WEATHER DERIVATIVES: *AN EMERGING TREND IN THE GLOBAL MARKET*

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Abstract

Indian Economy is mainly an agrarian economy. It has been estimated that in India, more than 30 % of GDP is wiped out whenever there is bad monsoon. The uncertain global weather conditions in recent years have affected many businesses and industries especially commodities. Any facet of the weather be it temperature, rainfall or snowfall has a bearing on the agricultural sector, tourism, corporate earnings, sports, transport, and distribution, etc. Traditional Tools & techniques have been unable to cope up with the unpredictable weather risk. Various weather derivative products are trading in the international market and are gaining popularity over the years. This necessitates the need for Weather Risk Management in India also.

Weather derivatives are financial instruments that can be used by companies or individuals to reduce the risk associated with adverse or unexpected weather conditions. The difference from other derivatives is that the underlying asset (rain/temperature/snow) has no direct value to price the weather derivative. Apart from applying weather derivative as a tool of hedging risk against adverse weather conditions, it can also be used as the mode of trading in derivatives. The most advantageous factor of weather derivatives is the fact that they can't be manipulated by any means like insider trading as the raining patterns are natural and beyond the scope of humans. This paper aims at providing the concept, types, utilities, beneficiaries and its present scenario in India.

Key words: Derivatives, weather risk, weather derivatives, weather risk management, collars, swaps, futures, options.

1.1 Introduction

Every Industry faces some or the other risk. Some are controllable while some are uncontrollable. We call them systematic and unsystematic risk in context of risk management. Weather i.e Mother Nature is an uncontrollable risk. Predictability of the amount of rainfall, snowfall, hurricanes, tsunamis and droughts is not in the hands of anyone. Small and medium segment businesses to huge conglomerates and Multi National corporations are sailing in the same boat. According to an estimate by meteorological research institutions, more than 80% of the business activity in the world is weather dependent **(Anjali Choksi, 2012).** Virtually every sector of the economy, however, is directly or indirectly subject to the influence of the weather in some form or other.

The types of impact of weather on businesses range from small reductions in revenues, as might occur when a shop attracts fewer customers on a rainy day, to total disaster, such as when a tornado destroys a factory. Tornadoes are an example of *catastrophic* weather events. Such weather events also include severe tropical cyclones, extra-tropical wind storms, hail storms, ice storms and rain storms. They often cause extreme damage to property and loss of life **(Stephen Jewson**

and Anders Brix,2008). Companies wishing to protect themselves against the financial impact of such disasters can buy insurance that will pay them according to the losses they sustain. Weather derivatives, however, are designed to help companies insure themselves against *noncatastrophic* weather events. Non-catastrophic weather fluctuations include warm or cold periods, rainy or dry periods, windy or calm periods, and so on**. (Stephen Jewson and Anders Brix,2008)**. They are expected to occur reasonably frequently. Nevertheless, they can cause significant discomfort for (or bring significant benefits to) businesses with profits that depend in a sensitive way on the weather. Farmers can also use weather derivatives to hedge against poor harvests caused by drought or frost.

Weather variability affects different entities in different ways. In many businesses weather is related to the volume of sales transacted. Examples of this would include:

- a natural gas supply company, which would sell less gas in a warm winter;
- a ski resort, which would attract fewer skiers when there is little snow;
- a clothes retailing company, which would sell fewer clothes in a cold summer;
- an amusement park, which would attract fewer visitors when it rains.

But weather can also affect profits in ways other than through changes in the volume of sales. Examples include:

- a construction company, which experiences delays when it is cold or raining because labourers cannot work outside;
- a hydroelectric power generation company, which generates less electricity when rainfall is reduced;
- a vehicle breakdown rescue company, which has increased costs on icy days, when more traffic accidents occur;
- a fish farm, where fish grow less quickly when the sea temperature is lower.

All these risks could be hedged using weather derivatives.

1.2. Weather derivatives

Any company whose revenue is affected by weather has a need for weather Derivatives. A financial weather derivative contract may be termed as a weather contingent contract whose payoff will be in an amount of cash determined by future weather events. The settlement value of these weather events is determined from a weather index, expressed as values of a weather variable measured at a stated location. Weather derivatives are financial instruments that can be used by organizations or individuals to reduce risk associated with adverse or unexpected weather conditions. The difference from other derivatives is that the underlying asset (rain/temperature/ snow) has no direct value to price the weather derivative.

A standard weather derivative contract, is defined by the following attributes:

- the contract period: a start date and an end date;
- a measurement station;
- a weather variable, measured at the measurement station, over the contract period;

- an index, which aggregates the weather variable over the contract period in some way;
- a pay-off function, which converts the index into the cashflow that settles the derivative shortly after the end of the contract period;
- for some kinds of contract, a premium paid from the buyer to the seller at the start of the contract**(Stephen Jewson and Anders Brix,2008)**.

