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THE HOLDING OF PUBLIC BONDS BY BANKS: EMPIRICAL EVIDENCES FROM THE RECENT FINANCIAL CRISIS

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The holding of public bonds by banks:

Empirical evidences from the recent financial crisis

Alberto Talpo

Abstract

The aim of the thesis is to study the determinants which led banks to purchase more public bonds immediately after the Global Financial Crisis occurred.
I have analyzed bank public bondholdings of ten states over 2002-2014. Banks held more public bonds in the wake of the Global Financial crisis, increasing the holding by 2.071 percentage points on average. Stylized factors which driven the propensity to retain a higher quantity of public debt were private sector leverage, yields, and the amount of bonds outstanding. The issuance of such debt mitigated when the 2008 crisis started whose effects were reflected further in the economic-financial situation of countries.
The thesis is an aid for future researches on public bondholdings and banks relation.

Introduction

The thesis calls into question why banks exhibited an inclination to acquire and then hold a consistent share of public bonds afterward the borne of the recent financial crisis. In this context, the elaborate takes a new look at the connection between the calamity started in the U.S.A. at the end of 2007 and financial institutions. A dataset has been developed which combines diverse resources on a quarterly basis for ten states, that is the epicenter of the financial crisis, the UK, the worst-performing Euro Area countries, the Netherlands, France, and Germany. The time framework covers the beginning of the economic boom until the aftermath of the turmoil mitigation, i.e., from 2002 to 2014.
Throughout the thesis I use the terms "i.e." and "e.g." refer to Latin expressions *id est*, which means *that is*, and *exempli gratia*, which denotes *for instance*.

The research is organized as follows.

Chapter 1 gives a brief overview of financial markets, defining what is security, and the generic classes in which financial instruments can be collected. Elton et al. (2013) provide a synthetic scheme to delineate how traders can negotiate in trading venues, directly with the construction of portfolios or indirectly acquiring quotas of mutual funds. We concentrate on the former way as banks hold sovereign bonds buying them into secondary financial markets. Thus, the fundamental distinction between assets falls on the maturity date. Moving along this line, *Money Market Instruments* represent debt securities which have got the shortest expiration sets to one year. In contrast, *Capital Markets Instruments* are characterized by a long-term maturity, or they do not exhibit a reference date to cease to exist. The final macro category of the financial environment is posed by *Derivative Instruments*, linked to other assets, financial or not, because prices and payoffs are affected by performances of the so-called *underlying*.
A full space is given to *bonds*, being the core of the analysis. Their peculiarities are extensively explained, ranging from the identity of the issuer to included provisions. Then, typical traders who negotiate debt instruments are placed in four macro categories, together with the distinction of bonds according to two criteria: the former one the kind of coupon rates or the presence of embedded options, the second one the nature of the debtor, where public bonds are elucidated. Finally, risks to trade such securities are clarified because traders could not detect potential risks of purchasing securities even if considered *risk-free*.

The second chapter examines the *Global Financial Crisis* as it shocked the international financial markets making them even more volatile and risky. A little example opens the chapter delivering a generalized idea of why trading venues are so uncertain. Once the concept has been expounded, the *Great Recession* is tackled due to its relevance for the spread of a banking crash around the world. Albeit recession connotes every epoch, it usually manifests itself by means of inflation with a duration equal to six months as Keeley and Love (2010) underline. However, restore interbank markets requires a long time, the effects of such a calamity were huge. Congdon (2015) states that the disaster began in the fourth quarter of 2007, caused by a bubble in real estate. The factors which contributed to the rapid expansion of the recession date back to the *economic boom*, an expansive period the U.S.A. lived after the ".dom bubble", namely at the beginning of 2002 up to the borne of the crisis. They were the slump in interest rates due to the FED policy to favor people to obtain easily loans where the only collateral was the immovable property, "yen carry trade" which made Japan invest in a relevant bulk of U.S. sovereign bonds, blended with oil prices shock and the high demand for Chinese goods.
All these entailed the *subprime meltdown* which stopped real estate, and banks were plunged into a tough situation since their business activities exacerbated a lot. There is still considerable ambiguity with regard to the proper cause which favored the banking sector deterioration. Congdon (2014) compares two theories, the *Mainstream approach* and the *Monetary Interpretation*. The main difference between them lies on who must be condemned: the classical view points the finger at commercial and investment banks due to their irresponsibility to prevent insolvency; while the less famous insight claims illiquidity to be the seed of the negative growth. A key problem about the former theory is that there are no strong empirical evidences which support it. An alternative consideration of the U.S. turmoil is provided by Piketty (2014) who argue that inequality turns out to be the real cause. A serious limitation with this argument, however, is that inequality can last for many years, it does not reveal vicious cycles as negative growths hold generally, but especially there is no correlation with the Great Recession.
Signals that the worldwide crisis sent were unemployment jump, GDP plunge, and flight-to-quality. Solutions to mitigate them invoked interest rate reductions, quantitative easing, and financial sector protections as Verick and Islam (2010) evidence principally.

The *Eurozone Crisis* came from the U.S. recession. The traditional thought about its development is attributed to *Sovereign Default risk*. Many researchers contend, on the other hand, that this evidence is not exhaustive. Many studies have been published on the right cause of the Euro Area financial crisis. Lane R. (2012) reaches the conclusion that the euro design is the root of the sovereign debt plague. Storm and Naastepad (2016) lists several reasons for the disagreement with respect to such a common idea. The jump of private sector indebtedness is the fundamental of our breakdown. Authors' theory is fully endorsed by data. Pereira B. and Rossi (2015) focus on the balance of payment imbalances,

arriving to formulate the concept of a foreign exchange crisis due to real exchange rates mismatching and bank bailouts. Engel (2016) claims that the crisis is an intrinsic characteristic of markets, he distinguishes normality from the turmoil via herd and isomorphic behavior definitions which in turn are tied. The crisis is necessary to trade in not-turbulent marketplaces.
Naturally, the outcomes of the crisis were public deficit surge, an exaggerated use of fiscal austerity, bailout became very common, unemployment soaring, and balance of payment deterioration.
To halt the wave of negative consequences, Pereira B. and Rossi (2015) solution is the return to separate currencies, which might increase the competitiveness of the poorest EU countries, but the long-run costs would avoid its implementation. Frédéric Lordon has proposed a common currency attached to national currencies, with the European Central Bank a sort of intermediary; Eurobonds adoption to prevent speculation, or a stronger Euro fiscal union to avoid national output movements as outlined by Lane (2012).

Chapter 3 investigates the question of why banks bought a consistent amount of public bonds over the 2008 crisis. The investment in this type of obligations augmented by 2.071 percentage points on average, with a peak of 7.465 percentage points in the UK.
Few academics have addressed the problem of the attitude those institutions kept towards debt instruments whose prices touched the minimum levels during that time. Gennaioli et al. (July 2014) have uncovered the relationship which links sovereign default, government bonds, and banks, including some episodes of a banking crisis in the sample from 1998 to 2012. This thesis is a preliminary attempt to demonstrate drivers of banks bondholding in empirical terms after Lehman Brother's default. To determine the holding of treasury bonds, fixed effects panel data models have been utilized being able to capture all the variability inside each nation which constitutes the dataset I have constructed. The most striking result to emerge from the data is that private credit-to-GDP ratio, bonds outstanding, yields, and the financial crisis supply a positive benefit to the escalation of monetary financial institutions public bondholding. Sovereign default makes banks less prone to acquire the securities (only Greek episode is incorporated in the sample), above all when both time and country effects are controlled. On the other hand, governments declined the issuance of public debt when the downturn initiated or they decided to strengthen interest rates.

The fourth chapter delineates theoretical solutions to overtake the disaster. Bank et al. (2011) create a reliable financial instrument, denominated *Performance-sensitive government bond* which awards policymakers when they emend measures to lock deficit upturn since agents will ask for lower nominal rates. Difficulties to put in place the project in reality may surround insufficient secondary markets, arbitrage and speculation chances after the issuance, or decision lag given that politicians do not recognize economic shocks immediately.

The second framework passes to Game theory where Carfì and Musolino (2012) have set up an interesting game where a large speculative bank, a central bank, and a distressed government are the players. The goal of authors is to find out a tool to neutralize gains from speculation within sovereign bond markets altogether; this latter increased fast right away the banking ”freezing”. They have discovered a tax which vanishes short-selling that the bank can exploit to obtain massive profits. The starting point is to ignore such a tax, with the consequence that the second and the third gamers will opt for purchasing the largest quantity of bonds available, the speculator for its account, the central authority to curb yields upsurge which damages ulteriorly the government. When the ”medicine” is in action, the Nash equilibria switches, the large financial institution goes out to the market, whereas Mario Draghi buys public bonds to bail out the close to the default state.

I have developed a model that has the target to pinpoint the optimal threshold which makes the central bank enact *Quantitative easing* program. Stochastic dynamic programming has been crucial for all stages of the pattern whose basic version not inspect uncertainty driven by the banking crisis outbreak; the more sophisticated variant envisages the control of such doldrums though a Poisson jump process placed within the stochastic process of public bond prices.

Chapter 1

Bonds and Characteristics

1.1 Financial Markets Overview

The financial world has increasingly become important during the last hundred of years.
A key factor in the rapid expansion of that world is played by High-Frequency Trading (HFT) which contributed (and it still doing so) to transact a large number of orders at fast speeds, exploiting powerful computers, sophisticated algorithms, and getting involved high turnover capital. HFT was the primary cause of Flash Crash on May 6, 2010, in U.S. stock exchanges where a large fundamental mutual fund firm placed an execution of a sell order whose size was equal to 75.000 E-MINI S&P 500 derivative contracts, taking into account trading volume only (execution rate set to 9%). Down Jones Index went down to 4%-5% in few minutes because of that algorithm trading technique. Such an order jeopardized both E-Mini and stock markets due to the borne of two liquidity crises as the Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC) reported (there is a strict relationship between E-MINI and stock markets).

Financial instruments are used for a lot of purposes when traders negotiate into markets. Harris (2003) mentions that usages include asset exchanging, speculation, hedging, moving wealth from a point to another point of time, or simply for entertainment.
Therefore, traders can negotiate securities in every financial market. *Security* is defined as *a legal contract representing the right to receive future benefits under a stated set of conditions*. (Elton et al. 2013)
Financial instruments cannot be classified with a unique method. Figure 1.1 proposes a useful and representative scheme to understand the main classes of assets bought or sold in markets.

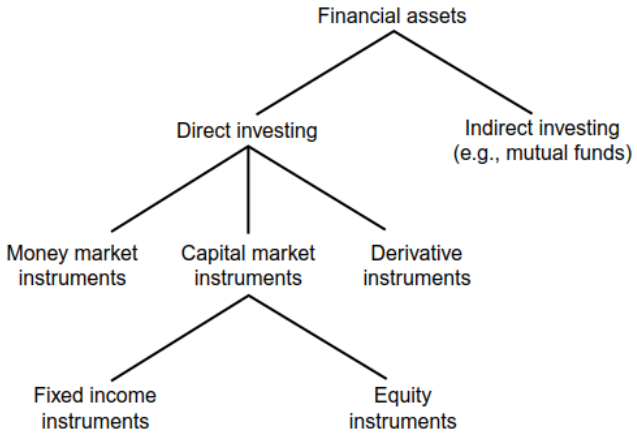


Figure 1.1: Classification of Financial Instruments.
Source: Elton et al. (2013)

Thus, an agent can negotiate either via direct or indirect investing. The former one comprises assets which broadly represent a type of contract on a private or government entity. The second one regards a financial intermediary (e.g., mutual, pension, or hedge fund) putting together a host of securities acquired through direct investments and then selling their parts to financial institutions which are used to holding them in the portfolio.
The direct investing can be classified beside the life that investors expect instruments will have. *Money market instruments* are the assets whose maturity is less than one year. In addition, they are identifiable depending on the nature of issuer (public or private).
Capital market instruments own maturity higher than a year. They are categorized into two main classes, that is *Fixed Income instruments* and *Equity instruments*, where the first ones can also be distinguished according to the issuer as for the money market securities.
Derivative instruments are the last category to be considered. Their payoffs and prices are estimated by the value of an asset called underlying.

The way to trade in an indirect way falls outside the scope of this section. The goal is to provide the reader a concise but at the same time extensively description of the core concepts of financial assets negotiated directly by individuals as much accurate as possible.

1.1.1 Money Market Instruments

Money market instruments are defined as short-term debt instruments with the maturity equals or less than one year, very low-risk, and highly liquid. They are issued by governments, financial institutions, and corporations. Returns are closely affected by issuing entities. The minimum size of a transaction is typically large for this type of instruments (greater than $ 100,000), along with the fact that some money market securities are not actively traded on exchanges (The New York, London, and Tokyo Money Markets are among the world's widest). Considering the minimum transaction size and the lack of liquidity for some issues, many traders who want to buy or sell these assets can swap to mutual or hedge funds (i.e. to trade in money market funds).
Table 1.1 highlights the main money market instruments.

Money Market Instruments
Treasury bills
Repurchase agreement (repos or RPs)
LIBOR
Negotiable certificate of deposit (CDs)
Bankers' acceptances
Commercial paper
Eurodollars

Table 1.1: Money Market Instruments Categories.
Source: Elton et al. (2013)

In the years immediately before the financial crisis of the previous decade, money market securities were to an increasing extent used by financial institutions as collateral for many transactions with a certain degree of safety. Such a crisis made agents avoid to use them since they were no longer be considered so much harmless. We will go to carefully describe the major assets belong to this environment in the next paragraphs.

1.1.1.1 Treasury Bills

Bills are financial assets with less than one year until the date that they will be redeemed by the original borrower. (Pilbeam 2005). Bills could or not could be offered to the same organizations that buy public bonds. Treasury bills (T-Bills) are therefore bills issued by governments (e.g., Germany and the U.S.A.) to augment short-run funds, so they are considered as the least risky and the most marketable of all money market instruments. The maturity varies from 4 weeks to 1 year. T-Bills do not entail any payment of coupons making them a sort of zero-coupon debt assets issued at a discount to the nominal or redemption value, with the holder benefits entirely from capital appreciation. The return obtainable stems from the difference between the purchase price and the amount that

lender receives at maturity. They are sold in minimum denominations[1] ($ 10,000 in the U.S.A.) with periodical issues. For instance, the U.S. Federal Government creates and then issues 91 day and 182 day T-bills every week, along with 52 week Treasury bills at a monthly frequency. UK Debt Management Office issues 28 day and 91 day T-Bills each week (on Monday), other than 182 day Treasury Bills on a monthly basis. To trade these instruments, a very liquid secondary market proves to be exploited. Hence trading happens at low transaction costs. We will see in the second section of this chapter that bonds, the most used and known debt instruments, also benefit the existence of large secondary markets. T-bills are sold at auction in two different ways. Bid price auction happens when individuals pay the price they bid. Strike price auction calls for the payment of the same price. In other countries, such securities are known as *Bon du Trésor* (France), *Schatzwechsel* (Germany and Austria), *GKO* (Russia), and *Buoni Ordinari del Tesoro* (BOT) in Italian financial markets. It is worth noting that Treasury bills with short maturity (typically three months) and mini-bonds[2] are very employed to manage liquidity due to their ability to cover temporary offsets of cash flows.

1.1.1.2 Repurchase Agreements

A Repurchase agreement (Repo or RP) is a type of secured, collateralized, short-term lending, usually between banks, assuming the structure of an agreement between a borrower and a creditor to sell and repurchase a security (government assets are much used due to their *default-free* feature and the presence of many large size public debt markets). A borrower, who usually coincides to a government securities dealer, institutes the operation by contracting to sell securities to a lender at a prefixed price and simultaneously incurring to buy back such assets at a future date at a well-defined price. The difference between the two values represents the lender's return, well him or her gain. Securities exchanged depict the collateral for the transactions where the amount required depends on the risk of this guarantee.
Haircuts were used to discount the face value of Repo Mortgage[3]-Backed securities (MBS) during Great Recession since financial instruments are generally devalued when their usage coincides with collateral activity, in order to get a "cushion" that lending parties evaluate in case market value falls. A haircut is a difference between prices at which a market maker can buy and sell a security. The term is also used to indicate the percentage by which an asset's market value is reduced for the aim of calculating capital requirement, margin and collateral levels.

[1] The term "Denomination" is generally understood to mean the classification of the face value of financial instruments.

[2] In the financial world, Mini-bonds usually refer to debt instruments bought by investors for lending directly to businesses.

[3] Mortgage, "ipoteca" in Italian Law, is the collateral attached to every immovable property purchases in real estate markets.

The maturity of repurchase agreements is usually less than 14 days, sometimes overnight (i.e. equal to a single financial working day). The counterpart of the repurchase agreement trades a reverse Repo to buy a security at a certain price and to sell it back at a price and time specified *a priori*.
Figure 1.2 shows haircuts applied on RPs before the financial crisis.

Security	April 2007%	August 2008%
US treasuries	0.25	3
Investment-grade bonds	0–3	8–12
High-yield bonds	10–15	25–40
Equities	15	20
Senior leverage loans	10–12	15–20
Mezzanine leverage loans	18–25	35+
Prime MBS	2–4	10–20
ABS	3–5	50–60

Note: Mezzanine capital refers to a subordinated debt or preferred equity instrument that represents a claim on a company's assets that is senior only to that of the common shares; an MBS is a mortgage-backed security that represents a claim on the cash flows from mortgage loans through a process known as 'securitization'; and an ABS is an asset-backed security.

Figure 1.2: Haircuts on Repos.
Source: Valdez et al. (2016). © IMF (October 2008) *Global Financial Stability Report*

The following scheme may turn out to be useful to illustrate, in simple terms, how a repurchase agreement works (securities used in the transaction are stocks).

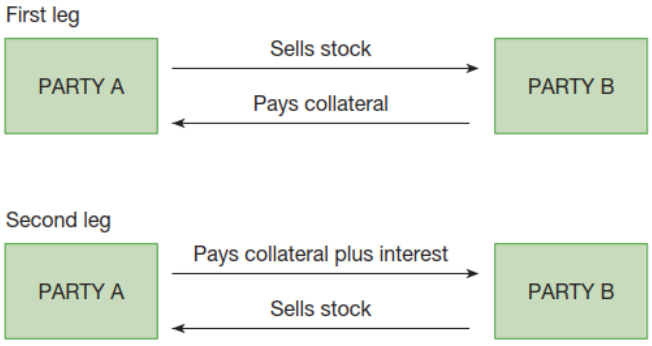


Figure 1.3: Repurchase Agreements Operating Principle.
Source: Valdez et al. (2016).

As one can note, trader A sells shares to the counterparty B, and he or she obtains a protection for the exposition of selling the stocks (namely a guarantee). After that, trader B gives back such shares to trader A who is obliged to pay the collateral and interests accrued.

1.1.1.3 Instruments involving Banks

A host of money market instruments allows investors to finance or satisfy their needs passing through the bank. I shed light on several assets which make these purposes feasible for every trader who needs to complete some peculiar operations.
Certificates of deposit (CDs) are momentary deposits, often with a bank, not withdrawn until the maturity (even if early withdrawal penalty is actually allowed which has the structure of a given amount of money), whose duration ranges from 3-18 months to 5 years. They are sold by banks, thrift organizations, and credit unions. The lenders might be investors who seek to obtain funding with low-risk and interests given by the safety of assets. They can be issued in the form of zero-coupon or fixed/floating securities. In general, certificate of deposits with longer maturity provide coupons. Instead, those whose life is up to a year coincide with zero-coupon. After issues, CDs are negotiable in a similar manner to bonds. They implicate some advantages both for the lender and the debtor. On the one hand, creditor's advantage is drawn on the chance that he or she has to get money back earlier by easily selling such an instrument to somebody else. On the other hand, borrower's advantage consists of lending of money for a specific period.

Bankers' acceptances are contracts whereby companies enforce the bank to pay a specific sum of money on a particular date (typically within six months). The bank agrees to receive a bill and may also discount it, or the client may discount it with another bank. These acceptances often operates as a guarantee for international import operations where the creditworthiness of one trader is unknown to the trading partner. CDs and bankers' acceptances are traded at rates that depend on the credit rating of the bank that backs them.[4] Eurodollar and Eurodollar CDs are particular kind of U.S. deposits often supported by non-U.S. banks.

Commercial papers are unsecured loans with a brief duration (the major common ones have a maturity equals to one or two months) released by relevant and high standing companies or corporations, typically used to face temporary cash flow needs. A discount program is many times planned for them. Yields are partially determined by the credit quality of the borrower.

Interbank deposits are short-term deposits carried out among banks, employing to provide for momentary lack or excess of liquidity. Interbank market is an *over the counter* (OTC)[5] market, in which the interest rate applied depends on the match between the demand and the supply of deposits.

[4] CDs are insured by the Federal Deposit Insurance Corporation up to a limit of $ 10,000 in the U.S.A.

[5] A decentralized market, without a central physical location, where market participants trade each other via a lot of communication methods such as the telephone, email and proprietary electronic trading systems. OTC markets are less transparent than exchanges and are also subject to fewer regulations.

London Interbank Offered Rate (LIBOR) and Euro Interbank Offered Rate (EURIBOR) are the most important interest rates in this financial environment. The acronym LIBOR stands for the rate at which large international banks in London lend money among themselves. It should be emphasized that LIBOR is used as a base rate for many types of long-term loans. Thus, one of its primary purposes is addressed to U.S. loans. The interest rate is computed for a set of currencies (e.g., U.S. Dollar, Yen, Euro) with severe maturities such as overnight (rate lists today and it will expire tomorrow), spot/next (rate lists today and it will expire in two days time).
EURIBOR denotes the interbank rate which has calculated by European Banking Federation since 1999 as an average of interbank exchange ask rates due to the link of LIBOR and EURIBOR to rates applied on the transfer of deposits. Furthermore, this latter is calculated at 11 a.m Central European Time inside a well-known panel of banks, having a high credit standing with life encompasses from one week to a year.
The overnight interbank deposits interest rate in the European Euro Area (EEA) is denoted as EONIA, and it is computed by the European Central Bank as an average of overnight performances carried out by creditor institutions inside EU interbank markets.

1.1.2 Capital Markets Instruments

Capital Markets is the class of financial markets that involves in trading assets with a medium/long-run maturity (i.e. greater than twelve months) and those with no specific maturity *a priori*. *Fixed Income instruments* and *Equity instruments* are the categories where such securities can be collected. Fixed income instruments have got cash flow patterns over time; Equity instruments promise to yield to the holder future gains of the institution that he or she believes it will keep having or it will get ongoing business, with the reward supplied in the form of dividends.

1.1.2.1 Fixed Income Instruments

Fixed Income instruments[6] are instruments of capital markets characterized by the existence of scheduled payments over the years. Harris (2003) underlines that all debt securities are collectively known as fixed income products. Fixed-rate bonds are the most famous in this category. Issues are put into default if there is a lack of satisfying a prefixed payment, with all remaining ones due immediately (interests plus principal value). The yield received is expressed as a predetermined interest rate as long as the investor does not sell the security before its maturity. Fixed income instruments can be differentiated according to specific characteristics such as the identity of the issuer, the collateral given to the lender, the maturity until the repayment date, or the type of disbursement of interest. I

[6] In Italian markets, they are called *Titoli obbligazionari*.

highlight that market prices are different from those that traders have to pay when fixed income securities are purchased, in particular, who buys a bond must add to the quoted value the accrued interest from the last coupon payment.
Examples of fixed income debt assets will be discussed now. A better explanation of the most famous category of fixed income securities, bonds, will be provided in the next section.
Looking at the U.S.A., *Treasury Notes and Bonds* are fixed income instruments issued by the U.S. Federal government. The first ones have a maturity from 1 to 10 years; the second ones own a maturity higher than ten years. These debt securities give to the holder coupons every six months and principal, that is the amount lent, on the maturity date. Another important distinction concerns the feasibility of some Treasury bonds to be callable, while Treasury notes cannot be recalled earlier under any circumstances. Call provision will carefully be explained when bonds will be discussed in detail.
Focusing on Italy, Italian Treasury issues a broad range of debt instruments because of its high public debt which persisting in the last years. Figure 1.4 shows the evolution of debt in Italy from 2001 to 2015.

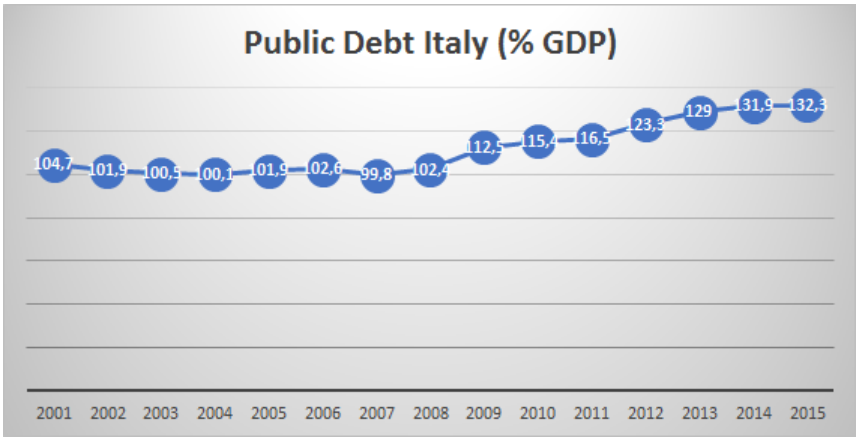


Figure 1.4: Italian Public Debt.
Author's elaboration. Data Source: Istat.

To report some issues, *Certificati del Tesoro Zero Coupon* (CTZ) are zero coupon debt securities with a life equals to 24 months. The gain of buying them comes from the difference between the nominal value and the purchasing price. CTZ are sometimes associated with BOT, in fact they are also called *superBOT* or *Bottoni*.
Buoni Poliennali del Tesoro (BTP) are fixed coupon securities with medium/long-term maturity (e.g., 3, 5, 10, 15, and 30 years). Such a fixed coupon is paid in half a year, as for Treasury notes and bonds above explained. Italian Treasury never triggered the early redemption of debt, *Certificati del Tesoro* (CTOs) excluded. Such financial assets were issued for the first time in 1998 with a maturity of 8 years and fixed coupon rates. The redemption provision was composed by a put, not a call option. The exercise of this embedded option permitted the lender to exit earlier from the investment at the half of life of the instrument about, without prejudice on capital in case of the boost of rates.

Certificati di Credito del Tesoro (CCT) are other interesting bonds in our country markets because they distinguish from BTP due to their floating rates and maturity sets to 7 years. The principal is fixed, while semi-annual coupons vary in function of 6-months BOT yield and after the first coupon.

1.1.2.2 Structured Bonds

Even if Structured Bonds are more hybrid financial instruments than fixed income instruments, it is worth to explain some of them because they incorporate both fixed income assets and derivatives (especially options) features and they lie between debt and equity instruments as we will see soon.
Reverse Floater are floating rate bonds, whose coupons are inversely connected to an interest rate (for example, Treasury rate, Federal Fund rate, or interbank rate) since if coupon increases, index rate goes down.

Convertible Bonds are bonds with predetermined maturity and fixed-rate coupons. They allow the holder to change him or her bonds in stocks (according to a scheduled conversion rate), in other words, to transform himself or herself from creditor to shareholder respect to the issuer of securities. To create a portfolio of convertible bonds is the same of buying bonds plus call options. *Reverse convertible* are inverse convertible bonds because the holding of them is similar to a portfolio built with bonds and put options.

Preferred Stocks, whose translation is "Azioni privilegiate" in Italian, deliver accurate payments to the trader by the distribution of dividends with a regular path. The failure to meet these payments does not lead to bankruptcy implicating the repayment of debt by tranches. The broad accepted use of the expression "Tranche" refers to the order with which a creditor is paid when a lack of cash arises. Seniors are the lenders with the highest grade for repayment; juniors are the final investors will see the fulfilling of debt payment completed. Therefore, when an enterprise fails to do so, dividends are cumulated, and those connected to preferred stocks must be settled before any common stockholders will be paid.

Asset-Backed Securities (ABS) *are securities where the payment of coupons and the return of the principal are guaranteed by a claim on the underlying assets*. (Patrick J. Brown 2006). ABS include loans, home mortgages, commercial mortgages, automobile loans, student loans, and credit card debt. A classical representation of this type of assets is *Collateralized debt obligations* (CDOs), building in tranches with different maturities and risk levels. Pilbeam (2005) reported on securitization as *the process of borrowing money through issuance of a security which is backed by stream cash flows or other assets*. Special Purpose Vehicles (SPVs) were created by banks during the Financial crisis to collect money from the market used to buy loans or credits in a wide range of credit

institutions. SPVs then issued instruments called Residential mortgage-backed securities (RMBS), CDOs even granted by Credit default swaps (CDS) to pay to banks the purchase of such loans or credits. ABS were crucial during that period due to their large composition in the portfolio of many financial institutions. RMBS and CDOs were the most well-known ABS in that violent episode. Figure 1.5 shows the holding of MBS in the U.S. pre and post-crisis with all maturities.

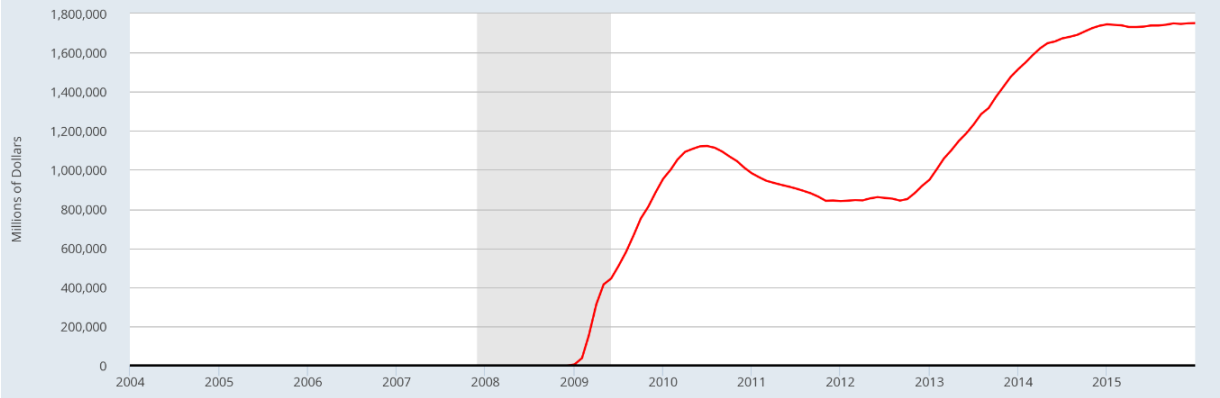


Figure 1.5: Mortgage-backed securities (MBS) held by the Federal Reserve.
Source: Board of Governors of the Federal Reserve System (US).

1.1.2.3 Equity Instruments

Equities, or Common stocks, provide stockholder some earnings as he or she participates to the future profitability of the company. After creditors of the firm are paid, satisfying shareholders' compensation is done by distributing dividends that portray earnings for investors. Holders of shares have limited liability because if the company is distressed or it goes to bankruptcy, they will lose the original amount invested only, not their equity. Preferred stocks are often intended as being common stocks, but this is misleading because the former ones are hybrid securities that stay between bonds and equities.

1.1.3 Derivative Instruments

The final category analyzed is derivatives that are securities whose values derive from a set of instruments (not necessarily with a financial nature). The other name of derivatives is *Contingent claims* because they are strictly affected by the performance of underlying assets. Probably the fastest growing sector of the financial markets today is that of derivatives (Valdez et al. 2016).
Section 2 carefully explains a particular category of debt instruments, Bonds, which are recognized as being very useful to lend or borrow money. In addition, they are crucial both to understand the other parts of thesis and to uncover why many financial institutions hold plenty of public debt instruments in their portfolios, especially during the Global Financial Crisis.

1.2 Bonds

I have singled out bonds in many occasions within the previous sections and paragraphs, even when financial instruments which own bond and derivative peculiarities have explained. I have done that since bonds are more and more exploited by all entities who seek to raise funds most safely as much as possible. The idea to lend money via ”banknotes” is often unsuitable both for the lender and the borrower. The creditor will not get any insurance against the capability of or the willing to repayment by the counterpart, whereas the debtor might face the credit or default risk with the consequence of not longer be able to honor the refund, incurring to legal actions. I anticipate that bonds own a put provision that helps the borrower in case of particular events (default included) to compel the issuer to buy back securities. Difficulties that the lender or the debtor faces might be true even when the interest rate at which money is borrowed suffer from a reduction. In the microeconomics literature, *substitution* and *income* effects demonstrated how loan changes in response to a drop in interest rate blowing savings of individuals. For the first effect, opportunity cost falls at present since everyone must give up to a quantity of future consumption for any additional marginal amount (i.e., a euro, a dollar) of actual consumption. Consequently, savings will drop. For the other effect, the lender will have less money goes back namely he or she will be poorer for the falling of interest rate. If one supposes that actual consumption is a normal good, in other words, its demand raises if disposable resources of individuals increase, less income induces to enhance savings. Combining the effects, the borrower's savings will be reduced, the lender's ones will go up.

As Choudhry (2010) points out, *Bonds are commonly referred to as fixed-income instruments. This terms goes back to a time when bonds paid fixed coupons each year*. Nowadays, that scenario is actually not so much true because there exists severe kind of debt assets which pay floating coupons or they are linked to an index, leading to the concept that bonds belong to fixed income securities world then they are traded in capital markets[7]. Indeed, issuers of bonds try to accumulate long-run debt capital.
To define bonds, Fabozzi (2012) argues that *a bond is a debt instrument requiring the issuer (also called the debtor or borrower) to repay to the lender/investor the amount borrowed plus interest over a specified period of time*. In this manner, bonds are mostly negotiable loans in broad and liquid secondary markets. I stress that primary markets are markets in which corporations raise new capital, secondary markets are markets in which existing, already outstanding securities are traded among investors. (Brigham et al. 2013).
Bond issues are composed by a fixed date when the amount borrowed is due and the contractual amount of interest (generally paid at prefixed times). The maturity date is the

[7]Debt instruments are used to be classified by their time horizon. In the U.S. for instance, bonds are those debt securities which own medium/long maturity otherwise, the word ”note” can detect short-lived securities in some debt markets.

date on which the invested capital must be paid back. If the issuer of bonds does not default or redeem the issues before the maturity date, the bondholder is assured of a scheduled cash flow path as long as he or she holds assets until the maturity date.
Bond prices are meaningfully influenced by policymaker choices and exogenous economic facts as well yields on individual public bonds are important indexes for the economy of a country as a whole. Consequently, the level of return is crucial considering that it indicates the direction that economy is covering and the economic-financial conditions of the state.
I will explain the fundamental characteristics of bonds available in financial markets in the following paragraph.

1.2.1 Features

Every bond has got some particular features. In this paragraph, I illustrate them to better figure out the structure of these instruments.
The first cited is *the nature of issuer* because such assets vary in function of the debtor. Local government authorities, sovereign governments, companies, corporations, and supranational entities (such as the European Investment Bank) constitute the major issuers.
The *term to maturity* denotes the number of years that the lender will wait for having the payment by the debtor of the amount lent plus any relative interests associated with it. The *maturity* stands for the date that debt will expire and consequently, the borrower will redeem the bond paying back the principal value. *Maturity* or *Term* are other terms with which maturity is called in literature. The only method to modify the term to maturity of a bond derives from *provisions* incorporated in it. According to the maturity, short bonds are typically characterized by life from 1 to 5 years, medium bonds' life ranges from 5 and 15 years. Finally, long bonds own a maturity longer than 15 years. The term to maturity of bonds is significant because the creditor is able to formulate some expectations about the time at which the lending amount will go back alongside the coupons due. Additionally, yields (in other words, earnings) by the investment in bonds fluctuates according to it, and the prices of such securities are also dependent on the term.
The *principal*, to be more precise, the *principal value* is the amount that debtor promises to pay to the lender (i.e. bondholder) at the maturity. The issuer has to comply with this obligation since the principal is the amount that bondholder has lent to him or her. In literature, there are other nouns to refer to the principal that are *Redemption value*, *Maturity value*, *Par value*, or *Face value*. Brown J. (2006) highlights that some bonds do not specify a final maturity date. These bonds often designate that they may be redeemed by the issuer on or after a specified date and at a particular price, subject to a notice period. That kind of debt instruments are known as *Undated bonds*, *Irredeemables*, or *Permanent interest-bearing securities*.

The *coupon*[8] or *nominal* rate is the interest rate obtained by the individual who purchases a bond. The coupon rate is expressed in percentage and when multiplied by the face value is equal to the amount of the coupon in currency unit. Coupons are not distributed by an only manner (zero coupon bond does not entail any payment of coupons. We will see them in the upcoming paragraph). In U.S. debt markets, they are paid at a semi-annual frequency, while in European Markets usually, that happens every quarter or year. In general, each bond is traded at a price strictly below to the nominal or redemption value, i.e. at a discount. The reason is that if interest rate applied to compute the "cash" value of coupons starts to rise, bonds will only be able to sell at a markdown from the face value since who buys assets can trade new bonds at the principal and paying a higher rate. Vice versa, to sell a bond with a premium means that its price is greater than the par value, hence there is the presence of a higher interest rate concerning other bonds owing to the same term, for example. Another feature of nominal rate is given by the degree of which prices of bonds are determined by interest rate changes: higher the interest rate of coupons, bonds' price fluctuates less according to yield variations.

Fabozzi (2012) considered the planning of principal payments to be a significant characteristic of bonds. Him theory is based on the hypothesis that the par repayment of a bond issue can call for the principal to be fully repaid at maturity or the par comes back from the creditor over the life of the bond. *Amortization schedule* must then develop. *Amortizing securities* are those securities originated from loans with amortization schedule such as MBS and ABS. Amortized loans are primarily home, personal, or auto loans. They do not properly have a term because this latter uncovers only the date at which principal will be given to the investor. Instead of the maturity, alternative measures are exploited as a weighted average.

Most embedded options have incorporated inside bonds since the first issue to alter some conditions. The term *embedded* is used because the option element cannot be separated from the bond itself. (Choudhry et al. 2014). Such options permit the debtor or the bondholder to replace some conditions with others, even if they might be triggered by sudden exogenous events like the issuer is taken over by a third company or the tax status of the issue is no longer the same of that initial.

The most famous option is the *call provision* which can be exploited by the issuer to settle the debt (all or partially) before the maturity date. Bonds which own this provision are called *callable bonds*. The provision can be exercised at the borrower discretion. Earlier debt repayment is dangerous for the lender because the term to maturity becomes obviously altered, inducing the investor's interest to likely face a downfall. To be more precise, the issuer can substitute the security initially agreed to the sale with a new instrument having a lower coupon or interest rate. As a consequence of it, the bond's market price will vary. A callable bond is though as a trading strategy consists of buying a

[8]The origin of this term stems from the condition whereby bearer bonds are those bonds with no registered holders. The entity that issues such debt instruments has the ownership of bearer. The bondholder are used to get physical bond with coupons one time which indicated the interest amount which he or she can obtain.

common bond and selling a call option which acts as a cap[9] for bond's price. The equation 1.1 seems to be accurate to explain this statement in mathematical terms. I propose a similar version of that of Choudhry et al. (2014) (P indicates the price of an instrument).

$$P_{callable\ bond} = P_{bond} - P_{call\ option} \tag{1.1}$$

Considering 1.1, if the value of the call option increases, the callable bond is influenced in negative terms. To put it another way, if the individual who gets the bond decide to sell the call provision (remember that it is represented by a short position on a call option), he or she obtains the price of such an option which depends on the exercise date. Furthermore, call feature has terms affected by its evaluation too. Call options included in bonds have the characteristic of European options "killed" just at the maturity or American option which can be exercised at every time before the expiration. Naturally, American options will be more expensive than EU ones beside the early exercise. Figure 1.6 reports an example of the redemption of debt earlier.

Aetna Life and Casualty Company $7\frac{3}{4}$ % Notes 2016

The company issued $200 million in July 1986 at 101. It pays interest annually on 17 July and will be redeemed on 17 July 2016 at 100 unless it is called earlier. The bond is callable as a whole or in part at any time on 30 days' notice at the following rates: from 17 July 2001 at 106; 2002 at 105; 2003 at 104; 2004 at 103; 2005 at 102; 2006 at 101 and 2007 at 100. It is also callable if its tax status changes.

Figure 1.6: Callable bond example.
Source: Brown J. (2006)

If the borrower has the chance to transform the term taking an advantage for the repayment, the lender can it as well, with the consequence to be entitled to sell the bond to the debtor. *Put provision* makes the action practicable due to the right to enforce the issuer to buy back the security at the principal on one or more dates. I underline that the put feature included in *put-able bonds* may be only used if particular events happen.
These bonds are similar to callable ones, even though their strategy is set up on a long position both for common bonds and put options. Choudhry et al. (2014) express that exploiting an equation and we provide an analogous version of their:

$$P_{put-able\ bond} = P_{bond} + P_{put\ option} \tag{1.2}$$

[9] A cap is the greatest threshold that an interest rate can reach. In literature, interest rate cap is a derivative instrument composed of a number of European call options (known as caplets which have particular interest rates) expire on the date the floating debt rate will be reset.

