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Hedging agricultural commodities in order to sustain economic growth of underdeveloped areas

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To my family

“No man is an island, entire of itself; every man is a piece of the continent, a part of the main. Any man's death diminishes me because I am involved in mankind; and therefore never send to know for whom the bell tolls; it tolls for thee...” (from Meditation 17, john Donne 1624)

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Introduction

The words “ecology” and “economics” originate from the same Greek word, *oikos* (οἶκος), “household” or “estate”: “eco-logy” is the study of the relation of living organisms to each other and their surroundings (*logos* means word, study), while “economics” is the management of the complex aggregate (*nomos* is intended as customs or laws). This common etymological root suggests a close link between the two disciplines that, however, has increasingly weakened over the years.

Growth, development, global markets are the factors of the dynamic, fast, competitive World economy. The rhythm is crazy and human needs seem to be forgotten. Good health, long life, happiness have been traditionally associated with the genuine food but, throughout the ages, men have neglected this and favoured forms of agriculture, focused on money and business but really far from people. The opening of all kinds of entry barriers for agricultural trade push local farmers far from the market, and the food that we eat every day comes from places that we usually do not know.

The key role of Agriculture in developing areas is an engine for growth and what we want to do is to push the concept of agriculture as a starting point for bringing the economy back to the old notion of market: a place where you know what you are buying. Is it impossible to achieve the real growth when there are different levels of development in the same land. This analysis deals with the example of a Farmers’ Cooperative for olive oil production in the South of Italy. For centuries the economy of that South Italy region (Puglia) has been focused on agriculture (especially on extra virgin olive oil production). The opening of the economic horizons to global markets has “reshuffled the cards”. The production at the Italian costs has become insufficient to economically sustain that area, so farmers have been exposed to the problems of international trade, without the knowledge required.

Like all rural areas, Puglia is exposed to the high risks caused by weather, which affects the production and the economy as a whole. This high risk (related to the weather, the price fluctuation or the yield uncertainty) causes the so-called "poverty trap" for people who have possibility to escape. The banks do not offer to them good rates for loans and the lack of money makes the capital turnover impossible. For this reason farmers (olive oil producers) are forced to sell their product at a low price to the main multinationals. The final product quality is therefore compromised because the olive oil that is marketed with the Multinational brand is a mix of different kinds of oil, not all of high quality.

Why is it impossible to place quality products on the market? Analysing the difficulties of the cooperative we found different types of financial instruments that might obviate them thus making the rural economy compatible with the modern markets and allowing them to trade their products without scarifying the quality.

1.

THE ROLE OF AGRICULTURE IN DEVELOPMENT AND THE POVERTY TRAP

1.1 THE ROLE OF AGRICULTURE IN DEVELOPEMENT

A longstanding question in economics is why some countries are so much richer than others. Today 1 billion people live on less than $1 per day; the per capita income in the World's richest Country is about 35 times the per capita income in the poorest. Approximately three quarters of the poorest people in the World live in rural areas and, over half of them depend on agriculture or agricultural labour as their primary livelihood strategy (International Fund for Agricultural Development 2001). There's no way to establish the actual causes of this wealth mismatch but it is possible to build links between real cases and try to focus on the appropriate steps or measures required to make the World a liveable place for everyone. Let's now try to better understand the link between poverty and agriculture. We have to start from the consideration that all the main industrialized countries have got a great agricultural/rural past. Over the years, however, lots of people shifted from rural to urban areas and right now we have too many people in cities and too less in rural areas. This allows the population of industrialized countries to delegate the food supply to Developing Countries and

use this source at the cheapest possible price. This approach does not take into consideration the potential role of Agriculture in development.

Classical theorists, led by Arthur Lewis in the 1950s, viewed economic development as a growth process of relocating factors of production, especially labour, from an agricultural sector, characterized by low productivity and traditional technologies, to a modern industrial sector with higher productivity. The contribution of agriculture to development was passive. Agriculture acted more as a source of food and labour than a source of growth. Although passive, agricultural growth was still seen as necessary for successful economic transformation for two reasons:

(1) to ensure the supply of food and prevent rising food prices and real wages from undermining industrial development;

(2) to utilize a major natural resource—land—as an additional "free" source of growth that would not compete with resources for industrial growth (Lewis 1954).

Nonetheless, Lewis' theory was employed to support the industrialization-led strategies adopted by many developing countries during the 1950s and 1960s, which resulted in a pronounced policy and investment decisions throughout this period (Lipton 1977).

The essential manner in which agricultural productivity growth improves our wellbeing is by reducing the amount of time and resources needed to meet our subsistence needs. When people have enough left over in their budgets after satisfying their food requirements, they demand non-agricultural goods and this is what creates markets for industrial goods and services. What is responsible for creating such a surplus over their subsistence is also what is responsible for enabling a small part of the labour force to produce enough food for the whole society: *growth in agricultural productivity*. In few words no industrial progress, no "global village" and no scientific progress would be possible without increasing agricultural productivity. Probably some of the causes of persistent poverty in the rural areas can be identified in the limited opportunity structure that is the outcome of past social and economic development policies but, getting

more in deep, we have to reflect about the economy as a whole. In fact, going back to the concept of Agricultural productivity, we can recognize the role of productivity in determining agricultural wages and of course, rural salaries are strictly correlated with urban wages. If the land productivity grows, the salary of farmers will grow as well and the Industry has to raise salary in order to attract them and keep the workers in urbanized areas (as it happened in the big migration of the Industrial Revolution). This is one of the reasons why in a crisis period, investing in Agriculture (increase productivity and trade) will improve the whole economy: more wages, more consumption, and more investments, in few words: *growth*. An important role in the increase of productivity in the agricultural sector is the strengthening of trade that allows farmers to obtain a better price or a better buyer (in terms of continuity) for his/her products.

An example that clearly demonstrates how the improvement in productivity will make the whole economy of a country grow is China's trade liberalization. The economic liberalization in China started in 1979 with agricultural price liberalization (41% increase by 1980 in the prices at which the State procured agricultural produce). From 1978 through 1990, agricultural production doubled in China. Not only did the percentage of labour force in agriculture fall from 70% in 1979 to 60.1% in 1990 but also the absolute amount of labour employed in agriculture fell by 31%. This period of great transformation in China is reflected also by the improvements in the Industrial sector. The index of industrial production went from 100 in 1978 to 388.7 in 1990 (source: Statistical Yearbook 1990 & 2000). In 1980 primary goods formed roughly half the total exports, but by 1990 they had dropped to only about a quarter (25.6%) despite the fact that the primary exports had grown by almost two-thirds in absolute amount. The proportion of people below the poverty line shrank from 28% in 1978 to 9% in 1990 (Asian Development Bank, 2000). The Chinese experience illustrates how agricultural productivity growth impinges on poverty not only by directly conferring benefits on those engaged in agriculture but also by promoting industry. In India it was pretty the same history. The liberalization for agricultural goods started in 1991, the tariffs were cut with a subsequent reduction in domestic

prices. The effects of this liberalization were amazing for the industrial sector with the boom in the private investment in Agriculture in the early 90's. The number of people below the poverty line in rural (urban) India declined by 7% (7.9%), from 37.2% (32.6%) in 1993-94 to 30.2% (24.7%) in 1999-2000 (Deaton 2001).

The traditional conviction of Agriculture as a low-productivity sector that only passively contributed to development by providing food and employment has to be reconsidered. But the importance of agriculture was expected to decline as development advanced. Agricultural growth was still considered necessary for development and for a country's transformation from a traditional to a modern economy. Two key characteristics of agriculture during the early stages of development justified its role in early development stages. First, agriculture produces goods that directly satisfy basic human needs. Secondly, agricultural production combines human effort with natural resources, such as land and agro-ecological assets. Moreover, in the early stage, agriculture growth satisfies an internal demand for manufactured goods and services. The surplus generated by agricultural production generates more savings for investment in both agricultural and rural areas. The Indian example shows that lower food prices, stimulated by increase in productivity or by institutional policy, maintain low real wages (especially in the industrial sector) and push the investment and the *structural transformation*.

There is also a growing literature that goes beyond the linkage described above, beyond the purely economic relations between labour, savings and investment. Studies have shown a positive link between nutrition and economic growth. Inadequate and irregular access to food increases malnutrition, reduces labor productivity, and is equivalent to a disinvestment in Human capital (Bliss & Stern 1978; Strauss 1986; Williamson 1993; Fogel 1994; Wichman 1995). Using an extended Solow growth model, Nadav (1996), found consistent results with Fogel who concludes "bringing the ultra-poor into the labor force and raising the energy available for work by those in the labor force explains about 30% of the British growth in per capita income over the past two centuries". More recent studies assure that Agriculture affects economic growth through its potential to

stabilize domestic food production and enhance food security. Periodic food crises undermine both political and economic stability, thereby reducing the level and efficiency of investment (Timmer 1989, 1996; Alesina and Perotti 1993; Barro and Sala-i-Martin 1995; Dawe 1996). Although food imports may alleviate such crises temporarily, they are not a viable solution for ensuring long-term food security. Finally, the smallholder agriculture can stimulate the process of learning and innovation (Timmer 1988). This is also confirmed in the second chapter where the key role of smallholders for the development of Agricultural financial instruments is discussed (see the development of Microcredit institution in Bangladesh).

Some frictional difficulties represented by Agriculture are still unavoidable: the Agricultural sector is unstable to guarantee a continuous economic growth; the farmers and the workers of the sector are in general not technologically oriented and are not able to manage the trade in a global environment. This is the reason why agriculture is not emphasised in the main global target for the development. The role played by the institutions is crucial for an effective implementation of the sector within a development perspective (as detailed in the second chapter).

1.1.1 How does low Agricultural productivity delay industrialization: a model of structural transformation

"In a world without multiple dynamic equilibria, everyone follows a growth path towards a unique, long-run standard of living"(Jerry R. Skees, 2007).

In 2002 Douglas Gollin, Stephen Parente and Richard Rogerson presented a model of structural transformation based on the neoclassical growth model. It demonstrates that the different growth rate of industrialization in a society is strictly connected with the agricultural productivity that results to be one of the main engines for development. This model starts from the neoclassical growth model but it includes the agricultural sector. As mentioned before, agricultural employment is decreasing over time (inversely related to industrial/"urban"

employment) so that the model considers agricultural employment asymptotically tending to zero.

There is an infinitely-lived representative family endowed with a unit of time in each period. Period utility is defined over a non-agricultural good (*c*t) and an agricultural good (*a*t). To generate a structural transformation we assume a utility function of the Stone-Geary variety. For simplicity we adopt the following functional form:

$$(1)\quad U(c_t,\, a_t) = \begin{cases} \log(c_t) + \bar{a} & \text{if } a_t \geq \bar{a} \\ a_t & \text{if } a_t < \bar{a}. \end{cases}$$

Lifetime utility is given by:

$$(2)\qquad \sum_{t=0}^{\infty} \beta^t U(c_t,\, a_t).$$

It follows that once (per capita) output in the agricultural sector reaches $\bar{a}$, all remaining labour will flow out of agriculture regardless of the state of the non-agricultural sector. A more general treatment would allow for the state of the non-agricultural sector to impact the labour allocated to agriculture. This potentially important effect is explored by Gollin (2000). What we want in this section is to focus attention on how the state of the agricultural sector affects the labour available for the non-agricultural sector.

The non-agricultural sector produces output (*Y*mt) using capital (*K*mt) and labour (*N*mt) as inputs:

$$(3)\quad Y_{mt} = A_m[K_{mt}^{\theta}((1 + \gamma_m)^t N_{mt})^{1-\theta} + \alpha N_{mt}].$$

In equation (3), *A*m is a total-factor-productivity (TFP) parameter, and γm is the constant exogenous rate of technological change. This production function is standard except for the term αNmt. It is added to allow an economy with no physical capital to accumulate capital.

The parameter *A*m is assumed to be country-specific, being determined by policies and institutions that impact on activity in the non-agricultural sector. In contrast, the parameters γm and α are assumed to be identical across countries.

Much of the stock of useful knowledge owes its creation to research and development in the rich countries. Since poor countries are generally not in the business of creating ideas, the assumption of exogenous technological change is reasonable from their perspective.

Output from the manufacturing sector can be used for consumption or investment (Xmt), and the law of motion for the economy's stock of capital is

$$K_{mt+1} = (1 - \delta)K_{mt} + X_{mt}. \tag{4}$$

The agricultural sector produces output (Yat) using only labour (Nat). Though we abstract from land as an input, adding land to the production function would have no impact on our results.

There are two available technologies for producing the agricultural good: a traditional technology and a modern technology. The key difference is that the modern agricultural technology is subject to exogenous technological change. Using the traditional technology, one unit of time produces $\bar{a}$ units of the agricultural good. There is nothing particularly special about this value, and our results would not be much affected if it were either somewhat higher or lower than $\bar{a}$.

The modern technology is given by:

$$Y_{at} = A_a(1 + \gamma_a)^t N_{at}. \tag{5}$$

In equation (5), Aa is a TFP parameter that is assumed to be country-specific, and γa is the rate of exogenous technological change in the modern agricultural technology that is common across countries. Like the non-agricultural TFP parameter, the agricultural TFP parameter is affected by country policy and institutions. It is also affected by both climate and the quantity and quality of land per person. Technological innovations that are useful for a specific crop in a given climate may not be particularly relevant for other crops in other parts of the world, thus generating large differences in cross-country productivity levels that are independent of policy. Output from the agricultural sector can only be used for consumption, so the agriculture resource constraint is simply at≤Yat.

We focus on the competitive equilibrium for this economy, and in particular

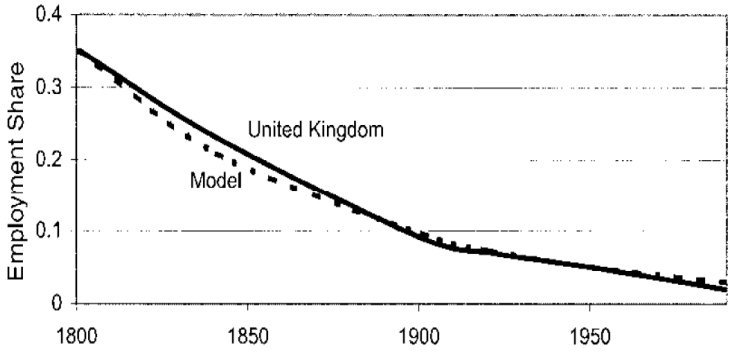
on how different values of the TFP parameters *A*a and *A*m affect the resulting dynamic allocations. Solving for the competitive equilibrium is straightforward and involves two steps. The first one determines the labor allocation across sectors in each period. Preferences imply that labor will be allocated entirely to the agricultural sector until $A\mathrm{a}(1+\gamma\mathrm{a})\hat{}\mathrm{t} \geq \bar{a}$. Once this equality is satisfied, agricultural production switches from the traditional technology to the modern technology, and labour flows out of agriculture at a rate of γa. Hence,

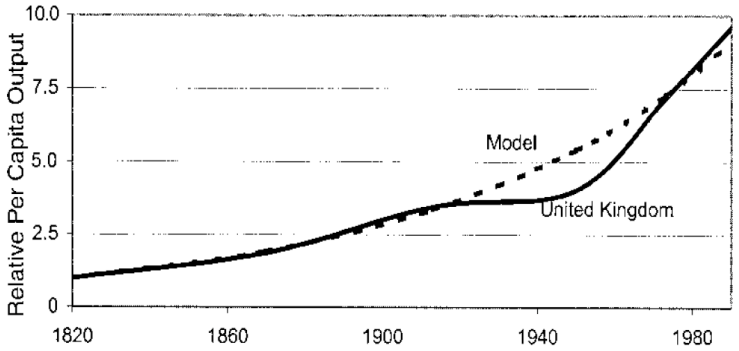
$$N_{at} = \min\left\{\frac{\bar{a}}{A_a(1+\gamma_a)^t},\ 1\right\}$$

$$N_{mt} = 1 - N_{at}.$$

Given the time path of labour allocations, the second step solves for the optimal path for investment. This is equivalent to solving the transitional dynamics of the neoclassical growth model with an exogenous time profile of labor input given by *N*mt. As technology in the agriculture sector increases at rate γa, *N*at eventually approaches 0, and *N*mt approaches 1. Asymptotically, the model is identical to the *standard one sector* neoclassical growth model.

An empirical analysis on the development of the United Kingdom over the last 250 years shows the results represented by the pictures below.





The empirical analysis shows some evidence. Analysing a cross-country database from 1960 to 1990 of 62 countries (data from FAOstat) it emerges that:

- there is a negative relationship between agricultural productivity and the share of employment in agriculture;
- there is a positive relationship between the growth in agricultural productivity and the movement of labour out of agriculture.

1.1.2 Agricultural demand led industrialization

The main implication is that countries that are growing in agriculture are able to experience a shift of workers from "rural areas" into the industrial sector. Considering that in poor countries the output per worker (productivity) is higher in the industrial sector, a shift of workers from agriculture determines an increasing in productivity showed also by the positive correlation with the GDP's variations. Work by Gollin (2002) showed the importance of agriculture in the early stages of development. Analysing the data of 62 developing countries for the period 1960-1990, the authors found that growth in agricultural productivity was quantitatively important in understanding growth in GDP per worker. Both cross-section and panel data analyses showed that countries experiencing increases in agricultural productivity were able to release labour from agriculture into other sectors of the economy. On average, the contribution of agricultural growth, non-agricultural growth, and sectorial shifts were 54, 17, and 29%, respectively.

We can conclude that agriculture productivity growth is an important source of economic growth in these countries.

Table 1: Elasticity Of Poverty Reduction With Respect To A 1 Percent Increase In Crop Yields

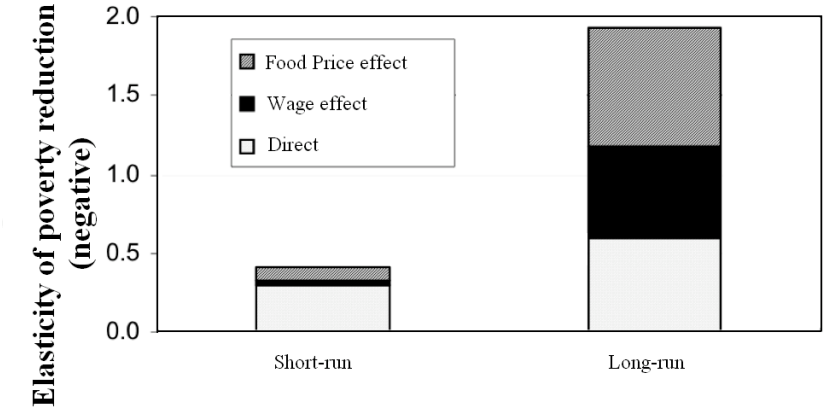
Region	Percent in poverty	Number in poverty (millions)	Elasticity of number of poor to yield changes
East Asia	15	278	0.48
South Asia	40	522	0.48
Africa	46	291	0.72
Latin America	16	78	0.10

Source: Thirtle et al. 2003

Because of these strong growth linkage effects, agricultural growth can lead wider economic growth in many countries, even open economies, during their early stages of industrialization, a strategy labelled "agricultural demand led industrialization (ADLI) (Adelman 1984). The ADLI strategy stressed the central role of increased agricultural productivity in achieving industrialization through expanding demand for goods produced by domestic industry.

There is a large econometric literature that uses cross-country or time-series data to estimate sectorial and sub-sectorial growth-poverty elasticities (Timmer 1997; Gallup 1998; Ravallion and Datt 1999). These studies generally find high elasticity estimates of poverty reduction with respect to agricultural productivity (showed by the figure below) especially in the early stages of development and relative to other sectors. For example, Thirtle in 2003, in a cross-country study, estimates that a 1 percent increase in agricultural yields reduces the number of poor people by 0.72 percent in Africa and by 0.48 percent in Asia. Datt and Ravallion (1998) estimated the elasticity of poverty reduction in India with respect to agricultural value added per hectare at 0.4 percent in the short run through direct impacts on farm incomes, and 1.9 percent in the long run, when the indirect effects of lower food prices and wage earnings are included.

Elasticity of poverty reduction with respect to yield growth in India



Source: Datt and Ravillion 1998

Agriculture provides other important contributions to nutrition, food security, and macroeconomic variables (Timmer 2002). At the micro level, inadequate and irregular access to food reduces labor productivity and decreases investment in human capital (Bliss and Stern 1978; Strauss 1986; Fogel 1994). Drawing on a sample of 97 countries, Nadav (1996) found that nutritional levels had a large and highly significant impact on economic growth. This finding is consistent with Fogel (1991), who reported that increased caloric intake reduced mortality and raised productivity amongst the working poor during the early stages of Western Europe's development. Overcoming hunger and malnutrition is now explicitly recognized in the first Millennium Development Goal.

Macroeconomic stability is especially sensitive to volatility in the agricultural sector (Timmer 2005; Perry et al. 2005). In turn, volatility in the agricultural sector tends to be relatively high because of climatic shocks that reduce domestic production and unstable world prices of agricultural commodities. The implication is that these shocks in the agricultural sector, especially food crises, are often the major source of macroeconomic instability in the early stages of development (Barro and Sala-i-Martin 1995; Dawe 1996; Timmer 1989, 1996). Agricultural growth combined with appropriate policies can mitigate the effects of these shocks, with benefits to the poorest and most vulnerable.

Partly because the agricultural transformation was so successful, the share

of agriculture in total GDP has declined in all regions. This trend is especially apparent in East and Southeast Asia, where the share of agricultural GDP is now less than 20 percent, and vibrant non-agricultural sectors have been established in most countries. Even after accounting for the linkage effects to agro-based manufacturing, it is clear that at least mathematically the contribution of agriculture to growth is now much less in these rapidly developing countries. Although in most of these countries the share of poverty in rural areas remains high (over 50 percent), the specific contributions of agricultural growth to the future reduction of poverty need to be revisited.

In the 1960s and 1970s governments, influenced by the dominant development paradigm of a passive role for agriculture, it was possible to bypass agricultural development through rapid industrialization (Timmer 1988). This strategy resulted in a pronounced urban bias in both public and private investments as well as in government economic and trade policies (Lipton 1977). Although these strategies failed in almost all countries that followed them, they left a legacy of public investment heavily biased to urban areas and "premature" urbanization. As one observer puts it, Africa has been "hollowed out" with the development of major urban centres on the coast, supported by migration from rural areas in the hinterland that have very low levels of infrastructure and other services (Wood 2002). The question now being asked is whether such biases can be reversed, given the "sunk cost" of past investments and the high investment requirements, especially in rural infrastructure. In African countries with low population densities, these costs are especially high. It is argued that this bias, combined with the new recognition of the role of trade discussed above, may lead in some cases to a lack of comparative advantage for agriculturally-led strategies in late-developing countries.

Focusing on what agriculture is able to give to the Countries in the so-called, "early stage of progress" the World Bank provided for a large number of case studies (Senegal, India, Romania, Burkina Faso, Bolivia, Vietnam El Salvador, Ghana, Brazil, Uganda, Bangladesh, Zambia, Indonesia) that seemed to show the same results according to Derek Byrlee and Xinshen Diao (2005). We

can identify five core contributions able to explain the role of agriculture in development in a pro-poor growth perspective consistent with the World Bank case studies:

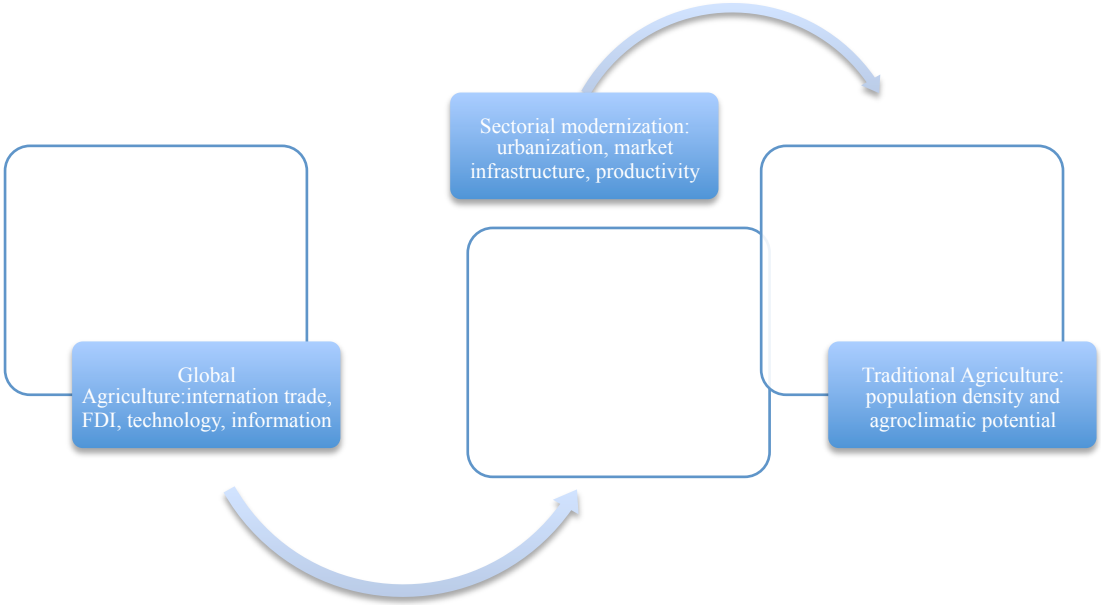
1. Agriculture has played an important and often a lead role in the early stages of pro-poor growth. Beyond its direct contribution to growth, a number of features specific to the sector enhance its contribution to pro- poor growth, including the concentration of the poor in the sector, the large size of its growth linkages to other sectors, and the positive externalities from assuring food security and reducing food prices.
2. The contribution of agriculture to growth naturally declines with structural transformation from an agricultural economy to an urban-based non-agricultural economy, although even well into middle-income status, agriculture continues to "pull beyond its weight," as measured by its contribution to GDP, because of its unique "externalities."
3. The role of the rural nonfarm economy increases as a source of growth, initially led by linkages to agricultural growth, but later tied increasingly to urban-industrial development, especially in areas of good infrastructure and high population density.
4. Even as the role of agriculture in growth declines with structural transformation, rural development continues to be critical to reducing poverty and inequality. Differences in natural resources and access to markets and assets often result in uneven growth and growing inequality within the sector, between small and large farms, and between regions. These differences increase rural-urban inequality and create poverty traps within rural areas, unless they are explicitly addressed through poverty-oriented rural development strategies.
5. The "agro-pessimists" have raised important questions about the future role of agriculture. These questions highlight how

agriculture's contribution to pro-poor growth varies enormously, not only at different stages of development for a given country but also across and within countries, because of initial conditions. More than ever, the design of public policy for enhancing the contribution of agriculture and rural development to pro-poor growth must be conditioned by local contexts.

