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SCHOOL OF PRODUCTION ENGINEERING AND MANAGEMENT

FACTORS THAT INFLUENCE THE BOND MARKETS – CASE STUDY OF THE 2008 FINANCIAL CRISIS

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CHANIA, OCTOBER 2022

Acknowledgments

First and foremost, I would like to thank my supervisor, Constantin Zopounidis, for his constant guidance during the preparation of the dissertation as well as for his flexibility regarding the topic. His character and energy motivated me to write this paper is the best possible way.

I would also like to thank my closest friends, who support me and push me to become a better person.

Contents

Περίληψη

Στην παρούσα διπλωματική εργασία θα παρουσιαστούν οι βασικές κατηγορίες ομολόγων και τα χαρακτηριστικά τους. Σε αυτή την εργασία θα αναφερθεί η επίδραση που έχουν τα επιτόκια στην απόδοση των ομολόγων καθώς και ο τρόπος με τον οποίο η νομισματική πολιτική από τις κεντρικές τράπεζες επηρεάζει τις αγορές. Επιπλέον, γίνεται μια λεπτομερής αναφορά στους παράγοντες που οδήγησαν στην δημιουργία της οικονομικής φούσκας στην αγορά ακινήτων των Ηνωμένων Πολιτειών και στη συνέχεια στην οικονομική κρίση του 2008. Αναφέρεται η καθοριστική σημασία που είχαν τα κριτήρια απόκτησης στεγαστικών δανείων εκείνη την εποχή καθώς και ο ρόλος των οίκων αξιολόγησης στην ενίσχυση της συστημικής κρίσης.

Η διπλωματική αυτή δεν έχει ως σκοπό την εξέταση εμφάνισης μιας ενδεχόμενης κρίσης στο μέλλον με παρόμοια χαρακτηριστικά. Η εργασία εξετάζει τα χαρακτηριστικά των αξιόγραφων σταθερού εισοδήματος και τον τρόπο με τον οποίο αυτά οδήγησαν την οικονομία σε ύφεση το 2008.

Introduction

In this dissertation, the basic categories of bonds and their characteristics will be mentioned. The thesis will present the way the interest rate environment affects the bond yields as well as the effects of monetary policy in the financial markets. This paper will also explain in detail the origins of the financial crisis of 2008 and present the key role fixed income instruments such as mortgage backed securities and collateralized debt obligations had in the creation of the bubble in the 2000s. This dissertation also explains the importance of lending standards in the formation of the bubble as well as the role of the credit rating agencies in this historical event.

It is not the purpose of this paper to provide information on the possible ways to avoid a similar crisis. This paper will simply present the basic characteristics of the fixed income markets and how the creation of ill fated fixed income securities led to the global financial crisis.

Fixed Income

Fixed income refers to the type of investment that pays investors a fixed or set amount of money as a percentage of the initial investment (interest payment) until maturity (BlackRock, n.d.). At maturity the initial investment is repaid to investors. Fixed income investing is considered to be a conservative investing strategy that carries low risk, mainly because fixed income securities are backed by large institutions and governments.

Generally, fixed income securities are less risky than stocks as their prices are correlated to a smaller extend with macroeconomic factors. These types of investment products are often included in a stock portfolio for diversification in order to offset the risk that stocks incur.

Bonds

Raising capital is necessary for governments and corporations in order to fund infrastructure, take on profitable projects and grow in general. This can be accomplished through several ways. For governments it is done mainly through taxes. Corporations raise capital from their organic growth, share issuance and bank loans. Most of the times, and especially for larger companies, a bank loan wouldn't suffice, therefore issuing debt is how corporations and governments acquire additional capital.

Issuing bonds is an easier and most of the times a cheaper way of raising capital than relying on a bank loan. The buyers of bonds can be institutional investors such as pension funds and insurance companies. The entity that issues the bonds - be it a large multinational company or a country – determines the characteristics of the loan. In essence, the issuer determines the interest payments and the date on which the initial investment will be paid back to investors.

The main characteristics of a bond are the following:

Face Value: Face Value refers to the amount of money an investor will receive at maturity. If a bond trades below face value, it trades at a discount and if its price is higher than face value it trades at a premium (BlackRock, n.d.).

Maturity Date: The maturity date is the date on which investors receive the principle of the loan, in essence, the time the bond issuer pays the face value of the bond.

Coupon Payment: The coupon payment refers to the interest rate an investor receives from the bond issuer. It is expressed as a percentage of the face value and it is usually paid semiannually.

Bond Price: The bond price is the price at which the bond is sold. It can be different from the face value and it usually depends on the credit rating of the issuer and the interest rate environment (FERNANDO, n.d.).

Bond Categories

Government Bonds

Issuing bonds has been the most common way common way countries raise capital, which is usually used for funding infrastructure projects, paying off existing debt or even finance the expenses of a war. Historically, the Dutch Republic issued the first securitized bond in 1517 to finance the debt incurred by the city of Amsterdam. In 1694, England was the first country to issue a bond with the purpose of raising money needed to fund its war against France.

In the USA, government bonds (also known as US treasuries) are divided into 3 main categories, depending on the time until the maturity of the loan. The fixed income securities with the shortest maturities are called Bills and their maturities range from 4 to 52 weeks. These bonds do not pay a coupon, however, they are sold at a discount from their par value (face value) and the difference in the price between their selling price and their face value paid on maturity date represents the interest paid on the loan.

Government bonds of medium maturity are called Notes and have maturities of 1 to 10 years. Their price can fluctuate depending on the economic environment at the time and the coupon payment is usually semiannual. The 10 Year Note attracts a lot of attention because it is considered as a benchmark for the mortgage market and also used to produce the yield spread – an indicator of the health of the economy.

Fixed income securities with longer maturities (more than 10 years) are called T-Bonds. Similar to T-Bills and T-Notes, they usually have semiannual coupon payments.

Treasury Inflation-Protected Securities

Treasury Inflation-Protected Securities (TIPS) are bonds issued by the US government, and whose face value is subject to adjustments depending on inflation (CHEN, 2022). The principle or face value of these bonds rises when inflation increases in order to protect investors from the decrease in the purchasing power of their capital.

An important aspect of TIPS is that because interest rate remains unchanged, the semiannual coupon payment can rise during periods of increased inflation, as it is expressed as a percentage of the principal of the loan. The inflation adjustments are made semiannually; therefore, the principal fluctuates accordingly. Conversely, during periods of deflation, the coupon payment will decrease due to the decline in the principle of TIPS. At maturity, investors receive the inflation adjusted principal or the initial face value, whichever happens to be greater in value.

To sum up, TIPS offer significant inflation protection in a fixed income portfolio and can guarantee that investors will not lose their capital, given that they hold their securities until maturity. However, the interest rate offered by TIPS is lower than that of other securities that do not account for inflation. In case of a deflationary period, holding TIPS can be deemed unnecessary as the return will be much smaller compared to other treasuries.

Municipal Bonds

Similar to government bonds, municipal bonds are issued by municipalities to finance infrastructure projects. The default risk of a municipal bond is higher than that of US Treasuries as it is more likely for municipalities to declare bankruptcy than governments.

Corporate Bonds

Corporate bonds refer to the debt securities issued by large companies, aiming to raise capital to finance existing debt or profitable projects. These bonds carry higher risk than government and municipal bonds, as companies are in greater risk of bankruptcy than the central or any local government. The fact that corporate bond investors bear more risk by investing in these debt instruments comes with a higher interest rate (coupon payments) to compensate for that risk.

Corporations find debt financing more appealing and preferable than issuing stock (equity financing) mainly because issuing bonds does not entail giving up ownership stake of the company. Furthermore, the interest paid to investors holding the corporate bonds is usually much lower than that of a bank loan.

Corporate bonds are several times issued with embedded call provisions, put options or other features which will be described below.

Varieties of bonds – Bond features

Callable Bonds

A callable bond is a debt security that gives the issuer the right to repay the investor the face value of the bond before the maturity date. It is preferable for a company to pay its debt early by exercising the call feature of the bond and not have interest obligations to the bondholders. Usually, whether this is for the best interest of the corporations highly depends on the interest rate environment. For example, if a company has issued a callable

bond during a period of high interest rates, and there is a decline in rates in the near future, then the issuer might decide to buy back the bonds repaying investors before maturity date and issue new bonds with lower interest rate this time. This situation is called refinancing and it is a risk investors of callable bonds have to take into account. For this reason, typically, callable bonds pay a higher coupon than non callable ones. In general, Treasury Bonds and Notes are non callable whereas municipal and corporate bonds usually come with call provisions.

