation in agricultural commodity markets, two indicators can be analyzed:

- the amount of futures contracts traded (volume);
- the amount of open interest.

The volume of futures contracts traded per month is an indicator that captures the total number of commodity exchanges, aggregating contracts with different maturities. The graph in Figure 2.33. shows the volumes traded on the wheat market at the Kansas City Board of Trade (KCBT), one of the world’s major marketplaces for futures and options trading in agricultural commodity.⁵²

The data shows that the futures contracts on wheat have increased significantly in recent years: between 2004 and 2006, the volume of trade in wheat futures increased by 30%, similar to what happened to other foodstuffs such as corn (+60% in the period of 2005-2006) and rice (+40%).⁵³

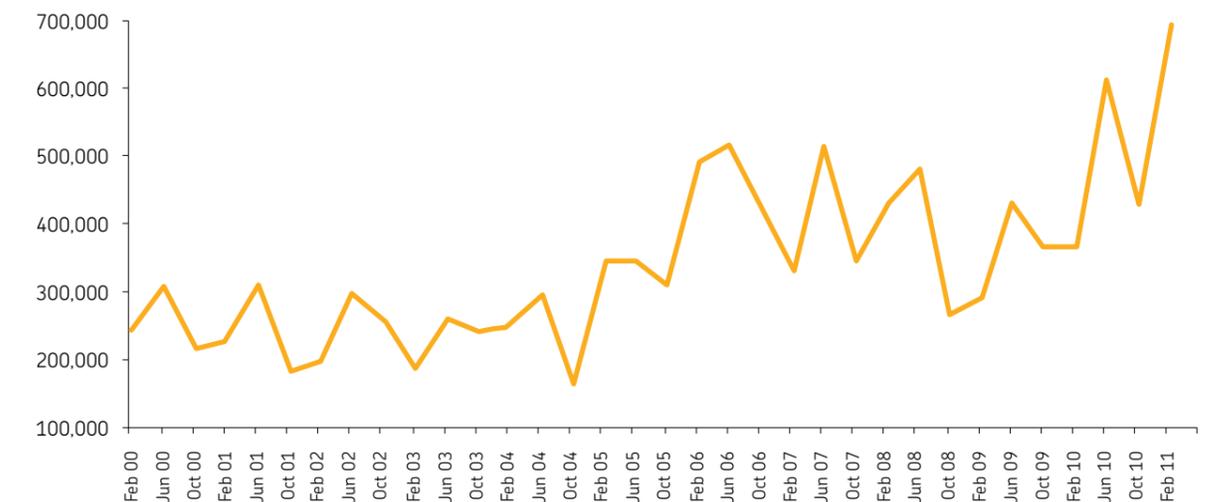
Regarding wheat, the last period observed showed a new upward trend, considering the fact that in the month of October, contracts are generally closed and the physical exchanges of goods take place. One reason for the increase in the trading and the impact on the level of commodity prices is to be found in the increasingly active participation by speculators in the market of food commodities.

The second indicator is that of the open interests representing the number of futures contracts not yet completed (i.e., not yet compensated by an opposite position, or with the merchandise yet to be delivered): every time a market operator takes a position,⁵⁴ it will immediately trigger an open position which will last until the trader himself does not take an opposite position, or until the expiry of the contract.⁵⁵

THE VOLUME OF FUTURES CONTRACTS TRADED

OPEN INTEREST

Figure 2.33. Monthly volume of futures contracts on wheat (February 2000-February 2011)



Source: elaboration by The European House-Ambrosetti of Kansas City Board of Trade data, 2011.

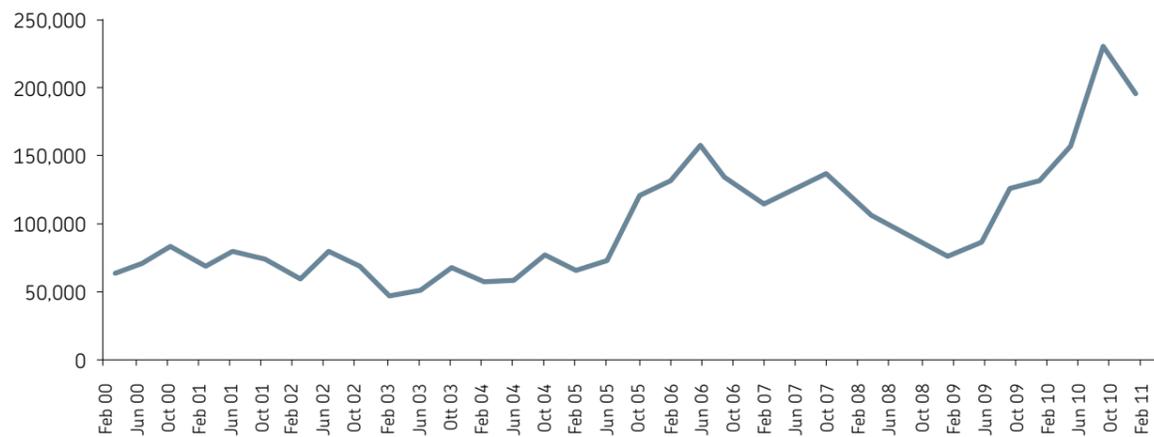
As shown in Figure 2.34., the amount of open interest is also growing and, in the case of wheat, between 2005 and 2006, a growth of 60% was seen, while between 2007 and 2008, there was a decrease due to the financial crisis. The upward trend was resumed in 2009, to then remain at a record high in October 2010 (+125% as compared to October 2008).

The data on open interest may reflect the entry of medium- and long-term speculators in the commodity market.

Therefore, it remains to test the degree of correlation between what can indicate the level of speculation and the price of food commodities.

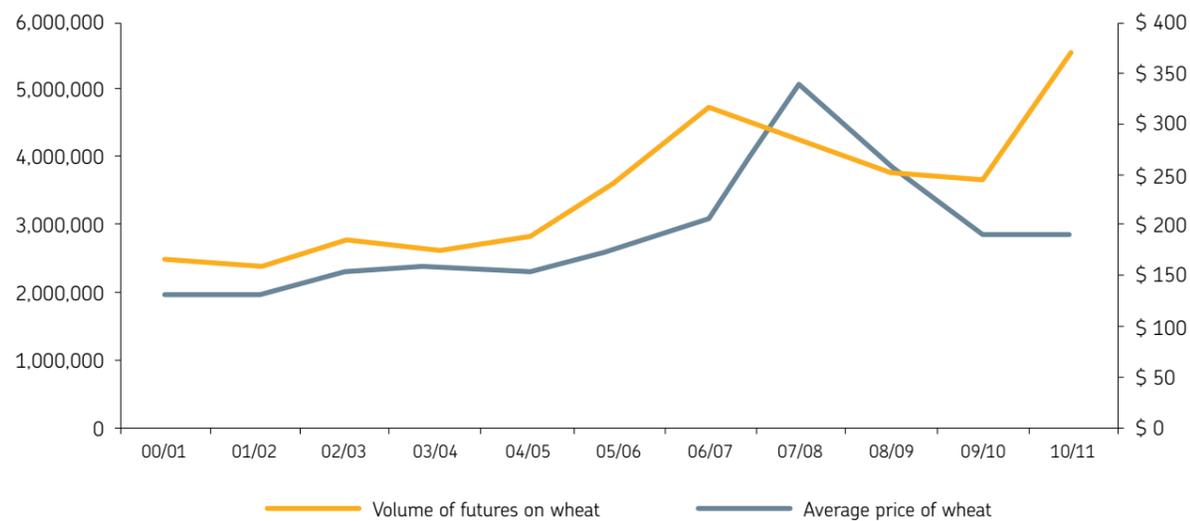
Figure 2.35. shows how the relationship was marked up to 2006 ($R = 0.82$ in the period 2000 - 2006), when, on the one hand, there was a large amount of long positions held by the Index Fund⁵⁶ and, on the other, the market for telematic futures trading developed further.⁵⁷ As a result of continued growth in telematic trading, the volume of futures contracts

Figure 2.34. Open interest on wheat (February 2000-February 2011)



Source: elaboration by The European House-Ambrosetti of the Kansas City Board of Trade data, 2011.

Figure 2.35. Trends in the volume of futures contracts traded and the price of wheat (2000-2011)



Source: elaboration by The European House-Ambrosetti of FAPRI and USETC (U.S. Futures Commodity Trade Commission) data, 2011.

