Growth and Financial Markets

Lecture 3

- Innovation in Financial Instruments -

Financial Innovation

In lecture 1 we saw that:

- Expansion of credit is a systematic development due to efforts to reduce transaction costs and holding of liquidity and money balances
- History of money is a story of continuing innovations so that the existing supply of money can be used more efficiently and of developments of close substitutes for traditional money in order to circumvent formal requirements applied to money

We now look at:

- **Innovation in financial instruments** (lecture 3)
  - Derivatives
  - Structured credit
  - Credit Default Swaps
- **Innovation in the structure of the financial sector** (lecture 4)
  - The "regulated" banking system
  - The "unregulated" shadow banking system

History of Derivatives (I)

- **Financial derivatives are not new; they have been around for years**. A description of the first known options contract can be found in Aristotle's writings (Politics, Ch. 9). He tells the story of Thales, a poor philosopher from Miletus who developed a "financial device, which involves a principle of universal application." People reproved Thales, saying that his lack of wealth was proof that philosophy was a useless occupation and of no practical value. But Thales knew what he was doing and made plans to prove to others his wisdom and intellect.

- Thales had great skill in forecasting and predicted that the olive harvest would be exceptionally good the next autumn. Confident in his prediction, he made agreements with area olive-press owners to deposit what little money he had with them to guarantee him exclusive use of their olive presses when the harvest was ready. Thales successfully negotiated low prices because the harvest was in the future and no one knew whether the harvest would be plentiful or pathetic and because the olive-press owners were willing to hedge against the possibility of a poor yield.

- Aristotle's story about Thales ends as one might guess: "When the harvest-time came, and many [presses] were wanted all at once and of a sudden, he let them out at any rate which he pleased, and made a quantity of money. Thus he showed the world that philosophers can easily be rich if they like, but that their ambition is of another sort." So Thales exercised the first known options contracts some 2,500 years ago. He was not obliged to exercise the options. If the olive harvest had not been good, Thales could have let the option contracts expire unused and limited his loss to the original price paid for the options. As it turned out, a bumper crop came in, so Thales exercised the options and sold his claims on olive presses at a high profit.

- The first known instance of derivatives trading dates to 2000 B.C. when merchants, in what is now called Bahrain Island in the Arab Gulf, made consignment transactions for goods to be sold in India. Derivatives trading, dating back to the same era, also occurred in Mesopotamia. Forward and options contracts were traded on commodities, shipments and securities in Amsterdam after 1595. The Japanese traded futures-like contracts on warehouse receipts or

History of Derivatives (II)

- **Derivatives markets were small until the 1970s**, when economic conditions, along with advances in the pricing of derivatives, led to spectacular growth. The volatility of interest and exchange rates increased sharply, making it imperative to find efficient ways to hedge related risks. Meanwhile, deregulation, along with soaring international trade and capital flows, added to the demand for financial products to manage risk

- Development of the Black-Scholes formula in the early 1970s (allowing to value options), introduction of faster computers to manage the computations, changed the trading of derivatives: financial engineers could invent new derivatives and easily find their value

- Until the 1970s, derivatives took the form of option, forward and futures contracts. The trading of derivatives was carried out "over the counter" (OTC) meaning without intermediation by an organized exchange

➢ **In 1972, the Chicago Mercantile Exchange started trading futures on currencies. The Chicago Board Options Exchange, where stock options are traded, was founded in 1973**

- In the late 1970s and early 1980s, the swaps market took off. Exotic derivatives trading exploded a few years later

- The notional value (the correct measure of exposure in the event of extreme unexpected events) of global derivatives grew from 21⁄2 times world GDP in 1988 to a staggering 12 times world GDP in 2008. Some of this mountain of derivatives is for socially useful purposes, such as end-users hedging business risks (*e.g.* an airline hedging the cost of fuel, a pension annuity minimising the volatility of income, etc). However, in the past decade socially less useful uses of derivatives have abounded. Notable in this respect is the use of derivatives for tax arbitrage (*e.g.* interest rate swaps to exploit different tax treatment of products). Credit default swaps (CDS) have been used extensively for regulatory arbitrage to minimise the capital banks are required to hold

The role of Financial Derivatives

- Many financial economists hold that **derivatives serve a key role of making markets more complete**, in the sense that **more states of the world can be hedged by a corresponding asset**.

  As a consequence, **financial markets become more efficient and stable**

- Alan Greenspan, probably the most influential proponent of this view. has fiercely objected whenever derivatives have come under scrutiny in Congress or on Wall Street. "What we have found over the years in the marketplace is that derivatives have been an extraordinarily useful vehicle to transfer risk from those who shouldn't be taking it to those who are willing to and are capable of doing so," Mr. Greenspan told the Senate Banking Committee in 2003. "We think it would be a mistake" to more deeply regulate the contracts, he added. "Not only have individual financial institutions become less vulnerable to shocks from underlying risk factors, but also the financial system as a whole has become more resilient." – Alan Greenspan in 2004

- Others disagree: the well-known financier G. Soros avoids using derivatives "because we don't really understand how they work." In the 2002 Berkshire Hathaway annual report, Warren Buffett observed that derivatives were "**financial weapons of mass destruction**", carrying dangers that, while now latent, are potentially lethal

- New out-of-equilibrium models of financial markets found that, paradoxically, on the one hand **the proliferation of financial instruments tends to make the market more complete and efficient by providing more means for risk diversification**, while at the same time **this proliferation of financial instruments erodes systemic stability as it drives the market to a critical state characterized by large susceptibility, strong fluctuations and enhanced correlations among risks**

Derivatives

- A derivative **is a financial instrument whose value depends on – or is "derived" from - the value of an "underlying asset"** (a financial instrument, and indicator or a commodity)

- The most common "underlying assets" include commodities, stocks, bonds, interest rates, currencies and market indices

- Plain vanilla derivatives include:
  - Contracts to buy or sell an underlying at a fixed price for future delivery (forward or futures contracts)
  - Contracts involving the right (but no obligation) to buy or sell an underlying at a fixed price in the future (options)
  - Contracts to exchange one cashflow for another (swaps)

Types of Derivatives (I)

- A **forward** is an OTC agreement – highly customized - between a buyer and a seller to exchange the underlying for a prespecified amount of cash (strike price) on a prearranged future date (settlement date)

- A **future** is a forward contract that has been standardized (notional amount, expiration date) and is negotiated on an organized exchange

- An **option** is an agreement between two parties:
  - The option buyer, who pays a premium and obtains a right (but no obligation) to exchange the underlying for a prespecified amount of cash (strike price) on settlement date
  - The option seller (or writer), who receives the premium but has the obligation to exchange the underlying for a prespecified amount of cash (strike price) on a settlement date, if requested by the option buyer

  There are two basic types of options:
  - **Call option**: gives the buyer the right to buy the underlying at settlement date
  - **Put option**: gives the buyer the right to sell the underlying at settlement date

