Unravelling the Credit Crunch

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Introduction

A credit crunch is an economic condition in which investment capital is difficult to obtain. Banks and investors become wary of lending funds to corporations, which drives up the price of debt products for borrowers. Often an extension of a recession, a credit crunch makes it nearly impossible for companies to borrow because lenders are scared of bankruptcies or defaults, resulting in higher rates.

The credit crunch of 2006-2009 is the most serious crises in banking and finance since decades, which shook economies of entire governments around the world. Thousands of houses have been repossessed, building sector was forced to quit their business, and unemployment rose, alongside with decrease of prices of stocks and bonds, bankruptcy of huge corporations and general instability of the financial system. The Crunch can be divided in three key phases: fall of U.S real estate prices and its impact on various financial instruments depending on them, contraction of credit due to losses of institutions exposed to the mortgage risk, and finally the failure of U.S leading broker/dealers which showed that the government will allow large institutions to fail.

In this work I will analyze the first two phases of the Credit Crunch: from mid 2006 to mid 2008. It will be focused on causes of Crunch, with specially detailed look at American mortgage lending system, the whole banking system, structure of the financial markets with their instruments and strategies in years before the Crunch, but also the actions that were made by American and European governments and their Central Banks to save the financial system and reduce damage to economies. It will also include a review of a previous major crises – Great Depression, and find parallels between two crushes, but also look at establishment of institutions that played crucial role in American economy and the crush of 2006-2009. This paper is based on a book “Unravelling the Credit Crunch” by David Murphy, but does not cover all book, and also uses other sources.
Chapter 1. The Crunch begins

1.1 The first stage

If we look at the history of American real estate prices, we will see that they rose from 2000 till mid 2006, and up to mid 2008 they fell about 20% from their prices on peak, so we can note this 2006 peak as the start of the Crunch. Particularly severe was the fall in Miami, Las Vegas and Los Angeles where prices previously rose higher than average. The property prices in some of the suburbs of these cities more than halved. This can be explained by the 2000-20005 trend of American population to move towards the sunny places. Three fastest growing states were Nevada, Arizona and Florida. New houses were needed there, and this conditions with rising demand house prices were rising respectively. This was very attractive situation for speculators: people who are involved in house building business, but also the people who bought property hoping to sell it on when prices rise. Fall of prices which followed, had much more dramatical impact on the wider economy, because speculators were not only using their own money, but commonly the leverage was involved. This means, that if the speculators suffer losses, that would also cause losses to the ones that lent to them. Since mortgage lending in America is usually non-recourse: in the case of default only the house is the collateral and can be repossessed, using leverage for speculation is even more attractive : if prices rise, speculators collect much bigger profit as they could have if they only used their own money, but if they fall, they losses are limited.

If the borrower fails to pay a mortgage payment, and it is not possible to arrange modification of the loan or cure the default in an extended period of time, it comes to foreclosure process. Therefore, foreclosure rates are indicator of completely failed mortgages. Foreclosure rates in Nevada 2008 have no historical precedent: whole areas became empty. If house prices fall, lenders suffer losses, that´s why some states give them some freedom in deciding when to sell a foreclosed property. But in the meantime they have to pay property taxes and insurance.

The lender doesn´t have the right to seize what is inside the house, and borrowers often take doors, lights and anything they can, what means that foreclosed houses are often not in a salable conditions. Empty houses which can´t be sold reduce the value of the whole neighborhood. It is hard for foreclosed property to compete with newly built one.

Major impact of residential property on broader economy is the volume of sales and not the price. If prices start to sink it makes owner unwilling to sell, and realtors and brokers make much less money. The buyers on the other hand, wait for the prices to sink even more, and building new houses is put off to the time when trend changes and prices go upwards again.

As for the European economies, the worst situation was in Ireland and Spain. After joining European Union these countries experienced fast economical growth, stimulated with low interest rates. House construction became an important sector of economy, in Ireland it was even connected to a quarter of GDP by 2007. With this came the home ownership boost. After the European Central Bank raised rates in 2008 , the costs of mortgages rose, as the majority were variable rate. Similar as in U.S. delinquencies rate rose, prices fell, and house building slowed dramatically, causing highest unemployment rates since 1998, and biggest
property firms, for example Martinsa – Fadesa declared bankruptcy. But European Crunches were much less severe as the American ones, for although they had negative impact on economies of these countries, they financial systems were not destroyed.

1.2 Old and New Style Banking

Financial institutions play key role as intermediaries in the financial system. To understand the system we take a look on following strategies: old style banking, and Originate to Distribute model.

Old style banking follows 3-6-3 rule: it has to borrow the money, and pay an interest for doing so, to lend it on for a higher interest rate, and take the profit from the difference, known as spread. The easiest way for a bank to fund they loans is taking deposits. This simple model was in use till late 1990s, and is characterized by keeping risk on originated loans. To cover the possible losses, and be able to pay depositors money back, they are required to have sufficient capital, and these capital requirement is set to amount of 8% of the loans made. This money comes from retaining earnings and issuing stock.

Due to the capital requirement, old style banking couldn`t achieve high return on equity. As this requirement was directly connected with the risk of a default, bankers came to idea to pass it on. This wouldn`t function well for single loans with borrowers whose credit quality was not easy to be proven by a potential buyer. The more reasonable approach seemed to be packaging loans in portfolios, and describe risk with help of statistics. To persuade the investors, interests were aligned: the bank agrees to cover a percentage of losses. This gives bank a good reason to make sure that portfolio will perform well, and if it keeps servicing rights, as it typically does, to do the servicing properly. This freed up the capital and increased ROE significantly. The new strategy reduced risk as much as possible, and concentrated on originating and servicing loans, and earning a fee for doing so, and is known as Originate do Distribute Model or ODM. This creates a secondary market of mortgage loans, and provides business for intermediaries, who increase liquidity of the market. The profit is dependent on the volume of originated mortgages. This is particularly dangerous when alignment of interest disappears (for instance, if recent history shows that risk is minimal). Banks became to originate loans of the quality lower than they would ever accept in old style banking, and this was one of the key reasons for the Crunch.

1.3 Capital Markets and Second Stage of the Crunch

Risk can be traded in the form of bonds and stocks, or derivatives and insurance. In the Crunch prices of many assets move significantly, and some assets which used to be regularly traded became illiquid.

To understand movements in capital markets, it is important to be familiar with short rate and Libor, as they are crucial indicators of the price of credit. Short rate (key government rate) is determined by the compensation that market participants demand for lending to the government for a short period. It is set to manage inflation: if inflation is high, short rate is increased to slow the growth down, but in ordinary conditions lowering the short rate
stimulates economy. The short rate is managed by central banks: some of them have special targets for inflation, others set it in a way to ensure price stability.

As the Crunch hit, FED reacted by lowering the short rate. The idea was to make it cheaper for banks to borrow money, so that they could keep funding their assets and continue lending.