Note that if the value of put option raises, even the value of a bond with put provision augments. Put feature acts as a floor[10] on *conventional* debt security's price.
Other thoughts for bond's peculiarities regard the collateral and the place in which trade and quotations are made. When the borrower decides to issue bonds, he or she has to state what kind of guarantee will be available to the buyer of such issues. Shapes of the collateral vary a lot. *Asset backing* helps the investor in case of debtor's default since it gives the opportunity to evaluate bonds at least their principal. *Negative pledge* implicates that the issuer did not pledge himself or herself to sell new bonds with a stronger claim on them in the future. Collateral could be absent in case of subordinated debentures or government bonds. For debt instruments issued by government authorities, they are practically risk-free. If they are sold in domestic currency, there exists the chance to put in circulation more money to cover any shortages and repay the debt. The weakness comes from the transformation of public bonds in risky assets because the coupon and redemption value payments might occur in a devalued currency.
The quotation of bonds is sometimes carried out in exchanges. A typical mistake committed by traders is to think that bonds will so be negotiated in regulated markets. This assumption looks to be true for many government bonds but if one cherry-picks the bond market for the negotiation, he or she can see that in the Eurobond market, a huge quantity of buying and selling of public bonds takes places on OTC markets in connection with market makers. Retail investors are few for such debt securities for the presence of high minimum denominations, or the quotations were not created in exchanges.

1.2.2 The Major Traders in Bond Markets

Bonds features are exhaustively explained in the previous paragraph. However, the main agents purchasing bonds in debt markets must be listed to investigate their typical attitude with respect to bonds. I have chosen to dedicate a brief subsection to such traders to give a general panorama to the reader. Furthermore, banks are important buyers of government bonds and this will be the aim of the thesis to be proved.
Following the proposal of Choudhry (2010) to consider the time horizon of the investment, bond market traders can be collected in four principal areas. *Short-term institutional investors* are the investors who negotiate above all in money markets among which banks, money market fund managers, and treasury desks of some corporates. Central banks trade in this kind of debt markets too. These investors formulate short-term decisions and expectations about future movements of instruments. I highlight banks might be expose to

[10] A floor is the lowest threshold that interest rate achieves. Like the cap, there are derivatives linked to the floor, called interest rate floors, which are developed by a host of European interest put options, with severe interest rates and they cease to exist on the date the floating rate will be reset. Both interest rates floor and cap are very employed for interest rate hedging. Cap and floor terms are usually used when one refers to derivatives.

respect some liquidity constraints by holding a portion (often considerable) of short-term securities in their portfolios. This last statement will result true when I run econometric analysis in Chapter 3 because banks hold a huge quantity of government debt instruments.
Long-term institutional investors are those with longer investment horizon. This category includes pension funds and life insurance companies. The length of investment horizon is correlated with the nature of liabilities that such investors own.
There is a class of investors characterized by a mixed time horizon called *Mixed horizon institutional investors* which includes insurance companies, sovereign wealth funds, and a lot of corporations, issuing bonds to increase their fundings.
Finally, *Market professionals* are a heterogeneous category since investors' time horizon spaces from 1 day to many years. Entities belonging to the category are represented by investment banks realize proprietary trading which consists of trades carried out by institutions (like firms or banks) to get earnings for their account, not through executing agency orders, together with bond market makers in securities houses and banks dedicated to customer services. Pilbeam (2005) maintains that a market maker acts as a dealer in a financial security, quoting both a price at which he is willing to buy a security (the bid price) and a higher price at which he is willing to sell the security (the ask price). The difference, or spread, between the bid-ask prices represents a profit margin. Market-makers provide liquidity for the market, a set of prices for investors, and reliable price information.

1.2.3 Types of Bonds

There is a vast amount of bonds despite the fact that *common bonds*, also referred to *conventional*, *plain vanilla*, or *bullet bonds* are the most known. Bonds are principally traded in OTC markets rather than exchanges. Some bond issues are highly liquid, others are rarely negotiated. In developed countries, markets for such debt securities represent a large segment of financial sector and they are vast and liquid. The initial point to list bonds might result to be a bit arbitrary. One might pay more attention to the nature of the issuer plays a significant role for all debt instruments rather than the form of nominal rates or embedded options. In my opinion, the second one is more appropriate on which to start to discuss because bonds are better differentiated one from each other with respect to the presence or not of provisions, and kind of interests due to money lent to individuals or institutions that could suffer from the financially distressed situation.
Following the classification of Brown J. (2006), *Fixed-rate bonds* or *Fixed-coupon bonds* (*Fixed-interest bonds* in the UK) are bonds which provide coupons with a fixed interest rate to the entity that owns them. This bond environment is divided into different parts.
Straight coupon bonds, also known as *option-free bonds* are referred to vanilla ones since they give to the lender periodically interest rates plus the par value at the maturity.

Call or put provisions are absent (the reason why they are called ”option-free”) inducing to authorize neither debtor nor bondholder to alter the maturity. Precisely, any provisions are not included in straight coupon bonds. The frequency of coupon payment differs across markets (according to continent or country).

Zero-coupon bonds (ZCBs) are a particular class of bonds considering the coupon payment. In literature, *zero-coupon bonds*, *pure discount bonds*, and *accrual bonds* are three classes of languages that convey the same concept of securities. The term zero-coupon has already met during the discussion of many marketable financial instruments. I define it in a precise way, notwithstanding the meaning is quite intuitive.

Focusing on bonds, zero-coupon implicates to not pay any coupons until the expiration though to give back the face value on a single date. To compensate and attract investors, issuers of ZCBs typically sold them below the face value. The earning reaped is simply the ability derived from the sale at the par, in other words, the difference which exists between the redemption value and the price at which ZCBs were ceded by the debtor. A feature of pure discount bonds regards the erratic approach of trading price from the price established initially by issuing individual to the par value reached during the life of the instrument.

Undated bonds are a particular type of fixed-coupon bonds without a maturity date. The borrower must keep providing the lender coupon payments, but he or she has the possibility to use the call provision reliably. Given the opportunity to keep paying coupons, *perpetual bonds* term mirrors the category of bonds addressed here.

Stripped, *Strippable*, or *Strip bonds* are debt instruments developed by splitting the payments from bonds which own coupons and then selling separately each zero coupon bonds obtained by this operation (they have different terms and maturity dates). Splitting is done when there is a lack of ZCBs inside financial markets, for instance. Fixed-rate bonds, as well as other bonds with coupons are involved in the process of creation of strippable debt instruments. Bonds derived by stripping make pension fund and insurance companies able to yield safe returns over time (for many years) due to the independence of coupon rates on reinvestment activities. A final consideration for strips entails the feasibility that is sometimes begun to ”recombine” bonds stripped in order to get back bonds with coupon payments fulfilled systematically. Figure 1.7 is an extract of U.S. Treasury Strips face value and the respective interest rates of coupons.

Maturity	Bid	Asked	Chg	Asked yield
Treasury Bond, Stripped Principal				
2017 Aug 15	99.801	99.803	0.001	0.84
2018 May 15	98.909	98.919	0.004	1.11
2018 Nov 15	98.379	98.394	-0.005	1.10
2019 Feb 15	98.019	98.036	-0.012	1.15
2019 Aug 15	97.094	97.116	-0.012	1.31
2020 Feb 15	96.337	96.363	-0.028	1.36
2020 Feb 29	96.271	96.297	-0.021	1.36
2020 May 15	95.727	95.755	-0.023	1.46
2020 Aug 15	95.210	95.241	-0.019	1.51

Maturity	Bid	Asked	Chg	Asked yield
2017 Jun 15	99.674	99.675	unch.	4.95
2017 Jul 15	99.588	99.589	unch.	2.77
2017 Aug 15	99.799	99.801	0.001	0.85
2017 Nov 15	99.532	99.537	-0.004	0.97
2017 Dec 15	99.039	99.044	unch.	1.70
2018 Jan 15	98.945	98.951	unch.	1.63
2018 Jan 31	99.220	99.227	-0.007	1.12
2018 Feb 15	99.177	99.185	-0.008	1.12
2018 Mar 15	98.796	98.804	unch.	1.48
2018 Mar 31	99.010	99.018	-0.011	1.15
2018 Apr 15	98.637	98.646	unch.	1.52
2018 Apr 30	98.860	98.869	0.005	1.21
2018 May 15	98.827	98.837	0.004	1.20

Figure 1.7: U.S. Zero-Coupon Strips Principal Value and Interests.

Quotes are as of 3 p.m. Eastern time based on transactions of $1 million or more. Yields are calculated on the ask quote.
Source: J.P. Morgan Pricing Direct Inc. via www.sstbond.com

We have treated bonds which hold an interest rate that does not switch over time. Corporations issue debt instruments where the first coupon owns a determinate nominal rate but the other coupons are computed by different interest rates. This is the case of *Step-up* or *Graduated-rate bonds*.

We move on to consider bonds pay coupons with variable interest rates, the so-called *Floating -rate bonds*, or *Floating-rate notes* (FRNs)[11]. Their coupon rate varies in function of external measures such as LIBOR or EURIBOR which we have already explained. Floating-rate bonds are in general reclaimed on a fixed date or they appear to be undated bonds. As the coupon payments are attached to an exogenous variable rate, yields that investor obtains are not predictable. Such payments have the purpose of push bond's price far away from the amount of loan. There is a spread given to bondholder with a fixed margin nature albeit *variable rate notes* allow a margin which fluctuates. A trade-off is borne by these considerations. While uncertainty derived from more risk of future earnings makes a trader more adverse to invest in those debt assets, he or she is rewarded by more frequently *tranches* of coupon payments, so the existence of a higher number of cash flows. As for fixed-interest bonds, there is no an only method to deliver coupons because it occurs every month, quarter, half a year, or 12 months. Cap and floor bounds are added to coupons. Choudhry (2010) denotes that on time, called coupon reset date when the nominal rate resets (in fact, the interest rate associated with coupons usually is readjusted), floating-rate bonds are priced at the par value. I believe that to spend a few words about the coupon reset is crucial since the attitude that many bonds own to clear nominal rates attributed to coupons. The readjustment of FRNs is based on the formula that Fabozzi

[11]The term "note" is often employed in finance to refer to a debt instrument with a maturity equal or less than five years, namely greater than a bill but lower than a bond.

(2012) reports with the name *Coupon reset formula*.

$$Reset\ rate + Quoted\ margin \tag{1.3}$$

where quoted margin is the marginal amount that debtor promises to give on the interest rate linked to the bond. If a floating-rate bond moves in the opposite side with respect to its reference interest rate, then trader negotiates a *Inverse-floating-rate* bond (or *Inverse floater*/*reverse floater*). This is only a recap of what we have seen in structure bonds paragraph, although reverse floaters seem to be more hybrid bonds than straight coupon or floating-rate bonds. If exogenous interest rate is an inflation rate[12], the word *linker* is used for the association with index-rate bonds.
FRNs are traded at a percentage of the cash value of coupons less accrued interests. Fixed-rate bonds employ those metrics too. Nevertheless, the calculation of an accrued interest completely differs if one treats fixed-interest bonds rather than floating-rate ones due to the quotation of these latter as *quasi*-money market securities. Thus, the date of coupon payments changes every time a fact happens within the market where notes are quoted. Naturally, the market must be open in order the payments will be made on business days. This is why conventions are applied to the issues. A final aspect that we stress concerns when FRNs are issued in debt markets, they are rated with a premium which is equal to that of the initial issue, with the consequence of the floating-bond' price reverts to the issue price (typically approaching the redemption value).
It should be noted that "mixed" bonds are quoted in financial markets, both exchanges and OTCs. They include features of floating and fixed-interest bonds, supplying fixed coupons payments for a certain time span then they assume a variable shape.

The type of bonds represented by their coupon payments and provisions has been clarified. Let's consider another possible classification of these securities paying attention to the entity who issue them. I have decided that identity of the issuer is relevant considering that the perception of risks associated to the investment is highly influenced by who sells this type of debt assets. Additionally, bonds are traded in a broad range of markets which engages severe agents. Therefore, to figure out how they change in response of the borrower is fundamental for the buyer as well as for the market.
The first class of bonds faced are *Government bonds*. The terms *Public bonds*, *Sovereign bonds* are also employed with the reference of government debt. Thousands of bonds are sold by the federal government in the U.S.A., the reason why *Treasury bonds* is another locution allocated to government bonds. We must pay attention to a subtle distinction rarely captured between government and sovereign bonds. If a foreign government issues bonds since it is looking for funds, bonds are linked to the concept of sovereign debt. Instead, when a government sells bonds in its own currency, government bond is a term

[12]In Italy, Istat estimates the *Indice Armonizzato dei prezzi al consumo (IAPC) con o senza tabacco* used lots of times as a proxy for European inflation rate.

more appropriate. Nevertheless, the two nouns are equally employed by traders. ”Sovereign” might be more precise since ”government” expression does explicitly not point out whether bonds are denominated in the domestic currency or not.
Public bonds represent the borrowing of state due to the large deficit of countries which leads to a lot of issues of debt, especially today. Sovereign bonds constitute the widest share of bond markets. Investors believe that government will be able to fulfill the commitment to fully repay its debt and it will not default, or better, the probability that government will turn out to be in default or distress situation almost vanishes. Hence, these bonds are considered *risk-free* and they represent the best credit risk albeit this is not so reliable nowadays[13]. Government debt markets are very liquid for this reason, along with sovereign bonds have high liquidity and lower trading costs than other assets (for instance, corporate debt securities, equities, derivatives). Settlement occurs immediately after the transaction (one day generally) and special tax advantages are sometimes attached to stimulate traders to buy these bonds. That involves the selling of bonds with a different yield to maturity, Flower bonds which are U.S. Treasury debt instruments usually sold at a price much lower than principal. However, they have got a provision which consists of the chance to buy them at the par value in payment of estate taxes. Consequently, their price is set above than the initial one and yield will be lower than traders would obtain if that provision has not been embedded into such bonds.
Purchasing sovereign debt implies that earnings will be lower than those of other bonds (e.g. corporate bonds) caused by yields. Government bonds own fixed coupon rates and a well-defined principal. They are therefore considered as fixed-interest bonds. Provisions to alter the term to maturity by the issuer can be presented. For example, the government is able to enforce bondholder to sell back the bond before the maturity at a specified price. Sovereign bonds are issued by the central bank in France, Germany, or the U.S.A., the Ministry of Finance in Japan, or by the Debt Management Office in the UK, Portugal. Moreover, the issuers might be specialist dealers or a syndicate of banks in stated proportions. Other features concerns pricing expresses in decimal or fraction and whether government bonds are bearer securities (”titoli al portatore” in Italy) or not. Bearer means that a registered owner does not exist.

Municipal bonds[14], also called *Local Authority* or *Public Sector bonds* are debt instruments released by entities smaller than treasury or government e.g. counties, airport or port authorities, post offices, cities. Their major distinguishing characteristic is the exemption of interest from federal and sometimes state tax. Municipal bonds are sold in two different kinds. *Revenue bonds* are backed by revenues of the agency that issue them. *Obligation bonds* leans on the faith and credit of the issuer. Municipal bonds have (rarely) default risk. Since no taxable status, yields will not be higher than other bonds. Many entities issue

[13] See diverse sovereign crisis episodes as Argentina 2001, Chile 1993, Slovenia 1992.
[14] The name is particularly used for U.S. public sector. Municipal bond market is very large in that country.

these bonds including SNCF, EDF, Gaz de France in France, German Unity Fund in Germany.

Corporate bonds are debt securities issued by corporations and they can be publicly negotiated or via private placement originated by the act of selling securities to a few private investors exempted from registration in the SEC under Regulation D. Comparing to public offering, private placement is a cheaper manner to increase fundings by corporations, typically with a bank or an insurance company.
Corporate debt markets are much less active than government bond markets since many issues are infrequently traded after the initial offering or not traded at all. However, borrowers are very wide with different skills to carry out their duties respect to lenders. There are markets that could be weak like European Corporate Bond market or strong like in the U.S.
Corporate bonds are pledged by the credit of issuing company. The ability to generate cash flows, along with the meet of obligations of the issue determine the default risk which has got different levels affected by the nature of the issuing entity and the maturity of instruments. Credit risk is increasingly linked to default risk. Provisions are included in these bonds e.g. call provision, convertibility, and sinking fund. Companies trigger the right to obtain bonds back when interest rates are lower than the initial ones. This occurs at given price and dates. Sinking-fund provision is very useful for companies or corporations as to the redemption of a part or the entire value of principal with amortization during a set of points of bond's life. Sinking-fund is considered equivalent to call provision. If that redemption is fixed and not equal to the full amount of par, bonds are known as *serial bonds*. Channels used to activate sinking-fund provision are composed by purchasing the established share (less or equal than 100%) of the face value in open markets delivered to the Trustee[15] or to call a portion of the bond at face value, similar to a call provision used partially. Sinking fund also serves to buy corporate bonds in debt markets until a maximum price unless there is a lack of bonds whereby the provision allows the issuer to redeem randomly bond shortfall. Instruments show a shortfall in case of the existence of excess amount that regards the available cash amount. A share of corporate bonds can furthermore be redeemed casually. The goal of the provision is to reduce default risk even though yield can raise, declining bond's price.
Considering the type of corporate bonds traded in financial markets, *Guarantee bonds* consist of bonds guaranteed by a third party that supplies a secondary "insurance" for the payment of principal value and interests. They are truly both corporate and municipal bonds. The protector is in general a government authority or a fund entity. *Debentures* are unsecured bonds issued by companies, though they result to be backed by assets such as buildings or land since if default risk occurs, those assets are sold to repay the lender.

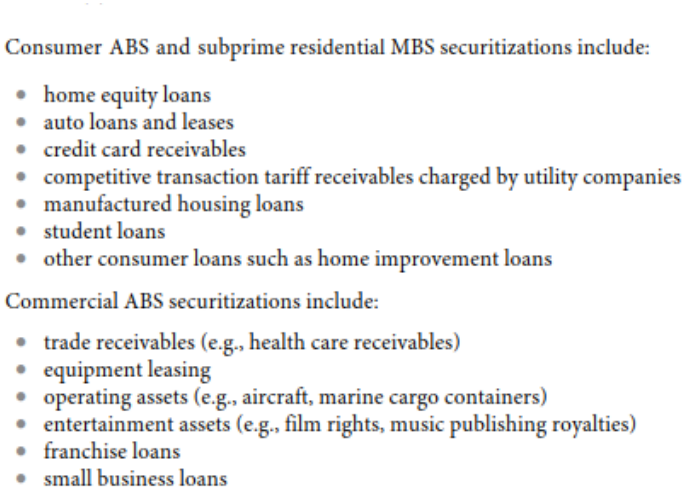
[15]Bond Trustee is a financial institution has got trust powers which give the debtor the power to enforce the term of a bond issue, protecting interests of the lender in case of default of the counterpart..

Investment funds sometimes invest solely in debentures. The shortage though is the uprising of lengthy and tedious legal procedure before those bonds are disposed of and replaced by other instruments. *Subordinated debentures* do not contain any guarantee and have lower priority on claims on liquidation if the company defaults. Thereby, *Bond Indenture* tries to give a collateral with a constraint on dividend distributions or new additional debt. Debentures are priced with narrower interest rates than *Junk* or *Speculative bonds* where these latter are corporate bonds with high yields that try to offset high probability of default of the issuer.
Income bonds are very particular debt securities because they promise to the bondholder to repay the redemption value only, with the relative coupons that the lender will get if sufficient earning will remain to the company. Credit rating developed by the major rating agencies (S&P, Moody's and Fitch) for bonds in whom the issuing body coincides with the company are listed in the below table. *Gilt edged* (or *Gilt*) characterizes securities issued by UK Government. *Investment grade* means low credit risk, in other words, the investor will be able to repay the debt with a high probability. Moody's rates the highest debt securities with the letters Aaa, S&P and Fitch with AAA. Aa or AA is the second top-grade then A is the third one for all three agencies. There are also other degrees which indicate lower ratings. A peculiarity of S&P and Fitch classifications is that a plus or minus sign provides a narrower credit quality for every class. Moody's exploits instead 1, 2, or 3. The expression *Prime* is very accepted for bonds quoted AAA or Aaa. *High quality* identifies AA or Aa debt instruments. *Medium grade* refers to triple B. We separate principally *Investment grade* bonds belong to the top four classifications from *Junk*, *Speculative*, or *Non-Investment grade* that define bonds own a bad rating.

Mortgage bonds are debt securities backed by a pool of mortgages which coincides nearly always to real estates. They are gathered regarding the credit quality of the debtor, that is Prime loans and Subprime loans, along with they are divided beside whether or not they conform to the underwriting standards of a federal agency or government-sponsored enterprise bundling up residential loans to develop residential MBS. In literature, the terminology "loan" plays the role of synonym of "bond" (recall that a bond is virtually a liquid loan negotiable in the secondary market). Many mortgage bonds are held by banks, insurance companies, or other financial institutions such as Fannie Mae, Sallie Mae, Ginnie Mae. The most liquid of the publicly traded mortgage bonds are Ginnie Maes. They ensure the payment of principal and interest on the mortgages and extracts fees for insurance and collection of the mortgage payments. The process of securitization to create ABS (also called *Covered bonds*) involves three major types of assets, which are Consumer Asset–backed securities, Subprime Residential Mortgage–backed securities, and Commercial Asset-backed Securities. A list of instruments falling into Consumer ABS, Subprime MBS, and Commercial ABS is shown in figure 1.8.

Fitch	Moody's	S&P	Summary Description
Investment Grade			
AAA	Aaa	AAA	Gilt edged, prime, maximum safety, lowest risk, and when sovereign borrower considered "default-free"
AA+	Aa1	AA+	
AA	Aa2	AA	High-grade, high credit quality
AA–	Aa3	AA–	
–A+	Al	A+	
A	A2	A	Upper-medium grade
A–	A3	A-	
BBB+	Baa1	BBB+	
BBB	Baa2	BBB	Lower-medium grade
BBB–	Baa3	BBB–	
–*Speculative*	*Grade*		
BB+	Ba1	BB+	
BB	Ba2	BB	Low grade; speculative
BB–	Ba3	BB–	
–B+	Bl		
B	B	B	Highly speculative
B–	B3		
Predominantly Speculative, Substantial Risk or in Default			
CCC+		CCC+	
CCC	Caa	CCC	Substantial risk, in poor standing
CC	Ca	CC	May be in default, very speculative
C	C	C	Extremely speculative
		CI	Income bonds—no interest being paid
DDD			
DD			Default

Table 1.2: Bond Credit Rating by The Big Three Rating Agencies.
Source: Choudry et al. (2014).


Consumer ABS and subprime residential MBS securitizations include:

- home equity loans
- auto loans and leases
- credit card receivables
- competitive transaction tariff receivables charged by utility companies
- manufactured housing loans
- student loans
- other consumer loans such as home improvement loans

Commercial ABS securitizations include:

- trade receivables (e.g., health care receivables)
- equipment leasing
- operating assets (e.g., aircraft, marine cargo containers)
- entertainment assets (e.g., film rights, music publishing royalties)
- franchise loans
- small business loans

Figure 1.8: Securitization assets.
Source: Fabozzi (2012)

Subprime depicts securities with low standing if one takes into account credit score assigned to every individual who purchases assets (e.g. a house in real estate). Prime is conceived as the top grade in severe scales (FICO is diffused to mark people in order to grant loans for immovable properties in the U.S.A.).

1.2.4 The U.S. Bond Market

The U.S. bond market is the largest bond market in the world. Fabozzi (2012) approaches this important market split it into six sectors that are U.S. Treasury sector, Agency sector, Municipal sector, Corporate sector, Asset-backed securities sector, and Mortgage sector.
The *Treasury sector* includes all financial instruments issued by the U.S. government, i.e., T-bills, Treasury notes and bonds. Such a sector is vital in the valuation of securities and the determination of interest rates in all bond markets.
The *Agency sector* is the smallest of the U.S. bond market gathering assets issued by federally related institutions and government-sponsored enterprises. The securities exchanged refers to *agency debenture securities*, debenture bonds that I have described during the explanation of corporate bonds.
The *municipal sector* is the trading venue where local authorities raise funds through municipal bonds. This kind of sector is split into two parts in function of how the interests that investors receive are taxed at the federal income tax level or not. The tax-exempt market is the widest one where interests are not taxable. The taxable sector is used to be a small sector of the U.S. municipal bond market until 2009 when Build American Bond was spread by the Federal government after that its size augmented a lot.
The *corporate sector* is composed of debt instruments put into circulation both by U.S. companies and foreign ones. Firms borrow funds from banks in this sector. Commercial banks that made loans are used to hold them in their portfolio but a full range of

commercial loans are traded into markets nowadays. Investment and Speculative grades represent the two areas of corporate bonds in U.S. debt market. Securities are well classified based on the assignment of a credit rating determined by a third-party.
Asset-backed securities sector permits institutions to bundle loans or receivables to use pools as collateral for the issuance of an asset. Captive finance companies are an example of issuers of ABS, that is to say subsidiaries which supply funding for loans to customers of the parent company to purchase the product manufactured.
In the end, in the *Mortgage sector*, securities are backed by mortgage loans, obtained to buy residential commercial properties. Residential mortgage and Commercial mortgage are the two macro areas of this sector. The first one incorporates prime and subprime loans[16], while the second one collects income-producing properties as a sample industrial properties, including warehouses, health care facilities, office buildings. Nonagency mortgage-backed securities are generally understood to mean the residential MBS not issued by federal agencies as Ginnie Mae, Fannie Mae, or Freddie Mac mentioned above.

1.2.5 Risks to invest in Bonds

We conclude this first chapter of the thesis discussing the principal risks that every trader must consider when he o she is deciding to invest in long-run debt securities namely bonds. Before to explain the risks, it should be emphasized that every bond issue is listed with Committee on Uniform Security Identification Procedures (CUSIP) number composed by nine characters in the U.S or Canada. For other bonds, CUSIP International Number System is applied (CINS).
Bonds like every asset are exposed to *Market risk* due to the variation of their market price. The market risk of bonds assumes the shape of change of interest rate. For this reason, *Interest-Rate risk* is another term used for market movements of bonds. The seller that is the issuer of bonds will probably have a loss if interest rate rises and bond's price declines in value considering that bonds will be sold at a price below redemption value. Market risk depends on embedded options, coupon, and term to maturity because they influence how the price varies in function of interest rate changes.
Currency risk is the risk associated of appreciation or depreciation of exchange rate. To better explain the dynamic of fluctuation of currency, *transaction risk* is the currency risk induced by changes of investor's revenues on a daily basis, *translation risk* instead affects the balance sheet of financial institutions and companies.
Reinvestment risk occurs when a trader decides to reinvest interest rate gained by bonds which suffer from market variability. Consequently, if coupons are reinvested at the current interest rate, bondholder might loss some earning of investment since that interest rate might fall (the additional amount due to reinvestment operation is referred to *interest-on-interest*). If a trader wishes he or she hedged against this risk, *Immunization*

[16] Subprime mortgage crisis started by subprime RMBS loans during Great Recession.

strategy is appropriated to exploit a balancing effect stems from raising of coupons because of interest-rate risk and reduction of them given by reinvestment income. To do that, the duration of a portfolio constituted by bonds must set up to be identical to the duration of liability to minimize *immunization risk*, i.e. the yield that traders want to lock-in will not result in the minimum total return of the portfolio. In a certain way, immunization risk is thought as reinvestment risk. The duration of a bond measures the degree of variation of the price in response of a raising or falling of the interest rate.
When an individual purchases bonds with high nominal rates and early cash flows, or the creditor holds them for a lot of time, reinvestment risk is surely greater.
Credit risk arises when the debtor is unable to fulfill the duty of repayment principal value and any relative coupons. The risk is usually divided in three components, i.e. *Credit spread risk*, *Default risk*, *Downgrade risk*.
Credit spread risk is the risk that variations of credit spread entail a drop of market price of bonds hurting the borrower. The credit spread is the excess premium required by investors to address more risk associated to take a long position in riskier securities (e.g. corporate bonds) than securities issued by safer entities such as government or Treasury (they are virtually risk-free financial instruments).
Default risk regards the risk whereby issuer of bonds does not meet the obligation stipulated by the bond issue. In Italian law, default stands for ”inadempimento” and it is the opposite of fulfilling. Who buys the bond will not be sure that the amount lent and nominal rates will be paid in the future. Thus, understanding when a party is in default in a financial contract becomes crucial because it means that the counterpart is not fulfilling the obligation which is subjected. To give a simple example, an interest swap derivative agreement is signed between two parties, say, part A and part B, where every 30 days, one of the two parties must pay to the other the difference between market price and the nominal amount of the contract. How much A or B must exactly pay? The proper term emerges because let's suppose that A will not provide for that payment, A will default, with the consequence of inducing B to go to the judge to ask to enforce the defaulting party either the obligation to pay or to charge interest on the payment for the delay. The unique possibility is that A is in default though B must have in mind the terms of A. If A fails to perform such an obligation, notwithstanding the order of the judge, another judgment will likely happen before default, stating that A will compensate the counterpart with netting (the offset of the value of payments between two or more parties in a contract, especially for swaps) plus interest and damages due to the early termination of the contract.
Default occurs through defaulting on any notes or loan agreements, violating any representations and warranties, or failing to perform obligations. Situations well-designed for default are the failure to pay or deliver, breach of Agreement, Misrepresentation, rules of default under specific transactions, and bankruptcy (”fallimento”), very common for Italian companies in this turbulent period. Bankruptcy stands for a termination clause dealing with the insolvency of the party, its Credit Support Provider (the entity issues the

credit to the party), or Specified Entities.
The third component of credit risk is Downgrade risk acts as a bridge between credit spread and rating. When creditworthiness of debtor enhances, credit spread tends to narrow and vice versa. Deterioration of credit quality is not a good signal for the market as bonds' price will fall down with a loss for the issuer.
Call risk arises when call provision is activated by the issuer of bonds to drop partially or completely the issue before the term to maturity. The lender is worried about the redemption of the obligation considering the negative effects reflected on him or her e.g. reinvestment risk caused by calling of bond when interest rate is going down, yields and coupon payments are not known with much confidence and bond's capital appreciation decreases due to the maximum threshold, like a cap, that price of callable bond must respect (not greater than the value at which borrower triggers the provision).
Liquidity risk involves the measure of how far a debt instrument is sold from its indicated value which comes from a recent transaction or the last market price. Liquidity is defined as *the ability to trade large size quickly, at low cost, when you want to trade* (Harris 2003). Dimensions that constitute liquidity are immediacy, depth, width, and resiliency, which in turn are influenced by price, size, time, and the ability of prices to go back to the fundamental values. If traders knew and analyzed all information about instruments correctly, fundamentals would be values of instruments. Immediacy expresses how fast trades of a certain size are planned at given costs. Depth is the concept of the size of each trade that can be planned at given costs. Width, or market breath when it is referred to the market, includes costs that traders must bear to negotiate financial instruments at a certain size. Resiliency is the speed at which prices can revert to fundamentals due to imbalances of orders undertaken by uninformed traders (exchanges are often resilient). Fundamental values of instruments cannot be estimated with a precise method; otherwise, uncertainty into financial markets would not exist and everyone who enters into them would gain without any risk. Therefore, how much information are required as well how to collect them make the estimation of fundamentals very technical and not so straightforward (informed traders, above all value traders, are the ideal candidates to do that operation). Markets have liquidity characteristic when there are a lot of standing limit orders, small bid-ask spread, short-selling is allowed, and low levels of volatility (determined by investors' decision and lacking liquidity). Another fact that comports liquidity in markets regards the presence of specialists inside them.
Operational risk arises when negative scenarios occur, but they are not touched to financial environment. This world collects e.g., fraud, system failure. A fraud event was Banca Etruria subordinated bonds. The bank wanted to place its very risky bonds as much as possible to the clients, whereas it should have done the best clients' interest. Placing bonds is not a good starting point for a credit institution, although collecting money from the public is the principal business of every bank. To perform the placement, being a financial

service listed in Annex I of Markets in Financial Instruments Directive (MiFID)[17], all this regulation can be applied. As a result, Banca Etruria needed to implement a valuation or clients' risk profile to place such bonds.
The most important deliverable documentation is the prospectus, even though it resulted in being too much difficult to understand by the retail clients. Key Information Document (KID) is more simple to read and comprehend since its index-related nature. KID will be included in MiFID II binding in January 2018. Nevertheless, Banca Etruria was able to meet all the retail clients after computing their risk profiles and changing them from low to high levels to place its harmful bonds. A lot of Banca Etruria branch managers were investigated to have done this fraud.
Volatility risk cares the worries that bondholders face when the volatility of interest rate goes up producing a negative impact on bond's price. In particular, callable bonds of MBS have the worst prices when volatility starts to raise because of the presence of an option, with the form of a call provision, whose value raises if uncertainty strengthens because the trader bears more market risk via volatility increment (especially in the short-term). As a consequence, the buyer leaves a more valuable option to the seller.
Basic risk is one of the main risks linked to purchase bonds that jeopardize lender's financial position when a specific risk exposure in security is hedged via an asset whose attitude is equal to that original.
Concentration risk is possible in circumstances where financial institutions or corporations make investments in a single type of bonds, or in a precise market. Diversification helps traders to overcome the problem.
Pre-payment risk might begin if ABS claim the enforcement to repay early the residual debt with the risk to address reinvest income if interest rates go down during that period.
Government bonds are subject to risk too. The default of a government or a country may let it not to fulfill the obligations due by investors. Such a risk is referred to *Sovereign risk*.
Finally, even the risk to not figure out or know the main risks, challenges, and imbalances which take place for purchasing debt instruments will probably constitute a huge problematic for lenders, banks included.

Before to pass to Great Recession that will carefully discuss in the following chapter, I argue that liquidity risk must be further explained since liquidity meaning is confused with market risk many times, along with no fairly definition of liquidity appears in literature. Choudhry (2010) considers two completely different fields that portrays liquidity risk. He suggests that *liquidity risk is the potential risk arising when an entity cannot meet payments when they fall due. It may involve borrowing at an excessive rate of interest, facing penalty payments under contractual terms or selling assets at below market prices (forced sale risk). It also refers to an inability to trade or obtain a price when desired, due to lack of supply or demand or a shortage of market makers.*

[17]MiFID is the main directive, i.e. a set of general rules, that EU Financial markets adopt.

A basic thought on liquidity engages the level of an asset to be rapidly traded with any effect on the market price of that security. Liquid bonds holding by investors may be sold until the term of maturity at a fair price according to liquidity concept. Factors that influence to a certain extent liquidity risk will be better investigated. Nature of issuer depicts an important piece of the bond's characteristics puzzle again in light of if the entity that issues these debt securities is high standing, there is a high probability that bonds will be liquid.

Size is one of the four dimensions of liquidity having the positive effect to augment the degree of liquidity of instruments.

Embedded options make bonds less liquid due to the fact the traders who buy bonds to hold them until the maturity, they wish they had an "insurance" on the future coupon payments, which in turn it is impossible to obtain if provisions are inside debt instruments because of the redemption chance is given to the issuer.

Currency is another meaningful variable for liquidity risk that conducts not to purchase bonds express in a given currency if traders suspect that it will face a depreciation against another currency. Bonds with a particular currency could be cheaper than another kind of debt instruments, notwithstanding this, agents will not choose to buy them.

Denominations tend to make bonds illiquid when the minimum size negotiable by each agent in financial markets is singled out.

A narrow bid-ask spread is viewed as the presence of liquid bond markets.

The existence of liquid bond indexes, other than a small group of investors affects positively the liquidity of bonds. The time elapsed from the issue of bonds negative influences liquidity. Many bonds flow into portfolios of long-run investors after a remarkable time frame.

Chapter 2

The Recent Global Financial Crisis

2.1 Why are Markets so Uncertain? A brief explanation.

We have analyzed meaningful channels whereby entities are willing to borrow or lend funds. Governments, banks, investment banks, and firms undertake financial debt instruments to do that. Bonds play a crucial role in the operation thanks to large benefits debtors employ for the aim of improving their indebtedness condition. Unfortunately, drawbacks must be taken into account every time we conduct a trade considering that the financial world is risky; differently, a vast range of assets would not exist, and cut-and-dried earnings will occur.
Let's suppose that a unique risk-free asset with a yield of 3% is available to an individual whose capital equals to $ 20,000. The agent recognizes there is always the opportunity to borrow at a rate coincides with asset's yield. For simplicity sakes, investment horizon is articulated in two periods, say, period 1 and period 2. The question raised is: How much should he or she save and consume to maximize the surplus? Once again, microeconomics literature helps us to investigate the problem and find out a solution. To calculate the optimal combination of investment and consumption which provides the best welfare for him or her, one must consider indifference curves express preferences of the individual across periods. Inside each curve, he or she has the same satisfaction grade, so the consumer is characterized by an indifference attitude vis-à-vis instrument combinations along a certain curve. Let's hypothesize that the utility function of the agent is represented as follows:

$$U(c_1;c_2) = ln(c_1) + (1+r)ln(c_2)$$

where c_1 and c_2 indicates consumption at periods 1 and 2 respectively, r the interest rate of such asset. The tangent point between budget constraint and indifference curves will be located to reach the optimum consumption-investment equilibrium. To do that, we have to impose the derivative of utility function rewritten in terms of c_1 or c_2 only be equivalent to zero and simultaneously the sum of consumption at time 1 and the present value of c_2 must

be set no more than the consumer's capital. Therefore:

$$c_1 + \frac{c_2}{1+r} \rightarrow c_1 + \frac{c_2}{1.03} = 20,000 \longleftrightarrow c_2 = 20,600 - 1.03c_1$$

$$\frac{\partial U(c_1;c_2)}{\partial c_1} = \frac{1}{c_1} - \frac{1.0609}{20,600 - 1.03c_1}$$

Putting the partial derivative equals to zero:

$$\frac{\partial U(c_1;c_2)}{\partial c_1} = 0 \rightarrow \frac{1}{c_1} - \frac{1.0609}{20,600 - 1.03c_1} = 0 \longleftrightarrow 20,600 - 1.03c_1 - 1.0609c_1 = 0$$

$$\rightarrow c_1 = \frac{20,600}{2.0909} \simeq 9,852$$

Substituting the value of c_1 just computed in the first constraint, one obtains:

$$c_2 = 20,600 - 1.03c_1 = 20,600 - 1.03 \times 9,852 \simeq 10,452$$

A is the equilibrium point in the below figure:

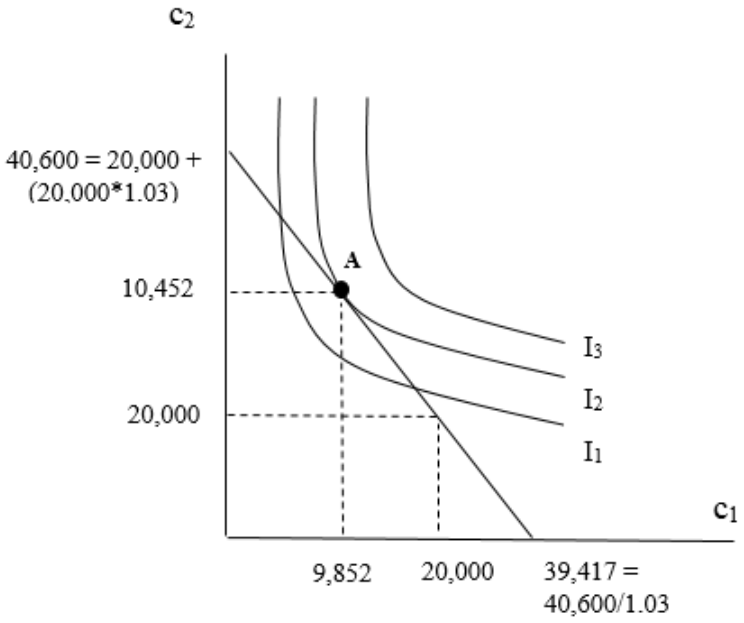


Figure 2.1: Optimal Choice of the Investor.
Author's elaboration.

The individual prefers to allocate the capital on I_2 because it guarantees him or her the ideal balance to reach the maximum surplus by the investment. To understand this thought, let's consider I_3, for instance. Since the individual is risk adverse as concavity of utility function and the great quantity of consumption at time 2 indicate, the consumer would always be attracted to the farthest curve from the origin, but there is no investment chance on it noting that the agent would find himself or herself outside the budget bound.

In addition, if another risk-free asset with a higher yield would be offered to the individual, it will always be chosen as alternative respect to the initial one.
This straightforward example states that in a world without any type of uncertainty and risk, even if trivial, traders will purchase the most profitable instrument without a doubt. The real financial markets are naturally risky and tough. When we buy bonds, particular risks could occur although the issuer is the government or federal authorities. Such risks have minutely discussed in the final part of Chapter 1.

We will tackle one of the worst economic-financial episodes happened ever, the *Great Recession* in the following section. I maintain that the recession must be taken into consideration because it detected a relevant driver of the *European Debt Crisis* started in the Eurozone countries in the wake of the Great Recession ascension.