1.1.3 Synthesis: Agriculture in development process

The role of Agricultural sector in the development process is evolving over time (Timmer 1988). While the role of Agriculture seems to be declining in the economic system in terms of both GDP and employment, we cannot forget the historical background that saw agriculture to be determinant in the development process (the industrial revolution was a direct consequence of the agricultural revolution).

The transfer of resources from agriculture to industry requires increases in farm's productivity. The so called "jump strategies" that extract resources from the field in the absence of increases in productivity are doomed to failure. The diminishing role of Agriculture in developed nations' GDP was the result of a structural transformation that during the years led this sector to low productivity due to the inefficient integration of Traditional Agriculture, sectorial modernization and Global Agriculture.



So, how does agriculture contribute to the economic growth? The agricultural sector is able to contribute to the national economy growth in four different modes (Johnston and Mellor, 1961):

1. in terms of products: food, raw materials.
2. In terms of resources (production factors): tank for the extraction of (surplus) labour and capital for use in non-agricultural sectors.
3. In terms of market: demand for agricultural products from non-agricultural sectors (consumer goods and investment).
4. In terms of exchange with foreign countries: improving the balance of payments (agricultural exports, agricultural production of substitutes for imports), source of much of the foreign currency for many countries (coffee for Central America, Chile for the fruit, sugar for Cuba), production of import substitute goods, extremely expensive (the bond exchange, opportunity cost).

However, many lagging areas have quite low growth potential because they have very limited suitability for agriculture and low population densities. In these areas there is likely to be a growth-poverty trade-off, since investment must be motivated by the objective of reducing poverty. In these poorer areas, a view much wider than agriculture is needed: in some areas a growing demand for

environmental services and agro-tourism provides an opportunity for diversification. Investment in the necessary infrastructure is often costly, however, because of remoteness and low population density, and even more so where the rural population is already in decline (for example, Brazil). In many areas, exit from agriculture is the only viable long-run strategy, facilitated by investment in education and skills. Migration is generally already high, leaving an aging and frequently female labour force, while safety nets and transfers are needed for the chronically poor.

1.2 THE POVERTY TRAP

Through the years, nations can accumulate wealth in different ways and this generates huge inequalities among people. What we can observe from the amazing growth rates of developing Country is an unequivocal tendency to *convergence.* The definition for *conditional convergence* states that if countries possess the same technological possibilities and population growth rates but differ in savings propensities and initial capital-labor ratio, then there should still be convergence to the *same* growth rate, but just not necessarily at the same capital-labour ratio. Using Social Accounting Matrices for 27 countries, Vogel (1994) examined the strength of the linkages between agriculture and rest of the economy at different development stages. At early stages of development, the backward linkages were very strong, while the forward linkages were much weaker. Rising household incomes represented almost 70 percent of the backward linkages. Along the development path, the forward input-output linkage strengthened due to the greater integration of the sector into the broader economy.

In the last year (from January 1998 to November 2010) Mexico GDP Value grew at 3.22% India at 8.80%, China at 9.60%, while United States grew at 2% and Europe has grown with an average of 1% (www.tradingeconomics.com). This is due to the fact that those developing Countries adopted different policies for the private savings, investment and at the macroeconomic level, but it can confirm that they are converging (maybe in 20 years) to the more industrialized Countries.

This kind of process can be stopped by the risk exposure of the Developing Countries. In particular the risk of shocks can shift one Country from a growing path to another, it adds noises to conditional convergence; for example risk leaves lenders vulnerable to default by borrowers; this limits access to credit especially for poor people who lack collateral to guarantee loan repayment. The combination of conservative portfolio choice induced by risk aversion, and credit market exclusion because risk exposure dampens lenders' willingness to lend,, help perpetuate poverty. This downward spiral is also generated by the measures taken by the people from poor countries: they adopt low-risk strategy (low investment) and the obvious result is a low - return with difficulties in the asset accumulation and consequently difficulties in climbing out of poverty. We can define *poverty trap* as any self-reinforcing mechanism that causes poverty to persist.

Institutions represent one of the main catalysts of the poverty reduction. There's a part of the literature that considers Institution as an exogenous factor that is confronted with the predetermined condition. There are others who consider the Institution as an endogenous factor. Actually institutions have the possibility to create conditions for going beyond the poverty threshold interacting with market failures and leading to the perpetuation of an inefficient status quo. The inefficiency of Institution as a market failure is confirmed by the key role of institutions, in the technology upgrading process. The failure in productivity improvement is seen as a falsification of the "neoclassical factors" that would drive a Country through growth (as in the Solow model), creating a discrepancy that drew people into inefficient equilibriums easily connected with poverty traps. The market inefficiency in particular, makes the adoption of new technologies and the improvements in productivity in general, difficult.

One of the main difficulties of inefficient equilibriums is that it has the key characteristic of reinforcing by itself: for example decreasing the productivity can mean also a decline in the educational system. The skilled people into an unskilled population could be seen as unskilled too by the firms (that decrease the demand for skilled people), and this generates a terrible disincentive for education, which is an unsustainable long-run policy in relation to growth.

One main deviation from the competitive neoclassical benchmark that is deeply discussed in this work is the failure in credit and insurance markets that is commonly identified as primary causal factor. Markets for loans and insurance suffer more acutely from imperfections associated with a lack of complete and symmetric information, and with all the problems inherent in anonymous trading over time. Borrowers may default or try not to pay back loans. The insured may become lax in protecting their own possessions. One result of these difficulties is that lenders usually require collateral from their borrowers. Collateral is one thing that the poor always lack. As a result, the poor are credit constrained. This can lead to an inefficient outcome that is self-reinforcing: collateral is needed to borrow funds. Funds are needed to take advantage of economic opportunities particularly those involving fixed costs. The ability to take advantage of opportunities determines income; and through income the individual's wealth, and hence his/her ability to provide collateral are determined. In poor-lower countries, in synthesis, access to credit is limited due to poor contract enforcement, asymmetric information, high transaction costs (poor societies are often highly populated and insurance requires personal information for every policy holder) and high exposure to covariate risk. A significant contribution to the persistency of poverty traps is the financial market failures that can be seen as another institution lack that feeds poverty directly and indirectly.

1.2.1 The theory

When we think about the whole economy we use to consider the World as a sea of opportunities useful to provide for productive effort, savings and wealth. This is not true for everybody. Income inequality has increased a lot in the last Century; the richest 10% receive over half of world income today, while the poorest 50% receive less than 10% of the World income. And the question is still: "how is it possible"?

The literature suggests three main causes for the persistence of poverty. The first is the so-called *achievement model of income determination* and is built around the Horatio Alger's vision. This theory suggests that the mechanism that

determines an individual's socio-economic prospects is under his/her control. "Initial poverty typically does not entrap; only those who don't make the effort remain in its clutches. By similar reasoning, those who have attained affluence must work to keep it; inertia alone will not perpetuate wealth" (Samuel Bowles, 2006). This theory, however, cannot be useful to explain the whole economic environment. The starting conditions cannot be excluded from this analysis, so we have to implement the Alger's theory with a second theory, the *dysfunctional institution*. The social responsibility of institution is determinant for poor countries because political forces united with social interactions may entrap people into poverty. The investments in school, education, infrastructures, drove a country in a growing path conscious on what property rights are and determined to shift the low returns investment (that usually characterize poor countries) into a more risky path, long-run oriented. The third theory is called *neighbourhood effects*. This term is a metaphor for an array of influences from one's membership in various groups, which may be fixed or may be determined by the economy. For example the corruption of a governor brings all the inhabitants to be corrupted and this generates a spiral very difficult to overcome. The decision of individuals can affect a group's decision and this is also reflected if we think about a country as an individual. For example virtuous growth of countries such as India or China drags all the countries around in that area (Bangladesh, Korea and so on); the contrary is right too, just think about Africa. So, the consequence of these distortions may be low-level equilibrium traps.

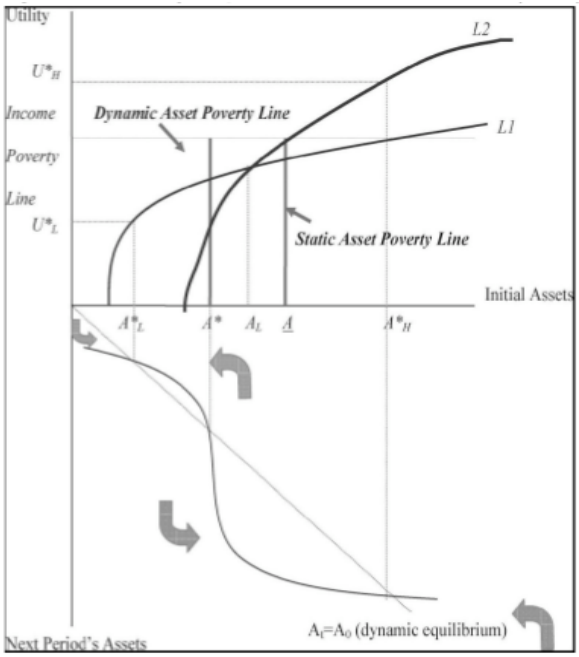
Costas Azariadis introduces one more model of poverty trap: *the Threshold Model of Poverty*. "An initially high level of poverty and low life expectancy may change the way an economy works because it may make the return to incremental changes in capital small or even negative" (Steve Bowles, 2006). The theory is based on the concept that poor economies cannot produce the levels of human and physical capital to exceed the threshold necessary for achieving a certain type of economic organization. The poverty trap has a sort of "macroeconomic" background that involves increasing return to scale to investments in health, human or physical capital due to incomplete markets sustained by a weak concept

of the “government for people”. Azariadis assesses that an important cause of this threshold are the *capital market imperfections*, which represent one of the main contents of this paper. The inability to collect wealth takes origin from the inability to access to the credit market. Poor people are often unable to finance themselves and this drove them outside from the productive sector of the economy, and let them adopt a simple persistence policy more oriented to survive rather than live.

1.2.2 How poverty traps develop

Many different models have been designed to understand and explain why some individuals are ensnared in a low level of economic development, while others seem to enjoy greater levels of welfare. Some underline the importance of institutions, kin systems and history in the development of multiple equilibriums, while others focus on the lack of insurance and the nature of risks individuals face.

In order to give a picture of the mechanism that circumscribes people into poverty, we will use a model developed by Carter and Barrett (2006) who tested their model in the agrarian society with success.



A household chooses to allocate its productive wealth to one of two distinct strategies. A household with a low level of assets AL would choose to use its assets within a strategy L1 yielding to a low level of well-being UL, while a wealthier household would choose to use its assets AH in a higher-earning strategy L2 leading to a higher level of welfare UH. Both asset allocations lead to locally stable equilibria with non-increasing marginal returns. A high-return strategy has higher returns, while a low-return strategy has lower ones, which creates non-convexities in asset accumulation. Setting a static poverty line at A emphasises the point that a household choosing to allocate its assets to a strategy L1 is caught in poverty. Nevertheless, a level of assets AS exists from which a household rationally switches from one strategy to the other. To reach this level of assets, however, a poor household must have asset holdings above the dynamic asset poverty line A*. Below the A* threshold, a household has less investible surplus and depressed marginal incentives to save; above this threshold, a household rationally starts accumulating assets through an autarkic accumulation strategy (Carter and Barrett, 2006). Through asset accumulation, a household would reach a level of asset from which it switches from a low return strategy to a high return one. Finding out this threshold requires an assessment of the asset

accumulation process which links the current level of assets to the future level. Plotting future asset holdings against current ones is expected to give an S-shaped curve, where the A* threshold would simply be the unstable equilibrium where the asset accumulation bifurcates (Carter and Barrett, 2006).

Therefore an asset accumulation process is what allows convergence to the high stable equilibrium and the improvement in welfare (Barrett, 2007). But the poorer households cannot accumulate assets, and Barrett and his co-writers point out different reasons for this (Barrett *et al*., 2006). They explain that poorer households cannot accumulate assets due to their portfolio choices. They would adopt a defensive portfolio strategy, preferring low-yield, low-risk activities rather than higher-yield, higher-risk activities. As returns on assets are positively correlated to their initial wealth, the rate of returns with this portfolio strategy is even less than the one the richer agents have with higher-yield higher-risk strategy (Zimmerman and Carter, 2003; Carter and Barrett, 2006). Another point they use in accounting for non-asset accumulation by the poor is the subsistence constraints they have to face. Poorer households have such low levels of consumption that they cannot reduce them further in order to increase their savings and start an asset accumulation process. A third justification deals with their lack of liquid savings and credit, which does not allow them to buy more assets and start an asset accumulation (Barrett *et al*., 2006). Both the weak development of banking systems for the poor and their lack of counterpart impede them in obtaining credit. This lack of credit makes them reliant on what they actually earn and they have to accumulate assets. Their asset accumulation is impeded if their earnings are not high enough to increase their asset holdings. Here analysis is centred on strategies and assets instead of on activities and income or consumption expenditures, because assets are expected to better reflect the heterogeneity of the livelihoods of poor people. Further, assets are the source of future earnings, so their accumulation is what allows individuals to reach higher levels of wellbeing (Coomes *et al*., 2004; Naschold, 2005).

Barett studies are focused on Sub-Saharan Africa especially in the-post apartheid era. In that period it is easy to recognize the two different strategies

leading to different levels of development, and the outcome was exactly the S-shape curve described above.

Moreover, Barrett and Carter complete their theory analysing the dynamic equilibriums that, through the years, make the asset accumulation a difficulty for poor Countries. They recognize in the *imperfect information* one of the main limits of the neoclassical growth model, because the creation of knowledge is an effective factor that drives a Country in a long-run growth perspective. The path-dependence nature of information driving the poor to create norms and institutions reflecting their available information is a crucial element in explaining why poorer individuals cannot implement higher strategies. Path dependence of the institutions impedes them from evolving according to emerging information, even if they may be a rational response to an individual's situation.

In conclusion, in order to stimulate economic growth and push Countries outside the threshold of poverty, it is necessary to encourage asset accumulation that generates better standards of living and creates the condition for a long-run investment plan.

1.2.3 The role of international Trade

The above reasoning presumes that the developing country is a closed economy. But suppose that in a closed economy, the domestic cost of producing textiles is lower than its international price, and the country now opens up to trade. It will clearly export the industrial good, and from the foreign exchange proceeds of these exports, it will finance the import of at least some of the agricultural goods demanded. The export market available for Textiles and the attendant imports of cheaper Grain allows the industrial sector to absorb more labour than would have been possible in a closed economy. By raising the land-to-labour ratio, industrial exports increase the wage rate of workers. Embarking on trade, in this case, would generate a once-of benefit to workers of this country. Further, if industrial technological progress in the developing country is proceeding at a faster rate than in its trading partners, the country will capture an ever-increasing share of the international textile market. By continuously

absorbing labour from the agricultural sector, this will bestow a continuous benefit on the poor. First Taiwan and South Korea and later China have followed the strategy of aggressively expanding their industrial exports to the rest of the world and posting very high growth rates, earning the title 'The East Asian Miracle'. A rapid increase in their manufactured exports has led to a corresponding decline in agricultural employment.

Those that recognized the potential role of trade emphasized that it was limited by the large size of Asian countries in relation to world markets, especially for the major staple, rice, which was very thinly traded (rice trade was then less than 5 percent of Asian consumption). In large part to avoid macroeconomic and political instability from food price shocks (see above), most countries pursued food self-sufficiency policies. The opening of economies to international markets has caused the role of trade to be re-examined. For example, many of the least developed countries are rich in mineral and oil resources, and it may be possible for these countries to depend on food imports, perhaps eliminating the need to modernize their agricultural sectors. Countries may even be able to embark directly on labour-intensive manufacturing of exports, using the proceeds to import food. This argument is reinforced by several considerations:

- Prices of agricultural commodity prices, including cereals, the major trade food product, continue their long-term decline, which has been aggravated by high subsidies on exports and barriers to imports of many agricultural products relative to industrial products, especially in rich countries.
- Many of the least developed countries that have yet to undergo an agricultural transformation are perceived to have a harsh natural environment, which may reduce their comparative advantage in food production.
- The much more robust global markets for food, including rice, have sharply reduced the national food security risks of relying on imported food.

Even where agriculture retains a comparative advantage, the liberalization of trade

raises questions about the pro-poor effects of agricultural productivity gains through lower food prices, since at least for traded food products in liberalized markets, prices will tend to be determined more by world prices than by domestic productivity.

The reform programs of the past decade or so have undoubtedly removed much of the urban bias stemming from macroeconomic policy. The overall production response was modest and much lower in agriculture than in the industrial sectors because economic reform in the agricultural sector has seriously lagged reforms in the economy as a whole. In addition, the enabling environment for the private sector to replace government and parastatal roles has not been in place. Producers of export crops have responded fastest and benefited most from trade and market reforms. Small-scale or subsistence-oriented farmers in remote or marginal areas may have been relatively unaffected or, in some cases, they may have lost access to subsidies and price supports. In these situations rural income inequality often worsened, because farmers in more favoured areas with better access to markets gained most.

In synthesis agricultural growth itself goes hand in hand with the expansion of markets, infrastructure, and producer services so that land and labour can be shifted continuously toward their most profitable use. Given that a vast majority of the poor in the world live on agriculture in developing countries, the process of agricultural growth also helps tap the enormous, but latent, entrepreneurial pool in these countries.

As new productive activities become available, people find niches for their intrinsic talents and generate new ideas to sustain the process. Improving the productivity of agriculture is the single most important step a developing country can take to reduce poverty.

2.

RISK IN AGRICULTURE: ANALYSIS AND MANAGEMENT

Approximately 1 billion people live on less than $1 per day. Three-quarters of those live in rural areas (Chen and Ravallion 2007) and over one-half depend on agriculture or agricultural labour as their primary livelihood strategy (International Fund for Agricultural Development 2001).

Risk concerns the deviation of one or more results of one or more future events from their expected value. Technically, the value of those results may be positive or negative. However, general usage tends to focus only on potential harm that may arise from a future event, which may accrue either from incurring a cost ("downside risk") or by failing to attain some benefit, the so called "upside risk" (Wikipedia definition of "Risk").

Agriculture is an inherently risky economic activity. A large array of uncontrollable elements can affect output production and prices, resulting in highly variable economic returns to farm households. In developing countries, farmers also lack access to both modern instruments of risk management—such as agricultural insurance, futures contracts, or guarantee funds—and ex post emergency government assistance. Such farmers rely on different "traditional" coping strategies and risk-mitigation techniques, but most of these are inefficient. Formal and semiformal arrangements—such as contract farming, joint-liability lending, and value-chain integration—have arisen in recent decades, but they too are limited and can be very context sensitive. One consequence of inadequate overall financial risk management is that farmers in general face constrained

access to formal finance. The smaller the net worth of the farm household, the worse the degree of exclusion.

In Agriculture the word risk is easily connected with the possibility of a bad outcome and this sort of uncertainty was a dominant part in the farmers decisions. Risk in Agriculture can be seen also as a disincentive in working for this sector because it reduces the overall productivity and makes the choice (for a worker) between rural areas and urban areas more pendent for the second one.

Analyzing the many components of Agricultural risk we can recognize five different main kind of risk:

- **Production Risk:** is the random variability inherent in a farm's production process. Weather, diseases, and pest infestations lead to production risk in crop and livestock activities. Fire, wind, theft, and other casualties are also sources of production risk. So the main component of this kind of risk is the uncertainty related to the *weather* that is seen as the main responsible for crop yield. The other component of production risk is the *technological risk* which represent the potential that current decisions may be offset by dramatic technological improvements in the future. For example the risk that durable assets can become obsolete in the future.
- **Market** or **Price Risk:** is associated with the purchase of inputs as well as the sale of commodities. Fluctuations in input and output prices cause income gains or losses. These fluctuations can occur within a marketing year as well as between years. Net worth may also be affected if prices of inputs such as land and machinery change. Availability of inputs is also a risk. And, in the longer run, the variability of prices, interest rates, and relative prices are risk factors that influence many decisions.
- **Financial Risk:** is the risk related to the financial health of the farm. Market imperfections and asymmetry of information make the market for credit, for the Agricultural sector, really difficult to

penetrate. This generates liquidity problems for the farmers that are pushed to choose low risk/low revenue strategy. Many times this is connected with the cash flow difficulties of the farmers that are often unable to meet their short and long - term liabilities.

- **Institutional Risk:** Institutional risk results from uncertainties surrounding government actions. Tax laws, regulations for chemical use, rules for animal waste disposal, and the level of price or income support payments are examples of government decisions that can have a major impact on the farm business.
- **Human or personal risk:** refers to factors such as problems with human health or personal relationships that can affect the farm business. Accidents, illness, death, and divorce are examples of personal crises that can threaten a farm business and can disrupt performances.

Other risks concerning the trade are related to the agricultural sector. For example we have to consider too the risks connected with a trade activity related to the global market. In particular a huge flow of income, especially for farmers is represented by the domestic demand that is not predictable and it is influenced by policies determined by institutional organization. The other component of the demand is the global one that is less predictable then the domestic one and it's interconnected with other countries offer. These factors and their predictability, determines the market power of suppliers and buyers that, as main actors, plays on fleeting equilibrium and give more uncertainty to the Agricultural sector.

In my analysis, due to time and argument constraints, I get more in deep in the analysis of the first three type of risk listed above. The weather risk (as the main component for production risk, price risk and financial risk management represent the key solution for the Agricultural uncertainty. Differently from the Human and Institutional Risk, the three analyzed types of risk can be managed directly from the farmer.

During the years, some solutions were provided going through the financial market for derivative (to reduce weather risk), to new institute for credit (as

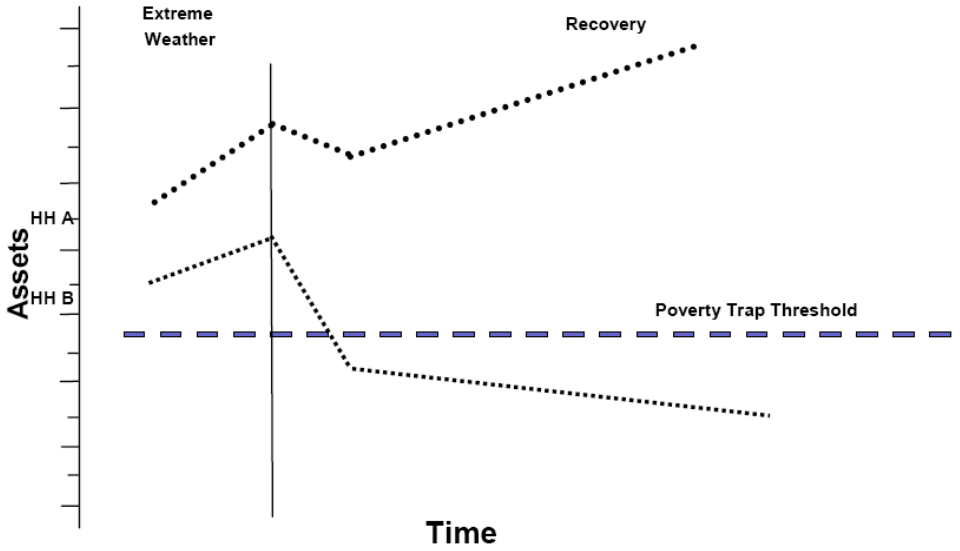
Microcredit), to social net and adaptive strategy. These possible management strategies drove the Agricultural sector into a delimited growing path with an upward sloping perspective of the risk.

2.1 WEATHER RISK

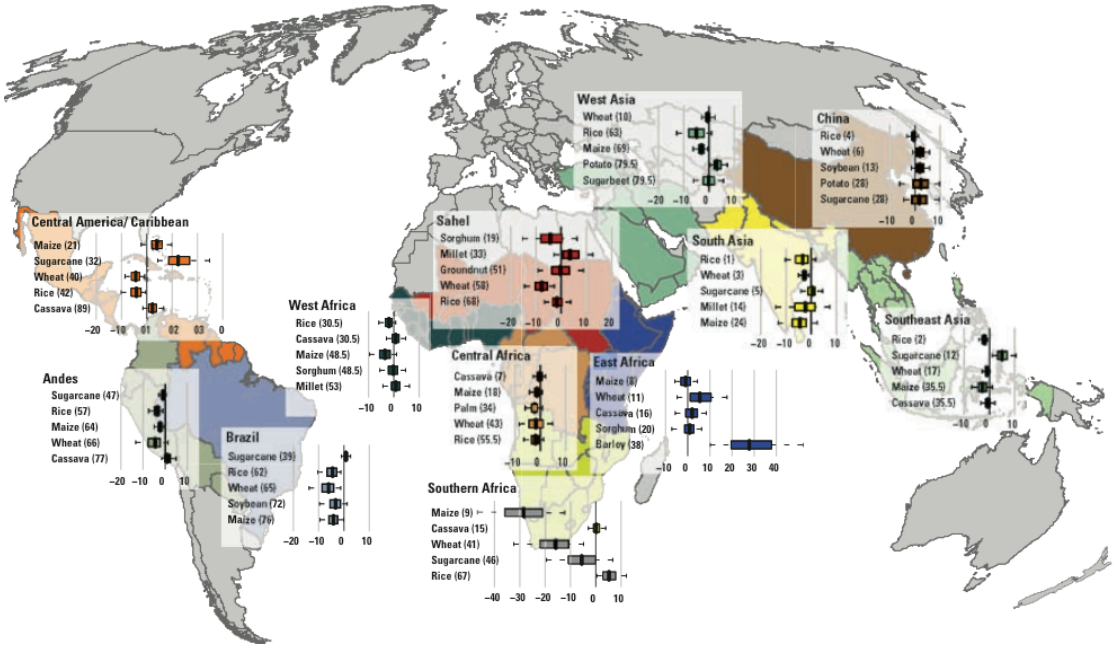
Production or yield risk occurs because agricultural production is affected by many unpredictable events often related to **weather**, including excessive or insufficient rainfall (as the Chapter 3 explains), extreme temperatures, hail, insects, and diseases. The "other leg" that improves the yield instability is **technology** that plays a key role in production risk in farming. The rapid introduction of new crop varieties and production techniques often offers the potential for improved efficiency, but may at times yield poor results, particularly in the short term. In contrast, the threat of obsolescence exists with certain practices (for example, using machinery for which parts are no longer available), which creates another, and different, kind of risk. Minimizing this type of risk requires a long research in the historical data focused on *Yield variability* and its correlation with the losses. The use of weather derivatives and the improvement in the marketing help the farmers to obtain a more predictable income and avoid some *"business risk"*. The predictability of the income is a key value for the farmer due to the connection with the lending. Lenders usually apply an higher tax to the farmers and this generate a problem of liquidity that depresses growth and introduce all the agricultural sector into a spiral of chronic poverty and inability to tackle the global market (but this argument will be considered in the "financial risk" section). Let's focus now on the uncontrollable events that affect agriculture and in particular weather.

