

The transfer of weather risk faced with the challenges of the future

Climate change, combined with an expanding risk universe, has led to a significant rise in the frequency and amount of claims paid by insurers and reinsurers over the past three decades. Major 21st century challenges, such as adapting to climate change, food security, and the development of renewable energy, have turned the spotlight on the ties that bind man to his environment.

At the end of the 1990's, a new market emerged to enable weather-sensitive players to protect themselves from weather hazards: the weather derivatives market. The exceptional reach and significant consequences of the financial crisis that hit industrialised countries in 2008 have led to greater awareness of the role of risk management in business and, consequently, have reaffirmed the necessity of a weather risk market. At the interface of finance and insurance, weather derivatives are bringing to light a new risk transfer model, in which reinsurers are destined to play a leading role.

Note: Although the term "derivative" leads most authors to class weather derivatives as financial instruments and to favour the expression "index-linked weather insurance" for insurance contracts, we have chosen here to give a broader sense to the expression "weather derivative". In this technical newsletter, a "weather derivative" signifies any risk transfer contract based on one or several weather indices.

► The weather risk market

Definition of weather risk

"Climate is what you expect, weather is what you get"

This sentence, taken from a work by the science fiction author Robert A. Heinlein and widely quoted by the scientific community, sums up well the difference between the notion of climate and that of weather conditions. Although climate science tells us which weather conditions are normal for a specific period of time and a given place, there is still considerable uncertainty over what the weather will actually be like in reality. Due to the complexity of interactions between the atmosphere and the oceans, weather forecasts, which have nonetheless improved greatly over the past thirty years, still only provide a small amount of information beyond a timeline of a few days. Thus, because it remains essentially unpredictable, weather conditions often impede human activity.

People talk about "weather risk" when the

random nature of future weather conditions threatens assets, business or the projects of individuals, associations and companies. Roofs torn off, forest fires, power cuts, frozen vineyards, delayed construction works, trains brought to a halt and grounded planes, are all possible consequences of weather risk. In Europe and the United States, the share of GDP directly concerned by the variability of weather conditions is estimated at 25%. A recent study¹ of the past 70 years, commissioned by the US research institute NCAR², reveals a production gap of more than 3% of GDP – i.e. the equivalent of around US\$ 500 billion – between the year in which the weather was most favourable for business and the year in which it was least favourable.

Obviously, not all countries and sectors of the economy are exposed in the same way. A study³ conducted in 2008 places agriculture, mining and transport at the forefront of the most vulnerable sectors. Brazil, an

agricultural giant with a tropical climate, takes first place among the most weather-sensitive countries. Particularly sensitive to cold winters, Brazil lost 70% of its coffee output in 1975. By no means exhaustive, the following are examples of particularly weather-sensitive sectors:

- The **energy** industry, where the variability of demand is seen principally through increased need for heating in winter and for air conditioning in summer. France is a great example of this: in winter, a fall in temperature of 1°C leads to a 2300 MW increase in electricity consumption, i.e. around 4% of average power requirements, according to the electricity transport network (RTE).
- **Agriculture**, where weather has an impact on crop growth throughout the growing season. For farmers, rain and fine weather are raw materials as important as soil, seeds and fertiliser.

¹ 2011, US economic sensitivity to weather variability, American Meteorological Society

² National Center for Atmospheric Research

³ Global Weather Sensitivity: A Comparative Study, Weatherbill, Inc.

- **Tourism and catering:** ski resorts fear winters that are too warm or too dry, while restaurant owners dread winters that are too harsh or too damp, and summer recreation centres hope for sun and warm weather.
- **Construction and transport:** bad weather can force companies to temporarily lay off employees.
- Finally, **retail**, where consumer behaviour evolves along with the weather. A harsh winter will promote sales of soup and warm clothing, while a hot and sunny summer will stimulate the sale of ice cream and sparkling drinks.

Managing weather risk

Prevention

The first response to weather risk should be prevention. The resistance of buildings and infrastructure to bad weather should be strengthened, weather forecasts should be followed closely and surveillance systems should be implemented in order to prepare for weather disturbances and limit their impact.

- For example, a construction manager will have to check temperature forecasts before deciding whether or not to cast a concrete slab. If temperatures are too cold, the concrete will only set if the formwork is insulated.

