Discovery Exercises

Module 4, Lesson 5: Climate Stress Testing

Foundation level. Two pre-class and two in-class activities. Full worked solutions are at the back: try each activity before you check.

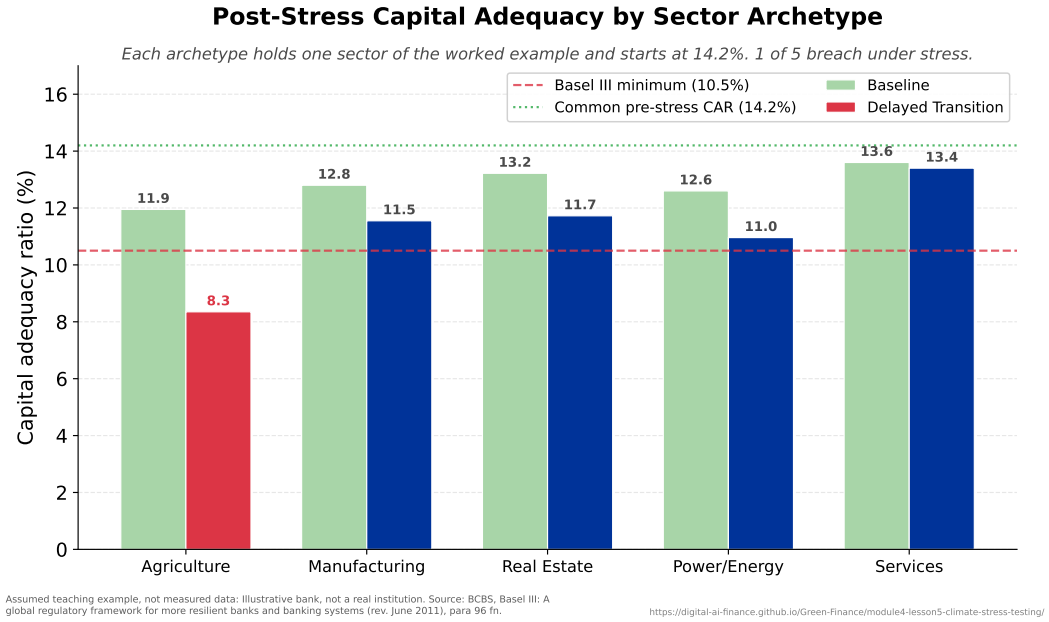
Four activities open the ideas of Lesson 4.5 before, and during, the lecture. The two pre-class tasks take 15 to 20 minutes each and you do them alone. The two in-class tasks take 5 to 10 minutes and you do them with others. Nothing here is graded; the point is to think first, then compare your thinking with the worked solution. A climate stress test asks one blunt question: if severe climate losses hit, can the bank still meet its minimum capital requirement?

PRE-CLASS Reading a stress test result off the chart

15 to 20 min, work on your own, pen and paper

Based on: guided discovery (Mayer 2004)

The single output of a climate stress test is the **post-stress capital adequacy ratio** (post-stress CAR), a bank's capital as a fraction of its **risk-weighted assets** (RWA, its loan book scaled by how risky each loan is). The Basel III regulatory minimum is **10.5%** (an 8% requirement plus a 2.5% conservation buffer). If a bank falls below 10.5% after the stress, it must cut dividends, raise capital, or shed exposures.



Five banks' capital ratio before and after climate stress, under two scenarios. The dashed line is the 10.5% regulatory minimum.

1. From the chart, before any stress, are all five banks above the 10.5% minimum? Under the milder (Net Zero) scenario, do they all still pass?
2. Under the severe (Hot House) scenario, how many of the five banks fall *below* the 10.5% line? What must a bank that breaches the line do next?
3. In one sentence, state what the stress test shows a supervisor beyond today's capital ratio.

Your attempt (before you check the solution at the back):

PRE-CLASS Build the stressed loss table yourself

15 to 20 min, work on your own, pen and paper (optional spreadsheet stretch)

Based on: productive failure (Kapur 2008)

Try this *before* the lecture walks through the loss table. A bank's yearly **expected loss** on a sector is EL = PD × LGD × EAD, where **PD** is the probability of default (chance of non-repayment), **LGD** is the loss given default (fraction not recovered), and **EAD** is the exposure at default (money at stake). Under climate stress the PD and LGD both rise while the EAD stays fixed (a "static balance sheet": the bank does not sell down during the test). Here are three sectors of a Thai bank (amounts in THB billions), under a Delayed Transition scenario:

Sector	EAD	PD base	PD stress	LGD base	LGD stress
Agriculture	100	5.0%	9.0%	45%	65%
Real Estate	80	2.8%	4.5%	35%	55%
Power/Energy	60	4.0%	7.2%	40%	45%

1. For each sector compute the baseline expected loss (PD base × LGD base × EAD) and the stressed expected loss (PD stress × LGD stress × EAD). Show your working in THB billions.
2. Add up the three baseline losses, and add up the three stressed losses. By roughly how many times did the total loss grow?
3. Agriculture is only 100 of the 240 total EAD (about 42%). Is its share of the *extra* (stressed minus base) loss bigger or smaller than 42%? What does that tell you about where the bank's climate risk lies?