Puttable Bonds

Contrary to callable bonds, puttable bonds are debt securities with embedded put options, giving investors the possibility to demand that the issuer repurchases the bond and get paid the face value before maturity. Normally investors exercise this option when interest rates rise, so they can buy newly issued bonds offering a higher interest rate.

Convertible Bonds

These are the types of bonds that can be converted into shares of common stock after a period of time, with a predetermined conversion ratio. The biggest benefit for corporations issuing convertible bonds is that the lower interest rates of these bonds, which is justified from the option of receiving common stock of the issuing company. Investors can take advantage of this feature by converting their bonds into equity if the company's stock appreciates in value. Otherwise, they can keep their bonds and receive coupon payments until the bonds mature. A prudent investor would decide to convert the bond to stock shares if their price exceeds the price of the face value and that of the rest coupon payments combined.

Yield Curve

From a mathematical point of view, the yield curve is a graph that depicts the yield of bonds of equal credit ratings but with different maturities (HAYES, 2022). It indicates investors' returns from short term and long term bonds, mostly referring to US treasuries. The reason is because these are debt instruments with such low risk that can be considered risk free and, therefore, not associated with other factors that impact other types of bonds. The shape of the yield curve is highly impacted by interest rates, as they set the expectations for the coupon rates for bonds of different maturities.

In a growing economy, when investors buy long term bonds, in essence when they lock their liquidity for longer periods of time, they take more risk because of the possibility of higher interest rates in the future. Therefore, investors would demand a higher return when investing in long term maturities. The steeper the yield curve, the greater the difference in yields and the more likely investors are willing to accept the risk of investing in long term bonds. The flatter the yield curve, the less investors are compensated for bearing the extra risk of tying up their cash in long term bonds and the less motivated they are to do so. The yield curve can have three different types: normal, inverted and flat yield curve.

Normal Yield Curve

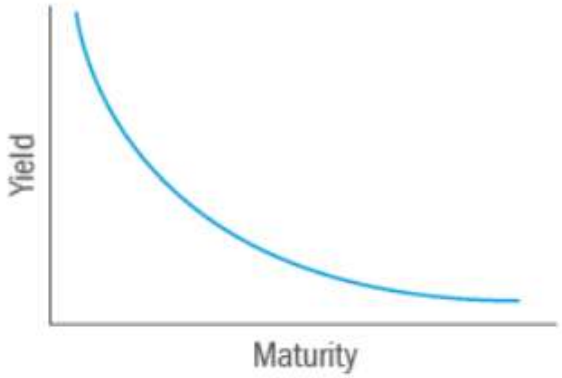
A curve of this type is generally pointing upwards and to the right. This indicated that bonds with longer maturities have higher yields than short term bonds. A normal yield curve is deemed as a sign of favorable economic conditions and implies future economic growth (HAYES, 2022). What this means is that investors are confident about where the economy is headed and do not think that a slowdown is imminent. These are times when the economy is stimulated by low interest rates by the Federal Reserve, which makes borrowing easier and increases productivity. Consequently, the equity market is more appealing than long term maturities, which pushes their price lower and their yields higher. The shape of a normal yield curve is presented in the following graph.

Normal Yield Curve

Inverted Yield Curve

An inverted yield curve is an indication of a future slowdown in economic activity (HAYES, 2022). The inverted shape of the yield curve is associated with short term rates being higher than long term rates, which typically results from increased demand for short term credit.

During a recession period, the expectation is that interest rates will be cut by the central banks in order to stimulate the economy and increase spending. At that time, most investors are reluctant to buy stocks and prefer safer investments like long term maturities. The increased demand for long term bonds causes their prices to rise and – based on the definition of the yield – yields fall. The shape of an inverted yield curve is shown in the graph below.

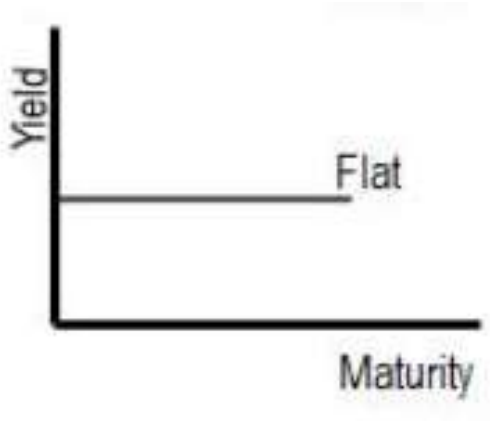


Inverted Yield Curve

Flat Yield Curve

A flat yield curve means that short term interest rates are similar to long term ones. The yield curve starts flattening when the Federal Reserve increases short term interest rates. Investors then consider bonds with higher maturity more appealing and as a result their yield falls, which causes a normal yield curve to gradually flatten and sometimes even invert.

This type of curve usually appears at the end of a period of increased economic activity which is the time when interest rates rise in order to control inflation. It can also appear at the end of recessions when the economy starts recovering.



Flat Yield Curve

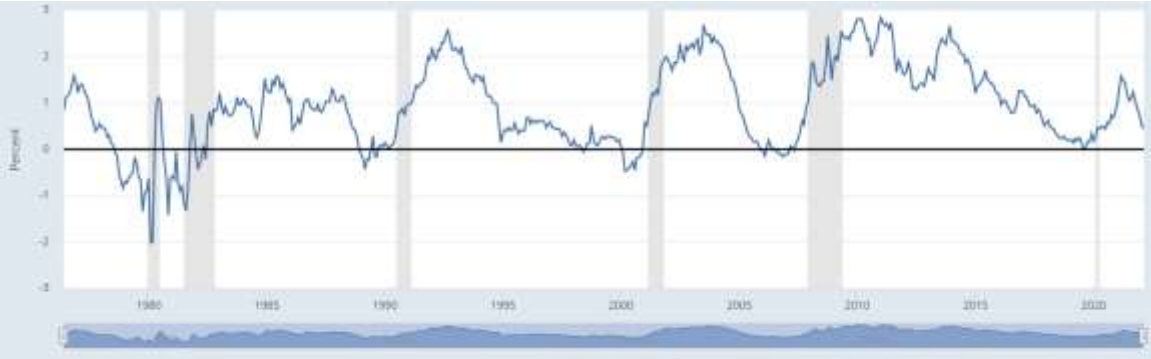
A yield curve analysis is done in order to determine in what phase of the expansion cycle the economy is at a particular point in time. It is a snapshot of the relation between short and long term rates and it is calculated for every month. The inverted yield curve is highly correlated with economic slowdowns; in fact, an inversion in the yield curve has preceded every major recession in history.

Yield Spread

Another common way of measuring the health of the economy is the 2/10 Treasury spread, which expresses the difference between the 10-Year and the 2-Year Treasury yields. Similar to the yield curve, the 2/10 spread indicates the health of the economy at any given time.

Historically, several times that the Federal Reserve cut interest rates, the spread between the two yields widened (the yield curve steepened) and when there was an increase in interest rates (short term) the spread narrowed. In the case of the spread dipping below zero, this translates into an inversion of the yield curve, and therefore, a possible imminent recession.

The three most recent times the spread turned negative were before the bursting of the dotcom bubble in 2000, in 2006 which was followed by the global financial crisis and briefly at the end of 2019, right before the stock market crash related to the pandemic.



FRED - 2/10 Treasury Yield Spread

How bonds are traded

Trading bonds is a vital part of the global financial markets. Even though bond trades take place less frequently than equity trades, the bond market is far larger than the equity market – in terms of capital invested- and it is where central banks apply their monetary policy. Contrary to common stocks, which are traded on exchanges (like the NYSE or the London Stock Exchange) bonds trade over the counter.

Concerning the issue of a brand new bond (primary market), there are two main ways this can take place: bond auction and bought deal. The latter is when investment banks buy all the new bonds issued by a company or a country at once. Investment banks submit bids for the bonds and then the issuer decides in which bidder to sell based on what they view as the best deal. A bond auction on the other hand is when buyers (usually investment banks) submit bids to purchase only a part of the newly issued bonds. Successful bidders might be paying the same or a different price for the issue of the new bonds, single-price auction and multi-price auction respectively (DODD, n.d.). After bonds have been issued in the primary market with one of the two ways mentioned above, they trade on the secondary market, where large and retail investors can purchase the bonds.