Although indispensable for protecting against climate hazards, preventative measures all too often only manage to mitigate risk, rather than eliminating it completely.

Traditional Insurance

Weather-sensitive players may then seek to mutualise or transfer their risks. Traditional methods of coverage consist of mutual insurance funds or indemnity-based insurance contracts, as it is the case in France:

- Thus the Union des Caisses de France has implemented a mutual insurance fund to which all companies in the Construction and Civil Engineering industry contribute. In the event of bad weather, the fund covers a large part of the operating losses suffered by the companies involved.
- Homeowners' all risk insurance, which includes mandatory "storm" and

"natural catastrophe" coverage, should also be mentioned here. Storm coverage covers not just the impact of wind (from storms, hurricanes and cyclones) but also the damage caused by rain, snow and hail. Natural catastrophe insurance, which is defined in article 125-1 of the French Insurance Code, covers avalanches, flooding and drought in particular. Nevertheless, the concept of natural catastrophes is subjective and is assessed by the public authorities. Natural catastrophe insurance only comes into play in specific areas and in the event of bad weather, as defined by inter-ministerial decree.

Traditional insurance contracts are generally unsatisfactory from the point of view of the insurer. For high-risk, low probability extreme weather events, insurers are often confronted with the problem of portfolio **diversification**. Moreover, and this is also true for low-risk, high probability non-catastrophic weather events, the indemnity reasoning behind traditional contracts exposes insurers to problems linked to **information asymmetry** (adverse selection and moral hazard) and generates significant management costs.

Risk sharing and index – based contracts

- To respond to the issues involved in the **diversification** of catastrophe risks, the insurer has three main choices:
 - To use co-insurance, thereby sharing catastrophe risks with other insurers;
 - To use reinsurance and cede a part of its risks to a reinsurer;
 - To turn to the capital markets by issuing a catastrophe bond (CAT-Bond). The operating principle of a catastrophe bond is simple, and comparable to that of a corporate bond. If a catastrophic event occurs, the bond may default, which for investors means total or partial loss of the capital invested. In exchange, the investors who buy such securities receive an annual coupon payment that is generally high, at a rate of around 8%⁴.
- To address the problems linked to **information asymmetry**, insurers may

create innovative solutions based on weather indices supplied by a reliable, independent third party. This is where "weather derivatives" come in: a weather derivative is a contract, to which weather variables-based cashflows are attached. The main features of a weather derivative are as follows:

1. **Period:** a start date and an end date.
2. **Place:** the locations of weather stations.
3. **Weather index:** an index incorporating the various meteorological measurements taken, called the underlying index.
4. **Payoff function:** a function that links the index level and financial fluctuations between the contract parties.
5. **Premium:** a possible premium paid by the buyer to the seller at the start of the contract.

The weather risk market

When you consider the diversity of risk aversion levels among economic agents and the highly unequal, sometimes contradictory nature of the impact of weather disturbances on these agents, it is easy to understand the relevance, usefulness and even necessity of a weather risk market. Aside from traditional insurance contracts, however, it was not until the end of the 20th century that the first weather-linked securities were traded in the US energy industry.

Key dates

The first weather derivative contract was signed in 1997 in the United States, between two major energy players. In 1999, Chicago, the main stock market for commodities, added several standard weather derivatives to its offer of futures. At the beginning of the 2000's, the market was primarily occupied by major energy groups. Enron, through its online trading platform Enron Online, livened up the market with several standard temperature-based contracts. Far from nipping the young weather derivatives market in the bud, the bankruptcy of Enron in December 2001 promoted the entry of new players into the market. The Enron weather traders dispersed into banks, insurance companies and hedge funds, here and there recreating, with varying levels of success, teams devoted

⁴ More specifically, the remuneration of a catastrophe bond is expressed in basis points above a benchmark rate, generally the LIBOR, representing the return on the assets in which the bond issue proceeds are invested, e.g. "LIBOR + 800bps".

to the management of weather risk and the trading of weather derivatives.

Until 2006, the weather derivatives market grew spectacularly: volumes exploded, contracts diversified and the market also developed in Japan and Europe. Subsequently, until 2010, the market went through a period of contraction, accentuated by the financial crisis and investor aversion to these products, which are hard to evaluate since they are very illiquid and often highly specific.