IT REMAINS TO TEST THE DEGREE OF CORRELATION BETWEEN THE LEVEL OF SPECULATION AND THE PRICE OF FOOD COMMODITIES

INDEX FUNDS ARE AN EXAMPLE OF LARGE INVESTORS THAT ARE ABLE TO INFLUENCE MARKET TRENDS

traded increases dramatically and does not initially have a high correlation with the price of wheat ($R = 0.2$).

The cause-effect relationship between the change of the positions held and the performance of food commodity prices is the subject of numerous studies on the relationship between speculative activity in futures markets and increasing food prices. The statistical analyses conducted to date have shown that it is difficult to prove that there is a direct relationship between the two variables.⁵⁸

As we saw in Chapter 1, another phenomenon occurring in the two food crises of the early millennium regards the volatility of commodity prices. The effect of volatility on the real economy is destabilizing, as it increases uncertainty about the future level of prices.

Nevertheless, the causes of its origin are still uncertain and subject to debate. Some economists argue that a destabilizing role cannot be assigned to the futures market because by definition the market reacts to external signals and contributes to the achievement of a balanced price. In this way, however, it does not take into account the presence of big investors with significant financial assets and great power in the market.

The growing trend of a particular commodity may generate a high and continuous volume of purchases linked to perceptions and expectations, that would distort the normal conformation of the prices as a result of the so-called fundamentals (stocks, production, consumption, import-export).

An Index Fund is an example of large investors that are able to influence the market outcome: in addition to injecting large amounts of cash, they hold contracts for a long time, which could alter the dynamics of supply and demand on the supply side by raising prices. At present, it is not possible, from an empirical point of view, to demonstrate the relationship between speculative activity on the derivatives market and the volatility of food prices, as has been made apparent by the numerous and influential studies in the literature. In addition, it is clear that the phenomena of high volatility are also present on the untreated commodity derivatives market.

On the other hand, the exchange of futures does not lead to the formation of balanced prices, inasmuch as each contract can be replicated many times, so that, for any level of demand, there will always be a corresponding level of supply – in contrast to what occurs on the real market.

The futures market and the Chicago Board of Trade: Origins and Evolution

While originating in Japan in the seventeenth century, the futures market – through a series of technological, historical and legislative developments – spread to Chicago in the first half of the nineteenth century.⁵⁹ Around 1840, farmers in Illinois obtained large crops of wheat destined for human consumption and of corn for animal husbandry. The portion of the crop that was not consumed was enclosed in bags and shipped by boat or wagon to St. Louis and Chicago.

City merchants extracted samples collected from different crops in the United States and determined their price of by trading on the spot. The so-called “sack-based” market (that is, based on the sacks of surplus grain) was, therefore, very expensive because of the transportation by sea or by carriage and the physical handling of the bags.

Starting in 1848, two innovations were introduced that radically changed the way trade was conducted: the development of the railway network around Chicago – which provided the opportunity to expand cultivation and, therefore, to transport the supply of wheat – and the introduction of the steam hoist, which improved the capacity to manage the goods in the city. In addition, to increase efficiency, the sacks were discarded in order to sell grain in bulk.

In 1848, the CBOT (Chicago Board of Trade) was established, a private organization designed to promote trade, first, in general, and in the 1850s, focused on the wheat trade. Between 1853 and 1856, the amount of wheat for Chicago was tripled and in 1856, the CBOT began to distinguish between the types and quality of the cereals, identifying three types of wheat. Initially, it created problems, since the goods were sold mixed and not separately as to place of origin. Wheat changed its commercial nature, going from

being a product of the individual farmers to a commodity product.

Moreover, thanks to the spreading of the telegraph, information on prices began to move much faster than the goods (which took weeks to arrive at the place of trade), leading to the creation of “to arrive” contracts (under which the delivery of goods was delayed until the signing of the contract).

In this way, buyers and sellers set a price at which an exchange would be paid on a certain date, thus reducing the risk of price for both.

The banks immediately became interested in this new type of contract and began to lend money and to use the “to arrive” contract previously stipulated as a guarantee. Then, speculators – namely those who were neither customers nor producers of wheat – also began to buy and sell contracts based on estimates about future price levels, helping to make the market much more liquid for growers and buyers. Whereas the “to arrive” contracts required the delivery of goods, speculators began to pay or receive monetary difference between the price at the contract and the market price at maturity, without the physical fulfillment of the exchange. In 1856, the CBOT created the “futures” contracts, regulating and standardizing the “to arrive” contracts. According to the estimates of the time, in 1875 the turnover of futures was ten times higher than that of physical goods, while in 1887 the relationship between futures contracts and traditional trade contracts was 20 to 1. The CME Group (Chicago Mercantile Exchange), formed by a series of mergers and acquisitions between small organizations, owes its present form to the merger with the CBOT 2007⁶⁰ and subsequent acquisition of NYMEX Holdings in 2008.



2.11 GEOPOLITICAL DYNAMICS

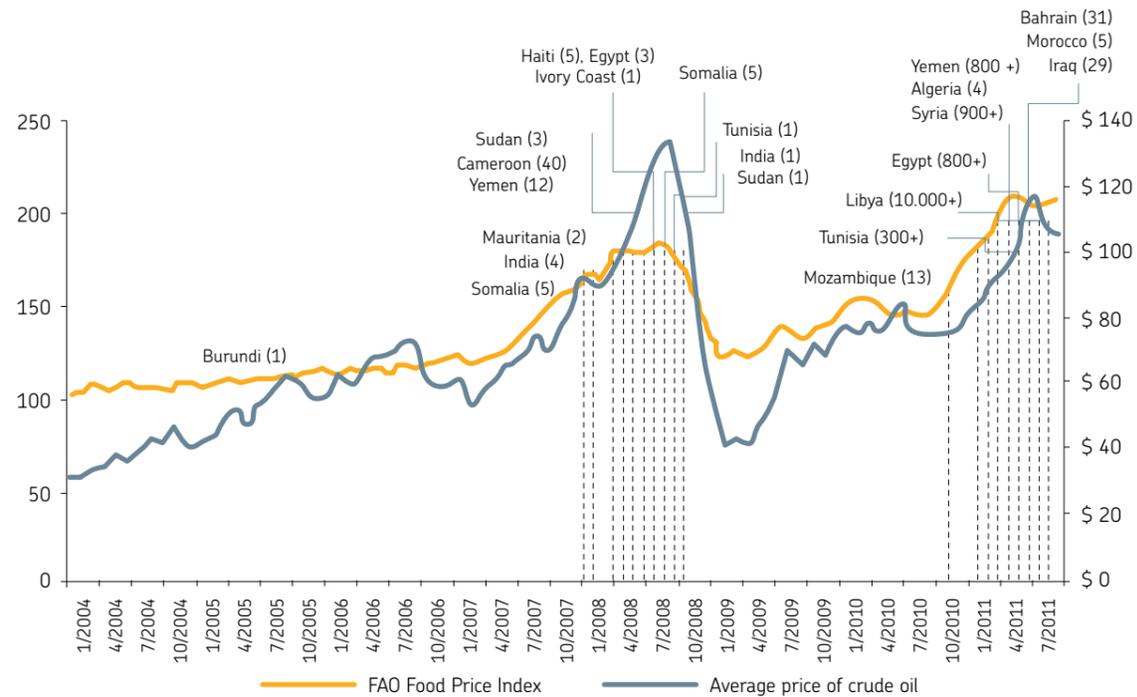
THE PHENOMENON OF "BREAD RIOTS"

Recently, we have seen several uprisings caused by the increase in food prices in less developed countries. The so-called "bread riots" spread, sparked by the growing impoverishment of the lower middleclass population. A growing number of people demanded, as a vital need, the maintenance of subsidized prices for many essential goods, starting with bread and basic foodstuffs. And yet this occurred in a context in which, with increasing frequency, many countries are faced with economies that are greatly depleted by the general financial crisis and are trying to cut these increasingly onerous items. For millions of inhabitants, especially in the Third World, even the slightest increase in minimum rates and tariffs means affecting incomes already cut to the bone.

THE FOOD CRISIS IS THE BASIS OF THE RECENT RIOTS IN AFRICA AND ASIA

In particular, in conjunction with the food crisis which reached its peak in mid-2008, when food prices increased by 51% in one year,⁶¹ we witnessed the eruption of several riots in many African and Asian countries (Figure 2.36.).