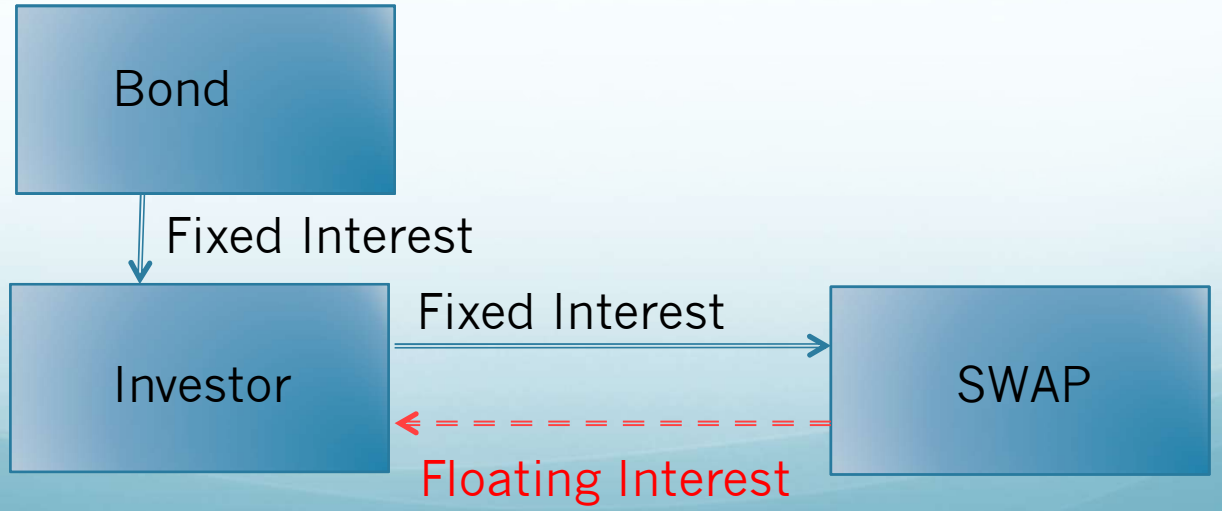
  An American option can be exercised at any date up to the expiration date

  A European option can be exercised only at expiration date
  - **Option have asymmetric payouts**, therefore are particularly suited to **transfer risks**

Types of Derivatives (II)

- A **swap** involves an exchange of cash flows (related to interest payments, or receipts) on a notional amount of principal, that is never exchanged

- The simplest asset swaps involves an investor buying a fixed coupon bond and at the same time entering into an interest rate swap that has a maturity equal to that of the bond. The investor uses the coupon received from the bond to pay fixed interest on the swap. The swap counterparty then pays a floating rate of interest to the investor. The fixed rate investment has been converted into a synthetic floating rate note, (FRN), see the diagram below:



Trading venues for Derivatives

- **Derivatives can be traded:**
  - "other the counter" (OTC), that is in private markets, directly between two parties, without standardization of contracts (swaps, forwards, caps & floors, and other exotic derivatives)
  - through specialized exchanges - "exchange-traded derivatives" (ETD) - in standardized contracts (futures and standardized options)
- **OTC derivative involve a "counterparty" risk** (often mitigated by requirements to post collateral), whereas the settlement of ETD is guaranteed by the "Clearing House" of the exchange where they are traded
- **In the OTC markets there is very little information provided by either the private market participants or collected by government regulators**. The prices and other trading information in these markets are not made freely available to the public like is the case with futures and options exchanges. Instead that information is hoarded by each of the market participants
- As a result of this lack of information in the OTC market, it substantially reduces the ability of the government and other market participants to anticipate and possibly pre-empt major market failures, manipulation efforts or the building of serious market pressures or of systemic risks
- Over-the-counter dealing and lack of transparency will be less common as the Dodd-Frank Wall Street Reform and Consumer Protection Act in US and the European Market Infrastructure Regulations (EMIR) & new MIFID in Europe come into effect

Use of Derivatives

- **Financial derivatives enable parties to trade specific financial risks** (such as interest rate risk, currency, equity and commodity price risk, and credit risk, etc.) **to other entities who are more willing, or better suited, to take or manage these risks [risk transfer]** - typically, but not always, without trading in a primary asset or commodity

- Financial derivatives contracts are usually settled by net payments of cash. This often occurs before maturity for exchange traded contracts such as commodity futures. Cash settlement is a logical consequence of the use of financial derivatives to trade risk independently of ownership of an underlying item. However, some financial derivative contracts, particularly involving foreign currency, are associated with transactions in the underlying item

- Financial derivatives are used for a number of purposes including risk management, hedging, arbitrage between markets, and speculation

Risks of Derivatives

- The main danger posed by derivatives comes from the **leverage** they provide to both hedgers and speculators. **Derivatives transactions allow investors to take a large price position in the market while committing only a small amount of capital** – thus the use of their capital is leveraged

- Leverage makes it cheaper for hedgers to hedge, but it also makes speculation cheaper: instead of buying $1m of Treasury bonds or $1m of stock, an investor can buy futures contracts on $1m of the bonds or stocks with only a few thousand dollars of capital committed as margin. The returns from holding the stocks or bonds will be the same as holding the futures on the stocks or bonds. This allows investors to earn a much higher rate of return on their capital by taking on a much larger amount of risk

- Sellers of options also run **very high risks**: **in exchange for a premium, they can face unlimited losses.** Options writing (selling CDS protection) brought insurance giant AIG almost to default in September 2008 (it was saved by a massive capital and liquidity injection by the US government and the Fed)
- Taking on these greater risks raises the likelihood that investors make or lose large amounts of money. If they suffer large losses, then they are threatened with bankruptcy. If they go bankrupt, then those who invested in them or lent money to them will face possible losses and in turn face bankruptcy themselves. **This spreading of the losses and failures is known as "systemic risk"**, and it is an economy wide problem that can be made worse by leverage and leveraging instruments such as derivatives

Structured Credit

FROM: "originate to hold".....

- Historically banks made loans and kept them on their books ("**originate do hold**"): the borrower would apply for a loan and, if approved, the bank would lend him money and then collect payments on interest and principal over a number of years

- Loans "consume" capital, which remains "tied up" for the whole duration of the transaction. Losses also remain with the lender bank.
- For centuries, the craft of banking has revolved around the relatively simple business of collecting deposits from companies, governments or consumers, and then lending the money out. But while previous generations of bankers had hung on to their loans, like farmers tending a crop, in the late 20th century financiers became more like butchers making sausages. They started to buy loans from anywhere they could (including each other), chop these up, and then repackage them into new instruments that could be sold to investors, with fancy names, from MBS to ABS to CDO.
- This slicing and dicing was supposed to make the financial system much safer. In the past, banks had gone bust when borrowers defaulted because the pain was concentrated in one place; slicing and dicing spread the pain among so many investors that it would be easier to absorb. Or so the theory went.

Structured Credit

..... TO: "originate to distribute"

- In 1970s Ginnie Mae put together the first **mortgage-backed securities (MBS)**, by pooling mortgages it had originated and issuing bonds on the basis of that pool

- **A mortgage-backed security (MBS) is a pool of home mortgages that creates a stream of payments over time paid to its owner**

- The issuer of the MBS (the bank) does not have to wait several years to recoup the proceeds on the mortgage, but receives a lump sum upfront from the purchaser of these bonds [**originate to distribute**]

- The **"securitized" loans** are taken off the books of the lender, freeing up capital to make new loans (this is not the case for "covered bonds" – widely used in some European countries - where the bank keeps the loans on its books and remains liable in case of default of its loans)

- **Securitization turns illiquid assets**, like mortgages and other loans, **into more liquid assets, tradable on open markets, creating new opportunities for borrowers, for financial intermediaries and for investors alike**

Creating an Asset Backed Security (ABS)

- An investment bank sets up a **"Special Purpose Vehicle" (SPV) that purchases a pool of mortgages from the originator** (a bank, a nonbank lender or a GSE) and issues bonds (called MBS) that would pay out the revenue stream received from the thousands of homeowners paying off their mortgages