Nevertheless, according to the Weather Risk Management Association (WRMA)⁵, the 2010/2011 financial year marked the return of growth to the weather risk market, with this type of transaction representing around US\$ 12 billion. Given the multiplication of recent initiatives, notably since 2011 (e.g. development of the offering aimed at the agricultural sector in the United States and Asia, and strategic investments and partnerships in Europe), and the attractiveness of an asset class whose returns are de-correlated from the rest of the market, along with the increasing importance placed on risk management in companies, the weather derivatives market seems assured of a promising future.

Market structure

Weather derivatives function like the financial markets: upstream, there is a primary market where securities are issued, and downstream there is a secondary market providing liquidity. The primary market is a meeting place for end users, i.e. weather-sensitive companies seeking to buy protection from weather risks, and companies prepared to offer such protection, mainly insurers, reinsurers and banks. On this primary market, sellers propose highly structured contracts in order to best respond to the needs of buyers. On the secondary market, coverage vendors trade standardised contracts that enable them to dynamically manage their weather risk portfolios.

This distinction between the primary and secondary markets is found in the division of the weather derivatives market between the over-the-counter market and the regulated market. End users buy customised products on the over-the-counter market from weather coverage

vendors, who in turn manage the risk using standardised contracts available on the regulated markets. It is important to note that the weather derivatives market offers a certain level of security to its participants, insofar as the weather data involved is determined by independent bodies (e.g. Météo-France through Metnext in France and the National Weather Service in the US). The risk of a dispute relating to manipulation of the underlying index is therefore significantly lower than, for example, in the equity market.

The Chicago Mercantile Exchange (CME) is the leading market for the trading of weather derivatives. In Europe, Euronext-Life suspended its weather derivatives activities in 2004. The CME offers futures and options. The most frequently traded contracts are based on cumulative Heating Degree Days (HDD) and Cooling Degree Days (CDD) in the major cities in the United States. The CME also proposes contracts based on the temperatures of several cities in Canada, Japan and Europe. It also allows traders to trade contracts based on accumulated precipitation (rain and snow) and frost values. The regulated CME market has a twofold attraction: it ensures a certain level of transparency (the prices are freely available on the CME website: <http://cmegroup.com/trading/weather>), and eliminates credit risk thanks to its clearing house.

End users

The vast majority of end users are weather-sensitive companies that buy coverage against weather risks likely to lead to a decrease in their production, a decrease in the demand for their products and services, interruption of their business activities or damage to their facilities. Weather risk coverage enables companies to smooth out their income over time, thereby improving the value created by each risk unit and, consequently, thereby facilitating access to financing. This market is also a vehicle for promoting the image of companies, and may serve as a medium for original publicity campaigns: let us take the example of the "Let it Snow" campaign in which a Canadian tour operator, which promised to refund its customers' trips if Montreal had more than five inches of snow on 1 January 2008.

Brokers

Brokers have made a significant contribution to the development of weather derivatives. As intermediaries between the end users and the risk takers (i.e. reinsurers and specialised funds), they introduce the former to weather risk management and the latter to alternative investments. They help companies to identify their vulnerabilities to weather conditions and offer them customised weather coverage. Then they work with the risk takers to determine which risks the latter can retain on their balance sheets and which coverage strategies can be implemented through the secondary market.

Providers of meteorological data and weather indices

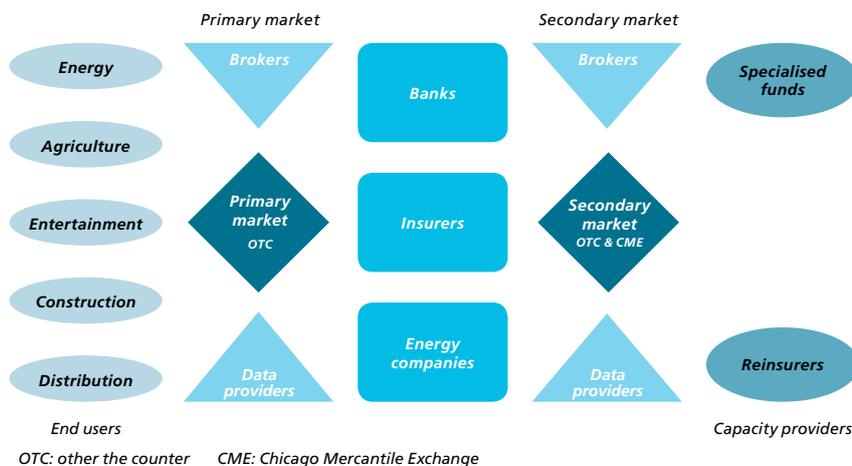
All weather derivatives are index-linked products. Their value, along with associated flows of money, is determined by a weather index. Thus the presence of an external, independent third party is critical. This trusted third party may act as a guarantor of the quality of the data used to construct the index (in which case, the relationship facilitating the calculation of the data-based index must be clearly specified in the contract) or as a guarantor of the index itself.

