Securitisation and the Credit Crisis

Lecture 8

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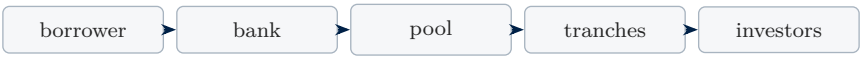

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Outline

1. Pooling, tranching, and the originate-to-distribute chain
2. Correlation, and the collapse
3. Lessons, reforms, and the Chinese case

Pooling, tranching, and the originate-to-distribute chain

From last week's bundles to this week's

Lecture 7's bundles decomposed in your hands — a swap was FRAs, bonds, and forwards, each priceable and checkable. Decomposability was the safety property. This lecture studies bundles engineered so that they could **not** be taken apart, and a year when the map of who owed whom became unreadable at the worst possible moment. The instrument is securitisation; the episode is the 2007–08 credit crisis; and the analytical question throughout is a single one — *what makes a pool of risky loans safe, and when does that safety fail?*

The honest problem

A mortgage is a long loan with a house behind it. A bank holding 10,000 of them holds three problems at once:

- decades of **duration** (Lecture 4);
- concentrated **credit** exposure to one region's households;
- an **illiquid** balance sheet — capital locked for thirty years, capping how much more it can lend.

Securitisation's honest purpose: sell the loans onward, recycle the capital, and spread the risk to investors who want it. A reasonable machine — which is why it grew large enough to matter.

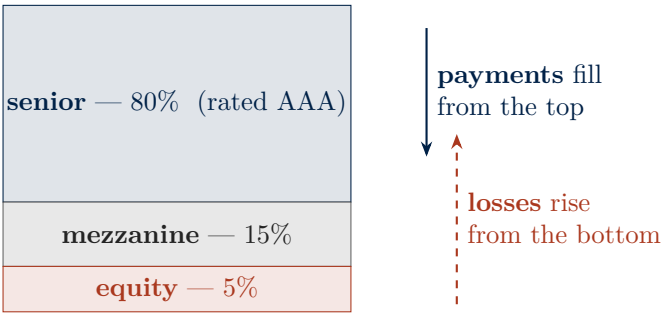
Pooling

A special-purpose vehicle (SPV) buys the 10,000 mortgages. The bank receives cash now; the SPV receives the monthly payments.

- The SPV is **bankruptcy-remote**: a shell whose only assets are the loans, so the pool's fate is separated from the bank's.
- The pool's cash flow becomes a single object — thousands of small promises, summed.

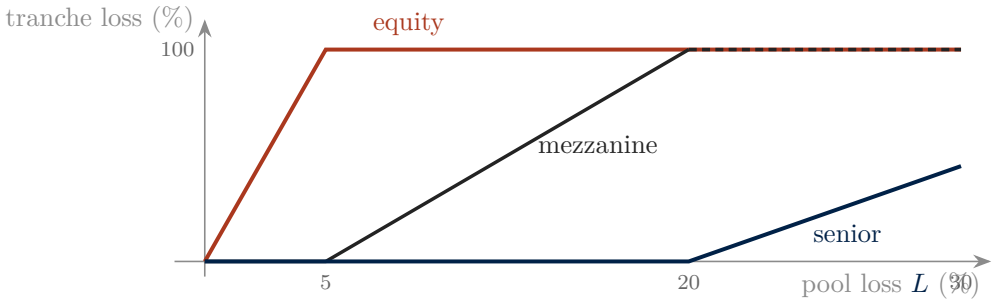
But summed promises are still risky promises. The next step makes them saleable by *slicing* them.

Tranching: the waterfall



Cash fills the senior tranche first; losses consume the equity first. Subordination is the whole technology: the lower tranches are paid more to stand in front of the losses.