Recent evidence and predictions indicate that climate changes are accelerating. The changes in the mean and the variance of rainfall and temperature, brings the farmers in the uncertainty of his outcome. Moreover climate events can result irreversible and generate huge losses of capital following

the increasing market fluctuations (increasing in Oil and food price volatility). This will cause **poverty traps**. Many business, including agriculture, insurance, energy, and tourism are strongly affected by the weather risk and the financial markets have devised a new class of instruments in order to reduce the risk exposure to the weather.



Below there's a map of Projected impacts of climate change by 2030 for 5 major crop in each region. And, as we can see from the map below the negative effects of climate change on agriculture are likely to be greatest in Africa, South and Central Asia and the Mediterranean Basin. Latin America includes region that are more vulnerable to climate changes as the north - eastern Brazil and semi-arid areas in Central America and the Andes.



Long –term risks to agriculture from climate change are likely to involve increased climate variability and prevalence of extreme events combined with an acceleration of warming, glacier retreat and sea-level rise, regional changes in mean precipitation, and increased risks of land degradation and crop loss from agricultural pests.

For example the table below shows the recent climate events and their impact on agriculture in Sub-Saharan Africa.

Country or Region	Period	Climatic Event	Impact
Kenya	1997–2000	Severe flooding followed by drought	10% loss of national GDP (Grey and Sadoff 2006)
Malawi	1991–1992	Drought	60% maize yield loss (Clay et al. 2003)
	2000–2001	Floods	30% maize yield loss
Zimbabwe and Zambia	1992	Drought	8%–9% loss of GDP from agriculture (Benson and Clay 1998)
Mozambique	2000	Floods	2 million people affected
	2002–2006	Drough	800,000 people affected (Hellmuth et al. 2007)

Between the sectors that may benefit from Weather markets, agriculture is for sure the one that offers the most significant growth potential. It's sufficient to think about the fact that agriculture and agribusiness are the prime sources of income in developing country: in 1999, 69% of the population in low-income

countries live in rural areas (account for the 27% of GDP), 50% in middle-income countries (10% of the GDP) and 23% in high-income countries (only 2% of GDP) according to the World Bank (2001). The natural disaster between 1988 and 1997 caused a damage valued at more than US$60 Billion a year. The main damages took place in Developing Countries, about 94% of the World 568 major disaster between 1990 and 1998 (freeman 1999). The reaction to this took place in the Developing County's financial markets. For example in India the agricultural sector accounts for 25% (more or less) of the GDP and involve approximately the 65% of the population. It is estimated that rainfall variability accounts for more than 50% of the variability in crop yield (Barnett and Mahul 2007). Due to this huge impact of weather variations in 2003 BASIX (a livelihood promotion institution established in 1996) formed a partnership with ICICI Lombard General Insurance Company to pilot the sale of rainfall index insurance contracts to small farmers in the Andhra Pradesh State of India. The project received technical assistance from the Commodity Risk Management Group (CRMG) of the World Bank and was the first weather insurance initiative launched in India and the first farmer-level weather-indexed insurance offered in the developing world. During the 2005 monsoon season, BASIX sold 7,685 policies to 6,703 customers in 6 States (World Bank Report 2007, Orsnaran Pomme Manuamorn). As the Indian example shows, it is necessary to build a more stable agricultural sector through an ex-ante and ex-post weather risk management including more investment in infrastructure and technology, in order to give more "growth chances" to farmers. Some successful policy for managing weather risks and improves hedging for production risk as a whole can be divided in:

1. Social Protection
2. Microfinance
3. Weather based index insurance
4. Financial instruments protecting the risk associated with weather.

2.1.1 Social Protection

The Institute of Development Studies (IDS) have developed the "forward-

looking" concept of "*adaptive social protection*" which results to be a right mix of Social policies that contributes to climate risk reduction and push economic growth. The aim of the "social nets/intervention" strategy is basically to smooth consumption and support income in order to develop a more suitable welfare economy and achieve growth through an improvement in domestic, international and regional investment. The role of social protection consists in social service provisions as transfers (cash and safety nets for climate shocks), pension schemes, public work programmes and promotion of workers right (to combat social and political vulnerability). The intervention in the financial area includes the building with the effective implementation of funds (as the Adaptive found established by the Kyoto Protocol) and the upgrade of the *access to credit* that affects especially the agricultural market. One of the most successful example of social programme that implements all the policy listed above is the UK Climate Impacts Programme (UKCIP). Established in 1997 UKCIP has been working with the public, private and voluntary sectors to assess how a changing climate will affect: construction, working practices, demand for goods and services, biodiversity, service delivery and health.

The primary role of government should be to address market and regulatory imperfections in order to encourage participation by the private insurance sector. Government should focus mainly on developing risk market infrastructure, such as a strong and enabling regulatory framework, public awareness campaigns, data collection and management, and capacity building. Some countries have developed a regulatory framework for agricultural insurance, usually under their non–life insurance regulation. Public regulatory activities are well developed in only a few countries, however, such as Mexico (as the Agroasemex case), Spain and Brazil (Bunge and Embrapa).

2.1.2 Microfinance and Bangladesh experience

Credit market imperfections can create inefficiencies in production, consumption and investment and this affect most of all the poor rural areas. Microfinance is based on social intermediation between poor people and their

savings with the aim of creating self-employment and reduce poverty.

The 'Task Force on Supportive Policy and Regulatory Framework for Micro-Finance' constituted by NABARD (National Bank for Agriculture & Rural Development) defines "micro-finance as the provision of thrift, saving, credit and financial services and products of very small amounts to the poor in rural, semi-urban and urban areas for enabling them to raise their income levels and improve their standard of living".

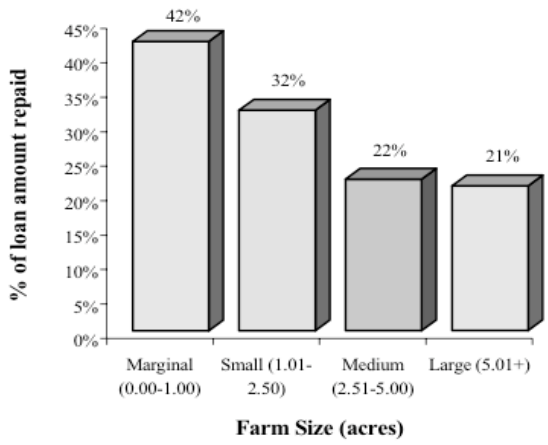
When we think about the agricultural market we have to consider the contribution of small/marginal farmers as primary. Let's have a look to the table below that shows the distribution of landholdings.

Bangladesh	1960	1977	1983-84	1996
0.02 – 1.01 ha	51.62	49.73	69.96	79.28
1.01 – 3.03 ha	44.89	40.84	24.90	18.28
3.04 – above	3.49	9.43	5.14	2.44
Average size (ha)	1.43	1.42	0.92	0.69

Source: Bangladesh Bureau of Statistics: Analytical Report, Census of Agriculture – 1996 (Volume-3).

In Bangladesh in 1996 they constituted 79.28% of total holdings, in the republic of Korea they was 57.6% in 1995 and in Indonesia the 70.8% in 1993. Moreover the small/marginal farmers contribute strongly to the economic growth and development of the sector: They're early adopters of new technologies (Asaduzzaman, 1979; BBS, 1986; Herdt and Garcia, 1982; and Hossain, 1989), more productive (Hossain, 1977 and 1989; and Mandal, 1980), more efficient (Lau and Yotopoulous, 1971 and 1972) and invest more in agriculture (Hossain, 1989 and Rahman, 1980). More income for small farmers means an increasing demand for investment and consumption goods in both the agricultural and non-agricultural sectors. The point is that access to institutional sources of credit is limited for small and marginal farmers. About 36% of small farmers borrowed money during the survey year 1987, but only slightly over 11% obtained credit from banks, the major institutional sources of credit (BBS, 1989). And have been worse then this in the last 20 years (it is one of the primarily difficulties of the

Cooperative took in consideration in the Chapter 3). In order to understand better how the Microcredit programs works let's focus on the Bangladesh example which is the first and one of the most successful according to the World Bank. The Bangladeshi experience until now shown the effective appliance for the microcredit mechanism: At least 7 million poor farmers in Bangladesh have access to microcredit for an mount of Tk 5000 crore distributed each year with a repayment close to 100%. This demonstrates that microcredit can be suitable, people can cover loan (with a 8% fixed rate) with their own business. Let's see how does it work. Crop production is much riskier than rural nonfarm production, however, both commercial and agricultural development banks allocate more of their loan portfolios to rural nonfarm than to crop production. Agriculture (mainly crop activity) accounted for about 20% of agricultural development bank loans, 18% of commercial bank loans, 9% of consumption loans, and 24% of informal loans and 32% of microcredit loans (considering livestock in the agricultural sector). *Farmers owning less than 2.5 acres of land were likely to be more liquidity-constrained than large farmers*. Production function analysis shows that the marginal product of capital was Tk 0.41 for marginal farmers (those owning less than half an acre of land), Tk 0.35 for small and medium-size farmers (those owning 0.52.5 acres of land), and Tk 0.07 for large farmers (those owning more than 2.5 acres of land).



Source: Bashar, Abul; K.Q. Elahi and Alam, F: An Investigation into the 100 Crore Special Agricultural Credit Programme in some Selected Areas of Mymensingh District: Bureau of Economic Research and Training, BAU, Mymensingh, 1981.

The table above show that small and medium- size farmers are more credit-constrained than large farmers. In contrast, the marginal product of labour was Tk 18 for marginal farmers, Tk 27 for small and medium-size farmers, and Tk 53 for large farmers. Small and medium-size farmers thus face higher prices for capital but lower prices for labour than large farmers, indicating that farming is more *capital-intensive* for large farmers than for small and medium-size farmers. But the success of Microcredit institution is strictly correlated with its weakness: not all rural poor are able to benefit from microcredit programs, utilizing loans in productive activities requires skills that most people don't have. Microcredit also suffers from its limited ability to increase the size of the loan per borrower because of the limited capacity of borrowers to absorb loans. Most of the programs set in Bangladesh, have developed a single-product credit delivery mechanism: group-based lending with a weekly repayment schedule. It helps to reach a large number of small producers. It is estimated that the 5% of microcredit users were able to push their families out of the poverty. This can be seen as a good result in a forward-looking perspective but it underlines the fact that credit availability is not the only cause of poverty.

2.1.3 Weather Based Index Insurance

Insurance markets are underdeveloped and very often non-existent in rural area (especially in lower income countries due to poor contract enforcement, asymmetric information, high transaction costs and high exposure to spatially covariate risk (Skees and Barnett 2006).

Weather index insurance pays indemnities based on realizations of a weather index that is highly correlated with the actual losses. Weather derivative are written on weather indices, build around an historical analysis on weather data, ideally highly correlated with local yields. Some weather indices can be *Daily average temperature* (DAT), *Heating degree Day* (HDD), *Cooling degree day* (CDD) or *rainfall index*. The most common are HDD and CDD that using 65°F as the baseline, are determined by subtracting the day's average temperature

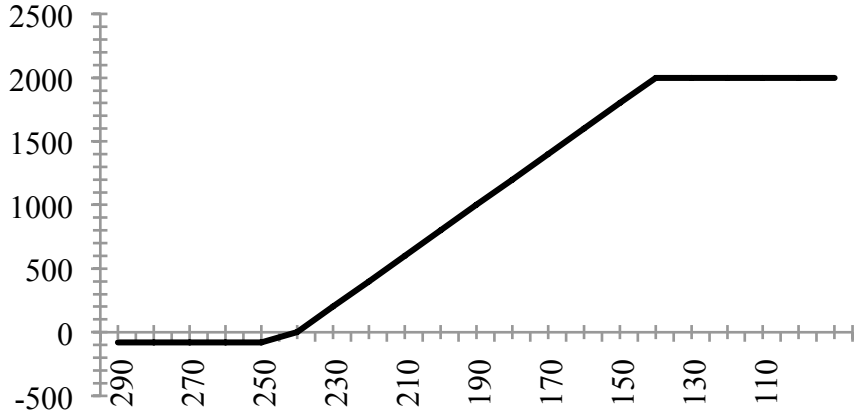
from 65°F for HDD, and subtracting 65°F from the day's average temperature for CDD values. . In this paper we will consider more the rainfall index because strictly connected with the practical case in the Chapter 3. The weather index requires:

i. Measure of a specific weather variable
ii. A specific weather station
iii. A defined period of time
iv. A threshold and a limit to define the range in which the payment will be made

Let's see how weather insurance work in a generic example (similar to weather insurance in the specific case in Chapter 3) in which the policyholders purchase a €2,000 of insurance protection and €80 of contract cost.

WEATHER VARIABLE	Against **insufficient RAINFALL**
DEFINED PERIOD OF TIME	7 month
THRESHOLD	250 millimetres
LIMIT	150 millimetres

If the rainfall will be less than 250 millimetres the policyholder will receive an indemnity equal to €20 for each millimetre less then 250 up to a maximum of €2000 for rainfall realizations of 150 millimetres or less. Above 250 millimetres the policyholder will pay just the cost of the contract. The payout is similar to a collar options and it is described by the graph below.



This type of weather insurance contract design was pioneered by Indian Insurance Company ICICI Lombard and sold to farmers for the first time in 2004. This kind of contract resulted popular and was chosen as the prototype structure for the first Malawi pilot and the subsequent African pilots (Tanzania, Kenya and Congo).

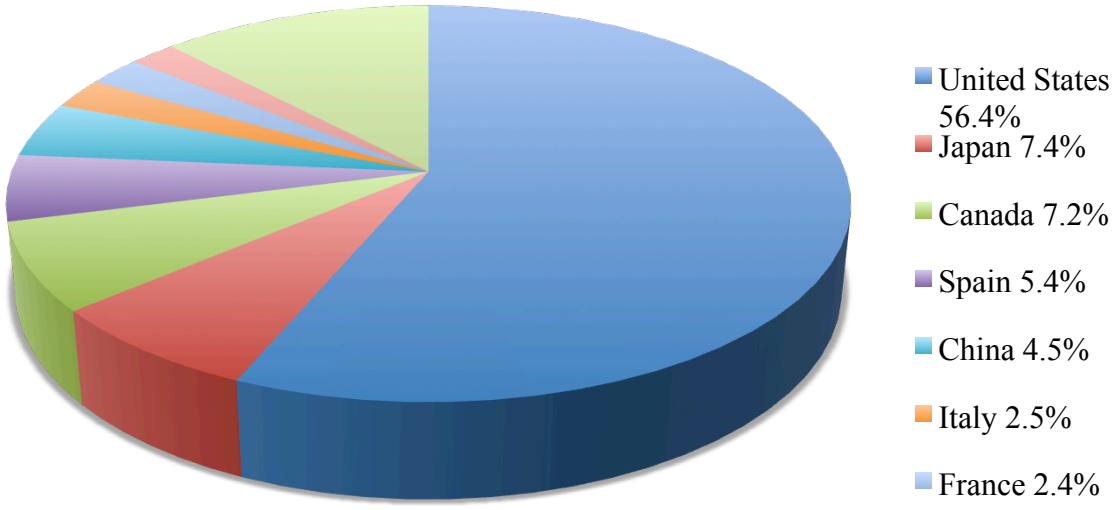
Weather index insurance contracts initially were traded only OTC (over the counter) but since 1999 the CME (Chicago Mercantile Exchange) starts to trade weather futures and option on futures. OTC transactions carry credit risk but CME transactions are contracts traded on the open market, are guaranteed and do not carry any credit risk. The CME contracts are standardized contracts and posses a different risk that is the biggest limit of weather index based contracts: *basis risk.* This kind of risk includes the possibility of mismatching for the location (of the enterprise's exposure to weather). We can define the basis risk as the imperfect correlation between the index and the losses. Basis risk can be reduced by offering weather index insurance only in areas where a particular, highly covariate, weather variable is the dominant cause of loss. Anyhow managing weather risk is still a rapidly growing business. The US department of Commerce estimates that 1/3 of all business are affected by weather risk (it is a big market share), and in 2007 about 730,000 weather derivative contracts were traded worldwide. The total value of the contract sold on the CME in 2006 was $45.2 Billion (USA Today 2008). In 2003–05 the global agricultural insurance premium volume was estimated at about $7–$8 billion (Kasten 2005; Guy Carpenter 2006). This figure had risen to about €16.5 billion ($21 billion) by 2008 (Paris Re 2008). The global agricultural insurance premium volume for the 65 countries responding to the World Bank survey is estimated at $15.1 billion in 2007. It is divided into crop premiums of $13.5 billion (90 percent of total) and livestock premiums of $1.6 billion (10 percent of total). Agricultural insurance is highly concentrated in the 21 high-income countries, whose premium volume was $11.9 billion (86 percent of the total), equivalent to an average of 2.34 percent of 2007 agricultural GDP in these countries. In contrast, agricultural insurance accounts for only 0.29 percent of GDP in upper-middle-income countries and just 0.16 percent of GDP in lower

– middle - income; in the six lower-income countries, it represented less than 0.01 percent of GDP.

Estimated 2007 Agricultural Insurance Premiums, by Country Development Status

Development status	Estimated agricultural premiums ($ million)	Percentage of global agricultural premiums	Agriculture insurance penetration (premiums as a percentage of 2007 agricultural GDP)
High income	13,061.3	86.5%	2.3%
Upper-middle income	912.7	6.0%	0.3%
Lower-middle income	1,123.5	7.4%	0.2%
Low income	5.0	0.0%	0.0%
All Countries	15,102.4	100%	0.9%

TOTAL GLOBAL PREMIUMS



Let's try to understand something more about the key factor of the success of these contracts. What about the advantages of Weather Based Index Insurance on traditional insurance?

Traditional Crop Insurance	
Damage based indemnity insurance (named –peril crop insurance)	Insurance in which the claim is calculated by measuring the percentage damage in the field soon after damage occurs. This figure, less a deductible expressed as a percentage, is applied to the pre-agreed sum insured, which may be based on production cost or expected crop revenue. Where damage cannot be measured accurately immediately after the loss, the assessment may be deferred until later in the crop season. Damage based indemnity insurance is best known for hail but is also used for other named-peril insurance product, including frost, excessive rainfall

	and wind.
Yield Based Crop Insurance	Insurance in which an insured yield (for example tons/hectare) is established as a percentage of the historical average yield of the insured farmer. The insured yield is typically 50-70% of the average yield on the farm. If the realized yield is less then the insured yield, an indemnity is paid equal to the difference between the actual yield and the insured yield, multiplied by a pre-agreed value of sum insured per unit of yield. Yield-based crop insurance typically protects again multiple perils.
Crop Revenue Insurance	Insurance that combines conventional loss crop yield based MPCI insurance with protection against loss of market price at the time of sale the crop. As of 2009, this product was marketed on a commercial bases only in US for grains and Oil seeds with futures contracts quoted on the CBT (Chicago Board of Trade)
Greenhouse Insurance	Insurance that combines coverage of material damage to greenhouse structures and equipment and conventional crop insurance (usually restricted to named perils to the covered greenhouse crop).
Index-based Crop Insurance	
Area-yield index Insurance	Insurance in Which the indemnity is based on the realized (harvested) average yield of an area such as a Country or a District. The insured yield is established as a percentage of the average yield for the area (typically 50-90% of the area average yield). An Indemnity is paid if the realized average yield for the area is less then the insured yield, regardless of the actual yield on a policyholder's farm. This type of

	index insurance requires historical area yield data on Which the normal average yield and insured yield can be established.
Weather Index Insurance	Insurance in which the indemnity is based on realizations of a specific weather parameter measured over a pre-specified period of time at a particular weather station. The insurance can be structured to protect against index realization that are either so high or so low that they are expected to cause crop losses. An indemnity is paid whenever the realized value of the index exceeds or false short of a pre-specified threshold. The indemnity is calculated based on a pre-agreed sum insured per unit of the index (for example, $/millimetres of rainfall).
Normalized difference vegetation index/satellite insurance	Indexes constructed using time-series remote sensing imagery (for example, applications of false colour infrared waveband to pasture index insurance, where the payout is based on a normalized difference vegetation index, which relates moisture deficit to pasture degradation). Research is being conducted on applications of synthetic aperture radar to crop flood insurance.

Now we're getting more in deep in the characteristics of Weather based index insurance in relation to the traditional insurance. What are the advantages?

- The insurance contracts are relatively straight - forward, simplifying the sales process.
- *Simpler information requirements.* There is no need to classify policyholders according to their risk exposure, the insurer just need the historic weather data.

- *No loss adjustment.* The traditional insurance has got high cost of loss adjustment. In index insurance indemnities are based solely on the realization of the underlying index.
- *Reduction of moral hazard.* Because the indemnities not depend on the individual losses, it's difficult for the policyholder to change his behaviour to increase the likelihood of receiving a payment.
- *Reduction of adverse selection.* Index insurance is based on available information; the asymmetries of information are avoided.
- *Low administrative costs.* The cost for the insurer result to be less, especially for small units and indemnities are based only on the realized (proportional) of the underlying index.
- *Standardized and transparent structure.* Contracts don't need to be tailored to each policyholder (lower administrative costs).
- *Reinsurance function.*
- Indemnities are paid based on the realized value of the underlying index. There is no need to estimate the actual loss experience by the policyholder.
- Unlike traditional insurance products, there is need to classify individual policyholders according to their risk exposure.
- There is little reason to believe that the policyholder has better information then the insurer about the underlying index. There is a little potential for adverse selection and a little potential for ex ante moral hazard since the policyholder cannot influence the realization of the underlying weather index
- Operating costs are low relatively to traditional insurance contracts. Start-up costs are quite significant. Reliable weather and agricultural production data and high skilled agro-meteorological expertise are all critical for the successful design and pricing of weather index insurance products.
- Since no farm –level risk assessment or loss adjustment is required; the insurance products can be sold and serviced by insurance companies that do not have extensive agricultural expertise.

What about the main problems?

- *Basis risk.* Again the chance that the indemnity payment received (by the policyholder) does not match the actual loss. Too much basis risk will deter interest because individuals will feel that the index will not be representative of their loss experience and will therefore offer them poor protection against risk. While basis risk is an inherent problem with index insurance but it can be minimized through product design and application.
- *Reliable and accessible data.* It is critical, for the index insurance, that the underlying index is objectively and accurately measured. Many difficulties are involved in the pricing of the insurance (also due to the many methods of pricing) and weather data results not so easy to obtain and costly in most of the cases.
- *Education.* Potential policyholder (Italy included) may not have previous experience with this kind of insurance.
- *Financing of large losses.* In most of the cases this type of insurance include a maximum payout that results to be insufficient if the weather conditions are catastrophic.

It is important to underline that the weather derivatives market is not targeted for individual households. The appropriate market is probably the local-aggregators, such as farmer's cooperatives (as the Chapter 3), input suppliers, mutual-aid associations, lenders and so on. They results to be more exposed to the weather risk (avoiding any individual casualty) and they held more potential contractual power then individuals.

The World Bank's Experience with Agricultural Index-Based Insurance

Since the late 1990s, the development of agricultural risk-modelling techniques and the emergence of insurance pools and index-based insurance have contributed to a revisiting of the potential role of agriculture insurance in emerging economies. The World Bank has provided technical assistance for the development of innovative agriculture insurance programs in both low- and

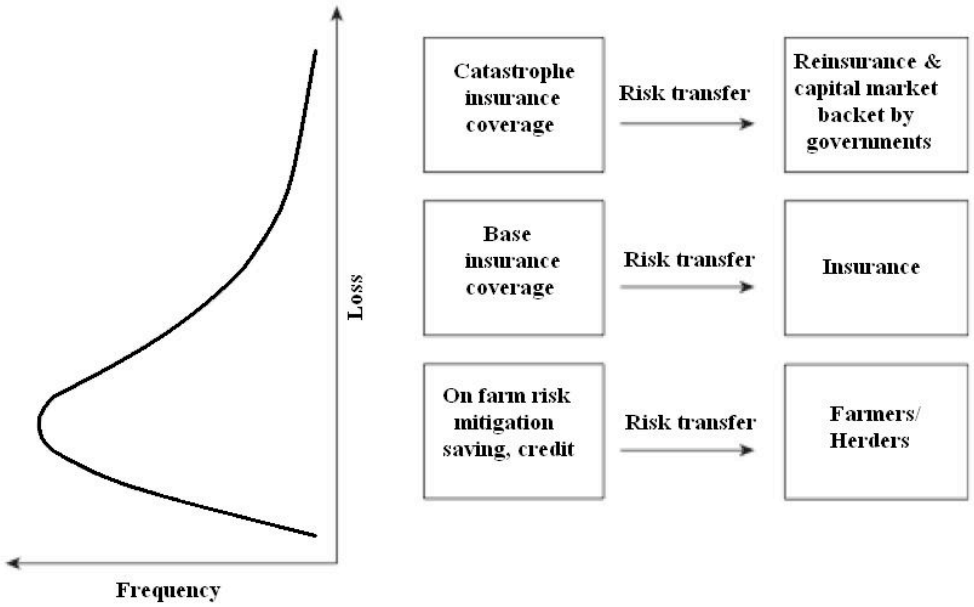
middle-income countries, often tying these programs into agricultural finance support efforts and complementary efforts in agricultural extension. In particular, the World Bank has assisted several of its member countries in developing or enhancing index-based insurance products. The interest in using index-based agricultural insurance has grown in recent years, particularly with respect to addressing the systemic component of agricultural production losses (such as those caused by a wide-spread drought). Index-based insurance offers several advantages over traditional insurance relying on individual losses, including lower monitoring costs and more transparent indemnity structure. However, this type of insurance faces some challenges (such as basis risk), which makes it cost-effective only for specific crops, perils, and geographical areas. The implementation of index-based insurance in agriculture is relatively new. A number of projects have been piloted in low-income countries. As of 2009, more than 15 index-based agricultural insurance programs had been implemented or enhanced with World Bank assistance in low- and middle-income countries. Mongolia has been piloting an index-based livestock product since 2005. Insurance indemnity payments are based on estimates of livestock mortality rates in local administrative areas from January through May, as estimated by the annual livestock census. This is the first time ever such a livestock index has been used for insurance purpose.