Exchange vs over-the-counter markets

Common stocks trade on stock exchanges, which are essentially places where all buying and selling is centralized. Price transparency and anonymity are major characteristics that stock exchanges provide. Once a trade takes place, it is recorded and it can be seen by every investor. Moreover, the fact that there exist rules for joining stock exchanges imposes a high degree of regulation and for this reason most large established companies trade on exchanges.

Over the counter markets on the other hand are decentralized networks where dealers negotiate directly with each other. That being said, one key characteristic of over the counter markets is the fact that they are not as transparent as exchanges because not all trades are disclosed to all investors. In these markets, dealers of an OTC security can basically decide at which price they are willing to sell to other customers/buyers. The fact that trades in over the counter markets are not visible to all market participants – as it happens with stock exchanges- gives the possibility to OTC dealers to not ask for the same price to all customers. Furthermore, prices in OTC markets are publicly available only after the trades are completed, highlighting the reduced transparency that these markets offer.

Why are bonds traded over the counter

The first reason that bonds trade OTC is associated with the size of the bond market. The number of common stocks listed in the largest stock exchanges in the USA (NYSE and NASDAQ) is around 6,000 whereas there are over 150,000 debt securities issued every year. Therefore, a centralized place for all debt securities would be huge as bond markets cannot be as centralized as equity markets.

Secondly, the size of bond trades is significantly higher than that of equity trades. A common equity trade amounts to several tens of thousands dollars, however, when it comes to bonds, trades over 10 million are not uncommon. The last main reason is about trading frequency. Bonds do not trade as frequently as equities do and as a consequence

there is not a constant and steady supply of dealers to justify a centralized place for the trades, i.e. an exchange.

Bond Yield

The bond yield is basically a metric that expresses the earnings a fixed income investor gets over a specific time period. There are several ways in which bond yields can be measured. The most simplistic method would be by dividing the coupon of the bond by its face value. The formula is defined as follows:

$$COUPRON\ RATE\ = \frac{ANNUAL\ COUPON\ PAYMENT}{FACE\ VALUE}$$

The above calculation, however, is rarely accurate, since an investor does not necessarily purchase every bond at its face value. Therefore, in order to be provided with a more precise estimate of the yield of a bond at a particular moment, the current yield offers a much better estimate. The current yield is defines as:

$$CURRENT\ YIELD\ = \frac{ANNUAL\ COUPON\ PAYMENT}{BOND\ PRICE}$$

This ratio is not always realistic since the price of bonds is constantly changing in response to market and economic conditions. The time investors sell the bonds they had been holding as well as the price at which they sell – if they choose not to hold the securities until maturity – will have an effect on the real yield the investors will gain. In essence, current yield is merely a rough approximation of the yield an investor could probably earn by investing in the respective bonds.

The yield to maturity can be expressed as the internal rate or return of an investment in a particular bond. The cash flows in this case would represent the principal paid plus every arranged coupon payments until the day the bond matures. The formula is as follows:

$$CURRENT\ BOND\ PRICE = \frac{\sum_{t-1}^{T} CASH\ FLOWS}{(1 + YIELD\ TO\ MATURITY)^{t}}$$

This type of yield calculation is based on the assumption that the fixed income security it refers to will be held until it matures. However, when it comes to callable bonds there is the possibility that the issuer of the security chooses to repurchase the bond before it is due. And this is where the yield to call comes in play. The part where yield to maturity and yield to call differ is that the time to maturity, which is in essence the time the bond owner holds the bond, is now replaced by the time to call in the formula. The latter refers to the period of time the bondholder owns the bond, only this time it is not until maturity but rather until the issuer prematurely pays back the loan.

Of course, the time the bond issuer decides to buy back the bond, the bond will have a different price than the face value – there usually is a predetermined value at which bond issuers will exercise their call provision- and so, the price to call replaces the face value.

How bonds are rated – Credit Rating Agencies

It is always prudent to research a potential investor in order to determine if he or she is trustworthy. Banks use the credit score, which is a number given to any credit card user and is affected by several factors such as payment history, amount of money owed by the user, length of credit card history, possible previous applications for new credit etc. In essence, the credit score is a metric that allows lenders – banks in most cases- to determine whether a certain individual is likely to repay a loan. In the case that the borrower is not a person but rather a whole company or even a country, the authority responsible for assessing the creditworthiness of that specific company or country is a rating agency. In other words, the role of rating agencies is to give an unbiased, trustworthy and accurate opinion about the creditworthiness of an issuer of a debt obligation (Maxfield, 2017).

Credit rating agencies were first created in the United States during the railroad construction era between the mid – 19^{th} and mid – 20^{th} century. At that time construction companies were in need of funding for financing their operations. Basically they needed to pay the construction workers and buy the materials necessary for the completion of the railway system. At that time, investors saw the railroad construction market as a great investment opportunity and were interested in loaning money to these companies. Even though the railway construction market was rapidly expanding, investors still wanted to determine which companies would be reliable in paying back their debts. Therefore, the main objective of the credit rating agencies was to sell this information to investors; and they sold this information in the form of credit ratings, which are metrics similar to the credit score mentioned above. These ratings provided by credit rating agencies essentially represent the probability that a company fail to repay its debt on time.

Theoretically, bonds are securities that provide investors with a steady and absolutely safe, rock solid stream of income. However, there is no such thing as a risk-free investment. Even though the interest rate of the US Treasuries is also known in the financial markets as the risk-free rate (which is mostly used as a reference point to compare all other bond yields), bonds of other countries, especially of countries of emerging markets, carry significantly higher risk. The more trustworthy a government is,

the lower the risk of its bonds and consequently the lower the credit risk of the country. The same situation exists in the case of debt obligations issued by big corporations. In essence, the degree of uncertainty in the coupon payments as well as the principal of the loan depends on the financial condition of the company. Rating agencies use an alphabetical metric of rating bonds, with AAA given to the bonds of the highest quality. Bonds with ratings of BBB and above are also known as "investment grade" bonds whereas the bonds with higher risk of default – and higher yields to compensate for that extra risk- are given ratings of BB through C and are called "junk bonds" or "speculative grade" bonds (Marcus, 2018). The D rating is the lowest there is and is given to bonds that have already defaulted in one or more payments.

The table below shows the ratings used by the two largest credit rating agencies, Standard and Poor's and Moody's.

Standard and Poor's	**Moody's**	**Grade of the bonds**
AAA	Aaa	Investment grade
AA	Aa	Investment grade
A	A	Investment grade
BBB	Baa	Investment grade
BB	Ba	Speculative grade
B	B	Speculative grade
CCC	Caa	Speculative grade
CC	Ca	Speculative grade
C	C	Speculative grade
D		Speculative grade

AAA / Aaa: Debt securities of this rating are the most reliable ones and the possibility of the issuer repaying the loan is extremely high.

AA / Aa: Bonds of this rating also indicate a great creditworthiness of the issuer and, along with AAA bonds, constitute the higher grade bond class.

A / A: Debt obligations of this category are safe and have a high probability of repayment, however, there are slightly more vulnerable to changes in the macroeconomic environment.

BBB / Baa: This credit rating is given to debt obligations that have an adequate quality. The chance of repayment is lower than that of the bonds with the above ratings and changes in the macroeconomic environment can potentially have a significant impact in the ability of the issuer to pay back the loan.

BB B CCC CC / Ba B Caa Ca: Bonds that receive this rating are generally considered speculative grade bonds and there is a high degree of uncertainty regarding the ability of the issuer to pay the coupon payments and the principal on time. These bonds carry a lot of risk, especially during times when the economy is not prospering.

C / D: These ratings refer to bonds of corporations or governments with extremely low credibility. Sometimes payments are even overdue or the bonds have already defaulted some previous payments.

