WHY HAVEN'T WEATHER DERIVATIVES BEEN MORE SUCCESSFUL AS FUTURES CONTRACTS? A CASE STUDY

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Abstract

Why have some seemingly promising futures contracts not succeeded in the recent past? In this paper, we examine one such example, the weather derivatives market. In two companion working papers, we also analyze two other futures market failures: namely, in the pulp market and in the uranium market. The structure of this paper is as follows. First we provide a brief history of weather derivatives contracts as well as a description of these contracts. Next we review customized over-the-counter (OTC) weather derivatives contracts, as provided by reinsurers, and then we review why futures contracts are not as successful a method of risk transfer. Lastly we describe how weather exposures do not sufficiently match up against the criteria for the successful launch of a futures contract.

Keywords: Future Contracts, Weather Derivatives, Trading

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History of Weather Derivatives Contracts

According to Thind (2014), "Weather derivatives were created in the late 1990s to help energy producers hedge against adverse atmospheric conditions. The first such contract was struck in July 1996, when the now defunct Aquila Energy structured a dual-commodity hedge for New York's Consolidated Edison for its electricity needs that coming August." Later, the CME launched temperature-based products in 1999, according to CME Group (2014). "The Chicago Mercantile Exchange … [now] lists more than 60 contracts including options and futures on rainfall, snowfall, and temperature … [and] is the world's largest weather derivatives exchange," wrote Thind.

It is in the over-the-counter market, though, where the weather derivatives business is booming. Thind (2014) points out that "[m]ost of the OTC business is provided by reinsurers, [who are] weather specialists by trade. "In December [2013,] Swiss Re assumed a portion of the risk of the biggest-ever weather derivatives trade – a $500 million deal between the World Bank and Uruguay's Ministry of Finance that became effective January 1 – to hedge rainfall risk associated with the … country's hydropower generators," noted Thind.

Brief Description of Weather Derivatives Contracts

Table 1 provides the terms of typical weather derivatives contracts.

Table 1. Terms of Weather Derivatives Contracts

Type of Risk	This is based on a measurable index, usually temperature, precipitation, wind speed, snowfall, or combination of temperature and humidity. Of all weather derivative contracts, it is estimated that temperature-related account for about 98 percent, rain-related about 0.9 percent, snow 0.5 percent, and wind 0.2 percent.
Limit	This is the maximum payout under the contract (also known as 'Notional Value').
Structure of the Contract	Swap, collar, straddle, put or call options, futures, etc.
Trigger or Strike Level	The predetermined weather index level at which the contract begins to pay out.
Mechanics of Trade	Weather derivative contracts are priced using actuarial analysis of historical payouts, factoring in recent weather trends and climatic cycles. 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 specific dollar amount (e.g., $1,000 per degree day) and 'capped', i.e., maximum payout is indicated.

Source: Ravindran (2011).

Figure 1 provides a specific example of calculating the payout for a temperature-related weather derivatives contract.

Figure 1. Example: Calculation of CDD Index

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

Note: 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.

Source: Ravindran (2011).

Customized Contracts and Reinsurers

The Role of Reinsurers

It may be that reinsurers are best suited for underwriting weather derivatives contracts. Notes Finas (2012): "At the interface of finance and insurance, weather derivatives are bringing to light a new risk transfer model, in which reinsurers are … play[ing] a leading role."

"Reinsurers, which possess significant levels of equity capital and already have a culture of … [managing] … catastrophe risks, are the players best placed to manage the weather risks of companies. They … [participate] both as risk takers, i.e. as providers of capacity, and as experts in risk analysis and the structuring of tailored weather coverage," wrote Finas.

Features Specific to Reinsurance

"The major global reinsurers… will … continue to be one of the main drivers of development … [of weather derivatives]," argued Finas. This can be explained by two features specific to reinsurance, and to Non-Life reinsurance in particular. These features are described in the next two paragraphs.

Features Specific to Reinsurance: 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 … In this regard, the reinsurance model is closer to that of climate derivatives than to that of traditional insurance," explained Finas.

Features Specific to Reinsurance: 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 analyze and manage weather risks," concluded Finas.

Example of Reinsurance Investing in a Hedge Fund Vehicle

In a 2010 *Opalesque TV* interview, Barney Schauble discussed the investment strategies of Bermuda-based Nephila Capital. At the time, Schauble was a managing principal with Nephila Capital, which was "a leading investment manager specializing in the reinsurance industry." The firm invested in "insurance-linked securities, catastrophe bonds, insurance swaps, and *weather derivatives*," according to *Opalesque TV*. (Italics added.)

This interview provided examples of weather derivatives investments. As of 2010, Nephila Capital was paid a premium to take on either the risk of large natural catastrophic events, or the risks of normal fluctuations in weather.

Relative to the catastrophe risk market, the weather-risk market is small. Counterparties who might lay off weather risk to Nephila Capital included:

(a) hydroelectric plants with low rainfall risk,

(b) farmers at risk to a freeze, and

(c) a golf course or amusement park at risk to an excessive rainfall.

Nephila Capital's investors were large sophisticated institutional funds, who not only liked the positive yield from such an investment, but, more importantly, wanted an exposure that is not correlated to the financial-market risks in their overall portfolio. The firm's sophisticated investors typically devoted 0.5% to 4-5% of their overall portfolio to Nephila's event-risk funds, according to the interview with Schauble.

Futures Contracts

Futures market activity has been a small proportion of the overall market. According to Chisholm (2010), "The market has expanded since exchange-traded contracts were introduced on [the] Chicago Mercantile Exchange in 1999." Table 2 shows examples of how weather futures contracts could be used by commercial-market participants.