The World Bank has assisted the government of India in improving the National Agricultural Insurance Scheme (NAIS), which offers coverage against crop yield losses, using an area-yield index in the indemnity payment schedule. About 20million farmers have been insured under this program, for a total liability of $7 billion, making this the largest crop insurance program in the world in terms of insured farmers. The World Bank Group has provided the government of India with technical assistance to move this scheme to an actuarial regime, in order to make it more attractive to farmers and reduce the fiscal exposure of the government. Area-yield crop insurance has recently been investigated in Bangladesh and Senegal. The World Bank has provided technical assistance for the development of weather-based crop insurance products. It has assisted the government of India in developing the Weather-Based Crop Insurance Scheme

(WBCIS). This scheme protects farmers against specific adverse natural events (rainfall deficiency, excess rainfall, low temperature) through weather-based insurance. More than 400,000 farmers purchased weather-based crop insurance in 2008. This program draws on small-scale weather- based insurance pilot programs conducted in India with World Bank technical assistance since 2003. Weather-based crop insurance has been piloted in Malawi since 2005. During the 2008/09 season, about 2,600 farmers were covered, with a sum insured of $2.5 million. Weather risk programs have also been developed in Guatemala, Honduras, and Nicaragua (although only the program in Nicaragua, where 2,500 hectares of export crops with a value of $41.6 million were insured in 2008, is currently operational). In Thailand weather-based crop insurance is being offered on a pilot basis to 400 farmers for a total sum insured of $300,000. Other excess/deficit rainfall projects are under development in Ethiopia, Kenya, and Senegal, and the feasibility of other applications of index-based insurance is being assessed in Bangladesh, Burkina Faso, Indonesia, and Jamaica. These weather-based crop insurance pilots are linked to agricultural lending. They aim to strengthen agricultural finance, agricultural supply chains, and profitability in agriculture. Some success has been observed in the pilot implementation of index-based crop insurance and particularly weather-based crop insurance. One of the main challenges in the future will be to scale up these pilot programs and develop risk market infrastructures that ensure the sustainability of these programs, mainly through PPPs.

Before getting more in deep in the financial instruments analysis, let's try to understand the basic responsibility that are involved in the risk transferring, assessing three level of coverage: catastrophe insurance, base insurance and saving/credit responsibility. The most complete level of coverage includes the activity of the Government for social nets, catastrophe coverage and the infrastructural contribution for regulating the sector (in a financial perspective), the activity of insurance companies (at local level) for the coverage of the base risk through the creation of Weather Based Index Insurance and the activity of the

farmer that is responsible for his saving and investments through a good level of technological implementation and strategic marketing choices (for example developing attention to the storage policy).



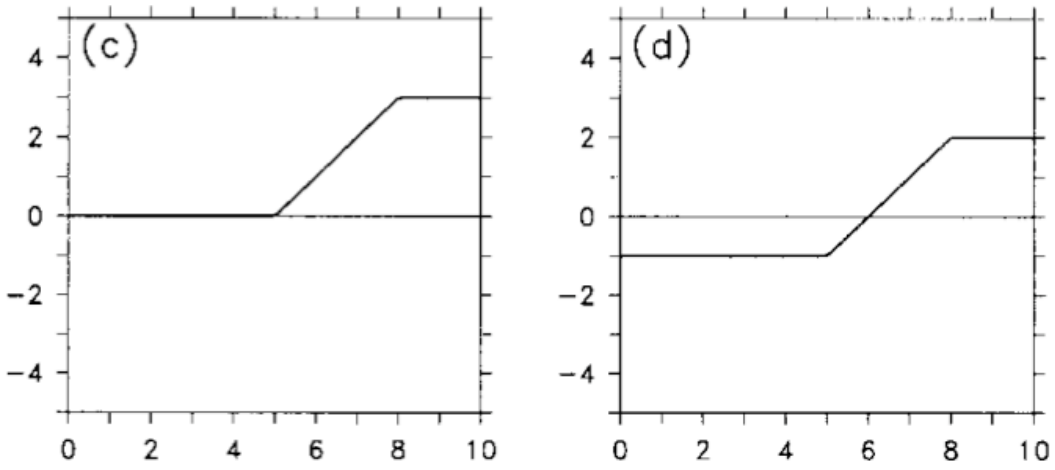
2.1.4 Financial instruments protecting the risk associated with weather

Financial instruments can help farmers to hedge the weather risk through a strategy that results not easy to be built. Structuring a risk management solutions goes beyond the choice of the right weather index (the one most highly correlated with yield variations), and presupposes a level of financial knowledge that the farmers usually doesn't have. The variation in crop yield predicted by the index must be converted into a financial equivalent that estimates the effective farmer's exposure. There are many ways to do this, but the basic difference between those, is considering the variations in terms of costs, production or revenues through, considering the production and input costs per hectare and considering the expected revenue from the sale. Running a regression analysis against historical data can be useful to establish the key relation between different values of weather index and the financial impacts on crop. All the strategies could be implemented

and integrated for building an overall hedging strategy with the highest coverage ratio.

To estimate the effective impact of one specific index on the crop in not easy. The stress received by a crop is due to many factors and can be attenuated by many techniques, whereby the difficulty is to recognize the real part of the risk that is determined by the weather index. To build this strategy in the right way requires a good data collection with daily reports qualitatively trusted and approved by WMO (World Meteorological Organization). So, a long (about 30 years), clean and consistent historical records, allow a proper analysis. A WIBC (weather index based contracts) needs this data background and it is one of the main troubles (especially in underdeveloped areas). Moreover the frictional trial of building a good relationship, at local level, between end users (farmers) and institutions is the key factor of a market success of such kind of products. A trusteeship relation between actors guarantees the efficient deliver of this new culture (the weather risk financial hedging) and the effective implementation and integration. The experience suggest this above, to be one successful factors as the Indian pilot program (made by local institutions with technical expertise. This linkage provide, moreover, incentives for the stakeholders involved in the system, for example credit company with are more available to lend because of the risk reduction of the sector and this allow the market to grow.

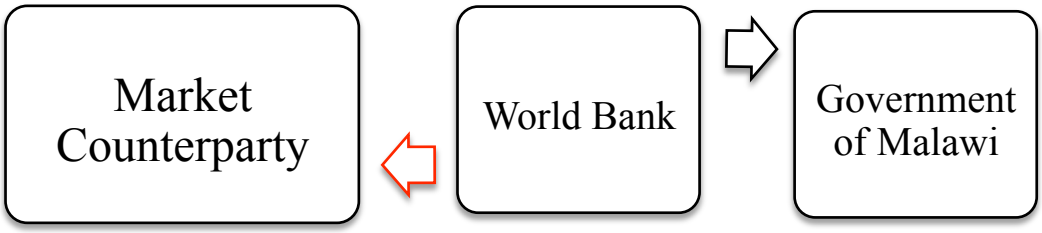
Getting more in deep into the financial instruments we can recognize one of the most popular (historically) which is the *vanilla* option. A representative type of vanilla option is the *call* option. A call option is similar to an insurance contract in that the buyer pays a premium at the start of the contract and may receive a payout at the end. It provides insurance against high value of the index. For values of the index above the strike, the seller pays the buyer an amount proportional to the difference between the index and the strike, with the constant of proportionality given by the tick. The payout is often capped. The figure below (left side) shows the money that changes hands at the end of a call option as a function of the final index, for the point of view of the buyer of the contract. The right side shows the net exchange of money including the premium.



In order to give a practical example of financial instrument applied in a cooperative context between the main actors (farmers and institution) let's talk about Malawi. This region is in the Southeast Africa with a low life expectancy and a high infant mortality. The 90% of the population lives in rural areas and Agriculture accounts for the 38% of the GDP. The main farming is the maize that, as known, was really sensitive to draught. So, the majority of the population is engaged in smallholder, rain-fed subsistence agriculture. Due to this the government of Malawi involved the World Bank in the building of a financial instrument for coverage against severe draught. The Commodity Risk Management Group (CRMG) within the ARD (Agricultural and Rural Development Department) assist the Government of Malawi in identifying the weather risk management instruments. They built up a strategy including price hedging (we will get in deep this argument in the next section) and micro and macro weather risk transfer product with the aim to reduce national vulnerability from draught. The contract was structured as an option on rainfall. This derivative links the rainfall with the maize production: if the maize production, as estimated by the rainfall index, fall significantly below the historical average, Malawi will receive a payout of up to a maximum of $5 million.

Type of contract	Put option
Max Payout	$5 million
Start date	October 2008
Final date	April 2009
Strike	10% below historical average maize production
Risk Taker	Swiss Re

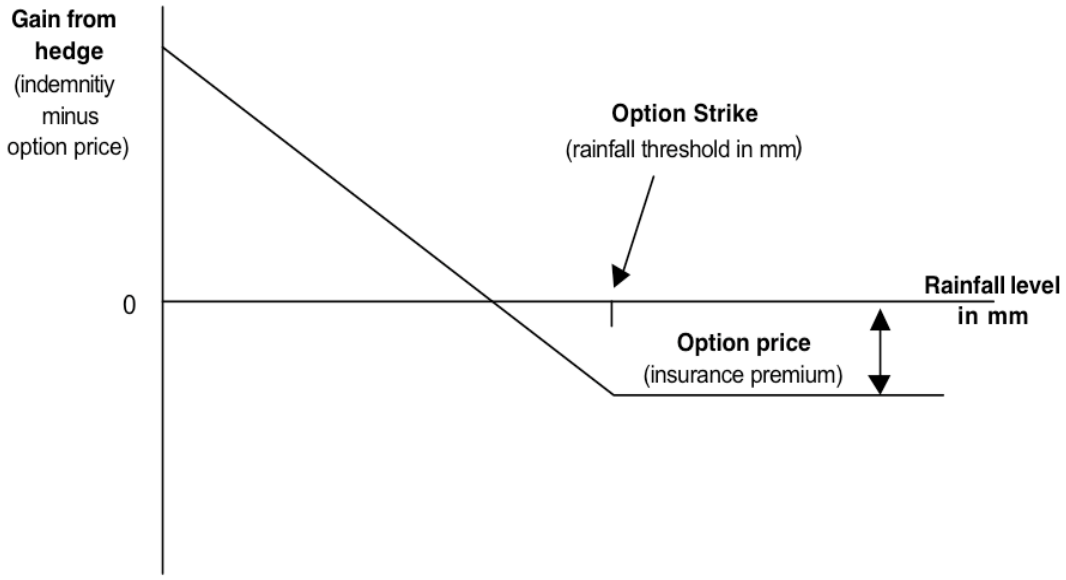
The World Bank offered intermediation services on index-based weather derivatives, it allows clients to access financial markets and transfer risk to market counterparts. In September 2009, the Government of Malawi renewed the weather derivative contract for a second-term.



In 2006, 892 groundnut farmers purchased weather-based crop insurance policies, for a total sum insured of $36,600. In 2008 the pilot was expanded to cash crops; 2600 farmers brought these policies, for a total sum insured of $2.5 million (the Malawi's GDP is around $7 million).

A similar experience was the Moroccan one. In 1995 the Moroccan Government activated the "Programme Sécheresse", it was a yield insurance programme connected with rainfall in order to avoid the consequences of severe draught and their strong impact in the Moroccan Agricultural sector. In 2001 the World Bank, after researches, recommended the adoption of pilot area-based rainfall insurance. The scheme of Moroccan insurance is similar to the other example we already considered: it was an European put option where the option

price is the cost of the coverage and the strike is the rainfall threshold below which an indemnity is triggered.



In order to structure the index it is necessary to quantify the correlation between the insured event and the yield. Over the time period 1978 – 2001 correlation between yield and cumulative rainfall results to be around 67%, which an high level but not sufficient to retain rainfall lack the main cause of yield variability. Better results came out tracking the rainfall in 10-day periods and to each period, between November and March, and assigning a weight through a mathematical procedure that maximizes the correlation between yields and rainfall.

Month	November			December			January			February			March		
10-day period	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Weight	2.0	2.0	2.0	0.5	1.0	1.0	1.0	0.5	0.5	1.0	1.0	1.5	1.0	0.5	1.0

The final value of the index is calculated by summing the values obtained by multiplying rainfall levels in each period by the weight assigned to the period.

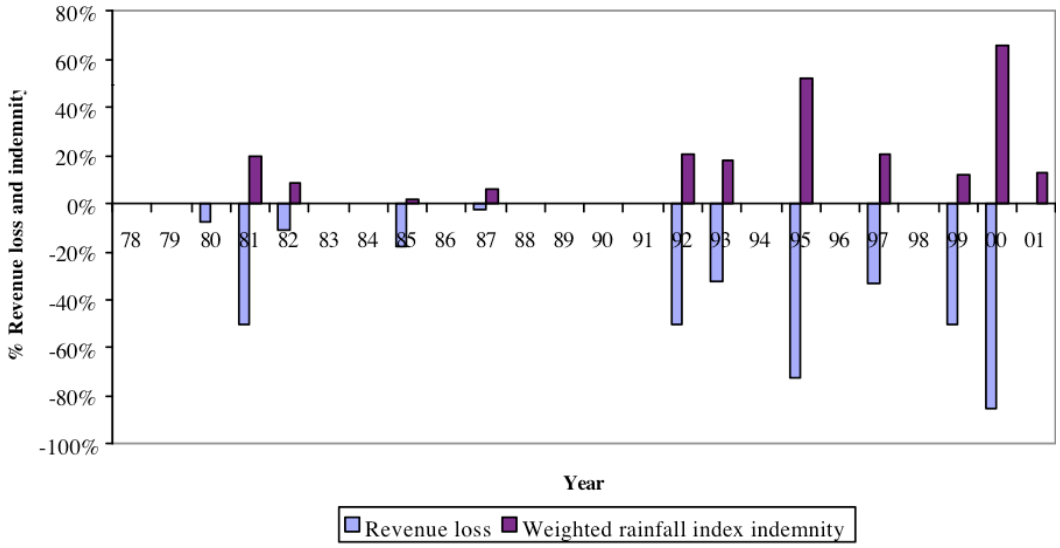
The inability of the farmers to store the water in excess (in some periods) pushed the insurer to cap the index with a maximum retention capacity of 60mm. So, the effective rainfall in the period *i* is defined as

$$r_i \equiv \max\left\lfloor r_i^*, CAP_i \right\rfloor$$

where *r** is actual rainfall in period *i* and *CAPi* is the amount of rainfall in period *i* beyond which additional rainfall does not contribute to increased yield (60mm). The rainfall index for the year t is defined as a weighted average effective rainfall

$$R_t = \sum_{i=1}^{m} \omega_i r_{it}$$

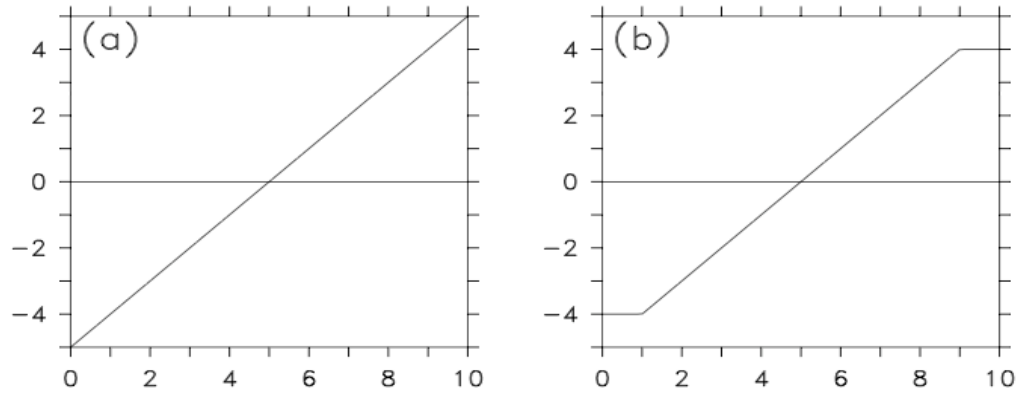
where *m* is the total number of 10-day periods and ω is the weight assigned to period *i* in the growing season (chosen to maximize the correlation between yield and rainfall index).



Above there is the result of the analysis with this weighted weather index and, as we can see, the coverage seems to be acceptable. The Moroccan experience shows the effective benefit of weather derivatives in managing agricultural production risk.

Another type of derivative contracts that results to be popular (after the options), are the *swaps*. In a swap contract there is no premium paid at the beginning: the two sides simply enter into an agreement. At the end of the

contract money is paid in both the directions according to weather. The index is above or below a predetermined value known as the strike, and the amount paid is proportional to the distance from the strike. Sometimes, the amount paid is not allowed to exceed a fixed upper limit, in which case the swap is said to be *"capped"*. For an uncapped swap the amount of money changing hands is a linear function of the index, while for capped swaps it is non-linear. The two graph below shows the money that changes hands in uncapped and capped swap contracts as a function of a final index, for the point of view of the buyer of the contract (who is defined as the party that receives money if the index hands up with high value, and pays money if it ends up with a low value).



One practical example of weather derivative swap is located in Italy in the 2003, it was the first Italian operation (with derivative) for the climate risk hedging. The operation was a swap between The *Banca Popolare di Sondrio* and *Fonte Tavina*, a company of mineral Water on the Garda Lake, recently acquired by Sangemini Group. Taking in consideration the temperature detected by the Airport of Verona-Villafranca in the fixed dates, the contract provides *Fonte Tavina* to pay a predetermined amount for each tenth of a degree over the temperature detected than contractually agreed. Conversely, The *Banca Popolare di Sondrio* had to pay *Fonte Tavina* if the measured temperature was lower than that written in the swap contract. The logic is straightforward: if the temperature is lower, *Fonte Tavina* bill less, and consequently has got a more modest cash flow, in this case, however gets a benefit from the periodic payment of the swap. If,

however, the temperature was particularly high, *Fonte Tavina* waived for the excess of the contractual level.

In every case when a Company starts up a derivative, it must be sure that the purchase was a true and fair hedge and not just speculations. Historically experience, especially in Italy, showed the inappropriate use of swap contracts. In order to avoid this risk it is recommended a good historical data processing accompanied by the precise selection of a time horizon that we want to hedge.

2.2 PRICE OR MARKET RISK

"Price volatility significantly impacts the incomes of farmers and the macroeconomic health of their countries. From 1983-1998, the price of many commodities fluctuated from below 50 percent to above 150 percent of their average prices. In the past many countries used marketing boards to guarantee farmers a minimum price for their production. But government policy that attempted to separate domestic commodity prices from international prices has proven financially unsustainable. With liberalization, many countries have abandoned marketing boards that were common to coffee, cocoa, and other import crops and thereby eliminated the smoothing effects this guaranteed minimum income had for farmers" (Erin Bryla, World Bank). Farmers are exposed to price fluctuations over the course of the season creating uncertainty about the price they will receive for their product when they take it to be sold. At the farm level, this uncertainty in commodity prices makes it difficult for producers to allocate resources efficiently, limits their access to credit for productivity enhancing inputs, and leads them to adopt low-yield, low-risk production technologies, thereby lowering average incomes. At the macro level, price volatility, can be devastating for poor Countries: more than 50 Developing Country depends on three or fewer leading commodities for at least half of their export earnings. So, it affects government's fiscal revenues, trade balance, exchange rate, and creditworthiness. The price volatility is dangerous also at micro-level: the

uncertainty about the price of the agricultural commodity, makes the farmer unable to take any type of decision especially if we talk about investments because it is impossible to determine weather it will be possible to pay back the loan. Uncertain price also create risk for the banks that are pushed to raise the rates for agricultural borrowing or simply refuse to make credit. Market based tools (futures and options) that insulate producers from the negative effects of short-term price volatility are widely used in high-income countries, the vast majority of agricultural producers in developing countries are, in general, unable to access these markets. In lieu of these alternatives, farmers take steps to mitigate their own risks. In the absence of markets for price hedging instruments, farmers try to cope with price risks by:

(a) self-insuring through asset accumulation, savings, and access to credit
(b) income diversification
(c) informal insurance arrangements.

In most poor commodity dependent countries and for most poor farmers, credit and savings markets are imperfect and asset accumulation is never enough in times of a crisis. Diversification to other activities is difficult because farmers lack skills, information and capital to do something else. Many farmers adopt low-risk and low-yield crop and production patterns to ensure a minimum income. These production patterns come at the expense of perhaps riskier but higher return production that could create income growth and the accumulation of capital. Finally, informal insurance arrangements at the local community level often break down in the face of large systemic risks such as the collapse in commodity prices. The use of market based price risk management instruments to mitigate this price risk would provide farmers with new alternatives and allow them greater certainty in planning their on-farm activities and possibly provide greater access to credit.

Financial institutions can combine hedging with lending in 3 main ways:

1. Hedging the exposure of the portfolio to commodity prices.
2. Hedging every single loan.
3. Prove the price protection when requiring a loan.

Without the sustain of the Governments or the presence of Local intermediaries, the access to the first hedging solution (futures and option) to insulate producers from the negative effect of short-term price volatility, is only available for big farmers in high-income countries. The brokerage company, in fact, are not available to share the risk with small producers for the fact that this could generate high transaction costs and for the inability of small farmers to guarantee a stable level of production. Moreover small farmers in developing country, doesn't use to be informed on new financial tools for hedging and due for that the demand of such tools is not so high. The point is that most of the "rural population" of the World is concentred in developing countries area and, in order to improve the mechanism of hedging commodity risks through finance it is necessary the presence of an Institutional operator that, in most of the cases that history saw, was the World Bank (Uganda, Tanzania, Nicaragua, Malawi and many others). Creating a sort of responsibility for the Governments all over the World, to push the agricultural sector in a sustainable path of growth, will be the real solution to the problem, but so difficult. Let's try first to understand how a farmer can hedge himself. First of all the simplest way to hedge the commodity price against fluctuations is the put option. The context has to be, necessarily, a transaction and the put option will guarantee a minimum price level based on an international price (not the local one) for a given commodity for a defined period. In this case producers must pay a fee (or a premium), which is market, related. When the price rise the producer receive no payout from the contract (because he can sell easily his product at the market price), when the price falls, the producer receive a payout equal to the difference between the price the producer choose to insure and the international market price on the date of the option coverage. Because of the size of this type of contract it is necessary to aggregate the demand for these derivatives.

2.2.1 Hedging price risk with *futures*

Another way to hedge against price fluctuations are *futures:* futures price quote can be useful proxies for the price of commodities. A futures contract is an

agreement priced and entered on an exchange, to trade at a specified future time a commodity. The use of features involves shifting risk from a party that desire less risk (the hedger) to a party who is willing to accept the risk in exchange for an expected profit (the speculator).

The Reuters Financial Glossary definition for futures is the following: ”A future is an undertaking to buy or sell a standard quantity of a financial asset or commodity at a future date at a fixed price. Futures resemble forward contracts in that they involve buying or selling an item for receipt or delivery in the future, but are different from them in that they are standardised contracts. Every futures contract has standard terms that dictates the minimum quantity and quality that can be bought or sold, the smallest amount by which the price may change, delivery procedures, contract months and so on. They must be traded on a recognized exchange. Unlike forward contracts, delivery of a futures contract is rare. As the delivery date draws near most investors close out their positions by making an equal and opposite trade. The futures markets bring together hedgers who wish to protect themselves against the rise or fall of prices and speculators who are trying to benefit from such movements. A *clearing house* acts as the counter party in every transaction to protect against the risk of default so buyers and sellers do not have to deal directly with each other. Futures markets developed as a method for establishing forward purchase prices and managing price instability caused by seasonal factors in agricultural markets.”

Futures contracts are commitment to trade in the future a certain quantity of good at a certain price. Delivery and payment are not required until contract matures. Due to this, buyers and sellers are required to make margin deposit (typically 5-10% of the underlying value of the contract) to guarantee their commitments. Let’s now give a practical example: an International hotels chain has to buy one contract for 5 tons extravergine olive oil at €2,50/Kg (it is the quotation of the 12 October 2010) for an amount of €12,500. The 10% margin the chain has to pay to his broker would be €1,250. A *margin call* occurs when the price of the contract goes against the trader (for example €2,40/Kg for the olive

oil). In this case the producer must post additional margin with his broker to cover the loss and restore the deposit. Instead, when the price goes in the opposite direction (favourably for the trader), money can be withdrawn from the deposit. The small margin for the deposit accompanied by the deposit margin mechanism use to attract speculators.

The difference between futures and cash price are termed *basis* and incorporate differences in price across space (considering transportation costs), time (storage costs associated), and quality. Through hedging it's possible to eliminate price level uncertainty but not basis uncertainty. A future contract can be purchased (go *long* in hedging) or sold (go *short* in hedging). In both cases there's behind an anticipation of the future prices and the two positions tend to offset each other. As we said before, hedging helps to eliminate price fluctuations risk and the farmers can hedge in 3 different ways:

- *Storage Hedging*: producers will short on *futures contracts* to protect themselves from declining prices, while a commodity is being harvested. Then, they will buy the contracts at the point when their commodity is sold in the cash market. This way, gains in the *futures* market will offset losses in the cash market.
- *Production Hedging:* contracts are sold at the point when *commodities* are being grown, to be bought back at the point when these commodities are ready to be sold. However, as the volume of production may vary while a crop is being grown, it is advisable for producers to purchase contracts for not more than two thirds of their expected yield.
- *Hedging Expected Purchases*: when raw material or *commodities* need to be purchased at a future time. In order to avoid purchasing at a higher price, buyers purchase long futures contracts to be sold when these raw material are purchased in the cash market. With this, profits from the futures market will offset the lower prices in the cash market.