Figure 2.36. Major riots (number of victims in brackets) and performance of the FAO Food Price Index and the price of crude oil (2004-2011)



Source: elaboration by The European-House Ambrosetti of FAO and Reuters data, 2011.

THE "ARAB SPRING"

Between the end of 2010⁶² and the first part of 2011, the phenomenon known as the "Arab Spring" arose, a series of riots and unrest currently underway in regions of the Middle East, Near East and North Africa, which has generated violent uprisings in Algeria, Tunisia, Egypt, Libya and Syria and the historical deposition of regimes like those of Ben Ali in Tunisia and Mubarak in Egypt.

The causes which led to the protests are numerous and include corruption, the absence of individual liberties, human rights violations and harsh living conditions, which in many cases relate to, or are bordering on, extreme poverty. However, the increase of food prices and hunger is considered one of the main reasons for dissatisfaction.

The correlation between the events of the first part of 2011 and the level of food commodity prices, nevertheless, still remains as a hypothesis being studied by scholars of geopolitics, since it is difficult to isolate a systemic phenomenon and of the market such as the increase in food prices and to study its effect on social and political change.

However, riots related to shocks stemming from the level of prices of food have been frequent in recent centuries. A study by Rudé (1964), for example, analyzes the trend of the price of food and factors interconnected to it in the period between 1709 and 1789. The study, in fact, shows precisely how in France in 1709, a period of extreme shortages in crops and adverse weather events led to a growing demand for English wheat, triggering a sharp rise in the level of international prices. The phenomena of scarcity and high prices were accentuated between 1775 and 1785, until the explosion of the popular revolts that led to the French Revolution. What happened in France before the Great revolution can be adopted as an interpretive framework for understanding the causes and destabilizing effects that have occurred and will occur as a result of events in the Middle East.

The main countries of the area affected by the riots of this Arab Spring (Egypt, Tunisia, Algeria, Yemen, Syria, Libya, Saudi Arabia, Bahrain) have shared characteristics in terms of the demand and supply of food. With a natural scarcity of basic resources such as arable land and water, the region of the Middle East and North Africa (MENA) has the world's highest level of imports per capita, which stands between 25 and 30% of the total domestic consumption.⁶³

In Egypt, where families spend an average of 40% of their income on food, the overall inflation was 20% between 2010 and 2011 and some products have increased in price tenfold. In addition, 40 million Egyptians (out of a total of 84 million) rely on the system of state subsidies for bread, a system that in recent years has been highly criticized by the public due to the high rate of corruption.

The Arab Spring, as well as including the increase in food prices among its causes, seems in and of itself to be a phenomenon capable of amplifying this problem and triggering a further worsening of the global food price crisis through the activation of two variables (already described in previous paragraphs): the increase in oil prices and "Aggressive Buying" policies implemented by the countries at risk of riots.

Figure 2.37. shows that during the period between the beginning and the intensification of the Arab Spring, the price of oil increased by 2.3% on average on a monthly basis, mainly due to the fact that the areas affected by disturbances and tensions were those where large amounts of crude oil and gas are extracted. With it, even the price of cereals, already high, continued to grow at an average monthly rate of 1.6%, with a peak recorded in April shortly after the "day of anger in the Middle East."

In the period considered, the correlation between the two variables was 0.82. This data can be read as a confirmation (with respect to what is already described in Paragraph 2.7) of a high correlation (even though it is exercised in an indirect way) between oil prices and trends in cereal prices, especially considering that it occurred in a period of a few months, during which there seem to have been no other variables capable of strongly influencing

HISTORICALLY IT IS POSSIBLE TO TRACE THE POPULAR UPRISINGS TO THE LEVEL OF FOOD PRICES

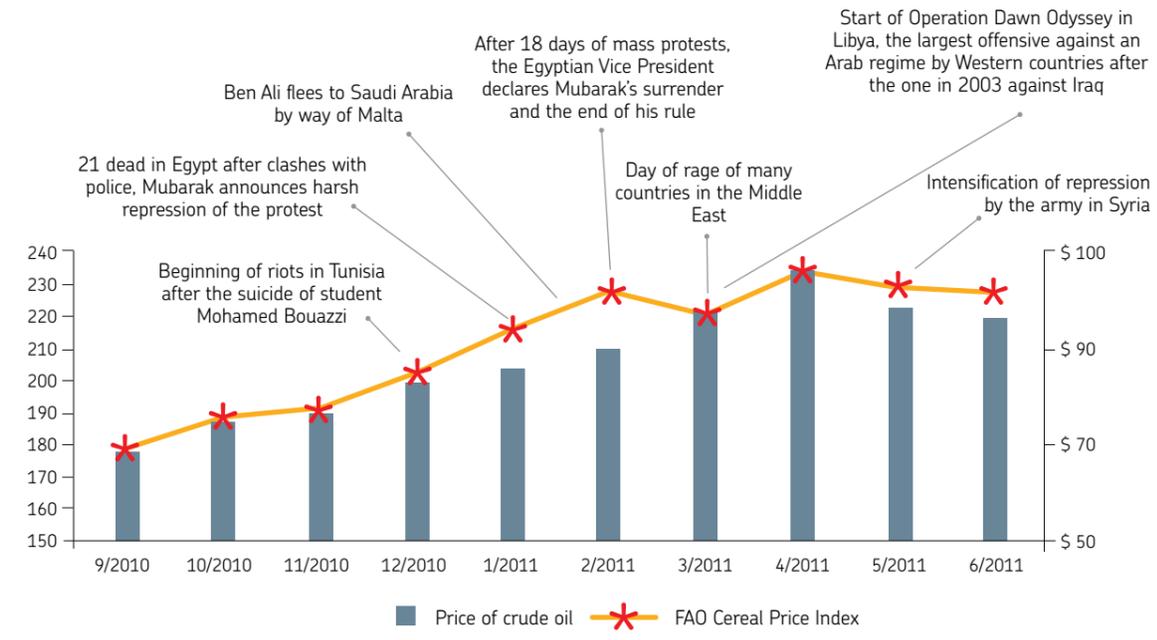
IN EGYPT, FAMILIES SPEND AN AVERAGE OF 40% OF THEIR INCOME ON FOOD

INCREASED OIL PRICES AND POLICIES OF "AGGRESSIVE BUYING" IMPLEMENTED BY THE COUNTRIES AT RISK OF RIOTS

LARGE QUANTITIES OF AGRICULTURAL COMMODITIES PURCHASED FOR DISTRIBUTION AT HIGH PRICES AS DOMESTIC SUBSIDIES

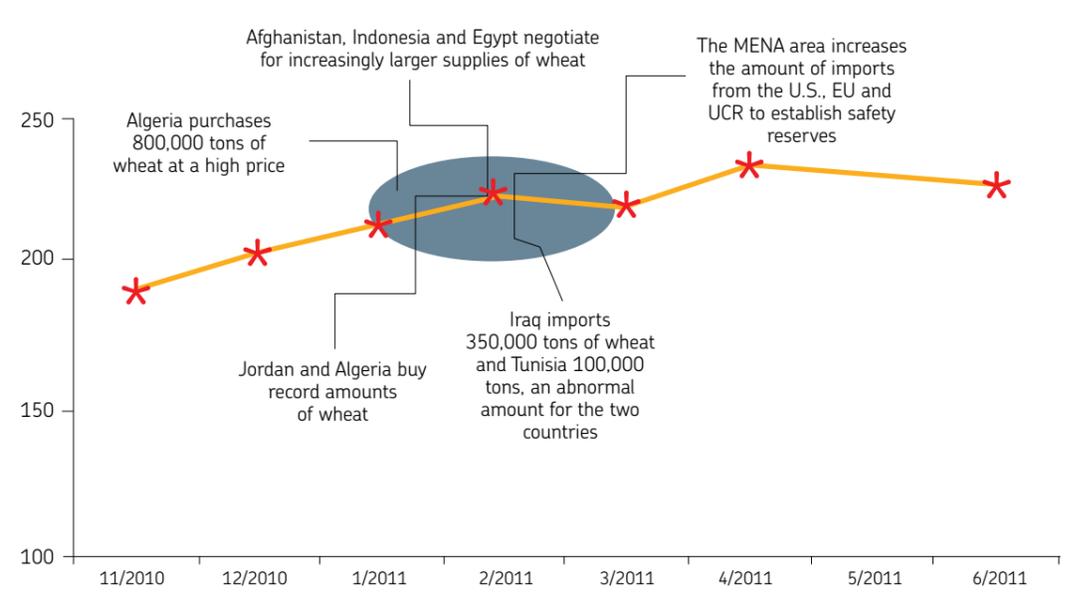
the dynamics of prices except for the onset of the expectation of a worsening of climatic variables for certain geographic areas (see Paragraph 2.6). Another phenomenon caused by the gradual increase in food prices and the difficult socio-economic conditions in certain states area involved in the Arab Spring is the purchase by these countries of large quantities of agricultural commodities at high prices in order to be distributed as subsidies on domestic markets. As discussed in Paragraph 2.8, these policies have been implemented in periods of insta-

Figure 2.37. Main events of the Arab Spring, trends in the price of crude oil and the FAO Cereal Price Index (2011)



Source: elaboration by The European House-Ambrosetti FAO data, Index Mundi and "The Guardian," 2011.