Most of the banks get their funding from other financial institutions rather than from a central bank. Common reference rate for interbank lending is Libor, in particular three month Libor is an important benchmark. In ordinary conditions difference between it and the short rate is small and stable. In the Crunch, banks didn’t trust each other’s credit quality, and were unwilling to lend to each other. Out of this reason, Libor remained high despite falling of short rate, and borrowing became more expensive across the financial system.

As the same companies that were exposed to the American mortgage risk were also trading bonds, once the Crunch came, and they suffered losses due to mortgage risk exposure, their liquidity dropped across all of their business, and bond buyers started demanding higher return. Confidence in all types of instruments issued by ODM banks fell. Credit costs increased not only in United States, and this affected lower quality borrowers the most.

Although bonds fell in value during the second phase of the Credit Crunch, stock market, despite increased volatility, kept growing until mid 2007 when the impact of the Crunch became obvious. Institutions, highly engaged in American residential property business failed eventually. The Northern Rock is an example of a bank that had to be fully nationalized by Bank of England. Another example of a failure of the major financial institution is Bear Stearns, one of five largest broker/dealers in U.S. As the bankruptcy of it would significantly depress the economy, FED arranged sell of Bear Stearns to JP Morgan. Several other institutions also failed. Amongst them SIVs: special purpose vehicles, that were established to remove bank’s assets from the balance sheet and make it appear less risky, but bank would own equity in this companies, and benefit from transferred assets. When value of assets in SIV fell, and their were unable to repay bond holders, they either defaulted, or the bank would buy they assets back. As Lehman Brothers, Fannie and Freddie, and other huge companies had to declare bankruptcy, or to be saved by nationalization, investors became very risk averse, and credit hard to get. This in turn slowed growth in many countries, and they were forced to recapitalize their financial systems.
2 U.S. Residential Mortgages

2.1 Structure of American Mortgages

Main cause of many losses in 2007 and 2008 is the combination of falling house prices and risky lending. In Europe countries have suffered from house price falls, but their financial system didn’t collapse, because European mortgage structures are not that risky.

The structure of a mortgage determines the monthly payment needed for a given house, and who can afford to buy it. Various innovations were made since 1980s to make home ownership more affordable, in combining lowered payments and wider range of people who could borrow. This brought the additional risk to the lenders.

The standard U.S mortgage is a loan of a fixed sum of money, known as the Notional amount, for a fixed term, to be repaid monthly, and payments are fixed for the whole term of the mortgages. An important feature is Prepayment, borrower can pay back the current mortgage balance and terminate the loan at any time. This is called a LEVEL PAY structure, and was common till 1980s. Payments at the start of the loan are mostly interest, and with time turns in almost principal-only. The process of moving the ratio in favor of repayment of principal is called amortization of the loan. Prepayment provides flexibility, and refinancing: if house prices rise, borrower can sell their property, prepay and take a new mortgage for more money.
One dimension of a risk of mortgage holding concerns notional value versus the value of the house. This ratio is called Loan to Value (LTV). Traditionally LTV had to be beneath 80%. This reduces the losses of a lender if it comes to foreclosure process, and falling of house prices.

In Europe most lending gives the bank recourse against borrower’s other assets if they default on the mortgage and the property is not sufficient to repay a loan, what makes LTV less significant. In many U.S state however, non-recourse lending is required. If the house prices fall, so that the principal of loan is larger than value of property there is no reason for borrower to keep paying it back, and he is incensed to remove and sell everything that he can, what declines the value at foreclosure. On the contrary, if house prices rise, there is no incentive to default.

One measure of affordability of mortgages compares the monthly payments on debt with the borrower’s monthly after-tax income. Payment-to-income (PTI) is typically limited at 40%.

Monthly payment on a new thirty year level pay loan depends on long term interest rates, because lender has to borrow for a long period to fund the mortgage, what reflects on a mortgage rate. Falling rates gives rise to prepayment: mortgage holders prepay in order to refinance, taking a cheaper loan and reducing their monthly payment. Rising rates do not encourage prepayments.

Alan Greenspan, the Chairman of Fer in 2001, cut interest rates aggressively after the tragedy on 09.11. This led to price boom which ended in 2006, because it allowed investors to borrow cheap and speculate, increased number of borrowers, and made markets go up.

Yield curve (plot of the interest rate for borrowing for a given period) is increasing: borrowing for a short period is cheaper than for a longer period. This is reflected in Adjustable Rate Mortgages or ARM. The interest rates is regularly (annually or every three months) reset, based on the current level off the reference rate (Libor, COFI or Treasury rates), and consists of this rate plus fixed spread. We can conclude, that ARMs offer cheaper rates for a borrower, compared to the level pay mortgage, but put on him the risk that rates could increase.
For a holder of ARM mortgage, falling interest rates will not motivate the borrower to prepay, because at the next reset he will receive a lower rate anyway. This makes ARM attractive to lenders who don’t wish to take prepayment risk. Possibility of prepayment leaves the lender uncertain about how long does he have to fund the mortgage. It would be prudent to use funding for the same period as the one at which mortgage is given for, but in the case of prepayment, he would have expensive liabilities, but no assets. And prepayment is usually caused by the falling of interest rates, so the lender cannot replace his assets with new mortgages on the same rate.

Possible way of making mortgages even more affordable than ARMs is in issuing interest only mortgages, where only interest is payed for the period of mortgage and the principal is repaid at after the period has expired. If prices rise, the borrower can sell the house for more than its’ original price, otherwise he may not be able to repay the loan. Hybrid ARMs offer very low rate for a fixed period known as a teaser rate. They cause a negative amortization and are particularly risky, because amount to cover losses due to foreclosure during first years of the mortgage would increase.

Option ARM gives the borrower choice between several mortgage rates during the initial period: minimal, interest only, or rate for level pay mortgage. At some point, negative amortisation has to be limited, for example if LTV grows from 90 to 100%. Therefore, the option ARM has a negative amortisation cap. Sometimes, initial teaser period rate is set. This products encourage speculations in rising house price environment. Person, who can monthly pay $1,000 a month on a mortgage can afford $220 000 level pay loan, $305, 000 ARM, but even $1,250,000 with 1% teaser rate option.

Measuring of credit quality of the borrower is reflected in credit scores, which include such factors as :speed of payment of previous debts, length of history (information about borrower), amount of debts taken, amount of debt applied for. When last two increase, the credit score declines. One of the most relevant credit scores is FICO. It has range between 300 and 850

Prime is the category of good quality loans. It is characterized by LTV below80%, FICO above 650, PTI bellow 40% and the ability to prove level of income. Other good quality borrowers, that out of some reason do not fulfil all the criteria for prime are called Alt-A

Subprime is below Alt-A. Typically, subprime borrower has one or more of following features : at least one 30-day delinquency last year, foreclosure or bankruptcy last years, low FICO or high PTI. For taking additional risk with subprime borrowers, lenders require higher spreads on ARMs. If house prices are rising, lending to subprime is relatively riskless.

