Critical success factors for weather risk transfer solutions in the agricultural sector

A reinsurer's view

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Paper prepared for presentation at the 101st EAAE Seminar 'Management of Climate Risks in Agriculture', Berlin, Germany, July 5-6, 2007

CRITICAL SUCCESS FACTORS FOR WEATHER RISK TRANSFER SOLUTIONS IN THE AGRICULTURAL SECTOR
A REINSURER'S VIEW

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Abstract

Agricultural yield and commodity prices are very sensitive to weather patterns such as drought, excessive rain, or frost. As a result unseasonable weather can cause major losses for players in the agricultural value chain, including input providers, farmers, commodity traders, and food processors. The National Crop Insurance Service (NCIS) estimates that about 70% of the losses suffered by the US crop insurance scheme result from drought or excessive rainfall. In this paper information recorded by PriceWaterhouseCoopers on behalf of the Weather Risk Management Association is complemented by Swiss Re's market intelligence to examine demand patterns for weather risk transfer solutions. There is a particular focus on the evolution of demand from the energy sector compared to the agricultural sector as a means of identifying the critical success factors needed for a prospering market. We found that recent growth in the weather risk transfer market is mainly related to speculative trading in the energy sector. Stakeholders in the agricultural sector around the world are growing increasingly interested in weather risk transfer products. However, the lack of exchange-based instruments in this field, the relatively high basis risk between weather indexes and agricultural yield, the fact that agricultural markets are still highly regulated and inadequate information and training are all impeding the growth of this business.

Keywords

Agricultural sector, weather risk transfer, demand patterns

1. Introduction

The largest exposure of the agricultural sector is related to systemic risks such as widespread drought conditions, frost and heat waves. Using loss data gathered by the National Crop Insurance Service (NCIS) from insurance companies participating in the US crop insurance market (the world's largest market providing extensive coverage for a large geographic area) we estimate that about 80% of losses recorded during 1981 - 2003 result from large-scale weather risks impacting yield over a prolonged period; i.e. drought (47%), wet conditions (22%), frost (13%). Within the last few years, drought-related losses have occurred in the US (2002), Europe (2003) and Australia (2006). For example, the hot and dry summer of 2003 caused an estimated loss of revenue to the agricultural sector in Europe of about EUR 10.7 billion (Swiss Re, 2004).

The introduction of Multi Peril Crop Insurance[1] schemes (MPCI) gave farmers the ability to protect themselves against nearly all systemic risks. This cover is widely used in the United States, Canada, Spain, Portugal, and Israel; not least due to government subsidies. Other stakeholders in the agricultural sector, such as input providers, commodity traders, food processors and farmers, working in the majority of the worldwide agricultural markets, have only limited or no access to MPCI cover and are therefore heavily exposed to weather risks. Furthermore, farmers in markets where MPCI cover is available typically carry deductibles of 25-50% of the average expected yield and hence even those farmers are, albeit to a lesser extent, exposed to the vagaries of the weather.

During the second half of the 1990s, US energy trading companies such as Enron, Aquila and Koch developed weather derivatives. These energy traders were quickly joined by banks and reinsurance companies who introduced the concept of weather derivatives and weather insurance, referred to as weather risk transfer instruments in this paper, to other industry sectors, such as agriculture, construction or tourism.

Therefore, agricultural sector stakeholders have had access to weather risk transfer instruments for the last 5-10 years. It is therefore interesting to compare the development of market demand for such instruments in the energy sector with demand in the agricultural sector. We have done this by comparing the development of weather risk transfer instruments for both industry sectors using data recorded by PriceWaterhouseCoopers (PWC) during its annual survey of the weather markets on behalf of the Weather Risk Management Association (WRMA) and market intelligence derived from Swiss Re teams acting in the agricultural and weather markets. Our comparison revealed some success factors considered to be critical for the further growth of weather risk transfer business within the agricultural sector.

2. Demand patterns in the weather risk transfer market

PWC has conducted a yearly survey of the weather risk transfer market since 2001. The survey is based on portfolio information provided by professional market participants on a confidential basis. Each survey covers 1 April to 31 March of the following year and records aggregated characteristics of transactions incepting during that period. For multi-year transactions only one calculation period is recorded. Whilst not all professional market players are covered by the survey we consider it to be reasonably representative of market developments (For further details see www.wrma.org).