Let's now better focus on the role of the basis risk in hedging. If the farmer does

not hedge, his risk is solely associated with the crop cash price (P2) which can also be calculated as the crop futures price (F2) plus the crop basis (B2). Thus, the farmer's net return in a cash-sale-at-harvest situation (Ru) can be calculated as the cash price (F2+B2) at harvest multiplied by actual production (Y2), minus production costs (C):

$$Ru=[(F2+B2)*Y2]-C$$

Suppose now that the producer places a short hedge to reduce the risk of a price decline and a lower sales price for his growing crop. The expected final net return at harvest (Rh) is based on the cash price at harvest (F2+B2), and the profit or loss associated with the farmers futures market position (F1-F2). The farmer's actual level of production is designated as Y2 in the following equation, and the quantity hedged is h*Y1, where h is the hedge ratio and Y1 is expected production:

$$Rh=[(F2+B2)*Y2]+[(F1-F2)*(h*Y1)]-C.$$

Assuming that output is known with certainty at the time the hedge is placed and that actual production equals the quantity hedged (for example, Y2=h*Y1), gives the following:

$$Rh=[(F2+B2)*Y2]+[(F1-F2)*Y2]-C$$

or

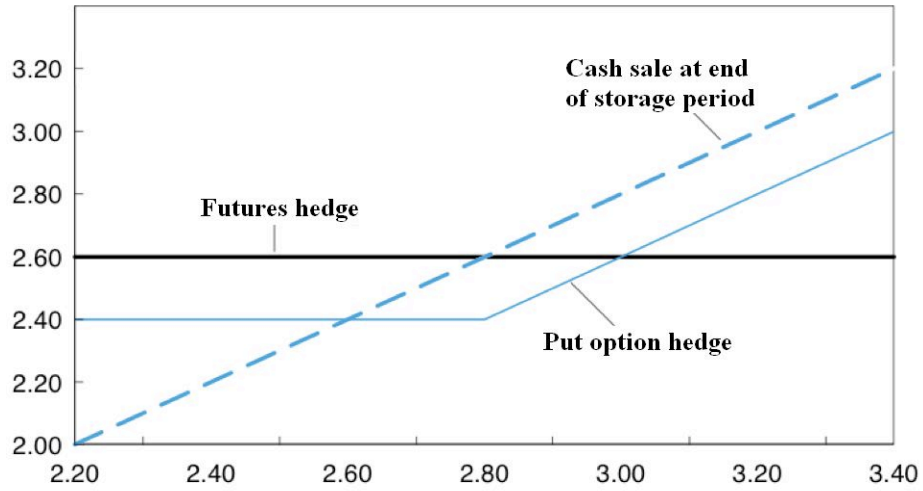
$$Rh=[Y2*(F1+B2)]-C$$

This last equation indicates that the price component of the farmer's net return depends on the futures price at the time at the hedge is placed plus the harvest basis. So the price risk is eliminated by anticipatory hedge, the only risk the farmer will face is the basis (B2).

2.2.2 Hedging price risk with *future option contracts*

A future commodity option gives the right, but not the obligation to take a futures position at a specified date. The advantage in this case is represented by the option that gives the change to hedge against adverse price movements. To gain this protection the hedger has to pay a fee (as in the insurance case). Let's give an example: a farmer purchase a put option with a strike price of €3/Kg. If

futures price move to €2.80/Kg, the option may be exercised for a net profit of €0.20, minus the premium paid at the option. If the crop cash price is €2.70/Kg, the farmer's return is €2.90/Kg (€2.70 + €0.20), minus the premium. The effects on realized return from hedging with futures and put options are compared for arrange of possible futures price outcomes as in the figures below.



Suppose that the olive oil in this case, was stored in November and sold in May. The May futures price is €2.80/Kg at the beginning of the storage period and the expected May basis is -€0.20. By hedging with futures, the farmer obtain an expected return for the oil in storage of €2.60 (€2.80 - €0.20). Alternatively the farmer can buy an at-the-money put option with a €2.80 strike price for a €0.20 premium. The put guarantees a price equal to a strike price, minus the premium, minus the basis (€2.80 - €0.20 - €0.20), allowing the farmer to gain if the futures price rises above €3.00 in May. By not hedging, the farmer gets the futures price minus the basis. The figures shows that the range of possible prices is greatest with the cash sale and least with the futures hedge. Moreover, futures hedging, the put does not limit the potential profit associated with increasing prices, but the price must rise more then the premium costs before a profit is realized. The premium paid for an option consists of *intrinsic* value added to a *time* value. The first one reflects the difference between the futures price and the strike price. The time value depends on the volatility of the underlying futures contract, the time

until the option expires, the interest rate, the strike price, and the underlying futures price. *Time value is the value that buyers are willing to pay for the possibility that the intrinsic value of an option will increase over time.* The table below gives us a picture on what the farmer's behaviour has to be in relation to the effectiveness of the basis.

	High Price	*Low price*
Strong Basis	Sell cash	Sell cash Re-own with futures or options (if expect an higher price) Long futures or **buy call**
Weak Basis	Hedge with futures Short futures or **buy put** Delay cash sale	Store

If the basis is weak there will be a basis gain through long hedge, if the basis is strong there'll be a gain through a short hedge. Let's now give 3 practical example of long hedging in different scenarios concerning cash and option value and considering basis held constant:

(a) Cash Price and Options Value both Increase

An increase in futures price is assumed to be positively related to a change in the option value. Thus, the option vale increases. Suppose today an Olive Oil multinational knows that they will be purchasing a huge quantity of Olive Oil from local farmers a few months for now. Additionally, the multinational knows that given the current cash price of €2.35/Kg they have the potential to buy oil for a profit. The multinational decides to purchase a €2.50/Kg out of the money call option for €0.20/Kg. Later when they'll be ready to purchase the cash and futures price have increased to €2.60/Kg and €2.65/Kg respectively. The futures price has increased such that the call option is now in the money. Therefore the multinational purchases the oil for €2.60/Kg and sells their call option for

€0.35/Kg with €0.15/Kg gain in value. By purchasing a call option, the multinational decreased their cost of purchasing the oil from €2.60/Kg to €2.46/Kg (€2.60/Kg + €0.01/Kg commission - €0.15/Kg gain in option value).

Cash and Futures	*Option Price*
Today: • Cash €2.35/Kg • Futures €2.40/Kg	Purchase €2.50/Kg call at €0.20/Kg (pay €1000 plus commission)
Later: • Cash €2.60/Kg • Futures €2.65/Kg	Sell €2.50/Kg at €0.35/Kg (receive €1750 less commission)
Results	- Cash price paid €2.60/Kg - Plus commission €0.01/Kg - Less Option Premium gain €0.15/Kg Net Buying Price €2.46/Kg

(b) Cash Price and Options Value both Decrease

A decrease in futures price is assumed to be inversely related to a change in the option value. Thus, the option value decreases. Suppose today an Olive Oil multinational knows that they will be purchasing a huge quantity of Olive Oil from local farmers a few months for now. Additionally, the multinational knows that given the current cash price of €2.35/Kg they have the potential to buy oil for a profit. The multinational decides to purchase a €2.50/Kg out of the money call option for €0.20/Kg. Later when the multinational is ready to purchase the oil, the cash and futures prices have decreased to €2.15/Kg and €2.20/Kg respectively (no change in basis). The futures price has decreased such that the call option is know even more out of the money. Therefore, the multinational purchases the oil for €2.15/Kg and sells their call option for €0.02/Kg, a €0.18/Kg loss in value In this case the multinational has increased to cost of purchasing the oil from €2.15/Kg to €2.34/Kg (€2.15/Kg + €0.01/Kg commission + €0.18/Kg loss in option value).

The multinational had the potential for the unlimited gains with limited losses.

Cash and Futures	*Option Price*
Today: • Cash €2.35/Kg • Futures €2.40/Kg	Purchase €2.50/Kg call at €0.20/Kg (pay €1000 plus commission)
Later: • Cash €2.15/Kg • Futures €2.20/Kg	Sell €2.50/Kg at €0.02/Kg (receive €100 less commission)
Results	- Cash price paid €2.15/Kg - Plus commission €0.01/Kg - Less Option Premium gain €0.18/Kg Net Buying Price €2.34/Kg

(c) The Cash Price Changes by a Minimal Amount and the Options Value Expires

Suppose today an Olive Oil multinational knows that they will be purchasing a huge quantity of Olive Oil from local farmers a few months for now. Additionally, the multinational knows that given the current cash price of €2.35/Kg they have the potential to buy oil for a profit. The multinational decides to purchase a €2.50/Kg out of the money call option for €0.20/Kg. Later when the multinational is ready to purchase the oil, the cash and futures prices have changed minimally (no change in basis) and the contract month expiration date is tomorrow. Therefore, the multinational purchase the corn for €2.34/Kg and allows their call option to expire worthless (and the multinational doesn't pay commission costs for allowing the option to expire). In this case the multinational has increased the cost of purchasing the oil from €2.34/Kg to €2.545/Kg (€2.34/Kg + €0.005/Kg commission + €0.20/Kg loss in option value). The multinational had the potential for unlimited gains with limited losses.

Cash and Futures	*Option Price*
Today:	Purchase €2.50/Kg call at €0.20/Kg

• Cash €2.35/Kg • Futures €2.40/Kg	(pay €1000 plus commission)
Later: • Cash €2.34/Kg • Futures €2.39/Kg	Sell €2.50/Kg at €0.0/Kg (receive €0 less commission) Option expires Worthless
Results	- Cash price paid €2.34/Kg - Plus commission €0.005/Kg - Less Option Premium gain €0.20/Kg Net Buying Price €2.545/Kg

2.3 FINANCIAL RISK

As we said many times before, one of the leading aspects that push entire rural population in the poverty trap is related to credit. The availability of liquidity is a lack that depresses accumulation of capital and makes the development difficult and slow. So, the aspect that we are going to consider in this paragraph is the financial risk related to Agriculture. Financial risk exists because of the need to finance business operations and maintain cash flow levels adequate to repay debts and meet other financial obligations. The ability to secure necessary loans is vital to many farm operations, but borrowing money induces numerous risks. The willingness of lenders to supply loans now or to continue to supply needed funding in the future is uncertain and volatility in interest rate produces an added risk to borrowing. These risks are largely influenced by greater economic factors and changes in financial markets mostly out of the individual farmer's control. In addition, changes in market values of loan collateral could also adversely affect agricultural producers' ability to maintain a profitable enterprise. Moreover, production risk (as we already saw) contributes to financial risk, relating directly to cash flows and the ability to secure and repay loans necessary for operation. So, another aspect of financial risk management *is liquidity* that involves the farmer's ability to generate cash quickly and efficiently in order to meet his or her

financial obligations (Barry and Baker). The liquidity issue relates to cash flow and addresses the question: "When adverse events occur does a farmer have assets (or other monetary sources) that can easily be converted to cash to meet his or her financial demands?" Since production levels and commodity prices produce the revenue with which farmers meet their financial obligations, it is significant to recognize how interrelated these different types of risks are.

In the credit, financial or liquidity risk one of the aspect that really affects agriculture and is the presence of a *collateral*. The market of credit requires information that results to be asymmetric and the transaction costs make them costly. The solution provided is the presence of collateral that pushes poor borrowers out from the market of credit and induce them into a liquidity trap. Without access to credit, farmers are often forced to choose low-risk (and low return) strategies that doesn't give them the possibility to accumulate and develop their productivity. "The wealthy are able to access higher-return niches in the non-farm sector, increasing their wealth and reinforcing their superior access to strategies offering better returns. Those with weaker endowments ex ante are, by contrast, unable to surmount liquidity barriers to entry into or expansion of skilled non-farm activities and so remain trapped in lower return...livelihood strategies." (Barrett et al. 2001, p. 15)

2.3.1 Basic Management tools

Coping with financial risk in Agriculture means also try to manage all the other risk a farmer usually face. It is impossible, in fact, to reduce the financial/credit risk without reducing the price and the yield risk. But trying to unbundle the strictly financial risk we can identify some basic strategy that has to be implemented and considered in every plan for hedging agricultural commodities. These are:

- Records
- Self-Liquidating Loans
- Reserves
- Renting/Leasing

- Manage Marketing and Production risk

One of the main aspects that can really help farmers to manage their financial risk is to improve the **records**. Having a good farm records gives a numerical picture of the direction in which the farmer is moving on. In the Chapter 3, analyzing the main difficulties of a farmer in South Italy emerged that the only records they have available (consider Italy is not a Developing Country) are about yield and price of selling. Most of all the data are available for a bunch of not more then 20 years and this make the financial analysis really difficult and imprecise. Evaluating balance sheets, income statements, cash flow statements and so on, a farmer can really made better decision regarding his business. Knowing his current debt-to-asset ratio, he can make better decisions when securing a loan and can possibly get a lower interest rate on loans by lowering that ratio. In synthesis, better records gives to the farmers the possibility to have a look on his liquidity panorama and manage solvency in order to meet his obligation, reduce the risk and the price of a loan and **manage the cash flow**. Managing cash flow is essential for the short and long term survival of any business. The manager has to make sure that there is available cash to cover operating expenses, make scheduled payments, and provide family living expenses. Suppliers and lenders like to know they will be paid in a timely manner. Otherwise, farm credit will dry up, making operating nearly impossible.

Getting more in deep in borrowing for farmers we have to point out the importance of the choice between the different time horizon and the structure of the rate of the loan. When it's a long - run loan is preferable to choice a fixed interest rate because the fluctuations, in the long - run, can cause huge losses and couldn't match the variations of the market.

A solution concerning the structure of the loan can be represented by the **self-liquidating loans**. The self-liquidating loans are loans that can be repaid by the productivity of what the loan was secured to purchase, such as loans for crop production. This last type of loan can be paid off when crops are sold and this allow the farmers to face the liquidity risk and take enough time to find out the best solutions for selling on the market.

Renting or **Leasing** can reduce financial risk too. By renting or leasing land, a farmer eliminates basically the risk associated with a large land loan. Land, leasing or renting equipment can also lessen financial risk by making equipment loans unnecessary. If the rented or leased equipment is newer or more reliable, the farmer can avoid the production risks associated with an equipment breakdown or the need to pay for costly repairs.

Manage production and **marketing risk**, as we list before, is a way to reduce the overall risk exposure. Giving more certainty to the yield is a credential that can be useful when a lender is valuating the possibility to give a loan to the farmer. Managing the production risk is also managing the production and the price policy adapting a **storage** policy in relation to the structure of the forward price curve of the commodity. This helps farmer to realize the possibility to accumulate reserves that are useful both guarantor for a loan and gives a breath in market recession periods or when decreasing yield trends occurs.

The recent recession is an evidence of the fact that liquidity and financial risk drive the economy into growing or decreasing path. A long-run perspective cannot prescient from the hedging financial risk, especially in the agricultural sector that is one of the most exposed to different risks.

2.3.2 Credit risk management in financing agriculture

Most of us consider working capital as not actually "working" since it does not earn a return. In stable environments, this is generally true. But, in more volatile environments, working capital acts as the insurance premium needed to help reduce financial risk. Increasing working capital, particularly short-term assets that can easily be turned into cash, is one way to reduce total risk.

In Developing Counties financial intermediaries have limited or non – existent means to transfer credit to third parties through, for example, portfolio securitization or credit insurance, which were common in mortgage and consumer finance markets in developing Countries prior to the 2008 financial crush. If more farm borrowers held agricultural insurance policies, this could serve to reduce credit risk for financial institutions, but agricultural insurance markets are grossly

underdeveloped in middle- and low-income Countries. For example, agricultural premiums totalled $18.5 billion worldwide in 2008 (World Bank, 2010), but the United States and Canada accounted for 62% of the premium volume (World Bank). Latin American, Asian and African regions, home to most of the lower-income Countries, accounted for 21%, or $3.88 billion. Moreover, the leading countries in terms of agricultural insurance development all depend on heavily subsidized schemes that would be difficult to replicate in other places.

Most of the strategies available to financial intermediaries in Developing Countries involve coping with and absorbing credit default risk.

According to the World Bank (Mark D.Wenner, 2010) there are some credit risk management techniques that upgrade the condition in the market credit for Development Countries:

- **Expert-based credit evaluation system:** the heterogeneous character of the Agricultural market requires a wide range of trained credit officials which can evaluate and process the request of credit acting on a local base. This kind of implementation results to be one of the more expensive but improve the effectiveness propensity on investments that generates growth.
- **Portfolio Diversification:** large institution of intermediaries of credit has got a diluted risk into a diversified portfolio that combine the specific risks generated by Agricultural activity with other sector's risk oppositely correlated.
- **Portfolio Exposure limit:** because of the Agricultural high exposure to risk it is necessary, for large institutions, to limit the share credit for Agricultural sector that is usually set as the 40% of the portfolio of Intermediaries (in Latin America Institutions).
- **Excessive Provisioning:** the so called "loan loss provisioning is an internal absorption if credit risk". This concept is based on an adequate risk classification schemes that helps the intermediaries to have a guaranteed liquidity. It is a common practice for the insurance companies.

What emerges from recent research is the fact that an improvement in the supply side of the credit market is costly, especially in Developing Countries. "The lack of high-quality weather data, limited supply of people with risk-hedging capabilities and expertise in agricultural risk management, small capital markets, and weakness in regulatory and legal infrastructure obstruct the progress making the structure of the market rigid and without any possible flexibility propensity. Since the depth and efficiency of financial markets are highly correlated with the speed of the overall economic development, innovative methods of improving rural financial services will be critical in facilitating and sustaining any marked improvement in rural welfare" (Mark D.Wenner, World Bank 2010).

Let's try to focus on the demand side of the market to understand how to access the credit market without a structural/institutional change. To manage financial risk, think critically about the management of:

- working capital
- credit reserves
- growth strategies.

In David Kohl's "Weighing the Variables" (American Bankers Association, 1992), for example, he suggests that a working capital level that is equal to 25% of a farmer's total cash expenses is a good benchmark rule. Different working capital levels will be required in different operations, but for many farmers 25% of cash expenses is enough to guarantee that that operation is producing at the "optimal" scale. If cash expenses increase, or if working capital is less than 25% of cash expenses, then producers should accumulate capital and increase the scale of their operation to accommodate the increase in capital. That is, the scale of the operation should increase. So the decision of how much working capital to accumulate is closely related to the growth strategy of the producer.

2.3.1 Interest rate risk management

As we discuss in the previous Chapter credit risk represent one of the main aspect of poverty trap. Unavailability of credit, pushes in fact Rural population

over a threshold of poverty and force the farmer to make low risk/low return investment.

Businesses who borrow over longer terms (five years plus) usually do so to invest in their assets or to consolidate shorter term borrowing. Taking advantage of longer term finance can help place businesses on a firm foundation, however, it can also expose them to risk if interest rates rise to levels that seriously affect their profitability. With this type of risk normally affecting businesses when they borrow longer term, it's not surprising that there isn't always a good understanding of the implications of this risk or of how it can be controlled. There are however a range of potential risk management solutions that can be integrated into your financing plans.

Taking a longer term view shows us that interest rates historically have been volatile, affecting the borrowing costs and profitability of businesses, many businesses wish to avoid this and look for greater certainty in cash flow planning and budgeting, seeking to protect themselves against a critical level of borrowing costs.

So, if you are borrowing longer term and are concerned about what might happen if interest rates rise, you are concerned about interest rate risk.

In all circumstances, the importance of considering a range of **interest rate risk management (spread hedging)** alternatives should be stressed as no single approach will suit all cases. A standard fixed rate won't be the best solution for everyone, the more recent experiences about hedging interest rate suggests for sectors that are considered risky to borrow at a variable rate and try to hedge it. The right approach for our business, cooperative in the Agricultural Sector characterized by high fixed rate, seems to be medium to long-term finance allied to a strong desire to eliminate uncertainty in financial performance. While taking advantage of longer-term finance places businesses on a firm financial foundation, it can also expose them to risk in terms of the uncertainty surrounding future interest rates. But let's have a look to three different ways to hedge interest rate with a complementary application in the Cooperative's case.

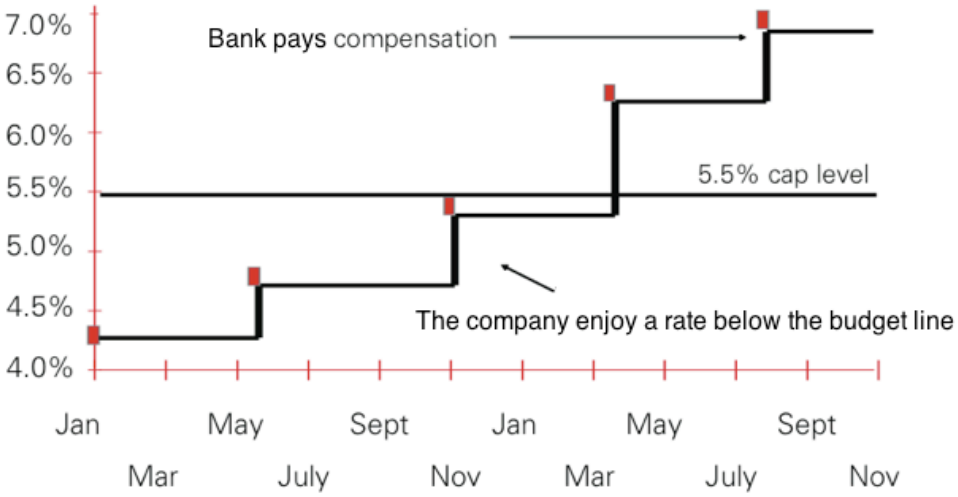
Base Rate Cap

Companies that borrow at a margin over a floating rate of interest will incur additional costs if interest rate rise. A **Base Rate cap** sets a ceiling on a borrower's interest rate costs. A cap takes the form of an agreement under which the Bank agrees to pay you the difference between the average Base Rate and the cap rate, where the average Base Rate is above the **cap rate**. Any payments due to you take place at preset times over the life of the cap. In return you pay the Bank a premium. This can be either up-front or in instalments.

Cooperatives Application

Company XYZ has a £1 million 15 year borrowing facility with an agreed loan margin of 2% over Base Rate. (Assume the current Base Rate is 5.75%.) The company wants interest rate protection for 10 years of the 15 year term but does not wish to 'lock in' to a fixed rate, given their view that short term rates will decline. The company decides that interest costs above 9% would be difficult to sustain.

Company XYZ draws down the £1 million loan and simultaneously buys a 10 year Base Rate cap with a cap rate of 7% vs 3 month average Base Rate. (N.B. The loan margin of 2% needs to be taken into account when selecting the appropriate cap rate i.e. 7% Base Rate + 2% margin = 9% maximum rate to the customer.) There is a premium payable for this type of protection, which can be paid up-front or in instalments over the life of the cap.



Features

- *Independent from underlying loan*. A Base Rate cap is not a commitment to borrow. Therefore a separate decision can be made as to how and where to borrow, and how to manage interest rate exposure.
- *Interest rate protection*. Most commonly, the buyer of a Base Rate cap is seeking to limit the risk associated with rising rates, while retaining the full benefit of declining interest rates. Unlike some other interest rate risk management products, the purchase of a cap does not 'lock in' the borrower to a fixed rate, and so if interest rates decline the benefits of cheaper funding are received.
- *Very flexible*. Base Rate caps can be adapted to provide the level of protection required. The cap can be for a constant borrowing amount throughout the life or structured on a reducing or increasing amount. Likewise the cap rate can 'step up' or 'step down' to suit specific cash flow forecasts.
- *No credit line.* If the premium is paid upfront, the seller of the cap has no credit exposure to the buyer, meaning that interest rate risk management can be implemented speedily.

Base Rate Collar

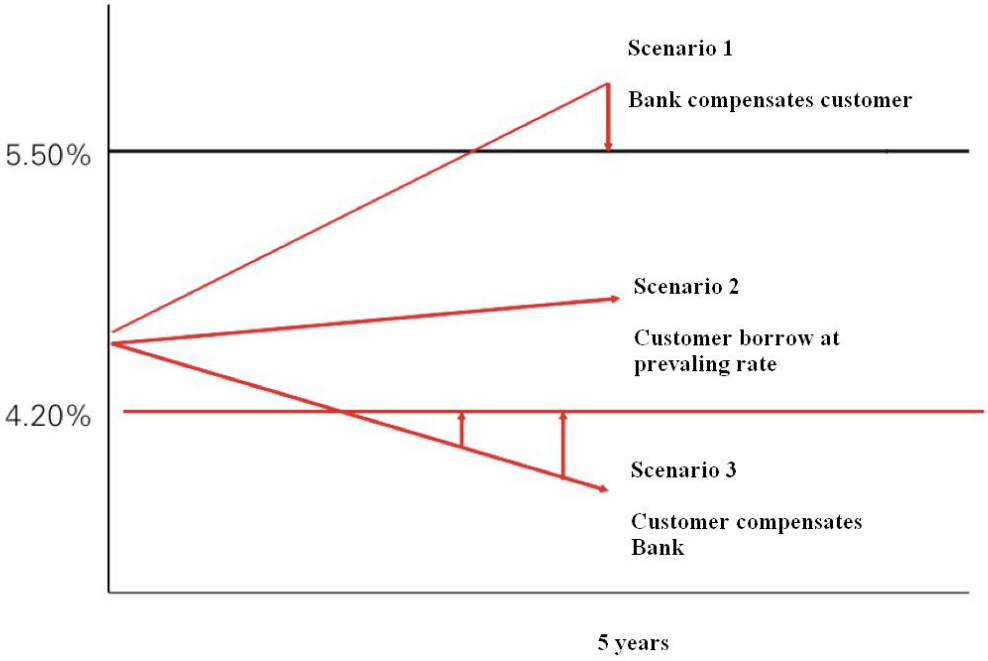
A **Base Rate collar** is a combination of an interest rate cap (maximum interest rate) and an interest rate floor (minimum interest rate) and is used to obtain protection from adverse interest rate movements. The borrower is able to benefit from favourable rate movements within a pre-agreed range. The inclusion of the interest rate floor makes the premium for a **Base Rate collar** lower than that for a comparable **Base Rate cap**. In fact, a 'zero premium' collar can often be structured so that no premium payment is required.

Interest on Base Rate loans is typically charged on a monthly or quarterly basis. Any settlement due on a Base Rate Collar is made at the end of your usual interest rate period. During each of these periods, The Bank will accrue on a daily basis any amounts owed or due under the collar and settle the net amount with the Cooperative at the end.

Company's Application

Company XYZ has a £2 million 15 year bank facility with an agreed loan margin of 2% over Base Rate. (Assume the current Base Rate is 5.75%.) XYZ wants interest rate protection for 10 years but does not wish to 'lock in' to a fixed rate, as they believe that short term rates will decline to a rate somewhere above 4.5%. From the forecast cash flow, they have decided that interest costs above 9% would be difficult to sustain and do not wish to pay an up-front premium for interest rate hedging.

The customer draws down the £2 million loan and simultaneously purchases a £2 million 10 year Base Rate collar. This involves the purchase of a Base Rate cap with a strike rate of 7% vs 3 month Average Base Rate and selling a Base Rate floor with a strike rate of 4.5% vs 3 month Average Base Rate. (N.B. The loan margin of 2% needs to be taken into account when selecting the appropriate cap strike rate i.e. 7% Base Rate + 2% margin = 9% maximum rate to the customer; 4.5% Base Rate + 2% margin = 6.5% minimum rate to the customer.)



Features

- *Independent from underlying loan*. A Base Rate **collar** is not a commitment to borrow. Therefore a separate decision can be made as to how and where to borrow, and how to manage **interest rate exposure.**
- *Certainty*. If the base rate moves above the cap strike rate, payments will be made to the customer, thereby allowing maximum borrowing costs to be quantified. This allows the customer to produce more accurate budgets and cash flow forecasts. Unlike some other interest rate risk management solutions, the purchase of a collar does not 'lock in' the borrower to a fixed rate, and so the benefits of lower interest rates can be obtained. The floor sets a limit on the level of benefit received. If the base rate falls below the floor strike rate, payments will be made by the customer.
- *Very flexible*. Base Rate **collars** can be tailored to provide the level of protection required. The collar can be for a constant notional amount throughout the life of the transaction or structured on a reducing or increasing notional amount. Likewise the strike rates on

either/both the cap and floor can ‘step up’ or ‘step down’ to suit specific cash flow requirements.