Energy companies

The costs and income of players on the energy market (producers, distributors, consumers) are heavily linked to the evolution of weather conditions. This explains why energy companies constitute the principal end users on the weather risk market. When they have trading subsidiaries, energy companies may, moreover, buy their weather coverage directly from the secondary market. Finally, they may seek to develop their expertise in weather



⁵ <http://www.wrma.org/>



risk management and become coverage vendors themselves, whether on the primary or secondary market.

Banks and Insurers

Banks offer their clients coverage products for the financial risks to which the latter are exposed: exchange rates, interest rates, commodities, etc. Banking activity therefore involves the transfer of a certain number of risks. The identification of weather risks and the structuring of suitable coverage instruments may therefore appear as a natural extension of such business.

Similarly, insurance companies specialising in the management of corporate and industrial risks may incorporate weather risks into multi-risk insurance contracts.

Reinsurers

Reinsurers, which possess significant levels of equity capital and already have a culture of climate-related catastrophe risks, are the players best placed to manage the weather risks of companies. They intervene both as risk takers, i.e. as providers of capacity, and as experts in risk analysis and the structuring of tailored weather coverage. They may also play the role of risk intermediaries or transformers when they use the standardised contracts available on the secondary market to cover their own exposures to weather risks.

Hedge funds

Hedge funds play a leading role on the weather derivatives market. The reasoning

behind these funds is diametrically opposed to that of traditional asset management, which seeks to “beat” a benchmark reference: hedge funds seek to offer an absolute performance that is unconnected to those of traditional indices. In this regard, weather derivatives, whose returns are largely independent from the fluctuations of the equity markets, constitute a particularly appealing asset class for these funds.

Legal and regulatory framework

Weather derivatives may take various different legal forms. The regulatory, accounting and tax restrictions will be different depending on the contract involved: an insurance contract, a reinsurance contract or a financial derivative. From an accounting point of view, the contract will be subject to the standards IFRS4 or IAS39, as necessary. These are international standards established by the International Accounting Standards Board (IASB) and adopted by the European Union in 2004. If the contract involved is an insurance or reinsurance contract, “payment must be based on changes in weather variables specific to one of the contract parties”, in order to comply with IFRS4. If the contract is a financial instrument, it must meet the requirements of IAS39. More specifically, it must be recorded on the balance sheet at fair value and its value variations must be recorded in the profit and loss account.

➤ A new insurance model to meet the challenges of the 21st century

Traditional insurance vs. weather derivatives

Premium calculation method

In traditional insurance, the premium is calculated on the basis of probability distributions relating to the frequency and amount of claims, which are themselves estimated on the basis of recorded historical claims data. For weather derivatives, the premium is calculated from historical weather data.

Claims compensation method

In traditional insurance, claims compensation follows a long and costly process. The insured must make a claims declaration, the insurance company then opens a case

file and, if necessary, sends an expert to the loss site in order to evaluate the amount of the claim. In general, payment of compensation takes several months. For weather derivatives, compensation is paid on the basis of weather observations and is made automatically. The insured receives the payment within a very short time, generally a few days. The method of claims payment, which is fast and transparent, is one of the main advantages of weather derivatives over traditional insurance. It provides a response to emergency situations through the almost immediate payment of financial compensation. Because it uses information taken from an index based on data provided by an independent third party, a weather derivative, unlike a traditional insurance contract,

is not impacted by issues of information asymmetry, i.e. adverse selection and moral hazard:

Adverse selection

In most traditional insurance contracts, the insurer is confronted with the problem of adverse selection. The insured knows his risk better than the insurer, and will take out an insurance policy all the more readily if he is likely to suffer a loss. Pricing based on historical compensatory losses leads, due to the over representation of high-risk insureds, to an increase in prices. This pricing increase leads to the cancellation of contracts by low-risk insureds and reinforces the over representation of high-risk insureds. The insurer must respond with a new increase in prices, etc. In the case of weather

derivatives, premium calculation is based on weather data and therefore does not depend on the characteristics of the agents involved. Consequently, the contract will be no less appealing to low-risk agents than to high-risk agents. High-risk agents will have to buy more coverage than low-risk agents, and therefore will naturally pay more.

