Managing Investment, Underwriting, and Production Risks from Drought-Related Agricultural Exposures

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INTRODUCTION

Consequences of global climate change include changes in the frequency, intensity, duration and timing of droughts (Intergovernmental Panel on Climate Change 2012). While low levels of rain or snowfall contribute to drought conditions, so, too, do rising surface temperatures, which accelerate moisture evaporation into the atmosphere, drying land surfaces and lowering water levels in streams, lakes and oceans. The evaporated moisture eventually returns to earth through precipitation, but not necessarily in the locations from which it was evaporated (U.S. Environmental Protection Agency 2013). The result can be unexpected precipitation shortfalls in some locations, and unusually large amounts of precipitation in others.

While predicting future weather patterns involves uncertainty, modeling techniques have advanced enough so that some experts feel able to make reasonable predictions about drought. In what might be the best analysis of climate change evidence to date, the Intergovernmental Panel on Climate Change reports "medium confidence that droughts will intensify in the 21st century in some seasons and areas", including in Central North America (Intergovernmental Panel on Climate Change 2012). Average temperatures will continue to increase, and in the Midwest, summers will be hotter and with longer dry periods, while winters will be warmer and wetter (U.S. Environmental Protection Agency 2013). Still, winter moisture is not expected to compensate for summer precipitation shortfalls and more evaporation in most of the Midwest (U.S. Environmental Protection Agency 2013). Thus, many water levels will likely fall, including in the Great Lakes (U.S. Environmental Protection Agency 2013), (Select Committee on Energy Independence and Global Warming n.d.). Consequently, water will become less available for agricultural uses.

The consequences of Midwestern droughts seem far-reaching, especially given the region's role in corn and soybean production. This paper provides an overview of the consequences of drought for farmers, crop insurers, the FCIC, reinsurers and more broadly, insurance company investment strategies.

DROUGHT CONSEQUENCES

The Midwest, consisting of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri,

Nebraska, Ohio, North Dakota, South Dakota and Wisconsin, accounts for much of the nation's annual crop and livestock production. The region is especially well known for corn and soybean production, and generates most of the world's supply of these two products (Carlson 2012). According to the U.S. Department of Agriculture, the region "produced 85 percent of the more than 10.4 billion bushels of corn binned, and 81 percent of the more than 3 billion bushels of soybeans produced" in 2011 (Carlson 2012). Much of that product gets shipped abroad, making the U.S. the world's leading corn exporter and frequently, the largest soybean exporter as well (Carlson 2012).

Even short-lived droughts can reduce corn and soybean yields if they occur at the wrong time. Those who buy corn and soybeans will try to adjust by substituting other products, but in some cases, good substitutes will not exist. Thus, the impact from drought conditions, even if only temporary, can include a decrease in food supply, a correspondent increase in food prices, and indirectly, more hunger and starvation in countries that are especially price elastic (Determining the Impact of Climate Change on Insurance Risk anbd the Global Community 2012).

Beyond the immediate increases in food prices caused by shortages, droughts during production season also raise the costs of farming, providing a second upward jolt to food prices. Failure to mitigate against these conditions creates greater volatility in farm income, making foreclosure more likely. Foreclosures make banks less stable, adding contagion risk to the entire financial system. As a result, the cost of agricultural lending to farmers in drought-susceptible areas rises.

RISK MANAGEMENT STRATEGIES FOR CORN AND SOYBEAN PRODUCERS

There are some viable risk management strategies for farmers to protect against drought. In the short-term, they can plant more drought-resistant varieties of corn and soybeans, but over time, temperatures may rise to the point that these varieties are no longer sustainable. They may then try planting other types of crops, but this can be risky because of the crop-specific nature of some farming equipment. (i.e., a corn picker cannot be used to harvest wheat). Many farmers will need to install irrigation systems, raising demand for water during a time of increased water scarcity, driving up water prices. Clean water may also become more expensive as less water is available to dilute existing emissions into bodies of water, necessitating more expenses to clean the water.

Farmers can diversify their sources of income with off-farm income sources, since all livestock and crop production depend partly on a steady water supply. They can also simply save more money and spend less, so that they have a greater financial cushion for absorbing drought-related income losses.

Turning to the financial markets, they can use weather derivatives to hedge precipitation shortfall risk (Considine 2000), realizing that hedges are typically less than perfect and the amount of capital available to back them somewhat limited. Weather derivatives have payoffs triggered by weather-related metrics, usually tied to temperature or precipitation. Since corn and soybean yields depend on both factors, derivative payoffs tied to temperatures being unusually hot or precipitation unusually low might help replace income lost to low yields. Most weather derivatives are traded over the counter (OTC) or at the Chicago Mercantile Exchange, but OTC transactions have become increasingly popular recently (Weather Derivatives, Come Rain or Shine 2012). In OTC markets, farmers need to beware of counter-party risk presented by derivatives sellers who may be unable to fulfill these contracts if overexposed. Insurance companies with large concentrations of underwriting risk tied to drought, or investment assets adversely affected by drought would make poor counter-parties for corn and soybean farmers seeking to hedge drought crop losses.

Farmers can purchase Federal Crop Insurance, also an imperfect hedge for yield and revenue risks, but should expect to pay more for it if weather related disasters become more frequent. They may also seek assistance through the Noninsured Crop Disaster Assistance Program.