Figure 2.38. Cereal Price Index and Aggressive Buying Policies (October 2005 = 100), 2011



Source: elaboration by The European House-Ambrosetti of USDA data, 2011.

bility and uncertainty of national governments: in fact, in a period of turmoil such as that taking place, there has been a sharp increase in purchases by countries of the MENA area of agricultural commodities at high prices. This phenomenon introduces further distortions on the equilibrium of the world market. In conclusion, it is possible to argue that the increase in food prices and the onset of geopolitical imbalances in countries with poor socio-economic conditions are related to each other, particularly if these countries are net importers of food. Moreover, in some cases, the pressure of events in these countries can successively influence the dynamics of international prices: this is the case of the Arab Spring, which caused a surge in oil prices – which was then transmitted to that of food commodities – and an increase in purchases of food at high prices by these countries.

CONNECTION BETWEEN THE RISE IN FOOD PRICES AND THE ONSET OF GEOPOLITICAL IMBALANCES



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3. CONCLUSIONS AND RECOMMENDATIONS



3. CONCLUSIONS AND RECOMMENDATIONS

In this paper, we wanted to define a rigorous methodological framework that, with sufficient clarity, can highlight the relationships between several key variables and the drivers of short- and medium-term intervention in the markets of food commodities. Therefore, for the proper understanding of the problem and the possibility of evaluating effective policy measures, we have considered it useful to provide an analysis of the most important variables in Chapter 2.

What emerges from the analysis is an extremely complex picture which must necessarily be interpreted in a systemic key, taking into account the many elements that combine to create the current imbalance. This imbalance results in a strong volatility of prices in the short term and the risk of a steady growth of the same over the medium to long term.

As mentioned in the previous chapter, on the basis of the interpretive model developed, the different factors affecting the level and price volatility of food commodities were analyzed separately, and their links of causation and possible correlations have been identified and described. In particular, for each factor, we have tried to understand “how” and “why” a certain relationship with the trend in prices is established. In some cases, where the variables are measured through indices or quantitative indicators (for example, oil prices, the exchange rate of currencies, the volume of derivatives contracts traded, etc.), it was possible to appreciate the more or less obvious statistical correlations with the trend in prices. In others, where more qualitative variables come into play, the analysis was based on the empirical observation of reality, which allowed for reconnecting significant changes in the price to the occurrence of certain events (such as adverse climatic events, trade policy choices, etc.).

The contribution of the experience of the economists and policy-makers who have agreed to comment on the document has been extremely important for the preparation of this paper, as has the involvement of various operators in those markets that have been analyzed.

In light of what emerged from the work, there is a first important consideration: it does not seem possible – with the state of available knowledge – to order all the factors analyzed according to their major or minor impact on price levels and volatility, also due to the often objective and not precisely quantifiable relationship that exists between the variables. This, in fact, requires further study by the scientific community and international institutions in order to develop more targeted and effective intervention measures.

However, it should be noted that this limit, while important, does not preclude the ability to understand some key factors and to then formulate specific policy indications.

To this end, it is essential to divide the factors analyzed according to the actual possibility of acting on them, both to reduce volatility and to avoid excessive price increases that would put global food security and the development of the agriculture-food sector at risk. The crucial consideration is the time span of the achievement of such interventions.

In our opinion, it is, therefore, possible to distinguish between:

- *contextual factors*: these persist directly on the side of the demand/supply, or act indirectly on the price of food commodities, but are constants upon which it is not opportune/possible to intervene. These factors include population growth and urbanization, economic growth in emerging countries, the trend of the currency markets, international geopolitical dynamics, and the close link between energy costs and oil prices and agricultural production factors. Even if it has to do with variable objects of intervention (energy cost), the realization of interventions designed primarily to achieve objectives related to food prices is inconceivable;
- *structural factors*: these are addressed through interventions that will produce their effects only in the medium to long term and their problems can be resolved in the process of adapting the system to the changing structural conditions of supply and demand. These concern the problems of agricultural productivity, wastage and losses along the food chain, the constraints imposed by the limited natural resources available, the effects of climate change, the phenomenon of the Westernization of the diet in many emerging areas of the planet and, more generally, an increase in the average calorie consumption. Regarding these issues, a process of a very broad change of lifestyles and the restructuring of certain components of the food chain is necessary. There are aspects in play of innovation, technological developments, the spreading of good agricultural practices, reducing waste and losses, adaptation to and mitigation of adverse weather events and the re-orientation of food choices and eating habits with the goal of sustainability and health. These are decisive factors in the long term but, unfortunately, are not aligned to the political cycles and, therefore, are often overlooked;
- *contingent factors*: these may bring about results in the short term through appropriate technical and political solutions and interventions. In particular, these interventions regard the following issues: the low level of the stocks of agricultural commodities, incentives for the production of first generation biofuels; excessive speculation and “financialization” on food commodity markets, the implementation of distorting trade policies on the market by exporting and importing countries. These are the levers of effective intervention in the short term, fundamental to dealing with the emergency, but not sufficient in the absence of interventions on the structural factors.

The BCFN has already addressed the main issues related to the structural factors in several of its recent publications. Therefore, the following will review just some of the recommendations and policy indications that have already been given by referring to the individual position papers to provide a better understanding.¹ These recommendations are not directly related to the issue of food commodity prices but their implementation may prove decisive in the medium-long term for the balance of agricultural markets and, hence, price stability.

Agricultural Production

The challenge is to innovate continuously, striving toward the development of models for agricultural production and higher productivity, higher quality and a lower environmental impact. Scientific and technological research on these issues, also promoted by large amounts of public investments, is therefore crucial.

- *Interventions should be promoted to support developing countries* through the transfer of scientific knowledge, good agricultural practices, appropriate agricultural techniques and programs aimed at bridging the gap in today’s know-how that exists between advanced and developing countries.

THE PRICE VOLATILITY AND THE THEIR CONTINUED GROWTH

THE LINKS OF THE CAUSATION AND CORRELATION AT THE BASE OF THE TWO PHENOMENA

IT DOES NOT SEEM POSSIBLE TO ORDER ALL THE FACTORS ANALYZED ACCORDING TO THEIR MAJOR OR MINOR IMPACT ON PRICE LEVELS AND VOLATILITY OF PRICES

CHANGES DIVIDED ACCORDING TO POSSIBILITY OF INTERVENING UPON THEM TO REDUCE VOLATILITY AND TO AVOID EXCESSIVE PRICE INCREASES