While the houses are rising, borrower could prepay and refinance, or take a second mortgage known as HEL (home equity loan) or it’s variant HELOC(home equity line of credit) which is structured as a credit card: there is a limit for borrowing, once it is repaid it can be reborrowed again, providing agreed interest rate is payed).

To summarize, we can say that mortgage lending, which was once low risk activity, with level pay loans, and risk that declined after first few years of repayment, changed a lot
during the Boom years. Required FICO declined, LTV rose, and PTI was measured on the basis of teaser rate. If house prices rose, this allowed the borrower to make more profit, if not, they defaulted on mortgages. Negative amortisation made mortgages riskier as the time passed, and more subprime ending was made. Hence, mortgage lending became much more risky

2.2 Mortgages in The Crunch

In U.S. mortgage brokers are common. Broker suggest the lender and the type of a loan for particular borrower after considering his circumstances. Many realtors have their captive brokers. Brokers are payed by the lender for each mortgage that is made. Therefore, it is in the best interest of a broker to make as many mortgages as possible. They are familiar to the lending process, which makes it easy for them to make the borrowers’ application to make it more attractive to lender. Broker’s fee also depends on the loan type, and they are usually incentivized to recommend more complex type of loans such as option ARMs. Brokers are lightly regulated in comparison to banks.

The lender of a loan is the party who fund the mortgage. The servicer is the party who collects payments, records balances and follows delinquencies, negotiating the modifications of the loan if necessary, and eventual foreclosure process. Servicers fee is typically a percentage of the interest paid on the loan: 0,25% for level pay and 0,375% for ARM are common. Servicers cannot be changed by the borrowers, hence, their tend to be under-resourced, and in case of too many delinquencies appear, unable to chase them up. If they are paid for the extra costs of high delinquency rates they are motivated to do their job efficiently and make modifications to reduce losses on delinquencies, or sell quickly if it comes to foreclosure. The servicer is usually not the holder of mortgage risk, instead he sells the loan on, and keeps the right of servicing in order to earn fee income, without exposing himself to risk.

In old style banking bank was the lender, and it used deposits to fund the loans it makes. Mortgage bank is a new style institution specialized in mortgage banking. It does not have banking license, and can’t take deposits. It raises short term funds in capital markets for funding loans, then makes portfolios of mortgages and sells them on.

Agreement that allows smaller institutions, the correspondents, to sell larger lender’s products as their own, and the larger institutions (aggregators) buy these loans is known as correspondent lending. This allows companies with small capital to be mortgage lenders, and frees them from the need to have own versions of diverse types of loans. Technology also reduced need for branching offices reducing the costs of lending.

In Old style banking, the person in charge of evaluating mortgage applications was loan officer. The lenders that were making loans in order to sell them to aggregators had no need to have such person. Process was automated, and reduced to filling an online form. Number such as LTV, FICO and PTI are from main importance.

Mortgage lending developed to be a complicated process where realtors were connected to brokers, who were further connected to investment banks, that sold originated mortgages
to aggregators, who kept the servicing rights and made sold the portfolios of mortgages on to broker/dealer and they to the final investors. Everyone wanted to earn fee, and no one of them was really concerned about borrower’s ability to repay the loan, and if the property is really worth the price stated in loan application. The main reason of such attitude was that the interests were not aligned. The investors were so distant of the loan origination that they had no precise information on the risk they were taking.

In Europe situation was better due to recourse on loan, and the borrower quality was better.

False property evaluation due to seller-appraiser-buyer collision, income misinterpretation, claiming that loan is taken in purpose of ownership instead of investment, taking more loans and appointing a single property as a collateral and similar behavior rose ten times from 1997 to 2005.

Some lenders wanted to be sure they will earn they minimal spread and appointed prepayment penalties for the fixed period of time.

Subprime lending rose significantly during boom years. Even state income loans, one of the most risky subprime loans rose from 20 to over 45%. Credit quality was declining, but amount of mortgages made was rising, and more estate buyers in market contributed to further rising of house prices.

Old style banking was following 3-6-3 rule. ODM on the contrary tended to originate as more assets as possible to sell them. If investor buys 5 year loan, with 15% profit, he might pay 10% for these loans. This way banks originates triple annual profit. Investors and see that bank is profitable and adjust requirements to their favor. Origination of more assets is needed to meet shareholders expectations. Quality of loan book is declining in order to let quantity rise. Demand was stimulated, and often unnecessary products were distributed (overpriced mortgage insurances). Some borrowers where categorized as subprime, so that they could be charged more expensive rates, even if they could be qualified for an Alt-A, lenders didn’t always explain terms of the loan to the borrower properly, such as fees which could be unreasonably high. Subprime lending is responsible for driving up houses in less desirable areas.

An example of the ODM-institution’s growth and decline can be found in Countrywide Financial-a mortgage bank founded in 1969, and biggest lender in America during Greenspan boom (lending $494B in 2005) It retained a significant amount of its mortgages ($175B) it sold most of them on. It lent to diverse quality borrowers, and diverse kinds of mortgages, but it had more subprime and made more speculative business as its competitors.

It was known as second largest servicer in America, with servicing rights values at $12B in 2005. Countrywide owed it’s dramatical growth to the expansion of Boom years, because in other circumstances there would not be enough mortgages to increase amount of assets 20 times in 10 years.
In April 2007 asset prices started to sink, as market became aware of high exposure to mortgage risk, and as falling prices were followed by subprime delinquencies, by September price pro share halved. In second half of 2007 even good quality loans became delinquent. At the same time it became impossible to sell mortgage risk, and that removed an important funding source, confidence in market fell, liquidity fell, and funding became even more difficult. Countrywide was forced to sell 16% of shares to Bank of America to fund. By the end of the year there was a real risk of bankruptcy. One of the reasons was that Countrywide had too fast growth, and had not well-diversified the risks it had taken, and leverage was too big in ratio with capital owned. Due to its outstanding servicing capabilities it was attractive investment, and was bought in January 2008 by Bank of America. After the takeover, it was announced that in future only conforming or even less risky loans, and ARMs with interest only period over 10 years will be originated.

Countrywide’s shareholders ended up with less than a 10th of the share-price at its highest. Shareholders in each company desire high returns on equity. For that, growth is necessary, but too fast growth brings with it the risk of blowing up. Market should recognize the risk of growing too fast, but in some cases, including Countrywide it hadn’t. Too few participants realized the amount of risk that was caused by teaser rates, subprime lending and high LTV’s before the prices started to fall.

3 Financial assets and their Prices

3.1 Securities

Most of the holders of the mortgage risk were financial institutions, either active in banking or in capital markets model of finance. Here we will examine how closing the mortgage risk market, and tightening credit impacted holders of various securities, and how did securities transmit risk around the financial system.

