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Analysis on Whether Climate Finance Derivatives Can Help Chinese Farmers Avoid Natural Risks

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Abstract: China has a vast population, but knowledge gaps hinder them from sensibly hedging the myriad natural hazards they face in agriculture, which financial derivatives might help counteract. This thesis committed to discussing how climate finance derivatives could enable Chinese farmers to hedge against natural risks based on relevant literature and existing data. The author explores whether financial derivatives have become a tool for Chinese farmers to mitigate natural risks, and puts forward some suggestions on how to introduce financial derivatives into the Chinese market. The research results indicate that climate derivatives are important for the management of agricultural risks, the economic stability of farmers, and the future quality of life of farmers. Farmers are able to use derivatives to hedge against economic crises caused by climate-induced reductions in crop yields, following farmer literacy on financial derivatives and the introduction of climate derivatives by other energy companies.

Keywords: Farmers, natural risk management in agriculture, financial climate derivatives, China's agricultural economy, risk hedging.

1. Introduction

According to the Chinese government's census, farmers account for a sizable portion of the country's population, owing to centuries of agricultural experience and fertile land. Employment in agriculture (% of total employment) (modeled ILO estimate) in China was reported at 22.57 % in 2022, according to the World Bank collection of development indicators, compiled from officially recognized sources[1]. With the rapid development of technology, China has steadily transitioned into a moderately rich country, and people's quality of living has increased as a result of their quest of food. Agriculture competition has also increased; a flood or a fire can entirely ruin farmers' hopes and the fruits of their labor, resulting in a massive wealth crisis. Financial derivatives, which play a major role in risk hedging, have remained inaccessible to some Chinese farmers, who lack information and skills. Farming sometimes involves entire families, and few have attended university or understand how risk hedging might manage agricultural risks. Oliver Musshoff, in his 2009 article, points out that farmers are always at risk, and they choose less weather-dependent production activities to offset the risk. Starting in the late 1990s, the use of new instruments based on weather derivatives has been discussed. Weather derivatives are financial market products, such as futures, options, or swaps, that allow for the exchange of weather risk. They are linked to objectively measurable weather variables

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(temperature, rainfall, wind, etc.). His study aims to shed light on the risk-reducing effects of using rainfall options, specifically considering wheat production in northeastern Germany through a with/without derivative comparison[2]. Many individuals face significant challenges when natural disasters devastate crops or livestock. Developing and emerging economies, in particular, often experience a critical shortage of insurance markets, and few local solutions have emerged to mitigate these risks. This paper examines innovative strategies in global financial markets that present unique opportunities for rural household insurance, helping them manage these risks more effectively. Two of the most promising approaches are: 1) utilizing global futures markets by intermediaries to provide price insurance, and 2) implementing index insurance contracts to shift natural disaster risks to global markets. The paper also offers recommendations for integrating these types of index insurance with rural finance systems[3] .This paper provides an idea: Can Financial Derivatives Serve as a Risk Mitigation Tool for Chinese Farmers Facing Natural Hazards?This article is based on the analysis of existing literature and research data. Climate derivatives developing today, when combined with farmers, have the potential to alleviate the permanent harm caused by natural disasters while also steadily improving their economic and quality of life. The results of this paper will help Chinese farmers to hedge against climate-induced economic losses in agriculture and in this way stabilize China's economic situation and farmers' incomes.