- *Low up-front premium*. Compared to a base rate **cap**, the up-front premium payable can be reduced to improve the negative impact on short-term cash flow. Potential breakage costs Additional costs may be incurred in the event that the customer wishes to come out of this arrangement, based on prevailing market conditions, such as interest rates and market expectations of future interest rate changes. This could be the case where, for example, the asset financed is sold and the underlying borrowing is repaid early or re-scheduled.

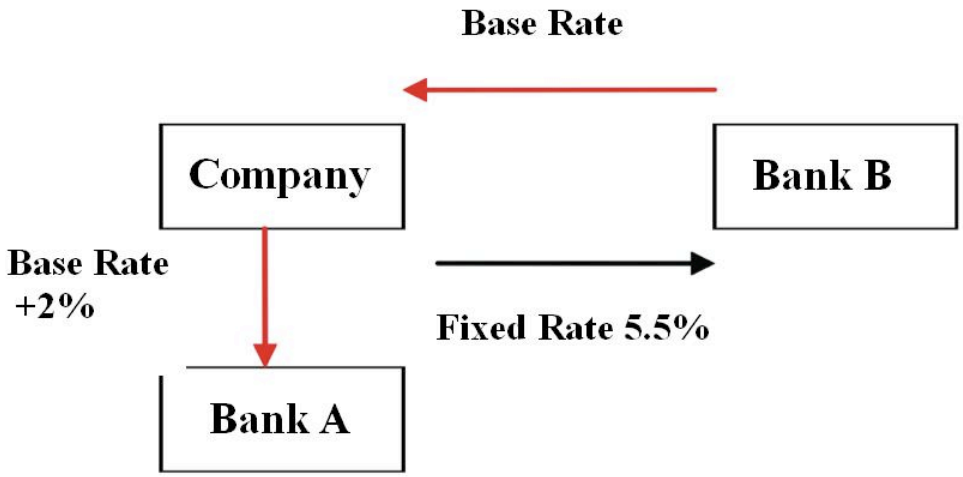
Base Rate Swap

Base Rate swaps are used by a number of businesses to manage their interest rate exposures. The Base Rate swap provides a means of converting floating rate (Base Rate) debt to fixed rate debt. For the two parties involved, it is a contractual agreement whereby they exchange a series of payments based on different interest rate indices, but on a common notional principal. There is no exchange of principal, only an exchange of interest payments.

Company’s Application

Company XYZ has a £1 million 15 year bank loan with an agreed loan margin of 2% over Base Rate (Assume the current Base Rate is 5.75%.). Whenever base Rate changes, your borrowing rate will be adjusted to the new level, and the risk to your company is that Base Rate moves up for part or all of the 15 year loan period. The Cooperative decides, in this case, to fix the rate by using Base Rate Swap. The Bank quote a fixed rate to pay the Base Rate in exchange. The swap covers only the Base Rate linked element of the borrowing costs and excludes any borrowing margin payable.

Once the Cooperative entered into this agreement, irrespective of interest rate movements in a specified period, will pay a fixed rate borrowing (for example 7.5% equal to 5.5%+2%).



Features

- *Independent from underlying loan*. A Base Rate **swap** is not a commitment to borrow. Therefore a separate decision can be made as to how and where to borrow, and how to manage interest rate exposure.
- *No up-front fee is payable*. Unlike some other forms of interest rate protection (e.g. interest rate **caps**), there is no fee payable.
- A fixed rate provide *certainty* for your interest costs.
- *Very flexible*. Interest rate **swaps** can be tailored to suit the borrower's specific debt repayment profile.
- *Can be reversed at a future date*. An **interest rate swap** can be unwound at the prevailing market rates to reflect changes either to the interest rate risk management strategy or underlying borrowing structure. Although this might result in a cost at the time of unwind, in this way a customer can, nevertheless, seek to change their interest rate management strategy depending on how their views on future interest rate movements have changed. Potential breakage costs Additional costs may be incurred in the event that the customer wishes to come out of this arrangement, based on prevailing market

conditions, such as interest rates and market expectations of future interest rate changes. This could be the case where, for example, the asset being financed is sold and the underlying borrowing is repaid early or re-scheduled.

If you are **hedging** an **interest rate exposure**:

- You will be exposed to interest rate risk if there is a mismatch between the start dates or end dates of the underlying debt and any interest rate protection. This mismatch may be caused by circumstances such as a deferred start to the agreed protection or alternatively by delay in drawing down the loan.
- You will be exposed to interest rate risk if there is a difference between the value of the debt that is to be protected and the notional principal of your interest rate contract.
- If you enter into an over-the-counter derivative transaction and decide to close out the transaction before its scheduled termination date, you may have to pay breakage costs. These will be calculated by reference to prevailing market conditions and include costs incurred by the Bank in terminating any related financial instrument or trading position. Please note that such break costs may be substantial.
- Where you enter into a derivative transaction for the purposes of **hedging** debt and you subsequently wish to repay the debt (whether through a refinancing or otherwise) or discharge all other obligations, you should be aware that it may be necessary to terminate the **hedging** transaction prior to its scheduled termination date and satisfy any liabilities that you have with the Bank with respect to such transaction (including break costs) before release of any security you have provided with respect to such liabilities.
- You are acting for your own account and will make an independent evaluation of the transactions entered into and their associated risks, and you should seek independent financial advice if unclear about

any aspect of the transaction or risks associated with it and you place, or will place, no reliance the Bank for advice or recommendations of any sort.

- You should request the Banks terms of business.

2.3.3 Financial Ratios in Agriculture

Assumed that farmers requires better records and needs to analyze better the performances of their activity let's try to focus, in this section the financial ratios that they have to look for. The Farm Financial Standards Council identified the following five critical areas for analyzing financial performance:

- repayment ability or capacity
- liquidity
- solvency and collateral
- profitability
- financial efficiency

Repayment capacity is the ability of a business to support a living, meet all expenses and debt payments, replace depreciating capital assets, and prepare for the future through business investments and retirement plans. The essence of repayment analysis is comparing capacity to requirement, or the earnings available to meet debt obligations to the total of annual debt payments and capital investment. For this goal *the term debt and lease coverage ratio* is the most used. The experiences indicates the greater the net earnings to cover debt payments, the easier an operation can handle unforeseen expenses, which lower the risk. A ratio greater than 150% is low risk, between 110 and 150% is acceptable and less than 110% is high risk. Another measure for the repayment analysis is *the capital replacement and term debt repayment margin*. The significance of non-farm income can be measured by comparing the level of non-farm revenue to the margin. If the margin approaches 0 or <0 when net farm incomes is deducted, this indicates a heavy reliance on outside sources of repayment. The margin should also be compared to annual depreciation expense. If depreciation is greater than the margin, it may indicate insufficient capacity to replace capital assets such as

machinery and equipment. Conversely, a small amount of depreciation and a large margin may indicate deferred maintenance on the machinery line. Another ratio measuring repayment capacity is *the debt payment/income ratio*, that measures the ability of a business to service debt over the term of a loan. This is calculated by dividing total debt payments by the adjusted farm and non-farm income. Since a heavier debt burden reduces an operation's flexibility and increases risk, a ratio of less than 25% is low risk, between 25 and 50% would be average risk, over 50% is recognized as high risk. Strategies to improve repayment capacity ratios are :

- reduce operating expenses
- increase off-farm earnings
- restructure debt
- increase net farm income through:
    - improved quality, price or amount of procuction
    - more effective marketing
    - sale of capital assets (short-run strategies)

Liquidity is defined as the availability of cash and near-cash assets to cover short-term obligations without disrupting normal business operations. The main ratio that measures liquidity status is considered to be *the current ratio* obtained dividing current assets for current liabilities. Generally a ratio >1.50 is considered low risk, between 1.00 and 1.50 is average and less than 1.00 is high risk. The improvement of this ratio can be obtained managing better the timing of cash inflows and outflows. A second common measure is *working capital* that is simply the difference between current assets and current liabilities. There's no level preferred in this case because is just a measure not a ratio but generally higher is the best because makes the business more flexible. The *working capital Rule* makes working capital a ratio through express it as a percentage of business expenses and establish that a level of at least 20% of total annual operating expenses is good enough. To increase an operation liquidity, a business can:

- structure debts to carefully balance operating needs and long-term debt reduction
- reduce production costs

- sell assets
- develop and follow marketing plans to_
    - match timing of cash flows
    - increase operating profits

Solvency addresses the relationship between assets and obligations, including the respective investment levels of both owners and creditors. *The debt-to-asset ratio* is calculated dividing total liabilities by total assets. It measures the level of debt held by outside sources. A ratio of less than 30% is considered low risk, 30 to 55% is average and >55% is high risk. If this ratio increase the chances of insolvency increases too with the management capability. *The equity-to-asset ratio* measures the owner's investment level in the business and it's simply the total equity over total assets. It is the reverse as the previous ratio. *The debt-to-equity ratio* is calculated dividing total liabilities by total equity and it represent how the ownership of the farm is divided (in shares) between owners and creditors. Strategies to increase equity and reduce leverage include:

- make additional principal payments, where prudent
- avoid unnecessary capital expenditures
- increase operating profits through a combination of:
    - increasing prices, quality, volume, or added value to production
    - improving production efficiencies

Profitability compares business revenues against all economic costs and evaluates how productively a business is utilizing its resources, both capital and human. A good measure that relates the business with profits is *the operating profit margin ratio* that relates profits realized to income generated. Is calculated dividing net farm income, adjusted for interest and operator management fee by gross revenue. As profit rise, repayment capacity, liquidity and solvency also improve, so a ratio of 25% or grater is low risk, between 10 and 25% is average and less than 10% is considered high risk. It is also useful to compare profits to the business resource used to generate them. A ratio that represent this is *the return on assets (ROA)*. Calculated dividing net farm income from operations,

adjusted for interest and family living expenses, by average total farm assets. Commonly a ROA > 5% is considered very good, from 1 to 5% is average and less than 1% is very weak. *The return on equity (ROE)* measures how well the owner's investment in the business is generating net income. The high volatility of owner equity across business doesn't drive us to benchmarks, the best way to evaluate it is through comparables. The following strategies can be used to increase profitability:

- aggressively monitor and increase efficiencies of production costs
- reduce unproductive capital or human assets
- reduce costs
- improve revenue through increased volume or quality of production
- better manage interest rate risk and interest costs
- reduce management draws
- improve working capital to take advantage of cash discount from suppliers

Financial efficiency measures how efficiently a business uses its productive capabilities. The key ratio of financial efficiency is *the operating expense/revenue ratio.* It is calculated by dividing total operating expenses (excluding total interest costs and depreciation) by gross revenues. An operation is considered very efficient is have a ratio <65%, an average operation has a ratio between 65 to 80% and more then 80% results to be inefficient. *The interest expense ratio* measures the percentage cost of debt in the operation. It is calculated by dividing interest expense by gross revenue. If the ratio is <12% it is very good, from 12 to 20% is acceptable, more than 20%is unhealthy for the business. *The depreciation expense ratio* measures the percentage cost of depreciable capital assets, or machinery and equipment. This ratio is calculated by dividing depreciation expense by gross revenue. *The asset turnover ratio* relates the asset and revenues and it is calculated dividing revenues over total assets. Companies with low profit margins tend to have high asset turnover, those with high profit margins have low asset turnover. This ratio is more useful for growth companies to check if in fact they are growing revenue in proportion to sales. High volume and low per-item margin

businesses increase if profits by increasing the through put when prices remain constant. *The net farm income from operations ratio* is the fraction of the euro left after deducting the percentage of expenses, interest and depreciation. It is calculated by dividing net income from operations by gross revenue. Higher is better. Strategies to increase financial efficiency includes:

- aggressively monitoring and reducing production costs where prudent
- increasing the quality, amount and value of production
- improving marketing practices
- properly structuring debt

Critical areas of financial performance	Ratios
Repayment capacity	• Term debt and lease coverage ratio (low risk if >150%) • Capital replacement and term debt repayment margin (heavy reliance on outside sources of repayment if ≤0) • Debt payment/Income ratio (low risk if <25%)
Liquidity	• Current ratio (low risk >1.50) • Working Capital (the Californian rule: >50% of annual operating expenses)
Solvency and collateral	• Debt –to –asset ratio (low risk if <30%) • Equity –to –asset ratio (low risk if >55%) • Debt –to –Equity ratio (low risk if <42%)
Profitability	• Operating profit margin ratio (low risk if <25% if it is mostly owned) • Return on asset (good if <5%) • Return on equity
Financial Efficiency	• Operating Expenses/Revenue ratio (efficient operation if <65% if it is mostly owned)

- Interest expense ratio (good if cost of debt <12%)
- Depreciation expense ratio
- Asset turnover ratio
- Net farm income from operations ratio (higher is better)

If we try to make a cross financial ratios analysis we will be able to recognize signal of unhealthy businesses. In Agriculture there are two many common situations of financial troubles:

(1) The Double Dip of Death: with debt-to-asset ratio>50% and operating expense/revenue ratio>80%

(2) The triple witch: with Debt-to-asset ratio>50%, operating expense/revenue ratio>80% and government payments>50% of the net farm income.

3.

THE SPECIFIC CASE: OLIVE OIL COOPERATIVE IN THE SOUTH OF ITALY

3.1 INSTRUMENT FRAMEWORK

In the analysis of this case study, my approach concern of a panoramic analysis of the Cooperative health from a point of view of trading and for second, I analyzed the risk component of the sector and the operator in particular.

3.1.1 Risk as vulnerability

The measure of vulnerability can be recognized in the simple quantitative assessment of risk, including climatic risk, in agriculture. According to White (1994), agronomists and engineers (for instance Nash and Nash, 1995) tend to define risk as a loss, while economists tend to use the word as a synonym of "probability of occurrence of a damaging event".

We start with the simple definition below. For a given factor (or *stress*), we have

*Average loss / annum = Average number of events / annum * Average loss / Event*

which we can rewrite as

$$Risk = Frequency * Vulnerability$$

where the loss can be expressed using different units (for instance loss of agricultural production in metric tons, loss of human life, loss of income, etc.). If losses can be due to several different factors, the unit acts as a common denominator, which is a convenient way of expressing a combined loss. Most geophysical factors can be expressed on a scale of intensities, in which case the definition above applies for each intensity (discrete case) and becomes

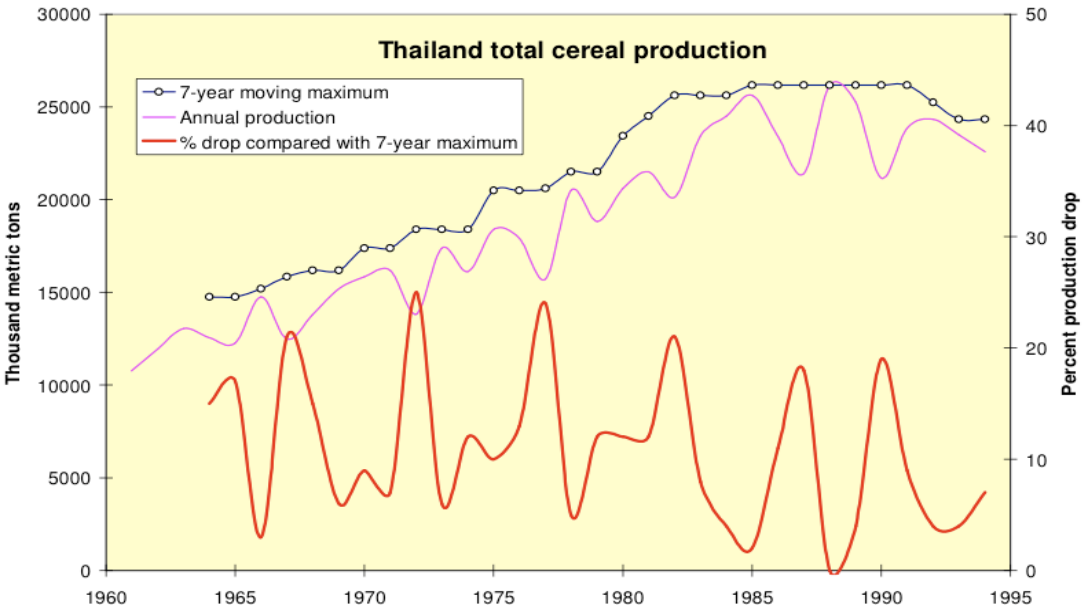
$$Total\ risk(\text{loss/annum}) = \Sigma i\ (Frequency\ i * Vulnerability\ i)$$

According to the definitions adopted here, total risk and impact are roughly synonymous. The total risk, for the factor under consideration, is the sum of the risks associated with each intensity. Again, the asymmetrical curve is typical. Most real world examples would be considerably more skewed than shown in figure 2, resulting in the largest portion of risk (losses) being due to relatively low-intensity factors (chronic risk), while extreme factors, i.e. by definitions those with a low probability of occurrence (major risks), have a relatively minor impact in absolute terms. If we try to estimate and quantify losses due to vulnerability, an attempt can be made to estimate how much production is lost currently because of the variability of climate. The following methodology was followed:

- take a national production time series
- for each year Y, take the maximum production value Pm in the 7-year interval from Y-3 to Y+3
- compute the difference between the production P of year Y and Pm, and express it as a percentage "loss": (Pm-P)/Pm*100%.

The approach assumes that no marked technological progress took place in the seven-year period. An example for Thailand is shown in below: the "loss" varies between 0 and about 25% and shows a slight downward trend probably due

to stagnating productions since 1980.



3.1.2 Essentials of rainfall insurance

For understanding rainfall insurance it is necessary to establish and define a profit function and how profit vary with rainfall. In classical insurance, indemnities are calculated on the changing in the marginal profit of the business. In this case, this kind of measuring can be very costly and imprecise so it results better to calculate a fixed payoff associated with a specific event was assumed.

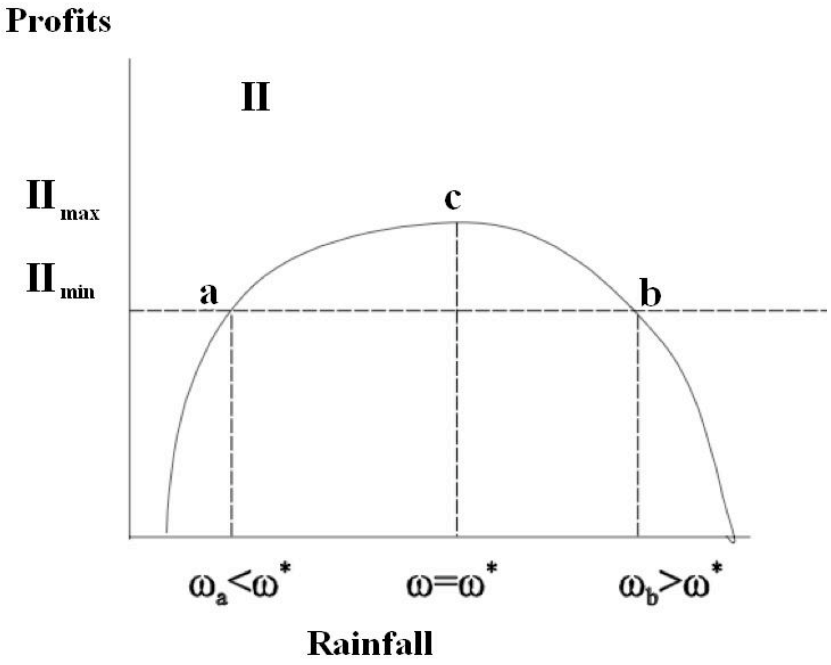
Draught insurance relies on the strike value (elected coverage level) of rainfall and its relationship with the underlying probability distribution or stochastic process that determines the frequency of specific rainfall events.

The literature suggests Calum G.Turvey to be one key researcher about the specific event risks hedging. In particular, Turvey's work are focused on the rainfall insurance and are based on a quite simple model of pricing. Assume that the farm profits are represented by $\Pi(\Omega|\omega)$ where ω is the rainfall event and Ω is the set of resources used in production. Profits are determined from revenues $P^*Y(\Omega|\omega)$ minus costs $C(\Omega|\omega)$ and both are considered to be conditioned by the rainfall and can be expressed in terms of ω.

It is assumed that **Y()** is concave in **ω** while **C()** is convex in **ω** which implies that as rainfall increases **dY/dω>0** up to some point at which **ω*** is optimal, **dY/dω=0**, and then **dY/dω<0**. This assumption admits that rainfall insurance does not apply to draught conditions alone, but also can be applied to specific event of excessive rain. The convexity argument in the cost structure is justified by a symmetric argument. There will be some **ω*** such that **dC/dω=0**. For **ω<ω*** costs will be increasing as the costs associated with drought (labour, capital and energy costs associated with irrigation) increase and for **ω>ω*** costs associated with excess rain (for example capital costs of tiling or drainage, down time etc.) are incurred. Marginal profits are the equal to

$$(1) \qquad \partial \Pi(\Omega|\omega)/\partial\omega = P\partial Y(\Omega|\omega)/\partial\omega - \partial C(\Omega|\omega)/\partial\omega$$

and will be convex with $\partial \Pi(\Omega|\omega)/\partial\omega>0$ for $\omega<\omega^*$, $\partial \Pi(\Omega|\omega)/\partial\omega=0$ for $\omega=\omega^*$ or $\partial \Pi(\Omega|\omega)/\partial\omega<0$ for $\omega>\omega^*$. The relationship between rainfall and profits is depicted in the figure below that shows a possibility frontier, all other things being equal.



At Point *c* the marginal impact of rainfall on profits is zero, and for rainfall above and below this point marginal profits decrease at an increasing rate as rainfall becomes too little or too much.

From the end users' perspective **Πmin** in figure depicts a critical profit level which needs to be protected. The insured can select a put option which would provide an indemnity if rainfall falls below **ω(a),** a call option if rainfall exceeds **ω(b)**, or both (collar). In general the price of these contracts (in the absence of time value) would be

$$V_{put} = \int^{\omega a} \Pi'(\omega)\ (\omega_a - \omega) f(\omega) d\ \omega \quad \text{for} \quad \omega < \omega_a$$

$$V_{call} = \ {}_{\omega b}\int\ \Pi'(\omega)\ (\omega - \omega_b) f(\omega) d\ \omega \quad \text{for} \quad \omega > \omega_b.$$

The two equations above rely on several factors to be priced. First, **f(ω)** represents the probability distribution function which describes rainfall throughout the growing season; second the insured must have some idea of the specific event to be insured. For the put option in the first equation, the specific event **ω<ω(a)**, and for the call option in the second equation, the specific event is given by **ω<ω(b)** where **ω(a)** and **ω(b)** are strike levels. The third element is the absolute value of **Π'(ω)** which will increase as rainfall moves away from the optimum. As written in the equation for put and call option, the pure-form derivative product would increase compensation at an increasing rate as the option moved further into-the-money. While theoretically precise equations above are not very practical since in practice they require the *a priori* examination of the profit-rainfall response function **Π(ω)** and its derivative **Π'(ω)**. It is unlikely that producers, insurers, brokers or reinsurers would demand such precision, and the estimation would require significant cost and time.

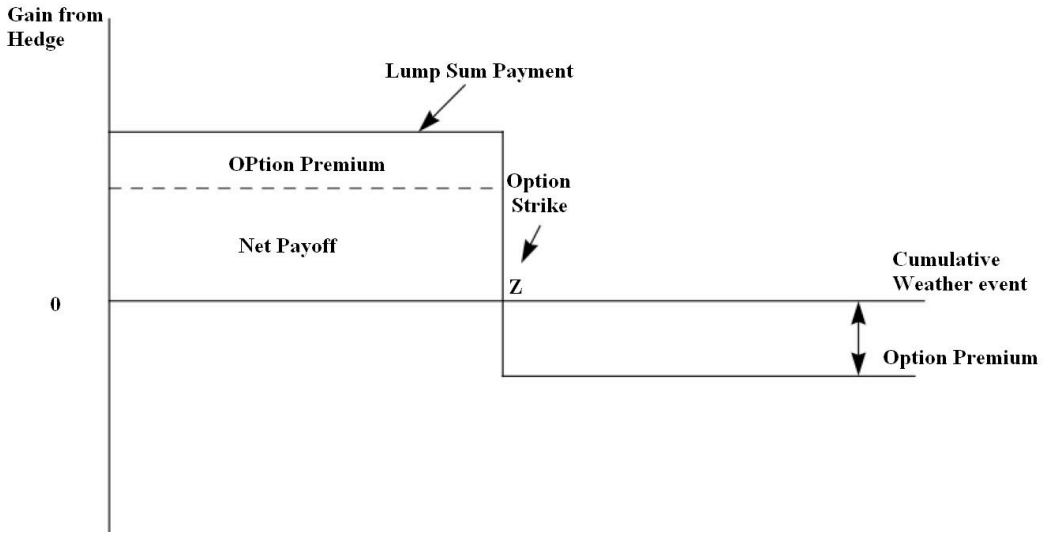
In practice, **Π'(ω)** will be defined by the end user (purchaser of rainfall insurance) as a constant dollar amount, Z, applied to each in-the-money outcome; that is the option would be priced according to

$$V_{put} = Z \int^{\omega a} (\omega_a - \omega) f(\omega) d\ \omega \quad \text{for} \quad \omega < \omega_a$$

$$V_{call} = Z\ {}_{\omega b}\int (\omega - \omega_b) f(\omega) d\ \omega \quad \text{for} \quad \omega > \omega_b$$

In formulations above, the integral calculates the expected value of the option when it is in the money: E[Max(ω(a)-ω,0)] for a put option with units of

rainfall (inches or cm or mm), while for the call option is E[Max(ω-ω(b),0)]. The value **Z** (with units €/mm etc.) is established perhaps as the expected value of **Π'(ω)** over the entire range of **ω** when it is in the money. It could also be a measured average cost derived from accounting and production records, or simply as a subjective allocation. An alternative to the simple call or put option is represented by *the lump sum option*. The value **Z** may be a fixed payoff on a specific event. By setting ω(a)-ω=1 and ω-ω(b)=1 in the equations above, the options are converted to a form in which the premium equals the cumulative probability of the event happening times the lump sum payoff assigned to the event. Alternative option can be much more specific. As it is showed in the figure below, the payoff function equals a loss of the premium if the event does not occur, and the total lump sum payment less the premium if the event does occur.