Case Study – The 2008 global financial crisis

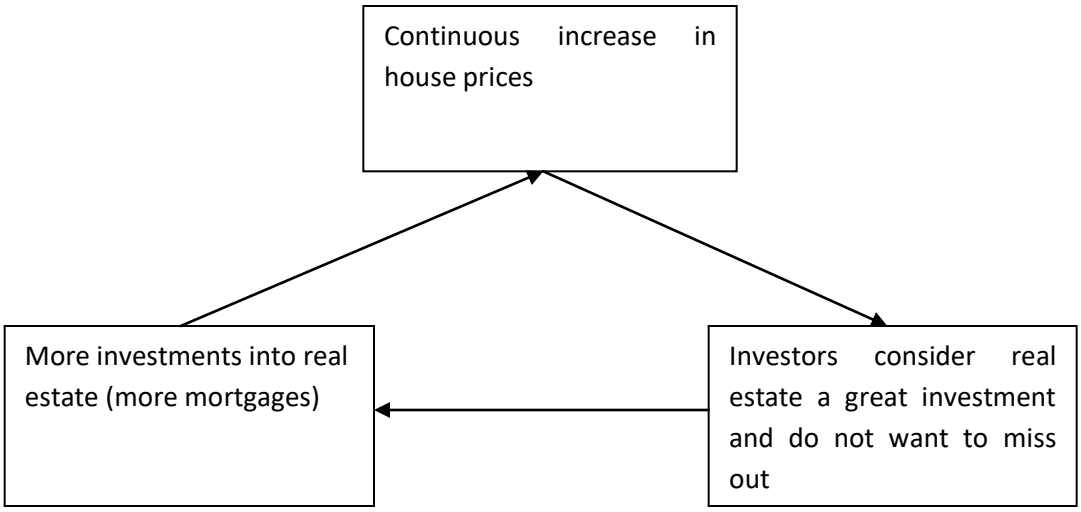
The financial crisis of 2007 – 2009, also known as the Great Recession, is the largest recession of the 21st century and the worst global recession since the Great Depression of the 1930s. The global financial crisis of 2008 is associated with the bubble in the real estate market. In order for the real estate and, more specifically, for the mortgage market bubble to be created, maintained and expanded, there existed a few conditions that helped this bubble to keep growing.

As it happens with every bubble in financial history, whether it is about the housing market bubble of 2007 – 2009, the dotcom bubble of the late 1990s or even the recent "bubble" of the cryptocurrencies market in 2018, increased demand about the respective asset, human sentiment and irrational behavior in general always play an important role. But increased demand and human behavior alone could certainly not be enough to create a bubble that would make the global economy collapse.

Another factor that fueled the creation of the bubble was, to some extent, the pursuit of easy and fast profit. Banks and mortgage originators did not want to miss out on the opportunities available in the lucrative at the time housing market and for this reason they started originating more loans that ever before, even to individuals who lacked the credibility to ever be given such loans. In general, the years that preceded the global financial crisis were characterized by a significant deterioration of the lending requirements. The aforementioned deterioration and the financial creativity of financial institutions (banks and mortgage issuers) regarding the securitization and the selling of several loans along with the lack of due diligence of the credit rating agencies proved to be detrimental for the global financial markets.

As mentioned above, the increased demand in the housing market was the basis for the creation of the bubble. House prices had been fluctuating between 1975 and 1995 mainly because of the high inflation of that period and consequently because of the changes in the interest rates. However after 1995, there was a steady and significant increase in house prices, leading people to become very optimistic about the future of real estate. As a result, the spike in house prices led more and more people wanting to jump into real

estate at that time since house prices were expected to only go up and therefore demand kept increasing, and so did the value of real estate (Wolf, 2018). This irrational human behavior was what created the self reinforcing loop that is observed in bubbles or even in any form of bull market. In essence, an increase in the price of a specific asset leads to even more increases in the future. The following graph shows this phenomenon more clearly.



The pattern mentioned above is a very characteristic pattern for every bull market, no matter how short or long lasting it can be. A great example of that investing behavior was seen during the creation of the dotcom bubble in the late 1990s. Most investors who invested illogically during the period of the early days of the internet were caught up in the thrill of the very promising future the internet would provide. At some point, even stocks of companies without a real product or service would surge only because the management decided to add the ending ".com" after the name of the company. Only last year, there was a short term frenzy with SPACs (Special Purpose Acquisition Companies) which is essentially a new way companies can go public without doing an IPO. For several weeks, SPACs had become very popular as investments of high risk and

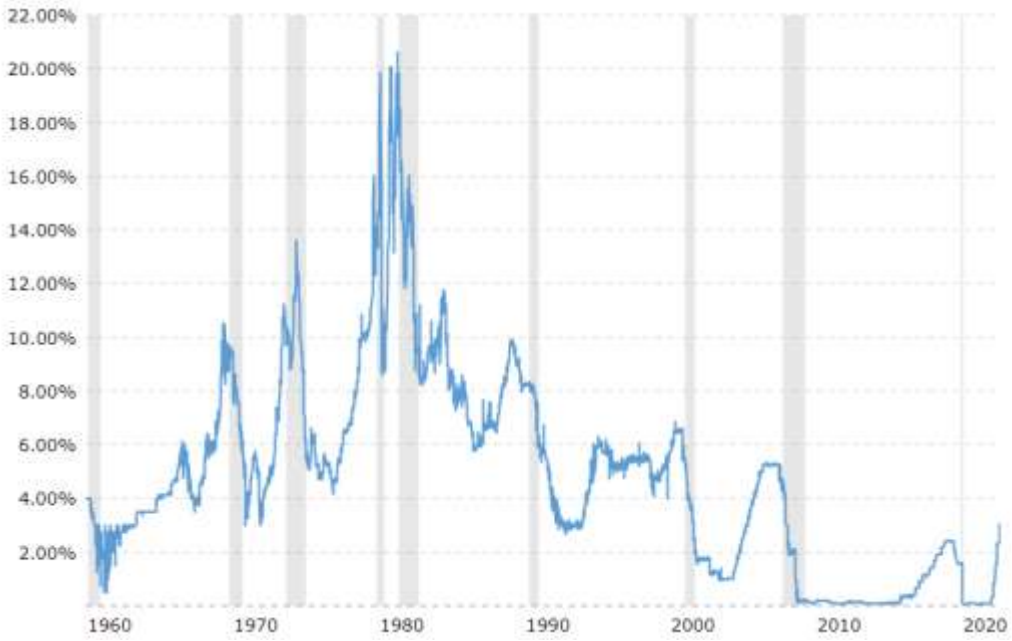
high return, since anytime a company announced a merger with a SPAC in order to go public, then this SPAC would skyrocket. This pattern did not last for very long though and the market regulated itself. SPACs stopped being seen as serious investments, as most of the times investing in these companies was pure speculation.

Going back to the real estate market in the years before the crisis, even though the prices in real estate kept going up, demand did not show any sign of decline. The main reason for that was that along with house prices, household income had been steadily increasing as well. When there is an increase in household income, people can afford to buy more expensive homes or, in other words, can afford larger mortgages. After the last drop in housing prices in the early 1990s, the housing market entered a bull market which lasted for almost 15 years. During that period of the early 1990s until around 2006, house prices increased rapidly, and so did household income. The increase in household income, along with the idea that real estate was considered one of the safest long term investments, was a very good reason for people to start buying more expensive houses, even by increasing their leverage.

At that time, people could afford these more expensive houses and large mortgages since they had realized an increase in their household income. Therefore, the spike in house prices did not seem to alarm investors about the valuations in real estate, but this whole situation was rather viewed as a robust housing market. However, after 2000, household income had started showing a slower rate of increase than house prices did. In essence, even though both house prices and household income had still been increasing, the fact that the former had been increasing at a faster rate than the latter indicated that individuals – in most cases mortgage borrowers – had started acquiring amounts of debt that were beyond the limits of their buying power. In other words, people were starting to, unknowingly, borrow more than they could afford.

Another major factor that had an impact on the demand of real estate at that time was the monetary policy conducted by the Federal Reserve. Interest rates were not close to zero like many other times in history; however they were significantly lower, especially compared with the high inflation decades before the 2000s. Low interest rate policy by

the Federal Reserve is essentially translated into lower mortgage rate charges to home buyers. The graph below shows the interest rates from 1960 until today.



Federal Funds Rate - Source: Macrotrends

The coexistence of continuously increasing house prices, steady increases in the household income and relatively lax monetary policy had created the ground for increased demand in house prices which, along with easy access to large mortgages, played a major role in the creation of the bubble in the housing g market.