2. Analysis of the Need to Introduce Financial Derivatives in Agriculture

According to the reference material, we can learn that on May 11, 2021, the main data of the seventh national census was released, and the population living in the countryside was 509.79 million, accounting for 36.11%. Therefore, the number of farmers in China accounts for a very large proportion of the population, and it can be said that agriculture is the basis of China's livelihood. China's economy greatly benefits from its farmers, as the country has experienced remarkable expansion since 1949. Massive resource transfers from agriculture have aided in the non-agricultural sectors' rapid expansion. Before 1978, when economic reforms took place, the state imposed high taxes on farmland in order to fund the growth of cities and industries. Since 1978, economic reforms have lessened the burden on agriculture; yet, the sector's development is still hampered by a lack of public funding. This research uses a cointegration technique along with empirical data to show how agriculture has helped China's economy grow. If the economy is not dealt with in a timely manner, the damage will be catastrophic — many people will be displaced, and many families will be left without a source of livelihood or even starve to death. According to the information from the food and agriculture organization, drought, floods, storms, and even some viruses (the New Crown Virus) will affect agricultural production and the economy. According to the information: “From 2008–2018, billions of dollars were lost as a result of declines in crop and livestock production in the aftermath of disasters. USD 30 billion was lost in sub-Saharan and North Africa. USD 29 billion was lost in Latin America and the Caribbean; USD 8.7 billion was lost across the Small Island Developing States (SIDS) in the Caribbean; and USD 49 billion was lost in Asia. It can be seen that the economic loss of agriculture, especially in Asia, is horrendous.”[4] It is therefore imperative to keep the agricultural economy out of the clutches of natural disasters. As we all know, financial derivatives can provide us with a hedge against risk (by using derivatives to lock in or transfer uncertainty about a particular type of asset or financial instrument. Using futures, forward contracts. Shorting or longing an asset so that we can reduce the value of our losses and alleviate financial stress), “While our financial system is filled with risks, it also offers tools for managing those risks through derivatives. Derivatives are financial instruments whose returns are based on the performance of other financial instruments, meaning their success hinges on how these underlying assets perform. They play a crucial role in risk management by allowing companies and individuals to transfer unwanted risks to

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other parties willing to take them on, often for a fee, particularly those who have offsetting risks or a desire to assume that risk."[5]

In today's market derivatives are mostly found in the inter-corporate world and in various financial institutions. But there are few examples in agriculture. In agriculture, weather conditions, changes in rainfall, and hours of light can all be risk variables. Therefore, we may wish to consider this as a risk and introduce climate-specific financial derivatives to hedge these potential risks. The introduction of various climate derivatives is also very advantageous for farmers: weather derivatives can effectively transfer the risk of income fluctuations due to extreme weather and help farmers to maintain the stability of their cash flow. Secondly, weather derivatives can be customized to specific regions, crops or production needs, ensuring that risk management tools are tailored to meet the needs of farmers and agribusinesses.

3. Steps for Developing Climate Financial Derivatives.

1. Setting a benchmark: First, the derivative contract will specify a benchmark value for a weather indicator. For example, a precipitation derivative might set a benchmark value of 400 millimeters of precipitation for a given area. A light derivative might have a benchmark value of 3,000 lux.

2. Define Trigger Conditions: The contract will specify how much the weather indicator deviates from the benchmark value to trigger a payout. For example, if the actual precipitation is less than or more than 500 millimeters, the contract will come into effect. The contract would then stipulate that a unit of cash should be paid out for a unit of precipitation above the benchmark.

Next, an example is used to analyze. The effects of climate on coffee are illustrated in Brazil, where temperatures in coffee-producing regions have increased by approximately 0.25°C per decade since 1974, while annual rainfall during the flowering and ripening periods has decreased. This long-term climate change has resulted in a more than 20% drop in coffee production in southeastern Brazil[6]. The biggest coffee-producing state in Brazil, Minas Gerais, has some of the greatest levels of climate risk and hazard due to continued coffee expansion. The country's hilly regions and many other municipalities with the lowest adaptive ability are likewise highly exposed to climate-related dangers. Targeting climate adaptation support to these high-risk regions, such as research, extension, and credit subsidies for improved coffee varieties, irrigation, and agroforestry, as well as diversifying agricultural production, may be able to mitigate negative climate hazards and exposure impacts for coffee-producing regions. The next example is: If a coffee grower in South America at a time when El Niño is very prevalent, growers predict that precipitation will continue to rise. So he predicts that precipitation will continue to rise, so he buys a precipitation futures contract and trades it in the future based on the actual precipitation. 1. First, growers purchase precipitation futures (the contract's base precipitation is 100 mm, and they go long on the precipitation derivative). 2. As El Niño develops, precipitation reaches 150mm, allowing them to cash in on the extra 50mm of precipitation at the time of contract settlement. 3. This conversion of precipitation to cash means that even if coffee bean production incurs losses due to the rainfall, growers can offset these losses through their knowledge of precipitation forecasting, effectively hedging against the risk of natural disasters in agriculture.