A tranche is an option on the pool's loss



Each tranche's loss is the Lecture 1 kink, drawn on the pool's loss: flat, then a ramp between its attachment a and detachment d, then flat. A tranche spanning (a, d) loses $\min\big(\max((L-a)/(d-a), 0),\, 1\big)$. *Main point: each tranche is an option on the pool's loss; the senior tranche is a far-out-of-the-money one.*

Reading the tranches with numbers

Suppose the pool loses 12% (a very bad year for mortgages):

tranche	computation	loss

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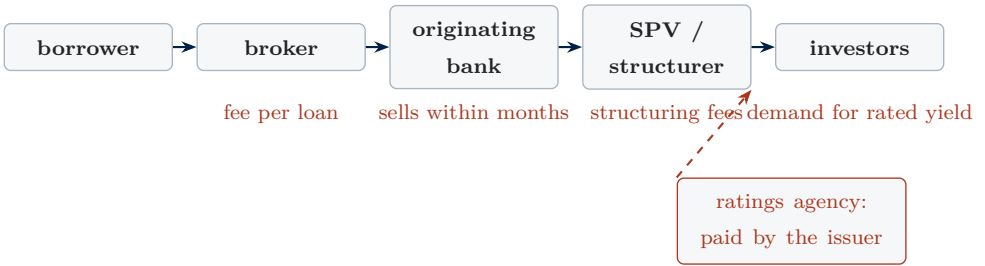
The senior holder is untouched by a 12% catastrophe. That is the sales pitch — and it is true, *conditional on* one thing that was never printed on the label. Block B is about that condition.

Why the rating mattered, and the alchemy

- **Clienteles**: pension funds and banks needed AAA-rated assets; others wanted the equity tranche's leverage. Each tranche found a buyer.
- **The rating**: an agency translated a structure few had time to model into a familiar symbol — AAA — borrowed from the corporate bond world.
- **The result**: from a pool of subprime loans, individually BBB-grade material, roughly **80%** emerged rated AAA.

That transformation deserves an audit: how does subordination manufacture safety, and what does it assume?

The originate-to-distribute chain



Every link is paid on the **flow** of loans; almost no one holds the **stock** of risk. "Originate to distribute" means each party passes the loan on quickly, and the rating agency is paid by the party whose product it grades.

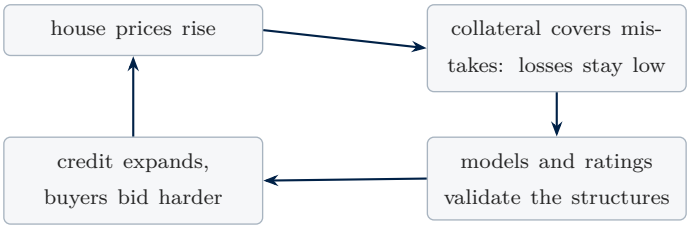
What the incentives produced

When every link is paid on volume, the underwriting standard falls:

- **documentation decayed** — low- and no-documentation lending (the era's term was the "NINJA" loan: no income, no job, no assets);
- **teaser structures** — the 2/28 mortgage: two cheap fixed years, then a sharp reset, with the borrower's plan being to *refinance before the reset*, which works only while house prices rise;
- down payments shrank toward zero, and by 2005–06 subprime was roughly a fifth of new US mortgage lending.

A teaser loan is therefore a **position in house prices** in the form of a mortgage — a point that becomes decisive in Block B.

The boom reinforced itself



Each variable confirmed the others, including default models estimated on the loop's own benign output. This is the same circular structure as Lecture 7's doom loop, running in the favourable direction.

The amplifier: the CDO of ABS

Senior tranches sold easily and equity found buyers; the **mezzanine** was hard to place. The industry's solution was to re-securitise it:

- collect the mezzanine tranches of *many* different mortgage deals into a new pool;
- tranche *that* pool — the ABS CDO — from which, again, roughly 80% emerged rated AAA.

The pitch was diversification across many deals. The flaw, from frame 11: those mezzanine tranches all depend on **one** underlying variable — the national housing market.

The amplification, computed

ABS tranching 5/15/80, and a CDO built on the mezzanine tranches with the same 5/15/80 structure. Track one number through both:

mortgage-pool loss	ABS mezzanine loss	**CDO senior** loss

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Main point: re-tranching a tranche steepens the loss profile — a 20% pool loss, terrible but conceivable, erases the CDO's AAA tranche entirely.

Correlation, and the collapse

The hidden condition

Every safety claim in Block A was conditional: the senior tranche is safe *provided pool losses rarely exceed 20%*. Why should they? The universal answer was *diversification*: ten thousand loans cannot all fail at once. But Lecture 3 taught that diversification reduces risk only when the risks are **independent**. So the whole structure rests on one unstated question:

how correlated are the defaults in the pool?