2.2 The Great Recession

2.2.1 Introduction

The first decade of the twenty-first century was a complete disaster for economy and finance throughout the world due to a sudden massive recession which brings the world to its knees. At the same time, the recession is not a new concept since almost each age includes a negative period. What is exactly a recession? I explain it to the reader based on the definition reported by Keeley and Love (2010): *A recession is a period when an economy grows more slowly or shrinks (sometimes called "negative growth"). In technical terms, it is usually defined as two consecutive quarters - that is six months - of economic slowdown or contraction*. The negative feature of the Great Recession is that the turmoil stemmed from a set of complex situations led to a banking crisis. The effects were more severe than negative growths caused by inflation. The economy shrunk twice or triple than normal recessions. However, the Great Recession was very similar to a precedent crisis started in the U.S.A. in the aftermath of the World War I, *the Great Depression*. The cradle of the recent recession was precisely the U.S.A. where a bubble in real estate prices elicited the borne of this financial catastrophe. When people experienced it personally, they did not have the tools and ability congruous to track down the real cause hurt them. Was illiquidity, insolvency, or inequality the dominant force of the global upside down? I will throw light on the proper motivation linked to such a recent negative far-reaching episode.
Academics and practitioners supplied theories, which conflicted each other sometimes, to uncover the plague of events which damaged a lot of countries [1]. I claim that low interest rates applied by the Federal Reserve System (or the Federal Reserve, FED hereafter) after the "dot-com" bubble, low interest rates Japan applied to rescue itself from the "Lost Decade", with the consequence of the emergence of "yen carry trade" which stimulated purchasing of U.S. debt instruments carried out by the national central bank, other than the impact of China and oil prices shock are the principal channels which contributed to spread the sentiment that a harmful period of strong imbalances and volatility will be coming into markets. All of them imposed a quickly falling of U.S. housing prices combined with the deterioration of subprime mortgage securities' prices. The recession was a sort of "surprise" for many policymakers, traders, and multilateral agencies. A wide range of academics was shocked too. In the next section, we will pay attention to the history of this recession.

[1] Some states, e.g., India and Australia, were not much influenced by the Great Recession. We will better see it in the subsequent parts of the chapter.

2.2.2 Facts occurred previously

Congdon (2015) reports that *the National Bureau of Economic Research has given the start and end months of the Great Recession as December 2007 and June 2009*. The period leading up to the banking crisis was subjected to debates between who pointed out that a quiet volatility was established inside markets (the *Great Moderation era*), and those maintained the recession was born due to some trends originated by the absence of growth rates in emerging and developing countries in the 1980s and 1990s, the *Lost Decades era*, or by the boost of oil and food prices began in 2002 and lasted for the fourth quarter of 2007, during the so-called *economic boom* which launched *the Crisis-Before-The-Crisis era*. Verick and Islam (2010) outline the expression *Great Moderation* created by Ben Bernanke, FED Governor at the time, referred to Organization for Economic Co-operation and Development (OECD) countries in the period from the epoch immediately after the 1970s energy crisis[2] to the burst of the Great Recession. Bernanke, at the meeting of the Eastern Economic Association in 2004, underlined that *fall of macroeconomic volatility can be attributed to structural changes... and improved macroeconomic policies*. For example, technology shift was one of the structural changes. Nevertheless, the authors are skeptical about the Bernake's statement because they argued that *this view contributed to the dangerous underestimation of risk (namely that low levels of macroeconomic volatility would continue), which was a major factor in the build-up to the crisis*.

I maintain Bernake's assumptions seem to be plausible by the monetary policy forced by the FED to low interest rates at the historical minimum levels, albeit the main limitation of him theory lies on negligibility of the gust of high instability delivered exactly by the economic boom. I agree with the Lost Decades view instead of the other school since the world did not be very stable as one could suspect.

A common outlook for the period between the end of the 1990s and Q4 2007 was a leap of growth in developing countries. On the other hand, "dot-com" bubble crashed in 2001, letting a lot of companies with losses on market capitalizations or they defaulted. Bubble describes, in technical jargon, a seesawing economic cycle realized via the jump of asset prices which finishes with the tumble of them. The origin of that technology bubble is dated back to 1995 when share prices in the Internet and Information Technology (IT) fields rocketed. Such a boost affected interest rates and unemployment to slip, matched with credit improvement due to traders wanted to buy more stocks with the hope to resell them at greater prices. The underestimation of risks of the bubble induced shareholders to purchase stocks increasingly as long as the FED augmented interest rates in 1999-2000. Investors recognized a downward peak in the technology–heavy NASDAQ index and the bubble collapsed. Figure 2.2 displays the technology shares blow during the "dot-com" bubble time.

[2]In the economic history, the general accepted use of the term Energy crisis refers to the turbulent period the main industrial countries addressed petroleum curtailments which came up the 1973 oil crisis and the 1979 energy crisis entailed stagnant economic growth and price inflation, better known as *stagflation*.

However, the positive sentiment about raising prices during the economic boom was driven by the vivacious market behavior of traders, what Congdon (2014) indicates with the name *Animal spirits* when he cites Akerlof and Shiller (2009), who are willing to buy at high prices because they are confident to sell instruments with a profit in the future, independent of their fundamental values. If no agents want to trade at great prices anymore, they will liquidate assets causing the bubble contraction and then its blast. Nonetheless, the globe lived a flourishing period derived from an increase in consumption in OECD countries by means of a strong upward trend in private capital flows, exports, and the funds originated by expatriates sent to their borne country, the so-called ”remittances”. In the developing states, exports and investments portrayed the role of benefactors to stimulate expenditure, even if food and energy price shocks took place close to the recession shown a wider threshold of poverty. As the life teaches, overoptimism will bring to make some mistakes sooner or later, especially in countries where economic and financial sectors are not so developed. The major drawbacks of the antecedent period of the Great Recession were a mix of the effects of trading, consumption, and investments improvement which masked the hint of the downward spiral, blended with sticky wages. I will discuss the unambiguous signals the economy provided markets to advise them of the incoming recession infected population as a whole.

Figure 2.2: NASDAQ Technology Index during ”.com” bubble.
Source: Dzikevicius and Zamzickas (2009).

The pillars had built up the base of the Great Recession were erected in the aftermath of the ”dot-com” bubble deflation.
First of all, the FED started to implement a cut interest rate policy attached to financial instruments. To promote individuals and firms for borrowing money, U.S. Central Bank carried out this act which pushed economy and spending up according to the increase of loan and house prices, albeit salaries did not augment. Consumption increased via drawing into families capital. The situation remained dangerous in developing countries considering even the oil and energy shocks which struck prices of those goods during the dawn of the crisis, locking-in growth and damaging populations left into a poverty status which was fed by the improvement of demand for many commodities in emerging countries (e.g. the so-called BRICS, an acronym stands for Brazil, Russia, India, China, South Africa, or CIVETS which denotes Columbia, Indonesia, Vietnam, Egypt, Turkey, South Africa), China especially.

Japanese Central Bank adopted a reduction of interest rates, that is to say, a policy similar to the recipe the FED created, to clean up the effects of the ”Lost Decade” (Japan was an interesting actor inside the Great Recession period). Let’s illustrate the dark period which undermined the country at the end of the 1990s. The term ”Lost Decade” regards the last decade of the previous century when Japan was facing problems of output growth closes to zero, a slight deflation, and public debt jumped above the 100% threshold of Gross Domestic Product (GDP) in 1997. The Land of the Rising Sun experienced the high level of debt in that year principally because of a positive trend in stock prices and the establishment of a real estate bubble in the last years of the 1980s. We have to bear in mind that bubbles always weak the sectors within they set themselves up, financial and real estate markets in this case. Japanese government promptly responded with a downturn in interest rates and a plunge of fiscal deficit. Remembering that where there is a recession, local currency falls, deflation was superior to interest rate decrease, imposing an appreciation of the yen real exchange rate (RER) which weights the readjustment of the nominal exchange rate in response to price movements. RER measures the relationship whereby goods can be exchanged among two nations. From a mathematical point of view:

$$RER = e \times \frac{P_{domestic\ country}}{P_{foreign\ country}}$$

in whom e is the nominal exchange rate estimated dividing foreign currency and local one.
Japan was not wondered why its financial sector was performing so poorly. I underline the ”Asian Contagion” in 1997 exacerbated Japanese banking system and each consolidation plan to halt the upsurge of national public debt. Therewith, exchange rate rose substantially without restrictions. It is worth noting that if a government is in trouble, four different policies are available to overhaul the debt. Such tools are *Fiscal policy*, *Monetary Policy*, *Public Debt Policy*, and *Industrial Policy*. When the government tries to raise its spending and low taxes, expansionary fiscal policy is in progress. Public debt has a proper

inclination of increasing when the occurrence of a negative growth emerges. Looking at all recessions people lived so far, the government earned less during a crisis than a boom period or in normal conditions because taxpayers attempted to avoid or mitigate tax payment. Furthermore, unemployment benefits designated by the government strengthen, where the phenomenon is linked to *Automatic stabilizers*[3]. I suppose that subsidiaries might prove to be truly helpful in the short-term and for countries in which labor market is flexible, i.e., layoff is permitted without legal consequences (like in the U.S.). My hypothesis takes inspiration from Fisher Equation and *trade-off* among unemployment and inflation which Phillips Curve shows. Irving Fisher discovered a relation between the nominal interest rate (i), that is the interest rate corresponded from banks, the real interest rate (r) which stands for the increase of purchasing power, and the inflation (π). He argued that the sum of r and π is equal to the interest rate of the banking sector. Equation 2.1 illustrates this relation from a mathematical perspective:

$$i = r + \pi \tag{2.1}$$

Phillips highlights that if policymakers tend to amend economy in the short-run, unemployment will go down, while inflation will upturn. Vice versa, if a contraction of output occurs, it will influence in negative terms unemployment, whereas inflation will decline. Rearranging Fisher equation: $\pi = i - r$. As a result, when the FED lowed interest rates, it acted on the nominal ones, declining inflation, and rising unemployment. Criticisms surrounded Phillips Curve which did not predict *stagflation* during the 1970s when output was keeping below the long-run natural equilibrium. Despite that, such a curve is still a great instrument which economists employ to predict economical macro fluctuations in the short-term, with some improvements. The modern version includes the substitution of inflation rate with salaries increment, the inclusion of expected inflation (thanks to Milton Friedman and Edmund Phelps) and supply shocks.
Conversely, states, e.g., Ireland or Hungary, decided to take the opposite direction declining government expenditure and growing taxes.

Monetary policy collects interventions usually implemented by central banks to control liquidity and interest rates in the economy. Acquisition of public bonds or liquidity injection are the most common forms which composed this field. Japanese central bank decided to adopt quantitative easing after the ”Lost Decade”, which is an unconventional class of monetary policy to reduce the value of interest rates through the purchasing of sovereign debt securities or other instruments from the market, along with the raising of money supply within the economic system.

[3]Economic policies or programs useful particularly to counterbalance economic variations of states without isolated policymakers or government interventions. In general, they gather transfer systems, unemployment subsidiaries, corporate and personal taxes.

Public debt policy consists of government debt management to enhance it and reduce state's vulnerability to domestic and external shocks. International Monetary Fund (IMF) and World Bank in *Revised Guidelines for Public Debt Management* (2014) stated that *Public debt management is the process of establishing and executing a strategy for managing the government's debt in order to raise the required amount of funding at the lowest possible cost over the medium to long run, consistent with a prudent degree of risk.*

The industrial policy comprises measures taken by the government to motivate companies to relaunch their manufacturing or service provided with the hope an incentive will happen at the economic improvement. I believe this is the tool of last resort for the government which seeks to deprive the output of a steady situation since it is sector-specific many times, even though import-substitution-industrialization represent a wider policy trade in whom some barriers are imposed on some industrial sectors.

Japanese monetary policy was mild during the "Lost Decade". Then, "dot-com" bubble driven the country to adopt other corrective instruments such as quantitative easing, banks recapitalization, liquidation of bad loans, and the setting of interest rates close to 0 in 2001. These tools alleviate the debt-to-GDP ratio which regrettably stayed at 185% GDP level. Notwithstanding Japan done its utmost, the Great Recession brought back the Land of the Rising Sun to a context equivalent to that already undergone. As money could be borrowed at no costs given small interest rates, speculation became attractive feeding the buying of foreign assets, in particular, Treasury bonds. The wave of Japanese speculators augmented money in circulation and created an essential pillar for the borne of the U.S. recession.

Large exports of China contributed to constructing another pillar from 2002 to 2007. Chinese exports worsened the U.S. economic and financial position due to its net worth created by intensification of good sales abroad and deterioration of imports.
The final pillar links emerging and developing states located especially in Asian continent with the U.S.A. since the unforeseen oil price leap led funds of those countries to be transferred to this latter.

As one can understand from the paragraph, U.S. markets were stable at all over the economic boom. This is the proof of my disagreement with the Great Moderation theory. The subsequent goal will be to pick up the seeds of the causes fashioned the Great Recession.

2.2.3 Causes - Bank Insolvency versus Bank Illiquidity

The way to cover to understand the roots of the Great Recession is far from the ease. I will attempt to be as clear as possible. *The key of the recession was the insufficient work done by the U.S. mortgage industry to prevent the subprime mortgages crisis*. Before the appearance of the negative growth, U.S. banks took care to assess the creditworthiness of who asked a loan because they were fostered to carry on this practice. We focus on the mortgage area being the container provoked the inception of the disaster. U.S. government pushed citizens to purchase immovable properties thanks by amendments and structural changes enacted in 2004. To recall the fundamental ones, American Dream home-owning policy that George W. Bush established in order to sustain the poorest people to receive a house, new tight rules forced to Fannie Mae and Freddie Mac (two government-sponsored enterprises very active in mortgage sector) caused the institutions to design and build other entities to sell their loans which in turn pay them money and allow to have collaterals, in other words, to securitize the assets. Instruments created were *Structured Investment Vehicles* (SIV) and *Structured Purpose Vehicles* (SPV)[4]. Finally, Basel II proposals, which favored securitization process, along with the enhancement of oversight enforced by the SEC against investment banks, which even produced benefits for them as falling down their capital requirements and increasing fundings into the mortgage industry using mortgage securitization.

All these actions made lending more feasible for everyone was looking for a financing to buy a house, other than the abuse of usage of RMBS. Banks were not worried about default or bankruptcy of their debtors as loans did not longer be appeared in assets of balance sheets exploiting the innovative debt instruments transformation. When credit institutions lent money, the loan was quasi immediately left to SPV or SIV which transformed it in a marketable debt security. The practice of granting loans or credits and selling them to be securitized is often labeled as the *originate to distribute model*. The securitization could be run by investment banks as well, though this could impose on banks and other firms handling mortgages to probably suffer from losses if they were not able to pass their loans to such financial institutions (whereby commercial banks started to make securitization by themselves). Bundling mortgages and tranche them, diversification advantage was given to banks and bore risks influenced by the level of tranches. Junior, or mezzanine, tranches are the most exposed to default expenditures due to low priority on claims. The framework seemed to work well as long as tranches began to be sold off. As Allen and Carletti (2010) stress, Purnanandam (2009) had discovered that mortgages lost a certain degree of quality respect to when credit institutions did not exploit securitization. Another aspect we cannot overlook regards reliability of credit rating agencies.

[4]SIV are a pool of securities such as mortgages whose goal is to make profits from the spread exists between short-term debt and long-run structured financial instruments such as ABS or MBS. SPV are subsidiary companies having a legal status, and they guarantee that obligations will be backed even in case of default of the parent company.

After the recession, lawsuits and inquiries emerged. To give a sample, S&P had to comply with the payment of 1.5 billion of dollars in February 2015 since it was accused by the U.S. Department of Justice to have performed a fraud. The rating agency altered the credit risk of some instruments and lots of traders, especially mutual fund firms obliged to trade assets safe enough (top four of the rating scale or at maximum BBB securities), bought them unaware of the damages exhibited after the buying. Even Goldman Sachs fulfilled the obligation to pay 5.06 billion of dollars to the U.S. Department of Justice for packaging, securitization, and sale of RMBS during the Lost Decades period.
Allen and Carletti (2010) state that *according to the mortgage incentives view of the crisis, the whole procedure for checking the quality of borrowers, and the mortgages underlying the securitization broke down... If the government regulated the mortgage industry to ensure everybody had the correct incentives, then this would prevent the problem in the future.*

One question remains unresolved: What was the main cause of such negative growth? As the reader can anticipate, a huge bubble in U.S. real estate market. The bubble is certainly born after the FED dropped interest rates in the middle of the economic boom. House prices started to go up, and American people had got a stimulus to ask loans with a narrow interest rate (1% about). Meanwhile, house prices were beyond raising. Additional incentives concerned tax advantages which came from the deduction of interest on mortgages. The demand for immovable properties switched abruptly with a jump ever seen in the history. Another contribution arrived from the credit boom during the Lost Decades. I believe predatory lending[5] is a tile of the loan slump puzzle in view of brokers were searching for individuals who needed credit for real estates, they promised to offer a sequence of loans with a reward destined not for clients but themselves. After having uncovered the important driver of the crisis, there is necessary to dig up the factors which contributed the wave of the recession to come to light. I propose the subsequent scheme which illustrates the key drivers of the Great Recession efficiently.
The actors that have conditioned the crisis both directly and indirectly were for that reason families, financial and housing markets, U.S. Government with its lax regulation, feeble monetary policy, combined with the worldwide deficits and interconnections in global financial system. Undoubtedly, narrow interest rates and the misuse of securitization damaged U.S. markets.

[5]The operation carried out frequently by brokers to assist or persuade a debtor to contract an obligation, in the form of mortgage, to obtain high fees or interest rates. Other practices have the shape of taking away the borrower of equity or placing him or her in a lower credit rated loan that benefits the broker.

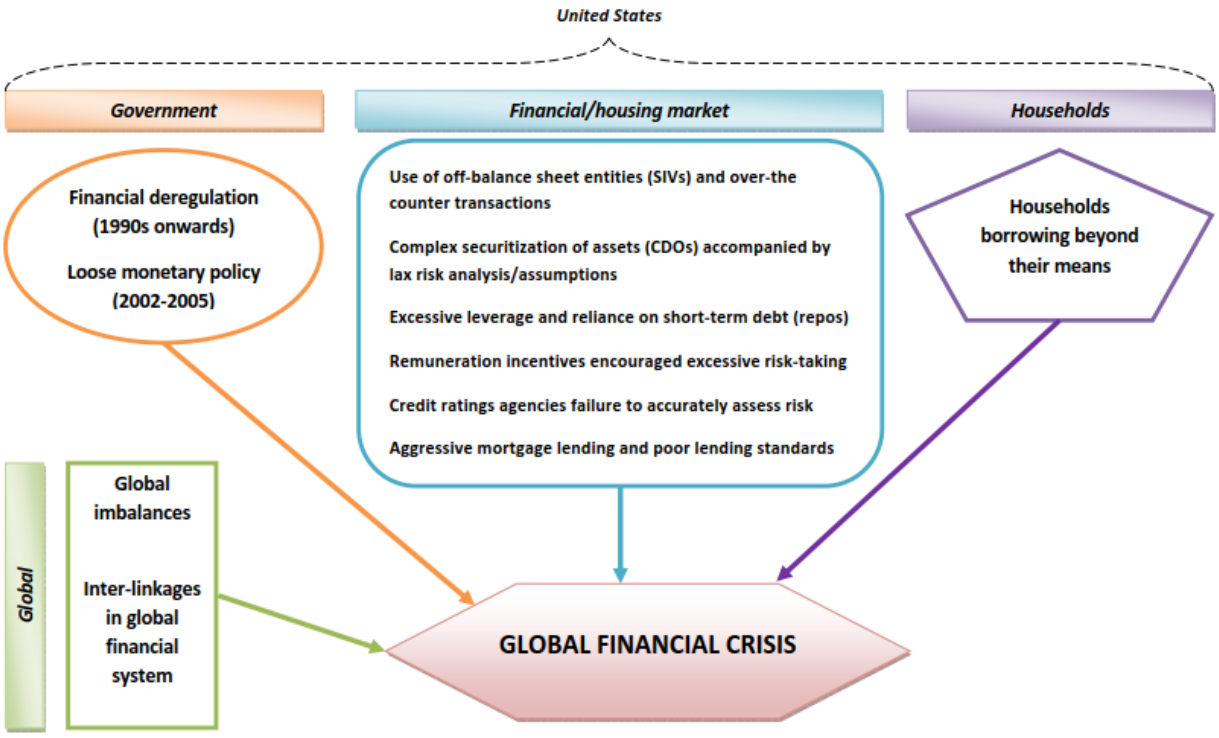


Figure 2.3: The Great Recession Factors
Source: Verick and Islam (2010)

The debt instruments whose underlying coincided with a pool of mortgages were much used (banks and investment banks traded a large volume of them) simply to pass the risk of loans to somebody else to earn profits generated by purchasing them and reselling later in exchange for an upfront fee[6]. All categories of ABS had a reference with subprime mortgages during the Great Recession, to wit loans with a very low credit score associated to the debtor. As one can find out, there was a tight connection between the *housing bubble*, indicating the bubble evolved in the real estate market in the 2000s, and subprime loans. When households and firms unmasked that barriers imposed on loans crumpled, they initiated to borrow freely considering the only collateral banks worthed was immovable properties, not whether the client would have been able to repay the principal and interests accrued. Consequently, lending to individuals rated "subprime" upturned enormously without financial regulation did something to quiet the *subprime mortgage phenomenon*.
The instruments mostly exploited for loan sale activities were RMBS, CDOs, and CDS. In the first chapter of the thesis, we deal with ABS, securitized assets which experimented an incredible diffusion formerly before house prices acme. RMBS were the cornerstone of the subprime meltdown. They represent ABS where the underlying layer holds mortgages allowed retail clients, not companies. Since interest rates ranged from 0% to 1% after the technology bubble, agents needed to invest in financial assets with a higher yield than securities issued by Federal authorities. The request for prime loans was dried up, convinced U.S. traders to switch to vary subprime loans such as No Income No job No

[6]In broad terms, the upfront fee can be defined as a charge imposed by a lender for processing a new loan.

asset (NINJA) loans in whom borrowers will be suitable to a concession of a credit or loan despite they do not have a salary or an employment; Adjustable Rate Mortgage (ARM) loans where the debtor pays a certain amount of money estimated contemplating the financial capability only and for the first period of the credit, say, 3 years, then the repayment assumes a diverse structure and obligates the borrower to restore the principal plus any relative interests; Payday loans which anticipate to the borrower a specific amount of the salary given to payday shops, triggering a sort of vicious cycle due to the necessity the debtor reveals to ask a further Payday loan to comply with the reimbursement of the previous one. All subprime loans were the basis of the creation of RMBS via the securitization procedure. How does it work? I will delineate the crucial stages. Initially, the bank grants loans and put them together waiting for a purchaser who is willing to satisfy its divestiture. Accordingly, the SPV, created by the bank most of the times, acquires loans by collecting money from the market to have sufficient cash, in a transaction called *true sale* which ensures mortgages will be backed even in case of the bank's default. The operation goes on, the bank receives the amount of cash yielded from the sale of loans, enabling it to make other credit concessions. Finally, the SPV transforms loans in ABS subscribed by investors and the cash raised is addressed to the bank. Once ABS comes alive, who buys them bear the same risk to purchase mortgages, with the difference that the intrinsic credit or default risk belongs to investors now. To sketch the hard-working process to securitize residential mortgages into safe high-yield assets, figure 2.4 appears convenience.

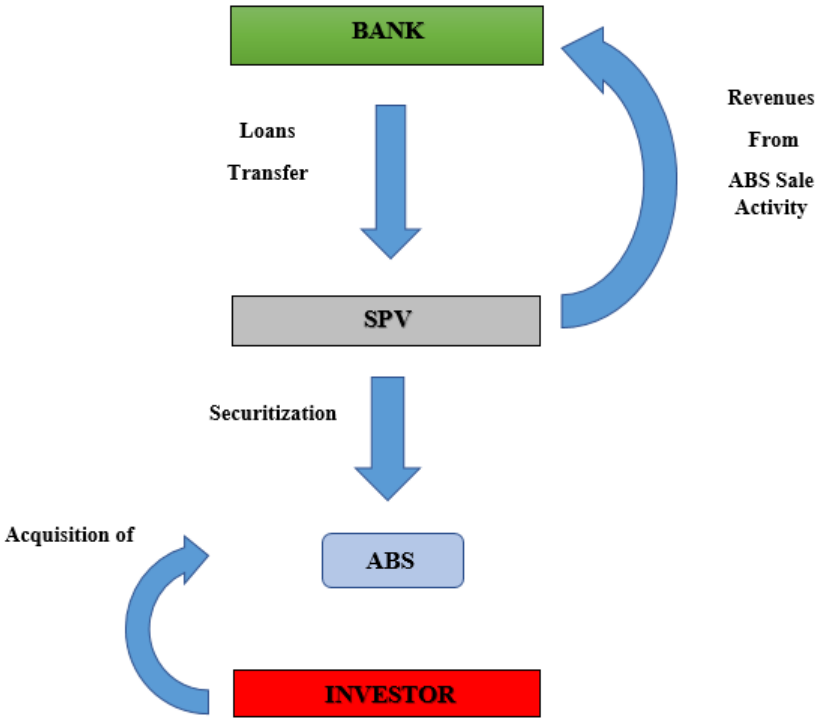


Figure 2.4: Securitization Process.
Author's elaboration.

RMBS became a basis to construct other backed securities. CDOs were devised via the securitization of RMBS because they claimed to give banks higher yields than ABS obtained by residential loans. CDOs were rated with top grades due to the collateral CDS provided. Hence, pricing of securitized instruments shown not to be so simple. CDS are derivative instruments, in other words, swaps belong to credit derivatives family, which typically employ a broad range of RMBS as underlying to transfer the credit risk exposition of specific financial assets (more precisely, debt instruments) to one or more other parties. The entity purchases CDS must give a flow of premium payments to the seller until the maturity date. When issuer's default occurs, the buyer will receive default payment by the short party which comprises the premium of the security and interests would have been originated from the default to the expiration date. The issuer of such swaps is also called Reference entity. Short selling a bond of the issuer could be seen as the same activity to purchase a CDS, this latter calls for actually more risk due to both the leverage position[7] that the long party must hold up, and the payments carried out to the seller. Traders were attracted towards these high-grade instruments, for speculation purposes too, causing the famous *subprime meltdown* which contributed to expanding the recession. Thus, the Great Recession launched as a real estate market crisis translated itself into a banking crisis following the subprime breakdown. Throughout the chapter, I have used the expressions "recession" and "crisis" as synonyms. This is not completely correct since the crisis is referred to a dangerous, unforeseeable and variable situation which hurt a population under several aspects include industrial, environmental, economic-financial, and social-political spheres. A recession is usually a consequence of a crisis.

The particularity of the Great Recession given rise to the drastic modification of how banks had to do their work. The consequent banking crisis fixed the world in a tough position from which to recover because the tools to rid countries from a global financial recession solicited lots of years and much effort. I will carefully list the acts that governments and institutions afforded to solve the issue in the final part of the section.
Shadow banking was preferred to the traditional system performed by commercial and investment banks given that it admitted the refusal of responding to requirements which financial firms must satisfy in normal circumstances. The non-regulated system developed concurrently with the securitization, can be thought as the lending business financial institutions effectuated each other outside the bounds imposed by common banking network. Investment firms, hedge funds, insurance companies, and pension funds were the actors behind such a "shadow" environment which grew fast over the recession. They could lend without be banks, in spite of they held on the same risks. To operate without limits was very suitable for every company which allowed loans and made the securitization. These financial intermediaries were not detected as banks by reason of they

[7] From a purely financial point of view, to long on a CDS is similar to buy a put option on credit rating of the reference entity.

did not subject to regulatory authorities supervision, being free to use higher liquidity, credit, and market risks not commensurate with capital provisions. Shadow banking avoided conventional deposits integration to favor deregulated trading of CDS or unchecked practices of regulated firms. No barriers and shortages which regular banking system owned during the crisis let investment banks build up capitalized companies to position owned directing businesses within them. High leverage, short-term fundings, risky securities, inadequate liquidity, and no federal backstop marked the fragility of commercial banking and the encouragement to opt for a more efficient system to complete financial firms aims. After the subprime downfall, shadow banking came under scrutiny and regulations. While the Great Recession was protracting, shadow banking collapsed. Adrian and Aschcraft (2012) claim *The collapse of shadow banking institutions and shadow banking activities occurred both on the asset and liability sides. On the asset side, the main issues were the underwriting standards. On the liability side, the main issues were related to the fragility of wholesale funding. As a result of these fragilities, the government sector set up a variety of backstops for the shadow banking system. These backstops consisted of both liquidity facilities and solvency guarantees.*
I state this form of banking was one of the components of the 2008 recession spread, and it should have been more monitored since securitization was guarded by lending among deregulated financial intermediaries. The mitigation of the banking crisis, at least partially, would have been possible if some little reinforcements were binding to the traditional system of banks. The negative growth changed expenditures radically for households and firms. People lost confidence about the economic condition driven by volatile markets which could have drastically undermined their savings inducing to spend less. Companies were hostile to make investments; returns fluctuated too much to brave uncertainty. Loans resulted expensive after the subprime turmoil, *credit crunch* was stabilized, halting the ”generous” lending which handsomely characterized the pre-crisis period.

The blame of all facts which led to the banking crisis seems to consolidate to commercial and investment banks. Condgon (2014) compares two approaches where one of them is many times reported by media and policymakers. He distinguishes the *Mainstream Approach*, in whom ”mainstream” emphasizes the common outlook of the crisis delivered to people, and the less famous and known *Monetary Interpretation*. I have wanted to deal with Congdon’s analysis as it offers the reader skills to criticize the common perspectives make available to clarify why OECD, developing, and emerging countries are even now suffering the severe damages of such a negative growth.
The *Mainstream Approach* crux rotates around the banking crisis begun when the international interbank market stopped in August 2007, implicating a credit crunch for financial institutions and the borne of insolvency problem which hit banks. The frame of the theory thus relies on insolvency which was fostered by Lehman Brothers default on September 15, 2008. Lehman Brothers was a big investment bank founded in 1850 as an

Alabama cotton broker. Its operations were transferred to New York after the Civil War. In the 1970s, the investment bank almost the bankruptcy after the paperwork crisis. The merger took place between Lehman Brothers and another investment bank, Kuhn Loeb, in 1977. In 1984, the institution was subjected to a crisis and Shearson/American Express acquired it for 360 million of dollars, to be spun off in 1994. Liquidity difficulties impaired the bank in 1998. Rumors about the liquidity crisis concerned large losses from economic crises occurred in Asia and Russia in that period. Furthermore, impossibility to roll over[8] commercial papers and RPs emerged. Yet, Lehman Brothers perked itself up from the bad scenario, taking advantage of real estate affected by a bubble at the starting of the 2000s as we have seen in the previous paragraph. In 2003, mortgage-backed holdings amounted to 39 billion of dollars and expanded beyond 111 billion in 2006. Such a prosperous period for the investment bank did not last for a long time. On March 17, 2008, shares of the firm dropped significantly, exactly the day after the Bear Stearns breakdown. Having large short-term assets and liabilities, Lehman Brothers tried to finance them with the aid of short-run RPs on a daily basis. The risk the investment bank needed to account assumed a ”counterpart form”, to be more precisely, if the short party of repos transaction would have been refused the obligation performance, the firm should have closed down the business. The anti-sentiment against Lehman Brothers developed on September 8 of that year being accused by its counterparties. The following day, JPMorgan Chase, a U.S. multinational banking and financial services holding company, asked for a collateral to support the credit line of the distressed bank but results were vanished because of an insufficient amount of money was raised, leading Lehman Brothers disclosed a loss of $ 3.9 billion in the third quarter. The crash took place at the fifteenth of such month due to the refusal of Henry M. Paulson, the CEO of Goldman Sachs at that time, to touch off government funds operation to help the investment bank. Goldman Sachs is the most likely impressive investment bank all around the world. In my opinion, a recovery plan was necessary to prevent Lehman Brothers default and consequently the subprime mortgage crisis.

Going back to the mainstream approach, the bankruptcy of one of the most significant investment banks muddled entirely the financial environment. Estimated losses were equal to 600 billion of dollars about. The banking crisis established itself with the backing of an increasing confidence toward the financial system[9] (I have cited Animal Spirits in the introduction). The overconfidence of traders transposed wholly conception of expected risks. The upturn of securities arisen at the half of the 2000s was interpreted as a natural heritage of wide positivism, laying the foundations for behavioral finance analysis. I maintain the flame which stoked distortions on trading comes under *Cognitive Dissonance*.

[8]The expression ”Roll over” regards the act of reinvesting funds from a mature financial instrument into a new similar instrument. Traders resort to rolling over to make profits (immediate income from day trading), or for tax savings.

[9]Financial system embodies financial transactions and the exchange of money between several actors, i.e. investors, lenders, and borrowers. The framework can be defined in three kinds of level: global, regional, or firm area.

Leon Festinger was a psychologist who discovered the theory which points out the attitude of agents to keep in mind solely positive memories to support purchasing choices they undertake. Doing this supposition, I declare implicitly the presence of brave individuals not so much risk averse. The common approach exaggerates the role of subprime lending and correlated real estate breakdown because of the great importance given to banks, in particular, their assets. Loan-to-value ratio, calculated as the maximum ratio of the size of loan and real estate value, remained too much high in the Great Recession period, posing questions about the laxity of regulation to impede banks of leveraging unreasonably. This ratio secures loans, hence creditors often employed it for risk measure.
The problem of the mainstream theory surrounds the weak robustness of the interpretation regarding the ascension of the recession. The ”brave heart” of banks looks like to be feeble for endorsing the cataclysm hurt the U.S.A. at the end of 2007. Furthermore, no financial institutions fallen down insolvency[10] condition during that turbulent phase, leverage did not be high in the pre-crisis period as well as losses from the resolution of savings and loans associations date back to the Crisis-Before-The-Crisis era. The Great Recession placed U.S. investment banks on harder positions than credit institutions.

The monetary theory roots are detached from those of the mainstream view. They assume a macroeconomics connotation where the income equilibrium of a country is achieved thanks to the quantity of money. Therefore, a precise value of income creates the amount of disposable money which reflects money balance holdings. The readjustment of a country's economy far away from ideal condition is linked to monetary shocks. To manage this approach, one must take into account that individuals have got a certain money function composed by national income and several indicators and this function lets traders choose a money to income ratio threshold.
Monetary shocks can assume the shape of either money growth alteration or quantity of money composition modification. What is important concerns the concept that such out of the blue changes make individuals poorer or richer in case of an upward shift of the current bulk of the money, for example. I explain, in few words, how to estimate the amount of money inside an economy. Money is a stock measure which represents values available immediately for transactions (namely it is computed in a specific moment of time). The Eurozone officially called the Euro Area, proposes the following monetary aggregates to calculate the measure. The basic one is M1 which collects overnight deposits and money into circulation (banknotes plus currencies). The second one, known as M2, is obtained adding deposits with an agreed maturity up to two years and those redeemable at notice up to 3 months to M1. M3 is the last one gathering all elements within M2 plus RPs, money market fund shares, and debt instruments whose term is no more than 2 years. In the UK, M4 is adopted rather than the indicators just reported because of its similarity with M3.

[10]It is worth highlighting that at the micro-level, some financial institutions were struck by the banking crisis, staying afloat to a solvency situation. In aggregate, such losses were negligible.

The core of the Monetary Interpretation derives from a steel relation amidst monetary growth and asset prices. As a result, the monetary theory of wealth measuring is interrelated to the monetary theory of income pinpointing via assets perception like incomes capitalization. If money growth rapidly, the improvement has implications for asset prices to go up with the instigation of the so-called Milton Friedman's "hot potato" effect. The idea behind Friedman's thought is that money in circulation inside an economy can be intended as an unwanted thing, or better, an unwanted hot potato, whereas traders are waiting for the establishment of a new equilibrium will probably bring greater prices to everybody. An important aspect the reader must pay attention lies on the Animal Spirit sentiment which the monetary approach seems to back up in the short-term as the driver of asset fluctuations, the ratio of savings institutions' money and total assets is meaningfully dependent on overconfidence too. The scenario diverges if one considers the medium/long-run since the determinant becomes money and that ratio rises slightly with respect to institutions' total assets or money holdings. To put it simply, there is a correlation between the change of money stock and the growth rate of money referred to fund management area.

The "hot potato" effect implicates a propensity to pass from a market to another. Such an effect was one of the official explanations offered to proof the Flash Crash on May 6, 2010, which we have discussed at the beginning of the thesis.

The quantity of money induces the surge of security prices, other than altering the level of the output of the total economy. Reporting the philosophy of the monetary approach to the banking crisis, at every stage of the recession time, money had a strong trend which taken its growth up. Not only money leaped, inter alia, considering the high increase of leveraged financial organizations such as subsidiaries of companies that govern a set of banks. These new institutions portrayed the more frequently tapping into wholesale finances, not from retail depositors. I anticipate that money growth rates were fast and great in the UK and the Euro Area. This consequence of the recession will be tackled afterward.

While the common idea of the Great Recession develop relapses on the excess of lending banks effectuated, leading to bank insolvency, the money approach claims instead that illiquidity was the main challenge for the banking system to avoid the dissemination of the crisis. The traditional banking framework was overall strong after the borne of the real estate collapse. Investment banks and shadow banking system were again responsible for having contributed to furthermore heighten the disastrous economic-financial scenario the world were living. The lens is to catch the halt the banking system experimented in the crisis period from a purely monetary point outlook. Mainstream philosophy points fingers to banks and investment banks for having granted mortgages without doing any creditworthiness analyses and letting insolvency threat to almost become real as a whole. The monetary school instead blames central banks and officialdoms for the bank regulation restriction which was imposed on October 2008 influencing money growth rates negatively. In August 2007, banks, investment banks, and other financial organizations, such as

shadow banks, had troubles to expand their assets due to a large ban within the interbank market, at the global level, so that the institutions felt the difficulty to grow as fast as before. The freezing was terrible, so much so that the quantity of money and its growth bore a radical tumble. Illiquidity arisen properly due to fundings stop imposed. Central banks did not After Lehman Brothers default, G7 finance ministers and central banks achieved a pact on October 10, 2008, to assure that financial organizations, banks included, could have the guarantee to sustain their assets and other practices from fundings made available by central banks and governments. A next meeting was organized on November 14 at the same year to amend new rules concerning banks' capital to asset ratios rise. The results were far from work well focusing on banks were recapitalized from private resources with the impairment of deposits. Credits and the quantity of money worsening happened for the previous ratio upturn. The only action that banks saw to implement was to sale off securities and loans in the aftermath of bank stock prices downturn. The slump of money growth made rates closed to 0% for some months over the U.S. crisis (both the U.S.A. and the Eurozone). Families were adverse to tighten their belts for preventive purposes maybe, while financial instruments prices were going down, despite milder than securities crash in the Great Depression. Monetary shock knocks real estate and stock markets pools the two crises, albeit assets were less affected during the Great Recession. To conclude, if stricter bank bounds inspired monetary growth plunge, every cloud has a silver lining because central banks incited quantitative easing programs to avoid the appearance of a more severe calamity in the future (money enhancement was stimulated in spring 2009).

When a dangerous recession appears, the likelihood of inequality establishment might be consistent. We then must consider the emergence of swings within social strata level. I supply to the reader the doctrine of Piketty (2014). The author has committed that a mutual change of inequality was the foundation of the Great Recession. Wrongly wealth distribution is too abstract at first glance. What is its proper meaning? How should we estimate it? Inequality can be imagined under three independent principal conceptions.
Income inequality is the amplest measure of the concentration of poor and rich people computed by the market gross or net (after tax and transfers from social insurances) Gini coefficient. Formula 2.2 allows to calculate such a index:

$$G = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}|x_i - x_j|}{2n\sum_{i=1}^{n}x_i} \tag{2.2}$$

in whom x_i is income of a person i in a population of n living beings.
Wealth inequality is affluence concentration on assets owned by the wealthiest people.
Opportunities inequality checks access to services and possibilities such as education, health. For Piketty's theory, inequality narrowed families spending and residential investment. Hence, income inequality can properly fit his thought. Let's concentrate on anti-capitalism sentiment expressed by Piketty now. I quote what he states, *The global*

financial crisis that began in 2007-2008 is generally described as the most serious of capitalism since the crash of 1929. The comparison is in some ways justified, but essential differences remain... the recent crisis has not led to a depression as devastating as the Great Depression. Remaining bound by that recession sight, the Great Recession must not be thought more severe than the Great Depression if one compares the declines in production happened in the developing countries. Over the 1930s, it was wider than in the first decade of this century. The statement loses importance for the unemployment rate since surges possessed almost the same amount. The financial system was protected from a drying-up episode introducing liquidity in order banks, financial intermediaries, and households to not be swallowed up into it. These facts participated to the noun *Great Recession* as to milder negative features that current crisis delivered concerning the Great Depression. To summarize the Piketty's vision, inequality was the major cause of financial turbulence which driven the U.S. and the remain countries towards the recession.

This vision of the banking crisis is interesting, well-appreciated and accepted in literature, albeit there are no sturdy empirical studies which favor the validation in reality. Congdon (2015) underlines in his paper the impossibility to cry out a causality between increasing inequality up to the Great Recession and its disadvantages. A weakness of Piketty's proposal is based on no proof for the free-market capitalism guilt (the 1930s and the starting of the twenty-first century are the only periods taken into account). Along these lines, I state that inequality can always be pinpointed for any economies analyzed, it requires long time to activate a "cleansing mechanism". Recessions are vicious cycles which generally protracted themselves for quarters, not years. Imbalances, instability, or wellness are by no means correlated with income inequality merely for different paths (relative to output or demand). I share the Congdon idea to point an accusing finger at regulatory lax to eliminate bank illiquidity. Inequality and money growth are certainly gears of the economy, yet the quantity of money does perform a significant active function on the U.S. banking crisis. I conclude Causes paragraph providing a graph about U.S. economy from 2001 (housing bubble deflation) to 2015.

Real GDP declined of -8.20% during the Q4 2008 joined with a hesitant recovery started in Q3 of the following year. The first feature of this chart which stands out is variability of Real GDP from the beginning to the end of the banking crisis, showing our supposition according to the Crisis-Before-The-Crisis era holds, along with an abruptly shock of M3 growth is translated in a huge real output modification, the monetary view is reasonable.