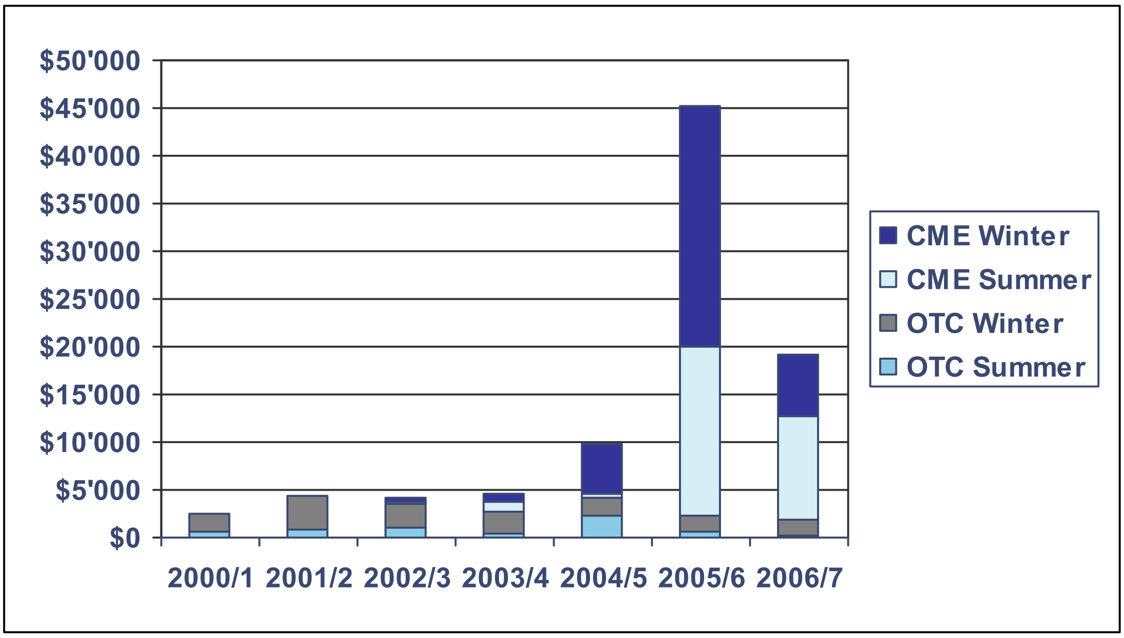
In addition to the above sources our comments are based on the market intelligence of Swiss Re's agricultural and weather teams. Both teams have longstanding market experience, act globally and have a solid market standing. We estimate the agricultural team's market share to be slightly more than 10% of the agricultural reinsurance market with higher shares in emerging markets. The weather team's market share is estimated to be about 30% of the

[1] In general MPCI products provide a very wide coverage for crop yields with only few risk exclusions and therefore are well suited to cover systemic risks such as unseasonable weather patterns which impact over a period of time.

OTC[2] market; the team is also one of the most active market participants in the Chicago Mercantile Exchange (CME) based degree day[3] trading.

An analysis of PWC's most recently published market survey reveals the following (Fig. 1):

Figure 1: Total Notional Value of Weather Risk Contracts: 2000/1-2006/7 (in million USD)



Source: PRICE WATERSHOUSE COOPERS, 2007, 18.

- The weather risk transfer market shows healthy growth, recording an aggregated notional value of USD 19.2 billion for 2006/7. This is well above the USD 2.5 – 9.7 billion range recorded for 2001/2 to 2004/5; however there is a significant reduction in size relative to the survey period 2005/6. Market intelligence indicates that the peak value recorded for the survey period 2005/6 is mainly due to the build up and liquidation of the weather portfolios of 3 large US-based speculators.
- There is a bifurcation of the market into CME business and OTC business. Since the introduction of CME products in 2002/3 there has been strong growth in CME trading. Since about 2004/5 OTC business has been shrinking. Market intelligence indicates that this is mainly due to the success of CME trading which has allowed former OTC market participants to shift their activities to CME and profit from easier execution and increased price transparency.
- CME business mainly involves speculative traders in the US energy sector. These market participants use weather risk transfer products in conjunction with commodity price risk products to enter into cross-commodity strategies. Market participants are attracted by CME as they can profit from the exchange's clearing house eliminating counter party credit risks. Additionally, products are standardized and liquid. Finally, we note there is no analogue development related to cross-commodity trading between weather and agricultural commodities.