Moral hazard

A farmer who has taken out an insurance policy based directly on the yield of his crops may tend to slacken his preventative efforts and to economise on input (fertiliser, plant disease control products, etc.). Conversely, if he has bought a weather derivative, he would be well advised to produce as much as possible since the payment he receives will under no circumstances compensate for his negligence, but will simply compensate for a lack of the conditions that make his work profitable.

Indexing eliminates the problem of information asymmetry, however it also generates a risk of inadequacy between the loss and the coverage, called the basis risk. A farmer who has bought coverage against a lack of rain may, for example, experience a particularly dry year without receiving any compensation, if such compensation is calculated on the basis of data from a weather station located too far away, where the drought was less severe.

Pushing the limits of insurability

By responding to the problem of moral hazard and adverse selection, weather derivatives facilitate the transfer of new risks, such as the weather risks faced by businesses. They may also advantageously complement certain traditional coverage solutions such as natural catastrophe reinsurance contracts. Although limited by the problems linked to basis risk, the scope of weather derivatives is considerable.

This is all the more true in the sense that people today must adapt to the inevitable consequences of climate change; they must prepare for a general rise in temperatures and greater variability in weather conditions. Add worldwide demographic growth and the increasing scarcity of natural resources

and fossil fuels to this, and it is easy to understand the importance of weather risk management. By accompanying the development of agriculture and renewable energy, the weather derivatives market reinforces the resilience of our societies in the face of weather hazards and tensions on the oil and gas markets, thereby promoting growth and development.

The example of agriculture

The global population is increasing by two people every second, which represents more than 200,000 extra people to feed each day. This is a real challenge for the agriculture industry in the 21st century. According to UN projections, the planet will be home to 9 billion people in 2050, i.e. 2 billion more than today. The destruction of arable land through urbanisation, the increasing use of agricultural raw materials for the production of biofuels, and the problems linked to water management, are all problems to which increasing weather hazards can only add. As of now, agriculture must find the means necessary to increase production, stabilise prices and ensure the durability of farms.

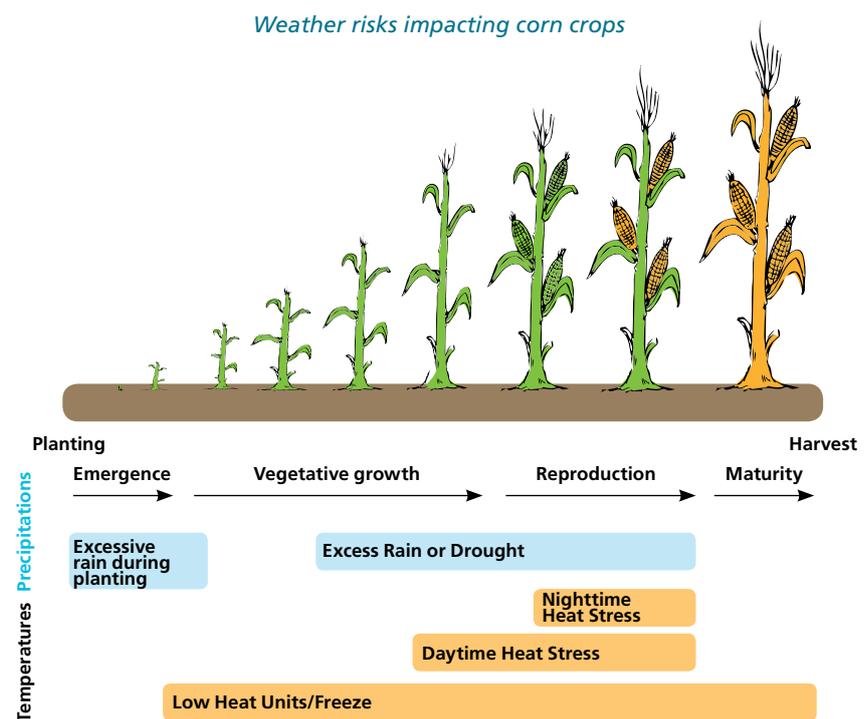
Index-linked solutions to the management of weather risks could solve a major part of the problem. However, the implementation of index-linked coverage necessitates prior identification of the risks that threaten a