CONTEXTUAL FACTORS

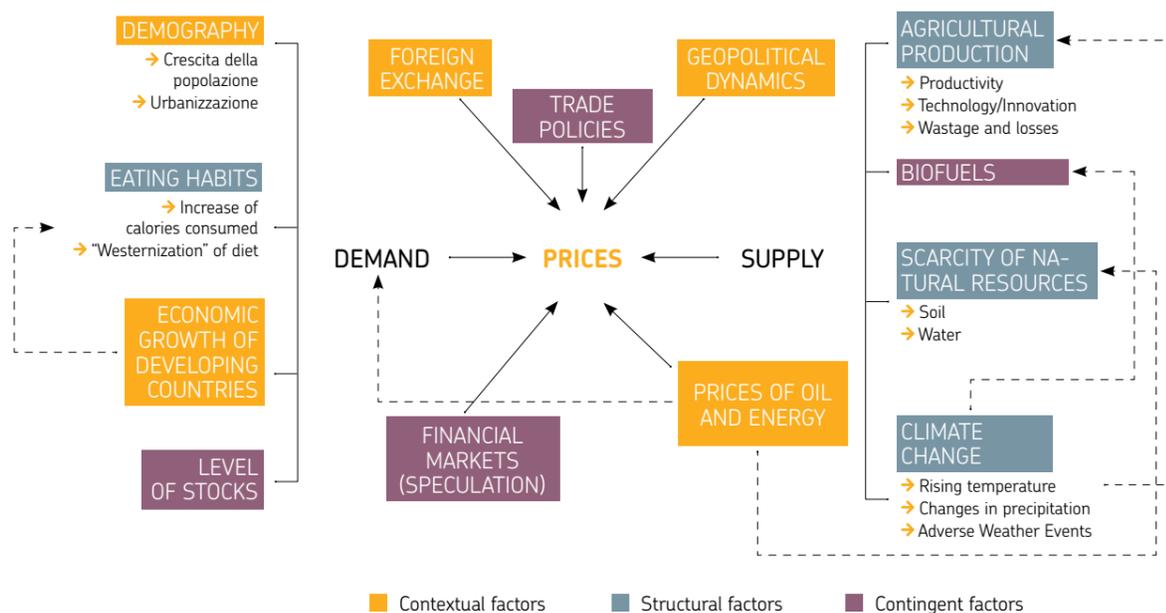
STRUCTURAL FACTORS

CONTINGENT FACTORS

THE ROLE OF CONTINUOUS INNOVATION

ACTIONS TO SUPPORT DEVELOPING COUNTRIES

Figure 3.1. The interpretative model of the factors affecting the level and volatility of food prices: contextual, structural and contingent factors



Source: elaboration by The European House-Ambrosetti, 2011.

MAINTENANCE AND DEVELOPMENT OF "LOCAL SYSTEMS"

OPPOSING FISCAL AND TRADE POLICIES THAT ARE DISTORTING WORLD FOOD MARKETS

INVESTIGATE DEVELOPMENTS IN TECHNOLOGY

ENCOURAGING INVESTMENTS IN TECHNOLOGIES

- It is necessary to support the maintenance and development of "local systems" of production-distribution-consumption of food goods, through appropriate policies and incentives/disincentives, preserving the quality of products and attentive to biodiversity and bio-sustainability.
- It is necessary to oppose fiscal and trade policies that are distorting the food markets of the world, especially to the detriment of developing countries. Combined with a more rational use of land, these measures alone would achieve significant results.
- Other means linked to the progress of technology – such as biotechnology – should certainly be explored in parallel, with the awareness that many profiles related to their use should be considered more thoroughly and evaluated carefully.

Agricultural productivity is also a factor that exerts a direct effect on one of the contingent factors, the level of stocks. This concept will be taken into consideration further on.

Scarcity of Natural Resources

As described in Paragraph 2.4, limitations to the availability of natural resources – with particular reference to inputs such as water and arable land – are an important constraint to the growth of the productive capacity of world agriculture.

With reference to water, for example, there is the need to implement measures to restrict its use in production processes and cultivation, particularly in the areas of the planet where rainwater is scarce. To do this, there is ample room for maneuvering, both on the reduction of waste and on the use of technology able to make water resources more productive (thus obtaining quantitatively the most significant output for the same input: the so-called *more crop per drop*).

- It is necessary to introduce some form of incentive for investment in technologies that are already available to obtain savings in the volume of water used in production processes,

- particularly in areas with high rates of low levels of water for irrigation and rainwater.
 - With regard to its use in agriculture – concerning 70% of global water consumption – support for the adoption of advanced techniques of collecting rainwater to use for irrigation is needed. Moreover, the spreading of irrigation technologies and agricultural management tools designed to maximize efficiency does not always translate into huge investments in technology, but often, more simply, can be achieved through the spreading of knowledge and know-how.
 - Greater attention needs to be given to the location of crops in relation to water efficiency. In particular, in the choice of the location of certain types of crops, the opportunity should be seized to maximize the consumption of green water (rainwater) of the water footprint compared to that of blue water (water taken from aquifers and reservoirs).²
 - It is possible to seize the opportunities offered by the increasing liberalization of international trade, or that is, to direct the trading of goods with high virtual water content from those richest in water resources to others that are poorer, adopting the logic of virtual water trade.
- Also with regard to land ownership, the challenge is to obtain higher yields per hectare through the operations described with respect to the issue of agricultural productivity.

Climate Change

The most reliable studies on the topic of climate change show that the future scenario – which is now deemed most likely to occur – predicts, in the absence of radical action, a decrease in the overall agricultural productivity equal to the agricultural area utilized.

In addition, the effects of climate change could affect certain geographic areas and the ability to secure adequate levels of production compared to the current volumes, mainly due to rising temperatures and more severe conditions of access to water (the most significant impact should be recorded in the equatorial belt, in the Mediterranean, Australia, etc.).

Finally, climate change is intensifying because of adverse weather events (droughts, floods, etc.) that can cause extensive crop losses.

Excluding the possibility of removing the effects of climate change (it is a phenomenon considered to be irreversible), remaining in the context of the agricultural sector, it is possible to focus on the following points.

- Encourage the implementation of measures to mitigate the problem, for example, through better management of crops and pastures to increase the carbon reserves in the soil; the restoration of cultivated peaty soils and degraded lands; improved techniques of rice cultivation and raising livestock and manure management to reduce CH₄ emissions; the improvement of the techniques of application of nitrate-based fertilizers to reduce N₂O emissions, improvement of energy efficiency, etc.
- Support actions to adapt to climate change, aimed at supporting agricultural productivity, such as the differentiation of crops (ex-ante) and the reduction of liquidity and stock reserves, the use of bank or informal loans, and the sale of key assets (ex-post).

Eating Habits

In light of the changes that can already be seen today and which will intensify in the near future (economic growth and the Westernization of the diet in developing countries, or the spreading of more sophisticated patterns of consumption by large sections of the population – see Paragraph 2.2), the future composition of the global demand for food is an important factor for the future sustainability of the agricultural system.

SUPPORTING THE ADOPTION OF ADVANCED TECHNIQUES OF COLLECTING RAINWATER

PAYING MORE ATTENTION TO THE LOCATION OF CROPS IN RELATION TO WATER EFFICIENCY

DIRECT THE TRADING OF GOODS WITH HIGH VIRTUAL WATER CONTENT

IN THE ABSENCE OF RADICAL CHANGES, THERE WILL BE A REDUCTION OF AGRICULTURAL PRODUCTIVITY

ACTIONS TO MITIGATE THE EFFECTS OF CLIMATE CHANGE

ACTIONS FOR ADAPTING TO CLIMATE CHANGE

THE FUTURE COMPOSITION OF THE GLOBAL DEMAND IS A DETERMINING FACTOR FOR THE FUTURE SUSTAINABILITY OF THE AGRICULTURAL SYSTEM

INCREASED FOCUS ON SUSTAINABILITY IN BOTH INDUSTRIALIZED COUNTRIES AND DEVELOPING COUNTRIES

THE IMPORTANCE OF CHOOSING SUSTAINABLE DIETARY MODELS: THE FOOD AND ENVIRONMENTAL DOUBLE PYRAMID

BARRIERS/SUBSIDIES ARE A DISTORTING FACTOR IN THE DYNAMICS OF SUPPLY AND DEMAND ON THE INTERNATIONAL MARKET

THE CREATION OF A TRADING SYSTEM BASED ON MULTILATERAL RULES TO ENSURE ACCESS TO FOOD WORLDWIDE

REDUCE THE SUPPORT TOOLS OF THE DOMESTIC DEMAND IMPROVE MARKET ACCESS

The environmental impact and consumption of natural resources (land, water, etc.) associated with different food choices may also be very different. The Western diet and the Mediterranean diet, for example, differ primarily with respect to the quantities of meat consumed: the models of consumption that are excessively unbalanced in the direction of the consumption of meat and food products of animal origin may, in fact, undermine global food security over time.

