

1 Context

It should be clear by now that investment and return comes with risk. Many of the instruments we have presented here in this course, are instruments that transfer risk from one party to another.

To finalize the course let us summarize one of the most recent and large financial crisis known as the credit crunch that started in 2007. The financial instrument involved in this crisis were securitizations.

In this chapter we will briefly introduce the product of securitizations, examine its role in the credit crunch and relate the key aspects of the crisis to the previous content of the course.

The contents follows mainly Chapter 8 from [1].

2 Securitization

The core business of a credit entity or more specifically of banks consists in getting in touch supply and demand of money, that is people with supply of money will deposit their wealth in the bank in exchange for an interest rate and the bank will lend this money to borrowers in the form of mortgages for instance. The initial scheme became unbalanced in the 60s and there were more demand than supply.

One of the solutions would be to securitized packs of mortgages and sell them to private investors, in that way the bank will rise capital to generate new loans and even though the mortgages were originated in the bank they did not keep them in their books. Soon after the initial residential mortgages backed securities (RMBS) were established, the underlying asset for securitizations were extended to other types of credit like credit cards, auto loans, ... generating a general class of asset backed securities (ABS), increasing their activity in the 80s.

The figure below shows a simple framework for an RMBS. From the total loan book of the bank a selection of mortgages worth EUR 100 MM is made. The interest and principal collections of this pool is no longer own by the bank but segregated in what is known as special purpose vehicle (SPV). The SPV will issue and sell notes or bonds to private investors, typically 3 bonds or tranches known as the senior, mezzanine and junior tranche. The proceeds from selling the notes are then transfer to the bank in exchange for the rights to receive the clients payments, let us call it C .

The total amount of cash flows, C , received by the SPV will be used to pay interest and principal to the noteholders in a waterfall form, meaning that it will first pay to the noteholders of the senior tranche, if there is anything left it will then pay the noteholders of the mezzanine tranche, and finally to the junior noteholders the rest. On the example in Fig. 1 it seems that the best deal is holding the junior tranche since the bond is paying an interest of 20% annually which is way above the 0.60% promised to the noteholders of the senior bond. The catch is that the cashflows are not guaranteed (see Fig. 2), they depend on the collections from the pool of mortgages:

- If all the clients were to pay their obligations, clearly all noteholders will receive what they are promised;
- If not all clients pay their obligations losses arise on the pool and the amount of cashflow received by the SPV will not suffice to pay all noteholder, but since the payments follows a waterfall scheme the first noteholder to take losses will be the ones who bought the junior tranche.

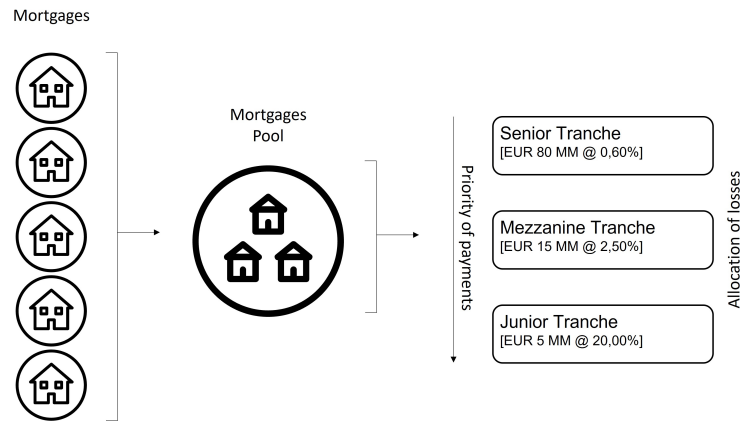


Figure 1. Schematic diagram of a RMBS.

Therefore the junior tranche is more likely to lose part of their principal and hence receive less cashflow that what was promised, and thus it has a larger interest rate. The allocation of losses is then upwards, in the sense that when the losses of the mortgage pool exceed 5% the junior tranche disappears and losses start being allocated to the mezzanine tranche.

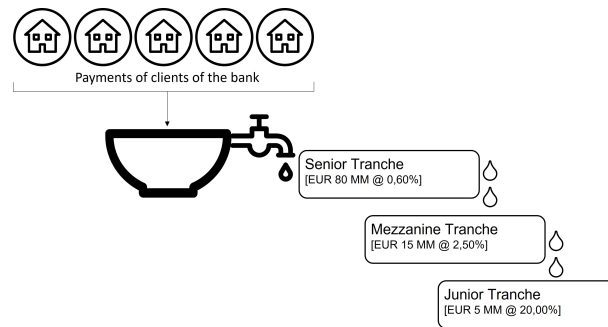


Figure 2. Schematic diagram of payment waterfall.

The above scheme is an oversimplification of an RMBS and several other features play a role in real transactions that are formalize in contracts that contain several hundreds of pages of legal provisions.

2.1 Rating Agencies

The high complexity of these financial instruments is simplify by the task of rating agencies. The main rating agencies are Moody's, S&P and Fitch which go back more 100 years. These agencies rate issuers and issues to qualify the credit risk associated and have become an universal source of analysis since:

- Independence of assessment;
- Ease of comparison across originators and financial instruments;
- Regulatory reliance;
- Issuer payment for ratings.