Figure 2.5: U.S. Real GDP change and M3 Growth Rate Seasonally Adjusted. Author's elaboration. Data Source: Bureau of Economic Analysis and OECD Stat.

2.2.4 Consequences

U.S. banking system failed absolutely over the recent recession due to the excess of subprime mortgages and illiquidity which conducted the financial recession to be transmuted into the worst banking crisis in the history. The behavior of banks and investment banks to adopt the same actions within a specific environment calls to mind a manner organizations frequently resorts to survive inside it. There was not a single bank or investment bank which prevented retail clients, firms, or other financial institutions to easily borrow money either encouraging acquisition of immovable properties or undertaking business investments. Examining corporate organization literature, Neo-institutionalism theory might explain why credit and investment firms decided to not take new lending directions until the recession. Meyer and Rowan created Isomorphism concept in 1977 where organizations work in extremely institutionalized environments which establish rational criteria for institutions. As an alternative, organizations have got criteria at their own diverse from those outside them. The authors investigated the relationship which ties systems (organizational entities where the shape is never unaltered) to an institution. They highlighted institutions which absorbs external methods to evaluate efficiency are e.g. schools, churches, whereas firms own internal methods to do that. Since the criteria decide survival of organizations, they must be respected to avoid possible conflicts among exogenous pressures and firm efficiency evaluation models. Powel and DiMaggio developed Neo-institutionalism doctrine in 1983 carried Isomorphism at the corporate level. Their theory acknowledges the presence of a process leads organizations to resemble each other on a given contest. Accentuation mirrors social aspects, together with inter-organizational relations, among other things, institutions incorporate cognitive,

regulatory, regulative structures. Processes are not close to empirical rules, they prefer to anchor to efficiency.

I have considered Powel and DiMaggio theory since banks did not make decisions to stop subprime mortgage phenomena during the economic boom or to respond to calamitous bank regulations which officialdom enacted on October 2008. Isomorphism well accompanied the economy pre and post-crisis. On the other hand, this could have entered a selection mechanism within financial markets. The rescue of big firms e.g. AIG, Goldman Sachs, GSEs Fanny and Freddy is interpretable as a consequence of Population Ecology theory of Hannan and Freeman, i.e. organization of populations[11] selects the most capable institutions wiping out the less suitable ones.

Passing to the economical range, vacillating effects come to light. Australia, China, and India, powerful world nations, experimented a petty GDP deterioration. Ethiopia and Uganda grew up and this was a surprise if one compares the two emerging countries with OECD and developing nations output. Statistics, whatever the source that releases them, communicate the magnitude negative episode of the crisis delivered to middle-income countries. To understand it, competent skills are not necessary, data speaks for themselves. Central and Eastern Europe which include Lithuania, Armenia, Ukraine, Latvia were territories mainly rocketed. GDP shrinking jumped out from -10% to -20%, frightful slides nobody would have expected come true. U.S. recession is extended at the general American territory, Mexico was really damaged. Impoverished countries endured to the banking crisis attack, in contrast, negative growth struggled acutely, diversifying states upon degrees. Open economies suffered a lot, the same is not true for China, India, or larger states dodged the growth interruption keeping improving net worth.

Labor markets status revealed big transformations being connected to the economic trend of nations. This supposition holds looking at unemployment rates of certain advanced countries which advised a negative inclination. Estonia, Ireland, the U.S.A., Turkey exhibited out of the blue downfall of employees from 2007 to 2009.

Japan was a particular case due to internal devaluation policy which reduced unit labor costs and mitigated high-skilled workforce firing, albeit the country experimented a large GDP crash when the recession surfaced. Greece unemployment upward trend emerged considering the global financial crisis placed the nation in a more difficult situation. We will discover Greece was damaged after its introduction of the Eurozone in the following section dedicated to the Euro Area crisis.

The way to rescue labor at the normal situations is articulated in three channels: working time, the number of workers, and wage/non-wage benefits. Modify the number of hours worked is more convenient and easier for firms according to *Employment Protection Legislation* (EPL), a host of norms and procedures which protect permanent workers if early termination of contract will be triggered. EPL acts as a sort of ”deterrent” for permanent employees. Disadvantages are distributed to unemployed or temporary workers

[11] In the organization field, a population contains homogeneous organizations beside foundations such as technology, internal governance, model activities.

because of engagement in long-term unemployment circles and secondary labor markets specifically.

Wages reduction and work benefits lead not to achieve social improvements but dismissals, plant decommissioning, or sustaining unemployment rates upturn. Labor policies carried out to defeat U.S. crisis shocks varied considerably in function of internal economy objectives, government constraints on responses to overcome the Great Recession hurricane, and the type of labor institutions (for instance, how much the wage is rigid, dismissal protection). What is common regards categories of people who sustained more costs to survive to the negative growth. Advanced countries saw young men hit tougher, as opposite to East Asia where young females were mostly hurt. The reason behind the preference of the Great Recession to blown youth might reside in working positions such groups occupied. Many studies concluded manufacturing sector gathers principally young people.

Less educated workers, migrants, and the form of contracts are meaningful variables to be taken into consideration for severe manners exploited to help states to go out from the abrupt spiral that the U.S.A. brought all around the world. The aversion of a lot of employers to cut off high-skilled workers seems plausible for a smaller demand of low-skilled people. Project workers augmented after the settlement of the subprime meltdown. Temporary working meets up immigration which implicates a causality of the phenomena. Analyses run on employment and migration displayed an obvious consensus from no native people to sign up for heavier jobs. Moreover, the crisis contributed to raise real salaries succeeding either a decline in inflation or a rapid fall of good prices. Real wages went up above all in the U.S.A. as an outcome of real hourly wage enhancement.

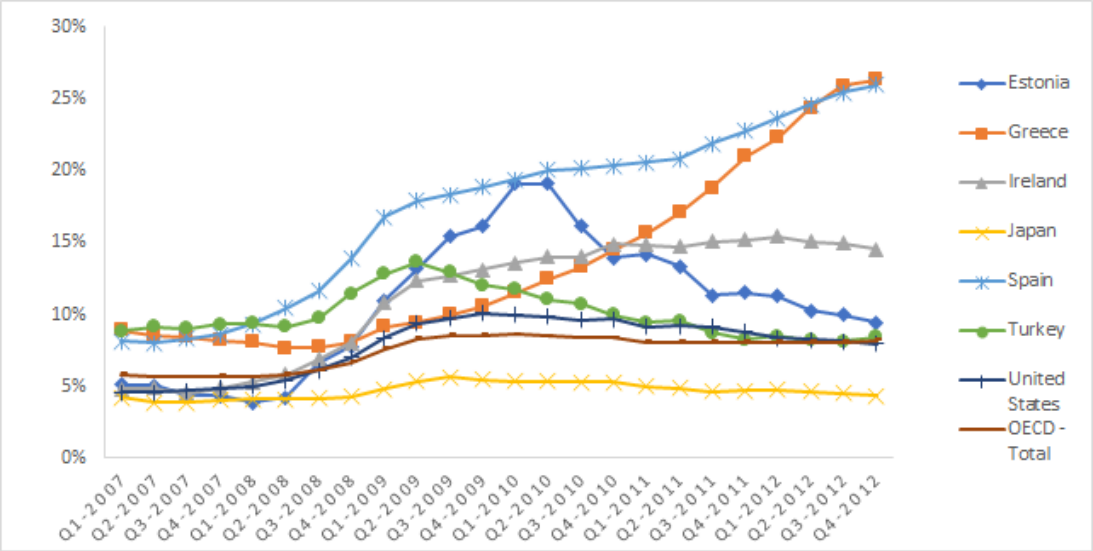


Figure 2.6: Unemployment Rate Aged 15-64, Males and Females.
Author's elaboration. Data source: OECD Stat.

Financial dimension perceived the upset of the Great Recession. I have beforehand mentioned the loss of confidence disclosed by household and firms for consumer goods and investment. This must be connected to the stack of toxic assets[12] contained on bank books and financial institutions participating in financial markets. I believe the ”bad taste” of the securities run agents to execute flight-to-quality[13]. Certainly, no one would have selected CDOs, MBS, namely every instrument developed with the aid of securitization afterwards the subprime meltdown. A wide range of banks undergone, once predatory lending linked to subprime loans flooded their balance sheets, provoking enormous deficits and the search of capital. Unstable financial markets did not favor borrowing, lending, and all practices made under unstressed conditions. The lack of liquidity did not let banks to meet their duties. Was run bank the proxy for illiquidity? We do not know for sure, despite the fact that jittery depositors might have twisted businesses of credit institutions. Withdrawing of deposits effectuated by banks' retail clients, or better, depositors, if they are worried about insolvency is noted as *Bank run*. When the recent Greek crisis have raised interventions, criticisms which has many times stemmed from impatient retail clients who have run down banks' liquidity.

2.2.5 Responses

We cannot stay unperturbed over against the awful impact the worst financial recession left to states, whatever one concentrates on rich, middle-income, developing and/or BRIC countries. All public and private entities have attempted since the fit of the U.S. negative growth to conceive state-of-the-art tools addressed to defeat the Great Recession ”monster”. Bear in mind that it is never straightforward to erase wounds made by a banking crisis, they remain for a long time, the strange feature of recessions lies on the already cited ”cleansing” mechanism embeds inside negative periods which permits economies to restart ridding of errors done in the past. I am not claiming that recessions are good, I would be crazy to assert such an oppressive judge, though we have to be as critique as possible when an argument so thorny as the Great Recession is singled out. Indeed, economics teaches us that the opportunity cost of a recession appears too wide. As a result, governments, policymakers, Chief Executive Officers (CEOs) of the biggest institutions felt the duty to collaborate in order markets, trade, society at large to become healthy climates again.
OECD countries fired up expansive monetary policies such as collateralized deposits, quantitative easing, interest rates downturn. They do not correspond to prevalent actions belong to the monetary field, excluded the third one. Many states chose fiscal solutions like encouraging public investment infrastructure, cutting taxes. Even trading regulations,

[12]The appellation was coined while U.S. negative growth was proceeding to list assets deeply illiquid, that is to say not easily convertible into cash at low costs, whereby their secondary markets cease to exist.

[13]The jargon refers to the mechanism which pushes traders to move on to the safest securities, not esteem riskier financial instruments.

employment clauses, further norms/initiatives donated a bit contribute for overcoming recession. Table 2.1 displays the excellent work Verick and Islam (2010) have conducted to delimit the circle of responses to the Great Recession. The sample gathers twenty medium/low-income states e.g. China, Pakistan, Indonesia, Egypt, South Africa.

Governments paid attention to cure banks from their ”sick” balances pulling out junk, i.e. toxic, assets destined for special entities, both real and abstract, which manage them. *Ring-fencing* is the junk assets virtual incubator backed by the government which provides collaterals for this category of unwanted securities. *Bad bank* instead relies on a physical financial organization which purchases such instruments which are deleted from banks' balance sheets and letting credit institutions to make their habit businesses. I stress commercial banking operates across a collection of money from the public (savings) exploiting bank accounts or issuing debt assets, together with granting of loans. Gathering money is crucial for commercial banks. If we open a deposit, property does not change and savings are not touched.
Nationalization closes government counterattacks. Flight-to-quality discards international markets. Thus, the nationalized banks idea became reality in some states, with the drawback to not fully resolved junk instruments management.
Allen and Carletti (2010) point out ”the most practical solution to the global imbalance problem”, to wit the Chinese Renminbi (RMB)[14] should become fully convertible and joins the U.S. dollar and the euro as the third major reserves currency. The IMF relayed the notice that the Chinese Currency did not be undervalued upon the U.S. dollar during the summer of 2015. The authors also suggested polices that have been beaten the banking crisis. I report some of them e.g. *Limited government debt guarantees* for financial institution. Imposing drops on bondholders who retain their bonds in the long-run, market discipline incentives may spring. Bank bondholders were protected in a certain sense by the virtue of ”government shield” which functions as a collateral. Putting a ceiling on leverage due to indebtedness levels of firms before the banking crisis as well. *Removal of tax subsidies for debt* should carry the employment of equities rather than debt stimulus. Interests of debt instruments are often deductible at the corporate level. The reduction of it might let markets to travel upswing road. *A role for public sector banks in a mixed system* spurs the training of public expertises whose goal consists of common banking system handling admission given to governments.
Carmassi et al. (2009) indicate the reject of Basel capital rules for risky securities. Basel III introduced an encouragement toward securitization process.

[14]The expression indicates the currency adopted in China, actually there were debates against if RMB or Yuan must be treated as the national currency. ECR Research affirms the RMB is the official currency, the Yuan the unit of account.

I want to emphasize that central banks should have assisted banking framework at the starting of the century, putting more funds inside the traditional system so that the misdeed would not be borne. My interpretation of the crisis embraces the pivotal task of the quantity of money, although the Monetary Interpretation does not adapt sufficiently to Japan where the ”yen carry trade” in foreign exchange reserves increased money amount in 2007-2008 period. However, money growth improvement is a good response to the recession, it permits economic output to restart to grow, banks recapitalization occurs by means of central banks financings, then monetary growth slows and a more placid environment returns. Recapitalization was carried out, the problem surrounded the capital to asset ratio escalation resulted in the quantity of money slumped.
Such a recession arrived until The Euro Area countries and shaped the European crisis. ”Sovereign” was the appellative charged on it. We will find out that the EU recession is not very sovereign as additional interpretations convince us to reject this hypothesis.

Policy Area	Specific interventions	Frequency (%)
Monetary and financial policy	Interest rate reductions	75
	Quantitative easing	40
	Deposit guarantee schemes and other measures to protect the financial sector	75
Fiscal policy	Overall tax and expenditure adjustments	65
	Public investment in infrastructure	100
Exchange rate/capital account	Exchange rate depreciations	40
	Export financing or tariff reduction	45
Income and employment protection	Efforts to limit lay-offs	30
	Unemployment benefits	25
	Employment guarantee schemes	20
	Minimum wages	40
Social Protection	Cash and in-kind transfer programmes	45
	Additional social expenditure	65
Increasing employability	Training and re-training	45
	Public employment services	20
Group-specific initiatives	Informal economy workers	10
	Youth	10
	Migrant workers	30
	Public sector employees	20
Sector-specific initiatives	Support for SMEs	70
	Support for key export sectors	20
	Support for ‘green’ jobs	10

Table 2.1: Policy Responses to the Banking Crisis
Source: Verick and Islam (2010)

2.3 The EU Crisis

2.3.1 Introduction

Tackle extensively the Great Recession allow us to pass to another wide episode that European countries are still defeating, i.e. the *European Crisis*.

Reading newspapers, listening to newscasts, and scrutinizing articles on the Internet, we grasp such a crisis, stemmed from the U.S.A. recession, seems to connote a Sovereign debt perspective in the first place. One cannot deny that states within the Eurozone did not store terrible debt levels in the aftermath of the crisis. Despite, the sovereign event must not be selected to delineate boards of the current negative period. I will expound the real constitution of the crisis which contributes to formulating the right perception that policymakers and media divulged information aimed to bias people understanding about its broadcast.

The mostly shared theory condemns our financial system to have done an insignificant task to rock the monetary union in order it did not perform principal and fiscal rules. Complex management networks were designed to alleviate the painful imbalances. Their outcomes were not very impressive and all EU states had to face the music.

Lane R. (2012) argues that *The origin and propagation of the European sovereign debt crisis can be attributed to the flawed original design of the euro*. To sum up, the euro is imperfect as it was conceived. The monetary union amplified its weaknesses over the crisis contamination, nurtured through the missing of buffers and solid banking systems at the European level. Storm and Naastepad (2016) do not share the same point of view. They indicated that the private sector should be mentioned due to its role in the crisis, namely the fundamental actor both on formation and propagation. Fiscal austerity did not work well from their insight.

Armingeon and Baccaro (2012) underline the inefficacy of internal devaluation policy that some poor Euro Area countries e.g. Greece, Italy were obligated to apply considering it intensified growth aggravation on them.

Pereira B. and Rossi (2015) lay the groundwork for the return to national currencies because the euro is the ”evil” made the internal real exchange rate to plug any prosperous positions. This balance-of-payment imbalance method of devising the crisis questions the deep-rooted opinion of the financial root for this turbulent period.

The final approach as a proxy for the nature of the crisis lies on Engel (2016) outlook where the ”sovereign debt market” institution endorses the borne of EU catastrophe, in fact, country rudiments bound from herd to mimetic behavior, representing normality and crisis scenarios which can show themselves either observable exogenous or operationalized fundamentals (these latter tied to market movements).

In the upcoming paragraph, my assignment will be to effectuate literature reviews on the aforementioned doctrines, expressing whether they deliver congruent views about the EU crisis reality.

2.3.2 A Tale of the Facts preceding the Crisis

The bill the European Crisis posed elicits member states in trouble given the rapidity, instability, and sharp whereby such straits manifested. This section will go to discuss the European panorama before the Great Recession signals arrived at our homes.
Public debt is correlated with crises, the occurrence of a deficit on government accounts amplifies when the adverse onset accomplishes a given country. The first ten years of the actual century were not perceived arduous hearkening the economic-financial system all told. A spurious interpretation may be picked up on the credit boom which surrounds the U.S. above all, or the euro currency which unified a lot of Eurozone states in 2002 convincing citizens to pay attention to benefits introduced with the new currency. I am cynical regarding the adoption of a sole money for the purpose of controlling monetary policies and problems of too diverse states one from each other. However, the subprime meltdown phase not only corroded the most powerful state in the world, but it also plagued Europe which found oneself in an uncontrollable financial process. The debt-to-GDP ratio restarted to go up for each government at the end of the 1990s (the ratio is a good indicator for the level of debt). Lane (2012) has calculated that U.S. public debt was equal to 60% in terms of GDP in 1995, whereas the ratio was estimated to 70% for states that created the EEA later. He indicated the propensity of U.S. and euro public deficit to shorten before the Lost Decades era, regardless of convergence to mid-1990s thresholds at the half of the economic boom. Debt values enlarged precisely with the arrival of the Great Recession.

Country	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Spain	41.7	47.2	61.8	66.6	77.7	92.5
Portugal	78.1	82.8	96.1	104.1	107.8	137.1
Italy	110.7	113.0	126.0	124.9	117.9	136.2
Ireland	27.4	47.4	67.7	84.1	109.7	129.2
Greece	112.8	117.5	135.0	127.1	109.2	164.5
Germany	64.2	68.1	75.5	84.5	84.3	87.0
France	75.6	81.5	93.2	96.8	100.7	110.4
Finland	39.1	38.3	49.2	55.1	57.5	64.3
Belgium	93.8	101.1	109.5	107.8	110.4	120.4
Austria	68.7	74.0	86.3	90.3	91.3	97.6

Table 2.2: Public Debt for some Euro Area Countries (% GDP).
Author's elaboration. Data Source: OECD Stat.

GIIPS countries that is Greece, Ireland, Italy, Portugal, Spain, achieved considerable public debt levels pre or post-recession periods. They belong to the renown Southern EU countries, a locution which calls to mind the collocation of them inside Europe territory but what I argue to be essential is not the geographical position which they occupy, but rather their reputations against Northern states, the most powerful countries inside the Eurozone too. For instance, opinions that Germany has on Italy are unmistakable; it rates our country

mishandled, leveraged, and not able to many times obey rules levied by European Commission. The fact that Italy keeps being in an indebtedness status is true, and I have shown public debt evolution in the previous chapter of the thesis which touched 99.8% of GDP (i.e. below 100% lower limit) only in the year before Lehman Brothers bankruptcy. Italian government resulted unstable over the last 25 years because it changed every 5 years on average, without taking into consideration political scandals (e.g. "Tangentopoli", a term indicates one of the biggest scandal in Italy accompanied by judicial inquiries, "Mani Pulite", in 1992), corruption, and other facts put our beloved country in a bad light and nearly reached the default (see Monti's technical government supplanted Berlusconi's one in 2011). The salient feature of GIIPS inhabits to devote too much and to earn too less. Borrowing attitude brought forth public bonds' prices by markets since there was necessary upturn interest rates reflecting debt which hesitated to slide. I did not explain how to price a bond yet. Let's consider cash flows associated with a bond, to wit coupons and principal until the maturity date. Bond's price will be equal to the sum of each single cash flow discounted at the appropriate interest rate. The succeeding equation demonstrates the statement in mathematical terms:

$$P_0 = \sum_{t=1}^{T} \frac{CF_t}{(1+r)^t} \tag{2.3}$$

P_0 stands for the price at time 0 (i.e. at the present period), CF indicates the cash flow at time t, r is the interest rate which forms a part of the discount factor and T the expiration date. The formula 2.3 draws attention to the relation amid price and interest rate: when bond's yield rises, its price goes down and vice versa. The connection roughs out illumination for cheap bonds issued by troubled governments which lie on a razor's edge. Greek sovereign bonds are not expensive given that high promised yields. Buying such securities is dangerous, one must remind that trading junk bonds is like a gamble.
The operation to estimate a price of a debt instrument can be difficult due to lacking interest rates in specific time frames. Statistical methodologies create term structure of interest rates for pinpointing their stock measures when not instantly usable (non-parametric regressions are chiefly adopted, see Appendix for details). Analysts deploy the structure additionally to formulate performance of spot rates in relation to the term to maturity.

When one refers to European states, the history behind the concept of integration could not be completely well-known. I offer an abstract. European Union (EU), a political, economic union contains 28 states nowadays, was enforced with the Paris Treat in 1951 and the Rome Treaty in 1957, settled by the European Coal and Steel Community (ECSC) and the European Economic Community (EEC) in whom Belgium, France, Italy, Luxembourg, the Netherlands, and Germany, six Western EU countries symbolized the pioneers of the tardive Eurozone. The integration should safeguard peace and prosperity, avoiding fierce struggles that demolished the earth in the past century as the two World Wars did, trusted

on the principle of delegating a comfort level of sovereignty all around the Union. That implicates advantages or to attract other states to come to ”restyle” Europe with an extensive venerated agreement. Unfortunately, the covenant was not feasible examining its complexity. Hence, a step-by-step mechanism permitted the advancement of the integration. To promote fairness, exterior concessions were guaranteed taking the structure of dissociations or exceptions, which proves my insight of the inconsistent strategy member states designed for the Europe unification project. The EU represents a hybrid construction with many institutional asymmetries. It does not fall under any simple definition such as a federation, confederation or international organization (Dabrowski, 2010). A trade-off appeared because gradually integration breakthrough manifested at the common trade policy level, not in the political environment if countries could forgo to seep financial fundings to all EU member states.

Resuming the sovereign debt issue, in table 2.2, Ireland debt boosted steeply contrast to the others focus states. Italy deficit is always above the 100% GDP bound according to OECD survey, while we have declared that debt-to-GDP ratio was strictly below 1 in 2007 if one takes care to Istat data. Such deviation is negligible; our country debt stayed high overall. On the other hand, the table allows two particular aspects to emerge. First of all, distressed or close to default countries were those displayed the highest leverages when the outset of the crisis was coming. In addition, relevant discrepancies between Northern and Southern EU states influenced both reputation and financial sight. The odd characteristics of a country's ability to repay its debt, indexed to the debt-to-GDP ratio, involves in the tendency to fall when 100% GDP limit is crossed, even though this requires a consistent portion of time to see some effects. Onerous public debt amounts are not advised due to sovereign debt risk will happen with an elevated probability, namely the difficulty to obtain loans in future and to pay back those already received, putting a government in a trap, better known as the *diabolic loop*.

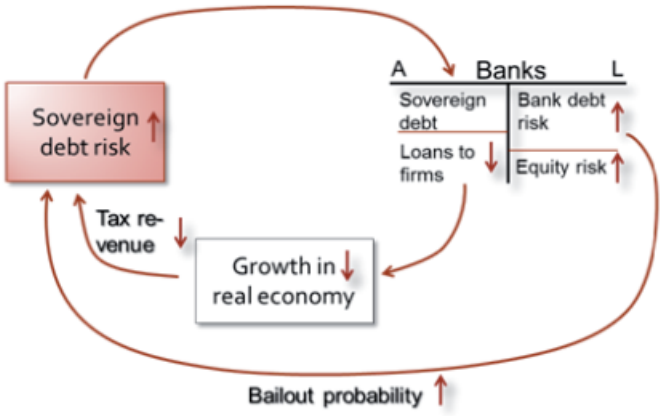


Figure 2.7: Relation between Sovereign Debt Risk and Banking System.
Source: Brunnermeier et al. (2011)

From the figure, one detects banks sustain sovereign risk approached by a country sending supportive signals under bailout[15], while they decline loans and equity, debt risks raise, worsening banks' solvency. The credit crunch means tax revenues go down, weakening government solvency which erodes market value of sovereign bonds held by financial institutions.

Banking crisis often precedes or contributes to sovereign default, therefore a bidirectional link springs. From the advent of the EU crisis, Storm and Naastepad (2016) report it for the first quarter of 2008, and the European Union has tried to uncover its proper driver. The same union has set up a risk management framework since 2009 for enhancing the Maastricht Treaty's principles and institutions joined with resolving the numerous shortages affect Stability and Growth Pact (SGP), creating the Outright Monetary Transaction (OMT), a program aimed for purchasing sovereign bonds issued by the Eurozone countries under predetermined conditions. The European Central Bank effectuated it trading virtually eligible assets outright on markets, along with the European Stability Mechanism (ESM), an organization which acts as a "watchdog" for the Euro Area which replaced the European Financial Stability Facility (ESFS) on September 27, 2012. I have mentioned Maastricht Treaty being the founding father of the European Union, signed on February 7, 1992. SGP signified the covenant, stipulated in 1997, thanks to whom the common currency was minted and released in the Eurozone.

Acknowledge a banking crisis may be misleading, its origins collect a medley of economic, financial, socio-political, and trade peculiarities. Thus, causalities must be inspected make us less hesitant towards whether marking the crisis with a sovereign debt connotation or not. Reinhart and Rogoff (2011) suppose the banking crisis would be originated by two significant events. To quote them, *(i) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; or (ii) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions*. Their key factors must be carefully examined as the authors run analyses on a small sample. Moreover, these proxies convey the impression to sound good, a liquidity crisis whose trigger coincides with a bank run might flow into a solvency crisis. Grauwe (2013) highlights the importance of a lender of last resort to bypass bank run action and then an imminent sovereign crisis.

A different technique for the banking crisis capture refers to the credit-to-GDP ratio, i.e. loans that banks allow private sector estimated as a percentage of GDP. Databases regarding such a circumstance list the Euro Area lived a good credit period over the previous and the actual centuries generated by the skill banks assimilated to gather money in their sole currency (the euro), other than narrower interest rates and disposable credit upward than multiple currencies circulated into the European economic system.

[15]The action that entities such as government, enterprises, individuals supply fundings to a troubled institution in order it will not default.

Nevertheless, current account balances have exacerbated since the last decade of the 1990s with GIIPS recorded deficits touched a negative peak of -11.1% about during the EU recession conform with the IMF estimates. Current account inserts transaction of assets (goods and services) and unilateral transfers in the balance of payment (BoP) which expresses a summary statement of economic transactions that residents of a country do and rest of the world residents accomplish during a specific time frame (the procedure hints quarterly or annually flows). GIIPS countries obtained wide wage upturns besides productivity growth, an unhealthy improvement let unit labor costs and inflation boost, real interest rates cropped, lenders received a smaller amount of loan benefits, and interest rates of public bonds diminished, pushing bonds' price up. The residual Euro Area did not experiment this frustration. I maintain beholden governments relied exaggeratedly on borrowing to retrieve economic growth, they issued a vast quantity of bonds to finance the debt with very high-interest rates as a matter of fact. These governments sold debt instruments at low prices, so that aspired to promote traders for buying them (who bought or sold in markets might have been extremely optimist, a behavior similar to the Animal Spirit seen in the U.S.A. at that time). The volatile global financial system contributed to expanding worries, disparities, and confusion as individuals could not become aware the recession which experienced, we are still living its influences today. Private area was relevant and unexpectedly neglected, the sovereign risk obscured households indebtedness, a big mistake which might have helped the Eurozone states to move correctly against the crisis dissemination.
The mild fiscal policy is the final aspect which comes full circle on the antecedent period of the EU crisis. The euro foundation had the effect of attenuating the countercyclical feature of fiscal policy. Governments discarded the fiscal policy contraction hypothesis in the middle of the credit boom. To explain this dereliction, methods for tightening fiscal policy valuation were poor. Concentrating excessively on the output gap, such models performed a bad analysis of fiscal positions without considering financial, fiscal, and macroeconomic risks which can drive to exogenous imbalances shocks.
The European Central Bank did not much aid during the debt crisis. I criticize its stop-and-go policy pursued as European government bond markets needed a huge quantity of liquidity that did not arrive from the Central Bank, engaged to maintain inflation at the target of 2%.

Causes of the Euro Area crisis will be explained in the following paragraph. I will show to the reader that sovereign debt was not the plague the U.S. recession delivered, fiscal austerity was the main mistake member states made to cheer up them, BoP imbalances played a very important part albeit almost nobody took them into consideration. The private sector was also meaningful since it covered an important field of the EU crisis determinants.

2.3.3 Causes - Was Sovereign Debt the Cradle of the Crisis?

Whatever tools, theories, or approaches cohesive for studying the crisis imputed to Europe, the Great Recession has to be understood as the fulcrum of the Euro Area crisis. Sovereign debt must not be meant able to unfold a crisis of huge magnitude; rather the private sector could explain a large piece of drivers arisen over the last decade. Dobra (2014) argues the Eurozone recession is an overlap of banking crisis originated from tremendous credit growth and/or asset bubbles, sovereign debt problem subsequent to fiscal imbalances, and BoP crisis formed in consequence of current account deficits or sudden stops. I agree with her that BoP gaps donated a suitable contribution to the crisis spread. Nevertheless, I reject the importance that sovereign debt owned by the establishment of the European recession vicious circle, the private sector was disclosed much more crucial.
Deliberations of authors hinted in the introduction will be unfolded bar none, accentuating their strengths and faintnesses.

Let's start with the hottest mindset concerning the European Crisis, *Sovereign risk*. The Monetary Union did not stick out for its good management. GDP of all countries belong to the Europe are not rescuing values previously the recession. Armingeon and Baccaro (2012) communicate that output growth was inclined to jump out from positive to negative appraises 2007 to 2010, in other words, over the crisis top. The disconcerting thing ensued after the evidence people did not fix the attention on the diabolic loop, instead of the European Central Bank operations for equilibrating the global financial system and maybe rescue it to the normal situations before the catastrophic turbulence. Short-term interest rate haircuts, currency swap agreements, and liquidity providing service should have been assured the proper cure with which replied to the U.S. banking breakdown arrived in 2008. I bring out that currency swap instruments negotiation takes place when cheaper debt is needed (it transpires borrowing at the best available rate in any currency and then interchange with debt in target currency using a mortgage where two entities borrow offsetting amounts each other respect to the other's currency), hedging against (i.e. exposure reduction to) forward exchange rate fluctuations, or beating off financial shocks, in particular, a country agonized by a liquidity crisis to let it borrow money with its currency. The Central Bank run by Mario Draghi should have been considered that a unique currency connects strong heterogeneous nations result to not be the ideal solution in the event of a crisis, underscoring already evident inequalities between Southern and Northern EU states. Feeble monetary union favored negative externalities. Indeed, interest rates increased, and agents lost the faith on the fulfilling regards public debt on constraints during the time. European sovereign debt markets worsened dramatically in late 2009, notwithstanding the stability of banking system weighted over 2008 and Q3 2009 which stopped the country-specific fiscal risks materialization. Primary balance deficit jumped and surpassed national wealth, European countries were not ready for a similar breakdown. Such a deficit lists governments were spending more than inflows (e.g. from taxes) proper

to underline the surplus of borrowing actioned by countries as a whole. The problem originated from the underpricing of sovereign debt, namely ongoing governments were placed on the same level as higher leveraged ones when the monetary union made interest rate values close to each other. This is a serious mistake, it is unimaginable Germany or France had got an equal risk to Greece, Portugal, or Spain, the nations are diverse below various profiles such as culture, working policy, commerce, financial. Take for example the spread among Germany government bonds and Greece public debt. Before the settlement of the recession, it seemed to converge to 0 due to the interest rate alignment, the criteria have disappeared at Q4 2009 as to the Global Financial Crisis pushed Europe to review sovereign debt right values (the debt was considered risk-free), reclaiming credit risks and volatility were modifying. Here, private sector stepped in, the abrupt credit growth joined current account deficits culminated into wide capital outflows from the private sector, that is to say, undesirable flows being a message of economic and political instability which characterizes the movement of assets outside a nation, reflecting foreign and domestic investors sell off holdings of a given state due to perceived deterioration of such a economy. In the subsequent table, I present private sector credit flows (% GDP) on a consolidated basis, transactions within the same sector are expunged. The net amount of liabilities accommodates sectors Non-Financial corporations and Households and Non-Profit institutions serving families have incurred over the year. Eurostat claims that the indicative threshold of private sector credit flow is 14%.

Country	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Spain	26.4	11.7	-1.2	0.9	-3.7	-11.2	-10.3
Greece	16.2	15.5	2.2	5.5	-6.5	-5.9	-6.4
Italy	12	6.6	0.8	5	3.1	-0.8	-3
France	11.2	9.8	3.3	4.6	6.4	4.4	2.1
Germany	2.2	0.5	-0.8	0	1.6	1.3	1.7
Netherlands	12.9	9.7	8.6	1.7	4.2	2	1.5
Belgium	16.8	16.6	6	2.6	21.4	15.7	8.5
Croatia	16.8	16.1	2.6	4.9	-2.3	-3	-0.6

Table 2.3: Consolidated Private Sector Credit Flows (% GDP).
Author's elaboration. Data Source: Eurostat.

The global crisis transformed private capital flows; they passed from positive to negative in many countries, well investments leaving a country for foreign sources exceed investments coming into a nation from not domestic resources, following a national currency's contraction since investors swap their local currency for purchasing foreign one. Investments became low, so that loans and real estate were frozen (loan losses entailed huge costs).

Looking at ten years government bond yields, Greece moved away against other GIIPS, it entered in a plummeting spiral and asked support to the European Union on May 2010 which arrived via the EFSF and the ESM. Naturally, GIIPS had greater borrowing costs consequently the recession, the banking crisis and the tight of households expenditure

aggravated their sovereign debt conditions. Banks joined the crisis immediately after real estate stopped, firms did not invest money for construction, and member nations of the economy were unchanged. Immovable property's prices fallen which led banks did not longer recover the amount of cash allowed in the form of property-backed loans. Sovereign debt issue and banking system constituted an "explosive cocktail" for member nations. The former component of that hodgepodge was not much serious under confederation or federation network. The motivation must be searched in government bond markets considering bonds the Eurozone governments issued are not controlled by fiat currency (which does not possess intrinsic value), inducing the collateral nonexistence (governments cannot have the liquidity to hack repayment duties). Where public bonds are issued by states which express them in their currency, the problem does not either demonstrate. The failure of bonds guarantees taken European sovereign bond markets prone to liquidity crisis and insolvency drama. I cry out a lender of last resort had to be essential for states with liquidity hurdles; the benefits would have been greater than detriments e.g. inflation risk, fiscal losses, or opportunism by governments which were inclined to borrow and issue debt obligations too much. At this point, one must lay claim CDS introduction would be suitable due to the chance they offer for reassuring the holder in case of debtor's credit default though no traders should confide bitter in this kind of ABS. Let's think of a CDS written on a treasury bond, the creditor is an agent and the debtor corresponds to a government. The derivative contract explicits that the borrower will pay the amount received, the interest rate is calculated beside its financial capability. Who lends money purchasing the derivative hoping the issuer will not have troubles and he or she will go to any length for assisting the debtor's ongoing business. If the government will disclose the default, the long party will exercise the repayment right, being not interested to support the debtor (counterparties are on opposite sides now).

Selvaraj (2015) lists the factors incited Europe crisis. Member states of the Eurozone failed to comply with SGP rules, France and Germany were the first, a penalty until 0.5% of GDP was attached to states transgressed them. Budget deficit-to-GDP and debt-to-GDP ratios were violated before and after the crisis (the author focused from 2005 to 2012). Greece and France disrupted both ratios, Portugal, Ireland, Italy, and Spain the deficit ratio, Germany the debt one. Greek government exhibited the largest values if compared with other EU governments. The European Council began to move in the opposite direction with SGP reforms in order governments broke down the deficit bound and motivated economic growth. Public debt sharply arose, missing of debt management as well pushed the states towards the economic downturn.
The euro currency persuaded traders for adopting trust on markets considered efficient and competitive. As inflation remained low during the economic boom period, that is closed to the European Central Bank price stability target, interest rates were narrow too, developed households and firms over borrowing which promoted a debt surge.

Wages increased during the 2002-2007 period, the concentration was in Italy, Spain, France, according to the author, making the costs of production of goods and services to rise, net exports deteriorated followed by manufacturing and production sectors. Labor costs augmented a lot for the aforementioned countries, France excluded. Germany is an outlier because of its working policies not oriented to reduce workforce and exports. Labor hoarding and internal flexibility[16] permitted it to exit from the crisis hurricane earlier than the others, the bill to pay might be very steep for the recourse to those short-term stabilizer tools.

The financial deregulation and liberalization did not prevent banks leverage. Capital inflows were huge, they leaked a real estate and consumption surge. GIIPS received numerous funds from the richest EU states. Bad loans caused banks to face balance sheet imbalances and the borne of the crisis.

Eurozone markets were further unstable due to the Great Recession which brought market confidence loss and capital flows reversion. European states lived financial field recession with the fiscal stimulus package response to it, which provoked more damages than benefits.

The author stressed finally that the Eurozone conception alimented the EU crisis since the Euro Area can have the monetary union but not the common fiscal policy, letting states to implement excessive public spending as no institutions appear to exist for entailing tax and expenditure caps.

The banking system has initiated to be fragile since Q3 2007 and it gone ahead for all the recession. Bear Sterns extrication on March 2008 signed the EU banking crisis which embraced the sovereign default situation of GIIPS and other member states. The recovered signal investment bank looked like an initiative turn to rid out the most relevant financial institutions from their default. In fact, the Eurozone conceived government bailouts ignoring the impacts on fiscal deficits which aggravated the banking field on July 2011. Interbank markets experienced aggravations as well, spread among EURIBOR and Overnight Index Swap (OIS)[17] enlarged enormously in the same month of Lehman Brothers default.

This vision of European recession accentuates interdependencies centrally located sovereign credit and banking aggravation. Along these lines, the crisis magnified intra dependencies within Northern and Southern states. The following hard to break circle exasperates the sovereign default risk and quality of financial institutions, maybe leaving non performing loans (NPL) into their balance sheets.

[16] Germany preferred to not fire labor force; it reduced the working hours per employee.

[17] The index establishes an interest rate swap whose function coincides with exchanging the overnight rate for a fixed interest rate.

Having completed the Sovereign credit risk outlook, I will discuss the second point of view where private sector holds a prominent part of the story.
The classical opinion encircles fiscal imbalances and a lack of discipline must not be treated as truthful. I cite fiscal austerity lots of times in this chapter, I did not explain either what it is nor its weaknesses against the crisis. In the political environment, *Austerity* often refers to economy policies governments implement for controlling public debt and adopted when default is prominent. For that reason, austerity became a powerful instrument in governments' eyes and abuse of it. There exist three kind of methods to introduce such a stimulus package into the economy. One of them is dependent on higher taxes, with the likely consequence of more government expenditures, called *Taxes and Austerity*, the second one has the effect of raising taxes and cutting redundant government practices, better knows as *Angela Merkel model*, the last one narrows taxes and public spending. The corrective mechanism does not entangle a slide of government public spending which is similar to austerity, the tool is activated solely in the presence of a shrivel regarding government receipts and expenditures.
Keep in mind this conceit, if European crisis was truly correlated with Sovereign debt risk, apart from the fact the Eurozone contained a fiscal discipline omission, fiscal austerity would be the solution. Therefore, fiscal overspending does not instigate a bad economic scenario in Europe. We can hold the statement for Greece, fiscal profligacy sums perfectly up the origin of its internal crisis. In my opinion, Greece would have been better not to choose the euro currency because Greek government condition initiated a downward path on January 2001, with the entrance of such a state in the Euro Area. Once Greece decided to join the member states, it gave up public finances and deficit was the worst of all Europe in 2007. I underline Greece should always be considered carefully due to its fragility and intricate conditions which are persisting today.
Obviously, when a government accumulates a significant bulk of debt, and fiscal indiscipline hesitates to drop out of sight, then there is impossible to continue of spending with any restriction for the future outcomes, also on the sole ground that borrowing could require high costs for countries fail to slash deficits (the most powerful Eurozone states forced budget cuts the so-called crisis countries, nations really pained by the global financial agitation, e.g., Spain, Portugal, Italy, and Greece). Fiscal profligacy was not the same for the GIIPS, fiscal positions diverge considerably, and those states have endured a buckling competitiveness since the start of the actual century. This transmuted into current account deficits for the poorest nations (GIIPS with the Ireland exclusion) and a surplus in that BoP component for Germany. Fiscal austerity expansion measures have the target of public expenditures reduction in all circumstances, the high level of unemployment included, driven by a plausible upsurge of future disposable income, consumption, and investment. In contrast, data supply an antithetic interpretation in whom fiscal irresponsibility did not anticipate the EU crisis bedrocks. Theatrical austerity consensus encouraged Southern states for internal correction mechanisms design, although it is

inconceivable such nations would have resources to do that. SGP was enforced just for preventing these terrible ideas will not be ever repeated. Indebtedness variations inside the Eurozone from 2000 to 2007 are illustrated in the below table.

