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Adapting Sovereign Debt to Climate Change

Toan Phan and Felipe F. Schwartzman. “Climate Defaults and Financial Adaptation.” Federal Reserve Bank of Richmond Working Paper No. 23-06, March 2023.

As stronger hurricanes become more common due to climate change, understanding what factors drive recovery is increasingly important. How quickly a country recovers is influenced by its ability to attract foreign capital — making recovery challenging for emerging economies, as investors are more reluctant to invest in countries that are more likely to default on loans. The challenge for these countries to secure capital suggests an area for financial instruments to be adapted to better suit their needs. To gain a clearer understanding of the interplay between climate-related disasters and these financial challenges, Richmond Fed economists Toan Phan and Felipe Schwartzman created a model to quantify the welfare implications of a change in disaster risks and the benefits of financial adaptation strategies.

Phan and Schwartzman used a modified version of a growth model of a small open economy. They based the risk of a climate-related disaster on empirical observations of disasters. In the model, the risk of an affected country defaulting is determined by the relationship between its debt-to-GDP ratio and the loss in output it suffers due to the disaster. The model includes variables both for whether a disaster occurs in each period and for how strong the disaster is, allowing variation in frequency and strength of the disaster. The country can borrow from international lenders by issuing one-period bonds that are repaid the following period unless the country defaults.

The authors found that the model generates results that are in line with prior empirical observations of

emerging economies. For example, the model demonstrates how severe weather can cause long-lasting adverse macroeconomic effects that are worse and longer lasting in countries with less financial development. Specifically, a disaster destroying a country’s capital increases the risk that the country will default, which forces the country to reduce its borrowing, resulting in lowered output and investment. That lowered borrowing capacity results in higher borrowing costs, creating a feedback loop that continually reduces a country’s capital post-disaster.

Using prior research from both the climate science literature and economics, the authors set up the disaster shock variable in the model to represent hurricanes. Mexico was chosen as the emerging economy that is subjected to the disaster risk as its business cycles are well studied in macroeconomics and the country routinely faces hurricanes. Under this calibration, the authors found that after a hurricane strike, the feedback loop described above can result in a significant delay in recovery by at least two decades.

By adjusting the variables to simulate more frequent and severe hurricanes, in line with current climatology predictions, the authors estimated the losses resulting from such hurricanes. Specifically, the authors utilized the well-known predictions published by several MIT researchers in 2008 that hurricane activity in the Atlantic is likely to increase 10 percent by the end of the century. Under those conditions, Phan and Schwartzman found, the welfare loss would be equivalent to a permanent drop in consumption of about 1 percent.

To understand the potential for financial adaptation to mitigate these effects, the authors examined two financial instruments: disaster

insurance and catastrophe bonds. Disaster insurance aims to smooth consumption and net worth across disaster and non-disaster periods, allowing the country to quickly rebuild its capital. The benefits are limited, however, by the country’s already-constrained debt capacity from which it must pay insurance premiums in non-disaster periods. Thus, the insurance results in a slight increase in wealth and capital in the long run, but not enough to offset the losses from climate change.

Catastrophe bonds are like regular short-term bonds where the issuer repays the principal with interest until it reaches maturity, except that in the event of catastrophe, the obligation is deferred or forgiven. Thus, by issuing these bonds, the country can decrease its debt burden in times of disaster, reducing its default risk. Insurance, on the other hand, does not improve a country’s default risk, as foreign creditors are generally not able to seize insurance payouts in the event of default.

By integrating both financial instruments into the model, the authors found that each one has its unique benefits. More specifically, insurance provides a country with resources to speed up its recovery but does not reduce default risk, while catastrophe bonds help a country avoid defaulting in a state of disaster but do not provide insurance that can be applied directly to disaster recovery. Thus, the two instruments should be seen as complements rather than substitutes. Used together, the authors estimated, about a quarter of the lost welfare from the increased hurricane risk can be recovered.

Phan and Schwartzman expressed hope that their research will help policymakers better understand the interplay between climate change and financial risks. **EF**