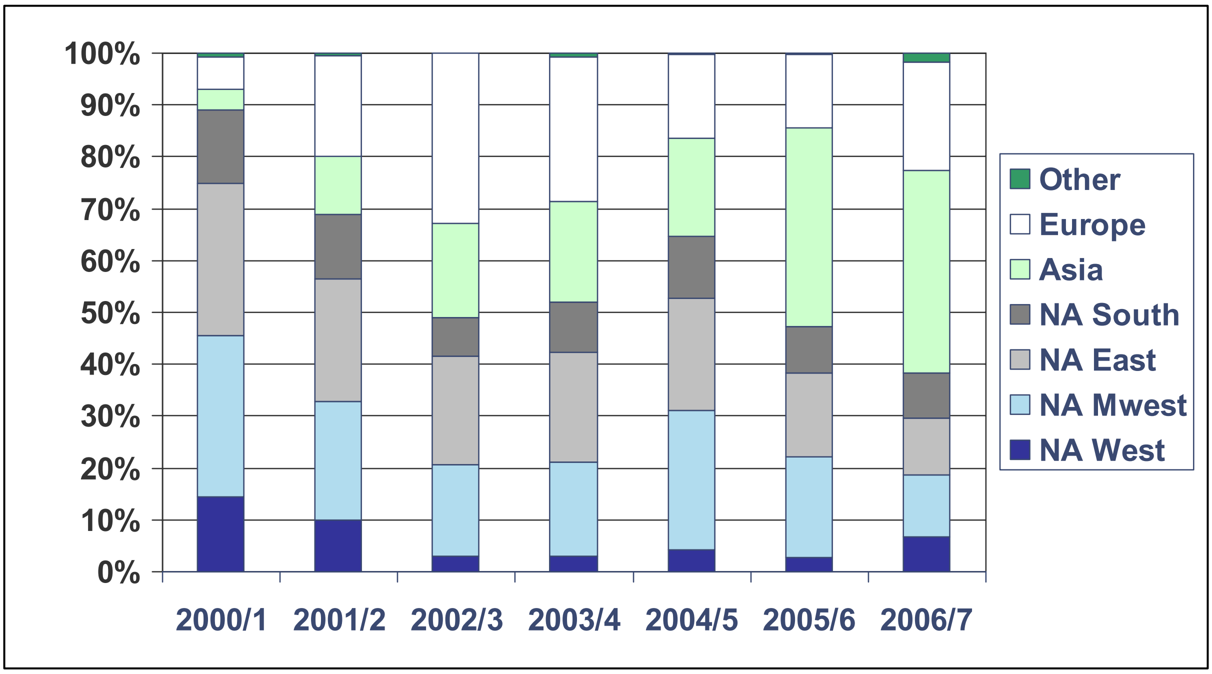
[2] Over-The-Counter (OTC) business refers to contracts directly closed between two counter parties. Business recorded in this category can either be in the form of derivative or insurance and reinsurance contracts.
[3] Here we refer to the trading in CME swaps and options which use Cooling and Heating Degree Days as underlying indexes.

- OTC business is mainly related to non-standardized structures tailored to the end users. This market segment suffered from a reduction in notional values. However, as it is of particular interest to the agricultural sector, it is worthy of closer examination.

In the following we analyze the PWC survey for expansion with respect to geography and industry segments of end users entering into OTC contracts. To track these developments we use the number of contracts by region rather than the notional amounts to avoid distortions related to the difference in valuation of goods and services covered in developed versus developing markets. Based on this metric the PWC survey records the following:

- A significant geographic expansion of business with a roughly 40/40/15/5 split for North-America/Asia/Europe/Rest of World recorded during the latest survey period versus a 90/4/5/1 split recorded in the 2000/1 survey (Fig. 2).