In sum, in times of drought, corn and soybean producers will pay more for agricultural capital, experience more volatility in production yields and revenues, incur higher production costs, and hold more capital in liquid sources to help them smooth the peaks and valleys of income fluctuations. Corn and soybean prices will rise, contributing inflationary pressures throughout the world. We now consider the effects of drought on crop insurance and reinsurance companies.

CAPITAL, INVESTMENTS, AND CROP INSURERS/REINSURERS

Among the 17 private property insurance companies writing crop insurance, most bear only a portion of yield risk and administrative expenses, passing much of this on to the Federal Crop Insurance Corporation (FCIC) through reinsurance agreements (Risk Management Agency/U.S. Department of Agriculture 2013). These companies typically specialize in agriculture insurance, and thus, cannot rely on other aspects of their operations to offset their drought losses.

Claims, which account for most liabilities, will likely be more frequent, more severe and thus, more volatile. When significant drought loss potential exists, these insurers should adjust their asset portfolio to better cover liabilities. They can, for example, increase liquidity by investing proportionately more assets in cash or marketable securities, and replacing some long-term bonds with short-term bonds. However, the investment actuary must balance the need for liquidity with the need for yields adequate to support underwriting losses and greater claims processing costs. The insurer may need to consider alternative investment classes that generate a higher expected rate of return, while still satisfying any risk tolerance and regulatory constraints. Another strategy is to consider investing some funds in assets that increase in value during drought periods (e.g. stock from irrigation systems manufacturers) so that drought-related losses might be at least partially offset by an uptick in other revenues.

In any event, capital resources must be sufficient to cover reasonably pessimistic scenarios. This may necessitate a higher "provision for deviation from expected" component in rates if market and regulatory conditions allow it, and price elasticities are conducive to revenue increases. The insurer could also purchase more reinsurance or employ weather derivatives as a hedge.

Crop insurance companies transfer much of their insurance risk to the FCIC. While farmers pay premiums for crop insurance, which then get funneled in part to the FCIC, most FCIC funding is through federal taxes. More drought claims mean more demand from taxpayers to fund them. If these funds cannot be secured, then the FCIC may bear less risk, either by requiring crop insurance companies to retain more risk, or by relying more on reinsurance. If laws and regulations permit, they may generate capital using weather derivatives.

When the FCIC purchases reinsurance (which is technically retrocession, since they are a reinsurer of crop insurance companies), the costs will vary based on both claims experience and demand for reinsurance/retrocession globally. More drought-related losses should raise demand for reinsurance/retrocession coverage worldwide. If rates rise, more capital may be attracted to reinsurance/retrocession, enhancing the worldwide supply of coverage. Rates of return must be sufficient to keep the capital engaged, meaning that costs of reinsurance/retrocession will likely need to remain higher for a sustained period of time to ensure coverage availability.

Crop insurance and reinsurance companies may use weather derivatives to help offset drought losses in a couple of different ways. They may write weather derivatives that will likely be "out of the money" (i.e., not require them to pay out any money) if drought conditions do not materialize in regions other than where they have exposure (Gandel 2012). They may also buy weather derivatives that will likely be "in the money, with a closer hedge formed if they can purchase them for the region where they are likely to suffer drought related losses. Of course, the ability to use these strategies depends on availability of counter-parties. In the next section, we consider how drought affects insurance company investment portfolios.

INVESTMENT STRATEGIES FOR MANAGING THE EFFECTS OF DROUGHT

Through investments, drought-related corn and soybean losses may directly affect even those insurance companies who do not write crop insurance. Adverse effects may arise from a specific asset class (e.g. equities heavily concentrated in drought-prone locations), industry sector (e.g. agriculture), or individual security (e.g. a food processor who relies heavily on corn or soybeans). While some partial offsets to drought losses may exist (e.g. investing in equities of air conditioning manufacturers whose revenues will likely rise during hot spells), they will likely not be large enough to completely offset the negative consequences of drought.

If the drought is widespread across a broad geographic region, or is especially severe in length and scope, market or contagion risk may also adversely impact equity returns. Default risk and credit risk may increase on corporate bonds issued by firms in affected regions and industries. Thus, the investment actuary may have to reweight the asset portfolio by either asset class or industry sector. A related concern is that the portfolio be not too heavily concentrated by region. For example, an insurer with an asset portfolio overly weighted in local companies may be undiversified, and thus, have significant exposure if a drought permeates the local area.

Insurers should also avoid investing in firms that are clearly making negative contributions to climate change (e.g., utilities with factories that use obsolete coal-burning technologies, and thus introduce extra pollutants into the environment). If the insurer discovers that any of its current holdings are not practicing or promoting "green" technology, these holdings could be sold and replaced by otherwise similar holdings that are more eco-friendly.

CONCLUSION

Evidence of climate change continues to mount, with results including adverse weather conditions like lower precipitation and higher surface warming, which raises the prevalence and

potential severity for drought in regions like the Midwestern United States. Crop insurance consumers, writers, and reinsurers must prepare for more volatility in claims, and be proactive in managing the consequences. So, too, must insurance companies with agriculture exposures in their investment portfolios.

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