crop throughout the various stages of its development, and quantification of the extent to which agricultural crop yields depend on weather conditions. This is precisely the objective of what is known as agro-meteorology. Thus, with the help of studies conducted by agriculturalist experts in this field, it is possible, using historical weather data, to quantify the risk, price it and therefore insure it.

To take a simple example, a farmer who produces corn knows that the yield of his crop will depend on the temperature, given that a too-low temperature will hinder the growth of the plants. To cover himself, he may buy "put" (forward sale option) cover, based on an index of accumulated temperatures called the GDD (Growing Degree Day). Similarly, he may compensate for the damage caused by late frost by buying "call" (forward purchase option) cover based on an index of the number of frost days, called the FI (Frost Index).

Today, weather derivatives interest both emerging countries, where the insurance industry does not have the organisational capacity to evaluate individual losses, and developed countries, where they complement traditional insurance products and thus reduce operator retention.

India was one of the first countries to implement index-linked insurance products,



designed to protect farmers from weather hazards. These products were developed on the initiative of the World Bank and micro-finance institutions, with the help of local insurers and the support of major global reinsurers and the State.

In developed countries, the use of weather derivatives to cover the risk of lower crop yields linked to bad weather is seducing more and more farmers. In the US, the sale of agricultural insurance based on weather indices exploded in 2011. These solutions make up for the limitations of traditional insurance subsidised by the State. Now, thanks to weather derivatives, a corn producer with an anticipated harvest of 180 bushels per acre, 120 bushels per acre of which are covered by federal insurance, may insure the 60 remaining bushels for a premium of around USD 40 per acre.

The example of renewable energy

Faced with the scarcity of fossil fuels, States must promote alternative energy research and development. This is the proviso that will enable them to maintain or regain their energy independence and prevent the potentially disastrous consequences of a leap in oil prices. The use of nuclear fission techniques means accepting considerable, hard to control risks. Japan, and the rest of the world with it, experienced this in a painful way with the Fukushima catastrophe of March 2011. Although nuclear fusion appears to provide a satisfactory response to problem of energy production, this promising technology is still only at the experimental stage. Consequently, nuclear energy cannot be the only response to the increasing scarcity of traditional fossil fuels. We need to know how to make the best use of sun, wind and water, which are inexhaustible natural resources from which we can produce energy.

Stimulated by the adoption of new State policies, the share of renewable energy in global production has not stopped growing over the past few years, and now stands at 19%. Hydro power still constitutes by far the main source of renewable energy, even though the growth rates for other sources (such as sun, wind, biomass, geothermal, etc.) are far higher. According to the International Energy Agency (IEA), annual



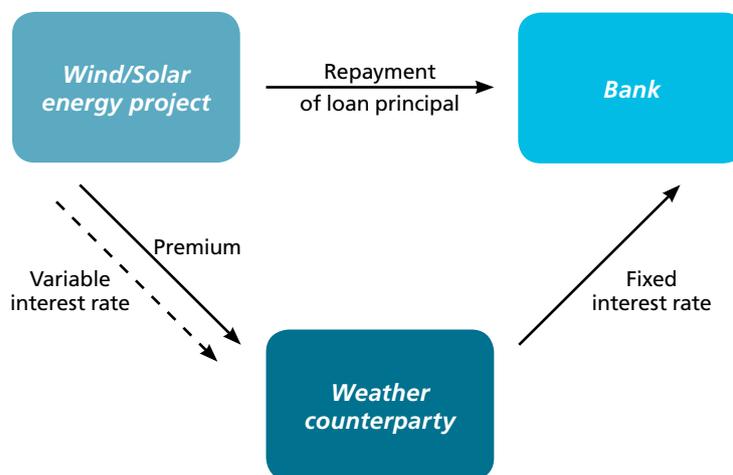
global production of renewable energy currently stands at around 4,000 TWh, i.e. already 1,000 TWh more than nuclear production, and should exceed 10,000 TWh by 2035⁶. Weather derivatives, by facilitating the financing of wind power projects, are set to play an increasing role in the development of renewable energy.