Ratings are an assessment of risk to default by a given instrument or credit entity coded into symbols. Fig. 3 show the comparison and high level description of the risk in each rating notch and agency. These notches can be segmented down to types of financial instruments, regions, maturity, ... Fig. 4 is an example showing the probability of default over certain period of time and different instruments:

| Moody's | S&P | Fitch | Description |
|------------------|-----------------|-----------------|--|
| Aaa | AAA | AAA | Highest credit quality, minimum credit risk |
| Aa1, Aa2, Aa3 | AA+, AA, AA- | AA+, AA, AA- | Very high credit quality, very low credit risk |
| A1, A2, A3 | A+, A, A- | A+, A, A- | High credit quality (upper-medium grade) |
| Baa1, Baa2, Baa3 | BBB+, BBB, BBB- | BBB+, BBB, BBB- | Good credit quality, currently low credit risk |
| Ba1, Ba2, Ba3 | BB+, BB, BB- | BB+, BB, BB- | Speculative elements, issuer faces major uncertainties and adverse conditions |
| B1, B2, B3 | B+, B, B- | B+, B, B- | High credit risk, but issuer still able to meet its financial commitments |
| Caa1, Caa2, Caa3 | CCC+, CCC, CCC- | CCC | Issuer currently vulnerable, default likely |
| Ca | CC | CC | Issuer currently highly vulnerable, near default |
| C | R, SD, D | C, RD, D | Lowest rating, typically in default on some (SD, RD) or all of its financial obligations |

Figure 3. Comparison between different rating agencies.

| Rating | Sovereigns | | | Corporate | | |
|----------------------------|-------------------|-------------------|-------------------|-----------|---------|----------|
| | 1 year | 5 years | 10 years | 1 year | 5 years | 10 years |
| Aaa | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 |
| Aa | 0.00 | 0.00 | 0.00 | 0.02 | 0.20 | 0.43 |
| A | 0.00 | 0.00 | 0.00 | 0.03 | 0.56 | 10.21 |
| Baa | 0.00 | 0.00 | 0.00 | 0.19 | 2.16 | 4.70 |
| Ba | 1.56 | 12.62 | 40.59 | 1.39 | 12.99 | 23.13 |
| B | 7.89 | 22.22 | 53.38 | 6.44 | 33.18 | 51.14 |
| Caa, Ca, C | 0.00 ² | n.s. ³ | n.s. ³ | 22.82 | 59.44 | 82.51 |
| Investment Grade | 0.00 | 0.00 | 0.00 | 0.07 | 0.87 | 1.82 |
| Speculative Grade | 3.87 | 16.59 | 45.39 | 5.45 | 25.06 | 37.77 |
| Total Sovereigns/Companies | 1.19 | 4.68 | 9.34 | 1.86 | 8.25 | 11.76 |

Figure 4. Rating notches can be converted into probabilities of default.

The information embedded in the credit ratings are very complex, including analysis of cross default probabilities, credit rating transition matrices and so on so forth. On the other hand it provides a tool that can compare the credit worthiness of a 10 year bond from a German bank and the 3 years senior tranche of a RMBS issued by an Italian bank, without the necessity to understand and analyze the German bank system or the pool of loans underlying the RMBS in Italy.

Top tranches are given the best rating levels since the priority of payments ensures a minimum return, and the lower tranches such as the mezzanine or junior are rated less.

2.2 ABS CDOs

Generally speaking for ABS markets, the senior tranche is the first or easiest to be placed or sold while the mezzanine is more difficult to be sold and the junior is normally sold to hedge funds or retained by the originator. To overcome this difficulty collateralized debt obligations (CDO) were created. Essentially these are ABS from other mezzanine and junior ABS as shown in Fig. 5:

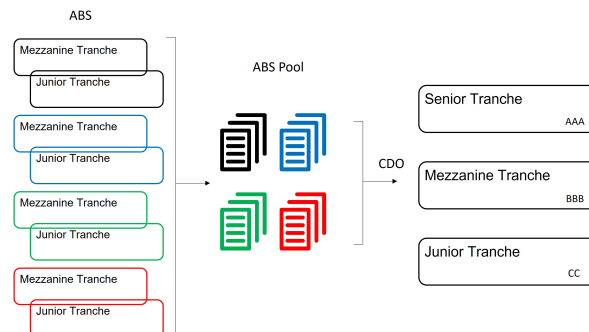


Figure 5. ABS CDO scheme.

Because the same waterfall principle applies here, the thickness of the senior tranche for the CDO is computed to get the highest rating possible and hence comparable to the original senior ABS tranche in terms of ratings. Clearly the thickness in this new structure cannot be 80% of the total pool again but depending on the pool of ABS tranches it can go to something around 65% of the total pool which means that one has found a way to sell most the more difficult tranches to place.

The structure can be further stressed by creating CDO², i.e. a CDO from debt coming from other CDOs. The analysis of the underlying risk becomes more and more complex as more layers of securitizations we include.