For the first time in history, government actions addressing the eating habits that take a profile of sustainability into account are becoming a decisive variable for economic policy. This is what is taking concrete shape in developed countries, where governments face a medical emergency related to the epidemic of metabolic and cardiovascular diseases and cancer, resulting from improper dietary habits. However, it is also becoming crucial in developing countries, for the impact this creates on the equilibrium of the global food market.

The choice of dietary models that are sustainable for the future can also allow for reducing the emphasis on productivity gains, which in turn places pressure on natural resources and environmental sustainability. To this end, the BCFN has developed and provides policy-makers with a model – the Food and Environmental Double Pyramid – which shows how eating behavior that is more suitable for the conservation of good health in people is also the most environmentally sustainable. This model, designed for Western countries, with the necessary variations in geographical traditions and eating habits, is potentially valuable in its guidance for all countries.

After having carried out a series of policy recommendations and guidelines regarding the structural factors, offered below to institutional policy-makers is the BCFN's proactive contribution on the four contingent factors upon which we believe it is urgent to take action in order to rapidly curb the sudden and uncontrolled growth of food commodity prices and the excessive volatility of these markets.

Trade Policies

Reduce the various forms of restraint of trade, first and foremost, prohibitions, quotas and export duties

As seen in Paragraph 2.8, the imposition of trade barriers/subsidies is a distorting factor in the dynamics of supply and demand on the international market of food commodities. In the 2008-2010 period, following expectations about a lowering of future harvests and rising prices on the international level, some major exporters of agricultural goods eliminated export subsidies (or, in some cases, even introduced taxes on exports) to increase their domestic supply and limit the internal effect of the global food prices. At the same time, some importing countries adopted protective policies (reduction or elimination of tariffs on incoming goods) to ensure a sufficient level of stocks aimed at limiting the increase in domestic prices. These dynamics have been proposed in recent months and are responsible for the new, rapid increase in prices.

One of the biggest challenges that the international community faces today is the need to create a transparent system of “responsible” trade based on multilateral rules able to provide greater access to food worldwide. There is hope for a general reduction in the use of import barriers, export subsidies and other trade restrictions. In particular, it is necessary to:

- *reduce the support tools of the domestic demand*, that produce distortions, especially when implemented by developed countries;
- *improve market access* significantly, while maintaining appropriate safeguards systems for

the developing countries, in order to improve their efficiency and competitiveness and strengthen their integration into international markets;

- *eliminate export subsidies* in order to create a level playing field in the international market, thus increasing the efficiency of the same;

- exempt humanitarian aid from any type of restriction so as to *avoid speculation*;

Finally, to maintain a stable price level at the regional level,³ the formation of a supranational authority that ensures the balance between supply and demand and equal access to food within the macro-areas can be hypothesized.

Also, in consideration of the close connection between the policies of procurement, storage and aid to the main food commodities (described in Chapter 2), it would be desirable that trade be regulated through the imposition of ceilings of the opposite sign to imports and exports:

- in the case of imports: in order to avoid aggressive buying policies by importing countries during times of uncertainty,⁴ the constituted Authority should set limits on volumes, above which progressive taxation would be applied that is directly proportional to the amount. This would help to limit this phenomenon, and would also establish an extra revenue available to the Authority that would have the task of redistributing it to the exporting countries, so as to limit the inflationary effect on prices and allow for adopting conservation policies (to increase the level of reserves or subsidize farmers hit by adverse weather events), without diminishing the flow of exports;
- in the case of exports, it would be desirable to set a minimum-volume ceiling below which one would incur the mechanism described above. The extra revenue generated could then be redistributed to importing countries that will be able to invest new capital in R&D projects in agriculture, in the establishment of a multilateral system of food reserves for importing countries⁵ and implementation of ex-ante policies for the adaptation to local climatic conditions.

Level of Stocks

Creating a multilateral system of food reserves and improving the transparency of flows and stocks

Several factors (see Paragraph 2.3) in recent years have made it necessary to draw on stock reserves accumulated over the years to meet the growing demand for food (which has grown faster than the supply) and to stabilize domestic prices. The analysis conducted during the study showed a strong link between changes in stocks and the development of prices of food commodities.

In particular, in a sufficient time span, it was observed that a reduction in the stocks-to-use of cereals tends to correspond to an increase in the level of prices; while, conversely, an increase in the stocks-to-use tends to make the price decrease.

In order to moderate this effect, it is proposed to adopt the following measures.

- Pursue growth in agricultural productivity, particularly in developing countries, through the *spreading of good agricultural practices and technical and scientific knowledge*, the creation of irrigation infrastructures, manufacturing, transport and storage, increased public investment in research and development, etc. The increase in agricultural productivity is a necessary condition for the realization of the surplus of production that can be allocated for the reconstitution of the reserves.
- It is necessary to *establish a multilateral system of food reserves, regional and cross-border, to increase the margins of elasticity of the global food system*. It is, therefore, necessary to promote policy coordination of storage at the international level.

ELIMINATE EXPORT SUBSIDIES

AVOID SPECULATION ENSURE THE BALANCE BETWEEN SUPPLY AND DEMAND

IMPOSITION OF CEILING OF THE OPPOSITE SIGN TO IMPORT AND EXPORT

THE LINK BETWEEN CHANGES IN THE STOCKS AND THE DEVELOPMENT OF FOOD PRICES

THE SPREADING OF GOOD AGRICULTURAL PRACTICES AND TECHNICAL AND SCIENTIFIC KNOWLEDGE

ESTABLISH A MULTILATERAL SYSTEM OF FOOD RESERVES

IMPROVE MARKET TRANSPARENCY AND CHANNELS OF INFORMATION

- Improve market transparency regarding the sharing of information relating to the supply, demand, stocks and import-export dynamics. This action would not only help to mitigate the phenomenon of the recent volatility in food prices, but – with reference to the guidelines for setting up a supranational authority to control the balance between supply and demand – would also guarantee the presence of an information system capable of collecting reliable data and providing operators with analyses and a statistical basis. With regard to supporting the decisions of national governments, the collection of data on the level of reserves and the distribution of estimates of supply and demand through mechanisms of predicting the extent of the crops are of particular importance.

Production of Biofuels

Reduce support for first generation biofuel production competing with food production in favor of those of second generation, increase investments in new technologies and achieve greater trade openness in this area

LINK BETWEEN THE PRICE OF FOOD COMMODITIES AND THAT OF OIL

Internationally, the price of food commodities is highly correlated to that of oil (see Paragraph 2.7). Increases in oil prices, in fact, result in increased costs of biofuels and boost the demand internationally. In addition, since most of the biofuels (first generation) are produced with the same input as for food or farming (cereals, sugar cane, etc.), competition is created between the energy and food sectors in the use of agricultural raw materials. Changes in oil prices and the political support of biofuel production are, thus, responsible for episodes of high volatility and the increasing prices on food markets (see Paragraph 2.5). Therefore:

- it is to be hoped that governments (especially in Europe and the U.S.) will significantly reduce their policies supporting the production and consumption of first generation biofuels, which, since they are produced through the transformation of agricultural raw materials, come into direct competition – in terms of use – with the products to be used as food for humans and for livestock;
- in the absence of the removal of these incentives, when markets are under pressure and global food supplies are reduced, governments should develop plans to regulate (at least in the short term) policies that stimulate the production and consumption of biofuels;
- it seems opportune to support, in parallel, second generation biofuels, produced from crops that do not compete in land-use with those for food, and to stimulate research on new technologies for the production of biofuels, to meet the growing demand for global energy and reduce the effects on agricultural commodity markets;
- in addition to the limitation of subsidies, it is also important to foster the opening of international markets, so that conditions of affordability can also be verified for biofuels.

Financial Markets

Regulation of excessive financial speculation on food commodities

The futures markets are an integral part of the market of food commodities and exercise two important functions: they help manage the volatility of prices and contribute to the setting of the price. However, the global financial crisis of recent years has caused “non-commercial” investors (pension funds, banks, sovereign funds, etc.) to increase investments in agricultural commodity derivatives in order to diversify their portfolio (see Paragraph 2.10).

REDUCE THE SUPPORTING OF THE PRODUCTION AND CONSUMPTION OF FIRST GENERATION BIOFUELS

DEVELOP CONTINGENCY PLANS TO REGULATE POLICIES ON THE PRODUCTION AND CONSUMPTION OF BIOFUELS

BIGGER SUPPORT TO SECOND GENERATION BIOFUELS

BIGGER OPENING OF INTERNATIONAL MARKET

THE GROWING NUMBER OF “NON-COMMERCIAL” INVESTORS IN THE FOOD COMMODITIES MARKET

Increase in the share of contracts in the hands of non-commercial investors may have prompted speculation, typical of other non-food items, such as oil. Insofar as the actual role of this phenomenon in influencing the rise in prices of agricultural goods is widely debated, financial speculation in agricultural commodity markets may have amplified the volatility in the short term.