	Households	*Nonfinancial corp.*	*Financial corporations*	*Government*	*Total debt increase*	*Real home price index*
Belgium	7 (11%)	57	124	–26	162	48.7
Germany	–10 (–25%)	0	33	5	27	–14.0
Ireland	54 (33%)	–13	612	–8	645	52.8
Greece	32 (24%)	13	41	4	90	37.2
Spain	34 (30%)	78	74	–24	162	73.1
France	15 (26%)	20	113	5	152	81.7
Italy	17 (48%)	23	22	–7	55	37.6
Netherlands	32 (53%)	–42	217	–12	195	14.4
Austria	7 (11%)	68	72	–7	140	1.2
Portugal	26 (74%)	12	71	13	122	–11.2
Finland	23 (23%)	–77	70	–11	4	37.7
Eurozone-11	*21 (27%)*	*12*	*132*	*–6*	*159*	*28.3*
Denmark	37 (76%)	60	145	–26	216	57.9
Sweden	24 (25%)	49	70	–10	133	55.3
UK	31 (35%)	–34	367	1	365	63.4
Average	23 (30%)	15	145	–7	176	38.3

Table 2.4: Eurozone Indebtedness Increasing (% GDP)
Source: Storm and Naastepad (2016)

Values in brackets explain the portion of real GDP that households contributed through their debt improvement. Table 2.4 captures a reduction of 7 percentage points in government debt on average, in other words, it is like every country of Europe would have squeeze public spending by 7%. Three of the GIIPS undergone a public debt reduction, the remain ones were characterized by negligible positive increments (up to 13% for Portugal), reflecting no worries of bond markets concerning sovereign credit risk for entire Europe. Asserting EU leverage turn up sharply before the turmoil does not have sense according to data reported here, inter alia, debt augmented ex-post the borne of crisis threat. A curious outcome that wipes out Sovereign debt risk seed lies on the private area, the fundamental of the recession in the Eurozone on average. OECD expresses the financial corporation sector as *all private and public entities engaged in financial activities such as monetary institutions (including central banks), financial intermediaries, insurance companies and pension funds.* What transpires is a tight financial corporation-private sector connection. Looking at the data, such a sector pushed the debt-to-GDP ratio until 1.45 on average, and 1.32 for the Eurozone states (the peak was achieved in Ireland with a 612% of raising), government debt numbers are tiny in comparison. There was a ”reverse crowding out” as to private expenditure dominated public spending, in particular, bad performer nations such as Greece (32% of households debt increase), Ireland (54%), Spain (34%), Netherlands (32%). One must infer a correlation amid debt and economic growth, that is to say when indebtedness jumps up, output plummets. Authors of the table above do not have found out

causality between two variables for all kind of fields explored: household, financial and non-financial corporations, so they stressed that *there is no (statistically significant) association between higher indebtedness and economic growth, defined here as the percentage increase in real GDP over the period 2000–2007... we cannot attribute higher growth in the Eurozone periphery to excessive state spending, and hence cannot logically attribute higher real wage growth, loss of cost competitiveness, higher imports and growing current-account deficits to a supposed lack of fiscal discipline in Southern Europe*. Nonetheless, families debt affects directly and not economic development: direct impact interrupts households liquidity constraints, indirect influence arrives from home asset prices positive trends. The outlier was Germany in this case thanks to converse leverage households climb which took place due to past events, including unification boom. To revive the terminology employed while we were describing the Great Recession, the ”mainstream” view of sovereign risk to be the ”evil” of Europe is misleading. I have demonstrated the surprising relevance of families, in wide terms, private field, for recession generating process. I state austerity alters cognitive systems, just think cut government spending, augment taxes, and lift salaries is seen the manner of mitigating debt issue when a country is falling or is already fallen into recession black hole. Yet, fiscal stimulus helped unluckily GDP negative pattern over the hearth of the crisis. The package produces bias estimations and spurious correlations with output growth, so it must be handled scrupulously given its uncertain nature (debt levels tend to not lower, and explanation of GDP narrow manifests itself in the presence of public debt overhang).

The emphasis can be fixed at capital flow environment. Doing this, almost each nation displayed current account negative values, debt over 60% GDP threshold, consistent unemployment rate, and a reluctant inner income upswing. Germany surpluses accompanied security acquisition programs of low/middle-income countries, with current account shortfalls brought speculative capital which begotten real-estate bubbles in crisis countries, whereas prices rose elsewhere. Let’s elucidate mainly commercial transactions at the core crisis. Table 2.5 stands out difficulties GIIPS met during the last years of the previous decade: capital outflows, government debt crossed tolerable degrees, unemployment rate moves away from natural rate whose estimate oscillates 4.7 to 5.8% based on Federal Reserve calculation[18], and an output departure more often than not negative. The adjective ”natural” refers to the equilibrium level of unemployment surrounds a country’s economy that labor market imperfections make it possible. Non-accelerating Inflation Rate of Unemployment (NAIRU) is the new terminology for the long-term unemployment rate, albeit some economists distinguish it from the common concept being composed of both frictional and structural unemployment, other than no occurrence of non-competitive markets.

[18]For further details, please see Natural Rate of Unemployment (Long-Term), St. Louis Federal Reserve

Country	Year	Deficit	Debt	Unemployment	GDP Growth
France	2007	−2.75	64.21	8.40	2.29
	2008	−3.34	68.21	7.80	−0.08
	2009	−7.57	79.01	9.50	−2.73
	2010	−7.08	82.32	9.80	1.48
Germany	2007	0.23	65.16	8.70	3.27
	2008	−0.06	66.66	7.50	1.08
	2009	−3.21	74.45	7.80	−5.13
	2010	−4.28	83.24	7.10	3.69
Greece	2007	−6.80	107.42	8.30	3.00
	2008	−9.91	112.97	7.70	−0.16
	2009	−15.79	129.31	9.50	−3.25
	2010	−10.76	144.89	12.60	−3.52
Ireland	2007	0.06	24.93	4.60	5.18
	2008	−7.34	44.35	6.30	−2.97
	2009	−14.19	65.21	11.90	−6.99
	2010	−31.31	94.87	13.70	−0.43
Italy	2007	−1.59	103.08	6.10	1.68
	2008	−2.67	105.81	6.70	−1.16
	2009	−5.36	115.51	7.80	−5.05
	2010	−4.51	118.43	8.40	1.54
Portugal	2007	−3.21	68.27	8.90	2.39
	2008	−3.71	71.58	8.50	−0.01
	2009	−10.17	83.01	10.60	−2.51
	2010	−9.79	93.32	12.00	1.39
Spain	2007	1.92	36.21	8.30	3.48
	2008	−4.49	40.07	11.30	0.89
	2009	−11.18	53.81	18.00	−3.74
	2010	−9.34	61.05	20.10	−0.07

Table 2.5: Main Indicators for France, Germany and GIIPS
Source: Armigeon and Baccaro (2012)

Exchange rate devaluation instrument is the immediate technical solution to alleviate competitiveness erosion. In this way, net exports intensify, salaries dwindle (real wages because of stickiness), inflation upturns when exchange rate declines as real domestic interest rate lows respect to foreign one for a depreciation of domestic currency, considering there are capital outflows (recall moreover Fisher equation, if real interest rate goes down, inflation lifts). GIIPS did not be able to implement internal devaluations for impediments that the Eurozone members impose on them. Another time, the European Central Bank should have been the lender of last resort for troubled countries, it perhaps aided that devaluation to mild favor GDP growth and provided liquidity for staying afloat regardless challenges the recession placed. However, such a mechanism must not be employed.

D'Erasmo et al. (2015) indicate a simplified version of Mendoza and Oviedo debt sustainability model where primary balance gets involved (I have changed some symbols

only). The model assumes the government must repay debt, output growth rate is exogenous (γ), the real interest rate r is constant, and expenditures are unaltered unless they are cut up to minimum tolerable levels (this happens if the government borrows money). The lower bound of debt assures the government will not retain more debt than the amount received under the worst possible scenario, that is primary balance with the lowest revenues, τ^{min}, public outlays at the minimum acceptable limit, g^{min}, in which a country is clearly in crisis. The situation might reveal feasible with a probability. The negative episode makes up an upper bound called *Natural Public Debt Limit* (NPDL) computed trough growth-adjusted value of public balance per year. The resultant debt limit will be:

$$b_t \leq \frac{\tau^{min} - g^{min}}{r_t - \gamma} = NPDL \tag{2.4}$$

b_t stock of debt at time t.
Blending 2.4 with government budget constraint: $b_t - (1+\beta_t)b_{t-1} = -pb_t$, in whom $\beta_t = \frac{1+r_t}{1+\gamma_t} - 1$ and $pb_t = \tau_t - g_t$ the primary balance, the optimal level of debt will be equal to:

$$b_t = \max(NPDL, 1 + \beta_t b_{t-1} - pb_t) \tag{2.5}$$

Equation 2.5 tells us that a surplus of government balance will probably contribute to curbing the amount of debt, facilitating loans refund. The model supposes the government will pay back the debt, this might not be held if default is cheaper than repayment, other than it illustrates a trade-off between public debt and primary balance: when the second one goes through an increment financed with expenditures tightening and/or taxes raising, GDP development deteriorates, the government is utilizing restrictive fiscal policies. On the other hand, interest rates are set to zero or actually negative nowadays, so relying on monetary policy for rising economic growth may produce small effects because it tends to be weaker due to macro-financial "headwinds" may blow more strongly when interest rates are so low or the impact of a change in interest rates on aggregate demand and output may be smaller at very low rates, i.e. non-linearities are present (Borio and Hoffman, 2017).
A endless loop which debt upturn builds is presented as follows:

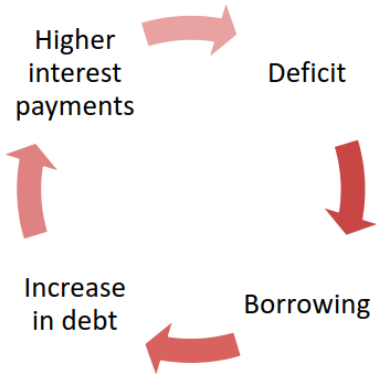


Figure 2.8: Debt Increasing Never-Ending Loop.
Author's elaboration.

I have decided the inclusion of figure 2.8 to elucidate outcomes of debt increasing, although it was not a real driver of the current crisis for motives previously expounded.

Pereira and Rossi (2015) vision about the cradle of European dilemma pivots on the internal exchange rate and making this, they accentuate asymmetries, imbalances, and problems of the euro currency which may be overcome pass to a new coin which does not contain the above drawbacks. The reader foresees that proceeding such philosophy, fiscal irresponsibility did not consign our continent a public trait. Current account deficits spread out the base of the misdeed, collecting households and enterprises debt. Eurozone government bond markets collapse were partially suspended in December 2012 by the European Central Bank which did not symbolize the lender of last resort; otherwise, the central bank would have immediately place liquidity for establishing internal devaluation. Buying of sovereign bonds in secondary markets assigned a faint weigh on sovereign credit risk. That undertaken action was not captured because of fiscal austerity and internal exchange rate biases which positioned hurdles for the euro reform resolutive tool. The economic unification project sounds good if states are very similar. In contrast, the Euro Area does not incorporate nations structured in this way. We have seen Germany responded faster to the turmoil than whatever EU nations with adequate working policies whereby unit labor costs did not explode as crisis countries. Our currency did not eliminate foreign exchange operations, instead, it promoted the formation of mutual exchange rates mismatched ex-post the currency unification in January 2002, which deprived members to control their monetary policy, fiscal power was retained at the country level. The *Mundell-Flemming Trilemma*, also called the *Impossible Trinity* or the *Trilemma* is a concept economists Robert Mundell and Marcus Flemming elaborated to show limited options nations own to set monetary policy. The Trilemma is presented in Figure 2.9.

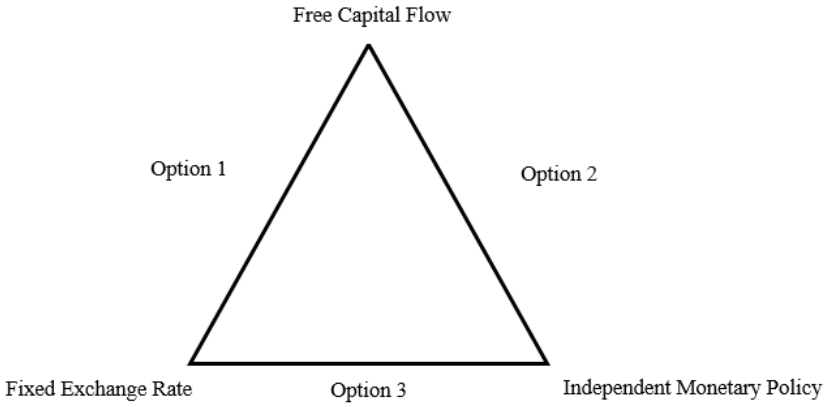


Figure 2.9: The Mundell-Flemming Trilemma
Source: Author's elaboration

The Eurozone chose to pursue Option 2. Therefore, the exchange rate must fluctuate to preserve market equilibrium, but they did not react in right ways so that imbalances strengthened. Pereira and Rossi are convinced that fiscal indiscipline could never detect the

seeds of the European recession dawn. They maintain that fiscal data manipulation of Greece fueled sovereign credit risk understanding. I agree partially with them because Greek government performed badly when the state joined the euro coin (fiscal pressure continued to persist), I consider it the stress of infinite problems Greece lived asking several subsidiaries. Conversely, the authors ranked target realities reflect fiscal profligacy misleading: internal exchange deficits and masked outcomes of crisis states perhaps persuaded high-income nations not to carry out adjustments, internal devaluation does not work well whether salaries downturn occurs, while capital returns are unchanged, marking our crisis as fiscal puts aside public sector tasks brings welfare ruin.

Blending all these ingredients, what surfaces is a foreign exchange crisis as real exchange rates mismatched for each country inside the Eurozone diluted with banks bail out during the global financial crisis (public debt anxiety emerged after 2012, i.e. when the sovereign risk was almost completely rid out by means of Mario Draghi measures). Private leverage and current account shortfall are anchored to real exchange rate. At all stages of the section, I have reported the expression *internal exchange rate* which refers to the implied exchange rate of countries measures competitiveness estimated via unit labor cost for a focus country relative to remaining ones. Those rates arose by the Euro Area network considering unique monetary policy and auto-managed real exchange rates at country bound, an evident imbalance effect of the euro. Labor production costs revision twist such a rate responsible for Germany speculation against GIIPS debt instruments and crisis countries depletion. Asymmetries would not manifest themselves under separate currencies nations detained. The authors highlighted that competitiveness does not notch monetary field (reflection goes to BoP), and mutual adjustment catches on Balassa-Samuelson effect. Béla Balassa and Paul Samuelson found out in 1963 the inclination countries with high productivity have got to associate this latter to strong growth regarding salary, making real exchange rate boost. Besides, wages improve in tradable goods sector flows into non-tradable services environment in emerging countries, with an increasingly fast trend for inflation. Emerging and developing nations own greater inflation rates than developed states.

Supplementary shortages of the euro may be disclosed as to no build of adjustment mechanisms by interest rates (the European Central Bank must satisfy the inflation target), and private range deficit carelessness until the Euro Union deals with it like an ease debt expense; negative current accounts shape consumption, price raising, internal exchange rate perception biases, families and enterprises deficits augment, there were foreign deficit fundings too. Southern and Northern EU states diverge more and more thanks to the impediment that firms belong to the first ones suffer versus domestic and foreign demand.

I conclude this sight of the recession declaring it was conceived from our currency which erroneously met interest rates, consumption inundated prices and wages to hike up, mismatching of real interest rates of nations occurred, and the private sector deficit projected the BoP disorder.

Engel (2016) concentrates on an uncommon aspect of the crisis. He infers the kernel of it should not be research in sovereignty, bailout, or over-confidence governments had to repay what they borrowed, sovereign debt markets functionality breathes life into the juncture. Once again, the euro robustness degenerated due to the tendency to obscure policymakers activities. The author underlined European institution was frail 2010 to 2013 when confused policies were signed for rescuing Europe. Germany leadership drew on rigid political tools (we have unfolded internal flexibility exploited in labor market), so chase after European economic architecture. That *Institutional Economics*[19] approach for the current recession is prudent to label such awful episode with a fiscal stigma, there seems a too strong assumption for the complicated crisis bears market malfunctions. Risk management techniques are essential to figure out the extent that traders run risks prudentially, correctly, and efficiently in financial market institutions where emergent traces their indelible stamp. The activity of describing fundamental definition by way of theoretical definitions steer risks valuation, along with to reproduce a characteristic of financial markets foundation.

The reader will be wonder how was it possible the EU meltdown overflowed from an embedded function of financial markets, not harmful borrowing, fiscal austerity, or any economic-financial supportive instruments. The answer inhabits on a distinction which separates what Engel calls herd behavior[20], from isomorphic behavior. He wants to leave a mark on the passage from a peaceful to a fright mindset. As a result, the crisis entangles emergence of institutions whose mission is not sole efficiency and transnational markets; economic behavior also covers the target. I believe stakeholders outlook of firms fits that mentality utilizing companies organize strategy around relations accommodating social interlocutors. Markets are generated by enterprises offerings which meet customers needs and dreams across cross-price elasticity. Markets features, structures, preferences, and customer types are emergent qualities, the product of actors observation respect to others in an isomorphic way, and *Institutional intelligibility* shapes forms of actors and trading venues. As traders observe each other mutually, the intelligibility creation entails observation and expression of theoretical customer tastes.

The methodology does not rid out the sovereign adjective. Indeed, sovereign Eurobond markets fundamentals are translated in macroeconomics indicators which lead riskier governments to fulfill consistent public bond interest rate payments being closer to sovereign default.

[19]Institutionalism, or Institutional Economics, is a school of economics borne during the 1920s and 1930s in the U.S. which perceives institutions to be meaningful in order economic behavior process develops. Thorstein Veblen was the founder of the theory, he criticized classical economy for its people's economic decision-making view, concentrating himself to a different vision under living beings continuously rotate customs and institutions.

[20]The expression is usually intended as the typical individuals' manner to replicate attitudes accepts by a host of people in Behavioral Finance.

Reveal government behavior and market evaluation does not appear straightforward. Wrapping up the section, fundamental analysis of securities can be conducted via customer preferences examination, crucial to distinguish mimetic behavior from herd behavior which means from crisis to normality. We trade into not-turbulent markets just because of the normality-crisis bridge which emergent market intelligibility perfectly explains. The surge of our crisis thus starts inside. There is no chance to have a given fundamental that supplies a convergence for market behavior, useful for herd-isomorphic attitude detach. Sovereign bonds transform debt roll over and financial flows of sovereign countries. The crisis is similar to an ”actor” which fills the absence of separation between the ideal equilibrium and insalubrious scenario. Engel's theory implications consist of reinforcement between national economy definition as the fundamental by sovereign debt markets and the crisis denotation discussed above which pins it on herd behavior, so that one can affirm sovereign markets sound good.

The Eurozone did not be attacked by lost of competitiveness attached with fiscal indiscipline, the statement proves not to be true as countries lived competitiveness downturn prior to the crisis did not growth less afterwards. Misleading is built around importance given to unit labor costs considered the primary variable for competitiveness.

In the next paragraph, I will recap the key consequences of the meltdown.

2.3.4 Consequences and Responses

Tools to well understand the financial disaster will be provided to the reader. Outcomes are quite intuitive. Moreover, I claim the main consequences and responses must be reported in a synthetic manner.
The public deficit condition of governments surfaced successive the crisis origination when the member states were obliged to bail out banks to avoid their default in some cases.
Families debt leap augmented borrowing which supplied home prices increase and a private sector indebtedness boom, Spain and Ireland were the most blown. Nowadays, economics sectors leverage reverse process is adversely impacting economic activity, and the problem begins to transpose at balance sheets deterioration. Fiscal austerity decreased GDP and any performance indicators, not sovereign debt, it made the fiscal irresponsibility endless circle attainable (clarified in 2.8). This retort turns out to be very dangerous if one looks at the potential recession which may happen according to every form of austerity exacerbates economy as a whole. Greece troubles were induced by austerity after the borne of the European crisis, the single episode where public spending was high before 2008. Wages cut and labor markets deregulation were amends used for mitigating bad performances though this ”medicine” gathers more disadvantages than improvements. Real GDP studies demonstrated how salaries cutting, precisely, internal devaluation, curbs real output growth, while unemployment enhances. Spain, Ireland, Portugal, and Greece recorded the greatest estimates for having slash wages and strengthen unemployment rates. Once again, Germany has seen the best country vis-à-vis Southern states for its working policies. The sight is inconsistent in my opinion due to there is need to establish how much the opportunity cost will be for German society in long-term, we should think those actions pertain to the short-run. Naturally, BoP worsened over the crisis, and no exchange rate alterations were practicable since the euro is a foreign currency for the Eurozone nations, devaluations would be the unique source though not the right way for recover (high costs for economic development and wealth). Deflation is obstructing upswing but even in that circumstance, experience teaches us everything is possible, e.g. the UK was substantially affected at the beginning of the global financial crisis, even if it done Sterling devaluation and it is recovering quite good now. I put ”quite” adjective because Brexit might provide the UK problems such as no longer subsidies from Europe. However the topic is not inherent for the aim of the thesis. States focused excessively on fiscal and debt responses. We have learned the euro is not health for Europe. Nobody takes care of return to control their monetary policy, maybe excessive costs in the long-run would discourage implementation of methods with serial currency mismatches would take place attached to larger deficits, yet competitiveness increasingly rescue, especially for GIIPS countries, Northern nations appreciate currencies and Mario Draghi would equilibrate the environment acting on national banks supervision, with positive benefits on sovereignty.

Common currency adoption is never much taken into account in whom the euro would not disappear and it would back up national currencies within the Eurozone. This idea comes from Frédéric Lordon, a French economist and I appreciate his proposal which points out the European Central Bank would be a sort of intermediary for converting state currencies at the overall central bank level, eliminating entirely exchange markets among EU members.
Lane (2012) expresses risks of multiple equilibria when sovereign debt achieved junk degrees during the crisis. The weakest countries are exposed to speculation for the sovereign debt which inflates public bond interest rates considering default probability climbs, the contrary for the strongest states. Discrepancies are more problematic under a single currency as flight-to-quality traders make in EU sovereign markets. The author indicates some methods to cherry-pick right equilibrium. A firewall fund via the availability of an official safety net which attenuates change governments could fall into the sudden sovereign debt spiral, or sovereign bonds purchasing programs carried out by Mario Draghi, imposing an upper limit of interest rates with respect to some states nominated beside fiscal criteria. On the other hand, he suggested some responses being careful to sovereignty view of the turmoil. A more solid fiscal union to share tax streams or expenditure programs in order to drop bridges between national output variations. Enhanced coordination of internal fiscal amends would favor the convergence of the Euro Union fiscal situation to macroeconomic levels. Eurobonds enter into European markets would impede speculation activities by powerful states against, say, Greece, Italy, Spain, then the new form of bonds would include restrictions for over-borrowing such as short maturities.

Theoretical frameworks helpful to go beyond an arduous crisis will be described in the final part of the elaborate. The next chapter will be the core of the thesis: I will prove why banks bought public bonds of crisis countries during the global financial disastrous. That looks crazy at first glance, I will show that robust evidences are hidden behind the holding of the bonds.

Chapter 3

Why Banks Purchased More Public Bonds During The Financial Crisis?

3.1 A Brief Overview

The Global Financial Crisis evidenced governments were not anymore safe. We have learned this lesson very well in Chapter 2. The out of the blue turbulence was more hazardous than inflation recessions since such a crisis made noxious both the worldwide interbank market and banking system, acting into sovereign bond markets where states were trying to raise funds by public bonds issuances. The operation acted as an alarm bell for banks and investment banks; they formulated hypotheses that distressed governments would have had poor performance in the forthcoming future. Nonetheless, financial institutions were not discouraged from purchasing, hence holding, a vast number of sovereign bonds when the wind recession announcement was sprouting prominent. The reader could feel confused. Economic agents are risk adverse on average that makes them reluctant to invest in debt securities considered thoroughly dangerous, these assets are known as junk financial instruments. The evidence of my analysis has drawn attention to banks acquisition propensity towards buying even more public bonds in the wake of and during crisis episode. My insight touch banks businesses due to public bond yields of crisis countries taken off extremely high levels up to the middle of the 2008 meltdown, encouraging banks to buy a lot of such bonds. The jump of yields sank prices and banks gained plenty of money. In the lead-up of recession infancy, national financial institutions retained a percentage of public bonds which spaced from 15.4% in GIIPS to 37.7% in Germany, passing to 1.9% in the U.S. and -1.3% in the UK. The banking crisis converted banks business as the treasury bondholding incremented by 5.23% on average, the holding changed to 21.2% in GIIPS, 6.2% in the UK, 1.9% in the founding father of the downturn, only Germany displayed a contraction but it was prompted by a r rising of foreign traders looking at the data. Private sector helped to swell banks balance sheets with a larger bulk of government debt. One must remind that public bonds depict a consistent part of banks' assets, mostly in emerging or developing states wherein finance is frail.

3.2 Banks, The Global Financial Crisis, and Public Bonds. An Empirical Study

3.2.1 By Way of Introduction

We will put much effort to investigate how banking sector reacted versus the financial crisis. There are no doubts concerning banks were influenced by the recent clash. The "ghost" U.S. created at the end of 2007 is still echoing in Europe, our country has started just now to see a bit retrieval, after all who would have suspected the magnitude of the crash was huge and resistant for almost a decade. As we have ascertained, top investment banks such as Lehman Brothers, Goldman Sachs were caught off guard (the former one defaulted), indicating the complex and unforeseeable propagation of a crisis anchored to banking system. Logically, when banks suffer, everyone agonizes as a matter of fact for the simple reason that financings scarce and bank run phenomenon could become reality. The Eurozone displayed sovereign default risk afterwards bail out was vital in order financial firms lighten a little businesses. The surprising evidence was that those institutions did not contract public bonds exposition when states became distressed due to a recession ensued from banking network, as opposed to the natural outlook whereby sovereign spread upturn accompanies commercial and investment banks decline gradually the holding of treasury bonds. This chapter of the thesis will be hinged on cover misinformation which takes us to think sovereign debt acquisition reduces when the government signals sound dangerous in reference to primary balance, private sector instability, and debt repayment capability. Likewise, learn the climb of debt securities banks done in the meantime of the Global Financial Crisis. The connotation transpires to not only be present in Europe and the U.S. Ogawa and Imai (2014) carried out an analysis on a sample of Japanese commercial banks from the end of the 1990s to 2010. They reported, assuming activities are made up of loans and government bonds, that credit institutions were changing habit as the focus passed to bonds the government issued, this passage was alimented due to a drop of the ratio computed dividing loan rate on unit lending costs, that means commercial banks bought Japanese government bonds (JGBs) to grant loans if price-cost margin resulted low relative to lending. The margin is calculated via the formula Ogawa and Imai represented in the paper and I report it here (2003 was selected as basis)[1]:

$$\frac{\alpha(\log MARGIN_{2010} - \log MARGIN_{2003})}{\log G_{2010} - \log G_{2003}} \times 100$$

in whom *MARGIN* is the ratio between the interest on loans and discount (what they labeled as *LOANINT*) and the total operating costs and expenditures for increasing funds ($TOTALCOST$), α the elasticity of JGBs respect to price-cost margin, G the demand of

[1]For more accurate details regard the computation of all variables reported, please see the original work listed in the references.

sovereign bonds equals to loans minus total assets of the ideal portfolio constructed by the authors. Looking at values of the margin, all commercial banks analyzed explains 58% of JGBs holding during the first ten years of the current century, second regional banks[2] contribution jumps to 158%. Yields stayed intact, while balance sheets status settles the high demand of the bonds.

In my empirical study, the focus has been given on economical and financial market aspects of countries because the aim is to uncover weight of internal changes induced by the crisis which were reflected on normal banking activities translated into an inclination to go long on many public obligations. We should not be impressed from percentages considerable, public bonds are very liquid debt securities which permits banks to store liquidity cheaper, faster, and safer. All banks' assets must be satisfied with future investments, so what better method to make sure this will become reality if nothing buying bonds issued by the government, i.e. debt instruments which are virtually reputed risk-free. Banks do not act in the same way of uniformed or pseudo-informed traders, they are unaware the government will repay with a higher probability the loan in case of good news about the investment. Here initial complications come to light: let's take into consideration the government choses to default, country's resources for consumption go up since they are incited to improve. The drawback erodes liquidity, banks end up with insufficient cash flows indispensable for any practices management e.g. lending, asset, and output reinforcement. In advanced economies, this latter implication dominates the former one, so much so that the government resolves the issue claiming it will be engaged with the repayment without exacerbate bank sector and provoke a banking crisis. On the other hand, evolved financial markets is a positive warning for traders as well as institutions given that banks might exert pressure on the government less prone to use default option which might show onerous for the state. My clarification behind these statements is founded on BoP equilibria: a solid state does not mean leverage nonexistence rather an affordable public debt level may attract foreign traders to invest in national economy and give a current account surplus which serves as a watershed between the amount of government bonds kept by domestic banks and the quantity of them foreigners want to purchase. The national demand of such debt expands inside the territory because of the rest of the world capital inflows, the quota of debt owned by foreigners diminishes and default becomes more expensive.

Gennaioli et al. (April 2014) moved on these steps, they offered a well-designed model whose assumption surrounds the expensive cost of default the government bears, deteriorating balance sheets of national financial institutions. Beside these fundamentals, the authors unveiled the key task banks own for public borrowing and private sector debt. Sturdy financial firms permits leverage raising fueled by dint of national and overseas borrow sources, along with the unfortunately weakness of fragile banks which drop credit, GDP, and leap default risk, thereby country's default corrodes banks' balance sheets, sovereign bond markets might become more volatile, thus agents lost a certain degree of

[2] A regional bank is a financial institution wider than a common bank and smaller than a money center bank considering its international operations.

confidence on them (it is worth highlighting the relevant part plays by the prior banking crisis which places the defaulting government in a tougher condition).
Their model formulates forecasts on domestic economy helpful to integrate my analysis on banks, government bonds, and the worldwide crisis considering Greece has been integrated in the analysis whose default happened in 2012, covered by the time frame of the dataset I have built. Private sector shrinking ex-post default tends to strengthen whether those institutions keep a large amount of treasury bonds. Furthermore, credit concession cuts off in states which have received more foreign funds and banks are mostly developed, making sovereign credit default to fall also thanks to wider capital inflows.

The quantity of sovereign bonds considerably vary across countries. Database used for an initial comprehension of sovereign bonds comes from Bruegel dataset which is a mainstreaming of the work reported in Merler and Pisani-Ferry (2012). The sample incorporates twelve nations, the authors collected the holding of such bonds in five categories due to the various characteristics of national authorities. The rated institutions are *Resident Banks*, *Central Banks*, *Other Public Institutions*, *Other Resident Sectors* and *Non-Residents Banks*. The following graphs polarize on the percentage sum of government bonds bought by residential and non-residential banks on the total quantity of treasury bonds issued by nations from the starting of the economic boom to the year of the beginning of faint sovereign credit risk issue.

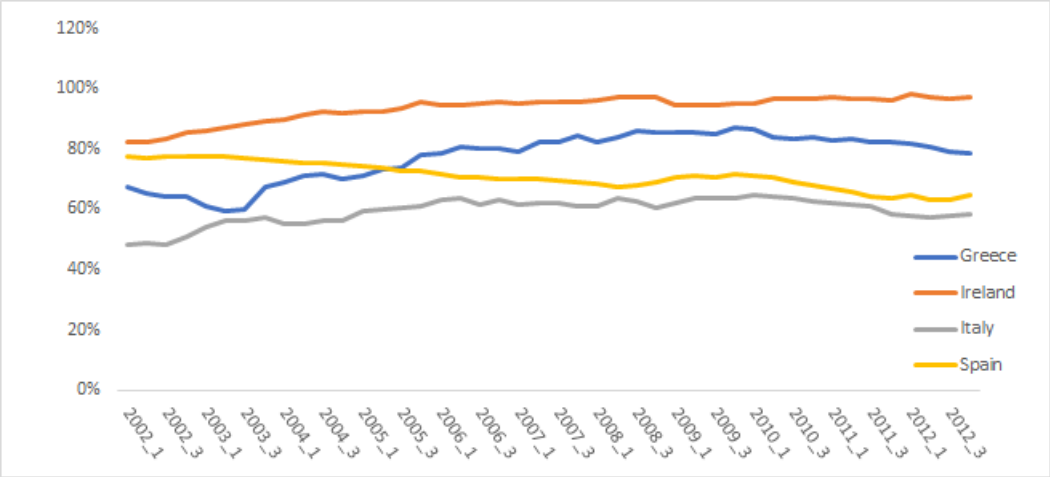
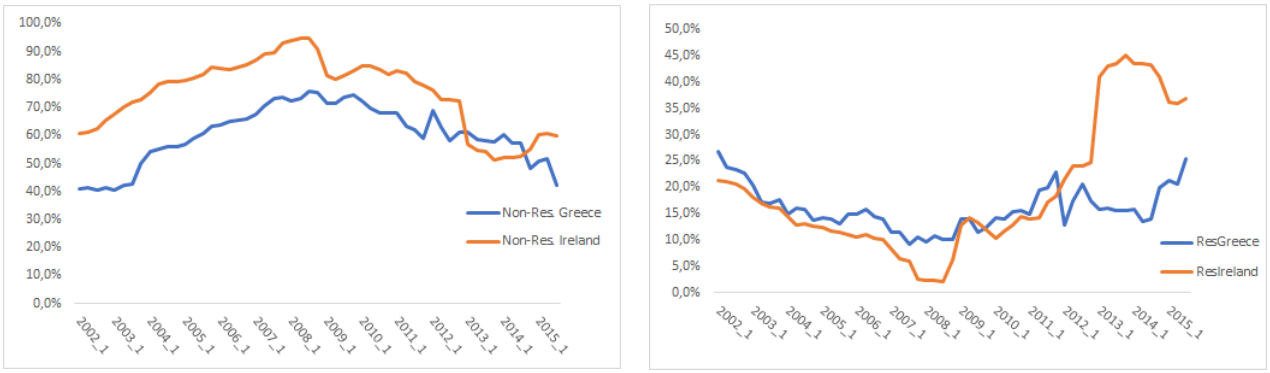


Figure 3.1: Sovereign Bondholdings by GIIPS Banks.
Author's elaboration. Data source: Bruegel database.

Portugal is not included in the graphic since the missing of the data pre-Great Recession. Banks kept a meaningful portion of public bonds which did never hike down 40% throughout the economic boom and until the deterioration of the Global Financial Crisis. I have focused on the GIIPS since they really blown by the glut of toxic repercussions the recession supplied them. Surprisingly, Ireland bond purchasing thresholds were always above Greece debt, the worst country before and after the meltdown.

To better figure out this fact, I point out that an exploration of domestic and foreign banks bondholdings of the two nations is helpful according to the feeling that Irish government could have experimented a surge of internal purchasing of sovereign bonds. In the literature, a vast range of researchers noted that before the crisis, foreigners shaped a wide piece of traders who negotiated government bonds linked to a specific country, in other words, traders of domestic sovereign bond markets hosted principally foreign agents. The U.S. recession reverted the process, residents were attracted to national bonds, meanwhile the second ones reduced investments on them. The subsequent plot delineates this right perception.



(a) Foreign Banks (b) Domestic Banks

Figure 3.2: Ireland and Greece Sovereign Bondholdings
Author's elaboration. Source: Bruegel database

The overhead graphs highlight my precedent suspect, namely there was a sharp upward trend of domestic government bonds in Ireland in the wake of the Great Recession formation.

Andritzky (2012) worked on investor shares for government securities in the G20 advanced economies and the Eurozone to find out a relationship which ties government bonds and the corresponding yields. Econometric model revealed a negative correlation amid government debt securities and their yields. An improvement of foreigners for domestic debt instruments equals to 10% is associated to a slide of 32 to 43 basis points of interest rates, the relationship is more consolidates at the Union Area. Volatility raises when non-residents augment buying of focus sovereign debt too. Another yields-bond holdings correlation emerges, that is increasing of regulatory treasury bondholdings coincides with a 10% which exacerbates promised returns until 25 basis points. The author cried out that an increasing share of non-resident investors is associated with lower yields, and domestic institutional traders delivered lower yields. He confirmed also that the onset of the crisis enhanced resident bondholding.

My quantitative analysis is devoted to empirically demonstrate the predisposition national banks leak about willingness to acquire the largest amount of sovereign bonds marketable upon a financial crash. Bond returns go down as sovereign spread wides, likely once banking bailout is triggered, possibility that the government default actualization becomes

real upsurges. My model will catch and predict all ingredients which plug banks and risky bonds. Data description will be outlined in the oncoming paragraph.

3.2.2 Data and Elaborations Used to Run the Analysis

I have engineered a database which comprises sovereign bondholdings of national banks as well as macro variables of states included in the sample. The proxy for public bonds is the percentage of the holding by banks with respect to the total outstanding amount of sovereign debt in a given quarter. These information have been extrapolated from Bruegel dataset which collects data for twelve states, i.e. ten European states (Finland, Belgium, Netherlands, GIIPS, France, and Germany), the UK and the U.S.A., standardized for cross-country analysis as the nature of authorities differs radically across nations. The ”normalized” entities that buy government bonds are five. To remember them, National banks, Central banks, Other Financial Institutions, Other Resident sectors, and Non-Residents banks. I have concentrated on national banks to explain rigorously how their acquisition of sovereign debt securities translates contemporaneously with modification of state status where the core driver of change is the attitude of national banking system to alter purchasing public bond programs after the country lived the rapid ascent of the misfit. I do not have selected monetary value of holdings because in my opinion, percentage variations are better to capture the contribution that explanatory variables provide to the phenomenon we want to analyze since fluctuations are already in percentage without taking any scale transformation, other than most of the regressors of the econometric model are expressed in percentage, and relative changes seem to provide a more immediate perception of how much government bonds financial institutions placed into balance sheets immediately after the 2008 contagion.
The control variables for public bondholdings at country level recap the situation of the Eurozone, the U.S. and the UK both ex-ante and ex-post the worldwide crush. Data are obtained combining different resources from OECD, Insight.com, and International Banking Statistics (IBS) dataset. Since the Great Recession repercussions affected labor markets, trading venues and exchange rates (that is goods and services trade), economy system must be analyzed in all facets, otherwise bias conclusions will take us to omit key factors behind our study. Labor market status is well-represented by the harmonized unemployment growth rate in comparison to the previous quarter. The rate is directly not available from the source, I have computed it performing a straightforward difference between consecutive unemployment rates. Economic statistics literature suggests estimation of tendential or conjunctural variations with absolute changes when variables are expressed in percentage points. The advantage of this measure lies on the uniform method to calculate increments or reductions of workforce which is comparable efficiently between several states (recall that labor markets are heterogeneous, they depend strongly upon regulatory policies and laws adopted inside the nation).

The economical panorama is expressed through the real GDP growth rate, whereby GDP calculated at constant prices (OECD uses 2010 as basis) at time t is compared with its adjacent value at $t-1$. I have opted for GDP being a popular and far-reaching indicator for wellness of states, specifically, the real approximation is inflation-adjusted which provides a mere tendency of output removing effects not connected to BoP, manufacturing, or service components. Another justification to prefer real connotation rather than nominal expression is developed by econometrics due to a correlation which might arise between GDP at current prices and unemployment rate, leading to endogeneity problem and making the panel data model which will successively be exploited bias and inaccurate. In the foregoing chapter, the relationship amid inflation and unemployment was reported thanks to the classical shape of Phillips curve and considering that the time frequency is set at quarterly basis, we will run analysis in the short-term, with the consequence that the spurious effect may originate and the model should be substituted.
Private sector is part of the crisis puzzle, therefore credit-to-GDP ratio represents a good accuracy for treasury bonds holding, the metric includes lending to non-financial sector that domestic banks, other sectors of economy and non-residents supply to households, for example. Dividing private credit to GDP allows us to infer how relevant those aids are on the overall net worth of a country.
Passing to financial panorama, public debt outstanding illustrates the cumulative issuances of bonds the government made in a specific period of time. This variable is taken into account because my feeling is that financial institutions purchase many bonds when the government or Treasury signals to be in trouble either via sovereign default or banking crisis.
Bond yields reflects sentiments of traders concerning economic-financial events which rock markets. My prediction lays the background that during the turmoil, the weakest states upturned interest rates for attracting national and foreign banks to invest in their debt assets.