Table 2. Hedging with CME weather futures contracts

Risk	Futures hedge	Potential user of the hedge
Hot summer	Buy CDD futures	Agricultural business that would suffer from lower crop yields.
Mild summer	Sell CDD futures	Drinks company that would face lower sales.
Mild winter	Sell HDD futures	Energy suppliers that would face lower demand.
Cold winter	Buy HDD futures	Construction company that would suffer from project delays.

Source: Chisholm (2010), Table 1.2.

Wrote Chisholm: "Almost one million contracts were traded on [the] CME in 2007 although growth slowed … [in the aftermath of the financial crisis of] 2008," with the declining trend continuing, as verified by Thind (2014).

"Exchange-traded contracts … have seen declining volumes over the past three or four years and account for a small proportion of the overall market. … Weather derivative volumes on the CME slid by 16 percent in 2013 to 167,396 traded contracts. Despite the snow [earlier in the year], the CME has yet to see any of its snow derivatives traded on exchange. In Europe [, the] derivatives exchange Eurex … saw no trading in … [2013] on its hurricane futures weather contracts, which are U.S. dollar-denominated and based on weather patterns in the Gulf of Mexico," wrote Thind.

"[T]he one bright spot in the exchange's weather portfolio … [has been its] weekly temperature contracts, [which] more than double[d] in size … from 4,250 contracts in 2012 to 10,100 contracts in 2013," recounted Thind.

Table 3 shows the CME HDD futures contracts that had greater than zero open interest as of November 21st, 2014.

Table 3. CME HDD Futures Contracts That Had Greater Than Zero Open Interest as of 11/21/14

Contract Name	Bloomberg Ticker	Volume	Open Interest
Amsterdam Strips	D2HDA	0	3,250
Atlanta Monthly	APA	0	50
Baltimore Monthly	B4A	0	150
Chicago Monthly	CQA	25	75
Chicago Strips	H2HDA	0	50
Cincinnati Monthly	CJA	0	300
Detroit Monthly	DHDA	0	75
Minneapolis Monthly	LMA	50	50
New York Monthly	NFA	50	300
Paris Monthly	J6A	0	500
Paris Strips	D1HDA	0	1250
Portland Strips	H7HDA	0	50
Washington-Reagan Monthly	HDWA	0	50

Source: The Bloomberg

Clements (2012) explains that "[w]eather derivatives … represent a unique pricing problem. The cost-of-carry method is based on the possibility of storing, or holding the underlying asset. … However, in the case of weather contracts such as HDD or CDD, the underlying asset is not storable in any meaningful way."

Weather Exposures versus the Criteria for the Successful Launch of a Futures Contract

Perhaps the issue with futures contracts on weather exposures is that this market is not naturally suited for futures trading. In this section, we will compare some of the criteria for the success of a futures contract against the characteristics of weather exposures.

Criterion Met

Level Playing Field

Gray (1966) and Silber (1985) both note that there needs to be a level playing field for speculators in order for a futures contract to be successful. In other words, speculators (or investors) cannot be at a huge informational disadvantage as compared to commercial hedgers.

This criterion is met in the weather markets. According to Chincarini (2009), "The weather derivatives market stands apart from many markets in [that] the symmetry of information between agents is very high. That is, there is no possibility for inside information …"

Criteria Not Met

Managing the Risks of Positions

Another criterion for the success of a futures contract is that speculators need to be able to manage the risk of positions they take on from commercial hedgers. Petzel (2001) explains that "one way [for speculators] to minimize these risks is to enter spread positions across markets. By monitoring the basis between related markets, traders are more likely to present bids and offers and supply the necessary liquidity … without incurring too much risk." This type of risk management would not be possible for temperature-related weather derivatives.

Reinsurance companies and funds can approach the risk management of weather derivatives differently from Petzel's technique. They can do so via superior statistical modelling of events when pricing a weather derivatives contract, and then by combining each deal in a diverse portfolio of uncorrelated risks, as noted in Schauble's *Opalesque TV* (2010) interview.

Homogeneous Commodity

According to Sandor (1973), one criterion for a successful futures contract is that the commodity is homogeneous, or there is close movement of prices of different grades of the commodity. It may be that there is too much basis risk in using standardized exchange-traded futures to hedge weather risk. Noted Kimbarovsky (2014): "There is a great deal of demand for weather contracts, just OTC due to ... custom demands."

Amplifying Kimbarovsky's point, Thind (2014) quoted "Martin Malinow, president of reinsurer Endurance Global Weather in New York" as explaining: "Exchange-traded products represent standardization in an increasingly bespoke world. For a snow removal contractor in Milwaukee, if all that is available for hedging is a CME snow contract indexed to Chicago, he will potentially bear a large basis risk between his exposure and the hedging product. For the product to be relevant for a business with localized operations, the product needs to be indexed to a more specific location."

Conclusion

The potential scale of the weather derivatives market is large. According to Finas (2012), "[i]n Europe and the United States, the share of GDP directly … [impacted] by the variability of weather conditions is estimated at 25%. A recent study 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 favorable for business and the year in which it was least favorable."

Even though the potential size of the weather-derivatives markets is large, it is likely that the specialized institutions, which are most equipped for managing weather risk, are outside the futures markets. Instead, it may be that reinsurance companies and funds, using customized OTC derivatives, may be the best suited for taking on and managing weather risk.

Endnotes

This article is excerpted from a three-day seminar on why some futures contracts have succeeded while others have failed.

The information in this article has been assembled from sources believed to be reliable, but is not guaranteed by the author.

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