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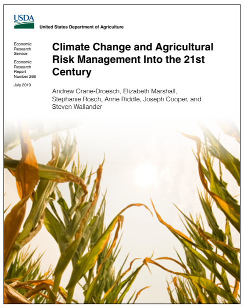

Climate Change and Agricultural Risk Management Into the 21st Century

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What Is the Issue?

The Federal Government implements a number of programs that mitigate risk in agriculture, including the Federal Crop Insurance Program (FCIP), Agriculture Risk Coverage (ARC), Price Loss Coverage (PLC), and several others. The FCIP provides subsidized insurance, while other programs provide payments to farmers in response to adverse production or market conditions. Together, the costs of these programs have averaged about $12 billion annually over the past decade. Year-to-year fluctuations in these costs are heavily influenced by weather variability, which affects yields and prices. The Federal Government's cost exposure is expected to increase as weather averages and extremes change over the coming decades.

This study uses statistical, geophysical, and economic models to explore the mechanisms by which climate change could affect future costs of farm safety net programs to the Federal Government. This approach first simulates the potential impact of climate change on yields of major commodities, then quantifies the implications of yield change on planting decisions and prices, which in turn affects the cost of risk management programs. This allows for analysis of three different pathways by which cost increases could occur: (1) the direct impact of climate on yield risk, (2) the indirect effect of yield risk on price risk, and (3) the impact of changed average yield, production, and price on the total value insured (liabilities). While farm safety net policies change over time, this study uses the current version of the FCIP's Revenue Protection program as a heuristic: a program that reduces both yield and price risk as past programs have, and as future policies may.

What Did the Study Find?

Of the mechanisms considered, changes to total liabilities are more influential than price volatility and yield volatility on the cost of the FCIP's premium subsidies to the Federal Government, though all were found to be significant. All climate scenarios considered suggest that climate change would lower domestic production of corn, soybeans, and wheat relative to a future scenario with climate identical to that of the past three decades. All else equal, this implies that prices would be higher than they would otherwise, which implies higher premiums and, consequently, higher subsidies. Foreign supply or demand changes that are driven by climate change would mitigate or exacerbate this effect, though this analysis does not model production in the rest of the world.

Changes to yield and price volatility also strongly influence the cost of FCIP premium subsidies, but the direction in which these factors would change is less certain. Yield volatility increases under most (but not all) climate scenarios and crops, increasing the frequency and/or depth of losses, and thus increasing premiums and subsidies. On the other hand, changes to price volatility differ by crop and scenario.

Much depends on the severity of future warming. This study compares two scenarios representing differing future rates of greenhouse gas emissions and, consequently, differing severities of climate change. Under the moderate emissions scenario, the cost of today's FCIP would be about 3.5 percent higher than under a future with a climate similar to that of the recent past. Under the higher emissions scenario, this cost increase is 22 percent.

These estimates would be higher if the analysis did not account for adaptation to climate change. While not all possible forms of adaptation are included, this study explicitly accounts for how farmers may change what they plant, where they plant it, and how they manage it in response to changes in expected yields and prices. If the study did not include adaptation in its models, the estimates of cost increases would jump to 10 percent and 37 percent, under the moderate and severe greenhouse gas concentration scenarios, respectively.

How Was the Study Conducted?

Detailed historical weather and yield data are used to train statistical models—semiparametric neural networks—to predict yields of corn, soybeans, and winter wheat. These models are then used to project yields under simulated weather data for the period 2060-99, which is used to approximate a distribution of possible weather for the year 2080. The study uses simulations from five different climate models to represent uncertainty in the response of the climate to greenhouse gas emissions, and two scenarios for each corresponding to moderate and higher emissions.

Next, projected yields are used as inputs to ERS's Regional Environment and Agriculture Programming Model (REAP), an economic model that simulates the co-movement of planted acres, yields, and prices. REAP simulates how farmers would change what they grow – and where they grow it – in response to changes in yields and prices. Finally, the output of the economic model is used to simulate the cost of the FCIP for corn, soybeans, and winter wheat for 2080, which is taken as a representative year in the second half of the 21st century.