Stages of the database design have required conjunction of multiple sources. I have started the project filtering out Belgium and Finland from the original Bruegel dataset because of the correspondent data has been estimated annually, instead central banks of the two nations have not disseminated government debt data every quarter in their own sites as the researchers have emphasized. We pay attention on quarters for marking ulteriorly down the rapid effect the subprime meltdown, Lehman Brother's default, and the banking calamity had on the general financial atmosphere. The dataset covers final years of the 1990s and it protracts the treasury bondholdings until 2016 but I have narrowed length of the sample from January 2002, the borne of the agents overconfidence and not less important the euro adoption in the Euro Area, to December 2014, few years following the endowment of U.S. crisis in Europe. Some data for selected states are missing, a recurrent situation when deal with longitudinal data insofar as there is impossible to observe all countries for a long

sequence of periods over time. I have tried to go beyond the problem applying a basic data mining technique which points out to replace missing values of a variable with the average of observations for the vector, unfortunately outcomes have not been satisfactory given that they have tended to falsify the real pattern of bondholdings pre-crisis, introducing large discrepancies compared with onward time information. The software program used to analyze the data was R which encompasses processing packages cross-sectional time series analyses and permits to ignore missing values, labeled with NA symbol. They can be positioned in macro categories according to their pattern. *Missing completely at random* (MCAR) does not imply that the distribution is random, missingness is independent on observations or missing data which means a strong restriction of NA placement. A weaker imposition claims that missingness is linked to observed estimates or entries of variable, and the missing method is referred to *Missing at random* (MAR). I report the expression, with a rearrangement, that Little and Rubin (2002) expressed for fixing MAR definition with the aid of maths :

$$f(M|Y,\phi) \ = f(M|Y_{obs},\phi) \ \forall \, Y_{mis},\phi$$

M the missing-data indicator matrix, $f(\cdot)$ the conditional distribution of M given Y, ϕ an unknown parameter, Y_{miss} the observed values and Y_{miss} the NAs. Whether the distribution of M depends on Y_{miss}, we are in the *Missing Not at random* (MNAR) panorama as the likelihood of data being absent is calculated with the value of attire and this is the most difficult scenario to manage. To detect in which class my database falls is not easy because it requires sophisticated analyses.
According to Luengo J, three issues are interlinked in the domain of missing values: (a) decrease in efficiency, (b) hurdles in analyzing and managing the data (c) differences between missing and complete data that impact on the result (Waqas et al. 2016). Management of information absence becomes important, the research of this topic is still going ahead.

Public bond yields are provided by Investing.com at daily, weekly, and monthly basis. In order to reach an appraisal quarterly[3], I have aggregated monthly estimations using average whose property permits to minimize the sum of squared deviations (the total of interest rates for each month is not the best way to reflect quarterly yield, the result would be distorted and would contain distortions such as interest rate overestimation). Introducing bond yields, observations in the database reduces from 480 to 472 as Ireland yield time series is discontinued for certain years. I want to stress that government bonds own a long-term maturity equals to ten years. These debt instruments are more volatile than one or three years bonds due to the principal will be brought back in a longer span of time, traders have to face more risk and yields are mostly shocked by the financial crisis.

[3]The estimate which I have computed must be interpreted as an approximation of the real intrinsic yield of bonds because an aggregation method has been employed.

To demonstrate the statement, we think in terms of par and duration: a bond with a coupon rate of 4% and a maturity equals to ten years own a longer duration than another bond with the same rate and a term to maturity of five years simply for a larger falling of price when interest rate growths. The principal of long-term bond will be repaid with more uncertainty and in a wider time, postponing reinvestment of lender.

The crisis effect is controlled building a dummy variable in the model, called *FinancialCrisis*, which is set to one whether the country was experiencing the negative results of the U.S. hurricane: GDP slide, unemployment surge, private sector spending turn, BoP deterioration, and above all banking crisis using the definition of Laeven and Valencia (2013) who defined it to be *an event that meets two conditions: 1) Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations). 2) Significant banking policy intervention measures in response to significant losses in the banking system.*

Sovereign default is controlled albeit there exists a single episode in the database, Greece in 2012. The reason is that sovereign credit risk might have induced banks to switch their holdings during the global turmoil, although it should not be deal with the driver of the Euro Area crisis consistently to the vision explained in the previous chapter. A dummy variable is inserted into the panel data, listed sovereign default, according to Gennaioli et al. (July 2014) who used the definition reported by S&P: Sovereign default as *the failure to meet a principal or interest payment on the due date (or within the specified grace period) contained in the original terms of the debt issue. In particular, each issuer's debt is considered in default in any of the following circumstances: 1) For local and foreign currency bonds, notes and bills, when either scheduled debt service is not paid on the due date, or an exchange offer of new debt contains terms less favorable than the original issue; 2) For central bank currency, when notes are converted into new currency of less than equivalent face value; 3) For bank loans, when either scheduled debt service is not paid on the due date, or a rescheduling of principal and/or interest is agreed to by creditors at less favorable terms than the original loan. Such rescheduling agreements covering short and long term debt are considered defaults even where, for legal or regulatory reasons, creditors deem forced rollover of principal to be voluntary.*

The variables used in the study are summarized in the next table.

Variable	Definition
Sovereign Bondholdings	Percentage of sovereign bonds holden by national banks. Source: Bruegel dataset.
Sovereign Default	Dummy variable sets to 1 when a sovereign default takes place. Source: Gennaioli et al. (July 2014).
Financial Crisis	Dummy variable sets to 1 when the country lives the effects of the Global financial crisis among whom banking crisis. Source: Laeven and Valencia (2013).
Unemployment Growth	Quarterly percentage change of harmonized unemployment growth indicating the unemployed as people of working age who are without work, are available for work, and have taken specific steps to find work. This indicator is measured in numbers of unemployed people as a percentage of the labor force and it is seasonally adjusted. Source: OECD (2017), Harmonised unemployment rate (HUR) (indicator).
Real GDP Growth	Quarterly percentage change of GDP computed taking 2010 as basis for prices. Source: OECD.Stat
Private Credit-to-GDP ratio	Total credit to the private non-financial sector, capturing total borrowing from all domestic and foreign sources. Credit is provided by domestic banks, all other sectors of the economy and non-residents and covers the core debt (loans, debt securities and currency deposits). Source: BIS dataset.
Sovereign Bonds	Total outstanding amount of sovereign bonds issued by the government of a country expressed in billions of euro. Source: Bruegel dataset.
Bonds Yield	Quarterly government bonds 10 year yield computed aggregating monthly returns. Source: Investing.com.

Table 3.1: Definition of Variables used in the Analysis.
Author's elaboration.

3.2.3 Preliminary Exploratory Analyses

To perform ad hoc econometric models, there needs to implement a prior descriptive and graphical analyses for understanding relationships which tie sovereign bonds of banks with variables able to explain such holdings. I have initiated calculating the percentage quantities of government bonds during the economic boom and the World Financial Recession. To investigate forcefully intricate dynamics which was formed inside Europe, I split the information about the Eurozone weighting the stock amount of bonds in GIIPS separately from the remain Euro Union members. Table below rates average, standard deviation and median of debt instruments for the periods and countries gathered.
Banks exhibited an increment of bonds in assets after the crisis. Germany had a contraction caused by more foreign traders who acquired its debt, a reverse approach respect to that initial we have tackled in the introduction. UK national banks holden a negative value of sovereign assets over the economic boom. A reason behind the fact might coincide with a "shy" raising of interest rates which led banks to short sell government bonds and pass to ulterior securities e.g. CDOs or MBS, very fashion in the epoch. The U.S. monetary financial institutions (MFIs) holdings raised by 0.1 percentage because non-residential investors are a large piece of markets. GIIPS were subjected to a considerable upward thrust, proving ulteriorly how banks promoted their assets buying increasingly public bonds in trouble or crisis countries. I have inserted median in the table according to less sensibility for outliers (a sort of robustness property). A notable change happened in the UK which transmuted MFIs propensity towards sovereign debt. I do not know the right determinant *a priori*, maybe it must be searched in yields once again. Bearing that in mind, let's take a look at sovereign holding and interest rates time series to formulate a theory. From figure 3.3, we note generally yields inclination to go up during the recession, then bonds' interest rates shrink generally in 2011 but banks do not stop debt purchasing due to positive trends in many states of the population. Focusing on UK, yields did really not oscillate before the crisis, there shows my supposition of why financial institutions sold treasury obligations in that period. The situation reverted with the crisis, nowhere downward yield trend discouraged MFIs holdings. As a consequence, thoughts which emerge are a positive correlation among crisis and the bulk of public bonds in banks' balance sheets; yields increased in the wake of private sector EU crisis (Greek bond interest rates jumped at 25% in 2011 being the one with the worst performances in the Eurozone, the state suffered from sovereign default in the successive year), then they dropped generally in 2012 when the European Central Bank started to make markets resilient adopting quantitative easing programs; in statistical jargon, there could be a positive yield-treasury bonds correlation and an interaction between yields and the crisis.

Banks Public Bondholding

	Mean	Std Deviation	Median
		Economic Boom (Q1 2002 - Q3 2007)	
GIIPS*	17.144	6.645	14.411
France	11.074	3.999	14
Germany	37.743	3.679	38.033
Netherlands**	8.217	0.240	8.309
UK	-1.269	1.192	-1.079
USA	1.653	0.713	1.619
		Financial Crisis (Q4 2007 - Q4 2014)	
GIIPS	21.2	10.028	20.042
France	13	3.094	14
Germany	25.162	2.477	24.2
Netherlands	9.187	1.970	9.482
UK	6.196	3.467	7.180
USA	1.9	0.445	1.947

*Data for Portugal are not available.
**Time series begins from Q4 2005.

Table 3.2: Statistics of Sovereign Bondholdings Pre and Post Crisis.
Author's elaboration.

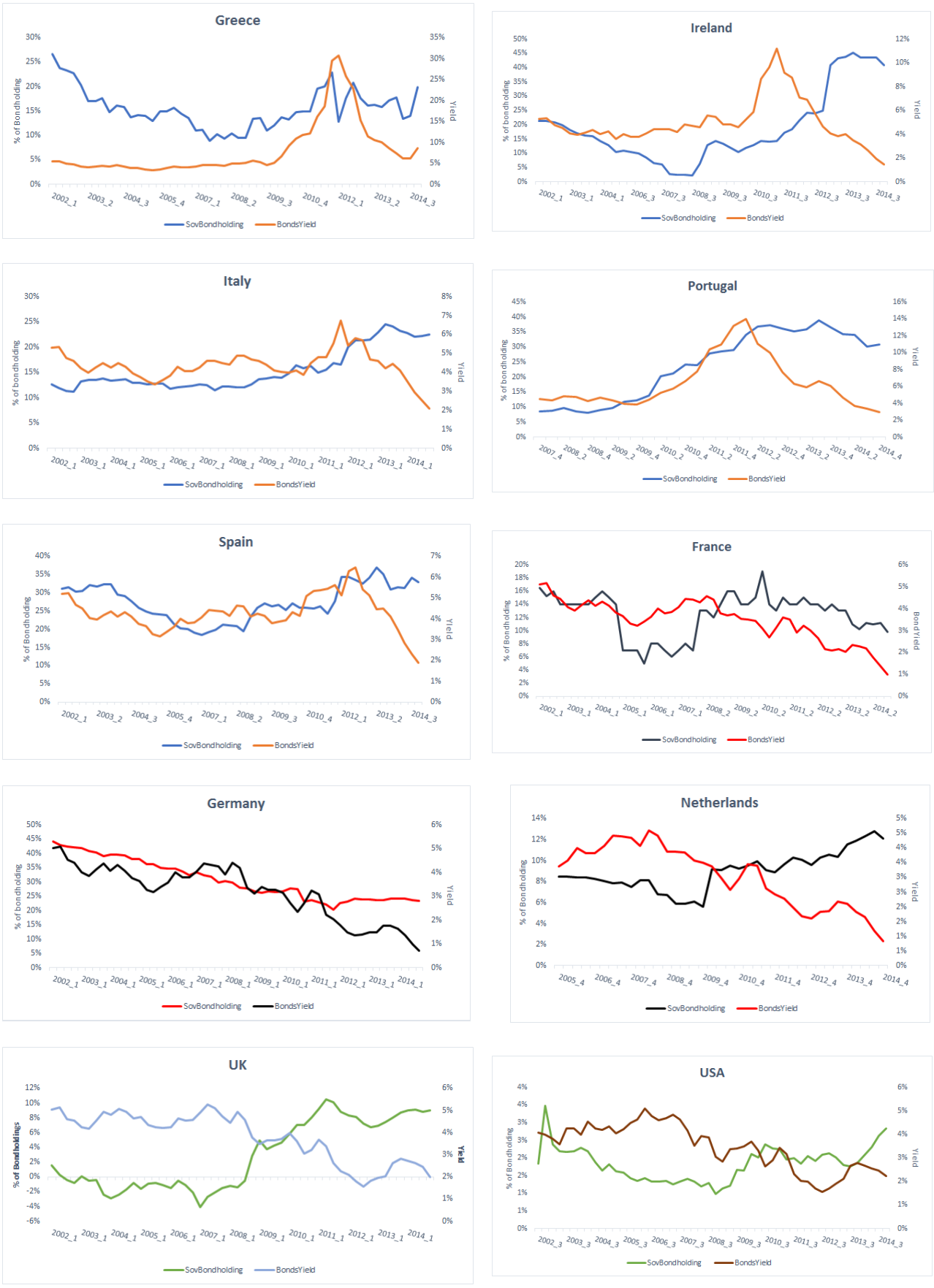


Figure 3.3: Public Bondholdings and Yields.
Author's elaboration.

Economical interpretation of the advents is attributed to leverage of non-financial segment in Europe and overseas: The U.S. subprime granting persuaded citizens to borrow without restrain, immovable property was unique collateral, the deriving collapse saw the Federal government binded to make debt as cheap as possible growing yields. An equivalent act was enforced in our continent when private sector did not cut spending and governments of the weakest states initiated to be very fragile, the immediate solution was raising interest rates. It must be a temporary action because a bubble might flourish and the danger of a new financial recession is not an utopia.
Surely, more distressed a state is, more funds it needs, so returns upsurge and banks will be attract from suitable profits. This is the kernel of heterogeneous public bonds issuances and procurement. The best tool to fix the concept is a plot of holdings dynamic for every nation and evaluate also how they respond somewhere along the line. I have developed two separate graphics enshrined in 3.4 which contain mean of sovereign holdings for states and quarters respectively, confidence intervals at 99%, and a zig-zag line connects averages evidencing heterogeneity. The second path enlarges the ascending pattern after Lehman Brother's bankruptcy, the increasing trend observed earlier is right. Differences are even remarkable when inferred on aggregate bond quantities owned by states. Astonishingly, German is placed at the top no matter a faint decline which has gone since 2002, confirming such residential banks kept a strong belief on Dutch economy after the Reunification which was protracted with high unemployment rate and labor markets problems. The U.S.A. and the U.K. stayed at the bottom as the recession pushed more foreigner MFIs to trade their securities. GIIPS bonds quota is high, spacing from 15% to 28% about, in whom Spain is the first of them.

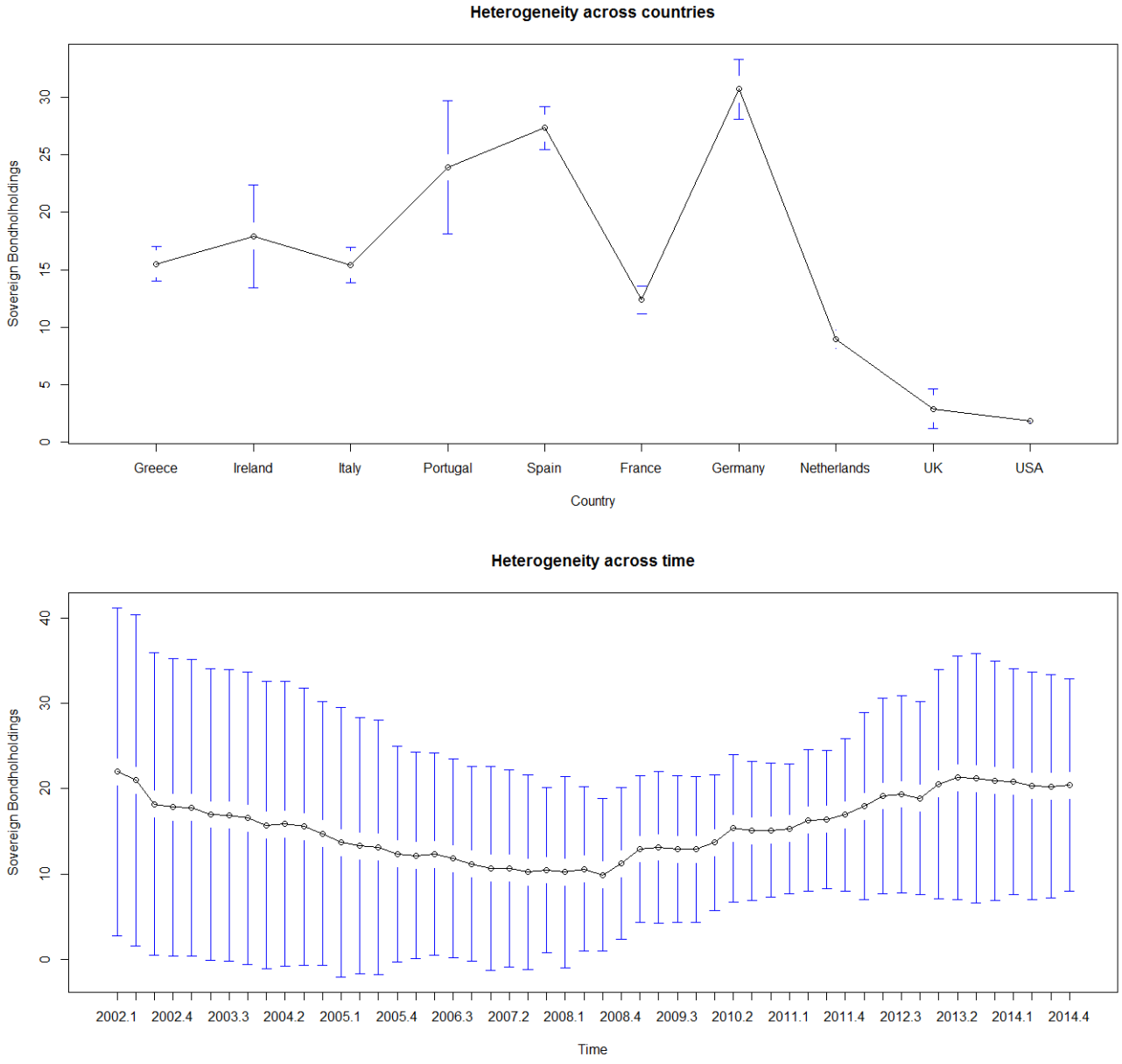


Figure 3.4: Government Bonds Heterogeneity.
Author's elaboration.

Toxic events for economic-financial system can have created an irregular pace on which bonds were negotiated. To unveil outliers, I offer a graphical instrument where the response variable is smoothed by a nonparametric regression of polynomial functions with local fitting. The corresponding lines trace the regular way public obligations follow and all points outside them are recorded as outliers for the reason that Mahalanobis distances are computed to detect irregularities. The distance is the metric prompted by a norm[4] represented in the following equation: $||a||^2 = a^T\Sigma^{-1}a$, $a \in R^n$, T stands for transpose, Σ portrays variance-covariance matrix. Let x and y be realizations of a random vector whose variance matrix is Σ, hence Mahalanobis distance will be equal to: $d_M(x,y)^2 = ||x-y||_M^2 = (x-y)^T\Sigma^{-1}(x-y)$. When $\Sigma = I_n$, i.e. identity matrix, the distance can be attributed to Euclidean norm. Such a metric enjoys interesting properties such as symmetry and invariance to scale transformations. I illustrate them briefly:

i) $d_M(x,y) \geq 0$ $(non\ negativity)$

ii) $d_M(x,y) = 0 \leftrightarrow x = y$

iii) $d_M(x,y) = d_M(y,x)$ $(symmetry)$

iv) $d_M(x,y) \leq d_M(x,z) + d_M(y,z)$ $(triangular\ inequality)$

I do not have deleted outliers from samples otherwise, some holding variability introduced by the crisis behavior would no be longer available and the study would be incomplete.

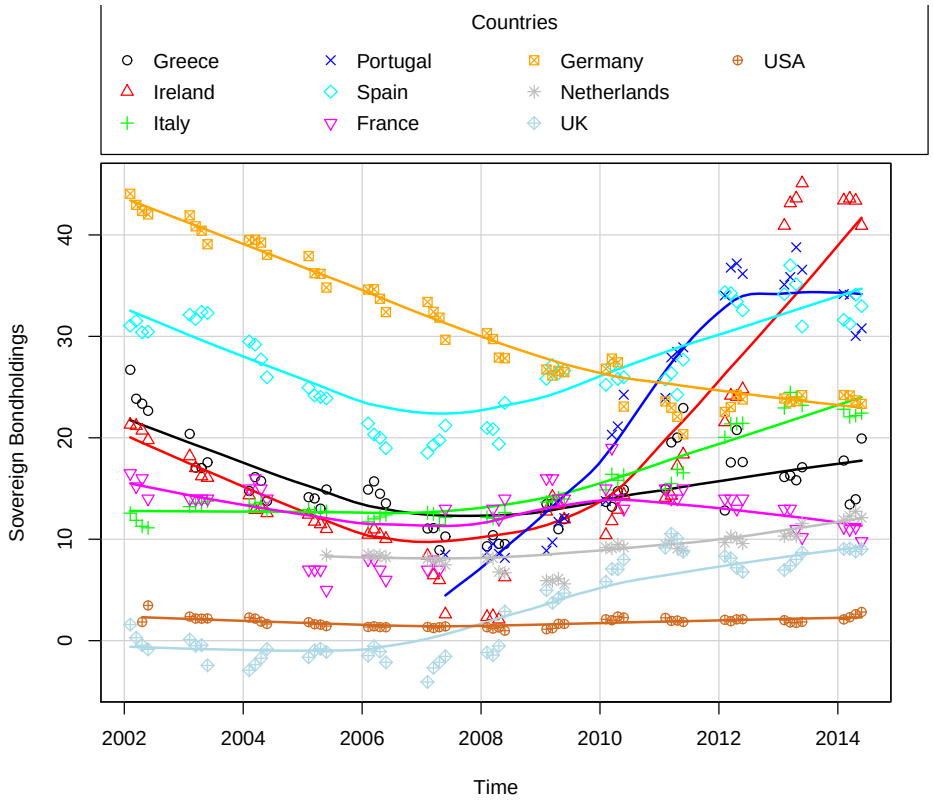


Figure 3.5: Sovereign Bondholdings Across Time and Countries.
Author's elaboration.

[4]In mathematics, norm is a function that assigns to each vector inside a vectorial space, zero excluded, a non-negative length.

3.2.4 Quantitative Analysis of Bank Bondholdings

3.2.4.1 Why Pooled OLS Regression Does Not Work Well for The Phenomenon

We have leaned that our longitudinal data are heterogeneous besides a remarkable intra and inter state variability. A pooled OLS regression would not work well because of the inability to capture variance within and outside entities of the sample, along with it suffers from abnormal observations, while panel model treats strong heterogeneity during time. Let's perform a graphical analysis developing plots which compare the independent variable with some quantitative explicative (not dummies) variables within which regression lines are incorporated which stem from a simple linear model.

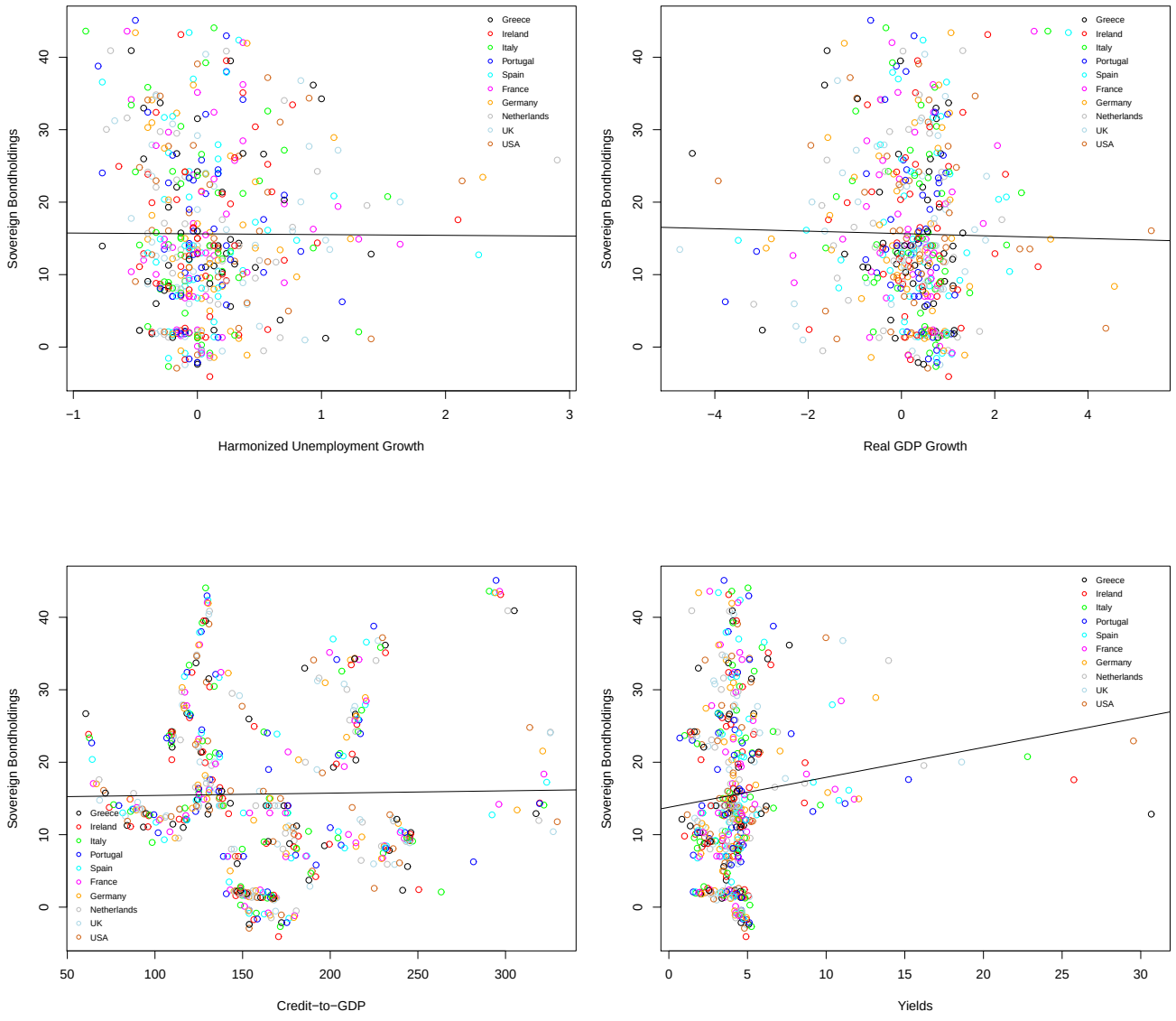


Figure 3.6: OLS Regression Limits.
Author's elaboration.

OLS regression produces a flat line in almost the boxes, it means that the model does not gather any information of expected value of $y_{i,t}$. When banks' public debt is regressed on yields, r squared is different from zero though it is insufficient to explain variability of banks bondholdings phenomena. Great interest rates are typically of crisis countries, Greek yields "explosion" were caused by default. We have to change strategy and passed to econometric techniques which explain why the response variable switches consistently over nations and in the aftermath of December 2007. Panel data models are reasonable given their capability to extrapolate unobservable characteristics of sample entities at the individual level. Advantage means that unobservable confounder correlates with independent variables is "pulled out" from the error term, wiping out endogeneity. My database mirrors the definition of panel data (or longitudinal/cross-sectional time series data), *time series of cross sections where the same individuals are monitored over time*. Panel data are suitable because they allow to isolate the effects of specific actions, treatments, or general policies, to deal with omitted (unobserved or mis-measured) variables, and to study a number of important economic questions that cannot be faced using cross-sectional or time-series data.
Estimators are divided in two areas: Consistent for a fixed number of periods T, whereas the amount of entities N goes to infinity (a usual situation known as "fixed T asymptotic) , or consistent for T which approaches infinity and N is fixed (common in countries analysis). An additional category includes that T and N are asymptotic. Large periods and individuals permit various types of cross-sectional dependence. My study falls in the second class as I have analyzed contained number of states for a quite large time frame. Having defined what a panel is and the main consistent estimators achieved thanks to advanced econometrics skills, we focus on statistical peculiarities of such models. Let's recall general linear model:

$$y_{i,t} = X_{i,t}^T\beta + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim IID(0,\sigma^2)\ \forall\ i = 1,...,N,\ t = 1,...,T$$

β detects the marginal effect of an unitary increment of $X_{i,t}$ on the expected value of response variable conditional of regressors for a certain individual i in period t. The multiple linear regression model seems too weak when more individuals are observed during time. Let's elevate its structure formulating a classical hypothesis that betas results unchanged for every i and t, constant $\alpha_{i,t}$ excluded. The rearranged model can be written in the ensuing manner:

$$y_{i,t} = \alpha_{i,t} + X_{i,t}^T\beta + \varepsilon_{i,t}$$

The restyling has introduced differences amid observations because average level can diverge from entity i to entity k captured by constant. If the error term holds the original distribution (expected value equals to 0 and variance set to σ^2 for every i and t) and $\alpha_{i,t}$ is the unique part which turns out to not be homogeneous and not follow a probability distribution, what we reach is a fixed effects model, i.e. a linear regression model where

constant varies across groups, time, or both within the sample. One thinks immediately to control individual gaps with dummies but that entails to estimate substantial estimators for each single entity and computational cost is not indifferent.
In statistical terms, one would go to implement a regression as follows:

$$y_{i,t} = \sum_{k=1}^{N} D_{k,i}\alpha_k + X_{i,t}^T\beta + \varepsilon_{i,t}$$

$D_{k,i}$ dummy variable set to 1 when one considers entity i. β is known as *Least squares dummy variables* (LSDV) estimator. An efficacy and efficient technique addresses the issue designing a linear model where the dependent phenomenon corresponds to $y_{i,t}$ minus $\bar{y_i}$, the average of y for individual i at time t, explanatory variables are $X_{i,t} - \bar{X_i}$ and the erratic component is $\varepsilon_{i,t} - \bar{\varepsilon_i}$. Averages of y, X, and ε are taken from this OLS model:

$$\bar{y_i} = \alpha_i + \bar{X_i}^T\beta + \bar{\varepsilon_i}$$

Hence:

$$y_{i,t} - \bar{y_i} = (X_{i,t} - \bar{X_i})^T\beta + (\varepsilon_{i,t} - \bar{\varepsilon_i}),\ \varepsilon_{i,t} \sim IID(0,\sigma^2) \tag{3.1}$$

Equation 3.1 shows *within transformation* from which we obtain OLS β estimator called *within or fixed effect estimator*. We label it $\hat{\beta}_{FE}$ whose formula is provided here:

$$\hat{\beta}_{FE} = \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X_i})(X_{i,t} - \bar{X_i})^T\right]^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X_i})(y_{i,t} - \bar{y_i}) \tag{3.2}$$

$\hat{\beta}_{FE}$ is not biased if all $X_{i,t}$ are independent on $\varepsilon_{i,t}$. Exogeneity assumption is strict because we hypothesize that $E[\varepsilon_{i,t}|X_{i,s}] = 0\ \forall\ s,t$, in other words, $X_{i,t}$ do not depend on past, actual, and future values of error term. I stress ulteriorly that $\alpha_{i,t}$ correlates with regressors (in the general form of longitudinal model, the error term is composed by an individual-specific component, "fixed effect", and an i.i.d. part uncorrelated with time).

Let's do a step beyond assuming that constants are diverse across individuals which derive from the same random distribution with expected value set to 0 and variance which is equal to σ_a. The model has the following form:

$$y_{i,t} = \beta_0 + X_{i,t}^T\beta + (\alpha_i + \varepsilon_{i,t}),\ \varepsilon_{i,t} \sim IID(0,\sigma_\varepsilon^2),\ \alpha_i \sim IID(0,\sigma_a^2) \tag{3.3}$$

β_0 represents the constant in 3.4. The error term owns a fixed-time component, α_i and a residual one, $\varepsilon_{i,t}$ uncorrelated during time, the two parts are independent one from each other. Strict exogeneity stays, while time-invariant erratic element does not correlate with explanatory variables. To derive the β estimator for the above model, let's start to the

variance-covariance matrix of the error term which is drawn on:

$$Var(\alpha_i I_T + \varepsilon_i) = \Omega = \sigma_a^2 I_T I_T^T + \sigma_\varepsilon^2 I_T$$

I_T identity matrix. Using generalized least squared (GLS), there is possible to build fixed effects estimator which is represented with the formula below:

$$\begin{aligned}\hat{\beta}_{RE} = &\left[\sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X}_i)(X_{i,t} - \bar{X}_i)^T + \psi T \sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X}_i)(X_{i,t} - \bar{X}_i)^T\right]^{-1} \\ &\cdot \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X}_i)(X_{i,t} - \bar{X}_i)^T + \psi T \sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X}_i)(y_{i,t} - \bar{y}_i)^T\right]\end{aligned} \tag{3.4}$$

$$\psi = \frac{\sigma_\varepsilon^2}{T\sigma_a^2 + \sigma_\varepsilon^2}$$

Random effects estimator is more efficient than FE due to inter-variability consideration across individuals. The proof is provided here:

$$Var(\hat{\beta})^{FE} = \sigma_\varepsilon^2 \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X}_i)(X_{i,t} - \bar{X}_i)^T + \sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X}_i)(X_{i,t} - \bar{X}_i)^T\right]^{-1}$$

$$Var(\hat{\beta})^{RE} = \sigma_\varepsilon^2 \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X}_i)(X_{i,t} - \bar{X}_i)^T + \psi T \sum_{i=1}^{N}\sum_{t=1}^{T}(X_{i,t} - \bar{X}_i)(X_{i,t} - \bar{X}_i)^T\right]^{-1}$$

If $\psi > 0$, RE has got low variance than FE when $E[\varepsilon_{i,t}|X_{i,t}] = 0$.
The dilemma which arises now is: What kind of estimator we should be directed? Hausman test can be executed to obtain an answer for replying to the question. The test envisages that under the null hypothesis H_0, $E[\alpha_i|X_{i,t}] = 0$, well both FE and RE estimators are consistent but we would like the one obtained by the random effect model being mostly efficient. On the contrary, H_1 states that $E[\alpha_i|X_{i,t}] \neq 0 \ \forall \ s,t$ and the second estimator is inconsistent because of its inability to converge to the real β. The quadratic form of the test is therefore:

$$H = (\hat{\beta}^{FE} - \hat{\beta}^{RE})^T [Var(\hat{\beta}^{FE}) - Var(\hat{\beta}^{RE})]^{-1} (\hat{\beta}^{FE} - \hat{\beta}^{RE}) \sim \chi_k^2 \tag{3.5}$$

The drawback of 3.6 is that $Var(\hat{\beta}^{FE}) - Var(\hat{\beta}^{RE})$ could not be invertible in little samples. Statistical softwares, amongst them R, resolve the problem reducing the dimension of the matrix and ignoring a pair of coefficients.
Another way could result what is the scope of the examination. If one thinks that heterogeneity inside a single group is crucial and serial correlation might occur, fixed panel should be the choice, otherwise random effect is always a good econometric model.

3.2.4.2 Methodology

Let $SovereignBondholding_{i,t}$ represent the percentage of public bonds purchased by national banks located in country i at time t. Let's suppose that bank decisions pertains to how much obligations acquire in a certain quarter has sprung in the previous span of time, so that bondholdings at time t are a function of bank's balance sheet and of the state of the economy at time $t-1$ [Gennaioli et al., July 2014]. The authors done this assumption since, to quote them, *The use of lagged independent variables is preferable to the use of independent variables that are contemporaneous to bondholdings for two reasons. First, bank-level explanatory variables are determined jointly with bondholdings within each year... Second, the bank does not observe the aggregate final state of the economy at time t until the end of period t itself. As a result, the forecast of macro variables performed by the bank or by the market at time t will depend on the state of the economy at time* $t-1$.
The lagged version of regressors cleanse endogeneity issue which I have tested run longitudinal data model without lagging $X_{i,t}$ and check covariances of Σ matrix whence meaningful correlations have sparked. I have then created a fixed effects cross-sectional times series data model and not a random effects panel regression because of the focus on the empirical analysis is to be fluctuations of MFI's treasury debt securities post-crisis inside a nation, not a bank holdings confront at country level through the entire decade of the century and onwards. I have deliberately controlled country-level features in the regression for ending up with implied movements. The "within" model will be run where the articulation is elucidated hereunder:

$$\begin{aligned} SovereignBondholding_{i,t} = \beta_i &+ \beta_1 SovereignDefault_{i,t-1} + \beta_2 FinancialCrisis_{i,t-1} + \\ &+ \beta_3 HarmonizedUnemploymentGrowth_{i,t-1} + \\ &+ \beta_4 RealGDPGrowth_{i,t-1} + \beta_5 PrivareCreditToGDP_{i,t-1} + \\ &+ \beta_6 OutstandingBonds_{i,t-1} + \beta_7 BondsYield_{i,t-1} + \\ &+ \beta_8 FinancialCrisis_{i,t-1} \cdot CountryFeatures_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{3.6}$$

in whom $SovereignDefault_{i,t-1}$ is a dummy variable taking value 1 if country i is in default at time $t-1$, 0 otherwise, $FinancialCrisis_{i,t-1}$ is a dummy variable equals to 1 whether the country i at time $t-1$ has experimented the Global financial crisis effects, $CountriesFeatures$ incorporates country-level controls, namely harmonized unemployment rate change, real GDP growth, private credit-to-GDP ratio, sovereign debt outstanding, and yields of the state i at $t-1$. I have added to the fixed effects specification country dummies, time dummies and country$\times$year dummies. Interactions between the crisis and state peculiarities has been inserted for the intuition surrounds the roots the "freezing" crisis has established in markets and economy. I have used both dataset which supply similar estimates and to solve heteroschedasticity, I have replaced standard errors with White robust correction and clustering them at the country level. Violation of unaltered variance

for observations has been tested exploiting Breusch-Pagan test whose null hypothesis claims homoschedasticity while the alternative H_1 points out a particular form of heteroschedasticity, that is $Var(\varepsilon_{i,t}) = \sigma^2 g(z_{i,t}^T \alpha)$, $z_{i,t}$ are variables which one supposes they violate homoschedasticity, $g(\cdot)$ a derivable function whose first derivative is continuous and $g(0) = 1$.
Coefficient β_2 detects the marginal effect which has scrambled financial institutions' balance sheets considering the improvement of sovereign bonds they have done when the world has gone to the crisis spiral, along with some exacerbations of contributions nations have delivered to holding in the panel regression. β_1 captures the effect of a sovereign default which is reversed to all businesses of MFIs. β_3, β_4, β_5 display how the country contribute to the buying of bonds carried out by banks. Finally, β_6 and β_7 reflect direct effect of bonds characteristics and indirect contribution of markets on bank sentiment for government bonds. One will expect that β_2 will be positive given that the preliminary graphical exploration, even β_6 and β_7 as higher yields are, more banks are attracted to purchase public debt. Private indebtedness should positively influence the response variable for the simple reason that non-financial sector caused the crisis blast, making financial institutions more incline towards such obligations. Coefficients concerns conjoined impact of crisis and state control variables must be significant and those relative to credit ratio and yields should benefit $y_{i,t}$.

3.2.4.3 Results

Table 3.3 exhibits outcomes delivered by several estimations of the fixed effects panel data model in 3.6. Columns (1)-(2) evaluate the behavior of public bondholdings where one takes into consideration country effect via dummies. The former panel is computed with the dataset where missingness has not been treated, the second one uses the full sample where absent values has been replaced with appropriate appraisals. Columns (3)-(4) assess such holdings with time dummies, i.e. panel includes time effect, not the country level. The fifth and the sixth models incorporate twoways effects, that is to say both country and time levels are placed into the panel. These models could not be sufficient to explain the study since the crisis impaired mutual fields e.g. workforce, trading venues, net worth, households, and enterprises. Columns (7) and (8) make it by means of financial crisis has been put in relation with every quantitative regressors. Interactions with the turmoil is crucial as it permits us to control its diffusion for the national economy. Dummies have the task to supervise fluctuations of treasury debt securities inside states.
Let's go ahead looking at results listed. The explanatory variables are accompanied by coefficients and robust standard errors (SEs) in brackets, alongside significance degree at 1%, 5%, and 10%. Longitudinal econometric models (1) and (2) expound a reduction of treasury bonds acquired when unemployment rate improves which range from -2.6% to -1%. An economical clarification might be connected to an abrupt falling of employment

which causes bonds' yields narrowing, driving banks to be a little reluctant to buy a wide quantity of public debt. Thinking in statistical terms, there should be a dependence amid unemployment rate and yields in the model. However, variance-covariance matrix has not revealed correlation for the two Xs. Good reaction of output does not mitigate or strengthen MFIs willing to retain more government bonds, the coefficient is never meaningful even when twoways control is added and dummies for crisis is put in place. Private financings plays a principal part of the banks rational conduct, showing the feeling that non-financial indebtedness influences directly financial institutions' assets simply because if leverage of small-medium enterprises (SMEs), families and other residential sectors increases, the government can be obliged to sustain them sending finances but resources are scarce for it as well, thus sovereign issues can enlarge to tackle all expenses accompanied by a surge of interest rates, banks are enticed to purchase the securities with a future profit. The beta passes from 0.042 to -0.023. Sovereign default coefficient is almost significant, at 5% or 10%, and states a reduction of holding over Greek default episode (this is the only event of state default in the dataset) equals to 7.1% about. In contrast, financial crisis shoots up bank exposition on public bonds by 2.4% and 6.6% according to the models ($y_{i,t}$ is in percentage points, so every increase of one unit of regressors is translated automatically in a β percentage variation. I have chosen this strategy to achieve an elasticity of the dependent variable without transform it in logarithm). Yields are meaningful with a contribution sets to 0.48% and 0.68%. The number of outstanding government obligation has a mild effect which is quite vanish. Reactions differs when one controls for time fixed impact rather than country effect.