These basic attributes are supplemented by:

- a measurement agency, responsible for measuring the weather variable;
- a settlement agent, responsible for producing the final values of the index on the basis of the measured values; according to defined algorithms that (hopefully) cope with all eventualities, such as a failure of the measuring equipment;
- a back-up station, to be used in case the main station fails;
- a time period over which the settlement takes place.

(Stephen Jewson and Anders Brix,2008).

1.3. Concept of Weather Derivatives

The first transaction in the weather derivatives market took place in 1997 in the U.S. The first weather derivative trade was between Enron Corporation and Koch industries. Most of the trades during that time were in the OTC market. they are traded privately between the two counterparties. The world's first exchange traded weather derivative began trading on September 22, 1999 at the Chicago Mercantile Exchange.

The weather indices most commonly used in the market are the Heating Degree Days (HDD), Cooling Degree Days (CDD), Cumulative Average Temperature (CAT) and the Cumulative total of 24-hour Average Temperatures (C24AT). The HDD index is computed as the maximum of zero and 65 F (or 18C) minus the average temperature of the day, accumulated over every day of the corresponding contract period. Equivalently, the CDD index is the accumulation of the maximum of zero and the average temperature minus 65 F (or 18 C). CAT and C24AT cumulate the daily average temperature (average of maximal and minimal temperature) and the 24-hour average temperature of each day respectively. The corresponding trading months for CDD and CAT contracts are April to October, for HDD October to April and for C24AT contracts all months of the year **(Wolfgang Karl Hardley etal, 2012)**.

Presently CME provides derivative trading in the following weather variables:-

TEMPERATURE-BASED PRODUCTS

City Locations	Index Used – Winter	Index Used –Summer
United States	HDD	CDD
Canada	HDD, CAT	CDD
Europe	HDD	CAT
Asia Pacific	CAT	CAT
Australia	HDD	CDD

HURRICANE-BASED PRODUCTS

CME offers several Hurricane-based contracts to meet the risk management needs:

- Hurricane futures, options.
- Hurricane Seasonal futures, options.
- Hurricane Seasonal Maximum futures, options .

RAINFALL BASED PRODUCTS

The CME Rainfall Index provides average monthly rainfall information for designated cities in the United States. Rainfall futures, options are available for a number of U.S. cities.

SNOWFALL AND FROST PRODUCTS

Snowfall-Based Products-Snowfall futures and options

Frost-Based Products-Frost Index futures and options (**www.cme.com**)

However, it is estimated that around 98-99% of the weather derivative contracts are based on Temperature Most temperature contracts in the US are based on Heating Degree Days (HDD) index for winter protection and Cooling Degree Days (CDD) index for summer protection. They are calculated as follows:

HDD = Max (0, 65° F minus average temperature in a day) CDD = Max (0, 65°F minus average temperature in a day). The threshold temperature for CDD and HDD has traditionally been 65°F.

The reason is consumers tend to use more energy to heat their homes when the temperature is below 65°F and when it is above 65°F, they tend to use energy on cooling. Pay-off is based on how the index performs relative to a trigger or strike value and not on actual loss. Pay-off is usually defined as a $1,000 per degree day) and 'capped', i.e., maximum payout is indicated.

Example: Calculation of CDD Index

Temperature	Degrees
Maximum	83
Minimum	61
Average	72
Base Temperature	65
CDD	7

If the dollar amount per degree was agreed to be $10,000 in the above example, the holder would have a pay-off of 10,000 times 7 or $70,000 in the case of a CDD contract. The rationale is that the buyer of such a derivative would be compensated by the amount for which his cash flows are adversely affected by the weather.

According to the CME, the weather derivatives traded were around thirty-two billion USD in March 2008 with a high touching forty-five billion USD in 2010. The weather market started gaining popularity beyond the US, in terms of types of risks addressed and the nationalities of firms involved in the market. Weather transactions started to name a few countries - US, the UK, Australia, France, Germany, Norway, Sweden, Mexico, and Japan. According to the survey on the weather derivatives market conducted by Weather Risk Management Association (WRMA), which

studied the status of the weather market from April 1, 2009 to March 31, 2010, customized weather derivatives grew by nearly 30 percent in FY2010 (www.wrma.org)

1.4 Types of weather derivatives

Various brokerage and trading firms customize the weather derivatives to the client's needs. Only certain parties may be interested in trading a specific type of weather commodity based on their business structure. Some of the common weather derivative products include -

1. Swaps: Swaps are contracts where two parties agree to exchange their risks. This will produce a more stable cash flow when weather conditions are volatile. In simple terms, one party agrees to pay the other if the contracted index settles above a certain level, while the other agrees to pay if the index settles below that level. Swaps have no premium but provide protection from adverse weather in return for giving up some of the upside of a favorable season.