Another alternative to the option-like rainfall insurance products described by the equations above is the all-or-nothing option. This Option is triggered as soon as the rainfall measure becomes in the money. Once this event happens a fixed payout is made. The all-or-nothing option is given by

$$V_{put} = Z \int^{\omega a} f(\omega) d\,\omega \quad for \quad \omega < \omega_a$$

$$V_{call} = Z \int_{\omega b} f(\omega) d\,\omega \quad for \quad \omega > \omega_b$$

where the integral term measures the cumulative probability of the event

happening.

There are three requirements to calculating the premium of a rainfall insurance product. The first is a determination of the dollar value placed on the event happening, i.e. **Z** or **Π'(ω)**. The second element is to determine the criteria for the vent; if the insurance is to insure that no rain occurs over a 14 day period, then the appropriate measure of risk would be the daily record of rainfall; if the derivative is designed to insure that at least 1'' of rain falls in a seven day period then the appropriate probability measure would be based on cumulative rainfall. The third element is the definition of the probability distribution or stochastic process which defines the risks and outcomes associated with **ω**.

The most practical approach, and one that is used in practice is to use historical time series to compute probabilities. The most common approach, often referred to as the *"Burn Rate"*, assumes that history will repeat itself or that there is a form of mean reversion which allows for the use of history to calculate the present with reasonable precision. In alternative, a normal distribution could be used. With a large number of observations the use of normal curve theory could approximate the *burn rate*, but it should be understood that the difference between the two approaches is that normal curve theory assumes that history repeats itself over an infinite time horizon whereas the burn rate assumes this repetition only for the period in which data is collected.

The specific details of an insurance contract has at least three elements: 1) the insured events, 2) the duration of the contract, 3) the location at which the event is measured. The contract would go on to stipulate the indemnity or payoff should the specific event happen. Once the terms have been established the product will be sold with a negotiated price.

3.1.3 The Methodology

The Methodology I used in the effective implementation of the theories described in the previous sections takes hint from the seven point for an insurance pilot cited by the CRMG. The Commodity Risk Management Group (CRMG) has drawn some lessons from its work to begun to develop a standardized approach to pilot implementation as well as contract design. While this approach is still evolving, there are seven basic components of pilot program implementation that need to be undertaken in order to develop a product that is not only technically sound but is demanded and can be afforded by clients:

1. Identify Potential pilot areas and carry out basic risk assessment. First, identify the targeted area and clientele for the pilot program including the crop (s), weather stations and potential clients. Second, carry out a quick initial assessment of the available data and risks to the clients and crops. This will dictate both the technical design of the contract and the operational arrangements for implementation.
2. Identify delivery channels for reaching the end users. Identify an Institution, such as bank, MFI, farmer organization etc., that can efficiently and cost effectively deliver this product to farmers. This institution must have both sufficient outreach to provide marketing and education to clients and te organizational capacity to handle a new financial product
3. Design Contracts. Design prototype contracts for the given weather station and client. These design process should ultimately aim to design a contract that acts as the most accurate proxy for the client's risks while taking into consideration the premium that a client is willing to pay.
4. Determine the marketability of the product. Discuss the prototype contracts with potential clients and stakeholders to determine their interest in insurance, willingness to pay for the contracts, and how closely the initial contracts match their risk. Since the initial

contracts are only prototypes, this is a critical step to determine if the product design is appropriate and if there is demand for the product.

5. Finalize contracts and insurance. Revise and finalize the contract structures based on the field research and discussion with clients. After the contracts are finalized, insurance arrangements with participating risk takers (insurers and reinsurers) and contracts will be drawn up.
6. Market the product. Market the product through the different delivery channels for the pilot. In order for farmers to purchase the contract, they must not only be aware of the product but also understand the product. In most cases marketing will require a substantial educational component.
7. Monitoring the pilot. Monitor the program in order to detect any unanticipated outcomes, determine if all participating stakeholders are meeting their commitments, and determine the performance of the contract.

Because of the experimental structure of this work, my analysis stops to the fourth point, and all the simulation that can be done in this seat could be never match the market rules.

3.2 THE CASE

All the assumption made until this point of my works are perfectly reflected in the real agricultural environment. Until now we just talked about the poor or developed Countries but I want to report the issue in a nearest reality. “Think globally, act locally” seems to describe this process of transposition that assume the South of Italy to be an underdeveloped (in terms of economic growth) part of a developed Countries.

The average GDP per capita in Northern Italy can far exceed the EU average (an example of this could be the Province of Bolzano-Bozen with a 2006

average GDP per capita of €32,900 (US$ 43,861), which is 135.5% of EU average), whilst some regions and provinces in Southern Italy can be considerably below the EU average (such as Campania, which has an average GDP per capita of € 16,294, or US$ 21,722).

Southern Italy continues to be the least prosperous area of Italy. Problems still include corruption, organized crime and high unemployment. Southern Italy includes 37% of Italy's population, occupies 40% of its land area, but only produces 24% of its gross domestic product. This does not, however, include the large underground black economy reported to be as high as 30% of GDP.

During the 1940s, 50s, 60s and 70s, the economy of Southern Italy has had a remarkable growth. Unemployment has been decreasing, since the 2003 controversial "*Biagi law*", as unemployment in Campania has fallen from 23.7% in 1999 to 11.2% in 2007, and in Sicily from 24.5% to 13%.

Today, Southern Italy has Italy's lowest GDP per capita, that of € 16,300-16,600 in 2006, and a 2003 GDP nominal of US$369 billion. The area's richest region, Campania, has a GDP nominal of € 94.3 billion in 2006, and a GDP per capita of € 16,294.

Region	**PPP per capita income (EU27 average=100) (2007)**	**Unemployment rate (2009)**
Abruzzo	85.3	9.7
Apulia	66.8	13.6
Basilicata	75.1	11.3
Calabria	65.8	11.7
Campania	65.9	13.4
Molise	77.9	9.9
Sardinia	78.4	14.1
Sicily	66.0	14.3
Italy	**103.8**	**7.9**

In particular this analysis took place in Apulia that in 2009 reached a GDP per capita of about 16,700 while Lombardy (an average North Italian region for income) in the same year reached 31,700, almost two times. Among the regions of the South, the economy of Puglia is one that has in recent years the better trend. GDP growth according to ISTAT data, represent a +1.8% (+1.5% in Italy and +0.7% in the South) due mainly to the growth of the tertiary sector (+2.9%) and industry (+0.7%) despite a noticeable fall in the agricultural sector (-8.8%). This data are consistent with the rest of the analysis reported in this work: there's a growing trend in the removal of the agriculture as concept of "*engine for growth*". Improvements in the sector represent an effective answer to the question: How Puglia can sustain his growth in long-run perspective?

In comparison with the country as a whole, the economy of Apulia is characterised by a greater emphasis on agriculture and services and a smaller part played by industry. The share of gross value added generated by the agricultural and services sectors in the total gross value added of the region is above the national average in 2000, whereas the share of industry is below.

3.2.1 The Olive Oil Cooperative

The Cooperative mill "Coltivatori Diretti" from Sannicandro di Bari founded in 1963, situated in a town on the first "large step" in the Murgia close to Bari (Puglia). The choice made by farmer to found a Cooperative was driven by the assumption that they produce all the same product. So, the Cooperative is a mono – culture producer: The Extravergine Olive Oil. The high quality of the product is testified by the chemical tests and by the recognition, at international level of a high quality brand. The quality – oriented product pushed the Cooperative to adopt the highest standards in the production process but the farmer results to be unable to sell the product at a high price. During the years they shift their production from domestic consumption destination to Multinational firms. Right now they sold the 20% of the production in the

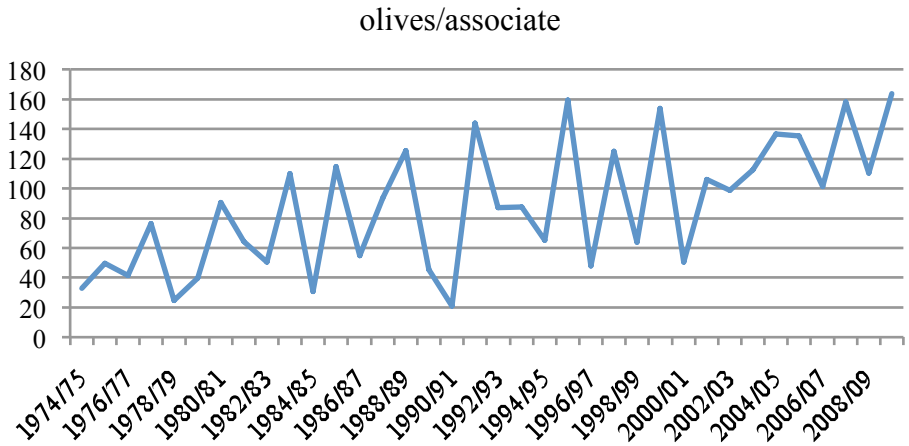
domestic market at the price established by Institutions and the 80% of the production goes to Multinational at about the half price. This pushed the average price of the oil sold lower years by years and the associates progressively left the Cooperative. The correlation between the price and the number of associates is around 0.68 so we can easily assess that the progressive leaving of the farmers from the Cooperative was caused by the ineffective capability of the Cooperative of being competitive in the market.

Table 1

Oil campaign	Olives produced	Oil produced	Average yield	Oil price	Associates
1974/75	4,952.58	1,043.39	Kg. 21,100	£.165.000	150
1975/76	9,050.01	1,648.32	Kg. 18,215	£.160.000	182
1976/77	8,645.14	1,433.96	Kg. 16,600	£.210.000	208
1977/78	19,219.89	3,787.08	Kg. 19,700	£.180.000	251
1978/79	6,168.95	1,187.01	Kg. 19,250	£.230.000	251
1979/80	9,986.77	2,008.61	Kg. 20,110	£.250.000	250
1980/81	22,638.98	4,358.62	Kg. 19,250	£.280.000	250
1981/82	16,570.81	3,705.99	Kg. 22,360	£.320.000	257
1982/83	14,260.46	3,345.36	Kg. 23,500	£.380.000	282
1983/84	31,065.96	4,791.75	Kg. 15,425	£.360.000	282
1984/85	8,835.16	1,592.76	Kg. 18,030	£.465.000	287
1985/86	29,540.56	4,944.95	Kg. 16,750	£.420.000	258
1986/87	14,157.56	2,753.72	Kg. 19,450	£.490.000	258
1987/88	24,140.98	4,568.41	Kg. 18,950	£.450.000	258
1988/89	31,669.82	6,494.50	Kg. 20,500	£.500.000	252
1989/90	12,215.41	2,351.14	Kg. 19,250	£.520.000	270
1990/91	5,725.98	1,046.41	Kg. 18,280	£.936.000	273
1991/92	40,834.82	8,434.12	Kg. 20,650	£.470.000	284
1992/93	26,304.71	5,138.37	Kg. 19,550	£.520.000	302
1993/94	28,033.01	5,409.84	Kg. 19,310	£.515.000	320
1994/95	20,466.72	4,093.80	Kg. 20,000	£.550.000	315
1995/96	50,287.50	10,221.42	Kg. 20,350	£.800.000	315
1996/97	15,058.32	2,690.49	Kg. 17,900	£.720.000	315
1997/98	37,964.67	7,182.42	Kg. 18,920	£.500.000	304
1998/99	19,040.68	3,697.12	Kg. 19,415	£.500.000	299
1999/2000	44,899.39	9,229.79	Kg. 20,560	£.450.000	292
2000/01	13,945.50	2,521.47	Kg. 18,080	€.240,00	276
2001/02	28,673.66	5,234.87	Kg. 18,260	€.260,00	270
2002/03	26,636.60	5,336.06	Kg. 20,030	€.290,00	270

2003/04	26,981.86	5,271.28	Kg. 19,540	€.320,00	240
2004/05	32,780.91	5,722.87	Kg. 17,460	€.320,00	240
2005/06	28,409.78	4,548.74	Kg. 16,010	€.420,00	210
2006/07	20,684.89	3,772.62	Kg. 18,240	€.310,00	204
2007/08	31,163.18	5,514.28	Kg. 17,690	€.325,00	197
2008/09	21,046.40	3,304.14	Kg. 15,700	€.240,00	191
2009/10	31,276.57	5,041.18	Kg. 16,120	€.260,00	191

In the table above is shown an overview of what the Cooperative's situation is at the moment. The yield is quite constant but what is upward sloping is the overall production. Separating this data for the different level of associates (considering the contribution of each farmer to the overall production) a growing yield is recognizable due to the improvement in productivity caused by developing in technologies.

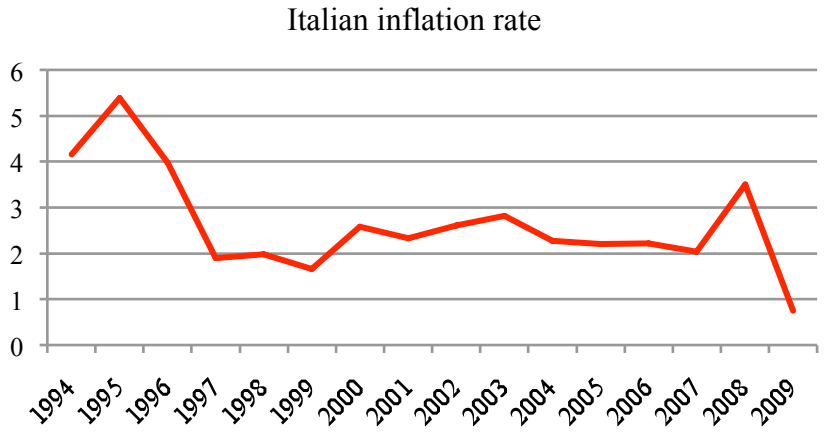


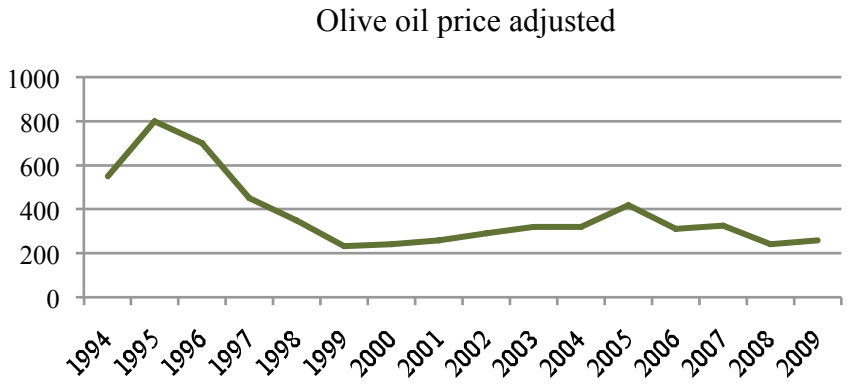
As we can deduce from the graph the olive production has a cyclical trend upward sloping. The cyclical characteristic is due to the type of culture that typically has got the year of *"piena"* (flood) with a consequent year of *"scarico"* (unloading).

The olive tree is a culture that doesn't require more attention in relation to temperature. In the area taken in consideration the temperature results to be almost constant and not determinant. What affects, more then any other weather agent, is the rainfall even if it is a xerofit plant (resistant to water stress). The fluctuations

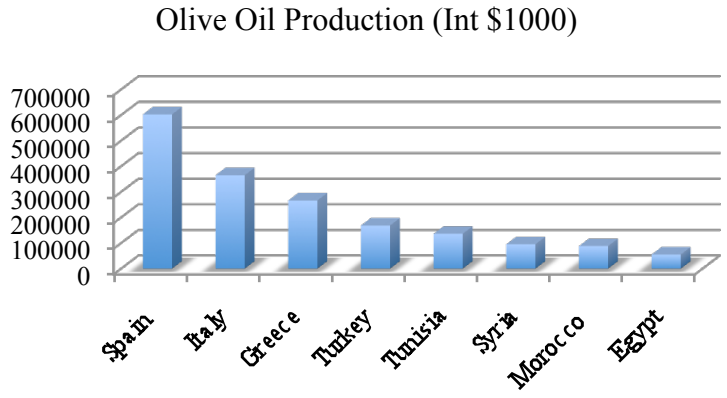
in the rainfall level determines huge variation in the crop yield. Other factors that influences in an almost decisive way are the pedoclimatic factors (responsible for the missing part in the correlation explanation). If we consider the north-African production (as Morocco) that posses a level of rainfall far below the South Italian, is even more evident the incisiveness of this factor on productivity.

The variable with the hugest fluctuations in this case results to be the price. We can retain this particular variability to be simply caused by the inverse correlation between yield and price but, in an open economy, the price of a commodity is necessarily dependent from Macroeconomic variables. For example the adjusted for PPP olive oil average price (applied from the Cooperative) results to have a correlation of almost 76% with the inflation rate trend.





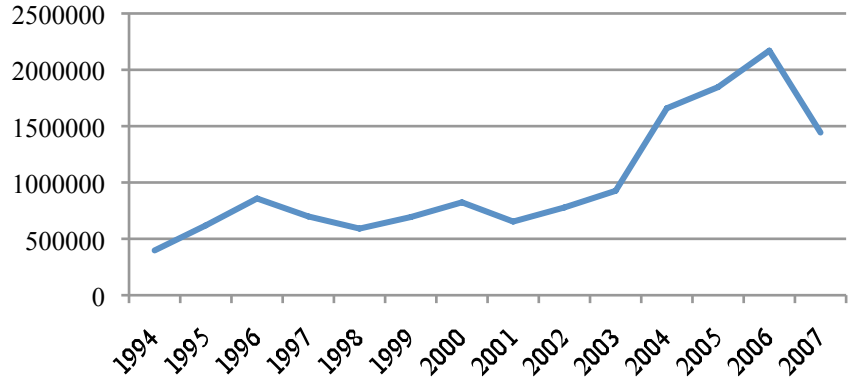
Considering that reality is far from the closed economy conception, the trend of the production of the same commodity by other countries combined with the price applied by competitors, makes the domestic price of the commodity adjusted for trade necessities. What drives the price up or down is simply the global demand that, in a global market, choose the better price-quality combination. As we can see from the table above, the price for extravergine Olive Oil, (determined by the market but within boundaries established "Camera di Commercio" – "Borsa Merci"), is decreasing over time (especially in the last 10 years). The opening of the global market and the increasing trend in olive oil production by other countries (Spain, Turkey, Tunisia, Morocco, Greece), push Italian prices down and not well balanced with domestic costs for the production. The Italian Extravergine olive oil results to have a negative correlation with the increasing of production in the rest of Europe, during the years. The international trade of olive oil doesn't make differences between different country and different costs policy. The actual situation sees Spain as the first world producer for extravergine olive oil with the lowest price (almost €2/L) and Greece at the third place with a price of €2.2/L.



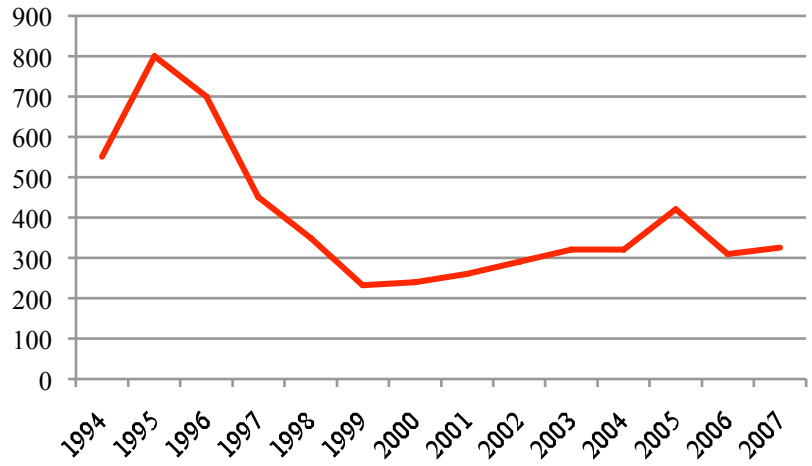
The actual situation is in excess of supply for internal market but sees a growing demand in the rest of the World

The role of Italian olive oil producer as exporter is increasing over time but, a decreasing trend in the real price (adjusted for PPP) for the commodity, can explain an evident crisis of the sector that is unable to upfront the challenges proposed by the global market.

Italian export extravergine olive oil value ($1000)



Italian real olive oil price (adjusted for PPP)



As it is showed by the figures above, a growing trend in the export value of olive oil is compensated by a decreasing price over time of this commodity. How is it possible? The inflation effect in the first graph cannot explain such this difference. The evidence is that Italy exports more, produce more (to the huge technological improvements in the sector) but the law of one market for the whole global market pushed the price at very low level, close to unsustainability for Italian farmers.

3.2.2 Risk analysis

As we can se from the table 1 there's a progressive trend in the departure of

associates from cooperative. This phenomenon is caused by the inability of the Cooperative to reach a good price for their commodity: the boundaries established by Borsa Valori (Camera di Commercio) is €4.50/l while the Cooperative sell the 80% of their production to Multinational for €2.10/l in tank and only the 20% of the production is sold at detail. This makes an average price of selling of €2.60/l that is below the fixed price for extravergine olive oil that single farmers are able to realize outside the Cooperative. Moreover the price results to be not adequate for the high quality produced by the farmer and this led to the question: Why most all of production is sold to Multinationals?

The answer is connected with the single farmers exigencies. When they bring olives to the Cooperative they ask for money as soon as possible, since Cooperative has to find how to sell the product as soon as possible turns the proposal of selling to ready buyer that results to be the Multinational. Although the Cooperative has got a storage capacity, it's impossible for them to pay single farmers in advance because of the unavailability of cash. To borrow money, as we discuss before in the same paper, results to be very costly for them, the Banks apply and higher rate for Agricultural activity because they're perceived as risky.

Trying to summarize all the types of risk related to Cooperative's activity we need to distinguish between risk associated with the Agricultural activity and risk associated with the Cooperative's product commercialization. It's basically a distinction between yield risk (for hedging agricultural activity) and price combined with financial risks that have to be faced directly by the Cooperative.

3.3 MANAGING YIELD RISK

In order to analyze the risks associated with the specific agricultural activities, it's preferable to take in consideration the balance sheet and the production of a single farmer because of the huge variability in the number of associates in the Cooperative during the years. This variability makes the data on production, earning and costs, far from the objective perceptions about the trends. Considering the example of farmer A, an existent farmer associate with

cooperative with a land of 10 hectares, let's try to understand and estimate the yield risks that have to be faced. Below is reported the trend in yield and production of a single farmer since the 1994, before that date resulted to be difficult to collect data because of the unavailability of digital records.

Year	Olives prod. (quintals)	Oil prod. (quintals)	Revenues
1994/1995	321.7	65.03	L.35,766,500
1995/1996	508.28	103.3	L.82,640,000
1996/1997	233.23	42.1	L.30,312,000
1997/1998	381.41	70.27	L.35,135,000
1998/1999	328.6	64.18	L.32,090,000
1999/2000	273.97	57.49	L.25,870,500
2000/2001	386.25	69.75	€16,740
2001/2002	525.67	102.27	€26,590.2
2002/2003	642.11	128.18	€37,172.2
2003/2004	425.19	82.39	€26,364.8
2004/2005	732.19	135.96	€43,507.2
2005/2006	585.61	93.57	€39,299.4
2006/2007	562.91	104.21	€32,305.1
2007/2008	665.74	119.78	€38,928.5
2008/2009	462.47	76.47	€18,352.8
2009/2010	622.23	98.89	€25,711.4

As we can see from the table above there's a perception of upward sloping trend in production; this is due, as we said before, to an improvement in the agricultural techniques and productivity. Correlations between rainfall and production results to be much higher than the other weather agents. Among other kinds of weather hedging in agriculture are included the CDD and the HDD but, during the years in the area object of the studies, resulted to be very stable (without huge variations) and not so incisive on the outcome of yield.

Fluctuations in the rainfall, determines uncertainty in the yield as amount (not all the farmers has got developed techniques to meet water shortages with irrigation) and in the other cases, an excessive incremental cost for irrigation that can be hedged.

It's necessary to establish how the rainfall affect yield giving different weight to the rainfall measure in relation to the growth phase of the plant. With

the help of farmers and agronomic engineers we established some criteria to assign marginal weights to rainfall amount in relation the phonological phase and it's relative contribution to the yield. The criteria for the evaluation of the weights in relation to the phenological phase, indicates as period with high relevance as water needed the efflorescence in which the pollen must have good moisture to ensure a fertile pollination.

During the winter /spring (the period of *mingolatura* and fluorescence), a prolonged lack of water could affect on the *allegagione* and increase the percentage of abnormal flowers. The other very critical period is between fruit set and veraison (of which the phase of hardening of the heart is the most delicate moment). The condition for a favourable evolution of these biological processes is made up of large amounts of water available in the soil. The lack of water during the growth phase of the olive fruit drop helps to accentuate the drops of fruits and therefore, reduce the productivity. In a very general way we can say thet the necessary seasonal inputs of water to the olive tree can be quantified in 1000-2000 cubic meters per hectare (60-80 for the adult plant every three days) in the June-September period.

The importance of the water in the others phonological stages is less important because of the conformation of the territory in question, which has reduced thickness (about 40cm) and therefore a lack of hydrological storage capacity before it gets into the groundwater. Thus, the first period to take into consideration is the so-called vegetative recovery that, according to the climate, begins at the turn of March and April, where the plant is still water retention in the soil of winter rains. During this stage the formation of flower buds begins, few rains in this period could determine flower reduction. The fertility of these flowers, which bloom in late May, early June is definitely the most sensitive stage for water stress (water shortage). In the successive phenological stage (the fruit growth) the water requirement appears to have less relevance in terms of yield, it determines a bigger fruit with less yield. It results determinant only for the following year yield. This phase runs throughout the summer from July to almost the end of September. In the last phase is so called veraison, in addition to change

in temperature (which is considerably lower) the plant has a water requirement almost irrelevant. Analyzing the production we have to remember that olive tree is a biennial crops and the production results to be cyclical, it can be hedged to a correct policy of pruning.

In light of this analysis in agronomic terms, weights have been elaborated associated to periods of 15 days (such as wheat in Morocco) with the help of mathematical regressions that maximizes the correlation between rainfall and yield.