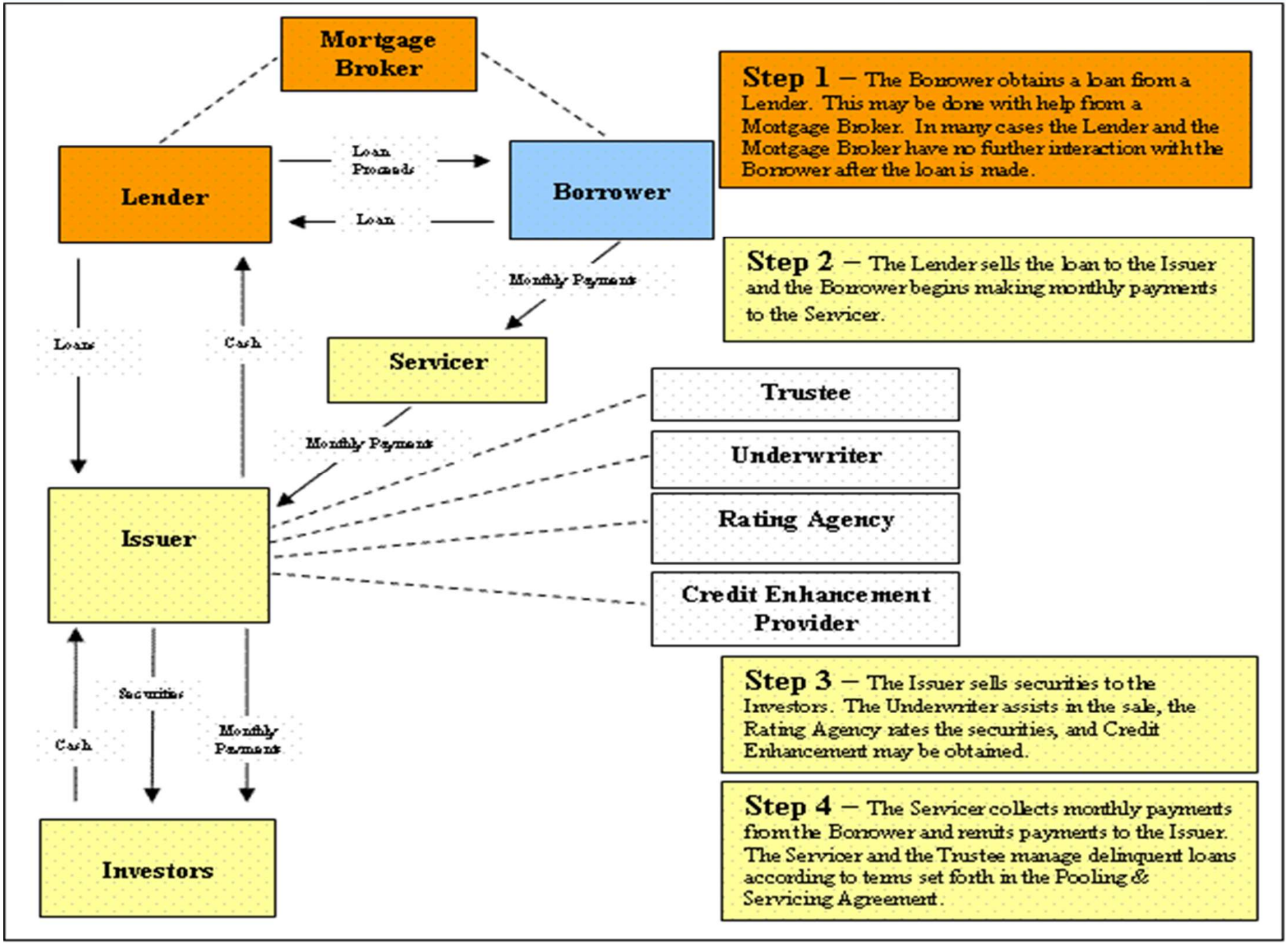
- **Holding a diversified portfolios of loans reduces the riskiness of an ABS** (provided loan default probabilities are not perfectly correlated, i.e. that not all homeowners default at the same time)

- "**Securitization**" spread from housing to commercial real estate mortgages (CRE) and to many other kinds of consumer loans: credit card, student and car loans. Corporate loans, such as leveraged loans and industrial and commercial loans, where securitized as well (LLO, CLO)

- The bonds resulting from "securitization" are generally called "**Asset Backed Securities**" (ABS)

- It seems as though anything can be securitized: airplane leases, revenues from forest and mines, delinquent tax liens, radio tower revenues, boat loans, state and local government revenues, and even royalties of rock and pop stars

- Most collateral requires the performance of **ongoing servicing activities** (like sending monthly bills to credit card holders or collecting payments). They will be carried out by a servicing agent (sometimes the originator itself) for a service fee


Mortgage Broker
Lender
Loan Proceeds
Loan
Borrower
Monthly Payment
Loans
Cash
Servicer
Monthly Payment
Issuer
Trustee
Underwriter
Rating Agency
Credit Enhancement Provider
Cash
Securities
Monthly Payment
Investors
Step 1 – The Borrower obtains a loan from a Lender. This may be done with help from a Mortgage Broker. In many cases the Lender and the Mortgage Broker have no further interaction with the Borrower after the loan is made.
Step 2 – The Lender sells the loan to the Issuer and the Borrower begins making monthly payments to the Servicer.
Step 3 – The Issuer sells securities to the Investors. The Underwriter assists in the sale, the Rating Agency rates the securities, and Credit Enhancement may be obtained.
Step 4 – The Servicer collects monthly payments from the Borrower and remits payments to the Issuer. The Servicer and the Trustee manage delinquent loans according to terms set forth in the Pooling & Servicing Agreement.

The risks of ABS: Interest Rate Risk

Holding a plain vanilla ABS necessarily implies taking on a certain amount of risk

The borrowers might:

- **prepay**, if interest rates fall (interest rate risk, duration risk)
- **default**, if they cannot repay interest or principal (credit risk)

- As with any bond, ABS are subject to **interest rate risk**:
  - if interest rates rise the price of the bond falls [the NPV of all future cash flows of the bond (coupon stream + principal repayment) is inversely correlated to interest rate]
    - $P = {}_t\sum_1^n [C_t/(1+i_t)^t + 100/(1+i)^t$
  - The longer the **duration** of a bond, the higher the sensitivity of changes in prices to changes in interest rates (given a change interest rates, the price of a bond with a very long duration will fluctuate more than the price of a short duration bond)

The risks of ABS: Duration Risk (convexity)

For many ABS (especially MBS) the cash flows of the underlying loans change because of changes in interest rates (**prepayment or convexity risk**)

- Many loans (in particular mortgages) permit prepayment:
  - If interest rates drop, underlying mortgage holders decide to prepay and refinance their mortgages, reducing the duration of the ABS
  - If interest rates rise, underlying mortgage holders try to extend as much as possible their loans at the lower rate they have fixed, increasing the duration of the ABS

  Since duration is inversely correlated to the size of price changes, the volatility of the prices of a ABS will be higher than the volatility of the prices of a "straight" bond with the same duration.
  - ABS are said to have "**negative convexity**" [convexity is the sensitivity of the duration of a bond to changes in interest rates, the second derivative of the price of the bond with respect to interest rates (duration is the first derivative)]
  - The higher the convexity the more sensitive is the bond price to changes in interest rates: therefore ABS must offer higher yields than comparable "straight" bonds (they have "**embedded optionality**")

The risks of ABS: Credit Risk

As with any corporate bond, ABS are subject to **credit risk**

- Credit risk refers to the risk that the borrowers will default on their debt by failing to make payments of principal or interest

- In assessing credit risk from a single counterparty, three issues must be considered:
  - **Default Probability**: the likelihood that the counterparty will default on its obligation either over the life of the loan/bond or over some specified time horizon (for a one year time horizon it is called "expected default frequency")
  - **Credit Exposure**: how large is the outstanding obligation when the default occurs
  - **Recovery Rate**: what fraction of the exposure may be recovered through bankruptcy proceedings or some other form of settlement

- **In ABS credit risk is mitigated by the diversification of the borrower pool**: therefore it is important that the default probabilities of each borrower in the pool has as low correlation as possible with the default probabilities of other borrowers in the pool

- Credit risk can also be mitigated by **credit enhancements** such as over-collateralization or third party guarantee, or by selling selling Credit Default Swaps

- To model the credit risk of portfolios with exposure to multiple obligors, standard default models, used to assess the likelihood of default by a single obligor, are integrated with correlation models (and also need to assess dynamically the recovery rate: during a crisis, when everybody is selling, the recovery rate will be lower than historical)

Securitization of Risks of ABS

- Can some or all of these risks be "sliced and diced" in order to redistribute them among those better equipped to analyse, understand and shoulder the outcomes (i.e. to "professional investors")?

