

ASSET-BACKED SECURITIES

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TRANCHES

Suppose there are two i.i.d. loans for \$10k each. Each independently has a 50% chance of defaulting. You buy them both at par for \$20k and securitize the bundle. Jointly, there's a:

- 25% chance that both default (payout is zero),
- 50% chance that just one defaults (payout is \$10k + interest),
- 25% chance that neither defaults (so payout is the full \$20k + interest).

You decide to offer:

- \$5k principal of A-notes, which get seniority: There's only a 25% chance of full default (since there's a 75% chance you collect at least \$5k + interest from your bundle of loans). So, since the A-notes are much safer than the underlying individual loans, under you can sell the A-notes at 2 points above par for \$5.1k.
- \$10k principal of B-notes, which will have a
 - 25% chance of full default (happens if you collect zero payout – nobody gets paid),
 - 50% chance of half-default (happens if you collect \$10k + interest – after the \$5k of A-notes get paid, you're left with \$5k to pay the B's),
 - 25% chance of no default.

So, even though the expected payout of the \$10k of B-notes is by Adam's law still \$5k—exactly the same as if you had bought either of the underlying individual loans—the variance of outcomes is lower (because instead of a 50+50 all-or-nothing bet, you're taking a 25+25 all-or-nothing bet with 50% of “cushion” in the middle). A mean-variance investor will consider these notes safer than either underlying individual loan. So, you can sell the B's at 1 point above par for \$10.1k.

Finally, you reserve \$5k of principal for the residual (“equity certificate”), which gets paid last. Unlike the notes, which are debt (the securitization is legally like a regular company, and the notes are like loans from the investors to you, which you promise to repay and collateralize with the underlying individual loans), the residual is equity, and gets paid the analog of “retained earnings”.

You could sell the residual shares (under no-arbitrage, this would necessarily have to be at \$4.8k, since the loans themselves are selling for \$20k, so the asset side of the balance sheet is \$20k, and you have \$15.2k worth of debt), but let's say you choose to keep them. There's a 75% chance that you will make nothing from this – The only way you make any money here is if neither loan defaults and you collect the full \$20k + interest, leaving \$5k + interest for yourself once the A's and B's get paid. Why would you take this deal, when you could have instead simply bought both loans and kept them for yourself which, thanks to diversification, would have given you a similar deal as the B's?

Well, now instead of taking your \$20k and tying it all up in loans, you continue to have some exposure to the loans, but you now also have \$15.2k of cash proceeds from selling the notes, and you can go invest it elsewhere or pile it up in your living room and look at it, or whatever else you want.

ABSBS: ASSET-BACKED-SECURITY-BACKED SECURITIES

In the Big Short, there's a patronizing pair of scenes where Anthony Bourdain and Ryan Gosling sneer that packaging B-notes from a random collection of existing securitizations into a single new securitization and selling A-notes off that because it's “suddenly diversified” is like taking a random collection of contaminated fish that they can't make into sushi and making it into a seafood stew. Yes! It is exactly like that – and that's why it makes sense.

Let me belabor their fish analogy. Suppose you have 7 fish, one from each of the seven seas, each weighing 100g. You know that each fish has a 20% chance of being contaminated with mercury. The fish are independent. The lethal dose of contaminated fish is exactly 100g. Assume you are averse to dying. Would you rather have:

- Seven pieces of sashimi, all cut from the same fish (you can have your pick of which one); or
- Seven pieces of sashimi, each cut from a different fish?

The rational answer is, of course, the second. In the first case, there's a one-in-five chance that your dinner will be lethal; In the second, there's only a one-in-hundred-thousand chance, because it requires that *every single fish* ended up being contaminated. This is what we call diversification:

- Compared to the one-in-five chance that the B-note from any single one of the underlying securitizations defaults;
- The chance that the B-notes from *every* one of the various underlying securitizations default is four orders of magnitude smaller.

Now let's make the argument a little more sophisticated, and account for "systemic" (AKA "undiversifiable") risk. Let's say that there's a 10% chance (I'm trying to match the once-every-ten-years pattern that recessions seem to follow) that there's been an insidious global calamity C and the entire global ocean has been contaminated with mercury. Other than that, each fish independently has an 11% chance of being contaminated. (This is constructed so that, even though now the fish are no longer independent, marginally, each fish still has exactly a $0.10 + 0.11(0.90) = 20\%$ chance of being contaminated.) You are *still* better off taking the mixed sashimi. In this case, by the law of total probability, your chance of having a lethal dinner L is

$$\begin{aligned}\Pr[L] &= \Pr[L \mid C] \Pr[C] + \Pr[L \mid \bar{C}] \Pr[\bar{C}] \\ &= 1.00(0.10) + 0.11^7(0.90) \\ &= \boxed{0.1000002}.\end{aligned}$$

This is barely more than $\Pr[C] = \boxed{0.10}$ by itself!

You understand now why, out of the 20% chance of any single fish being contaminated, we call 10% "undiversifiable" or "systemic", and 10% "diversifiable" or "idiosyncratic". (It just ended up being half-and-half here because I decided that $\Pr[C] = 0.10$ – if I had set $\Pr[C] = 0.05$, then 5% of the chance would have been systemic and 15% idiosyncratic.) You can never have less than a 10% chance of fatality, but the other 10% pretty much vanishes if you diversify it away by sampling from each of the seas.