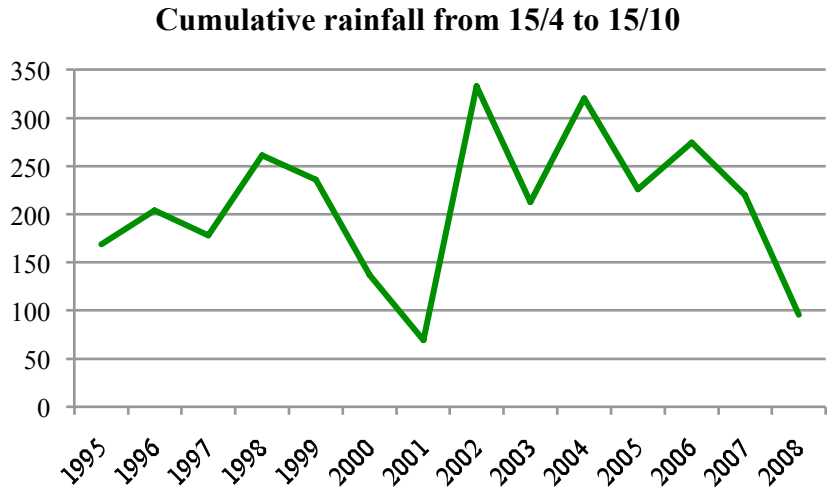
PERIOD	WEIGHT
April 15 to 30	2.2
May 1 to 15	1.6
May 16 to 31	2
June 1 to 15	2.2
June 16 to 30	2
July 1 to 15	0.8
July 1 to 31	2
August 1 to 15	3
August 16 to 31	0.5
September 1 to 15	1
September 16 to 30	1

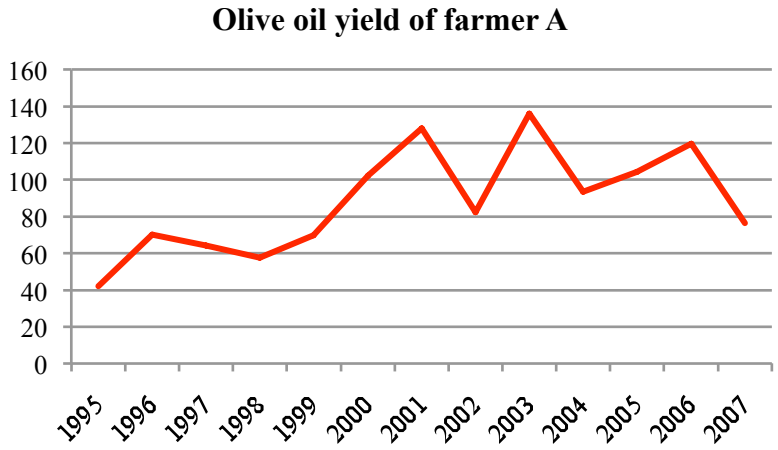
The solution to the inefficiency caused by weather is partially solved by rainfall insurance contracts or derivatives. Let's try to analyze and build a derivative based on the Farmer A's exigencies.

3.3.1 About the derivative

In this section we are trying to build a derivative to hedge against draught. We base our analysis on European type of options that will be priced using the "burn-rate" approach and will use historical observations to predict current risk. This implicitly assumes that history repeat itself in one form or another. In this simulation on a single farmer experience (that maintain his hectares of production

constant during the years) in the area of Bari, it is assumed to be the ENAV (Ente Nazionale di Assistenza al Volo) Station the only weather station in the area that has got complete information. The purpose of this section is to find a relationship between yield loss and weather event in order to make calculations on strike price trusted.





The data expressed in the tables above establish a correlation between yield and rainfall of 0.50. That is a good result in terms of dependence of the crop from the weather event in question.

The correlation between rainfall and yield, tends to rise until 65% if we multiply by the weights described above, the quantity of rainfall in the specified

period. In order to price correctly the derivative we have to establish also a relationship between the rainfall and the incremental costs it generates. The costs of irrigation for example have got a correlation of -98% with the rainfall adjusted (for the weights) so, what results necessary, is to determine the level of rainfall far from the average that for sure, determines losses in terms of yield combined with incremental costs.

Year	Rainfall weighted	Irrigation costs	Revenues – i.c.
2000	92.36	5280	11460
2001	220.24	4400	22190.2
2002	497.08	2875	34297.2
2003	282.76	4370	21994.8
2004	352.44	3720	39787.2
2005	312.98	3840	35459.4
2006	490.92	3125	29180.1
2007	391.2	3750	35178.5
2008	253.48	4420	13932.8
2009	421.42	3510	22201.4

Considering that irrigation costs accounts for more then 70% on the outcome to retain an year positive (incremental irrigation doesn't mean same yield) we can assume irrigation costs as the main parameter to quantify the losses caused by drought. Assuming €27,000 the average for revenues minus costs for irrigation and 310mm of rainfall in the period described above the strike limit under which the Farmer A incurs in undesirable outcome, we can quantify the losses in €135/mm of rain below 310mm in the considered period.

The analysis from the point of view of the farmer, doesn't match necessarily the market and the insurers, so realistically this kind of insurance should be scaled down into a more acceptable payment for mm below the strike and a possible collar structure.

3.4 MANAGING COOPERATIVE'S RISKS

Once the Agricultural activity is finished and hedged, it's necessary to provide to the commercialization of the product. Manage the price fluctuation and

avoid credit risk (borrow money) are tasks in the hands of the Cooperative that has the aim of producing the oil and find adequate buyers for their product. The main problems that the subject in question has to face are in synthesis related to the **price**, including avoiding huge downward fluctuations and finding the perfect selling strategy to reach the target price. In order to maximize their capabilities to sell is necessary to have availability of cash, it improves the contractual power of the Cooperative in relation to the time: the Cooperative can pay the farmers as soon as possible before receiving the money from the buyer (they can avoid most of the sales to multinational). In order to hedge this kind of financial problems, three levers are recommended to be used: improve the contractual condition for *borrowing* through reaching a lower rate from Banks, improve the *working capital cycle* to a different administration of cash flow and apply a more efficient (looking to forward prices) *storage policy*.

3.4.1 Hedging the price and storage policy

Before requiring a loan it is necessary for a company as the Cooperative that is affected by a propensity to the market risk, it is recommended to prove the price protection. As it was proposed in the previous chapter, two paths are recommended to hedge the price of this commodity:

- Futures
- Futures Option Contracts

Let's now take in consideration the possible scenarios in both cases of hedging.

Futures

Suppose the Olive Oil Cooperative will be selling 1000 quintals of oil two months from now. The producer knows that by selling oil for over €3.0/l, they can insure a satisfactory profit. The actual olive oil price is €3.5/l and the Cooperative believes that the oil price may drop during the next few months. By knowing the costs of production, the Cooperative knows that €3.5/l will allow for a satisfactory profit. The producers cannot sell oil now, because it's not in stock; however they

could enter the futures market and off-set any loss in value (decrease in price) with a gain in the futures market. In the scenario analysis of the consequent payout we have to take in consideration two main scenarios:

1. Cash and Futures price both decreases
2. Cash and Future Price both increases

1. Cash and Futures Price both Decrease

1. Cash Price Decreases Faster than the Futures Price (Basis Weakens)

In this scenario basis is said to be weaken. Suppose today the Cooperative could sell oil for €3.5/l and the relevant futures contract is trading for €3.8/l (basis in €0.3 under). Knowing that the Cooperative will sell at a later date and wants to protect against a price decrease, they take a short position in the futures market at this time. Over the next few months the local cash price decreases to €3.0/l and the futures price decreases to €3.3/l. At this time the Cooperative decides the oil need to go to the market. They sell olive oil in the cash market for €3.0/l and buy back the futures position for €3.3/l. Therefore, the revenue from selling olive oil is €3.0/l plus €0.5/l gain from the futures position less any commission costs (suppose to be €0.1/l). Instead of selling for €3.0/l the Cooperative sell for €3.4/l.

Cash	*Futures*	*Basis*
Today: €3.5/l	Sell olive oil contract at €3.8/l	-€0.3/l (under)
Later: sell olive oil in local market at €3.0/l	Buy olive oil contract back at €3.3/l	-€0.3/l(under)
Results	Selling Price €3.0/l Less Commission €0.1/l Plus Futures Gain €0.5/l Net selling Price €3.4/l	-€0.1/l basis loss

2. Futures Price Decreases Faster than the Cash Price (Basis Strengthens)

In this scenario basis is said to be strengthen. Suppose today the Cooperative could sell extravergine olive oil for €3.5/l and the relevant futures contract is trading for €3.8/l (basis in €0.3 under). Knowing that the Cooperative will sell at a later date and wants to protect against a price decrease, they take a short position in the futures market at this time. Over the next few months the local cash price decreases to €3.0/l and the futures price decreases to €3.0/l. At this time the subject decides the olive oil need to go to the market. The Cooperative sell the olive oil in the cash market for €3.0/l and buy back their futures position for €3.0/l. Therefore, the revenue from selling olive oil is €3.0/l plus €0.8/l less any commission costs. Instead of selling for €3.0/l the Cooperative sell for €3.7/l.

Cash	*Futures*	*Basis*
Today: €3.5/l	Sell olive oil contract at €3.8/l	-€0.3/l (under)
Later: sell olive oil in local market at €3.0/l	Buy olive oil contract back at €3.0/l	-€0.0/l
Results	Selling Price €3.0/l Less Commission €0.1/l Plus Futures Gain €0.8/l Net selling Price €3.7/l	€0.2/l basis gain

3. Futures Price Decreases at the same rate as the Cash Price

Under this scenario the price you pay is exactly equal to the price you would have paid earlier with the exception of commission. There is no basis change here and the net price is simply equal to the original price less commission.

2. Cash and Futures Price both Increase

1. Cash Price Increases Faster than the Futures Price (Basis Weakens)

Suppose today the Cooperative could sell olive oil for €3.5/l and the relevant futures contract is trading for €3.8/l (basis in €0.3 under). Knowing that the Cooperative will sell at a later date and wants to protect against a price decrease, they take a short position in the futures market at this time. Over the next few months the local cash price increases to €4.0/l and the futures price increases to €3.9/l. At this time the Cooperative decides the olive oil need to go on the market. They sell olive oil in the cash market for €4.0/l, and buy back their futures position for €3.9/l. Therefore, the revenue from selling olive oil is €4.0/l less €0.1/l lost from the futures position less any commission. Instead of selling for €4.0/l the Cooperative sell for €3.8/l.

Cash	*Futures*	*Basis*
Today: €3.5/l	Sell olive oil contract at €3.8/l	-€0.3/l (under)
Later: sell olive oil in local market at €4.0/l	Buy olive oil contract back at €3.9/l	€0.1/l (over)
Results	Selling Price €4.0/l Less Commission €0.1/l Less Futures Loss €0.1/l Net selling Price €3.8/l	€0.3/l basis gain

2. *Futures Price Increases Faster than the Cash Price (Basis Strengthens)*

Suppose today the Cooperative could sell olive oil for €3.5/l and the relevant futures contract is trading for €3.8/l (basis in €0.3 under). Knowing that the Cooperative will sell at a later date and wants to protect against a price decrease, they take a short position in the futures market at this time. Over the next few months the local cash price increases to €4.0/l, and the futures price increases to €4.3/l. At this time the Cooperative decides the olive oil need to go on the market. The Cooperative sell olive oil in the cash market for €4.0/l, and buy back futures position for €4.3/l. The revenue from selling olive oil is

€4.0/l less €0.4/l lost from the futures position less any commission. Instead of selling for €4.0/l the Cooperative sell for €3.4/l.

Cash	*Futures*	*Basis*
Today: €3.5/l	Sell olive oil contract at €3.8/l	-€0.3/l (under)
Later: sell olive oil in local market at €4.0/l	Buy olive oil contract back at €4.3/l	-€0.2/l (under)
Results	Selling Price €4.0/l Less Commission €0.1/l Less Futures Loss €0.5/l Net selling Price €3.4/l	-€0.1/l basis loss

3. *Future Price Increases at the same rate as the Cash Price*

Under this scenario the price the Cooperative pays is exactly equal to the price they would have paid earlier with the exception of commission (€0.1/l). There is no change in basis so the net price received is exactly equal to the original price less commission.

Futures Option Contracts

Reduce the price risk associated with the sale of an output in the option market means short hedge that can be reduced as the purchasing of a put option. For example the Olive Oil Cooperative knows that they have to sell olive oil two months from now. The farmers knows that by selling olive oil for more then €3.0/l they can insure a satisfactory profit. Currently, the local olive oil price is €3.5/l and the farmers believes that the price may drop during the next few months. The producers cannot sell oil now, because it's not in stock; however they could enter the options market and partially off-set any loss in value (decrease in price) with a gain in option value. In the outcome analysis of the consequent payout we have to take in consideration three possible scenarios:

1. Cash Price and Option Value both Decrease

2. Cash Price and Option Value both Increase
3. The Cash Price Changes by a Minimal Amount and the Option Value Expires

1. Cash Price and Option Value both Decrease

A decrease in the Futures price is assumed to be positively related to a change in the put option value. Thus, the option value decreases. Suppose today the Cooperative knows that they will be selling olive oil a few months from now. The Cooperative knows that given the current cash price of €3.35/l they have potential to profit. They are concerned that the price may decrease prior to selling. The Cooperative decides to purchase a €3.5/l in the money put option for €0.2/l. Later when the cooperative is ready to sell the olive oil, the cash and futures prices have decreased to €3.15/l and €3.20/l, respectively (no change in basis). The futures price has decreased such that the put option is now further in the money. Therefore the Cooperative sells the olive oil for €3.15/l and sells them put option for €0.35/l, a €0.15/l gain in value. In this case the Cooperative has improved them selling price from €3.15/l to €3.29/l (€3.15/l less €0.01/l commission plus €0.15/l gain in option value).

Cash and Futures	*Option Price*
Today: • Cash €3.35/L • Futures €3.40/L	Purchase €3.50/L Put at €0.20/L (pay €1000 plus commission)
Later: • Cash €3.15/L • Futures €3.20/L	Sell €3.50/L Put at €0.35/L (receive €1750 less commission)
Results	- Cash price received €3.15/L - Less commission €0.01/L - Plus Option Premium gain €0.15/L Net Buying Price €3.29/Kg

2. Cash and Futures Price both Increase

An increase in futures price is assumed to be inversely related to a change in the put option value. Thus, the option value decreases. Suppose today the Cooperative knows that they will be selling olive oil a few months from now. The Cooperative knows that given the current cash price of €3.35/l they have potential to profit. They are concerned that the price may decrease prior to selling. The Cooperative decides to purchase a €3.5/l in the money put option for €0.2/l. Later when the Cooperative is ready to sell the olive oil, the cash and the futures prices have increased to €3.6/l and €3.65/l, respectively (no change in basis). The futures price has increased such that the put option is now out of the money. Therefore, the Cooperative sells the olive oil for €3.6/l and sells their put option for €0.05/l, a €0.15/l loss in value. In this case the Cooperative has decreased his selling price of the olive oil from €3.6/l to €3.44/l (€3.6/l less €0.01/l commission less €0.15/l loss in option value).However, the Cooperative had the potential for unlimited gains with limited losses.

Cash and Futures	*Option Price*
Today: • Cash €3.35/L • Futures €3.40/L	Purchase €3.50/L Put at €0.20/L (pay €1000 plus commission)
Later: • Cash €3.60/L • Futures €3.65/L	Sell €3.50/L Put at €0.05/L (receive €250 less commission)
Results	- Cash price received €3.60/L - Less commission €0.01/L - Less Option Premium gain €0.15/L Net Buying Price €3.44/Kg

3. The Cash Price Changes by a Minimal Amount and the Options Value Expires

Suppose today the Cooperative knows that they will be selling olive oil a few months from now. The Cooperative knows that given the current cash price of €3.35/l they have potential to profit. They are concerned that the price may decrease prior to selling. The Cooperative decides to purchase a €3.5/l in the money put option for €0.2/l. Later when the Cooperative is ready to sell the olive oil, the cash and futures prices have changed minimally (no change in basis) and the contract month expiration date is tomorrow. Therefore, the Cooperative purchases the olive oil for €3.34 and allow his put option to expire worthless (and the Cooperative doesn't pay commission costs for allowing the put option to expire). In this case the Cooperative has decreased the price received from €3.34/l to €3.135/l (€3.34/l less €0.005/l commission less €0.20/l loss in option value). However, the Cooperative had the potential for unlimited gains with limited losses.

Cash and Futures	*Option Price*
Today: • Cash €3.35/L • Futures €3.40/L	Purchase €3.50/L Put at €0.20/L (pay €1000 plus commission)
Later: • Cash €3.34/L • Futures €3.39/L	Sell €3.50/L Put at €0.05/L (receive €0 less commission) Option expires worthless
Results	- Cash price received €3.34/L - Less commission €0.005/L - Less Option Premium loss €0.20/L Net Buying Price €3.135/Kg

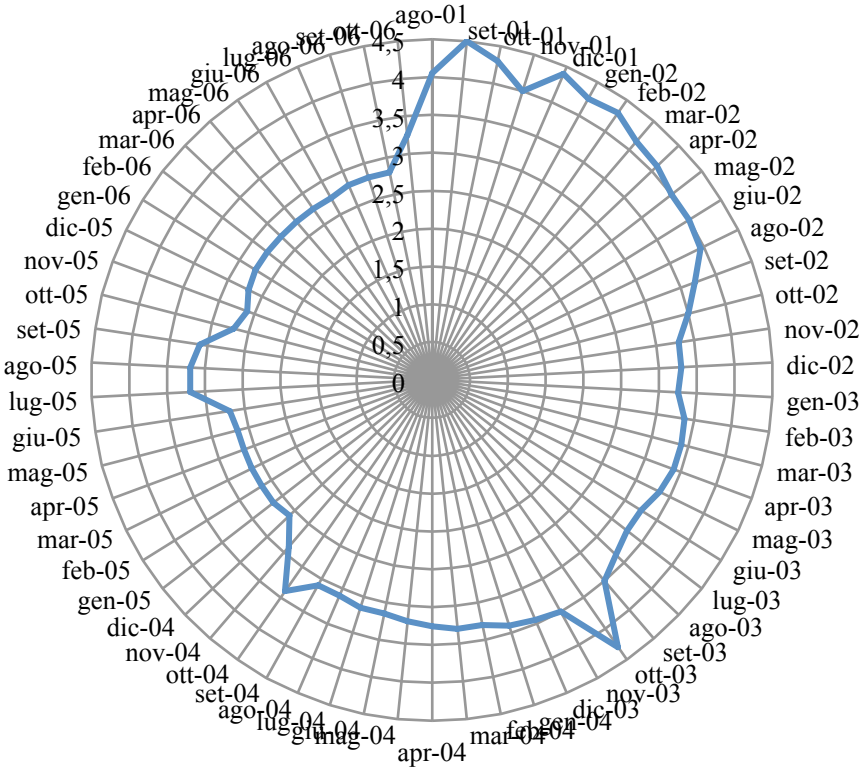
3. The exercise of a put option

In this case the futures price decreases substantially and the option premium

only realizes a modest increase in value. In this case the Cooperative wants to exercise the put option. The Cooperative wants to sell a futures contract at a later date at €3.5/l and buy back in the futures market at the current price of €3.0/l. Therefore the Cooperative would receive €3.19/l instead of the current cash price of €2.95/l. Furthermore, if the Cooperative would have sold its put option, it would have received €3.09/l because the put option only increased by €0.15/l.

Cash and Futures	*Option Price*
Today: • Cash €3.35/L • Futures €3.40/L	Purchase €3.50/L Put at €0.20/L (pay €1000 plus commission)
Later: sell olive oil in local market at €2.95/L Futures €3.0/L	Option value is €0.35/L.Therefore, exercise option at €3.5/L and Offset in Futures Market at €3.0/L for a increase in value of €0.35/L (receive €2250 less commission)
Results	- Cash price received €2.95/L - Less commission €0.01/L - Less Option Premium loss €0.25/L Net Buying Price €3.19/Kg

All the possible scenarios described above starts from the conception that someone knows where the market is going. From a certain point of view it is right, because historical data, especially in the market for commodities, tend to have a cyclical trend (for example during the year) that indicates the right periods to sell the product.



The detection of the extravergine olive oil price, with acidity less then 0.5% (the Cooperative's olive oil is 0.18% of acidity) indicates that the right period to sell the product, in terms of highest price is between October, November and December. This can be helpful in a **storage policy** perspective because helps the Cooperative to reach the highest price every year. For example with a right storage policy in 2007 (that is not the highest in terms of spread of prices) that is supposed the Cooperative to sell the 60% of the production in November and the rest of selling spread during the year, the overall outcomes (in revenues) could be €230,000 higher, that represent an incremental income of 16.5% (considering the revenue in 2007). The storage policy of course is strictly correlated with the availability of cash: it becomes possible only if it is sustained by a strong credit risk management policy.

What result difficult to manage is the internal demand for commodities that is function of too many variables to be calculated. The highest price in the early winter is due to the fact that supply of olive oil is lacking, the olive oil campaign is just finished, the *monitura* and packaging requires time and most all of farmers

have sold their product during the year without make use of the 18 month storage capacity of the olive oil. During the sale what contributes to a successful outcome is the supplier bargaining power. The Cooperative needs also to invest on a better commercialization of the product in order to spread their sale through a wider client portfolio.

The solution to avoid price fluctuations risk result to be the use of futures contracts, that are already present in the sector and often used by multinational to buy from farmers. To manage effectively the prices fluctuations an extended futures contracts strategy has to be developed. Short selling on futures market (when a basis gain is predicted) or buying a put option on futures contract represent an effective hedging strategy that generates incremental income with less dependence from the market condition.

3.4.2 Managing credit risk

As we mentioned earlier the Cooperative doesn't have enough cash available. Farmers requires money for their olive production too early and the Cooperative is pushed to sell the outcome as soon as possible and without reaching the best price. An evident necessity for the Cooperative is the availability of cash for meeting imbalances of cash. Asking to the market of credit the conditions for this king of financing is confirmed the credit market perception of Agriculture as a risky sector.

The Cooperative's situation of solvency, presents an equity to asset ratio of 0.85 (remember the benchmark we set is >55%) and a debt to asset ratio of 41% (remember the benchmark is set to 42%). This gives the banks the capacity to consider the Cooperative as a solvent subject and allow them the access to credit. Banca Carime (in according to the whole Italian Banking System) proposed two different path for giving credit to the Cooperative; fixed rate and floating rate. For the fixed rate the European parameters is the IRS (5 years) and for the Cooperative, that has got an average solvency capacity, was proposed the solution IRS+1, the rate calculated is 7.167%.

Managing a fixed rate is impossible, the only lever available for that is the

solvency and from the point of view of market trend it results inefficient. A floating rate follows the market trend and put the Cooperative in the position to meet his financial expenses with sales compensation. In Europe the benchmark for floating rate is the EURIBOR and Banca Carime proposed to the Cooperative a 10 years loan (with an easier amortization) with the rate EURIBOR +1.1%. Managing a floating rate requires some of the instruments already described above. In the Cooperative's case the most indicated resulted to be a Base Rate Cap that avoid the possibility to pay a floating rate too high but let the possibility to enjoy the benefit of a low floating part of the rate.

The interfacing with banks describes above starts from a typical situation of the company taken in consideration. The Cooperative doesn't produce for net earning (the operating benefit of the business are shared between associates), the exercise is often in parity. In the last year the Cooperative presented a negative net earning due to long run policies including investment.

	RATIOS			Benchmark
Liquidity	Current ratio		0.95	>1.5
	Working Capital	421657	0.42	>50%
	(div. for op.expenses)			California r.
Solvency	Debt –to –asset ratio		0.34	<30%
	Equity –to –asset ratio		0.84	>55%
	Debt –to –Equity ratio		0.41	<42%
Profitability	Operating profit margin ratio		-0.05	<25%
	Return on asset		-0.03	<5%
	Return on equity		-0.04	
Financial Efficiency	Operating Expenses/Revenue ratio		1.03	<65%
	Interest expense ratio		0.01	<12%
	Depreciation expense ratio		0.02	
	asset turnover		0.7	

The financial ratios presented above are described in the previous sections. What is clear from this table is that this company is not involved in a low risk business. The Current ratio is considered high risk (<1), so to manage better liquidity is necessary to restructure the inflows and outflows of the company. This

will have positive effect also on working capital, that is far below the Californian rule of 50% of the operating expenses. A solution to this inefficiency is represented by the selling of some assets that is not required them to be owned by the company. For example the Cooperative has got machinery for an amount of €1,124,500 that represent the 80% of their total asset. The technological risk that often occurs in agriculture suggest to us that lease some assets allow the firms to be every time peace with technology and peace with the level of productivity. Sell a part of their asset accompanied to a development in the marketing plan can improve the Cooperative's capabilities to match the timing of cash flows and increase operating profits.

What is critical in the financial ratios analysis is the financial efficiency. Without considering profitability (that is not the final aim of a Cooperative) the ratios indicates a low capability to make money from their asset. This suggest again as key factor for the Cooperative upgrade, the improvement in their value of production through a marketing process design to find the best buyer for their product.

Conclusions

The willpower of bring back the path of the economic growth, along the wayside of the real economy, finds its necessity in the incompleteness of the actual global market. The agricultural sector, always engine of the whole economy, is therefore in a cage built by the international trade and the impossibility of the direct control. This let the farmer in a sort of limbo with uncertainty of the future.

The constant growth of the labor costs in the Agricultural sector accompanied by an exponential increase of the production costs doesn't find the right feedback in the prices of agricultural commodities. These present a downward sloping trend that results dangerous for the subsistence of the entire system.

A collapse in the Agricultural sector could bring the system to new crises era on the financial market that, for sure, will be hard to manage. It's a duty of the financial market to sustain the real economy because on its shoulder had built the success and the expansion of a system made of bubbles.

Through the concepts expressed by the neoclassic economic literature, it's easy to discover the key role of the production factors in the growth model (Solow). The level of technology, the labor, the capital, are the main driver of the growth perspective hypothesized more then half century ago. Perhaps what have been left out is the homogeneous expansion of these concepts in all the sectors of the economy.

The poverty spread in the rural areas testifies the failure in the updating and the development of the agricultural sector. The industrialized countries show a growing unselfishness in the agricultural policies with a progressive detachment from it by the labor force, without considering the fundamental role of agriculture in our lives (just think about nutrition).

Agriculture is a risky sector, difficult to manage, that interfaces with a number of problems with uncertain resolution, first the role of ignorance in the sector's operator.

To upfront the most intractable issues is and has still to be, the main goal of the human challenges; the progress travel through the victory of impossible bets.

Activating a responsibility mechanism by whom knows how to solve problems, against those who has got such problems, evident results can be obtained.

The olive oil Cooperative taken in consideration in this work, in August activated a 10 year loan with floating rate (to upfront the imbalances of cash) and stipulated a futures contract with a multinational reaching the highest price obtained in the last 3 years (for selling in tank in the area considered). This first step toward a sector development results to be a push, even if moral, for those who support economic growth in the area considered (in Sannicandro di Beri over the 40% of the population belongs from olive oil production).

The increasing in productivity is the key concept of this paper. It wants to be a food for thought for those who believe that a non-productive activity is destined to remain so.

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