The financing of wind and solar projects is often achieved through massive use of debt, with debt to equity ratios that can reach 90/10, offering shareholders a high degree of leverage. Naturally, all else being equal, the higher the leverage, the higher the financial risk. The yield of a wind or solar project depends mainly on the abundance of the natural resource at the project location. A deficit of wind or light will lead to a fall in revenue and potentially to the failure of the project. Consequently, promoters of such projects will be all the more keen to seek

financing facilities if the site on which they wish to locate their project has a significant quantity of the resource they wish to exploit, with low levels of variability.

Weather derivatives enable the promoters of wind or solar projects to reduce the variability of their income and therefore allow them to make greater use of debt or to obtain better loan rates. For example, a weather index-based swap contract may be incorporated into the financing structure of the project. The wind or solar farm will then only have to repay the principal of the loan. A weather counterparty will enable such farms to pay the loan interest to the bank, in exchange for a variable rate based on a weather index designed to reflect the farm's income. The weather derivative concluded between the wind farm and the counterparty could generate the payment of a premium at the inception of the contract.

Example of renewable energy project financing including a weather derivative



⁶ For more details, see the SCOR Focus publication "The risks and challenges of renewable energy in a fast changing environment".

➤ The conditions necessary for the development of weather derivatives

Even where the sensitivity of economic activities to weather conditions is proven, it may be difficult to accurately identify the link between the variability of weather conditions and income volatility. In addition to this, the weather derivatives market is still suffering from a lack of liquidity linked to demand asymmetry. Thus, coverage against a too-cold summer is far more sought after than coverage against a too-hot summer. This is, moreover, why the Euronext Liffe market stopped trading weather derivatives after three years, in 2004. Due to the difficulty involved in quantifying risk, and the low level of liquidity on the secondary market, risk premiums remain high for weather contracts. This constitutes one of the major brakes on development. The mastery of new technology and the adoption of an appropriate marketing approach will help to overcome this problem. Regulatory transparency also constitutes one of the development conditions for weather derivatives. States and international institutions must therefore continue to work in this direction.

Two key development priorities

Marketing

The climate is often viewed as an inevitability that it is virtually impossible to curb. Even though weather-sensitive agents often deplore the negative impacts of the weather on their business, they are not in the habit of protecting themselves against this risk. Marketing therefore plays a key role in the development of weather derivatives. This involves properly understanding the

sensitivity of potential clients to pricing and drawing up a business strategy that will make them aware of the advantages of protection. As the culture of weather risk management spreads, pricing data will become more abundant, risk premiums will get lower and coverage will become more appealing.

New technologies

Indexed solutions for the transfer of weather risks are also developed through the mastery of new technologies. The companies designing such solutions must be able to understand and digitally analyse weather data taken from measuring instruments as advanced as the Cross-track Infrared Sounder (CrIS) on board NASA's National Polar-orbiting Operational Environmental Satellite (NPP), which provides profiles of temperature, pressure and humidity. Moreover, in order to measure the link between the potential losses of an agent seeking to cover himself and weather conditions, data concerning the economic activity of the weather-sensitive agent must be collected and compared with weather data, in order to be able to construct a weather index that captures the weather-sensitivity of such activity. Consequently, the designing companies must be able to manage large databases. Cloud computing, which is expanding rapidly, provides appropriate responses to the problem of managing large volumes of data.

The support of States and international institutions

States and international institutions have a major role to play in the development of weather derivatives. Indeed, States and international institutions must continue to define the regulatory framework surrounding these new products, with regard to both the legal form that they may take and their associated accounting methods. Moreover, the development of weather derivatives, particularly in the agricultural sector, often rests on the implementation of public-private partnerships (PPP). International organisations seeking to promote private development initiatives, such as the World Bank, offer their expertise to poor countries in order to enable small farms to access the

weather risk market. States, for their part, act through subsidies. Anxious to support the two key business sectors constituted by agriculture and energy, governments facilitate the transfer of risks that curb the development of these sectors. Thus, agricultural insurance is largely subsidised by States, which may pay for up to almost two thirds of premiums and a portion of reinsurance. Finally, States may also stimulate the development of weather derivatives by facilitating access to data and promoting the roll out of weather stations on their territories.