Financial Innovations and Deterioration of Lending Standards

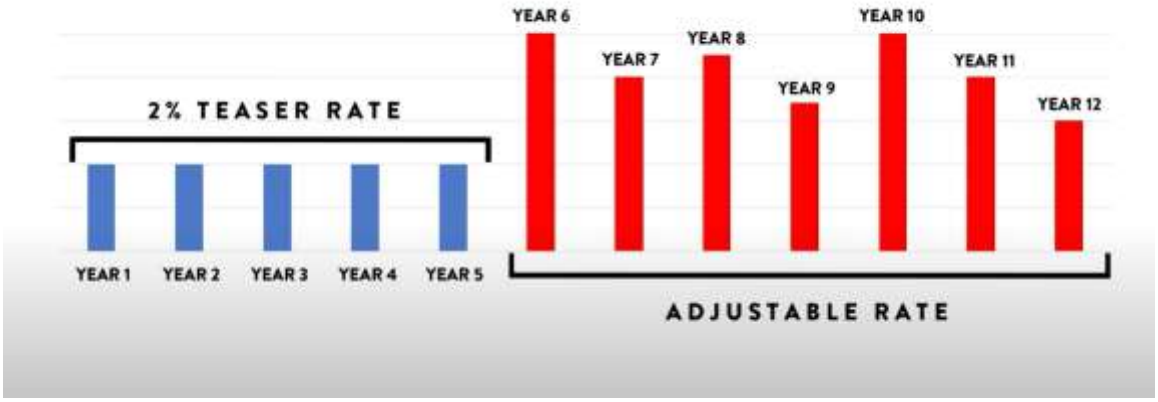
Before the financial crisis of 2007 – 2009, the most recent bubble in history had been that of the dotcom stocks. As it happens in almost all recessions, central banks steadily cut interest rates in order to stimulate the economy. Since the middle of 2000, the Federal Reserve had been reducing rates and after 2001 the economy had started recovering.

This recovery was also noticed in the housing market, where lending had started growing again, albeit at a slow rate. The majority of mortgages at that time were conforming mortgages. In other words, these were mortgages whose borrowers met all the requirements to be given loans. In essence, they were individuals with adequate income and assets to be considered creditworthy. Therefore, these mortgages did not incur a high risk of default. For as long as mortgages were given to individuals with a good credit score, mortgages were considered a good investment, and since the housing market was booming investors saw an opportunity they could take advantage of. Houses had been rising in value and more and more investors did not want to miss out on the opportunity of purchasing assets whose value would keep appreciating.

At this point, it is important to mention that the most popular characteristic of the American dream has always been the ability of people to own their own house, and that was the idea that kept demand for mortgages high. In the same way that individuals wanted to grasp the opportunity of getting a cheap mortgage (because of the favorable interest rate environment), mortgage originators felt the need to create more mortgages and make a profit as well.

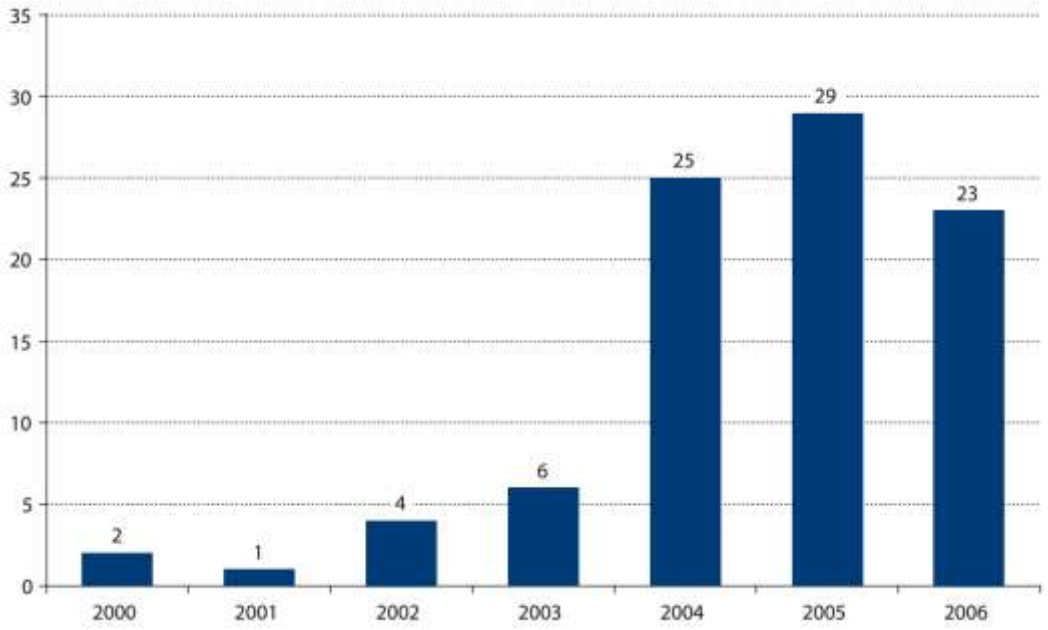
However, after some years of massive mortgage originations, a problem arose. The problem was that there were not enough borrowers who met the requirements of a prime mortgage, meaning that most creditworthy people had already been given loans. Of course, mortgage originators desired to keep creating mortgages. This was when financial innovations started appearing in the mortgage market in order to tackle this problem. The new target for mortgage originators were subprime borrowers, in other words, people who lacked the necessary income or assets to be get mortgages in the first place.

The biggest financial innovation that mortgage lenders came up with was the Adjustable Interest Rate Mortgages or Teaser Rate Mortgages. The main characteristic of this loan was that it had a very low fixed interest payment during the first years (Authers, 2018). In this way, families and individuals of lower income would be able to repay their mortgage at least for the first few years of the fixed rate. After some years, the interest would stop being fixed and would be adjusted to a higher number. This whole idea of adjustable rate mortgages was based on the speculation that house prices would keep increasing, and that after some years of low interest rates, the holders of these mortgages would be able to refinance their debt with a second or even a third mortgage of more favorable terms (Fergusson, 2008). That would be possible because the expected appreciation of their asset would make them more credit worthy borrowers. The graph bellow is a simple illustration of the change in the interest rate of an adjustable rate mortgage.



A good example of this irresponsible behavior of mortgage lenders was the interest only adjustable rate mortgages, which were loans that required that the borrower only pay interest for a fixed period of time. The borrower did not have the obligation to be paying any principal owned, leading to an increase in home prices as more people were able to

afford houses thanks to this financial trick. But perhaps the climax of the lack of logic in mortgage originations was the Interest Only Negatively Amortizing Adjustable Rate Mortgage. The characteristic of this loan was that the borrower did not need to submit any monthly payments for a specific period. The monthly payments would simply be added to the principal of the loan and the outstanding principal would just keep increasing. The following chart shows the percentage of mortgages of this type in the years before the crisis.



Subprime Mortgages – Credit Suisse

This type of loan was mostly given to people who had no income or assets. It was an easy way for them to get access to credit since there was no need for down payment or, in fact, any payment at all for some years. Even though it was obvious that excessive lending could not have a fortunate ending, there are mainly two reasons that this situation actually happened. The first is that mortgage originators did not have any incentive to do their due diligence about the quality of the loans they originated. In fact, they helped mortgage buyers "lie" in the mortgage application process about their income, employment

situation or assets. These subprime mortgages were also called NINJA loans (No Job No income No Assets) or "liar's loans". The goal of the originators was to simply issue these loans, get paid a commission and then sell the loans to Wall Street at a profit and pass the risk to whomever bought that loan (Fergusson, 2008). The securitization process of these mortgages played a crucial role in their selling as will be mentioned later. The second reason was that people who took these loans usually lacked financial education and most of the times could not comprehend the terms of the debt they acquired or their potential future financial situation.

The massive origination of these "bad loans" increased at a very fast rate during the years that preceded the crisis. Until 2003, 85 percent of mortgages were high quality ones but the share of these mortgages as a percentage of the entire mortgage market kept becoming lower. In 2006 roughly 50 percent of mortgages were subprime. Most of the subprime mortgages issued during that period had teaser rates until 2007. When the teaser period expired, most home owners who had bought their houses with these mortgages would be unable to pay the adjusted interest payments and they would default on their loans, leading eventually to the start of the decline of house prices. The graph below depicts the median sales price for houses in the USA.