Your attempt (before you check the solution at the back):

Optional stretch

A capital-adequacy calculation. A bank has regulatory capital of THB 71B and risk-weighted assets (RWA) of THB 500B. Its capital ratio is capital divided by RWA. Set up a spreadsheet: cell for capital, cell for RWA, cell for the ratio. First confirm the pre-stress ratio. Then subtract a climate loss of THB 18.5B from capital and recompute the post-stress ratio. How much headroom is left above the 10.5% minimum? Now try a loss of THB 22B: does the bank still pass? (This is the CAR / RWA calculation the lesson uses; a spreadsheet or Colab notebook makes the "what loss breaks the bank?" question one keystroke away.)

IN-CLASS Which sector will dominate the stress loss?

5 to 10 min, think-pair-share

Based on: predict then reveal, testing effect (Roediger and Karpicke 2006)

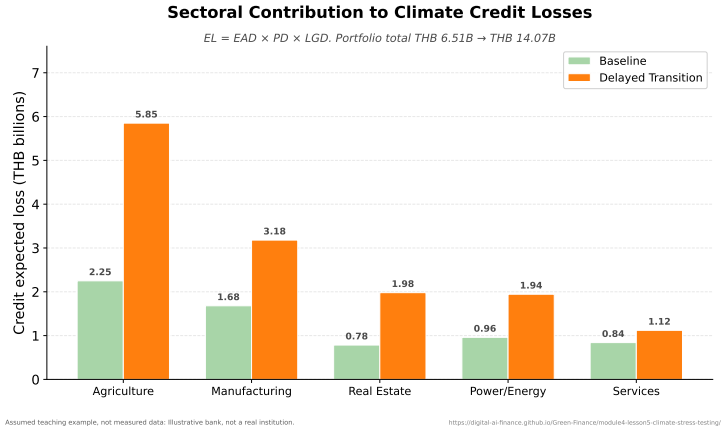
When a Thai bank is stress-tested, the total loss is not spread evenly across sectors. One or two sectors usually dominate. In this activity you predict which, before your instructor reveals the lesson's sectoral-contribution chart.

1. **Predict (1 minute, on your own).** A Thai bank lends to agriculture, manufacturing, real estate, power/energy, and services. Under a climate stress, which *two* sectors do you think contribute the most to the total loss? Write your top two, and one reason:

   Biggest: _____ Second: _____

2. **Pair (2 minutes).** Compare with a neighbour. The lesson notes agriculture contributes about 42% of the *incremental* climate loss despite being only about 20% of the loan book. Agree on one sentence for why a small book can account for an outsized share of the loss.

3. **Share and reveal.** Your instructor shows the sectoral-contribution chart. Were your top two right? State the one rule about why exposure *size* alone does not tell you where the risk is.



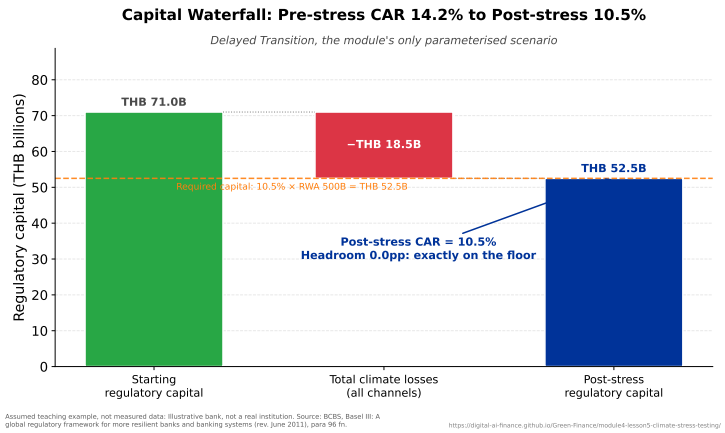
Each sector's share of the total climate stress loss for the Thai bank (revealed after you predict).

IN-CLASS Does the bank survive the stress?

5 to 10 min, small groups of 3 to 5

Based on: data and case interrogation, active learning (Freeman et al. 2014)

The final step of a stress test turns the loss into a capital verdict. A bank's post-stress capital ratio is its capital *after* losses, divided by its risk-weighted assets (RWA). If it falls below the 10.5% minimum, the bank must act. Work as a group with the lesson's worked figures.