The first case of "tranching" of MBS securities was aimed at securitizing "prepayment risks", that amounts to **securitizing interest rate risk** (i.e the risk of being repaid more quickly when interest rates fall). The junior tranches were the first one to be repaid and the holders of these tranches received a higher return in exchange for taking the risk of receiving their capital back ahead of time if interest rates dropped (meaning they would have to reinvest their capital at a lower yield)

Next came the **securitization of credit risk**: suppose we have two mortgages each with face value $ 1m and a 10% chance of total default. If we package them together and then issue two securities against the package:

(i) a junior security, face value $ 1m that bears the brunt of losses until they exceed $ 1m

(ii) a senior security, face value $ 1m that bears losses after the first $ 1m

Therefore the senior security suffers only if both mortgages default

- If mortgage defaults occur independently (that is, if they are uncorrelated) the senior tranche defaults only 1% of the time, and therefore can be rated AAA
- If correlation was 1, the senior security would default as often as the junior, that is 10% of the time (no benefit from diversification)

Collateralized Debt Obligations (CDO)

The magic of combining diversification and "tranching" of the liabilities:

The **Collateralized Debt Obligation** (commonly known as CDO)

- **The CDO** (other acronyms include CMO – collateralized mortgage obligations -, CLO – collateralized loan obligation and CBO – collateralized bond obligation) **divides the ABS in tranches (or slices), and creates securities of different seniority and rating, with different maturity and credit risk characteristics**

- Put a sufficient number of subprime mortgages (or other risky loans) together from different parts of the country and from different originators (in the hope of achieving low correlations), issue different tranches of securities against them, and it is indeed possible to transform a substantial amount of risky loans in AAA securities (provided correlation between loan defaults is assumed low enough)

- The simplest CDO has three tranches: subordinated/equity, mezzanine and senior
  - The holders of the equity tranche get the highest return but also take on the greatest risk: if any borrower defaults, the holder of the equity tranche sees losses before anyone else
  - The holders of the mezzanine tranche carry less risk (and consequently got less return), but its purchasers would still suffer if a large percentage of loans in the underlying pool defaulted
  - The holders of the senior tranche are the most secure (and receive the lowest rate of return), since they get paid first and sustain losses last. These tranches have the highest credit rating

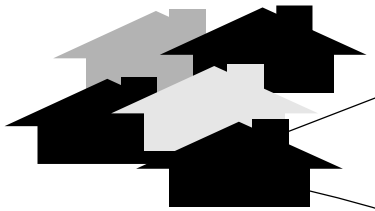
- **Each tranche receives its own credit rating, reflecting both the credit quality of the underlying collateral as well as how much protection a given tranche is afforded by tranches that are subordinate to it**

Residential Mortgage-Backed Securities

Financial institutions packaged subprime, Alt-A and other mortgages into securities. As long as the housing market continued to boom, these securities would perform. But when the economy faltered and the mortgages defaulted, lower-rated tranches were left worthless.

1 Originate

Lenders extend mortgages, including subprime and Alt-A loans.

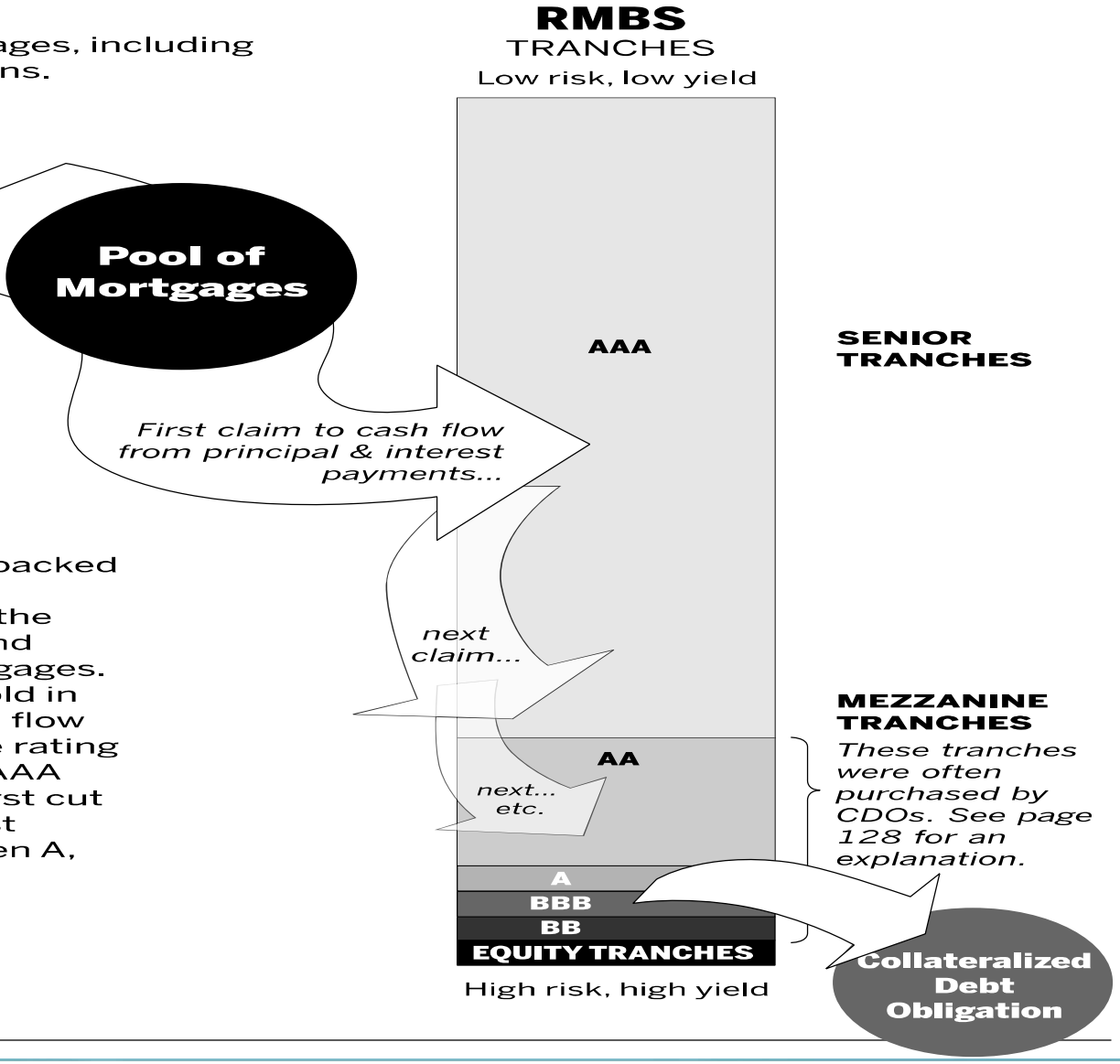


2 Pool

Securities firms purchase these loans and pool them.

3 Tranche

Residential mortgage-backed securities are sold to investors, giving them the right to the principal and interest from the mortgages. These securities are sold in tranches, or slices. The flow of cash determines the rating of the securities, with AAA tranches getting the first cut of principal and interest payments, then AA, then A, and so on.