A security is an agreement which entitles holder to certain payments under certain conditions. Common types of securities are:

- **Fixed rate bond**: payments of a fixed rate for a fixed period. At the end of the period the principal of the bond is repaid. This is in contrast with level pay mortgage, where principal is repaid over the whole period of the loan.
- **Floating rate bond**: rate consists of Libor plus some spread
- **Equity**: payments are entirely at issuing company’s discretion. Dividends are payed only if company makes profit. Additionally voting rights may be included.

Each of these is asset for the holder, and liability for the issuer.

Initially, securities are sold on primary market, and the sale is arranged by an investment bank (which is not a bank, but broker/dealer) who may underwrite some securities—undertake purchase if there are not sufficient buyers. Holders can further buy and sell securities in the secondary market. The existence of the secondary market makes the primary market less risky and more liquid.
Let us look more closely to the equity market. An equity holder makes an investment that is never to be repaid. Dividend payments are optional, and fully dependent on the performance of the firm. These features make equity loss-absorbing. Shareholders’ funds consists of retaining earnings, and issuing new equity. Equity holders take a biggest risk, and that is compensated in possibility of really high return in form of dividends.

Leverage is the ratio between value of assets and capital. 100:8 leverage corresponds to $100 loans funded by $8 of capital and $92 of debt. If the firm makes profit and retain $1 than it can issue $112.5 loans with same leverage. If it loses more than $8-shareholders’ capital, it is insolvent and must declare bankruptcy.

The safest bonds are issued by governments, large banks are considered highly safe, and industrial firms are riskier issuers. That is reflected in the interest rate they have to pay on their bonds. Libor curve expresses the interest rates bank have to pay for borrowings they make. It is above the government yield curve and almost parallel to it, but increasing are little bit faster.

![Typical Government and Libor Curves](image)

Smaller banks have to pay additional spread on Libor, usually expressed in basis points, which are percentage multiplied to 10 000. AAA rating refers to the best credit quality security, and hence, their have a narrow spread, were securities rated B have several times higher spread. The other factor influencing the spread is maturity: spread increases when the borrowing period increases.

If demanded spread is too high, there is a possibility to pledge an asset as a collateral on debt. In this case we are dealing with secured bonds. On the other hand this increases the risk of the unsecured bonds of the company, because there are less available assets for the unsecured creditors in case of bankruptcy. This concept leads further to the idea of Asset backed securities. It is important that the assets of the firm originate regular and predictable cashflows.

The principle if following: the firm founds a separate company called a special purpose vehicle (SPV) which buys their assets. It buys the majority of all assets with the money it gets
by issuing bonds to other investors. The rest of assets is bought with shares, partly bought from the original firm, and partly by other shareholders. This amount assures the investor that the bonds will be repaid: the SVP and the original firm due to shares it holds in it are the first to suffer the losses. This makes asset backed bond highly rated, and their rates relative low in comparison with profit from the assets, which provides residual cash, so that shareholders receive dividends. The originator gets cheap funding for the majority of assets, and gets profit from return on its shares in SPV.

3.2 Prices

Does market price really represent the fair value for the things that are bought and sold?

To evaluate an asset, we could estimate the price for which we could trade it. This is convenient when:

1. There are many similar assets in the market which are understandable for participants.
2. There are many independent buyers and sellers of such assets, and the trade is frequent.
3. Ability to trade depends not on factors beyond control of buyers and sellers.
4. Prices of recent transactions are available to buyer and seller.
5. There are rules against market manipulation.

We conclude that “fair” price doesn’t make sense if not compared with the prices of similar (this would not apply, for example, on the market of unique paintings), often traded assets, and information about market prices help evaluating the price without testing the market.

Securities are traded via stock exchanges (which can trade bonds as well as stocks), electronic exchanges, and market makers (who trade directly). The principle of valuating securities using current market prices is called ‘fair value’. This is a good approach in situation where assets are traded regularly. This doesn’t hold for all securities, this is why liquidity is of high importance.

3.3 Liquidity

In order to answer the question how quickly and at which price can a firm liquidate its assets, as well as how much might the sale impact the market prices one should estimate the liquidity risk. It should be noticed that there are no fixed characteristics for measuring
asset liquidity. If situation in the market changes, assets that has been liquid for a while can turn illiquid.

Equities with major indices like S&P 500 of FTSE 100 are highly liquid. This is the result of equity markets fulfilling five conditions for estimating the “fair value”: transactions are reported, all equities are same and large amount of them is traded, market participants are diverse: retail investors, pension funds, hedge funds and investment banks. All of this lowers the exposure to the liquidity drought caused by events like the Crunch.

Most single loans are illiquid. If they have to be sold, it is better to package them up together and try to sell a portfolio. Bonds from large corporations and government bonds are considered to be very liquid, and bonds of from smaller issuers are often less liquid. Here we have much smaller number of participants than in equity market, and most of them are high leveraged institutions. Hence, when borrowing gets expensive they tend to leave the market. For ABS is the pool of identical assets particularly small. It is not that easy to compare the prices of ABS, because they are packaged in portfolios with diverse bonds, and vary among themselves in quality. Therefore last reported price of an ABS is much less relevant then the one of major equity. It does provide useful information, but includes uncertainty.

3.4 Profit

First, we will look at loans in Old-style banking. There, profit can be interpreted as the compensation for default risk, and the cost of capital that is required against the loan. This is reflected in credit spread between Libor, the rate that bank funds, and the rate at which loan is made.

If we look at bonds, they are similar to loans in the way that principal and interest are being paid, and we can say that it has credit spread (we can measure in basis points the difference between received interest and Libor). On the other hand, buyer of the bond is exposed to more risks. Loans are not liquid, and therefore not marked to market, but some of the bonds are, and their value can change during the time period. The main difference is in accounting: for a loan, nothing will change in balance sheet if credit rating of the borrower declines, but holder of the bond they would suffer unrealized losses.

Beside default risk, bond holder is usually exposed to some of the following risks, which together require corresponding non-default component of spread:

- **Funding risk** may occur due to uncertainty
- **The volatility of bond price**, due to marking to market, may require more capital to absorb possible losses. Without sufficient capital to do so, the firm would be insolvent. This is reflected in higher returns on higher volatility securities, as a compensation for extra risk.
- **Current liquidation risk.** This is typical for illiquid assets. We assume that selling such assets will take time, and note the possibility that future value may not be equal to the current value, hence, to hedge this risk holders must require higher spread.
• **Uncertainty in future liquidation risk.** Even if an asset is liquid now it may turn illiquid over the time.

• **Uncertainty in current evaluation.** If we know that the fair value of bond is in certain price interval, but we do not know the exact value, we don’t just take the mean value, but also put the difference between the mean and lowest value aside as a valuation adjustment. This ties up the part of funds. Similar problem is the uncertainty in future evaluation.

Marking to market increases volatility and allows prices to go down, even if default risk does not increase, but liquidity goes down, or funding costs rise. In the Crunch, holders of mortgage assets sold as long as they could, which made prices drop further. The positive side of marking to market is providing participants of the market better risk information.