Longitudinal models in (3) and (4) list that unemployment reinforcement does not agitate residential MFIs to resist for purchasing treasury obligations as well as GDP enhancement benefit disappears. Private credit-to-GDP contribution amounts to 0.066% and 0.070%, meanwhile Greece crush soars and oscillates between -6.464/-6.543% with a significance at 10%. Even global banking collapse estimator upsurges at 7.5%. Interest rates are no longer meaningful and issuances effect are still low. Introduction of country and time dichotomy remarks harmonized unemployment rate to negatively address bondholdings, GDP restarts its weight on response variable, credit ratio marginality is positive like at the beginning, the 2008 recession weight is attenuated in reference to commercial and investment banks intention of government debt, issuances do not contribute as betas are vanish. The message which models have sent so far concerns the reality that banks business shifted radically after the world lived such a catastrophe. The private sector sent a semi-elasticity of 0.07% on average to incentive financial institutions to retain a lager bulk of government public debt into their portfolios. Performances of manufacturing and service providing are unable to catch variations in the data. On the other hand, when employment slips, the signal they enact sounds not good with respect to propensity on bonds with a fluctuation around -2/-3.9%, although it is substantial when state control is plugged and interactive terms are omitted. Time must be taken into account due to a diagnostic analysis

which I have run provides a relevance of time effect into 3.7. The test has been developed with comparison of a panel regression in whom state control is added and a model where time has been placed by virtue of factor variables (per quarter). H_0 has been rejected, hence there needs to include country$\times$quarter dichotomous variable.
Yields raise by 1 percentage growths sovereign exposure of 0.340% averagely and loses relevance whether time dummies are the ones which display the unaltered country features. Financial crisis marginal outcome equals to 7.513% in (4), the highest of all regressors and substantiates the *strategic choice of banks* to buy as public bonds as feasible because bonds will not be cheap as over the recession, so yields will go down when banking recession dying out will initiate, albeit this requires a long period of time.
To understand how to calculate the effects of the model in the last column, credit ratio increase of 1% is associated to $(0.066 + 0.676)\% = 0.742\%$ of holdings upward. Sovereign decreases $y_{i,t}$ by 6 percentage points, outstanding bonds beta is close to 0, interest rates marginality accounts for $(4.280 - 3.963)\% = 0.317\%$. If one supposes that quantitative explanatory variables increment by 1 unit or 1 percent, financial crisis is weighed for $(12.942 - 2.144 + 0.676 + 0.001 - 3.693 + 0.001)\% = 7.513\%$.
The crisis which we are still living has got a repercussion on interest rates and bond issues contribution of banks holding according to the last two econometric analyses.

	Dependent variable:			
	$SovereignBondholding_t$			
	(1)	(2)	(3)	(4)
$HarmonizedUnemploymentGrowth_{t-1}$	-2.619^{***}	-1.048	-2.002^{**}	0.003
	(0.941)	(1.479)	(0.778)	(1.105)
$RealGDPGrowth_{t-1}$	0.609	0.427	0.572	0.091
	(0.468)	(0.575)	(0.401)	(0.404)
$PrivateCreditToGDP_{t-1}$	0.042^{***}	-0.023^{***}	0.070^{***}	0.066^{***}
	(0.016)	(0.008)	(0.015)	(0.016)
$SovereignDefault_{t-1}$	-3.914	-11.305^{**}	-6.543^{*}	-6.464^{*}
	(3.179)	(4.964)	(3.701)	(3.732)
$FinancialCrisis_{t-1}$	2.425^{***}	6.555^{***}	4.132^{***}	12.942^{***}
	(0.802)	(1.490)	(1.059)	(2.911)
$BondsYield_{t-1}$	0.481^{***}	0.264	0.362^{*}	4.280^{***}
	(0.176)	(0.269)	(0.192)	(0.592)
$OutstandingBonds_{t-1}$	0.0003^{***}	-0.001^{***}	0.0002	0.0003^{*}
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
$FinancialCrisis_{t-1}$ * $HarmonizedUnemploymentGrowth_{t-1}$				-2.144
				(1.384)
$FinancialCrisis_{t-1}$ * $RealGDPGrowth_{t-1}$				0.676
				(0.755)
$FinancialCrisis_{t-1}$ * $PrivateCreditToGDP_{t-1}$				0.001
				(0.011)
$FinancialCrisis_{t-1}$ * $BondsYield_{t-1}$				-3.963^{***}
				(0.623)
$FinancialCrisis_{t-1}$ * $OutstandingBonds_{t-1}$				0.001^{***}
				(0.0001)
Other Controls?	Yes	Yes	Yes	Yes
Country Dummies?	Yes	Yes	No	No
Quarter Dummies?	No	No	Yes	Yes
Country * Quarter Dummies?	No	No	Yes	Yes
No Observations	462	462	462	462
R^2	0.118	0.205	0.182	0.251
Adjusted R^2	0.086	0.093	0.045	0.115
F Statistic	8.475^{***} (df = 7; 445)	14.867^{***} (df = 7; 404)	12.551^{***} (df = 7; 395)	10.900^{***} (df = 12; 390)
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 3.3: Factor Explaining Banks' Sovereign Bondholding
Author's elaboration.

To investigate scrupulously in which manner the 2008 banking freezing swayed the quantity of government instruments traded into financial markets, I have constructed a separate cross-sectional time series model where the response variable is the logarithm of sovereign debt which has been issued from Q1 2002 to Q4 2014 under the full observations database. I have opted for this transformation as outstanding metric is expressed in euro, therefore to place the variable without any scales gives us marginal effect, not a semi-elasticity change and then a percentage movement. A proof is reported here. Let's consider a multiple linear model:

$$y_i \;=\; X_i^T\beta \;+\; \varepsilon_i,\; \varepsilon_i \;\sim\; IID(0,\sigma_\varepsilon^2)$$

Marginal outcome of X_j is nothing more than the partial derivative of the conditional expected value of y_i on the focus explanatory. In mathematical terms:

$$\frac{\partial\; E[y_i|Xi,j]}{\partial X_j} \;=\; \beta_j$$

Let's concentrate on the log-lin non linear regression where OLS can again be exploited to calculate estimators. Hence:

$$log(y_i) \;=\; X_i^T\beta \;+\; \varepsilon_i$$

Using that, coefficients portraits semi-elasticity due to an unitary increment of a regressors involves a $\beta \;\times\; 100\%$ variation of the independent variable. Indeed:

$$\frac{\partial\; E[y_i|Xi,j]}{\partial X_{i,j}} \cdot \frac{1}{X_j} \approx \frac{\partial\; log(E[y_i|Xj])}{\partial X_j} = \;\beta_j$$

I have estimated the following general panel regression:

$$\begin{aligned} OustabdingBonds_{i,t} \;=\; & \gamma_i \;+\; \gamma_1 FinancialCrisis_{t-1} \;+\; \gamma_2 BondsYield \;+ \\ & +\; \gamma_3 SovereignBondholding_{t-1} \;+\; \gamma_4 FinancialCrisis^*_{t-1} BondsYields_{t-1} \\ & +\; \gamma_5 FinancialCrisis^*_{t-1} SovereignBondholding_{t-1} \;+\; v_{i,t} \end{aligned} \tag{3.7}$$

In some specifications, the original amount of public bonds purchased has been substituted with a difference between sovereign bondholdings and the average pre-crisis called *SovereignNormalBusinessBondholding*. This approach is useful to assess the result of treasury securities differentials respect to in periods of normal business practice, to cite Engel(2016), herd behavior of financial markets. Finally, I have evaluated how much the quantity of banks' government obligations explain the amount traded prior to the Q1 2008. Table 3.4 recounts coefficients and White SEs with clustering correction to mitigate serial correlation of errors. Columns (1)-(3) and models (5), (6), and (7) infer that the crisis have

diminished the inclination of governments to emit debt instruments. In my opinion, this can be attributed to bail out supplied to banks. Public bonds acquired by national institutions offer a modest contribution to the outstanding debt equals to 0.018% on average. When treasury holding is replaced by the correspondent time varying measure, the semi-elasticity is similar. Potential gains from public debt discourage government to emit obligations in the past decade afterward the crisis switched direction, nevertheless there was not sufficient to cancel out the detrimental result which is like -0.05%. The forth expression has been introduced for the reason that I have wanted to figure out the scenario when the prosperous period in the U.S. markets flourished. For the purpose, I have regressed traded securities on 10 year yields and possession of them until the first quarter of 2008, so that the sample has been restricted approaching 242 data. The explicative variables are statistically not important (adjusted r squared is negative because unlike the standard R_2, it imposes a penalize term when an additional X is meaningless). The dispatch is precisely: banks and market reactions vis-à-vis governments deficit did not scratch their willingness to release medium and long-run investments in the form of ”government-backed” financial instruments.

Throughout the chapter, I have discussed about banks and their government bonds scheduled agenda. This must not be confused with thoughts that institutions are exclusively domestic, there may be branch of foreign financial firms, further they do not effectuate investment exclusively into national instruments, whilst *home bias* might spring good incentives for the government. Asonuma, Bakhache, and Hesse (2015) study on advanced (AM) and emergent (EM) economies found out that home bias is not always a sorrow given that borrowing costs drop for states whereby debt is restrained to high, favoring governments to bear primary balance imbalances but the advantage is counterbalanced by a pricey bill that states will pay in the future for fiscal consolidation postponement.
I conclude the chapter with some findings regarding CDS-public bonds basis that is defined as the CDS premium minus the spread pf a fixed-coupon government bond of similar maturity over a risk-free benchmark [Fontana and Scheicher, 2016]. The researchers declared that sovereign CDS and treasury assets hold the equivalent risk and return of debt, that is the basis should be zero. Processing weekly data from January 2007 to December 2012 where sovereign market distress episodes are embedded, they discovered credit risk worsened frictions[5] to enact short selling in sovereign bond markets with the appearance of positive basis (that might partially answer to a negative value of UK banks bondholding before the recession), conversely the financial mayhem adversely conditioned highly risky treasury debt with a negative basis.
Chapter 4 will illustrate theoretical solutions to subdue a banking emergency via start-of-the-art economic and financial tools.

[5] All direct and indirect costs for executing orders in capital markets such as fees, commissions, opportunity cost of searching time, tax implications for transaction.

	Dependent variable:						
	log(OutstandingBonds)$_t$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FinancialCrisis$_{t-1}$	-0.408^{***}	-0.372^{***}	-0.569^{***}		-0.410^{***}	-0.479^{***}	-0.487^{***}
	(0.074)	(0.074)	(0.121)		(0.053)	(0.098)	(0.095)
BondsYield$_{t-1}$			-0.147^{***}	0.023		-0.138^{***}	-0.134^{***}
			(0.031)	(0.039)		(0.026)	(0.028)
SovereignBondholding$_{t-1}$	0.018^{***}	0.017^{***}	0.019^{***}				
	(0.002)	(0.002)	(0.002)				
SovereignDefault$_{t-1}$		-1.074^{***}	-0.148				-0.205
		(0.095)	(0.225)				(0.225)
FinancialCrisis$_{t-1}$ *BondsYield$_{t-1}$			0.092^{***}			0.080^{***}	0.081^{***}
			(0.029)			(0.026)	(0.026)
FinancialCrisis$_{t-1}$ *SovereignBondholding$_{t-1}$	-0.001	-0.001	0.003				
	(0.002)	(0.002)	(0.002)				
PreCrisisSovereignBondholding$_{t-1}$				-0.003			
				(0.003)			
SovereignTimeVaryingBondholding$_{t-1}$					0.028^{***}	0.030^{***}	0.030^{***}
					(0.003)	(0.003)	(0.003)
FinancialCrisis$_{t-1}$ *SovereignTimeVaryingBondholding$_{t-1}$					-0.015^{***}	-0.013^{***}	-0.014^{***}
					(0.004)	(0.004)	(0.004)
Other Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Dummies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country * Quarter Dummies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No Observations	462	462	462	233	462	462	462
R^2	0.173	0.269	0.390	0.008	0.191	0.402	0.404
Adjusted R^2	0.058	0.166	0.301	-0.174	0.078	0.315	0.316
F Statistic	31.123^{***} (df = 3; 447)	41.107^{***} (df = 4; 446)	47.340^{***} (df = 6; 444)	1.001 (df = 1; 197)	35.091^{***} (df = 3; 447)	59.721^{***} (df = 5; 445)	50.099^{***} (df = 6; 444)
Note:							*p<0.1; **p<0.05; ***p<0.01

Table 3.4: Factors Explaining Government Bonds Issues
Author's elaboration.

Chapter 4

How To Overcome The Financial Crisis? Some Theoretical Proposals.

4.1 Performance-Sensitive Government Bonds

4.1.1 Structure and Working

The final part of the thesis will be devoted to incentive the discussion for notional instruments which may be applicable in the foreseeable future to prevent or face recessions taking the form of banking crisis. What we have leaned insofar can be enshrined in few lines: government bonds are debt securities that traders negotiate a lot to make money as safe as possible. Unfortunately, even treasury debt is not exempt from risk and this fact was amplify after the world was overturned by the crisis alimented with Lehman Brother's default. Banks bought very much public bonds in that period to attain huge profits being the premium yields were swollen in order to price such bonds at minimum historical levels. Private indebtedness also favored the banks' operation.

Policymakers adopted motley fiscal actions which would have helped to mitigate and remedy the destructive tokens the meltdown left. The measures carried out the reverse rather that they were hoping. We will move on this direction to explore a distinctive innovative debt instrument that Bank et al. (2011) declared to be useful for public debt handling.

There are a plenty of studies which highlight aversion of debt to not go down after a crisis or legislative elections. Governments stock deficits with additional debt but they do not try to reduce expenditures and shortfalls move up automatically. Let's give the attention on policymakers. A possible reason about why debt-to-GDP ratio hesitates to decline be that elections years impose considerable costs for the state, e.g. ballot initiatives, propaganda, manifestos. Attaching to it, parties or interest groups express the unwillingness to sustain budget consolidations[1], we can refer to them as *public goods* because there is no rivalry

[1] In accounting literature, budget consolidation means the operation of combining assets, equity, liabilities and operating accounts of a parent firm and its subsidiaries into a comprehensive financial statement as the reporting entity was unique.

among politicians to enact consolidation, so to consume it, alternatively budget institutions are able to discipline poor budget process instantiating auditing, transparency, or any other devices to fulfill some criteria as Europe makes being subjected to Maastricht Treatment and relative to Economic and Monetary Union (EMU). Difficulties to restrain government spending is moreover linked to the lack of stimuluses that policymakers flaunt, otherwise re-election flame might increasingly turn off. AM countries are very subjected to all matters I have described because they issue debt assets in coalition, which implies the poorest nations borrow without any limits and leverage shrinks at all. The thing which is worser regarding a sort of "isomorphism" that more developed economies engage seeing the opportunity cost of debt ratio restriction crosses high degrees. To fix the gist in mind, let us turn back to notorious GIIPS analyzed profusely in chapters 2 and 3. When Greece asked help to the Union Area in 2010, the Greek government received collaterals, loans, and subsidies to fight back and recover the access to Eurozone sovereign bond markets. Despite the fact that the reliefs were suitable for such a country, default was not remedied due to sending economic-financial tools to a vulnerable nations produces an incredible consolidation effort which wears out in political instability and sovereign credit risk explosion. The aforementioned authors attempted the reply to this complex environment since as long as a bunch of inducements will not be handed, indebtedness will not fall and short-term countermeasures by politicians to curb it will be ineffective. I am emphasizing public debt since the instrument that I will present soon is anchored to policymakers actions, albeit the Euro Area crash was not a sovereign debt crisis. The researchers maintained that a debt restructuring will push economy trough a growing and welfare long-run path. What they proposed are innovative debt securities called *Performance-Sensitive Government Bonds* (PSGB). Coupons of obligations are related to efforts a country done to enhance its leverage status. Bank and the other academics claimed that *such bonds will give governments a strong incentive to i) to timely restructure the economy, and ii) to limit additional debt, in order to not only avoid higher coupon payments for total outstanding debt but also to reduce financing costs*. Performance-sensitive debt (PSD) was also studied by Adam and Streitz (2013) to verify whether a relationship between bank lending and PSD exist or not. They run a multinomial logistic regression as follows:

$$PSD_{i,t} = \alpha + \alpha_{Ind} + \alpha_t + \alpha_{Rat} + \beta Rel(M)_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t}$$

where $PSD_{i,t}$ is a variable taking values in the range $0, 1, 2$, specifically, 0 in case of straight bond, 1 when the loan contract contains a performance pricing provision on an accounting measure, the remain value if lending incorporates a performance pricing provision on the borrower's credit rating, $Rel(M)$ one of the measures the authors have computed for the loan investor-debtor relation, α_{Rat} an indicator for the goal of loan (such as takeover), X loan and borrower features e.g. deal maturity, market-to-book asset ratio. The authors discovered that PSD is evoked when hold- up if feasible. Hold-up problem, or commitment

problem, flourishes when there are some impediments in writing complete contracts. The obstacle takes place when two factors are present. According to Rogerson (1992), *First, parties to a future transaction must make non-contractible specific investments prior to the transaction in order to prepare for it. Second, the exact form of the optimal transaction... cannot be specified with certainty ex-ante*. The recourse to PSD becomes more moderate in syndicated relationship loans[2] due to a low occurrence of commitment issue. They unmasked finally that PSD shortens hold-up whereby covenants.[3]

Coming back to PSGB, these public bonds are driven by choices politicians make affecting economic policy and their coupon rates instantaneously. The three mainstays elevated by PSGB limit governments to borrow at untenable tiers, encourage politicians to generate reputation permanent with whom depresses financing costs, and restructure economy framework. All the pillars galvanize state to effectuate budget consolidation when due in order to plummet deficit. The coupons of those obligations move symmetrically to underlying variable e.g. debt ratio or market price information whose rate is not fixed though the key point are good economy policies which push coupon rates up and narrow interest payments. Instead, they fluctuate besides schedule, one of the main characteristics of bonds met in Chapter 1. The program is agreed before such floating policy-oriented bonds will be traded in international markets. PSGB limits options with a burden attaches to investors and the set of decisions contracts considerably (options constitute a premium for agents, making interest rates to downturn). On the other hand, to not be long on bonds penalize bad policy and award future traders when policy sphere works well could be thinly interpreted by markets merely for seeing primary unbalance does not lessen which strengthens credit risk premiums considering policymakers have done nothing to prevent debt-to-GDP mitigation. The consequence are that obligations underlying PSD are the first best also for politicians because if they promise to reduce shortfalls and promote budget consolidation issuing this kind of bonds, traders will be time after time attracted by the new investment chance which comports a positive externality for society at large and a feasible future reelection.

[2]Syndicated loan is identified as a grant supplied by a group of creditors, named syndicate, who work together in order to give a substantial proportion of money to a debtor. The loan can contain a pre-established quantity of funds, a credit line, or both. The type of lending results suitable when it is difficult for a single lender to afford the incurrence or an expertise trader is necessary for a specific security class.

[3]The generally accepted use of the term Covenant in finance refers to terms of financial contracts such as a written document that claims constraints at which the debtor is able to lend ulteriorly. Investors utilize covenants to protect themselves from borrower's default who could not comply with obligations and the recourse to financial actions looks deleterious.

4.1.2 Opportunity Cost for Postponing Economic Growth

The cost of impeding the short-term resumption is not trivial as PSGB might trigger a cycling effect due to governments aversion converges to postponing continuously the enhancements discussed in the first paragraph. The target of politicians resonate elections, no matter that undermines community in a big extent. To demonstrate how harmful policymakers' actions are dangerous, let's start with *Binomial Approach*. Suppose that politicians of a given country have got the decision for investing in infrastructure, education, public services with the hope to achieve an output upturn in the near future. Such decision-making process is equivalent to the exercise of a call option. The government can wait for future prospects before to "kill" the option. If public expenditures program possesses sunk costs, investing now rather than waiting entails major opportunity costs. First of all, I will introduce Discounted Cash Flow (DCF) approach and its main limitations when uncertainty and irreversibility envelops the project. Let C_0 be the actual cost of the output growth, say, 10 billions of dollars. After one year, the investment can assume one of the subsequent states of nature: $V_1^+ = 16$, $V_1^- = 6$. Let's impose that the pattern of the investment coincides with a binomial process in which: $V_1^+ = V_0(1+u)$ and $V_1^- = V_0(1-d)$. The precedent states happen with probability q and $1-q$ that we suppose be equal to 0.5. The net present value (NPV) of this project must be calculated taking into consideration the opportunity cost. Let suppose that a security A is negotiated in the market which has the same risks of the project where $A_1^+ = 1/2 \cdot V_1^+ = 8$ and $A_1^- = 1/2 \cdot V_1^- = 3$. The current price of the instrument is set to 2 billion of dollars. The risk-free interest rate is set to $r_f = 0.5\%$ whose proxy are 1 year government bonds yield. Expected return of the project is estimated as follows:

$$k = \frac{E_0[A_1]}{A_0} - 1 = \frac{0.5 \cdot (8 - 3)}{2} - 1 = 0.25\ (25\%)$$

The value of the GDP investment will be equal to:

$$V_0 = \frac{qV_1^+ + (1-q)V_1^-}{1+k} = \frac{0.5 \cdot (16 + 6)}{1 + 0.25} = 8.8 \tag{4.1}$$

Therefore: $NPV = V_0 - C_0 = -1.2$.
u and d values are derived in this way: $u = \frac{V_1^+}{V_0} = \frac{16}{10} = 1.6$ and $d = \frac{V_1^-}{V_0} = \frac{6}{10} = 0.6$ As the NPV is negative, the project should not be considered.

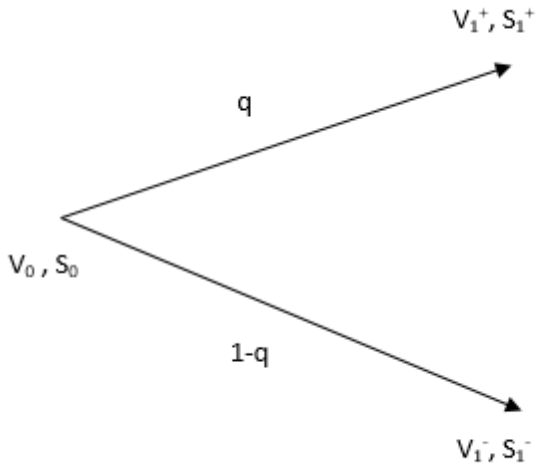


Figure 4.1: Evolution of GDP Investment in Discrete Time.
Author's elaboration.

Let's switch our mentality and enter into Contingent Claim Approach in order to have a little bit of flexibility. Let Z be the value of the investment project which correlates with V or S. To get the best optimal investment choice, we design an hedging strategy developing a replicating portfolio. We long on S buying a specific quantity N and borrow a bulk of B at r_f to repay it. The value of the portfolio at time 0 will be: $P_0 = NS_0 - B$, while at $t = 1$:

$$\begin{aligned} P_1^+ &= NS_1^+ + (1 + r_f)B \ \ if\, S_1 = S_1^+ \ with\ probability\ q \\ P_1^- &= NS_1^- + (1 - r_f)B \ \ if\, S_1 = S_1^- \ with\ probability\ 1-q \end{aligned}$$

If one hypothesizes that P replicates the value of Z, at t_1 one obtains:

$$\begin{aligned} F_1^+ &= NS_1^+ - (1 + r_f)B \\ F_1^- &= NS_1^- - (1 + r_f)B \end{aligned}$$

Supposing that no-arbitrage assumption is not violated, one puts these latter equations into a system to have values for N and B:

$$\begin{aligned} N &= \frac{F_1^+ + F_1^-}{S_1^+ - S_1^-} \\ B &= \frac{NS_1^- - F_1^-}{1 + r_f} \end{aligned}$$

Then:

$$F_0 = \frac{pF_1^+ + (1-p)F_1^-}{1 + r_f}$$

p risk-neutral probability defines as: $p = \frac{(1+r_f)S_0 - S_1^-}{S_1^+ - S_1^-}$. When there is possible to wait before undertaking immediately the investment, contingent-claim approach modify probabilities as the discount rate is affected by contingencies.So:
$F_1^+ = (V_1^+ - I_1)^+ = (16 - 11.005)^+ = 4.995, F_1^- = (V_1^- - I_1)^+ = (6 - 11.005)^+ = 0$
Politicians do not take action in the aftermath of they recognize the chance. The present value of option will be:

$$F_0 = \frac{0.405 \cdot 4.995 - 0}{1.005} \approx 2.013$$

The cost of postponing is set to: $F_0 - NPV = 2.013 - (-1.2) = 3.213$ Using DCF, $F_0 = 1.998$, and opportunity cost: $1.998 - (-1.2) = 3.198$. The hedging strategy instead: $N = \frac{4.995 - 0}{8 - 3} = 0.999$, $B = = \frac{0.999 \cdot 3 - 0}{1.005} = \approx 2.982$, $F_0 = 4.995 - 2.982 = 2.013$. The government will not deal with DCF because the option to invest can be purchased at a lower price under replicating portfolio. The postponing cost is always relevant and burdens to public bond markets as a whole.

Let's do further steps and pass to continuous time. We denote γ the expected return of the GDP growth project V, ξ the payment of the investment, so that $\gamma = \xi + \theta$, when θ specifies an improvement of the capital invested. The relative change of V_t will assume the structure: $\frac{V_t - V_{t-1}}{V_t} = \theta\Delta t = (\gamma - \xi)\Delta t$. Supposing that the project is risky, its Data Generator Process (DGP) is a Random Walk. In Time Series literature, one refers generally to Random Walk as non-stationary stochastic process[4] where the erratic term is a White Noise (WN) and the process has this form:

$$Y_t = Y_{t-1} + \varepsilon_t, \ \varepsilon_t \sim WN(0, \sigma_\varepsilon^2)$$

Therefore: $\frac{\Delta V_t}{V_t} = (\gamma - \xi)\Delta t + \sigma\Delta\eta_t, E[\eta_t] = 0$. The null expected value has the spin that the deterministic component of $\Delta V/V$ is its trend, namely the lung-run movement the process exhibits over time. If η_t matches a Standard Brownian Motion: $\eta_t = \varepsilon_t\sqrt{\Delta t}$, $\varepsilon_t \sim N(0,1)$. A Wiener process, or Standard Brownian Motion, is a continuous stochastic process that associates $\forall\, r \in [0,1]$ a scalar or real random variable $W(r)$ satisfying the conditions as follow: $i) W(0) = 0$; $ii) \forall\, 0 \le t_1 \le ... \le t_k \le 1, W(t_2) - W(t_1), ..., W(t_k) - W(t_{k-1})$ are independent normal variables with the shape: $W(t) - W(s) \sim N(0, t - s)$; $iii) W(s)$ is continuous in s. When one envisages little time intervals, differential form of V_t is written in this manner: $dV_t = (\gamma - \xi)V_t dt + \sigma V_t d\eta_t, V_0 = c$. At time $t = 0$, the process value is a constant. Such a particular form of the investment in small intervals is called *Geometric Brownian Motion* (GBM) in order V_t does be positive. GBM has an actual expected value equals to $E[\int_0^\infty V_t e^{-rt} dt] = V_0/(r - (\gamma - \xi))$.

[4] A family of random variables indexed by time.

Reusing the values of the precedent example, $V_0 = 10$, $(\gamma - xi) = u = 1.6$ when there is an increase of GDP at t_1, $(\gamma - xi) = d = 0.6$ in case of the adverse event, and taking $r = 2.4$, one obtains: $E[V_1^+] = V_0/(r-u) = 10/(2.4-1.6) = 12.5$, $E[V_1^-] = V_0/(r-d) = 10/(2.4-0.6) \simeq 5.56$. An increment of one percentage point of the capital put in the project, i.e. the expected rate of GDP raise, is associated to a cost of 124.820% of GDP surge, a huge postponing expenses for the state. PSGBs have to be enter into financial markets because they may be the key for politicians to upgrade the situation of community, thing that austerity does not make as cut spending mirrors the reelection probability alteration and boost primary unbalance delays even more consolidation and all plans for reviving the country.

4.1.3 Pricing

Computing the opportunity cost to not take any actions for economy improvement, we have recognized the huge issue that a nation would find itself to defeat in the future induced by policymakers' refusal to opt for PSGB. Nevertheless, we have understand the incredible importance the bonds attached to policy performances have to the overall society. Given the fact that restructuring probability will be increase under those bonds, the cost of output project will be narrow and traders will ask lower premiums. That is the great benefit of PSGB. I will bring the model the authors of the paper made up for pricing the debt assets with some rearrangements. Let *DebtGDP* be the debt-to-GDP ratio with a GBM pattern:

$$dDebtGDP_t = \mu DebtGDPdt + \sigma DebtGDPdW_t$$

W_t is a standard Brownian motion, μ and σ the drift and volatility coefficients. I highlight that $dDebtGDP_t/dt$ owns a normal distribution because $dDebtGDP_t$ is log-normally distributed (which safeguards non-negativity). There is a default threshold dft set to 150% of GDP when sovereign risk must be disclosed. PSGB have been thought as public bonds with a term to maturity sets to 30 years, they have got a coupon equivalent p and a variable part given by *DebtGDP* times its marginal cash flow. GBM is not a Martingale process under the real probability measure $\mathbb{P}$. We would want $DebtGDP_t$ holds Martingale assumption as this stochastic process has an expected value equals to $0 \forall t \in [0,T]$ (a sort of fair play property) and its expected value at time t conditional on past information at time s is equal to the value at $t = s$. I have concentrated on the properties on Martingale at continuous time. A definition rigorous is reported here: A stochastic process $\{M_t\}_{t\geq 0}$ is a Martingale with respect to the filtration $\{\mathscr{F}_t\}_{t\geq 0}$ when:
a) every M_t is measurable with regard to $\mathscr{F}_t$;
b) every M_t is integrable;
c) $E[M_t|\mathscr{F}_s] = M_s$

A simple rule to state if a continuous process is a Martingale or not, after having applied Itô Lemma, concerns the presence of a d_t part or not. When it is included, there is no Martingality. *DebtGDP* is not a Martingale because it contains the drift part. To transform it in a "fair play" process, one shall applicate Girsanov Theorem which allows to switch probability measure and to achieve a risk-neutral likelihood under which compute further derivatives whose underlying is a PSGB. I will show the reader essential stages to arrive at the desirable neutral form of the focus process. We have to choose a measure which eliminates the d_t component from $DebtGDP_t$ differential form. To do that, the theorem makes available a Brownian motion $\hat{W}_t = W_t + \int_0^t \psi_z d_z$ under the future neutral-probability $\mathbb{Q}$. Applying Girsanov to our model:

$$
\begin{aligned}
(\mathbb{P})\ dDebtGDP_t &= \mu DebtGDP_t dt + \sigma DebtGDP_t dW_t = \\
(\mathbb{Q})\ dDebtGDP_t &= \mu DebtGDP_t dt + \sigma DebtGDP d_t W_t = \\
(\mathbb{Q}) &= \mu DebtGDP dt + \sigma DebtGDP(d\hat{W}_t - \psi_t d_t) = \\
(\mathbb{Q}) &= DebtGDP_t dt(\mu - \sigma\psi_t) + \sigma DebtGDP_t d\hat{W}_t
\end{aligned}
$$

To eliminate the drift coefficient, one select $\psi_t = \mu/\sigma$ which is a constant and Nokivov condition that Girsanov Theorem must respect is satisfied *a priori*. The variable ψ outlines the market price of cash flow risk. A closed form solution of derivatives connected to the government-policy bonds is accomplished by Itô Lemma. The theorem states that an Itô process Y_t with dynamics: $dY_t = K_t dt + H_t dS_t, Y_0 = y_0$, if one considers a function $f : \mathbb{R}^+ \times \mathbb{R} \to \mathbb{R}$ where $f \in \mathbb{C}^{1,2}$ with respect to time and Y_t, i.e. $f(t,Y_t)$, then:

$$
df(t,Y_t) = \frac{\partial f(t,Y_t)}{\partial t} d_t + \frac{\partial f(t,Y_t)}{\partial Y_t} dY_t + \frac{1}{2}\frac{\partial f(t,Y_t)}{\partial Y_t^2} dY_t^2 + \frac{1}{6}\frac{\partial f(t,Y_t)}{\partial Y_t^3} dY_t^3 + ...
$$

It is worth noting that $d_t^2 = 0, dY_t \cdot d_t = 0, dY_t^2 = H_t^2 dt$. We can stop at the second power given that every dY_t elevated to an exponent greater than 2 would be accompanied by d_t^2. In our context, let G indicate a call option C to invest in PSGB where the mention stochastic process is $DebtGDP_t$. We have to invest in the bonds underlying when the threshold $DebtGDP^{OPTIMAL}$ is reached since it means the optimal investment timing. Taking into account that trading costs to purchase a call derivative contract is K, the problem is represented in this way:

$$
C_t(DebtGDP) = max_T E[(DebtGDP_T - K)e^{-\gamma T}]
$$

γ expected return of a portfolio which includes the call option. To maximize such expected value, we need *Stochastic Dynamic Programming* (SDP). In the time between 0 and $T^{OPTIMAL}$, a trader will not receive any cash amount as he or she is not investing in PSGB, whereas when the threshold is crossed, the entity will obtain some cash flows because the option has been exercised (i.e. "kill" it). In the next page, I will synthesize the timing with the support of a graph.

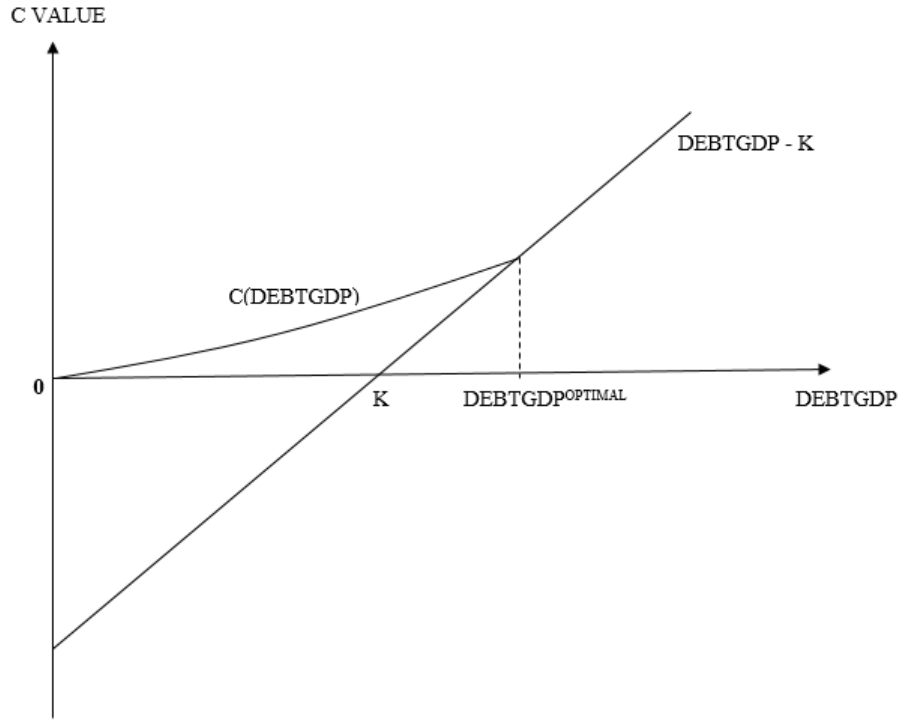


Figure 4.2: Optimal PSGB Investment Decision
Author's elaboration.

The value of a call option does not growth linear with the underlying. In the no investment region, that is to say $DebtGDP \leq DebtGDP^{OPTIMAL}$, under Bellman Equation:

$$C_t(DebtGDP_t) = \frac{E[C(DebtGDP_t + dDebtGDP_t)]}{1 + \gamma dt}$$
$$\gamma C_t(DebtGDP)dt = E[d(C_t(DebtGDP_t))]$$

The last expression states that keeping option when it is cashed must be equivalent to the gain on it. Another implication of the Bellman formula is an imperative to hold the call option up to the optimal time for triggering the investment. Assuming that $\theta > 0$, one obtains by Itô Lemma:

$$\begin{aligned} dC_t(DebtGDP_t) &= \frac{\partial C_t(DebtGDP_t)}{\partial t}dt + \frac{\partial C_t(DebtGDP_t)}{\partial C_t}dC_t + \frac{1}{2}\frac{\partial C_t(DebtGDP_t)}{\partial C_t^2}dC_t^2 = \\ &= \left(C_t + \mu DebtGDP_t C_t^{'} + \frac{1}{2}\sigma^2 DebtGDP_t^2 C_t^{''}\right)dt + \sigma C_t^{'} dW_t = \\ &= \left(C_t + (\mu - \sigma\psi)DebtGDP_t C_t^{'} + \frac{1}{2}\sigma^2 DebtGDP_t^2 C_t^{''}\right)dt + \sigma C_t^{'} d\hat{W}_t \end{aligned} \tag{4.2}$$

We heave to change the probability measure from real to risk-neutral to compute the price of the derivative instrument. Neutral measure expresses the neutrality of agents who do not ask a premium offsets more risk they bear when uncertainty goes up, well PSGB improves with a risk-free rate on average under $\mathbb{Q}$.

The expected value of the call derivative under such a measure will be:

$$E[dC_t + (p + mDebtGDP_t)dt] = r_f C_t dt \tag{4.3}$$

Substituting Itô decomposition in 4.2 inside the above formula and denote $\mu^{\mathbb{Q}} = \mu + - \sigma\psi$, it follows that:

$$\frac{1}{2}\sigma^2 DebtGDP^2 C_t^{''} + \mu^{\mathbb{Q}} DebtGDPC_t^{'} + mDebtGDP_t + p - r_f C_t = 0 \tag{4.4}$$

Expression 4.4 is a stochastic ordinary differential equation where call option at time t is zero if one considers perpetual public bonds. The guess solution form has the configuration $C(DebtGDP) = ADebtGDP^{\beta}$. Putting this ideal condition into the overlying formula:

$$\begin{aligned}&\frac{1}{2}\sigma^2 A\beta(\beta-1)DebtGDP^2 DebtGDP^{\beta-2} + \mu^{\mathbb{Q}} A\beta DebtGDPDebtGDP^{\beta-1} + mDebtGDP_t + \\ &+ p - r_f ADebtGDP^{\beta} = 0 \leftrightarrow S(\beta) := \frac{1}{2}\sigma^2\beta(\beta-1) + \mu^{\mathbb{Q}}\beta + p - r_f = 0\end{aligned} \tag{4.5}$$

The final reduced form of 4.5 is a quadratic equation whose solutions are β_1 and β_2 which take opposite sign (e.g. $\beta_1 > 0$ and $\beta_2 < 0$) having the following frame:

$$\beta_{1,2} = \frac{1}{2} - \frac{\mu^{\mathbb{Q}}}{\sigma^2} \pm \sqrt{\left(\frac{1}{2} - \frac{\mu^{\mathbb{Q}}}{\sigma^2} + \frac{2r_f}{\sigma^2}\right)}$$

The plot 4.3 delineates the acceptable region of the roots of 4.5:

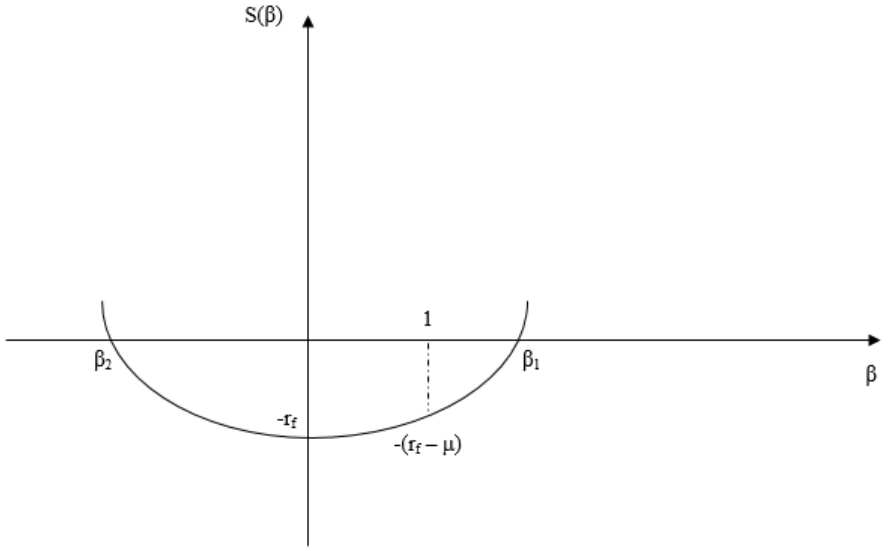


Figure 4.3: Feasible Region For Stochastic Ordinary Differential Equation Solutions
Author's elaboration.