The smallest experiment: two loans

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The same two loans, the same 20% individual risk — yet the senior note is **five times** more likely to be hit in one world than the other. *Main point: a senior tranche's safety is set by default correlation, not by the average quality of the loans.*

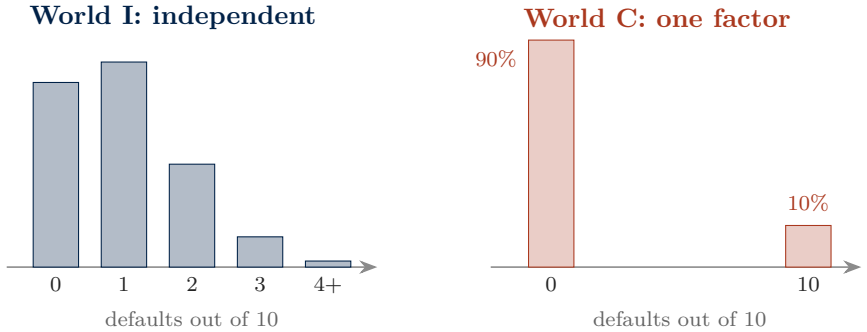
Scaling up: ten loans, two worlds

Ten equal loans, each defaulting with probability 10%; a default loses its share. Two worlds:

- **World I (independent)**: each borrower's outcome is its own.
- **World C (one common factor)**: with probability 10% the common factor fails and *all ten* default together; otherwise none do.

The **expected loss is 10% in both worlds** — same loans, same average, same price for the whole pool. Only the shape of the loss differs. *Main point: correlation does not change the pool's expected loss; it changes the shape of the loss, and therefore its split across tranches.*

Same average, opposite shapes



World I clusters around one default; World C is all-or-nothing. A tranche is a kinked claim (frame 7) on *this* distribution — so the same tranche is a different instrument in each world.

What correlation does to the senior tranche

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World C (one factor)	10% (1 in 10)
ratio	$\approx$ **700**$\times$

The more senior the tranche, the more its safety depends on correlation alone. *Main point: a AAA senior tranche is, in effect, a short position in the assumption that defaults are independent.*

The model that set the one number

The industry did not roll dice; it priced tranches with the **single-factor Gaussian copula** (David Li, 2000), which compresses all pairwise default correlations into one parameter ρ.

- A low ρ describes World I; a high ρ describes World C.
- The model was calibrated to historical data in which US national house prices had not fallen year-on-year since the 1930s. In that data, mortgage defaults looked nearly independent, so ρ was estimated *low*.
- The model therefore priced senior tranches as if the world were World I — while the chain had quietly built World C.

Main point: the crisis was, in large part, the price of one parameter — default correlation — estimated from a past that had never fallen.

Correlation as a mechanism, not a Greek letter

What was the common factor in reality? **The national house price.**

- The teaser borrowers of frame 11 all shared one exit: refinance against a higher price. When prices stalled, every exit closed in the same season.
- Falling prices also reduced recovery values everywhere at once — recoveries fell exactly as defaults rose.
- So the pool was never ten thousand independent risks; it was closer to one risk, realised ten thousand times.

The transferable skill is to find the variable that everyone's survival shares — the basis trade's repo line, the LDI fund's gilt yield, here the house price.

Why the CDO made it worse

Re-read the amplification table (frame 14) with this in mind:

- a mezzanine tranche pays in good weather and is wiped in the tail — it is almost a pure bet on the common factor;
- pooling a hundred mezzanine tranches does not diversify; it collects a hundred copies of the *same* bet, whose correlation in the states that matter is near one;
- so the CDO's AAA senior tranche was, in substance, a deferred wager on national house prices — sold to investors who believed they held the opposite.

Same probability, different fate

The deepest mispricing was about *when* an asset fails, not how often:

- a AAA *corporate* bond defaults idiosyncratically — one weak firm in an otherwise ordinary world;
- a AAA *senior tranche* defaults only in a systematic catastrophe — exactly when markets fall, jobs vanish, and cash is dearest.