Basis of ABS, similar to other bonds is, that it passes risk from one party to another in exchange for cash. However, some specific for ABS features are not to be overseen. We note that ABS was invented after accounting transformation (marking to market). ABS, unlike many other bonds, can be traded, which provides greater price visibility. At the same time, information available at the origination of collateral backing the assets is not available to the buyer, because in ODM originator of assets doesn’t have to be holder of the risk, instead he sells them further in form of portfolios. This produces information asymmetries between buyers, who don’t always understand what exactly are they buying, and sellers. Passing of the risk also stimulates servicers to do as little job as required to earn their fee and decreases quality of servicing. If the originator is still concerned about performance of bonds backed by the assets that they originated, it would be due to risk to their reputation.

Willing to trade is based on long term expectation of the fundamental value, but also on funding costs, liquidity and price volatility. Changes of each of these imply changes of fair value. Expectations must not surely accurately predict the future. Other factor that increases volatility are other people. If many of them buy an asset, price will go up, but it has nothing to do with fundamental value. If you assume that people will keep buying it encourages you to buy, and expect price to rise further. This is called reflexivity of the market: prices change quickly if the general view on the market changes.

Asset returns are modeled with help of random variables. In order to avoid underestimating of big losses, it is rational to use heavy-tailed distribution. It is recommended to use lognormal instead of normal, Pareto and Bur distributions. There are several approaches to handle extreme losses in extreme-value theory, which answers this questions using the fractal approach. Furthermore, rational behavior of participants is assumed.

In time of low interest rates companies can borrow cheap, and invest more, fundamentals improve and asset prices rise. This encourages further investment. But cheap borrowing also stimulates speculation and this is how price bubbles are developed. Rising assets prices even make speculation rational. If belief that prices will continue increasing changes, prices will fall very fast, for the assumption that prices will continue rising is crucial to stimulate investing. We saw this situation during years of the Greenspan Boom. Credit spreads were getting lower and lower. In order to get reasonable profit, investors turned to riskier, thus
lower quality lending, which promised higher returns. This is known as Hunt for Yield. There were various warnings about the danger of low spreads, but predicting the crash wouldn’t make companies withdraw from the market, because in that case they would give their part of business to concurrence, and would surely make no more profit. Participants ran into the credit crunch, many were forced to bankrupt, and others were saved by governments, more precisely, by Central Banks.

4 Central Banks

In high-leveraged business as ODM is, Central Banks have big influence, first for they are the ones who control amount of the money supply in an economy, but also as lenders of last resort. In 2007 and 2008 Central banks provided liquidity and helped avoiding widespread bank failures. Various new instruments were invented in attempt to keep banking system functioning.

4.1 The Basis of Old-Style banking

The process of ensuring that a firm has enough cash to meet its needs is called funding. Simple companies have two types of funding: equity and debt. Equity or capital comes from retaining profits or issuing new shares. This has never to be repaid, but high return is required as a compensation to shareholders.

The other kind of funding comes from borrowing money: taking deposits, borrowing from other institutions, issuing bonds. This requires timely payments of interest, and principal. Companies are regulated more strictly than individuals: if they don’t pay on time they are declared insolvent and default. Financial reporting of a firm includes balance sheet. This consists of the left side, representing assets, and the right side representing liabilities and capital. Sum of assets has to be equal to the sum of capital and liabilities.

As we have previously seen, costs of borrowing increase with the time. Therefore there is a great temptation to fund long term assets with short term liabilities. This is followed by funding liquidity risk. Replacing funding after expiration of borrowing period with the new one in order to fund same asset is called rolling of funding. Taking one loan to repay the previous one is necessary, but interest rates on these loans are significantly lower, as on the one that could be taken for the whole period. Firm can also rely on its ability to liquidate the assets if it has no way to continue funding them. Hence, the safest way to fund an asset-to borrow to term is also the most expensive one and more typical for non-financial institutions.

Primary sources of funding debt for financial institutions are: taking deposits, issuing of bonds, and borrowing for short term in interbank markets. Retail deposits are demand instruments: the depositor has the right to demand his money back at any time. This is not
likely to happen: if all depositors would demand their money at the same time (bank run) the bank would default. This illustrates the meaning of confidence: people are willing to leave their money in bank only if they believe that it will not fail, and provided that it gets lot of deposits bank is able to fund it assets, and much less probably will it fail. Retail deposits are now protected by states, which protects not only depositors, but also bank from eventual run.

Financial institutions fail either because they cannot roll their funding (liquidity crisis) or because they are insolvent due to high losses. If firm loses much of its capital its credit rating will drop. It has less capital, which means less means for further loss absorption. That makes it less attractive to investors to lend to it, and increases the costs of borrowing for the company, and therefore also lowers its profits. Even the rumor of firm being insolvent can cause serious problems to its business due to loss of confidence.

Old-style bank, which follows 3-6-3 rule makes a profit that consists of interest on default risk, and mismatch in the term funding. From these two, profit on mismatch term is higher. Income at the end of a year is called net interest income or NII. The information which part of NII comes from taking which risk remains unknown to the investor.

4.2 Liability liquidity

In order to understand the process of rolling funding we make a closer look at the main classes of liabilities. Retail deposits are very stable source, in particular because government guaranties deposit protection, good for funding long term lending. Wholesale deposits (deposits from other firms) are larger than retail ones, but they are much more confidence-sensitive.

In order to make more money, old-style bank is forced to originate more assets, for getting cheaper funding can be difficult, and earning higher spread involves more risk, and that can increase funding costs. Beyond a certain point, there won’t be enough deposits to fund this new assets. In the UK this happened in 2001. After that lending grew faster than deposits, which meant growth of the illiquidity risk.
Another funding source is issuing a commercial paper (CP). Debt is issued for a short period of time and in large size. Once issued, CP is rather illiquid. Debt is unsecured, and only firms with excellent credit rating can sell CP. Interest that has to be paid is lower as it is for bonds. CP is usually rolled many times, and is one of the riskiest sources of borrowing.

Term debt has advantage of providing certainty for years and doesn´t have to be refinanced, but also disadvantage of being expensive.

The Line of credit is paying a fee for the right to borrow money if needed. But drawing on line is a negative sign which can sink confidence and do more harm than good.

Borrowing against collateral is also possible o the capital markets. The most common form is a repurchase agreement or repo. Repos are usually overnight and continuously rolling. Bond is pledged against repo as a collateral. The difference in value of the bond and the loan is called repo haircut. At the expiration interests and principal are paid and bond is bought back. Repo is cheap and typical for broker/dealer since they can´t take deposits. Repo risk analysis is in many ways similar to mortgage risk analysis. LTV is comparable to haircut, and FICO to credit quality. House prices dropping makes the mortgage more likely to default. In case of falling collateral value, repo could also be more likely to default, if borrowers quality is highly correlated with the value of collateral bond. This is known as wrong way risk. The bonds themselves are much more diverse as mortgages. Government bonds are safer, and their repos have lower haircut then corporate bonds.