Figure 2: Distribution of Total Number of Contracts by Region

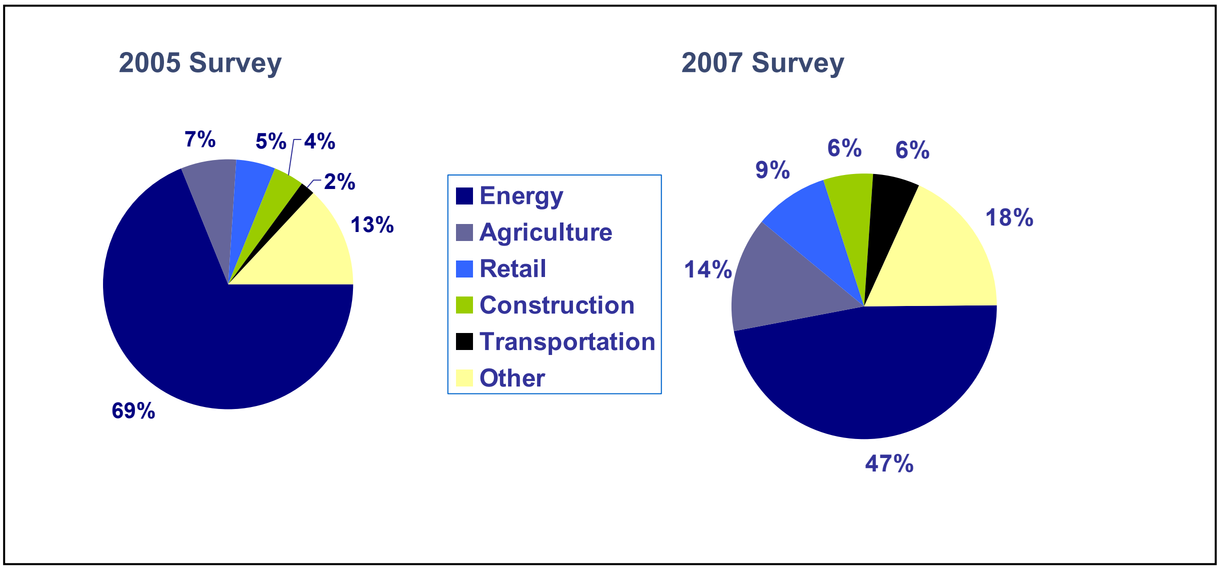


Source: PRICE WATERSHOUSE COOPERS, 2007, 26.

- A doubling of the percentage of end user business potentially[4] attributable to end users in the agricultural sector within the last two survey periods (Fig. 3). This is in line with developments in Swiss Re's own client base where the majority of the business covering weather risks outside developed countries (North America, Europe, Japan, Australia) is with counter parties in the agricultural sector.

[4] Note that counter parties in the OTC derivative business may not necessarily be identical with end users.

Fig. 3: Split of transactions recorded by industry sector of potential end user



Reported values weighted by number of trades reported by respondent.

Source: PRICE WATERSHOUSE COOPRES, 2005 & 2007, 25.

So far we have used historical weather market data to explain agricultural sector demand patterns. We note however, that demand patterns are also influenced by farmers' traditional risk management strategies and market regulations. For example farmers, both in developed and developing countries, often diversify their sources of income. It is estimated that within the EU 29% of farmers receive income from off-farm activities (Foa, 2005, 42). Furthermore, within the EU the Common Agricultural Policy grants subsidies by guaranteeing minimum prices to producers and paying directly for crops planted. The system is currently being reformed comprising a phased transfer of subsidy to land stewardship from 2005 to 2012 (European Commission, 2007). In the US the U.S. Agricultural Department is required by law to subsidize over two dozen commodities yielding farmers extra money for their crops and guaranteeing a price floor. With the World Trade Organization Doha Development Round currently stalled, trade-distorting support measures still protect farmers to a large extent from price volatility, which makes risk transfer products seem less important. However, there are also some markets that have recently engaged in measures fostering the use of weather risk transfer products. In India, for example, the government has asked Agricultural Insurance Corporation (AIC) to start a weather-based crop insurance scheme on a pilot basis in two or three states, in consultation with the State Governments concerned, as an alternative to the indemnity-based National Agricultural Insurance Scheme (NAIS). To foster this development the government will allocate about EUR 18 million in 2007/8 (Banknetindia, 2007). Finally, we note that many stakeholders in agriculture are still unaware or lack understanding of modern financial risk transfer instruments.

Based on the above findings we draw the following preliminary conclusions. Firstly, the growth in weather risk transfer business is primarily related to speculative trading in the US energy sector. It is interlinked with exchanged-based trading; i.e. the ability to exclude counter party credit risk, standardization and liquidity. Furthermore, trading is not dependent upon end user demand but rather motivated by exploiting market inefficiencies that can be captured by cross commodity trades. As demonstrated by the strong episodic expansion of market size during the 2005/6 survey period, speculative trading has the potential to trigger enormous market growth. Secondly, there is no speculative cross commodity trading between weather and agricultural commodities. There are various reasons for this. For example there is no simple relationship between agricultural commodity price action and temperature or rainfall and there is no exchange-based trading in rainfall related instruments. Thirdly, during the 2000/1 to 2006/7 survey periods OTC business shrunk in size but expanded in terms of geography and industry sectors involved. Our own market experience suggests that there is increasing demand from stakeholders in the agricultural sector based in emerging markets; mainly Asia, South America, and – to a lesser extent and often in the context of fighting poverty – in Africa. Indeed a recent study (SWISS RE 2007) on agricultural risks in emerging markets highlights the market potential in this sector and sheds some light on the role of weather risk transfer instruments for these markets. Finally, the agricultural sector is more heavily regulated than the energy sector in many developed markets and farmers engage in a range of risk management strategies other than risk transfer instruments offered by financial service providers.