Creating a Collateralized Debt Obligation (CDO)

- A **sponsoring organization** (banks, investment banks, asset managers) **sets up a "Special Purpose Vehicle"** (SPV) **to hold collateral and issue securities** [expenses associated with running the SPV are subtracted from the cash flow to investors]

- A CDO can be static or managed:
  - In a static CDO collateral is fixed throughout the life of the CDO, therefor investors can assess the various tranches of the CDO with full knowledge of the underlyings
  - In a managed CDO a portfolio manager (IM) is appointed to actively manage the collateral of the CDO. This adds IM risk (the risk of poor decisions by the IM) as well as moral hazard risk. It also increases the costs of the CDO, because of IM's fees

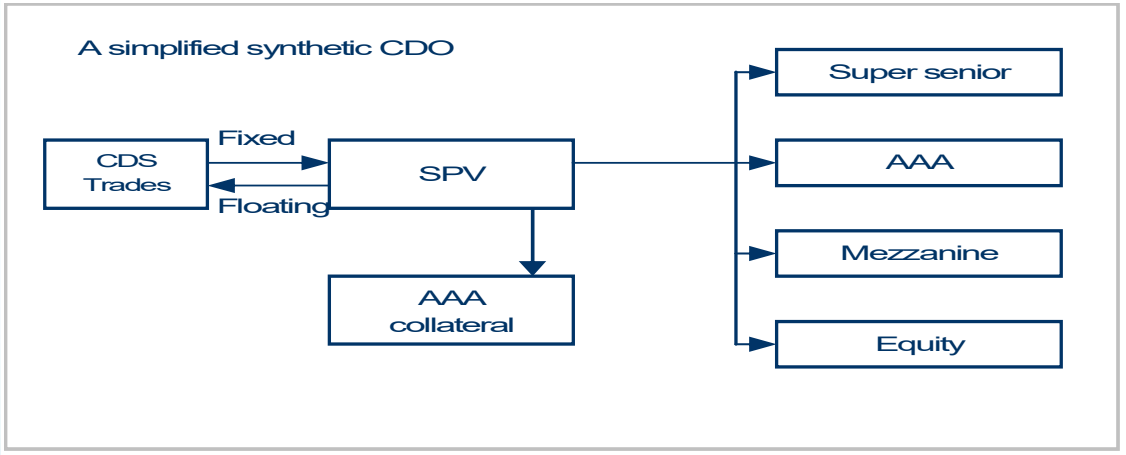
- A CDO can be structured as a cash-flow or as a market-value deal:
  - In a cash-flow CDO cash flow from collateral are used to pay principal and interest to investors, according to seniority of the tranches
  - In a market-value deal, principal and interest payments to investors come from both collateral cash-flow as well as sales of collateral. Payments are not contingent on the adequacy of the collateral cash-flow but rather the adequacy of its market value

- The issuance of a CDO can be motivated by balance-sheet reasons or by arbitrage reasons:
  - In a balance sheet CDO the sponsoring organization wants to remove loans or debt from its balance sheet
  - An arbitrage CDO is motivated by the opportunity to make a profit by repackaging collateral into tranches that sell for a higher price than the underlying. Because a tranche's credit rating largely determines its price, this leads to "credit rating shopping"

From CDO to CDO^3 and Synthetic CDO

The level of complexity achievable through securitization is apparently unlimited:

- Pooling the equity tranches of a number of CDOs we could build a **CDO^2**, turning a sizable amount of highly risky investments in AAA rated paper
- Even the equity tranches of CDO^2 were sometimes pooled to build **CDO^3**!
- When the underlying assets were in short supply, investment banks pooled CDS (credit default swaps) on those loans/bonds/ABS/CDO to mimic the underlyings of CDO and called these products "**Synthetic CDO**" [a synthetic CDO holds high quality or cash collateral, with little or no default risk, and gets credit risk exposure through CDS]



- Banks claimed that synthetic deals were motivated by regulatory or practical consideration that might make a bank want to retain ownership of the underlying debt while achieving capital relief through CDS. In retrospect, the motivation for some investment banks appears to have been to sell short CDOs. A bank that structured a synthetic arbitrage CDO and sold it to clients held no offsetting collateral. The bank was essentially betting against the very instrument it was assembling and promoting to its clients

Evaluating a CDO

A BBB ABS, constructed by bundling together a bunch of high risk loans (Alt-A or"sub-prime" mortgages or "high yield"/below investment grade loans/bonds) can be sliced into several tranches with different "seniority" (i.e credit protection) and the senior tranche, often accounting for approximately 80% of the underlying assets, would receive a AAA rating

- "Structuring" transforms "toxic waste" in gold-plated, AAA securities purchased by the most conservative investors around the world
- In 2007, roughly 60% of all ABS-backed securities were rated AAA, vs typically less than 1% of all corporate bonds

The soundness of a CDO depends on the assumptions about likelihood of defaults on the loans pooled in the ABS and especially about the correlations of such defaults

- It is very hard for a final investor (even a professional investor) to properly value a CDO, especially a "complex" CDO
  - For a "simple" CMO the investor would have to analyse each and every individual mortgage in the MBS, evaluate the risk of default and estimate the correlation across all mortgages
  - To increase diversification, often CMO pool together a number of MBS, which makes this computation even more difficult
  - "Complex" CDO, like CDO^2 or CDO^3 or Synthetic CDO are so fiendishly complicated and unique that it is difficult, if not impossible, to find appropriate markets prices. Financial firms resorted to mathematical models to value them, but too often these models were flawed, since they relied on optimistic assumptions that minimized risk