In addition to this, the introduction of a climate derivatives exchange that matches and screens different buyers and sellers could greatly reduce transaction times and ensure the security of the transaction. In some countries in Europe, they have already started to use weather derivatives and created great value. It is believed that this derivative decision will also be realized in China, a large agricultural country. In a practical example from Southern Africa, agricultural production is severely affected by climate change, threatening food security and business sustainability. Insurance and reinsurance companies have not been able to provide coverage for climate change risks due to underwriting capacity issues. Furthermore, using derivatives to hedge these risks is not a dependable solution. As a result, the idea of catastrophe bonds (CAT bonds) for funding climate change risks is

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examined in this article. CAT bonds support post-disaster recovery efforts, catastrophe risk reduction, sustainable socio-economic-agricultural development, and preparedness for disasters through a combination of money market returns and premiums escrowed in collateralized accounts. The use of CAT bonds may make it easier to coordinate humanitarian aid, civil and social protection, and catastrophe response. Development, employment, food security, and agricultural land policies may all be improved, along with frameworks for disaster risk reduction and management strategies."[7]

4. Integration of Climate Derivatives into the Chinese Market

It can start by introducing derivatives in the energy market. First of all, the energy market is very dependent on the weather, among the studies of the scholar Sorin Gabriel Anton, it can be found that the relationship between business and energy is very strong. "The empirical results show that the effect of the increase in average annual temperature on the profitability of enterprises is not homogeneous at the level of all quartiles: the increase in temperature increases the operating profitability of low-profit and high-profit enterprises. Overall, this study suggests that not only firm-specific but also energy market-related factors have a significant impact on the profitability of companies listed in the energy and natural gas industry."[8] Based on this, they need to closely monitor weather conditions and use this to predict the ability of wind power to generate electricity. The power companies are able to pinpoint weather changes even within minutes. They build very sophisticated machines to predict the weather. "In global weather models, mesh sizes typically range from 10 kilometers (km) to 50 km. For instance, the American Global Forecast System (GFS) has a resolution of approximately 25 km, while the European Centre for Medium-Range Weather Forecasts (ECMWF) operates at around 10 km. However, precise forecasts require highly granular weather data. A notable example is Meteomatics' EURO1k, an exceptionally high-resolution weather model for all of Europe, developed by the company's experts at a unique resolution of 1 km." [9] Furthermore, "it's fairly easy to understand how certain forms of infrastructure and power generation are affected by weather." It goes without saying that in order to produce solar electricity, wind must blow, and all types of violent storms can severely damage transmission and distribution networks as well as other energy-related infrastructure. Therefore, having reliable and frequently updated weather information is crucial to electricity businesses. Consequently, they are much more certain about financial derivatives to be able to profit from them. So, starting with energy companies is the right decision, and there will certainly be a considerable number of sellers and buyers. After the introduction of climate financial derivatives to these companies, it is natural that they can be publicized and promoted by the government to bring climate financial derivatives into the homes of ordinary farmers. The government can then use the data already available on energy companies to convince farmers to invest in climate derivatives themselves.

5. Conclusion

According to these findings, climate finance derivatives can indeed play an important role in agricultural risk hedging. Some countries in Europe have already begun work in this area, and it is believed that this form of derivative will become more and more important in the future. What's more, the "reinsurance" organizations that will be created will provide more jobs for young people and students of finance. The development of climate finance derivatives in China should be smooth, and as a large energy country, many energy organizations will open the first door for climate finance derivatives and develop them in the context of China's large agricultural sector. The current analysis is mainly based on the results of existing literature and data, and future research authors will conduct in-depth analysis by combining relevant financial models and specific examples.

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