Securitization in the housing market

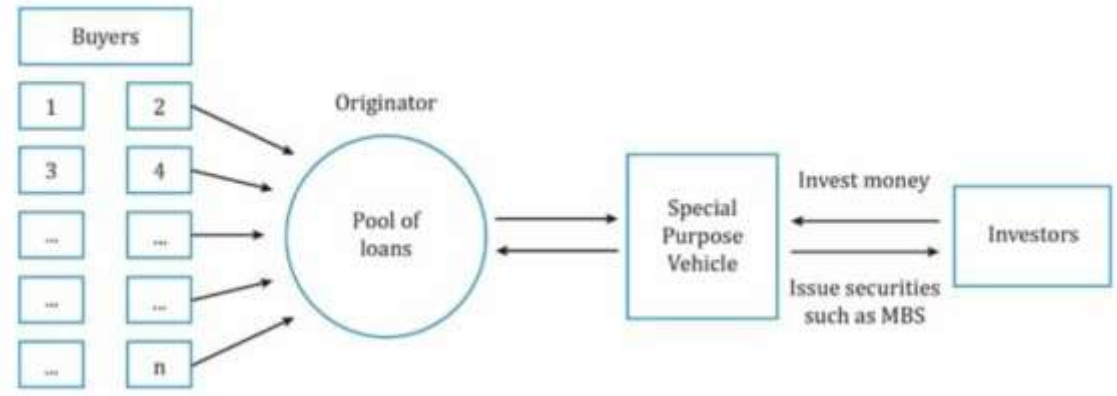
As lending standards had deteriorated, regional banks and mortgage originators had been issuing mortgages to all sorts of borrowers, from the most creditworthy to those who only managed to get loans using the financial innovations mentioned above. The financial institutions that had been issuing the mortgages had then created steady streams of cash flows for the next years. As a result, banks would have to keep the mortgages or, or any other type of loan (credit card debt, student, debt, auto loans etc.) on their books for the entire duration of the loan. The problem with this practice was that the typical mortgage duration was around 30 years. This asset was very illiquid, meaning that they would have to wait 30 years to receive the total payments of the loan. Therefore, mortgage originators were choosing to sell the mortgages and not keep them on their books. Another reason that they chose to sell the mortgages to third parties was that it was a way to free up some capital. In other words, mortgage originators needed money instantly in order to originate more loans.

The two companies that were buying mortgages to keep them on their balance sheets were the Government Sponsored Agencies, Fannie Mae and Freddie Mac. In the years before the crisis, these companies had received pressure from the US government to buy more loans in order to justify the implicit government guarantee they had (Commission, n.d.). Apart from Fannie and Freddie, big investment banks were buying mortgages originated by banks and mortgage originators. These mortgages were considered safe as they generated a stream of cash flows and, even in the case of default, the collateral was houses whose value was on the rise. Like regional banks, investment banks wanted to jump in the mortgage market and start making a fast profit by selling these mortgages.

Mortgage Backed Securities

The way investment banks started selling these mortgages was through a securitization process that allowed them to bring into the market mortgages of lower quality while distributing the risk. More specifically, investment banks collected thousands of mortgages they had bought form regional banks and other mortgage originators and

transferred them into a “Special Purpose Entity” or “Special Purpose Vehicle”. Special Purpose Entities were companies created by investment banks with the sole purpose of holding the mortgages mentioned above. The banks then would sell “stocks” of these companies to the market. These “stocks”, which were the securities created by the gathering of thousands of mortgages are called mortgage backed securities. A mortgage backed security is essentially a type of derivative with the underlying asset being a mortgage, or more specifically, a pool of thousands mortgages. In this way investment banks transformed a non tradable asset – a mortgage – to a tradable security. The process of creating mortgage backed securities is shown in the picture below.



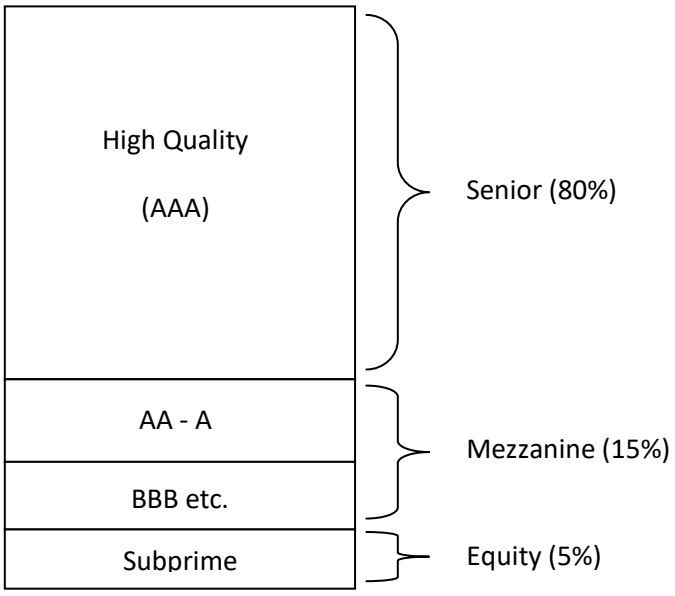
Source - IFT 1

Collateralized Debt Obligations

A Collateralized Debt Obligation (CDO) is a type of asset backed security and is created with the purpose of re-distributing the risk of fixed income securities. In the financial crisis of 2008, CDOs were the means for mortgage bonds to be sold in the markets. These mortgage bonds were created by placing thousands of mortgages in a pool. These mortgages were of different qualities and even though every mortgage had a specific risk,

it was very difficult for the whole pool of mortgage backed securities to be evaluated and rated (Sorkin, 2010). This meant that there was a huge limitation on who could buy these mortgage bonds. Institutional investors like insurance companies, pension funds of sovereign funds could not legally invest in these bonds, as they were allowed to only invest in securities that have a rating assigned by a credit rating agency.

Investment banks collected the mortgages along with other assets such as auto loans and credit card loans and grouped them together in different classes or categories according to their risk. These classes are called tranches and each tranche carries a different level of risk. Unlike mortgage backed securities, each tranche was much easier to be evaluated as it contained loans and other assets of similar quality. The best quality tranche is called "senior" tranche, the second best is the "mezzanine" tranche and the last one is the "equity" tranche which is the riskiest of all types (Janet L. Kaminski Leduc, 2008). The following picture represents the structure of a CDO.



Every time there is a payment, the holders of the senior tranches of the CDOs are those to be paid first, however they receive the lowest interest. Mezzanine tranches are paid next and the equity tranches are paid last, receiving the higher interest as they incur the highest risk. The safety of a tranche, in essence the level of its risk, is highly dependent on the degree of subordination. The subordination of a tranche is measured by the percentage of the CDO that is covered by tranches of lower quality. For example, in the CDO of the picture above, if less than 5 percent of the payments default, then the mezzanine tranche will not bear any losses and if more than 20 percent default, then even the holders of senior tranches will lose money.

In general, securitization and CDOs have several benefits. Firstly, by selling CDOs, investment banks could pass the risk of the mortgages to investors while at the same time make profit from the sale of CDOs. Secondly, selling CDOs is a way for sellers to stop having their liquidity tied up until maturity and last, investment banks can use the capital from the sale of CDOs and create more securities increasing their leverage. CDOs had been the source of immense profits during the years that preceded the crisis as it was a way for banks to increase their leverage; and when the economy is growing, the use of leverage can magnify the expected returns. However, once real estate prices stopped increasing and the assets that backed the CDOs lost their value, most CDO investors took heavy losses. The biggest losses were incurred by overleveraged financial institutions that started fire-selling these assets – that after some point had very small value - in order to get them off their balance sheets (Cassidy, 2018). One miscalculation of the banks was that they did not predict that the bubble in the mortgage market would affect the payments of other kinds of debt, like auto loans, credit card loans or anything else that the CDOs included. Therefore, in the case of CDOs, diversification did not make them any less risky.