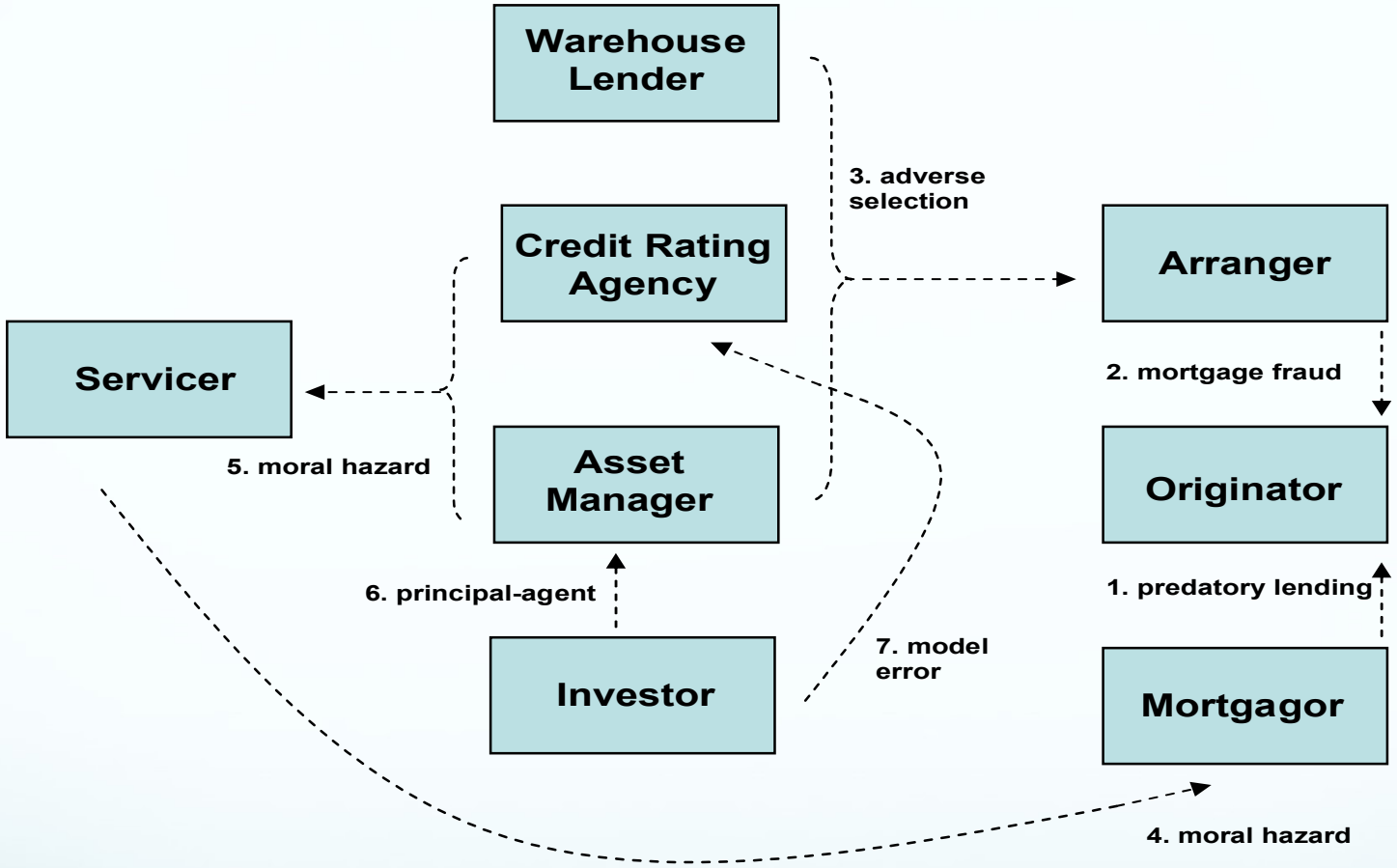
The role of the Rating Agencies

- **Investors outsourced the analysis and valuation of these complex instrument to the rating agencies**, who where ridden by **conflicts of interest** (intrinsic in their business models, since they are paid by the issuers of the securities) but also had a difficult time in properly valuing these securities, due to lack of historical data
- Rating agencies were supposed to create transparency by rating accurately the riskiness of the financial products generated by banks and financial actors. Their rating should have provided the basis for sound risk-management by mortgage lenders and by creators of structured financial products
- Since ABS structures represent claims on cash flows from a *portfolio* of underlying assets, **the rating of a structured credit product must take into account systematic risk**. Correlated losses matter especially for the more senior (higher rated) tranches, and loss correlation arises through dependence on shared or common (or systematic) risk factors. For ABS deals which have a large number of underlying assets, for instance MBS, the portfolio is large enough such that all idiosyncratic risk is diversified away leaving only systematic exposure to the risk factors particular to that product class
- Unlike corporate credit ratings, ABS ratings should rely heavily on a forecast of economic conditions and require a long history of data, often not available to rating agencies and investors alike
- The models completely missed the possibility of a global meltdown of the real estate markets and the subsequent strong correlation of defaults. The complexity of the packaging of the new financial instruments added to the problem, since rating agencies had no historical return data for these instruments on which to base their risk assessments
- Finally Rating Agencies often felt compelled to deliberately inflate their ratings, either to maximise their consulting fees or because the issuer could be shopping around for the highest rating
- Credit ratings have a long history of playing a role in the regulatory process going back to the 1930s: in the U.S. asset managers such as pension funds and insurers often have strict asset allocation guidelines which are ratings driven, such as, for instance, a ceiling on the amount that can be invested in speculative grade debt
- Notwithstanding all their drawbacks, **with the introduction of the Basel II standards, credit ratings have also entered bank capital regulation**

The conflicts of interest in Securitization

- **The soundness of a securitized product depends on the behaviour of several participants in the securitization value chain**:
  - The borrower, interested to get the loan
  - The mortgage broker, interested to earn a fee
  - The appraiser, interested to earn a fee
  - The mortgage lender, interested to securitize the loan, offload it from its balance sheet and earn a fee
  - The investment bank, interested to earn a fee
  - The rating agencies, interested to earn a fee
  - The institutional investors (mutual funds, pension funds, sovereign wealth funds), looking for "extra yield" (called "alpha") to keep their clients and keep earning a fee
  - The final investors, who trusted all the participants in the securitization chain to do a proper due diligence and invest accordingly, basing their decisions on the "prudent man principle"
- This is a **multiple principal-agent problem**, fraught with **moral hazard and adverse selection** issues, where **incentives at each stage where not aligned with the interests of the final investor**

Key Players and Frictions in Subprime Mortgage Credit Securitization



A. Greenspan, the former Chairman of the Federal Reserve stated on October 23, 2008 in a testimony to the U.S. Congress, in reply to questions by Congressman H.A. Waxman: "**I made a mistake in presuming that the self-interests of organizations, specifically banks and others, were such as that they were best capable of protecting their own shareholders and their equity in the firms**. I have found a flaw. I don't know how significant or permanent it is. But I have been very distressed by that fact."

The funding of securitized assets

If banks used securitization to "originate to distribute" loans, why before the crisis were they holding (directly on their books on indirectly through conduits) so much of this securitized debt?

Two main factors behind banks' demand for securitized products:

- **Securitized debt was used as collateral to attract repo funding, and through this to boost banks' leverage and returns:** Banks already retained most of the equity tranche of securitizations (either directly or by providing protection to vehicles holding such assets), as most investors did not want to assume that risk. But in addition, banks also accumulated, on their balance sheets or in affiliated investment vehicles, a significant share of the long-term AAA claims produced by securitization. Banks used these claims in part as collateral for repo funding. By pledging high-quality securitized debt, banks could raise wholesale funds (and increase leverage) more cheaply and in larger volumes than if they relied on traditional liabilities, such as deposits and unsecured funding
- **Another reason some banks held on to the safer securitization tranches was regulatory arbitrage:** Regulations require banks to maintain capital against loans on their balance sheets. Securitization as practiced offered two ways to reduce such capital charges:
  1. hold securitized debt through affiliated investment vehicles (e.g. conduits, SIVs) that were funded in short-term money markets – mainly Asset-backed Commercial Paper (ABPC) - and relied on both *implicit* (thus not requiring capital charges) and *explicit* credit and liquidity support from banks
  2. Given how ratings came about, banks could sometimes reduce capital charges simply by holding on their own balance sheet securitized but higher-rated claims instead of the same non-securitized debt

The crisis of Securitization

The **factors that led to the crisis of securitized products** are:

- Deteriorating loan underwriting standards that undermined underlying asset quality (sometimes linked to fraudulent behaviour)
- Lack of incentives to conduct the oversight and due diligence necessary to confirm that the underlying loans would be paid off
- Complexity of products, lack of transparency and standardization, embedded leverage (often misunderstood by investors)
- Overreliance on rating agencies (sometimes imposed by regulators), which did not properly represent risk to investors
- Misjudgement of liquidity risk and maturity mismatch, especially since a relevant share of these securitized products where held by leveraged investors and funded at short term maturity [SIV (Special Investment Vehicles issuing short term debt) or through ABCP (Asset-Backed Commercial Paper)]

When the crisis came ....

- According to the Securities Industry and Financial Markets Association, aggregate global CDO issuance grew from US$150 bn in 2004, to close to US$500 bn in 2006, and to 2 trillion by end of 2007. From US$ 0.6 trillion, the cumulative notional value of CDOs grew to 26 trillion dollars at the end of 2006. This bubble was fuelled firstly by the thirst for larger returns for investors in the USA and in the rest of the World. It was made possible by a wave of financial innovations leading to the illusion that the default risks held by lenders, principally banks, could always be diversified away

- Investors could not penetrate the portfolios far enough to value the securities and, because of **asymmetric information** (at each step of the chain one side knew significantly more than the other about the underlying structure of the securities involved), it became a typical "**market for 'lemons'**" case:
  - prices of all securitized debt collapsed with no relationship to underlying values or expected cash flows and the market for securitizations simply disappeared

- Some of the assets underlying a "plain, vanilla" ABS (for instance, the mortgages underlying an MBS) defaulted:
  - junior and mezzanine tranches of the ABS suffered, but normally the cashflows of the most senior tranches were not affected
  - in many cases even the most senior tranches of the CDOs (AAA rated) became worthless, because they were constructed "slicing and dicing" the junior and mezzanine tranches that all simultaneously defaulted
  - AAA-rated tranches of CDO are generally structured to withstand idiosyncratic risk, but by their nature are vulnerable to systematic risk and particularly tail risk. Consequently, the performance of highly-rated structured securities exhibits higher correlation in an extreme environment than one would predict from observed behaviour in a more benign environment

For this reason **ca. US$ 600 billion of mortgage defaults triggered several trillions of losses on securitized credit**: an inverted pyramid of securities had been built on the "same" underlying asset!