While not wishing to demonize the activities of financial intermediaries, there could be some actions taken that would promote greater transparency, order and balance in the markets without impeding their action:

- on the one hand, to allow regulatory authorities to identify any anomalies in financial actions and to prevent speculative behavior, there must be a better flow of information and transparency of over-the-counter operations (OTC), by monitoring the activity of speculators (through a system of reporting transactions/positions and registration requirements for operators) and the possibility of imposing ceilings on their activities. For instance, there should be an introduction of mechanisms of diversification between commercial and non-commercial traders, so as to impose limitations on operators who are speculating, to prevent them from making “bets” on excessive price movements, while leaving the “real” market free to act.
- on the other hand, it seems desirable to encourage the introduction of rules⁶ to define the scope of action of financial intermediaries in the market for agricultural commodities, in the direction of a progressive harmonization of trade on these markets. As also recently stressed by the UN speaker for The Right to Food, Olivier De Schutter, at the G-20 Summit of the Ministers of Agriculture in Paris in June 2011, the United States has legislated in the field of financial derivatives for about a year and the G-20 could encourage the other economic powers to move in the same direction.

THE “FINANCIALIZATION” OF COMMODITIES MAY HAVE PROMPTED SPECULATION

PROMOTE GREATER TRANSPARENCY IN THE FINANCIAL MARKETS

BETTER INFORMATION AND GREATER TRANSPARENCY OF OTC OPERATIONS

MECHANISMS OF DIVERSIFICATION AMONG THE TYPES OF INVESTORS

DEFINE THE SCOPE OF ACTION OF FINANCIAL INTERMEDIARIES



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NOTES AND
REFERENCES



NOTES AND REFERENCES

CHAPTER 1

- 1 Paris, 22-23 June 2011.
- 2 The plan of action developed by the Agriculture Ministers of the G20 will be submitted to the leaders of the countries for their approval in November 2011.
- 3 The variables that influence the dynamics of the prices of agricultural commodities will be analyzed in more detail in the next chapter.
- 4 *Food Outlook – Global Market Analysis*, FAO, June 2011.
- 5 *Price Volatility in Food and Agricultural Markets: Policy Responses*, FAO, IFAD, FMI, OCSE, UNCTAD, WFP, World Bank, WTO, IFPRI and UN HLTf, May 2011.
- 6 The standard deviation is an indicator that is used to estimate volatility and measures the average deviation of the price compared to its performance in the medium to long term.
- 7 The variables that directly and indirectly influence the price of food commodities will be subject to detailed analysis in the next chapter.
- 8 This represents the market's expectations about the future volatility of prices and is measured as the percentage of the deviation of the future price of a commodity (after six months) from the expected value below. In general, an increase in implied volatility reflects how the market conditions and unforeseen events result in subsequent increases in uncertainty for market participants.
- 9 *Behind Concerns about Volatility Lie Concerns about Price Levels and behind both, Lie Concerns about Food Security*, in *Price Volatility in Food and Agricultural Markets: Policy Responses*, FAO, IFAD, FMI, OCSE, UNCTAD, WFP, World Bank, WTO, IFPRI and UN HLTf, May 2011.
- 10 *Price Volatility in Food and Agricultural Markets: Policy Responses*, FAO, IFAD, FMI, OCSE, UNCTAD, WFP, World Bank, WTO, IFPRI and UN HLTf, May 2011; *Agricultural Outlook 2011-2020*, OECD-FAO, June 2011.
- 11 The transmission of price changes occurs in urban areas first and then in rural areas, since the latter often live in a state of isolation with respect to external phenomena.

CHAPTER 2

- 1 As a measure of the price level, reference will be made to the FAO Food Price Index, and in some cases we will refer exclusively to FAO Cereal Price Index.
- 2 *Agricultural Outlook 2010-2020*, FAO-OECD.

3 According to the IMF, emerging markets are countries that are growing socially and economically and in which there is a process of industrialization. About 28 markets are recognized as emerging, including China and India, which account for 70% of the population of the emerging markets.

4 Estimate made by the United Nations.

5 In recent years, the world's urban population has grown more than the rural one and the United Nations estimates that in 2050, 69.6% of the world's population will live in cities.

6 In China, the number of dairy cows has increased from around 5 million head in 2000 to 15 million in 2011 (+10% on average each year).

7 Please note, for example, that in the Bible, the book of Genesis (41, 48-49) celebrates the astuteness of Joseph, who interpreted the premonitory dream of the Pharaoh and in the seven years of good crops accumulated a lot of grain in silos and then redistributed it to the population in the next seven years of famine.

8 The level of stock is always difficult to measure because the data is based on spontaneous statements by individual states.

9 Between 1930 and 1970, the United States implemented programs to support the price of wheat using the so-called "buffer stocks." The buffer stocks played a key role in maintaining the balance between supply and demand: when faced with excess demand, the government drew on their reserves to stabilize the price, while in the face of oversupply, the superfluous harvest was stored for future use. See: Wright B., *International Grain Reserves and the Instruments to Address Volatility in Grain Markets*, The World Bank, Policy Research Working Paper.

10 The stocks-to-use ratio is the ratio of stock levels and consumption of a certain asset in a period of time equal to one year.

11 FAO, 2010.

12 The FAO has estimated that about 1/3 of the food produced for human consumption is wasted by retailers or consumers (especially in developed countries), or is lost along the production process (particularly in developing countries): this is a total of about 1.3 billion tons.

13 Anuradha Mittal, The Oakland Institute.

14 The rate of growth in recent years has been, on average, always higher than the demographic shift. FAO data shows that about 7 billion people living in the world today have a 15% greater availability of food compared to the 4 billion inhabitants of the Eighties.

15 This value is even higher in medium-low income countries (in some developing countries, 95%), while in developed countries the weight of the industry on the total consumption is largely predominant (59%).

16 According to more long-term estimates, in 2050 agriculture will consume 90% of the water used globally. See: *World Water Assessment Program*, 3rd United Nations World Water Development Report: Water in a Changing World, UNESCO.

17 WBCSD, *Facts and Trends – Water*.

18 "Land which due to natural processes or human activity is no longer able to sustain properly an economic function and/or the original ecological function." Quote from Land Degradation Assessment in Drylands (LADA), FAO – UNEP, 2008.

19 Land Degradation Assessment in Drylands (LADA), FAO-UNEP, 2008; Global Assessment of Human-induced Soil Degradation (GLASOD), ISRIC, 2008.

20 Biggelaar A.H. *et al.*, 2004.

21 Biggelaar A.H. *et al.*, 2004; Henao J., C.A. Baanante, 2006.

22 Calculated on the loss of 75 billion tons of soil due to erosion.

23 The yield of cereal, measured in kg per hectare of harvested land, including wheat, rice, corn, barley, oats, rye, millet, sorghum, buckwheat, and mixed grain. The data relating to the production of cereals refers to crops harvested solely for dry grain.

24 The European Union, for example, in its 2020 Strategy, has set a target that the share of energy from renewable sources in the final energy consumption in 2020 be at least 20%. More specifically, the European Directive 2009/28/EC of April 23, 2009 sets the target for renewable energy use in transport at 10%, with great emphasis on the gradual substitution of biofuels produced from food crops with second-generation biofuels (produced starting from wastes, residues, non-food cellulosic and ligno-cellulosic materials).

25 Biofuels are a type of fuel derived from biomass and indirectly include liquid fuels (ethanol and biodiesel) and various kinds of biogas. Ethanol is obtained from the fermentation of the sugar component of plant materials, mainly grain sugar and starch. It can be used as fuel in its pure form, although it is basically used as an additive to gasoline to increase octane content and improve emissions. Biodiesel, produced from vegetable oils, animal fats or recycled oils, in its pure form can also be used as fuel (the diesel engine was invented using rapeseed oil), but like ethanol, it is basically used as an additive to conventional diesel fuel to reduce the level of carbon monoxide and hydrocarbons.