2. Collars: Collar is similar to swap in that protection against adverse weather is provided in return for giving up some of the returns generated in favorable conditions. The difference is that the payments to and from the parties' takes place outside an upper and lower level. This allows revenues to fluctuate within a normal range of weather conditions but protects either party against extreme weather.

3. Puts (Floors): Put options or floors are contracts that compensate a buyer if a weather variable falls below a pre-determined level. This type of protection involves a premium being paid upfront. It provides protection against adverse weather whilst allowing profits to be retained in a favourable period.

4. Calls (Caps): Call option or Caps are contracts that compensate a buyer if a weather variable falls above a pre-determined level. This type of protection also involves a premium being paid upfront. It provides protection against adverse weather whilst allowing profits to be retained in a favorable period. To illustrate, a commercial air-field might buy a call option when the number of days that the average wind speed exceeds a certain level. This would compensate the airfield for the loss of revenue during days when they had to stop flying.

1.5 Utility of weather derivatives

Let's consider a farmer growing Wheat in a village in Rajasthan. He is worried because of the expectations of unusually low rainfall in the state this year. He usually produces 100 quintals of Wheat in his farm. But this year, he thinks the production will drop to 80 quintals. The Minimum Support Price for Wheat is Rs. 1000 per quintal. This means that the farmer fears losing Rs 20,000 this season due to poor rainfall. If the farmer had access to weather derivatives, he could have bought or sold (depending on the future outlook for rainfall) rain day futures contracts today and entered into an equal but opposite contract at a later date, making a profit on the transaction, thus offsetting the losses due to low volumes produced.

Apart from applying weather derivative as a measure of hedging risk against adverse weather conditions it can also be used as the mode of trading in derivatives. The most advantageous factor of weather derivatives is the fact that they can't be manipulated by any means like insider trading as the raining patterns are natural and beyond the scope of humans **Nagarajan K. (2009) .** Current users of weather futures are primarily energy companies in energy-related businesses. However, there is growing awareness and signs of potential growth in the trading of weather futures among agricultural firms, restaurants and companies involved in tourism and travel.

1.6 Beneficiaries of weather derivatives

Any company whose revenue is affected by weather has a potential need for weather derivatives. Some of these industries include -

* Agriculture
* Soft drinks and confectionery retailers
* Hotels and leisure industry
* Sports
* Engineering and construction industry
* Energy producers and distributors
* Insurance, re-insurance companies
* Banks and financial institutions
* Breweries, pubs and restaurants
* Transport and distribution companies

1.7. Weather derivatives in India

There is a considerable scope for weather derivatives in India. India is a huge country where still today agriculture is the major source of income for majority of the population **Nagarajan K. (2009) .** Agriculture and the related agro industries support around 60% of the population. According to the economic survey agriculture contributes to more than 30% of the total GDP of India **(Anjali Choksi,2012).** But in a vast country like India where agriculture is spread throughout the length and breadth of the country Mother Nature has a very important role to play. The Indian agriculture is still dependent heavily on the south west monsoons. It still doesn't have a strong irrigation system to support its farmers. The south west monsoons play a very important role in the agriculture industry of India. Most part of India is dependent on the monsoons for a better crop yield. Hence it is most likely that weather derivatives in India should have the monsoon or rainfall as their underlying. It is also based on the way that normal derivatives are traded on the exchange.

Weather trading in India has a long way to go. First and foremost until and unless the bill is passed and trading is allowed on intangibles such as rain, weather trading will be a dream. Even if the bill is passed and weather is traded on the exchange a very strong infrastructure should be created so as to have a far reaching effect. Farmers from every nook and cranny of the country should be able to hedge of their risks. This can be done with the help of the local Grama Panchayats. Farmers and traders should be given exposure and educated about the benefits of weather trading.

1.8. Conclusion

No doubt, weather derivatives are appropriate instruments for hedging climatic risks. In a vast country like India, where agriculture is spread throughout the length and breadth of the country, Mother Nature has a crucial role to play. Hence it is most likely that weather derivatives in India should have the monsoon or rainfall as their underlying. It is also based on the way that normal derivatives are traded on the exchange.

However, Weather trading in India has a long way to go. First and foremost, until and unless, the bill is passed and trading is allowed on intangibles such as rain, weather trading will be a dream. Even if the bill is passed and weather is traded on the exchange a very strong infrastructure should be created so as to have a far reaching effect. Farmers from every nook and corner of the country should be able to hedge of their risks. This can be done with the help of the local Grama

Panchayats. Farmers and traders should be given exposure and educated about the benefits of weather trading.

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