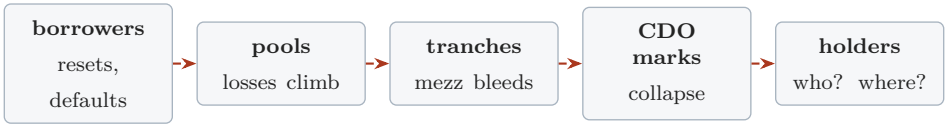
Lecture 5 distinguished probability from price. An asset that pays nothing precisely in the worst states should be **cheaper** (yield more) than one that fails at random. These two paid almost the same — systematically rich to the seller. *Main point: an asset that fails only in the worst states should yield more, not the same, as one that fails at random.*

The turn

- **2006**: US house prices flatten and then fall; the national index begins a decline that reaches roughly a quarter, peak to trough.
- The teaser resets arrive on schedule and the refinancing exit is shut; delinquencies climb through **2007**, first in the newest, weakest loans.
- Equity tranches are wiped as designed; mezzanine begins to take losses; every CDO built on mezzanine marks toward frame 14's table.

The boom loop of frame 12 is now running in reverse.

The chain, in reverse



the discovery that broke the system: the bundles sat on **bank** balance sheets and in vehicles **funded overnight** — the risk had never really left

Losses flowed back upstream, and the unreadable map meant no one knew whose balance sheet held them. Uncertainty about a counterparty has a price — Lecture 1's point that no one promises for a stranger.

The crisis was a funding run

Opacity turned a credit problem into a liquidity problem:

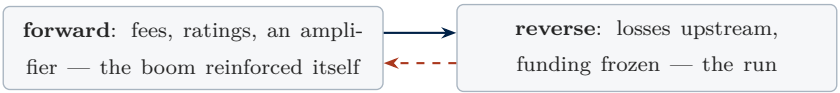
- **Aug 2007**: a major European bank suspended funds holding subprime paper because it could no longer value them; the asset-backed commercial paper market shut within weeks.
- **Northern Rock** (UK) funded long mortgages with short wholesale borrowing; when the next roll failed, depositors queued — Britain's first bank run in a century. It was nationalised in Feb 2008.
- **Repo haircuts** on structured collateral jumped from slivers to double digits — Lecture 2's margin spiral — and **Bear Stearns**, financed overnight, was run by its lenders and sold in March 2008.

Main point: a bundle that cannot be valued becomes collateral no one will lend against — opacity became a funding event.

September 2008

- **Lehman Brothers** filed for bankruptcy on 15 September 2008 — the largest in US history. No one could tell who was owed what by whom, so trust between institutions collapsed.
- **AIG** was rescued days later: a single insurer had written credit protection on senior CDO tranches at scale — insurance on the bundles, concentrated in one seller. (Credit default swaps are beyond this course.)
- A large US money-market fund holding Lehman paper **"broke the buck"**: even "cash" funds held these bundles, and corporate treasuries learned it the same morning.

Where we are



Block C: who paid, what was rebuilt — and the architecture you have been studying all semester — and whether 2008 could happen in China.

Lessons, reforms, and the Chinese case

How it reached China

China held little of the paper, but the crisis arrived through the real economy:

- world trade fell sharply in 2009; export orders collapsed within a quarter and coastal factories idled;
- policy responded at scale — the **¥4 trillion** stimulus of November 2008, an infrastructure and credit expansion that shaped the following decade;
- for a firm dependent on global demand, 2008's lesson was not CDOs but a demand shock that needed no financial intermediary.

Could the course's tools have seen it?

Apply Lecture 3's instrument test to a 2006 AAA CDO tranche:

- *what does it pay in the feared scenario?* It **is** the feared scenario — it fails precisely when housing, jobs, and markets fail together (frame 23);
- *what does it owe in the good scenario?* Nothing visible — which is how it was sold;
- *can its funding survive a bad week?* It was held on overnight repo, so the funding failed the same day the asset did.

Three questions, three failures. The analytical tools were sufficient; what was scarce was the habit of asking.

The reforms, mapped to the failures

The autopsy in four words — **incentives, correlation, opacity, funding** — and the reform that answers each:

incentives	risk retention: securitisers must keep about **5%** of the risk — "skin in the game" (Dodd-Frank; an EU equivalent)
opacity	standardised OTC derivatives pushed into *central clearing* with daily margin, plus trade reporting
funding	Basel III: more capital, and a liquidity rule requiring banks to survive a 30-day funding freeze
correlation	the honest gap: an assumption cannot be legislated; ratings reform was modest, and vigilance stayed with the buyer

The architecture you already know

The post-2008 response is the plumbing this course has studied all semester:

- Lecture 2's central counterparties and default waterfalls;
- Lecture 6's mandate moving Treasuries toward clearing;
- Lecture 7's collateral agreements and centrally cleared swaps.