ODM can’t use repo directly if their collaterals are not bonds. They find solution in issuing ABS and selling them to SPV.

Financial risks are easier to manage if they are quantifiable. With funding liquidity risk situation is much more complicated, due to its sensitivity to confidence, which is not quantifiable. There is no unique formula for estimating the optimal balance between cost of borrowing and funding liquidity risk.

One important principle is diversification of funding, through using various forms, but also spread of maturities, in hope that if difficult period comes, firm won’t have to much debt to refinance. Most firms who used this concept expected that this problematic period would last for months and not for years, and were unable to provide sufficient funding. Limits on term structure mismatches are important, because it is safer not to rely on rolling of high amounts of funding sources, and to restrict impact of confidence. Banks can limit this up to 20%, but broker/dealers have no alternative, because they are not allowed to take deposits.

If financial institutions can not borrow, they might try to sell their assets. This works if assets are liquid, but in time of crisis liquidity drops. In normal times factors increasing profits are: funding liquidity risk, asset liquidity risk due to higher returns on illiquid assets and leverage, because it’s cheaper then equity, and returns to shareholders will be higher if they are divided to smaller number of shares.

As defense from high leverage should be lowering of credit quality of highly leveraged firm and increasing costs of borrowing. But level of firm´s leverage is measured relative to it´s peers. If everyone increases leverage, credit spread doesn’t increase. High leverage
combined with the high funding liquidity risk exposure leads the firm to forced selling. More dramatic is the situation when many firms become forced sellers at once. Cycle of dropping prices, dropping confidence, absence of buyers and hence dropping liquidity, increased costs of borrowing lead many firms to bankruptcy, and those who were important enough were rescued by Central Banks.

### 4.3 Central Banks Policy in the Crunch

We will analyze actions on central banks through the examples of Federal Reserve System in U.S., European Central Bank (ECB) and Bank of England. Every central bank has the same goal: price stability and sustainable economic growth, maximal employment. Some central banks have explicit inflation targets, for Bank of England it is between 1% and 3%. The others control inflation implicitly, but they all aim to keep the inflation low using monetary policy.

The other thing that Central banks are interested in is financial stability. There are various aspects of financial stability:

1. The safety of deposits: deposit insurance means that governments have to cover losses in case that banks default, so that it’s in their interest to minimize numbers of failures of banks.
2. The availability of credit, for credit is necessary for growth of economy, and it should be affordable at a reasonable price.
3. Orderly financial markets. An assumption that Central Banks aim to control asset price volatility exists, but it is not supported by all financial analysts.
4. Failures are localized: Failure of one firm should not cause failures of the others, or in other words minimizing systemic risk.

Monetary policy is the process by which Central Banks try to achieve their economic growth and stability goals. Central Banks control demand through controlling supply of money available in the economy, and adjusting interest rates, specifically short term interest rate,
also called short rate. Short rate is raised to slow the inflations, and cut down to stimulate the demand.

Now we look at the instruments of Central Banks that are used to control the short rate. The Central Bank has a monopoly on new money. Other banks who need cash can take a loan from it at short rate. This is arranged in form of a repo: collateral bond is pledged. This is called going at the window. Therefore by controlling supply of money at the window Central Bank controls the short rate. Use of repos is known as open market operations, and there are various types of these.

Interesting is ECB’s main refinancing operation. One week repos are offered, and can be accessed by regulated Euro area banks which hold minimum reserves (deposits) at ECB in order to fulfill minimum liquidity standard. Former it was purposed to ensure that bank had enough cash to cover redemption of demand deposits. Some Central Banks like Bank of England dismissed practice of requiring reserves entirely. Actual refinancing is performed by national banks of Eurozone. After announcing of the refinancing operation, banks are invited to bid on repo bonds, with minimal rate allowed equal to the target for short rate, and minimal amount of million Euros. Submitting bids lasts one day, and national banks pass them back to ECB. Banks can submit up to ten bids at different rates. The ECB fills the bids with higher rates first. Cash is transferred to banks on the next day, and has to be repaid within a week. On 10th September 2008 EBC lent to Eurozone banking system €176.5B at average rate of 4.41%.

Defaults of financial institutions are stressful to the whole economy, and Central Banks intervene to avoid bankruptcies of systemically important institutions, even if they are not banks. These firms are taken over instead and Central Bank has the role of the lender of last resort. Banks have many advantages over other institutions: deposit protection makes it easy to attract funding, and they are highly leveraged, which contributes to big returns on equity and profit for shareholders. This comes with stricter regulations, and the right of the state to intervene before the failure, which protects depositors, but leaves shareholders no control. Bank is not allowed to come very close to the edge of default before it is nationalized. In this case shareholders lose everything, and holders of senior debt receive what is left after depositors are repaid.

Central Bank has a difficult task to decide if an institution should be rescued: it must consider consequences of allowing bankruptcy, versus cost of rescuing to taxpayer. Central Banks can’t allow institutions to be sure that they will be rescued if needed, as that would encourage reckless risk taking. Systemic risk of failing plays the key role in making decision. Banks that are “to big to fail” are supervised more rigorously as a compensation for the implicit guarantee of state support. In case of important non-banks, Central Banks can arrange a bail-out.

Until 1990s it was common to cut rates to stimulate economy if there was a crises. But cutting rates too much create risk of inflation and price bubbles. Some economists think that this happened during Greenspan boom.
In normal conditions, providing even small extra amount of liquidity makes system to function better and faster, but in a crisis it doesn’t make any change. This is because of shattered confidence, and liquidity drought. Banks are unwilling to lend to each other, and prefer keeping liquidity for the case they need it. Central Bank has to provide enough money to allow banks to deleverage themselves. Liquidity of a collateral is directly connected to safety of repos. If liquidity falls interbank repo funding dries up.

During the Crunch, assets became hard to finance, many non-banks were forced to sell their assets as they were unable to keep funding them. This makes non-default component of credit spread rise. Crucial importance has the question which assets are acceptable as collateral at the window. If they are, they can still be funded cheaply. Central Bank must limit it’s help in funding, because otherwise banks would become reliant on it and unable to raise most of funds in the market. During the Crunch, Central Banks provided large broker/dealers with liquidity in order to maintain financial stability. But in general case not everyone is allowed to the window.

Let us look at differences in policies of FED and ECB before the Crunch. Beside repos, FED used discounted window-very short term lending to banks. Repo dealing was indirect: primary dealers were permitted at the window and these distributed funding to the rest of the market using repos. In Eurozone national banks are in charge of refinancing operations.

Due to difficulties in interbank and collateralized markets borrowing, inefficiency of cutting rates was acknowledged. FED introduced new facility :Term Auction Facility or TAF o 12th December 2007. This let banks to bid for funds directly with the FED, and they also extended terms of lending first at one, and later to three months (unlike European one week repos). TAF was successful: it helped to reduce the Libor/FED credit spread significantly.