3 Sequence of events

After 2002 the low level of interest rates made easy for buyers to take a mortgage to buy a house and simultaneously house prices began to rise. It was a very expansionary part of the economic cycle.

3.1 Subprime mortgages

Generally speaking mortgages are probably the last debt obligation client fail, meaning that they are more likely to pass due their installments on credit card or auto loans firstly. This in turn means that default on mortgages tend to happen after some period of time post origination of the loan.

In this situation, the increase market for RMBS was virtually a very profitable market as there were little defaults at the beginning. The demand for more RMBS products by the international investment community was growing and nor the RMBS or CDO market were able to meet.

Under this circumstance, banks were inclined to issue more mortgages, since they will gain the fees generated and then issue a RMBS so other investors will bear the risk. When the pool of regular clients was exhausted they start granting more loans by relaxing their risk standards, for example the amount lent as a percentage of the house price was increasing, interest rate were fixed at low percentage for the first couple of years and then make rise to above market standard, ... The term subprime refers to the fact that this kind of loans were of second lien or second quality.

Credit lending activity was transform from *what risk I want to hold?* to *can this risk go into an RMBS?*. This effect was in turn incentive by government policies to expand home ownership. The situation escalated quickly to the point that some of the pools of loans used in RMBS were known as NINJA loans, to account for non-income, no-job and no-assets.

3.2 Bubble burst

In 2007 interest rates start to rise and many mortgage holders find it difficult to pay their installments. The consequence was a huge increase in foreclosures which inevitably make that a large number of houses were put in the market to sell. The impact on the house price was immediate and borrowers that signed a mortgage for 100% the value of their home found out that they had negative equity, i.e. their house had a lower market price than the mortgage principal they were repaying. Since many states have a non-recourse legislation, meaning that borrowers declared in default could return their home keys to the banks and close its debt.

The non-recourse feature of USA mortgages means that the borrower has a put option embedded in their loan, he could at any time return back the house to the lender for the remaining principal of the loan. This feature created some peculiar situations for speculators, assume borrow A owns a house, α , and has a mortgage of EUR 200.000; borrower B has a mortgage of EUR 250.000 on β house. And assume that in the financial crises house prices drop in such a way that houses α and β has equivalent market price of EUR 170.000. Then speculators A and B should exercise their mortgage PUT options, which will make the bank to try to sell the house to the market, and therefore A and B should buy their neighbor's house for a cheaper price. In this situation, the loss bears with the seller of the PUT which is the bank.

It is worth noting that the vast majority of cases were people struggling financially suffered greatly when they had to give their house, but the impact of the speculative players should not be underestimated.

3.3 Losses

The value of ABS tranches rated BBB originally lost about 80% of their value by 2007 and 97% of their value the next year. The value of ABS CDO created from BBB ABS and rated AAA lost about 80% of their value by 2008. Large investments banks had enormous positions on those assets and suffered great losses, some of them had to be rescued. Some institution were forced to take in others to save the financial market such as Bear Stearns, founded in 1923, taken over by JP Morgan Chase.

Due to the situation central banks start to increase interest rates and ask banks to better capitalized which in turn create a more difficult environment for financial activity and a great recession started that lasted several years up to the 2020s.

4 The recipe for a crisis?

Many factors contributed to the credit crunch but the most relevant could be summarized in:

- Relaxation of credit standard by banks;
- Rating agencies involved in rating new structured products for which they had very little experience and lack of historical data;
- Complex products lacking relevant information to properly asses the underlying risk;
- Lack of correlation and dependence analysis;

The above were magnified by the predominant thought that house prices would never drop, that they might be localized readjustment here and there but the scenario were price house drop more than 35% widespread was not even considered.

5 The aftermath

The aftermath of the credit crunch is well known but let us focus on the key aspects related to the content of the course that change afterwards.

- Securitization regulation made explicit rules to ensure that banks keep a certain skin in the game, that is they are not allowed to include all the principal of a loan into a securitization and must keep a certain portion in an un-hedge basis in their balance sheet. This is meant to avoid a potential relaxation of risk standards in origination.
- There are only few exceptions to the rule stating that a securitization cannot be composed of securitized positions, i.e. there are only very few exceptions were CDOs are allowed to be created.
- Rating agencies have developed new standard and analysis that are tailor made for structured product.

6 Recap

Overall we can link the several factors giving rise to the credit crunch with the different chapters of the course:

- **Mortgage installments:** A great majority of borrowers were unable to estimate future mortgage installments if interest rate were moving from current values, and hence unable to asses own risk in repaying their loans.

- **Macroeconomic Studies:** There was an overestimation of macroeconomic projections, specially house prices and their relation with interest rate and economic cycle.
- **Valuation of Financial Derivatives:** The models to price such complex structured product were very simple, specially with respect to CDOs.
- **Portfolio Management:** There was an underestimation of the correlations between assets and the impact of a macroeconomic change on it.
- **Risk Management:** Rating agencies lack experience in assessing the risks of these products and underestimate some of the risk factor affecting its price.

References

- [1] John C. Hull (2014) *Options, Futures and Other Derivatives*, Pearson.