Reinsurance, a development driver for weather derivatives

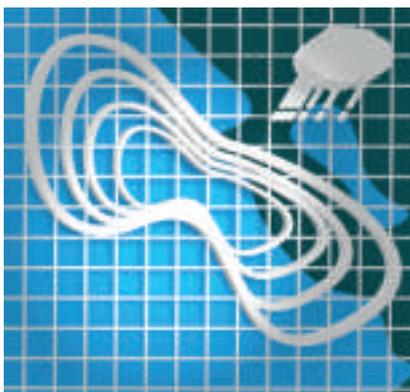
The major global reinsurers have played a leading role in the birth of the weather derivatives market, and they will undoubtedly continue to be one of the main drivers of development in the coming years. This may be explained by several features specific to reinsurance, and to Non-Life reinsurance in particular:

Premium calculation method

Unlike direct insurance, the calculation of Non-Life reinsurance premiums relies less on the modelling of loss frequency and amount than on the modelling of events that actually generate losses: earthquakes, storms, hurricanes etc. In this regard, the reinsurance model is closer to that of climate derivatives than to that of traditional insurance.

Meteorological expertise

The natural catastrophe modelling teams of most major reinsurers include physicians, geographers, actuaries and database experts. They therefore combine all the skills necessary to analyse and manage weather risks. Thus, the ENOA (El Nino Oscillation Australe) phenomenon, which manifests itself through an exceptionally warm current in the east of the Pacific Ocean, is well known to reinsurers. Indeed, modelling teams monitor the appearance of this phenomenon very closely, as it could impact seasonal precipitation patterns and reroute tropical cyclones from their usual



paths. Reinsurers were also among the first to study climate change and its possible implications for man. Some of the questions they considered were: How can we define climate change? What impact is climate change likely to have on economic activity? Which regions, populations and businesses are the most vulnerable? With a wealth of such research behind it, the reinsurance industry can now provide tailored responses for weather-sensitive agents, helping them to analyse their weather sensitivity and to create effective risk coverage solutions.

Proximity of the financial markets and risk intermediation

For more than twenty years, reinsurance has been at the heart of the process of convergence between insurance and finance. It

therefore occupies a privileged position from which to play the role of intermediary on the weather derivatives market. Reinsurers may thus reproduce the risk transformation process that they have implemented for catastrophe bonds: vendors of coverage on the primary market, they retrocede a large part of the risk to the financial markets using standardised contracts available on the secondary market.

International presence and portfolio diversification

Moreover it should not be forgotten that reinsurers are first and foremost risk management experts. When a risk cannot be easily transferred to the financial markets, they can comfortably retain it on their balance sheets. Their international

positioning and their presence in numerous business sectors guarantee reinsurers a high degree of regional weather risk diversification within their portfolios.

As weather risk management experts and capital market specialists, reinsurers appear to be crucial partners for institutions, States and companies wishing to implement weather coverage solutions. They do not confine themselves to the role of capacity providers, but also intervene in terms of risk analysis, the drawing up of coverage and the study of possible ways in which to transfer risk to the financial markets.

➤ A diversified offer of services

Today, SCOR and its business partners are deeply committed to promoting the culture of weather risk management and providing coverage solutions tailored to the needs and expectations of their clients. For forty years, SCOR Global P&C has provided companies with tools for the coverage of corporate risks, including weather risks where necessary. At the same time, underwriters from the Group's various Specialties,

assisted by alternative risk transfer experts, draw up innovative solutions tailored to each business sector: agriculture, energy, construction, etc. Finally, as part of its strategic plan Strong Momentum, SCOR has launched two initiatives in the field of insurance risk securitisation. In 2011, the Group created the ATROPOS investment fund, which enables third parties to invest in Insurance-Linked Securities (ILS). In order

to give its clients the benefit of its securitisation expertise, gained over the past 15 years through the regular issue of catastrophe bonds under the ATLAS programme, SCOR also offers risk transformation services.

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ISSN : 1967-2136

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