Despite this, TAF was unable to solve liquidity problem. Holders of assets that were not eligible for TAF who were not primary dealers were in particularly difficult position. To stimulate distribution of cash among the system FED introduced Term Securities Lending Facility and Primary Dealer Credit Facility.

TSLF works using two way repo: lower quality asset is exchanged for the treasury bond, which is high quality and easy to finance. This way, TSLF provides liquidity without changing money supply. PDCF simply extended access to the discount window to wider range of depositary institutions.
5 The crush of 1929 and it’s Legacy

5.1 Begin of the Great depression

To understand the development of the Credit Crunch 2006-2008, we know look at the crunch of 1929 and following Great Depression, which lasted until the Second World War. There was a stock market crash, banking crisis and a credit crunch.

This was also preceded with house price boom. In mid 1920s in Florida property prices were increasing, stimulating speculations. After two hurricanes hit the state, prices fell, and mortgage banks failed. But this was only an example that price bubble can occur, and burst. These period was characterized by cheap lending, and high leverage level as a consequence of it, together with high confidence. Investment trusts, who were offering diversified equity for retail investors. This wouldn’t cause problems if they hadn’t used the leverage. Buying on margin became very common, and allowed investors to borrow against stocks as collateral up to four times the notional they had to invest. Share prices were growing rapidly. The Dow Jones Industrial had doubled its stock prices from 1926 to October 1929, when they started falling tremendously. Investors became forced sellers, and the value of investment trusts fell fast. Early 1930s were characterized by small recoveries followed by larger falls.

5.2 The New Deal

At the beginning, government didn’t react, believing that the financial system will recover itself. As unemployment rose, and banking crisis developed, it became unavoidable to government to intervene.

First step were so called Pecora Hearings, which investigated crash of 1929, and uncovered general patterns of misbehavior related to finance: insider information has often been used for profit by company officers, accounts were falsified, quality of bonds was overrated, and many largest firms payed no taxes.

RFC or Reconstruction Finance Corporation was a further innovation of 1932, an independent agency that at first lent to banks against collateral, providing liquidity to banks that were not able to borrow from FED. As RFC published the names of the banks who lent by it, many institutions were unwilling to use it. Bank runs began all over U.S, and bank holidays were declared to prevent widespread bank failures.

The series of innovations by Roosevelt administration are known as The New Deal. As the crash in 1929 started the Great Depression, there was a sense that something must be done to prevent the stock market from disrupting the whole economy to such a large extent in future. Two programs of action were launched:

Banking Acts of 1933-35 to separate securities market from damaging banking system, and Securities Acts of 1933-34, which created Securities Exchange Commission SEC to oversee securities trading. SEC required disclosure of information to security buyers and made fraudulent disclosure illegal.
The most important result of the Banking Act was the deposit protection. When deposits were guaranteed by government to be paid back, this made lenders more willing to leave their money in banks, and in this helps to prevent a bank run. Banking Act was renewed in 1935, and this version is commonly known as Glass-Steagall Act, and included four mane changes:

- Banks were forbidden to purchase a significant amount of U.S. securities for their own account
- They could only trade securities when they had a direct customer order
- Issuing securities and selling equities was forbidden for banks
- Banks couldn’t be affiliated with entities engaged in securities underwriting and distribution.

This had the effect of reducing the cost of deposit protection, but also made banks actions limited, and gave opportunity to rise of specialist securities firms: broker/dealers. This situation was specific for U.S. for European banks continued to be active in both banking and securities trading.

Banks ability to lend is restricted with the capital requirements, and ability to fund their lending. But in depression people don’t have much money to leave deposits, and interbank borrowing is hard due to distrust to each other’s credit quality. This is also a time when liquidity decreases, together with banks tolerance for liquidity risk. Lenders are suspicious about borrowers’ credit quality, and reluctant to make loans. Banks try to persuade their shareholders that they stopped taking particular risks by lending, in order to maintain confidence, but this also reduces the profit. All this factors create a credit crunch.

In 1933 RFC was not only lending, but also providing the capital. This made RFC significant instrument in state capitalism, and by 1938 it distributed over $10B and became the largest single investor in American economy.

As foreclosures came to rate of thousand houses per day, reforms had to be done to protect homeownership. HOLC or Home Owners’ Loan Corporation was established to take over and restructure unaffordable mortgages extending the period of loans, and reducing the interest rates.

Federal Housing Administration was offering insurance against default risk, and this encouraged banks to lend. This was the first time when default mortgage risk could be hedged.

To assist funding in way of purchasing FHA-insured mortgages and freeing up the capital, Federal National Mortgage Association, known as Fannie Mae was founded. Fannie also created a secondary market for residential mortgages. If the banks could count on selling their mortgages to Fannie, they kept lending, but this also split the market into conforming loans – ones eligible to sale to Fannie, and the rest. Fannie’s borrowings counted as government liabilities.

By 1968 during the administration of Lyndon Johnson, Fannie was semi-privatized to reduce he U.S. government debt (at least the appearance of it). However, Treasury would continue
to back their liabilities. As Fannie had the monopoly position on secondary market, the competitor enterprise: Freddie Mac was established. Freddie and Fannie (F&F) enjoyed various benefits compared to other institutions: they were not obligated to register their securities at SEC, had their own regulator, and various tax breaks. The problem with F&F was, that shareholders benefited from their profit, but if their suffered losses, taxpayers had to cover them (although there was no legal obligation for this). This resulted with management and shareholders of F&F becoming really rich.

Now we take more detailed look on the loans that Fannie and Freddie were allowed to buy: conforming loans. Its three key features are: size limit, documentation requirements, and 80% LTV limit, although the size limit has been raised over the years, as house prices went up. Loans bigger than the required limit are called jumbos.

Remaining establishment, that will be important later is FHLB system: it was a sort of mini mortgage-based FED. Regional FHLB lent against mortgage collateral rather than bonds that were eligible at FED window. FHLBs are owned by the banks they support, their equity is not publicly traded.

The New Deal reforms helped to restore efficiency of U.S financial system, and provided safety to it. HOLC, FHA, Fannie and FHLB made mortgages cheaper. Long term level pay mortgage structure replaced short term interest only loans that predominated before the Great depression. With separation from securities market, banking system became more safe. The disadvantage of the new system was, that it became very complicated, and that each class of institutions had different regulators, which made further reforms more difficult.

5.3 Evolution of Freddie and Fannie

An interesting feature of F&F is, that they issued the first kind of ABS: bonds that allows them to pass on the prepayment risk to the bond buyer.