Credit Default Swaps

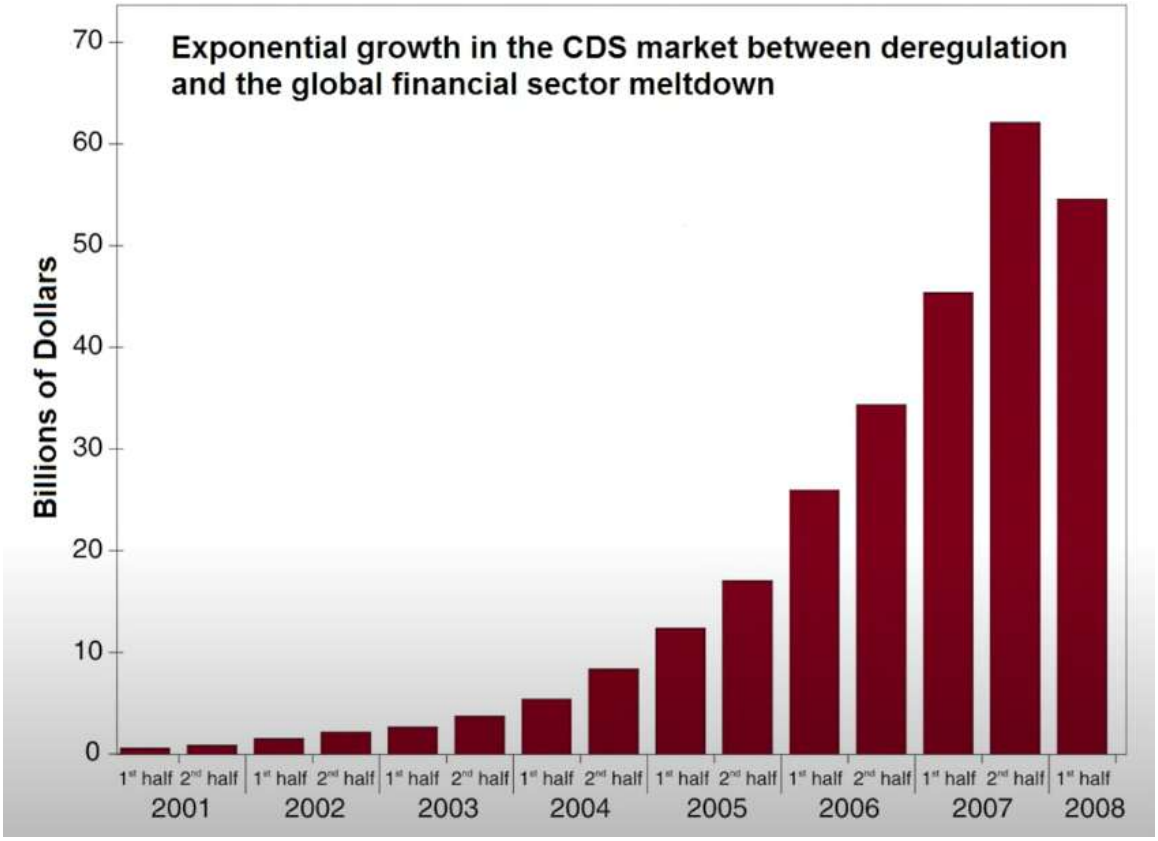
The last major product of securitization in the bond markets is a Credit Default Swap. The Credit Default Swap is a derivative that provides insurance against a fixed income

security. The first derivative of this type was created in the 1970 by insurance companies that provided insurance against municipal bonds. The parties involved in the sale of a credit default swap are the issuer of the loan, the buyer of the loan and the seller of the CDS. The long maturity dates of most mortgages make the issuer's ability to pay back the loan plus the interest relatively hard to predict. The buyer of the mortgage can choose to buy a credit default swap from a third party in order to control the losses in case of a default. The seller of the CDS receives premiums regularly from the buyer of the CDS with the promise to cover all the losses from a potential default. CDS are very important because they provide fixed income investors with safety in case of default and at the same time can be highly profitable for CDS sellers, given that a default doesn't occur.

In the early 2000s as the housing market was growing and investment banks were becoming highly leveraged from investing in MBS and CDOs, the selling of credit default swaps was just another way to make a bet on that side of the trade, the "long" side of the housing market. Even though the purpose of a CDS is to provide insurance to fixed income investors, it is still a financial product available in the open market and in the years before the crisis it was widely traded as speculation. CDS trades were taking place in OTC markets so there was no supervision by a regulatory body. This meant that nobody had information regarding the details of a specific trade – the premium payments or the quality of the bond each CDS insured – or the total amount of CDS a seller has sold. Moreover, the selling of these instruments did not require that the sellers disclose their assets; therefore the ability of a CDS seller to cover the payments of a bond in default was completely unknown (Alloway, 2015).

CDS sellers had realized immense profits before the crisis as they received the premiums from the CDS buyers and mortgage bonds had not defaulted on a massive scale. In fact, the market value of all CDS issued had reached a peak value of slightly more than 60 trillion in the second half of 2008. The American Investment Group, one of the most leveraged institutions of that period, had insured more than half a trillion dollars worth of subprime mortgage bonds before the market meltdown. Investment companies that wanted to get exposed to the mortgage market could do it very easily with CDS because this type of instrument could give them rights to the premiums paid by investors without

any capital requirement (Marcus, 2018). The chart below depicts the size of the CDS market from 2001 to 2008.

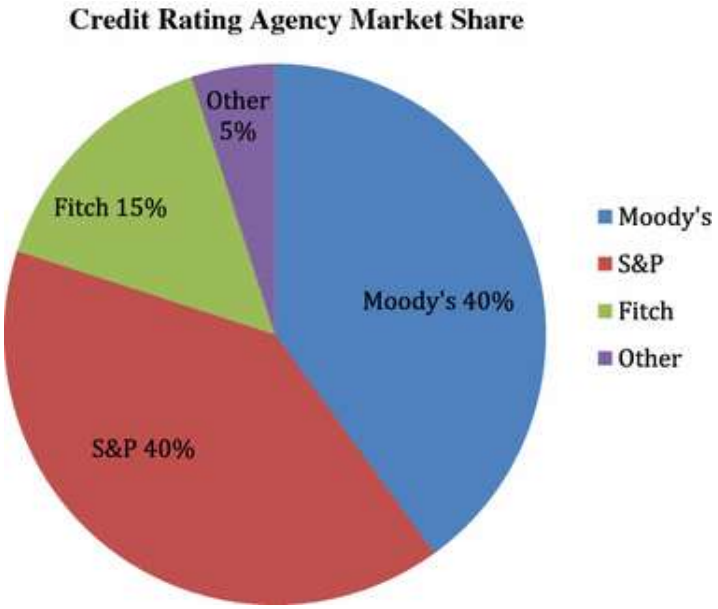


CDS market size - Bloomberg

Inevitably, when home prices started dropping and defaults occurred in a nationwide scale, overleveraged institutions had major solvency problems as they had the obligation to cover the losses of securities they did not even own, and these losses were much larger than they could afford. The effect to CDS buyers was in some cases as detrimental to CDS sellers, since the overleveraged financial institutions could not afford to cover the losses of mortgage bonds. In some way, the insurance the credit default swaps provided was relatively illusionary.

The role of the credit rating agencies in the financial crisis

By the end of 2000 the three major credit rating agencies were Standard and Poor's, Moody's and Fitch. Other credit rating agencies existed as well but these three were certainly the most established ones, forming 95 percent of the bond rating market (Maxfield, 2017). Any institution (government or corporate institution) that issued bonds would have to refer to one of the three big names in order to receive information about the quality of the debt they issued. In the early 2000s, the amount of financial instruments based on subprime mortgages i.e. mortgages that had a very high chance of default, had started growing at a very fast rate, and this growth was fueling the creation of the bubble in the housing market of the United States.



The decisions and actions of credit rating agencies during the early 2000s played a crucial role in the performance of mortgage bonds. The sale of the bonds comprising to a high

degree of subprime loans was highly affected by the credit ratings those speculative securities received. In other words, the deliberately favorable credit ratings contributed to the massive sale of the mortgage backed securities and the rapid increase of house prices. This rapid rise of prices in the housing market continued from the 2000 until almost the end of 2006, when it peaked. After that time, the housing prices started falling and so did the demand of mortgage backed securities. Consequently, this decline in housing prices caused a spike in the default rate of mortgage bonds, bonds that were rated as "investment grade" even until some weeks before their default. It was then obvious, that rating agencies were all but objective or legitimate in the ratings they gave to many of these securities.

In order to understand how the credit rating agencies had obtained the freedom to operate in this way, it is important to mention several historical facts that resulted in rating agencies being so powerful. In the very beginning, rating agencies would sell their services (their opinions about the quality of the debt issued by different institutions) directly to investors. Investors did not have the obligation to buy this information and were free to do their own research and due diligence about their bond investments. They could even consult any other source they considered reliable before purchasing any fixed income securities.