3. Stakeholders in the agricultural sector and their demand for weather risk transfer instruments

Having reviewed the aggregated market information, we now discuss transaction-specific features related to the agricultural sector's demand for weather risk transfer products. More specifically, we focus on client segments and their motivation followed by a discussion of the index definitions and the risk components covered.

The client segments involved in the traditional indemnity-based agricultural insurance business are mainly farmers, direct insurance companies servicing retail customers, and reinsurance companies taking aggregate risk positions. Additionally, in some markets, services are provided by brokers and underwriting agencies which specialize in the distribution / placement of risks and structuring / pricing of products.

The development of index-based risk transfer products could attract additional client segments. More specifically, there is demand from input (seed, fertilizer, pesticides) providers, financial service companies and aid organizations such as the World Food Program (WFP) or non-governmental organizations acting in emerging markets as well as grain handlers and processors of food and bio energy.

The motivation of these client segments is manifold. Input providers and grain handlers are mainly trying to smooth weather-induced demand patterns for their goods (input providers) and services (grain handlers). Additionally, input providers are mostly acting in saturated markets. They therefore try to gain a competitive advantage by differentiating their product offering through bundling with weather risk transfer instruments. For example seed companies have bundled weather risk transfer products with seed bags so their clients can cover the expenses for the seed in case of a drought. Financial services companies, governmental and non governmental aid organizations use weather risk transfer products as a substitute or complementary risk transfer instrument for indemnity-based agricultural insurance. Finally, food processors use weather risk transfer products to cover increased costs related to a lack of quantity and / or quality of raw material needed for their processes.

Weather risk transfer instruments typically try to cover a shortfall in yield using weather indexes as a proxy. Sometimes, indexes are also defined to cover weather conditions that lead to a reduction in the quality of agricultural products.

Whilst the first products were simply based on the aggregate amount of precipitation during a certain period, the market has since become increasingly sophisticated. Today, index definitions typically feature:

- a variable inception date defined as a function of the amount of rainfall during about 10 days prior to inception of cover against dry conditions during planting,
- a combination of precipitation and temperature measurements used as input variables for the index definition during sub-periods related to the various growth phases (establishment, vegetative, flowering, yield formation, ripening) to cover weather risks specific to each growth stage,
- an index calculation defined as the weighted sum of index contributions during the above mentioned sub-periods.

Despite these rather complicated index definitions, the typical correlation between such an index and agricultural yield is around 60-80%. Additionally, as the geographic distribution of rainfall is more complicated than the distribution of temperature, the correlation of weather indexes tends to deteriorate quickly the further they are from weather stations. Again, this is increasing the basis risk related to weather risk transfer products for the agricultural sector.

There are several developments to overcome these limitations. For example market participants rely on a combination of temperature, rainfall and soil information to calculate the amount of water available to a plant. Moreover, remote sensing data is being increasingly used to compensate for the lack of a coarse network of weather stations.

In contrast to the above situation for the agricultural sector, the weather risk transfer instruments used for the energy sector typically profit from a high correlation between temperature-based indexes and retail energy consumption: often above 90% for gas and about 80-90% for power.

We therefore have strong reason to believe that the basis risk related to the use of weather risk transfer instruments for the agricultural sector is one of the main obstacles for end users to enter into weather risk transfer instruments. We note however, that there is also basis risk related to indemnity-based products resulting from inaccuracies related to the loss adjustment process peculiar to these products.

4. Conclusions

The introduction of weather index-based risk transfer instruments has broadened the range of market participants involved in the traditional agricultural insurance market. Additionally, index-based products complement and/or substitute indemnity-based products; especially in emerging markets that lack reliable loss adjustment processes.

However, we have identified a few critical factors for an acceleration of market growth: the high basis risks typically observed between certain weather indexes and agricultural yield, trade distortions such as subsidies to production and exports as well as lack of information and/or inadequate training.

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