Stress Testing: Could the Bank Survive a Harsh Climate Future?

Module 4 Companion 5 of 6 lessons

For complete beginners. After this companion you will understand what a climate stress test is, how losses eat into a bank's capital cushion, and how to read whether a bank passes.

The capital left at the end of a harsh future

Banks have run stress tests for years, but they usually ask, "Could we survive a bad three years?" Climate poses a harder question: "Could we survive the next thirty?" A stress test takes a deliberately harsh future, pushes the whole bank through it on paper, and checks one thing above all: is there still enough capital left at the end. That check works with arithmetic you can follow.

Start Here: what you need to know first

To read a stress test you must be able to read a bank's cushion. These build to that.

a bank balance sheet. A **balance sheet** is a snapshot of what a bank owns and owes. On one side are its **assets** (mostly the loans it has made). On the other are its **liabilities** (mostly the deposits it owes savers). The difference, what is left for the owners, is its **equity**, also called capital. Climate losses shrink the asset side, and so eat into that equity cushion.

capital adequacy and risk-weighted assets. Regulators do not count every loan as equally risky. They scale each by how risky it is to get **risk-weighted assets** (RWA). The bank's safety is then judged by its **capital adequacy ratio** (CAR): its capital divided by its RWA. International rules set a floor of 10.5 percent (an 8 percent minimum plus a 2.5 percent buffer). Drop below it and the bank faces hard consequences: it must stop paying dividends and raise fresh capital. A climate stress test asks whether the CAR stays above that line after a climate shock.

the credit-risk triad and expected loss. When a bank lends money it asks three questions about each loan. **PD**, the **probability of default**, is the chance the borrower fails to repay (for example a 5 percent chance, written 0.05). **LGD**, the **loss given default**, is the share of the money the bank would lose if that happens, after selling any collateral (for example 0.60, meaning it recovers 40 percent). **EAD**, the **exposure at default**, is how much is owed at that moment (for example 300 million). Multiplying the three gives the **expected loss**, the average amount the bank expects to lose on the loan: $\text{EL} = \text{PD} \times \text{LGD} \times \text{EAD}$. Climate risk raises PD (borrowers hit by disasters default more often) and LGD (flooded collateral is worth less), so it raises the expected loss.

percentage points versus percent. Two small units cause big confusion. If a default rate rises from 5 percent to 8 percent, that is a rise of 3 **percentage points** (the gap), not "3 percent." Saying it rose 3 percent would mean it barely moved, to about 5.15. For finer steps bankers use **basis points**: one basis point is one hundredth of a percentage point, so 25 basis points is a quarter of a percentage point. Keeping these straight keeps the numbers honest.

the logit function. A probability of default must stay between 0 and 1; it can never be negative or above one. But the simple straight line of a regression can wander outside that range. The **logit** (or logistic) function is a gentle S-shaped curve that squashes any number back into the range from 0 to 1, so it is the standard tool for modelling a probability. You only need the picture: an S-curve that keeps a probability where a probability belongs.

The core idea 1: what a climate stress test is

A climate stress test is a controlled what-if. You take a chosen climate future (often one of the NGFS scenarios from Lesson 3), translate it into bigger defaults and lower recoveries on the bank's loans, add up the losses, and subtract them from the bank's capital. Then you ask the only question that matters to a regulator: does the capital adequacy ratio stay above its legal floor of 10.5 percent? If yes, the bank passes. If no, the bank would have to raise fresh capital or shrink, possibly in the middle of a crisis.

The core idea 2: five moving parts

Every climate stress test, however fancy, has the same five parts. It helps to name them:

1. a **scenario** (the harsh future),
2. the **transmission** (how that future reaches each loan),
3. the **mapping** (which loans are in which exposed sectors and places),
4. the **loss** (the expected loss, PD $\times$ LGD $\times$ EAD, now with stressed PD and LGD), and
5. the **capital** (what the losses do to the ratio).

You already own the fourth part from Lesson 1. The new step is the fifth, and it is just one subtraction.

The core idea 3: what losses do to capital

A bank's safety is its capital adequacy ratio: capital divided by risk-weighted assets. A stress test computes the losses, takes them off the capital, and recomputes the ratio:

$$\boxed{\text{CAR}_{\text{after}} = \frac{\text{capital} - \text{climate losses}}{\text{risk-weighted assets}}.}$$

Worked example, every step shown

A bank holds \$71 of capital against \$500 of risk-weighted assets, so today its ratio is $71/500 = 14.2$ percent, comfortably above the 10.5 percent floor. A delayed-transition scenario produces \$18.5 of climate losses.

Step 1, shrink the capital. $71 - 18.5 = 52.5$ left.

Step 2, recompute the ratio. $52.5/500 = 10.5$ percent.

Step 3, read it. The ratio fell from 14.2 percent to 10.5 percent, a drop of 3.7 percentage points (not "3.7 percent"; it is the gap between the two ratios). The bank lands exactly on the floor. One more bad assumption and it would breach, which is precisely the warning a stress test is built to give.

Beyond this companion: see the lecture deck

Researchers estimate the stressed default rates from the ground up with a logit model, $\text{logit}(\text{PD}_i) = \alpha + \beta_1 \text{climate}_i + \ldots$, which keeps a probability between 0 and 1, and they study the rare catastrophic tail with Extreme Value Theory (the GPD and GEV distributions). These sharpen the numbers but do not change the logic of the subtraction above; the lecture deck covers them.

Now you are ready

You can now read whether a bank passes a climate stress test. **Handout Chapter 5** adds the real supervisory exercises (the European Central Bank's 2022 test and the Bank of England's CBES) and the Thai case, anchored on the 2011 floods (about US\$46.5 billion in damage). Then **Lesson 5 (Deck L5)** develops the loan-level models from the advanced box.

Check yourself

1. What is the legal floor a stressed CAR must stay above? *(10.5 percent.)*
2. A bank has \$60 capital, \$20 losses, \$400 risk-weighted assets. What is its post-stress CAR? $(60 - 20)/400 = 10$ *percent.*
3. A ratio falls from 12 percent to 9 percent. By how many percentage points? *(3 percentage points.)*
4. Which of the five parts did you already learn in Lesson 1? *(The loss,* $\text{PD} \times \text{LGD} \times \text{EAD}$*.)*

Mini-glossary. *Climate stress test:* pushing a bank through a harsh climate future to check its capital survives. *Post-stress CAR:* the capital ratio after losses. *Floor:* the 10.5 percent line a bank must not cross.

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