The importance of Securitization

- The securitization and structured credit markets are anyway critically important to the global capital markets and thereby also to the growth of world economies

- **Securitization has offered significant benefits to consumers, borrowers, investors and the economy, lowering the cost of credit and increasing its availability, by freeing bank capital that could be lent back into the economies to the benefit of consumer and businesses alike**

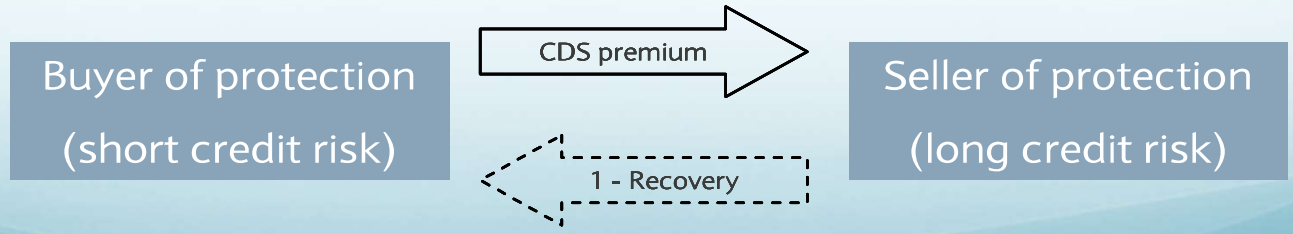
- To return the securitization market to a normal level of functionality the industry needs to:
  - Enhance transparency with regard to underwriting and origination practices
  - Improve disclosure of information on underlying assets
  - Improve confidence in valuations, methodologies and assumptions, adopting standardized methods as much as possible
  - Restore credibility of rating agencies and return final responsibility of evaluation to investors by redesigning relevant accounting and capital treatment rules

  Finally it is key to ensure that:
  - There will be alignment of incentives along the securitization and structured credit value chain ("skin in the game" by each player)
  - Overly complex products are banned (or restricted to non-levered investors)

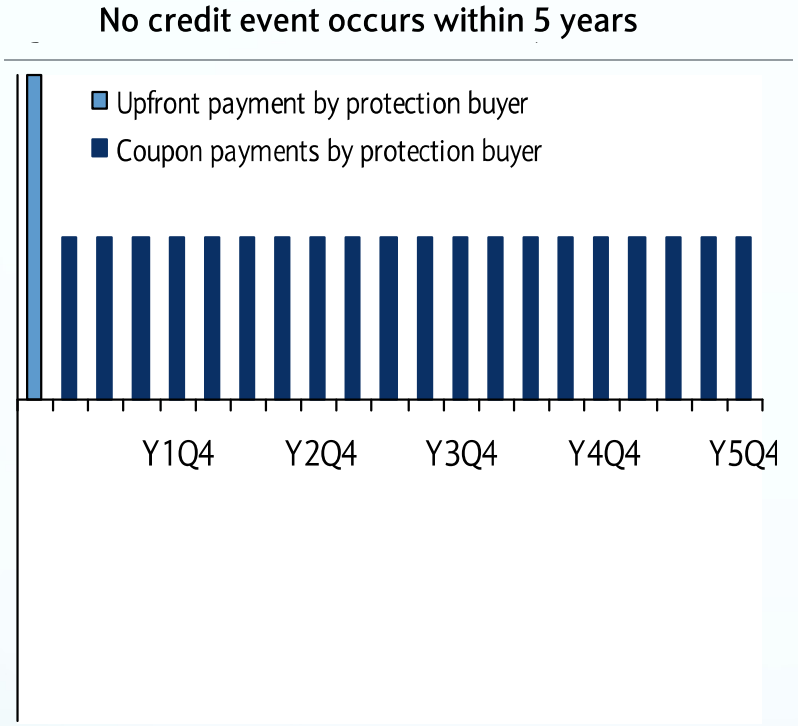
Credit Default Swap (CDS)

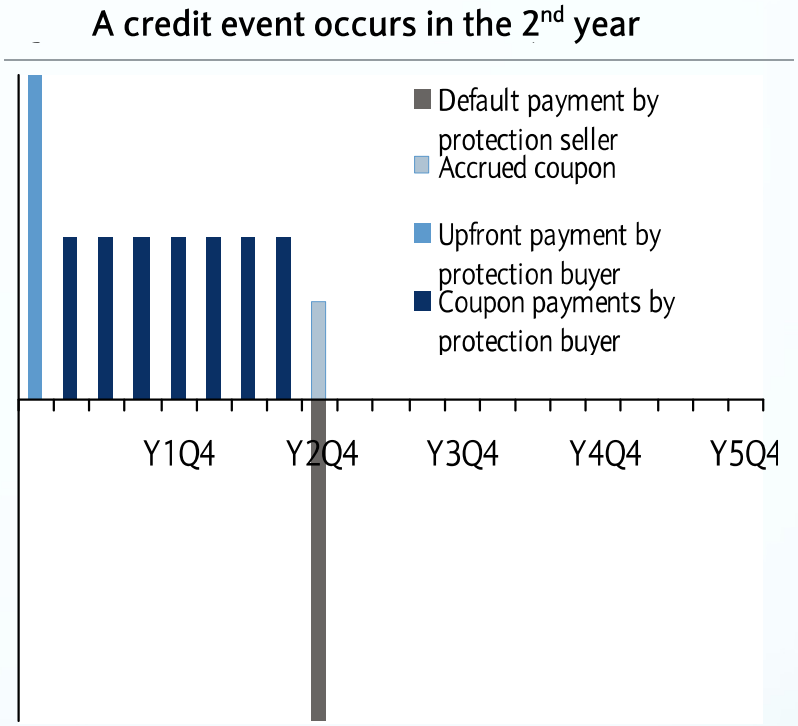
- **A CDS is a credit derivative in which two counterparties agree to exchange a regular, fixed coupon for a one-off payment contingent on the occurrence of a credit event of a specified reference entity or obligation**

- A CDS can be viewed akin to **an insurance contract** where the buyer of protection pays a premium to the seller of protection in order to receive protection against a credit event, as illustrated in the figure below. As such, the trade comprises a premium leg (the fixed-coupon stream) and a protection leg (the one-off, contingent payment).



CDS Cash Flows





- Fig 1 Fig 2
- Figure 1 depicts example cash flows in the cases where a credit event does not occur
- Figure 2 depicts the cash flows in the cases where a credit event does occur before the contract maturity.

The termination of a CDS

- The contract terminates on a predetermined, fixed maturity date, unless it is triggered prior to that date by one of the counterparties.
- Typically, either party may trigger the contract upon the occurrence of a Credit Event (CE)
- What is **a CE must be clearly defined**. This is why ISDA (International Securities Dealers' Association) produces standard documentation for these transactions. It helps avoid confusion: when the counterparties enter the trade they must decide what credit events they wish to include
- CE that are frequently used are bankruptcy, failure to pay and restructuring (all of these have specific definitions). It is also normal to have reference to publicly available information in order to demonstrate that a CE has occurred
- In the occurrence of a CE:
  - the premium payments terminate and the buyer of protection makes an accrued interest payment to the seller to pay for the protection received since the previous coupon date;

  and

  - the protection buyer may sell any valid deliverable obligation to the protection seller for a price of par and for the notional of the contract. Valid deliverable obligations depend upon the type of and timing of the credit event.