26 United States Department of Agriculture (USDA), 2010.

27 The United States has established a subsidy of \$ 0.51 per gallon of ethanol, compared to an import duty of \$0.54, and a similar measure of protection has also been adopted for producers of biodiesel. Congress had initially set a limit on production at 7.5 billion gallons of biofuels in the period between 2005 and 2012. The US Renewable Fuel Standard (RFS-2) provides volumetric targets for different types of biofuels: by 2020, 1 billion gallons of biodiesel, 3.5 billion gallons of second-generation biofuels and 15 billion gallons of ethanol will have been consumed. Finally, the current U.S. regulations are expecting to double the production of ethanol and to triple that of biodiesel, if produced within national boundaries by 2020. Europe has also set duties on imports of ethanol amounted to €0.192/liter and an ad valorem tax of 6.5% for biodiesel, significantly reducing the tax burden on producers and introducing compulsory standards of production.

28 *Agricultural Outlook 2011-2020*, OECD-FAO.

29 *Agricultural Outlook 2011-2020*, OECD-FAO.

30 *Agricultural Outlook 2011-2020*, OECD-FAO.

31 Brittain R., NeBambi Lualadio, *Jatropha: A Smallholder Bio-energy Crop The Potential for Pro-Poor Development*, Cambridge University Press, 2010.

32 Lobell D., W. Schlenker, J. Costa-Roberts, *Climate Trends and Global Crop Production Since 1980*, in "Science," May 2011.

33 It is a recurring climatic phenomenon that occurs in the central Pacific Ocean every five years on average, but with a period ranging between three and seven years, in the months of December and January. La Niña causes floods, droughts and other disturbances that vary with every manifestation: developing countries along the Pacific coast, which depend heavily on agriculture and fishing, are the ones most affected.

34 See in this regard: Burke M., D. Lobell, *Food Security and Adaptation to Climate Change: What Do We Know?*, in "Advances in Global Change Research," 37, 2010.

35 See, among others: Lobell D.B. et al., *Prioritizing Climate Change Adaptation Needs for Food Security in 2030*, "Science," 2008, pp. 319, 607.

36 Nelson G., et al. (edited by), *Food Security, Farming, and Climate Change to 2050: Scenarios, Results, Policy Options*, International Food Policy Research Institute (IFPRI), 2010.

37 Höök H., R. Hirsch, K. Aleklett, *Giant Oil Field Decline Rates and their Influence on World Oil Production*, in "Energy Policy," 37, 2009.

38 Aleklett K., et al., *The Peak of the Oil Age: Analyzing the World Oil Production Reference Scenario*, in *World Energy Outlook 2008*, and in "Energy Policy," 38, 2010.

39 *World Energy Outlook 2010*, International Energy Agency (IEA), 2010.

40 In the case of the United States, 9 of the 10 U.S. recessions since 1945 (except that of 1960) were preceded by significant increases in oil prices. See: Balke S., S. P. A. Brown,

M.K. Yücel, *Globalization, Oil Price Shocks and U.S. Economic Activity*, Federal Reserve Bank of Dallas, 2004.

41 According to the International Energy Agency estimates, the total oil production of OPEC countries will continue to grow until 2035, exceeding 50% of global production. See: *World Energy Outlook 2010*, International Energy Agency (IEA), 2010.

42 The terms of trade are given by the ratio between the change in export prices and the change in import prices in a given time interval.

43 Krugman P.R., M. Obstfeld, *Teoria e politica del commercio internazionale, (International Trade Theory and Policy)*, Pearson Publishers, 2007.

44 The examples are taken from the USDA paper, *Why have food commodity prices risen again*, June 2011.

45 Arezki R., M. Bruckner, *Food Prices and Political Instability*, FMI Working paper, March 2011.

46 Slayton T., *Rice Crisis Forensics: How Asian Governments Carelessly set the World Rice Market on Fire*, Center for Global Development.

47 *Where are food prices heading?*, Deutsche Bank Research, March 2011.

48 Derivatives may, in fact, be treated in a standardized and transparent form in official markets (in the case of listed derivatives), or very customized forms can also be negotiated privately between two parties (such as between a company and a bank) in the so-called over-the-counter market (OTC).

49 The mutual funds right now account for about 25-35% of all agricultural futures contracts and, with other investors, are an important source of liquidity in the market. Also see: FAO, *Price Surges in Food Markets: How Should Organized Futures Markets be Regulated?*, Policy Brief 9, June 2010.

50 A Commodity Index Fund is a financial product that offers investors the opportunity to take a synthetic position on the commodity market without making a physical exchange. These funds are created and grow thanks to the ease of market access, without the need for specific information on individual assets.

51 Robles M., M. Torero, J. Von Braun (edited by), *When Speculation Matters*, IFPRI (International Food Policy Research Institute) Issue Brief 57, February 2009.

52 The KCBT specializes in the negotiation of the red winter wheat, the main ingredient of bread. Two other major markets in the futures on wheat are the CBOT (Chicago Board of Trade) – CME (Chicago Mercantile Exchange), rating Soft Red Winter wheat, and the MGEX in Minneapolis, specializing in the Hard Red Spring.

53 For further details, also see the analysis contained in: M. Robles, M. Torero, J. Von Braun (ed.), *When Speculation Matters*, IFPRI (International Food Policy Research Institute) Issue Brief 57, February 2009.

54 What is meant by "position" is all of the investments made by a person using the available capital. One says "open," if the asset price fluctuations cause variations in portfolio valuation; or "blanket" (flat), if the growth in value of some components of the portfolio is equal to the decline in value of others, so that the assets as a whole do not change.

55 The futures market is characterized by the correspondence at any time, of the number of contracts bought with that of the contracts sold: there is a single counterpart that manages the market and ensures, with adequate safeguards against economic operators, that all obligations are met.

56 This is a category of workers – both commercial (such as investment funds and pension funds) and non-commercial traders (speculators) – who hold long positions.

57 For example, in 2006, the CME Group in Chicago bought Swapstream, an electronic trading platform based in London. In 2007, the CME Group exceeded one billion contracts traded electronically in a single year.

58 See, among others: Robles M., M. Torero, J. Von Braun (edited by), *When Speculation Matters*, IFPRI (International Food Policy Research Institute) Issue Brief 57, February 2009; Irwin S.H.,

D.L. Good, P. Garcia, E.L. Kunda (edited by), *Comments on Permanent Senate Subcommittee on Investigation Report "Excessive Speculation in the Wheat Market,"* University of Illinois – Department of Agricultural and Consumer Economics, July 2009.

59 For further details about the creation of and strategic choices made by the Chicago Board of Trade we also suggest reading the paper: Reinhardt F., J. Weber (ed.), *CME Group*, Harvard Business School, Case 711-005, April 26, 2011.

60 CME Group is now the largest and most diverse financial exchange and the largest market for futures and options in the world. In 2009, CME Group, against revenues of \$2.6 billion, managed a total of more than 2.5 billion contracts worth a total of 1,000 trillion dollars.

61 FAO Food Price Index.

62 Many observers identify the beginning of this period in December, after the suicide of Mohamed Bouazizi, a Tunisian activist, who became a symbol of the 2010-2011 riots in Tunisia for having set fire to himself in protest for the economic conditions of his country.

63 Jones S., J. Mazo, *Global Warming and the Arab Spring*, April – May 2011.

CHAPTER 3

1 *Access to Food: Challenges and Prospects*, 2011; *Water economy, April 2011; Double Pyramid 2011: healthy food for everyone and sustainable for the environment*, July 2011; *Climate change, agriculture and food*, June 2009.

2 The consumption of *green water* has a less invasive impact on environmental balance than that of *blue water* which, instead, is the most strategic and important water resource.

3 What is meant by "regional" is an aggregate of neighboring countries with heterogeneous agricultural characteristics, so as to avoid the coexistence of groups of countries with the same commercial interests.

4 Consider, for example, the subsidies to domestic consumption recently launched by Algeria (the world's largest importer of wheat), which bought large quantities of wheat at high prices, to then resell them at lower prices internally.

5 This is, for example, the case of ASEAN, with a common pool of 85,000 tons of rice.

6 At present, some European operators in the physical market and some derivatives on commodities are not covered by supervision or regulations, in that they benefit from the exceptions (and shortcomings) of MIFID (Markets in Financial Instruments) and MAD (Market Abuse) directives.

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