By issuing the bonds, F&F got the money they needed to buy the mortgages they kept. These were at first similar to government bonds. Funding was cheap, thanks to the general belief that enterprises had government support. An important question was for how long should they borrow to minimize the prepayment risk, but also to prevent expensive refinancing if interest rates rise. Unlike by classic ABS, where both prepayment and default risk were passed to SPV, the Agencies wanted to pass the prepayment risk, but keep the default risk. Therefore they guaranteed the performance of the mortgages backing their bonds. The ABS holder receives most of the interest and all of the principal on the underlaying mortgage pool, while spread they were paid was considerably over U.S. treasuries, and Fannie and Freddie solved their prepayment risk management problem, and pool of funds available to support primary mortgage lending was expanded.

As the MBS market was established, in 1977 the first private labeled MBS was issued by Bank of America. This passed through all the payments on fixed pool of mortgages to investor, but unlike with F&F, there was no guarantee against default risk. The first MBS were backed by very high quality mortgages, to persuade the investors to buy them.
In 1980s there were two big boosts for private label MBS market: 1984 financial institutions were allowed to buy private label MBS, and 1986 changes in tax code enabled issuance of more sophisticated types of MBS. After that private MBS issuance developed very fast, by 2005 approximately same volume was issued by private sector as by F&F. It became possible to keep or pass any risks that originator wanted to, which was the key to the following real estate crunch.

6 Securitization of arms and financial modelling

6.1 Securitization

Securitization is the term used to refer to process of creating asset backed securities. As we have seen, the most important type of these are mortgage backed securities, but other assets can also be used, such as bonds or corporate loans, or credit card receivables.

Most important features of these assets are

- Self-liquidation (they are already so arranged to turn themselves into cash)
- Diversification
- History of comparable assets is a guide to estimating future movements of prices
- Statistics are accessible

To meet the needs of different investors for a different levels of taken risk we use tranching of the securities. That means, that we split the value of these in three or more classes. Here we observe splitting in three classes, but note that in reality up to ten classes are possible.

Junior tranche is the first to absorb losses, their principal is likely not to be fully returned, and respectively requires highest interest rates. Holders of mezzanine tranche have much lower risk that the principal will not be returned, and they receive lower credit spread. The remaining senior tranche is very safe, it will return really low interest rate, but also be very highly rated. It is reasonable to make the senior tranche as big as possible (over 90% of the total investment).

Senior tranche has considerable privileges in comparison with other tranches. Whenever collateral pays the interest, cash is payed first to the senior. After paying them out, next payments go to mezzanine, then to junior, who receives excess spread on the collateral over that needed to pay senior and mezz. If the spread is high enough junior may profit even if no principal is repaid to them at all. As we see, losses come from bottom up, but cash from the top down.
If the principal is prepaid, there are two possibilities of sharing the cash between tranches: in sequential structure Techniques that intend to provide better credit quality of specific tranches are known as credit enhancement. Attachment points – amounts of losses that tranches absorb are arranged so that senior is as large as possible and rated AAA, and junior is only so large as needed to get a better rating for mezz.

Typical forms of credit enhancement are:

- Sequential prepayment structure - prepayment comes from top down, instead of using parallel structure where each tranche is paid pro rata.
- Wrapping: buying an insurance that would cover the losses if they take values in certain interval
- Creating a spread account between mezz and junior, which would be used to cover later losses. If losses are less, residual is paid to junior
- Early amortization provisions: if loss level is higher than expected, excess cash is used to prepay senior instead of paying the junior

Securitization is meant to transfer risk, free up capital and provide cheaper funding. The investors also benefit from having access to assets that otherwise wouldn’t be available. Typical situation is, that originator of assets sells senior tranche to investors, but keeps lower ones to themselves. This way it keeps first losses, but passes very large losses on, and the investors are more willing to believe that assets are of good quality. Additional benefits are

- Funding arbitrage: credit spread for senior tranches is lower than for unsecured bond, which provides bank cheap funding, while keeping most of risk and return
- Capital arbitrage: bank has to meet requirement of 8% of capital against notional. If bank sells the senior tranche, it has to set capital against residual only, and this way free the capital without changing risk or return. This praxis was used in late 1990s and is now present in more sophisticated forms, as regulators try to close this loophole.
- Fee from ancillary transactions

With increasing complexity of the instruments, investors relied on credit ratings, although single rating cannot possibly capture all behavior of a complex asset. Serious problem war rating shopping: as the rating agencies are paid by issuers, and to keep their clients, agencies were too generous while giving ratings to ABS. They also gave their models to structuring banks, and these optimized their ABS structures to get a better rating for each tranche.
6.2 Models in Finance

We take look at derivatives: instruments whose value depends on underlying asset. Their important feature is that they are not traded frequently: once the dealer sells the option it’s not probable that he can buy it back. Therefore they try to immunize a portfolio against possible losses, or hedge. This includes giving profit up in exchange of money, or paying a fee, or both. The valuation of derivatives is based on hedging processes. If we use the hedging model, we estimate the “fair value” of the derivative by calculating the cost of hedging it.

Another approach is pricing model: this one uses interpolation between the prices of liquid assets, which are known. Here we are not trying to predict the fundamental value, instead, assuming the given benchmark prices are correct, we derive a price for a related instrument.

Risk model has the goal to estimate possible losses for particular scenarios. Significant features for risk models are market volatilities and correlation.

Properties, specific for financial models are: once the model is accepted, it is used to make trading decisions, which affect the market, and change its’ behavior this way. They also depend on the data to which they are calibrated. This leads as to conclusion that the financial models are strictly limited to the certain periods in the markets, and may become inappropriate if some conditions change.

In crisis, when liquidity disappears, and market quotes are not available, firms are forced to mark to model. Therefore, mistakes that arise in modeling are called model risk. Errors in coding and implementation of numerical algorithms are caught by model review process. The other problem is calibration, specially when inputs are uncertain, such as value of an illiquid asset. Together with calibrating to recent history, implicit assumption that the future will be like the past makes predictions based on a model unreliable in the crisis. To improve their models, firms are required to practice stress testing of their portfolios, and hedge the losses that would occur in eventual stressful situations.

Before the crunch, together with small and medium sized ones, very large risks were distributed through the financial system. Risk of mortgaged lending was misjudged, because historical data implied that mortgages were safe. As the originators of ABS passed the risk through the system, they didn’t truly tend to estimate the risk of subprime lending realistically. Main error of the rating agencies was calibrating to the period of raising house prices, while possible fall was not considered. Only later after number of defaults increased dramatically, they discovered that the credit enhancement used to protect senior tranches was insufficient to protect senior tranche. Not only the firms directly involved in mortgage market, such as Wachovia and Washington mutual, suffered great losses, but also Merill Lynch, Citigroup and UBS, who were buyers of the senior tranches of AAA rated ABS, who had the privilege to fund under Libor, and although senior tranches paid only few basis points spread, they could record profit. After liquidity disappeared all of them had to take write-downs, mostly caused with falling prices of subprime ABS. It is worth noticing that there also were firms, that despite their exposure to subprime risk didn’t write them down. This made investors skeptical, and ratings were downgraded equity prices fell, and ratings
were downgraded, while confidence continued to decrease. This was the point at which Credit Crunch entered its final third state.
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