However, in 1930 some major changes happened in the regulations regarding the securities in which banks could invest in. Bank regulators did not allow banks to invest in risky, speculative bonds. Banks were not allowed to hold in their portfolios any bonds that – in today's terms – had a below "investment grade" rating. The best way to ensure that was to oblige bond investors (banks, pension funds, insurance companies etc.) to invest only based on the information provided by the major credit rating agencies. Any other type of research on the creditworthiness of debt obligations would simply not be acceptable. At that point rating agencies had become the center of the bond market as every investment decision made by bond investors depended on a rating provided mainly by the three major credit rating agencies. After rating agencies had become so powerful, bond issuers stopped being concerned about their estimations regarding the risk their

bonds carried and were instead solely concerned about how rating agencies evaluated their debt.

There was one specific event in the history of the credit ratings agencies that proved to have a detrimental effect for the global economy and to some extend contributed to the financial crisis in 2008. This event was the change in the business model of the rating agencies. Normally investors who wanted to be informed about the risk of potential future investments would pay the rating agencies to receive information.

This business model changed at the end of 1970. Financial institutions or any investor who was interested in investing in fixed income securities would no longer have to pay to be provided with information about the risk of the loan. Instead, any issuer of debt (bond issuers) would have to refer to the credit rating agencies and ask for an evaluation of the risk their bonds carried. In essence the bond issuers were now expected to pay the major credit rating agencies in order to have their creditworthiness evaluated.

One possible explanation for this transition in the "who pays whom" procedure is the bankruptcy of several major corporations in the 1970, corporations whose bankruptcy was relatively unexpected. Debt issuers had suddenly become more concerned about the risk their bonds carried, and wanted to make sure that financial institutions were not reluctant to invest in their securities. So, the idea of issuers paying rating agencies for evaluating their bonds – even more favorably sometimes- was viewed as a great opportunity for inflated credit ratings (better credit ratings than what the bonds deserved).

During the crisis, there were several times when it was noticed by investors and regulators that credit rating agencies had maintained high bond ratings (in many cases investment-grade ratings) in companies that eventually declared bankruptcy. A very common example is the case on Enron, an American energy company. The debt issued by Enron had continued to be given investment-grade ratings by the major rating agencies even some days before the company filed for bankruptcy in 2001. To some extent, credit rating agencies had received pressure from investors to maintain a high rating at the company's bonds that could potentially benefit them financially (the possible acquisition of Enron by Dynegy would benefit holders of Enron's securities). However, once many

scandals regarding the financial situation of Enron became public, credit rating agencies downgraded the bonds of Enron to junk-bond level. It was only five days later, on December 2 1001, that the company filed for bankruptcy (Maxfield, 2017).

Lehman Brothers

Another major event, perhaps one of the most important reference points of the global financial crisis, is the bankruptcy of Lehman Brothers in 2008. Lehman Brothers was one of the biggest US investment banks and had become a very strong player in the market of subprime mortgages. From the start of the boom in the housing market in the beginning of 2000, Lehman Brothers had acquired some companies that specialized in mortgage origination in order to expand its business in the area of mortgage backed securities. The sale of these securities had been highly profitable and had a very positive impact in the bottom line of Lehman Brothers, which by 2006 was issuing more than 50 billion dollars in mortgage backed securities every month (Warwick J McKibbin, 2 0 0 9).

This process of massive origination of subprime loans had led Lehman Brothers to become one of the most highly leveraged firms, perhaps along with AIG, which by 2004

had bought more than 50 billion in triple-B-rated subprime mortgage bonds by selling insurance against their default (Lewis, 2011). Before the start of the stock market meltdown in 2007, Lehman Brothers was leveraged to an extent of 31 to 1 in leverage ratio. In essence, total assets of the bank were 31 times the equity of the owners, indicating the degree of exposure to the highly speculative market of subprime loans the company had at that time.

During the turmoil in 2008, especially in the third quarter of that year, Lehman Brothers' and other executives were desperately seeking liquidity in order to save the company and referred to investment companies with enough cash in hand like Berkshire Hathaway as well as the US government. But the US government made clear that there was no plan for a Lehman Brothers bailout. On September 15 2008, Lehman Brothers filed for bankruptcy, holding more than 600 billion dollars in assets, making it the biggest bankruptcy in the history of capitalism yet (Lynch, 2000).

A very alarming event in the Lehman Brothers debacle was the fact that credit rating agencies had maintained their investment-grade score in the bonds of the company and changed it only at the very morning of the 15th of September of 2008 – in essence the same day that the company collapsed. These facts regarding the judgments of credit rating agencies raise the question of whether the latter can really provide investors with valuable information and whether they can be trusted in the first place.

Regarding the "trust" part, credit rating agencies mention in their annual reports that for a large period of time, since their creation, they have provided investors with very accurate information about the debt securities they evaluate. The basis of this statement is that, historically, the rate of default of bonds that have received a low rating is eventually significantly greater than that of securities rated as investment-grade. However, when the market crashed in 2008, the fact that most of the mortgage backed securities that were the root of this crisis had been very favorably rated caused credit rating agencies losing the respect and trust of investors and of the public in general. At that time, credit rating agencies emphasized on the fact that credit ratings are merely opinions, and by no means should these opinions be taken as precise measurements. What these opinions represented was just the agencies' best guess at a rank ordering of risk (Lewis, 2011).

There can be several possible reasons for the inaccuracy in many ratings provided by the rating agencies as well as for the slow reflexes of the agencies when it came to downgrading several companies that had s poor financial condition. First of all, when credit rating agencies reevaluate the rating of a debt security – either when they upgrade or downgrade it – there is a particular reaction in the markets. The reason for this is that bondholders whose securities are reevaluated have to assess the risk of their portfolio again, which can be time consuming and costly. Bond issuers on the other hand do not like the idea that this portfolio re-assessment of bond investors might result in selling some of their bonds. Therefore, credit rating agencies often receive pressure from bond issuers in order to be more lenient and slow in the process of downgrading bonds. Clearly, the "issuer pays" model of rating agencies certainly gives bond issuers leverage in this situation.

Furthermore, during the years that preceded the financial crisis, credit rating agencies were increasingly given the task of evaluating mortgage backed securities, which are financial products of much greater complexity than the ones they had been evaluating for all the previous years – most of them being corporate and government bonds. Therefore, even though normally the agencies would receive pressure from issuers in order to give their bonds a good rating, which would contribute in the bonds' selling, many times agencies would provide investors with wrong evaluations, not deliberately, but simply because they lacked experience in evaluating such vague and complex securities. Additionally, many times that a mortgage backed security did not meet the requirements necessary for the investment-grade ratings, the agencies would act as advisors as to which mortgages should be packaged in order to make the whole pool of mortgages i.e. the mortgage backed security diversified in such a way that could be deemed appropriate for the good rating the issuers were seeking. The fact that eventually rating agencies rated the same securities they created was another reason for the lack of objectivity in the credit ratings.

Conclusion

The financial crisis of 2007 – 2009, which caused lending between banks and other institutions to stop, was in large a crisis of transparency and trust. There was a general lack of confidence in the ability of any party of a transaction to provide true information regarding their financial situation. Therefore every institution was reluctant to lend to another as it did not have solid information to assess the risk of default.

Moral hazard played a very important role in the financial crisis. Even though this is a term that started from the insurance industry, it generally refers to a situation where a person or institution does not have to suffer the consequences of a risky activity it engages in. For example, the deterioration of lending standards by mortgage originators gave them the opportunity to originate more loans and receives more fees. They then sold the loans to investment banks which in turn securitized these loans into mortgage backed securities that would be sold to investors. This risky activity where one party passes on the risk to another creates a moral hazard.

Asymmetric information was another major reason for the lack of transparency in the credit markets at that time. Mortgage originators were aware that many of the mortgages were ill fated and destined to lead individuals to default on their loans. At the same time, people getting those mortgages did not understand the terms of these loans and could not imagine that they would get financially destroyed. Credit rating agencies understood that many of the bonds they rated as AAA were of much lower quality but continued inflating the ratings as they received pressure from bond issuers. Meanwhile, most investors relied completely on the judgment of rating agencies, only to find out that they themselves were the ultimate holders of some very bad debt.

The question is could the fueling of this bubble have been stopped at any point? Tighter monetary policy could have been one way to decelerate the creation of the bubble in the mortgage market, however without any certain outcomes in the long run. More supervision of the rating agencies and mortgage originators as well as more regulation over the lending standards would have certainly prevented the creation of many of the securities that destroyed the housing market in 2008.

Increased regulation should definitely not be desired, as it limits competition and is a hindrance to free markets and liberal economies. However, regulations and monetary policy that aims at ensuring efficiency in the financial markets and at avoiding systemic crises and recessions is necessary.

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