Moving standardised promises into clearing houses was the regulatory answer to *this* chapter. The honest qualification: clearing converts credit risk into liquidity risk, so the episodes of Lectures 6 and 7 (the basis trade, the LDI funds) are this chapter's sequels, not its repeats.

Securitisation after the crisis

The instrument was disciplined, not abolished:

- auto loans, credit cards, equipment leases, and mortgages are still pooled and tranched, now with retention rules and simpler structures. The honest problem of frame 4 still needs solving.
- The CDO-of-ABS, the re-securitisation of tail tranches, largely disappeared.

The tool was not the cause. A chain paid on flow, one unpriced correlation, and bundles built to be unopenable were.

The Chinese case: the channel that was narrow

Could 2008 happen in China? Compare the structures, factually:

- **down payments**: Chinese mortgages have historically required large down payments (commonly 20–30% or more), so the zero-equity borrower of frame 11 largely could not exist;
- **recourse**: borrowers remain liable beyond the house, so walking away does not erase the debt;
- **distribution**: mortgages mostly stay on bank balance sheets; securitisation exists but is small beside the loan books, and the chain is short.

The 2008 channel — highly levered household credit distributed through opaque bundles — is structurally narrow in China.

The Chinese case: a different balance sheet

Property became systemic in China through the **developer**, not the securitised mortgage:

- **pre-sales**: buyers pay before completion, so households in effect lend to builders, and construction runs on that float plus debt;
- **2020**: the "three red lines" capped developer leverage, and the most extended developers could no longer roll their funding (Lecture 3's mechanism);
- **2021–24**: Evergrande defaulted and was later ordered into liquidation (January 2024); the sector has been adjusting, with policy focused on completing pre-sold homes.

Main point: when one asset class is the collateral of a whole economy, its price is on everyone's balance sheet — whatever the instrument.

The bill

- System-wide writedowns ran into the trillions of dollars; governments committed rescues of historic size (the US authorised $700bn for bank support alone).
- The broader cost was a deep recession, US unemployment peaking near 10%, and millions of foreclosures — borne most by those at the chain's first link.

The autopsy, once more: incentives, correlation, opacity, funding — and the one that a rulebook cannot fix is correlation.

Summary

- Lecture 1: transfer. Lecture 2: concentrate. Lecture 3: exchange. Lecture 4: every date a price. Lecture 5: the present, carried. Lecture 6: leveraged balance sheets. Lecture 7: bundles redraw the map.
- Lecture 8: pooling spreads risk; **correlation quietly collects it back into the senior tranche.**

A pool's expected loss does not depend on correlation; the split of that loss across tranches depends on almost nothing else. The crisis priced safety from a past that contained only the calm world.

In-class problems

A. Tranching 5/15/80; the pool loses 9%. Compute each tranche's loss, and identify which holders are indifferent between 9% and 6%.

B. Two equal loans, each defaulting with probability 20%. A note absorbs only the *second* loss. Find its probability of loss if the defaults are independent, and if they are perfectly correlated. What did the structure actually sell?

C. The CDO machine of frame 14 with a pool loss of 14%: compute the ABS mezzanine loss and the CDO senior loss.

What carries into Part II

- the **tranche as an option on pool loss** (frame 7) — a layer struck between two loss points is a spread of options — is the direct bridge into Part II, which prices the option itself;
- **correlation's lesson** — that the *shape* of the loss distribution, not just its average, sets each layer's value — returns as the option's dependence on volatility;
- **probability versus price** (frame 23) is the doorway to risk-neutral valuation, the lens on which option pricing beyond these no-arbitrage bounds is built;
- the **common-factor question** (frame 21) is a permanent habit: ask every "diversified" claim what variable it secretly shares.

Part I priced *symmetric* promises — forwards, futures, swaps, where both sides are bound.

Part II prices the instrument with a choice on one side: the option.

Topic 9: the mechanics of options markets — then their bounds, trees, and the Black–Scholes formula.