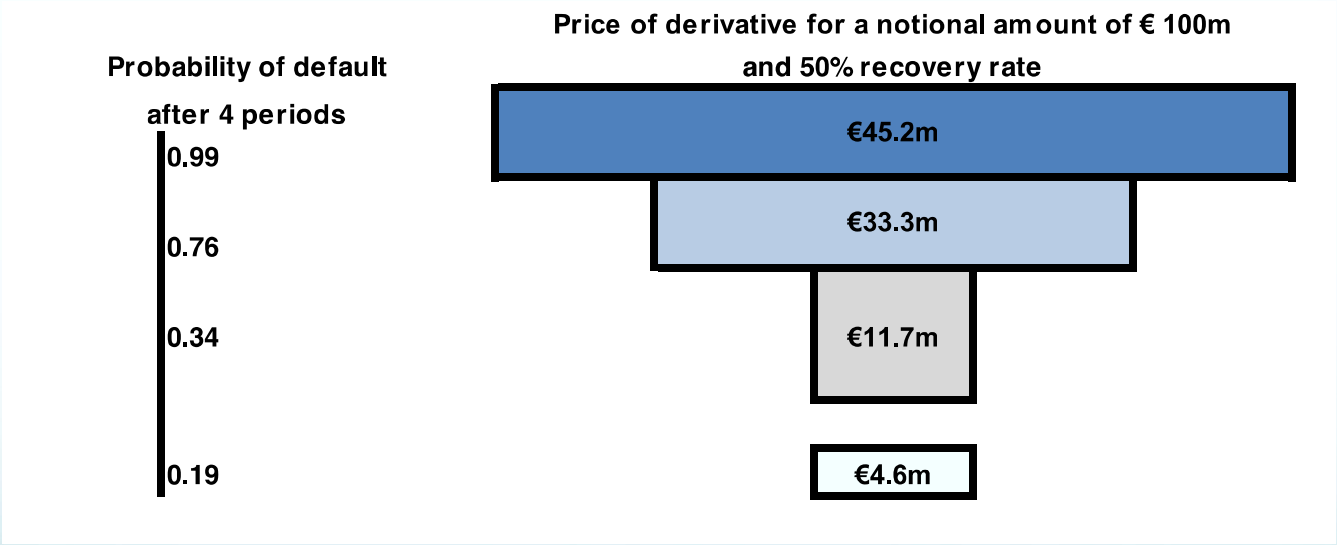
  The value of the delivered security at the time of delivery is known as the Recovery Value or Recovery Rate

  The economic transfer is therefore Par minus Recovery

The CDS "atomic bomb"

In this example notional protection of $100m is bought, and a 50% recovery rate in the event of an actual default is assumed (so $50m is the max payout). A four-period model is used: in the first period, four successive re-evaluations of the survival in each of the subsequent periods are considered: 95%, 90%, 70% and 30%

- The value of the contract where the probability of the reference entity surviving in each of the 4 periods is 95% is shown in the bottom box: since the probability of default over the life of the contract is only 19% (shown on the left-hand side) the value of the contract is $4.6m. As the survival probabilities fall (to 90% per period, resulting in a 34% probability of default over the life of the contract), the value of the contract rises to $11.7m. It rises to $33.3m for a 76% chance of default over four periods and $45.2m for a 99% chance



Source: OECD.

- It is not difficult to see how a bank (or insurance company like AIG) that wrote (i.e "sold") this contract would come under scrutiny if the probability of default of the reference entity rises in a crisis situation: the diagram begins to take on an **'atomic bomb' shape for potential losses**.

From CDS to Synthetic CDOs

We saw that investment banks pooled CDS (credit default swaps) on loans/bonds/ABS/CDO to mimic the underlyings of a CDO and called these products "**Synthetic CDO**" [a synthetic CDO holds high quality or cash collateral, with little or no default risk, and gets credit risk exposure through CDS]

Why did investment banks create such ''synthetic'' CDOs?

- Since the BBB rated tranche of an ABS was only a few percentage points of the total volume of the loans extended (even in the case of a portfolio of subprime loans, thanks to the rating agencies' complacency), **the amount of BBB asset backed paper actually available to create CDOs was quite small**. Put it in another way: to create a a billion dollar CDO composed solely of BBB rated tranches of subprime MBS, more than 20 billion in cash had to be lent to actual human beings!
- A CDS replicated almost perfectly the cashflows of a BBB rated subprime mortgage bond but did not require all the time and efforts of "physically" selling all those mortgages: it was only necessary to find an investor (or speculator) willing to buy such an insurance on different tranches of BBB rated securities and the CDO could easily be constructed
- Therefore a pool of mortgages became the underlying of a pile of structured debt often worth several times the amount of those mortgages (as if a house had been insured against fire for several times its value)
- **When subprime mortgages started to default, losses were multiplied several times across the financial sector**

Key issues with CDS

- A CDS resembles insurance: it allows a buyer to purchase protection in the event that a debtor defaults on his obligations
- Unlike the purchaser of an insurance contract, **the buyer of a CDS does not have to own the "underlying" asset**, i.e. the asset subject to the bet
- **Therefore the buyer of a "naked" CDS has all the interest to make the default happen** [it is like buying homeowners' insurance on your neighbour's house and then trying to set fire to it]
- Moreover since subprime bonds had a nominal life of 30 years but were designed to be repaid in just a few years (especially those with underlying "teaser" rate mortgages, where the interest rate the borrower was supposed to pay would jump after 2-3 years), buying a CDS on a subprime bond (mezzanine tranche) meant paying an insurance premium of roughly 2% a year (before the financial crisis) for at most 6 years (the longest expected lifespan of the putatively 30 years loan) for a potential gain of 100!
- As perceptions of solvency problems for the **seller of a CDS** rose and it failed to post collateral, its counterparties began to take defensive action, exacerbating the dealer's weak cash position: the moment a CDS seller does not have a sufficient buffer of high quality short-term securities to meet collateral calls it is essentially, in the absence of direct official support, going to **move rapidly from a liquidity into a solvency crisis** (as happened to AIG and to "monoline" insurers in 2008)
- **CDS are traded OTC**, which brings:
  - lack of transparency
  - counterparty risks
    - the two main causes of loss of investor confidence during the recent crisis
    - raising the risks of an institution becoming "too interconnected to fail"

New Regulations for OTC Derivatives

- Following the financial crisis, the leaders of G20 nations agreed to a series of measures to **increase the transparency of the over-the-counter (OTC) derivatives market and to reduce systemic risk**. These reforms bring sweeping changes for all financial institutions
- They fundamentally alter the structure of the OTC derivatives markets, significantly impacting the business models, profitability, legal entity structures, operations, data and technology of financial institutions' derivatives businesses
- Global regulatory reform initiatives are underway to implement these measures – e.g., the US Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank), the Markets in Financial Instruments Directive/Regulation (MiFID II/ MiFIR) and the European Market Infrastructure Regulation (EMIR)
- Ideally, all derivatives should be listed on "**Central Exchanges**", so as to make trading, clearing and settlement straightforward and transparent. Since in this case the counterparty to all trades would be the central clearing counterparty (CCP), counterparty risk could be greatly reduced through adequate collateralization (posting adequate initial and maintenance margins)
- Unfortunately not all derivatives can be standardized and traded on such a "Central Exchange": to mitigate the inherent opacity of OTC derivatives it remains essential that real-time reporting of data and pricing information is guaranteed by an entity (called **Trade Repository** or **Swap Data Repository**) that centrally collects and maintains the records of all OTC derivatives transactions
- In the US, under the Dodd-Frank Act, swaps that are accepted for clearing by at least one central counterparty (CCP) will become required to clear. This means instead of an OTC agreement between two parties, the CCP will step in and buy the swap from the seller and then sell it to the buyer. In doing so, the CCP will take on the responsibility for guaranteeing the contract. Because the CCP will be required to hold large amounts of capital and will be closely monitored, this can reduce the risk that one counterparty default will trigger a chain of defaults in swaps markets. These cleared swaps also will be required to be traded on an exchange or a swap execution facility (SEF) if they are made available for trading

Suggested Readings

- NY Fed, Staff Reports: **Understanding the Securitization of Subprime Mortgage Credit**, 2008, www.newyorkfed.org/research/staff_reports/sr318.pdf