A capital "waterfall": starting capital, minus the climate loss, giving the post-stress ratio.

A Thai bank has regulatory capital of THB 71B and RWA of THB 500B.

1. **Estimate first.** As a group, compute the pre-stress capital ratio (capital divided by RWA, as a percentage). Is it comfortably above 10.5%?
2. **Apply the stress.** A Delayed Transition scenario produces a climate loss of THB 18.5B. Subtract it from capital and recompute the ratio. How much headroom (in percentage points) is left above the 10.5% minimum?
3. Now suppose the loss is THB 22B instead (a harsher run, agriculture and power dominating). Recompute. Does the bank still pass, and what does your group conclude about how thin the margin is? List the actions a bank on or below the line must take.

Full Solutions

Try each exercise on your own before you read its solution.

Solution: Reading a stress test result off the chart

1. Yes: before stress all five banks are above the 10.5% minimum. Under the milder Net Zero scenario they all still pass, keeping roughly 1 to 3 percentage points of headroom.
2. Under the severe Hot House scenario, **2 of the 5** banks fall below the 10.5% line. A bank that breaches must restrict dividends, raise fresh capital, or reduce its risky exposures.
3. The stress test forces the conversation *before* the crisis: today's ratio only says the bank is fine now, whereas the stress test reveals which banks would fail under a plausible but severe climate future, while there is still time to act.

Common misconception. That a bank comfortably above the minimum today is safe. A bank can be well above 10.5% now and still breach it under a severe climate scenario; only a forward-looking stress test exposes that.

Solution: Build the stressed loss table yourself

1. Per sector (THB billions): Agriculture base $= 0.05 \times 0.45 \times 100 = 2.25$; stress $= 0.09 \times 0.65 \times 100 = 5.85$. Real Estate base $= 0.028 \times 0.35 \times 80 = 0.78$; stress $= 0.045 \times 0.55 \times 80 = 1.98$. Power base $= 0.04 \times 0.40 \times 60 = 0.96$; stress $= 0.072 \times 0.45 \times 60 = 1.94$.
2. Baseline total $= 2.25 + 0.78 + 0.96 = 3.99$. Stressed total $= 5.85 + 1.98 + 1.94 = 9.77$. The total grew about $9.77/3.99 \approx 2.4$ times (in the full five-sector deck example the total roughly *doubles*, from THB 6.5B to THB 14.1B).
3. Agriculture's extra loss is $5.85 - 2.25 = 3.60$ of the total extra $9.77 - 3.99 = 5.78$, that is about 62%, far more than its 42% share of EAD. Lesson: the biggest exposure is not always the biggest risk; a sector's PD and LGD sensitivity matters as much as its size.

Common misconception. That climate stress raises losses a little across the board. Because PD and LGD both rise together and multiply, the stressed loss can be double the baseline, and it concentrates in the most climate-sensitive sectors.

Solution: Which sector will dominate the stress loss?

Agriculture and power/energy dominate: in the lesson's Thai bank they together account for roughly 70% of the losses. Agriculture alone contributes about 42% of the incremental climate loss while being only about 20% of the book.

Why a small book accounts for an outsized share: agriculture has both a high physical sensitivity (floods and drought raise its PD sharply) and a high LGD (flood-damaged, largely uninsured land recovers little), so each dollar lent to it produces far more stressed loss than a dollar lent to services. The rule: exposure size alone is misleading, the loss depends on size times the sector's PD and LGD climate sensitivity.

Common misconception. That the sector with the largest loan book must drive the loss. Services is often the largest book but among the smallest loss contributors, because its PD and LGD barely move under climate stress.

Solution: Does the bank survive the stress?

1. Pre-stress ratio = 71/500 = 14.2%, comfortably above the 10.5% minimum (about 3.7 percentage points of headroom).
2. After a THB 18.5B loss: (71 − 18.5)/500 = 52.5/500 = 10.5%. Headroom above the minimum is **0.0 percentage points**, the bank is exactly on the regulatory threshold.
3. After a THB 22B loss: (71 − 22)/500 = 49/500 = 9.8%, which is *below* 10.5%, so the bank **breaches** and fails the stress. The margin is dangerously thin: a difference of a few billion in losses moves the bank from just-passing to breaching. A bank on or below the line must restrict dividends, raise capital, or cut exposures.

Common misconception. That landing exactly on 10.5% means the bank is fine. Sitting on the threshold means zero headroom: any further loss, or any modelling error in the downward direction, pushes the bank into breach, so supervisors treat "on the line" as a warning, not a pass.

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