The form of $C(\beta)$ should consequently be: $C_t(\beta) = A_1 DebtGDP^{\beta_1} + A_2 DebtGDP^{\beta_2}$. We add two boundary conditions, that is:

$$i)\, C(0) = \frac{p}{r_f};$$
$$ii)\, C(dft) = V.$$

The first constraint is imposed when the debt ratio converges to 0, the second one claims in case of debt goes beyond levels endurable, PSGB must be set to the rescue value V. The solution for the stochastic differential equations is:

$$C(DebtGDP) = \frac{p}{r_f} + \frac{mDebtGDP}{r_f - \mu^{\mathbb{Q}}} + A_1 DebtGDP^{\beta_1} + A_2 DebtGDP^{\beta_2} \tag{4.6}$$

We eradicate A_2 from the last expression because if $DebtGDP$ goes to 0, $DebtGDP^{\beta_2} \to \infty$ in order to have a bounded price of bonds. Putting into system the constraints where C is replaced by its term in 4.6. The price for a PSGB will assume the shape:

$$C(DebtGDP) = \frac{p}{r_f} + \frac{mDebtGDP}{r_f - \mu^{\mathbb{Q}}} + \left(V - \frac{p}{r_f} - \frac{mDebtGDP}{r_f - \mu^{\mathbb{Q}}}\right)\left(\frac{DebtGDP}{dft}\right)^{\beta_1} \tag{4.7}$$

In case of fixed-rate debt security, i.e. when additional cash flows are null, PSGB will become (coupons are q):

$$C(DebtGDP)^{FIXED} = \frac{q}{r_f} + \left(V - \frac{q}{r_f}\right)\left(\frac{DebtGDP}{dft}\right)^{\beta_1} \tag{4.8}$$

4.1.4 Implications

To understand the evolution of bonds dependent on economy policy, Figure 4.4 displays it with three different plots: in (a) debt-to-GDP and drift coefficient are the drivers, in (b) and (c) PSGB in normal and straight debt conditions are influenced separately from μ, which varies taking the values -2% (thick line), 0% (dashed line), 2% (dotted line). The authors imposed the risk free rate at 3%, the volatility at 2%, the added cash flow payment m at 2, fixed coupon equals to 3 for both kind of debt. Looking at the graph b), we note that the value of PSD is sensible to debt-to-GDP for the overall fluctuation of drift parameter. The same is not true for fixed-coupon debt security which presents a bit variation when μ is diverse from the negative value of the range imposed. The considerations cannot hold whether the drift moves during time span. Constant drift may be a too strong hypothesis since it would mirror a flat trend over the investment horizon. The academics concentrated on two scenarios completely different: i) a whole drift coefficient, ii) μ of PSGB is lower

than the drift of straight debt. The former context is underpinned in the event that fixed bonds are the only one issued and the government thinks to emit PSD, while the second one has already included PSGB. Tables 4.1a and 4.1b illustrates results of the landscapes.From the first table successive we delineate an inverse relationship for the percentage of debt and the price of PSGB. Selecting $\mu = 2\%$, when debt raises from 60% to 100% of GDP, the relative variation of $C(DebtGDP)$ equals to -16.766% which is also due to an increment of coupon rate achieves the top when the ratio approaches the default limit, $dft = 150\%$ (coupons rates regards the first period after they has been issued). Nominal rates of policymakers-sensitive bonds are always lower than perpetual coupons offered by straight obligations, indeed Δ detects the basis which is the difference among the rates and it could be elucidated for the simple reason that good economy policy narrows interest rates required as debt and sovereign risk fall down. In contrast, if consolidation or any adjustments boost economy are postponed, the cost will be so high that politicians shall comply with restructuring to halt coupons and drift parameter upsurge.
The other panorama contains different trends for the closed-form of assets. Drift of PSGB is -1%, the other one 2%. The researchers chosen parameters with opposite sign to clarify more explicitly the reaction of financial markets when bonds attached to policy are just traded. Basis is remarkable at high levels of debt (it overtakes 100 basis points close to default), whereas price declines again when the restructure commitment is violated. Coupon payments contact during time because of the negative value did for μ^{PSGB}. The common feature of the analysis emerges benefits that such PSD instruments offer in short/long-run according to low coupon disbursement especially when budget consolidation, policy strengthens are undertaken for sustaining and enticing people to invest in domestic economy.

The collateral effects might concern lack of sufficient secondary markets where negotiates these new public bonds, albeit nominal amounts nourishing should preserve the threat, speculation or arbitrage expertises practice altering the underlying of call option, although predetermined schedule deadens the problem, or the elapsed time between the economic shock and corrective intervention, known as *inside lag, inside recognition, or decision lag* but this issue seems to be neutralized by coupons escalation (it is worth highlighting the presence of an outside lag which is the time between fiscal or policy measure activation and the effect on economy).
The section right after will be centred to Game Theory relevance in order to counteract speculators who upturn the credit risk when they trade in sovereign Eurobond markets.

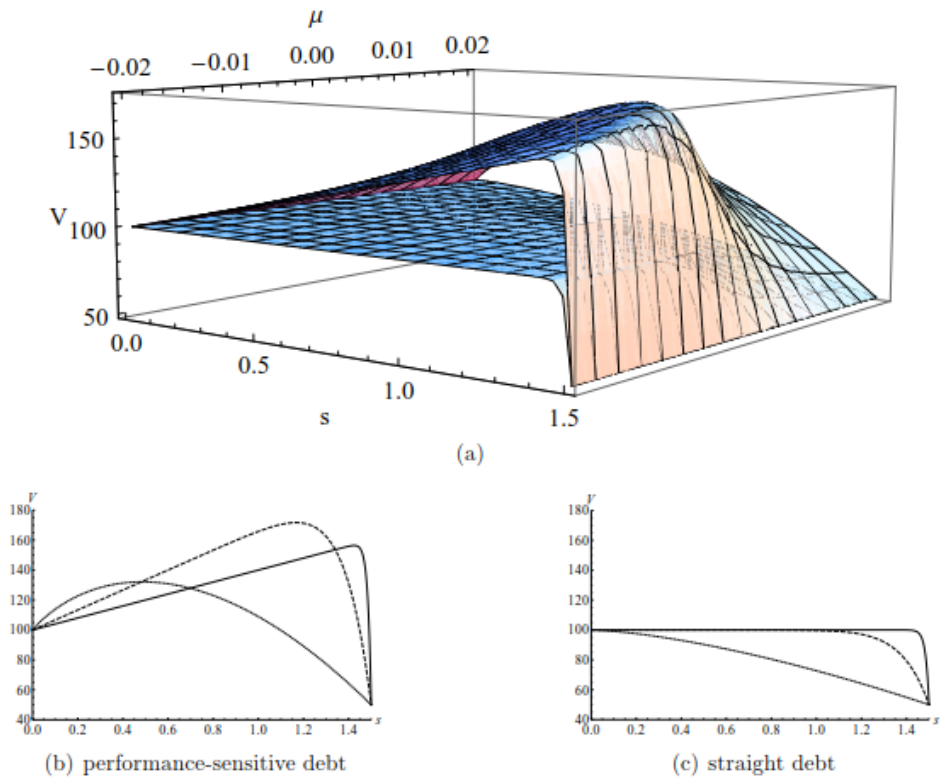


Figure 4.4: PSGB and Straight Bonds Value Variation
Source: Bank et al. (2011)

s	$F(s)$	k_{PSGB}	$k_{Straight}$	Δ
0.01	101.80	3.02	3.05	-0.03
0.10	113.85	3.20	3.45	-0.25
0.20	122.71	3.40	3.79	-0.39
0.30	128.32	3.60	4.08	-0.48
0.40	131.33	3.80	4.33	-0.53
0.50	132.10	4.00	4.56	-0.56
0.60	130.86	4.20	4.75	-0.55
0.70	127.80	4.40	4.94	-0.54
0.80	123.05	4.60	5.10	-0.50
0.90	116.72	4.80	5.25	-0.45
1.00	108.92	5.00	5.39	-0.39
1.10	99.70	5.20	5.52	-0.32
1.20	89.15	5.40	5.65	-0.25
1.30	77.31	5.60	5.76	-0.16
1.40	64.25	5.80	5.87	-0.07
1.49	51.48	5.98	5.97	+0.01

(a) Unique Drift

s	$F(s)$	k_{PSGB}	$k_{Straight}$	Δ
0.01	100.50	3.02	3.02	±0.00
0.10	105.00	3.20	3.18	+0.02
0.20	110.00	3.40	3.39	+0.01
0.30	115.00	3.60	3.64	-0.04
0.40	120.00	3.80	3.94	-0.14
0.50	125.00	4.00	4.29	-0.29
0.60	130.00	4.20	4.72	-0.52
0.70	135.00	4.40	5.25	-0.85
0.80	140.00	4.60	5.94	-1.34
0.90	145.00	4.80	6.84	-2.04
1.00	150.00	5.00	8.11	-3.11
1.10	155.00	5.20	10.00	-4.80
1.20	160.00	5.40	13.15	-7.75
1.30	164.94	5.60	19.43	-13.83
1.40	166.94	5.80	37.35	-31.55
1.49	87.27	5.98	114.05	-108.07

(b) Diverse Drift Coefficients

Table 4.1: Performances of Debt in the two Scenarios
Source: Bank et al. (2011)

4.2 Game Theory and The Tax To Eliminate Speculation in Sovereign Bond Markets

4.2.1 Model Setup

We pass from SDP to Game Theory to verify if Economic doctrine will foster states which are on the verge of collapse after the banks' drama began. I want to suggest a work painstaking that Carfì and Musolino (2012) operated to revert public bond markets to stable criteria having been left with volatility growing strongly and a lot of liquidity into them, precluding yields do not react exaggeratedly to an eventual country's default realization with a soaring crazy by the use of a tax which lets the game be in the equilibrium condition for running a gradual economic recovery. The model is articulated in three periods named time 0, time 1/2 and time 1 which I abbreviate them hereafter t_0, $t_{1/2}$, and t_2 where the players are a broad speculative bank fills the role of speculator, a nation which satisfies the definition of "crisis country" that I have delineated in Chapter 2, and the European Central Bank. There are no impediments for sovereign Euro Area markets for the speculator, I can hazard the hypothesis of perfect competitive markets does not hold for the possibility to do speculation and/or arbitrage which it appears to be within trading venues. At the present time, i.e. t_0, the bank is standing at a crossroads: to make short selling in the light of predict downward future price changes, or to not go into public debt markets. At $t_{1/2}$, the EU Central Bank has the capability to understate yields growth acting with quantitative easing[5] probably, the Country would attain funds for the restoration. At $t = 1$, if the speculator has short sell government bonds, it is binding to purchase and return them to the original tenant.

Game theory is helpful for understanding the desired ideal situation of markets since Myerson (1997) defined it as *the study of mathematical models of conflict and cooperation between intelligent rational decision-makers. Game theory provides general mathematical techniques for analyzing situations in which two or more individuals make decisions that will influence one another's welfare*. The theory is eligible when symmetric information and perfect competition assumption are not truthful. The fundamentals are the identity of independent actors, their preferences and knowledge, decisions they make observing the acts of other players, and how each decision impinge on final outcome of the game. Discounted factor has been dropped because it is very low vis-à-vis yields on the government bonds, so the actualization or capitalization is negligible (if discount factor would be greater than bond's return, NPV of a project consisting to invest in such a bond should be negative and the investment would not be pursued). I have changed some symbols of variables from the original work. Let Q be the quantity of public bonds issued

[5]The program of the Central Bank dwindles interest rates because demand and prices of bonds move up. The actuation is financed by printing new money placed into system. The dangerousness to adopt an expansive monetary policy like this for a long time lies in the fact that inflation might bring up enormously which ends up with the borne of *Liquidity trap*.

by crisis state, x bank's strategy which measures the percentage of debt bought at t_0, well $s \in [0,1]$. We have to include 0 recalling that the speculator could decide to not take any purchasing actions at the present time. When $t = 1/2$, the Central Bank decides how many fraction of Q securities pick up indicated with $e \in [0,1]$. The region of the game strategy is portrayed as follows:

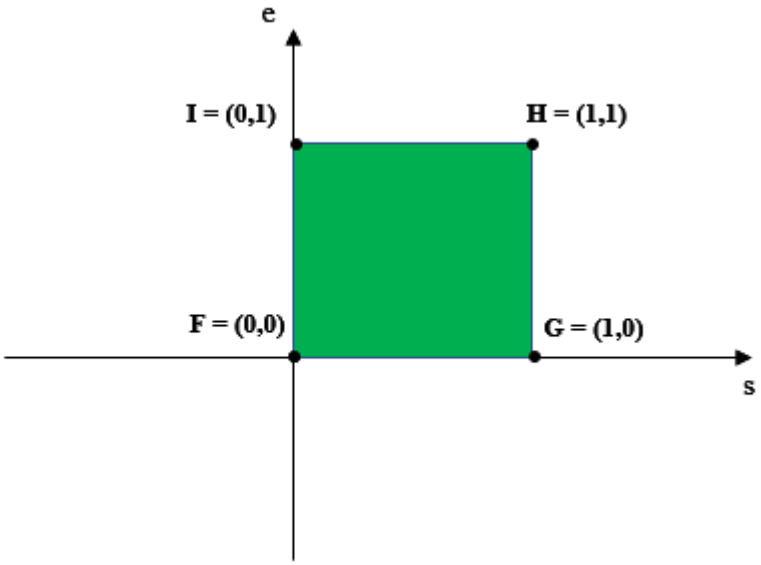


Figure 4.5: The Range of Strategy of The Game.
Source: Author's re-elaboration from Carfì and Musino (2012)

I will explain the game where the "speculation killer" tax is absent, then I will go beyond relaxing the assumption and put it into framework.

4.2.2 Equilibria Without Anti-Speculation Tax

The gain the speculator will take as to the trading conducted at t_0 will become:
$G(e,s)^{Speculator} = sQ(Yield_1(e,s) - Yield_0)$, the fraction of bonds for which the bank has been long times the differential between the rise expectation of yields from $t = 0$ to $t = T = 1$. The actual nominal interest rate is exogenous and equivalent to r. At t_1, it will deal with marginality of operations that the speculator and the European Central Bank have employed (pegged as u and v): $Yield_1(e,s) = r + u \cdot s - v \cdot e$. The marginal outcome of the Central Bank is negative because of a jump of demand decreases potential profits, short selling poses the inverse spin (a surfeit of instruments leads markets to hike coupon rates). Placing the expression of yields into the speculator's profit function, it follows that:

$$G(e,s)^{Speculator} = sQ(r + u \cdot s - v \cdot e - r) = sQ(u \cdot s - v \cdot e) \tag{4.9}$$

The Mario Draghi's institution will meet earnings at $t = 1/2$ led by the current nominal interest rate plus the weight of the speculator decision on trading venues.
Using maths: $Yields_{1/2}(e,s) = r + u \cdot s)$. The return function will be produced multiplying yields for the amount of government debt hold by the central bank:

$$G(e,s)^{Central\ Bank} = eQYields_{1/2} = eQ(\ r + u \cdot s) \tag{4.10}$$

The stumped country will have more favorable condition when nominal rates climb down being the issuer of securities (it shall pay a stream of lower coupon rates). The payoff function will be calculated from the product among issuances and the difference yields own at time 0 and upon the residual player have their moves. As such:

$$G(e,s)^{Distressed\ Country} = Q(Yield_0 - Yield_1(e,s)) = Q(r\ -r - s \cdot u + e \cdot v) = Q(e \cdot v - s \cdot u) \tag{4.11}$$

Interest rates at the final stage will be lower or greater than their values at t_0 upon the dominance of one game plan on the other one. The authors represent the profit function of the overall game with a vector where the bits are the mutual functions 4.9, 4.10, 4.11. The game is nonlinear because its payoff function does not satisfy linearity. A definition of linear game is presented by Broom and Rychtář (2016). A matrix game Ω is linear on the left if it is linear in the strategy on the focal player p, i.e.:

$$\Omega\left[\sum_i \alpha_i p_i; \Pi\right] = \sum_i \alpha_i \Omega[p_i; \Pi]$$

Π a population, p_i a strategy of the focus player belong to the vector $p = (p_1, p_2, ..., p_m)$, α_i nonnegative constants whose sum amounts to one. A game is linear on the right if it is linear in the strategy of the population:

$$\Omega\left[p; \sum_i \alpha_i \delta_{q_i}\right] = \sum_i \alpha_i \Omega[p; \delta_{q_i}]$$

δ_{q_i} is used to represent a population where the probability of a randomly selected player being a q-player is 1. I stress that a linear matrix game can be written as $\Omega[p; q^T] = pAq^T$, A the payoff matrix equals to $(a_{i,j})_{i,j\ =\ 1,\ldots,n}$, with payoffs: $\sum_j p_j (Aq^T)_j$ or $\sum_j (pA)_j q_j$ in case of linearity for the overall population.
In our game, these conditions are not valid. Thus, to find out the critical space of the game without anti-speculation tax, one needs to analyze the critical points of the region reported in Figure 4.5. The critical zone is detected putting the determinant of Jacobian matrix equals to 0 as we are treating potential profit function with two variables, e and s. The partial

derivatives of the bank's payoff will be:

$$\frac{\partial G(e,s)^{Speculator}}{\partial s} = Q(2us - ve); \frac{\partial G(e,s)^{Speculator}}{\partial e} = -Qvs$$

For the European Central Bank:

$$\frac{\partial G(e,s)^{CentralBank}}{\partial s} = Que; \frac{\partial G(e,s)^{CentralBank}}{\partial s} = Q(r + us)$$

The Jacobian matrix $J(e,s)$ will contain the derivatives which has just been computed:

$$J(e,s) = \begin{bmatrix} \frac{\partial G(e,s)^{Speculator}}{\partial s} & \frac{\partial G(e,s)^{CentralBank}}{\partial s} \\ \frac{\partial G(e,s)^{Speculator}}{\partial e} & \frac{\partial G(e,s)^{CentralBank}}{\partial e} \end{bmatrix} = \begin{bmatrix} Q(2us - ve) & -Qvs \\ Que & Q(r + us) \end{bmatrix} \tag{4.12}$$

The determinant of a squared matrix can be calculated with the multiplication of the element lie on the principal diagonal minus those of the secondary one:

$$|J(e,s)| = Q^2(2us - ve)(r + us) + Q^2uevs$$

Imposing that $|J(e,s)| = 0$ and $s = u = 1/2$, $r = 0.25$, we will arrive at a critical region drawing as a segment $(F0)$ of right arch of a translated parabola with equation $e = 1/2s^2 + 1/4s$.

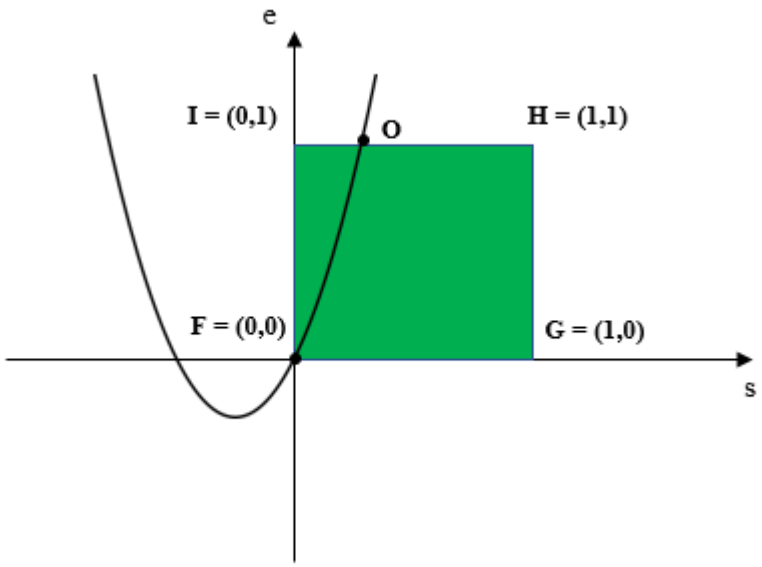


Figure 4.6: The Critical Zone of The Game
Source: Author's re-elaboration from Carfì and Musolino (2012)

Introducing the concept of vector function in the strategy space displayed in 4.6, labeled v and made up by $G(s,e)^{Speculator}$ and $G(s,e)^{CentralBank}$, the researchers draw the payoff

space trough a transformation of both critical and strategy region. Let's start the operation considering the segment FG of the square. Along this subset of the area, Mario Draghi's will not intervene to prevent speculation (e is always 0), s is comprised between 0 and 1. We estimate the image of the point $(s,0)$ for v: $v(s,0) = (s^2Qu,\ 0)$.
Setting: $S = s^2Qu$ and $E = 0$, where $r,\ u,\ v$ holds the previous values and $Q = 1$, one shall be obtained: $S = 1/2s^2$. The image is hereby a segment with extremes $(F^{'} = = v(F),\ G^{'} = v(G))$. Reiterating the method for the remain zones, the result will be:

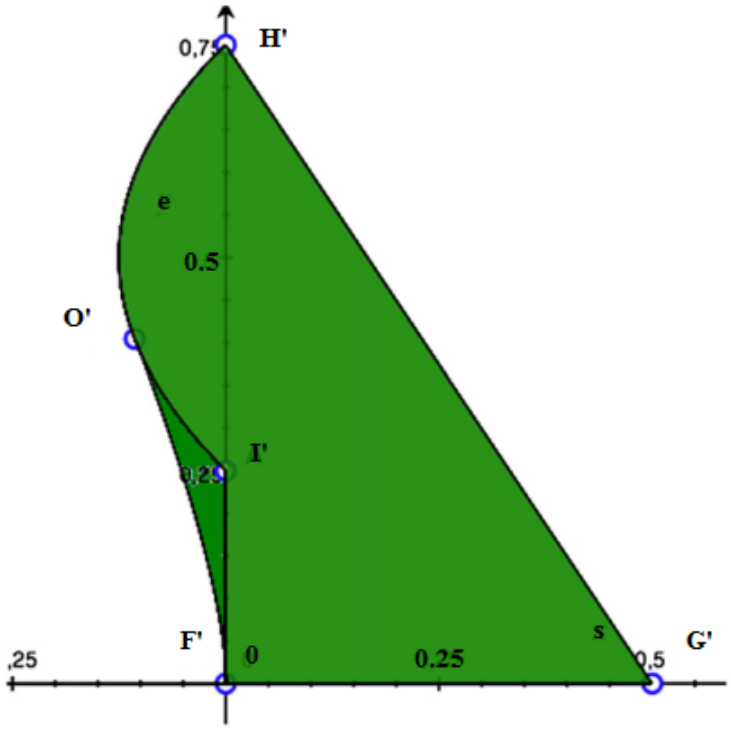


Figure 4.7: The Payoff Region
Source: Adapted from Carfì and Musolino (2012)

The ideal point for the country lies on $F^{'}I^{'}$ as it get funds and does not pay a too high yield. Nominal rates narrow thanks to expansive monetary policy carried out by the second player. Reporting the thought at the game space, the equilibria should be I.
To maximize earnings, we have to select Nash equilibria theorem which determines the most convenient strategy given plans of the other players. To lure out behaviors of the speculator and the central bank, the actions which maximize $G(\cdot,e)^{Speculator}$ and $G(s,\cdot)^{CentralBank}$ are essential. When the actors, nation excluded, acquired the 50% of the bonds issued set to 1, and recalling the composition of derivatives $\partial G(s,e)^{Speculator}/\partial s$, $\partial G(s,e)^{SCentral\ Bank}/\partial e$, then:

$$N(e)^{Speculator} = \{1\ if\ e < 1;\ 0,1\ if\ e = 1\}$$

$$N(s)^{Central\ Bank} = 1\ \forall\ s$$

		Central Bank	
		Act	Not Act
Speculator	Enter	(1,1)	(1,0)
	Not Enter	(0,1)	(0,0)

Table 4.2: The Nash Equilibria of the Game without Anti-Speculation Tax. Author's elaboration.

The Nash Equilibria will intersect $N(s)^{Central\ Bank}$ and the inverse of $N(e)^{Speculator}$ has been formulated in conformity with the first entity. The optimal responses are $\{(1,1),(0,1)\}$. $(0,1)$ is not the first best for the bank as yields will low already at $t_{1/2}$ when the European Central Bank promotes the country's bailout. The attention will fall to the first of the obtained equilibrium which does not serve to the third entity.

4.2.3 Equilibrium Introducing The Tax

The authors of the paper designed a tax that eliminates completely profits yielded with speculation, reassure to the government financings for relaunching the economy, and make financial markets resilient again. The imposition shall be equal to the marginality of bank's trading *us*. The payoff of the former individual will feel the burden of such a incidence, meaning that: $G(s,e)^{Speculator} = sQ(Yield_1(e,s) - Yield_0 - T(s)) = sQ(r + uv - ve - r - uv) = -sQve$, $T(s)$ the "benefactor" tax. For the European Central Bank, the tax must be expensed in assets of balance sheet since it constitutes a financial reserve being issued by regulatory authorities. The future earnings will follow this path:
$G(s,e)^{CentralBank} = eQYields_{1/2} + eQT(s) = Qe(r + us) + Qs^2u.$
Money derived by speculation making matches the size of public bonds traded by the financial institution. The authors claimed that the imposition does not impinge on the country's payoff and I agree with them. A tax considerable might perturb informed traders by means of *ex-post regret* if they submit limit orders when price move toward and trough their limit prices, seeing fulfilling will take place rapidly, yet markets move against their positions loosing money. All those things would persuade speculators to go out from markets and a large share of agents who are willing to purchase treasury assets would disappear (I suppose the Central Bank will stop expansive monetary policy at a certain time, otherwise a new crisis may occur), complicating the country's potential gain from sovereign debt issuance. The payoff is untouched, to wit: $G(s,e)^{Distressed\ Country} = -Q(us - ve)$.
Partial derivatives will become:
$\frac{\partial G(e,s)^{Speculator}}{\partial s} = -Qve$; $\frac{\partial G(e,s)^{Speculator}}{\partial e} = -Qvs$;

$$\frac{\partial G(e,s)^{Central\ Bank}}{\partial s} = Q(ue + 2us); \frac{\partial G(e,s)^{Central\ Bank}}{\partial e} = Q(r + us).$$

Thus, the determinant of Jacobian matrix will be: $|J(s,e)| = -Q^2ve(r + us) + Q^2vs(ve +$
$+ 2vs)$. The critical space will remain FO segment though the focus of parabola is the origin. Replicating the procedure for the payoff region, one will obtain:

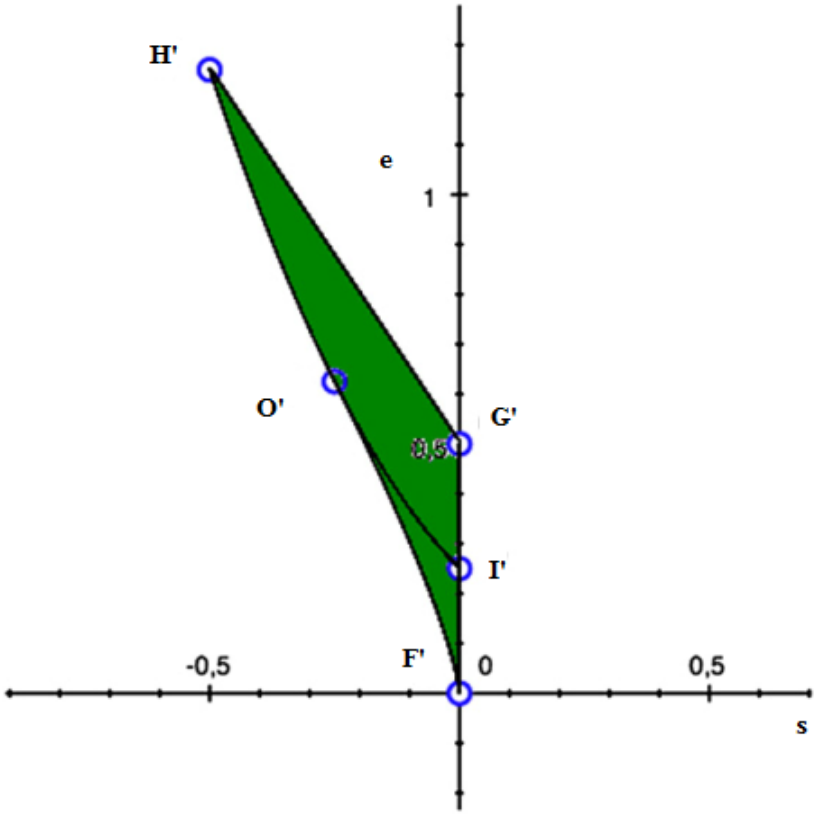


Figure 4.8: Payoff Region When Tax Has Been Introduced
Source: Adapted from Carfì and Musolino (2012)

What has been changed here is the loss that the speculator must sustain if it short sells public bonds at t_0 which broadens the second player's profitability . The aggregate profits is stable at 0.75 as when the tax is not added.
The Nash Equilibria will be attain estimating the best response of the entity in reference to the others again. The strategies must maximize $G(\cdot,e)^{Speculator}$ and $G(\cdot,e)^{Central\ Bank}$ respectively, for that reason we exploit the derivative of the payoff in s for the speculator, and that in e for Mario Draghi's central bank. With a amount of bonds issued at 1, nominal interest rate at 0.25, and similar quantities of debt acquired (50% for the bank and the European Central Bank), it follows that: $N(e)^{Speculator} = 0\ if\ e > 0;$
$\{0,1\}\ if\ e = 0.$
$N(e)^{Central\ Bank} = 1\ \forall\ e \in \{0,1\}$. Taking the inverse of $N(e)^{Speculator}$ the greatest reply of the monetary policy holder, the Nash equilibrium will be given by the intersection of the two optimal strategies, therefore point I in Figure 4.6 which is good for all the players as

the state will pay lower coupon rates and is able to raise capital for the recovery, the large bank does not negotiate without any contingent losses, and the central bank helps the first entity to go out from the distress position. This optimality can be better explained with a neoclassical economics term, *Pareto improvement* or *Improvement in terms of Pareto* due to a redistribution of resources that enhances the condition of one individual without exacerbates those of the other people.

4.2.4 Closing Thoughts

Imposing that the marginal trading gain of the speculator coincides with the tax works well, the country debt interest rates do not augment and funds are available as the central bank intervenes into markets. Relaxing the hypothesis, i.e. when no burdens are imposed on speculation activity, the responses of the actors translate towards another place of the square represents the decision area of the game. I maintain that selfish behavior under the no tax game develops a dominant strategy to go into markets for the former institution and to enact monetary policy countermeasures for the second large bank, even when the play renders imperfect information such that at least one individual must react unless knowing the choice done antecedently or by another gamer. To support the statement, let's look at the matrix in table 4.2. The bank is an informed trader and has skills to forecast a downward trend of bonds' prices in the next future. Whatever the plan of the central bank, it will be inclined to participate to markets short selling the larger feasible amount of government instruments with a view to repurchase them at narrower costs. In fact, the payoff along $G'H'$ oscillates around 0.5/0.75 as we can seen in the picture 4.7. The European Central Bank increments the profitability by investing in treasury obligations, the fraction of bank bondholding bolsters it. The first player owns the top earnings in case of no Mario Draghi intervention. However, $(1,1)$ shows the dominant strategy for the basic game. The option "not enter" is dominated by the willingness to negotiate as no sanctions are charged.

The situation reverses when the expected profit from short selling is nullified by the fee. In that circumstance, the informed trader will not take any positions into markets, it would incur in detriments since trading costs are relevant when one submits orders. The equilibrium passes to $(0,1)$ with advantages for both the country and the quantitative easing adopter. Imperfect information is a natural feature of markets, agents are equipped with limited rationality, so they opt for opportunistic attitude and transactions happen with asymmetries, yet the pivotal authority has an externality for the future of the national government.

I will give the reader in the last part of the chapter the model that I have designed for studying the timing of quantitative easing that the central bank should implement in case of a financial crisis threat.

4.3 Quantitative Easing Timing Model

4.3.1 Assumptions

A country trade in primary financial markets to issue public bonds in order to face imbalances of its debt. The bonds will then be negotiated in secondary marketplaces in whom a central bank covers the role of perfect potential buyer. Let's assume that an abrupt financial crisis may hit the international sovereign markets such that the focus state gets in mayhem due to banks crash, high leverage of non-financial sector, and an economic slump. The main authority holds the monetary tools for encouraging a slow restoration for the country and I suppose the best facility is *Quantitative easing* cited more times in the thesis. The institution undertakes the investment not only to aid the nation blown by the meltdown but to resell the securities at better prices under a long-term vision. The idea behind the strategy is that the state boosts interest rates to push remarkably down the cost of debt when blown by the crisis. Let denote with c the trading costs for the central bank to acquire an exogenous Q bulk of government debt instruments, strictly higher than 0 and expresses in billion of dollars. The price of the central bank's public debt follows a GBM whereby μ stands for the expected improvement of interest rates, σ the instantaneous volatility[6]:

$$dS_t = \mu S_t dt + \sigma S_t dW_t,\ S_0 = k \tag{4.13}$$

dW_t represents differential form of a standard Brownian motion and k is a non-negative constant. This is the basic version of the model which cannot allow for the reflection of the turmoil. Let hypothesize that the total return of the program ρ is greater than μ and cash flows public bonds delivered are discounted by a real rate sets to $\rho - \mu$, the rate must be lower than the investment return because I claim that the central bank calls for a payout rate for the bailout undertaken, differently if there was an equality, all risk would be diversified and the return of the project would be a risk-free interest rate.
Time span is enveloped in the range $t \in [0,T]$. The occurrence of the financial calamity is controlled by a Poisson process P_j. To model jump towards the crisis, Poisson stochastic process is very fashion since it handles discrete non-systematic events which are diversifiable. The frame is very similar to a Wiener process:

$$dP_t = \begin{cases} j\ with\ probability\ \lambda dt \\ 0\ with\ probability\ 1 - \lambda dt \end{cases}$$

j the size of the jump which belongs to $(0,1)$ and it can be random, λ the mean arrival rate greater than 0.

[6]The square root of variance which weights equally returns. This is a weakness of the approach respect to other estimators exploiting information like opening jump, maximum and minimum daily prices. For the model, standard deviation of historical prices is good because we are not working with high frequency data.

The monetary program is a equivalent to a call option:

$$H(S_t) \;=\; \max_{T} E[(S_t \;-\; c)e^{-\rho T}] \tag{4.14}$$

The Bellman Equation will be in the no-investment region ($S_t \;<\; S_{T^*}$):

$$\rho H(S_t)dt \;=\; E[dH(S_t)]$$

The equation is a necessary condition under dynamic programming considering it assures optimality and breaks the optimization into easier subproblems. The proof is reported as follows: For small d_t time intervals, the present value of $H(S_t)$ can be decomposed as:

$$H(S_t) \;=\; E_t\left[\int_t^{\infty} S_s e^{-\rho(s\,-\,t)}ds\right] \;=\; E_t\left[\int_t^{t+dt} S_s e^{-\rho(s\,-\,t)}ds\right] \;+\; E_t\left[\int_{t+dt}^{\infty} S_s e^{-\rho(s\,-\,t)}ds\right] \;=$$
$$=\; S_t dt \;+\; e^{-\rho dt}E_t\left[\int_{t+dt}^{\infty} Se^{\rho dt}e^{-\rho(s\,-\,t)}ds\right] \;=\; S_t dt \;+\; e^{-\rho dt}E_t\left[\int_{t+dt}^{\infty} Se^{-\rho(s\,-\,(t\,+\,dt))}ds\right] \;=$$
$$= S_t dt \;+\; e^{-\rho dt}E_t[H(S_{t\,+\,dt})]$$

As $S_{t\,+\,dt} \;=\; S_t \;+\; dS_t$, one obtains the Bellman Equation:

$$H(S_t)dt \;=\; Sdt \;+\; e^{-\rho dt}E_t[H(S \;+\; dS)]$$

Recalling that $e^{-\rho dt} \;\simeq\; 1 \;-\; \rho dt$ for Taylor expansion, the expression can be rearranged as a hedging condition:

$$\rho E_t[H(S_t \;+\; dS_t)] \;=\; S_t \;+\; \frac{E_t[H(S_t \;+\; dS_t)] \;-\; H(S_t)}{dt}$$

For $dS_t \;\to\; 0$:

$$\rho H(S_t) \;=\; S_t \;+\; \frac{E[dH(S_t)]}{dt}$$

The second component of the R.H.S. is the capital gain.
The expected profit for selling bonds will be: $\Pi_t(S) \;=\; Q(S_t^{Resell} \;-\; c)$, S_t^{Resell} the raising price to sell the option in the future.

4.3.2 Programming

To figure out how the timing for "killing" the quantitative easing option varies upon the banking crumple, I will run two distinct programming problems. In the first place, status jump will be overlooked due to supposition that the central bank has rationality which allows it to exercise the derivative instrument if and only if when there is actually a financial turmoil. Jump process will be then treated into the GBM of the public bonds' prices to investigate how the optimal triggering threshold changes in response to the market sentiment after the imposition of the crisis.

4.3.2.1 No Financial Crisis Jump

Let's initiate the optimal dynamic programming with the simplest context. No jump process is brought into play, the main authority decides to intervene when the banking disaster has actually been begun in order the optimum threshold finding comes down to a standard real option investment. Retrieving Itô Lemma:

$$dH(Q_t) \;=\; \frac{\partial H(Q_t)}{\partial t}dt \;+\; \frac{\partial H(Q_t)}{\partial H_t}dS_t \;+\; \frac{1}{2}\frac{\partial^2 H(Q_t)}{\partial H_t^2}dS_t^2 \;+\; ...$$

The derivative with respect to time can be removed since it equals to 0 and we stop at the second power as d_t^2 would nullify the further derivatives. The expected value of monetary policy's project will follow the pattern:

$$E[dH(Q_t)] = E\left[\frac{\partial H(Q_t)}{\partial H_t}dS_t \;+\; \frac{\partial^2 H(Q_t)}{\partial H_t^2}dS_t^2\right] = \frac{\partial H(Q_t)}{\partial H_t}E[dS(Q_t)] + \frac{1}{2}\frac{\partial^2 H(Q_t)}{\partial H_t^2}E[dS_t^2] \tag{4.15}$$

Linearity of expected value has been used. Computing dS_t^2:

$$\begin{aligned} dS^2t \;\equiv\; d[S,S]_t \;&=\; (\mu S_t dt \;+\; \sigma S_t dW_t)\cdot(\mu S_t dt \;+\; \sigma S_t dW_t) \;= \\ &=\; \mu^2 S_t^2 d^2t \;+\; 2\mu\sigma S_t^2 dt dW_t \;+\; \sigma^2 S_t^2 dW_t^2 \;=\; \sigma^2 S_t^2 dt \end{aligned}$$

Then, replacing dS_t and its quadratic form into (4.15), the equation will become:

$$\begin{aligned} E[dH(Q_t)] \;=\; \frac{\partial H(Q_t)}{\partial H_t}E[\mu S_t dt \;+\; \sigma S_t dW_t] \;+\; \frac{1}{2}\frac{\partial^2 H(Q_t)}{\partial H_t^2}E[\sigma^2 S_t^2 dt] \;= \\ =\; \mu\frac{\partial H(Q_t)}{\partial H_t}S_t dt \;+\; \frac{\sigma^2}{2}\frac{\partial^2 H(Q_t)}{\partial H_t^2}S_t^2 dt \end{aligned} \tag{4.16}$$

Remark: $W_t \sim N(0,t) \rightarrow E[dW_t] = 0$. Substituting (4.16) in Bellman Equation, one obtains:

$$\frac{\sigma^2}{2}S_t^2 H^{''}(S_t) \;+\; \mu S_t H^{'}(S_t) \;-\; \rho H(S_t) \;=\; 0 \tag{4.17}$$

The wanted solution has the architecture: $H(S_t) \;=\; AS_t^{\beta}$.

Inserting it into the above ordinary SDE:

$$O(\beta) = 0 \rightarrow \frac{\sigma^2}{2}\beta(\beta - 1) + \mu\beta - \rho = 0$$

Roots of the squared SDE will be composed in that manner:
$\beta_{1,2} = \frac{1}{2} - \frac{\mu}{\sigma^2} \pm \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + 2\frac{\rho}{\sigma^2}}$.

We impose that β_1 is the positive solution and β_2 the negative root. The general solution will be closed to: $H(S_t) = A_1 S_t^{\beta_1} + A_2 S_t^{\beta_2}$. We filter out β_2, otherwise $S_t^{\beta_2}$ goes to infinity when $H(S_t) \rightarrow 0$. The financial intuition is that a bubble might appear. We construct a system collects boundary conditions:

$$\begin{cases} H(0) = 0 \\ H(S_{T^*})^1 = S_{T^*} - c \\ H^{'}(S_{T^*})^1 = 1 \end{cases}$$

The second constraint states that the rescuer must be indifferent among waiting and NPV of the project when investment triggering threshold S_{T^*} is reached (value matching condition), the third tie takes care that linearity is retained in the model so that arbitrage will not take place (smooth-pasting condition). Thus, focusing on these constraints:

$$\begin{cases} A_1 S_{T^*}^{\beta_1} = S_{T^*} - c \\ A_1 \beta_1 S_{T^*}^{\beta_1 - 1} = 1 \end{cases}$$

From which:

$$S_{T^*} = \frac{\beta_1}{\beta_1 - 1} c \; ; \; A_1 = \frac{S_{T^*} - c}{S_{T^*}^{\beta_1}} \tag{4.18}$$

$\frac{S_{T^*}}{c} = \frac{\beta_1}{\beta_1 - 1}$ is called Tobin q and given the fact that it is higher than 1, markets allocate to the invested capital a superior value than the costs backed. A_1 is positive as $S_{T^*} > c$.

4.3.2.2 Financial Crisis Event

The jump from a corroded surroundings is incorporated in the framework. Public bonds markets live the financial hurricane at some point which pushes the prices down. The event has to be integrated in the stochastic process of the prices:

$$\begin{cases} dS_t = \mu S_t dt + \sigma S_t dW_t - V dP_t \\ S_0 = k \end{cases} \tag{4.19}$$

Let assume that the Poisson process P_t is independent of the standard Brownian motion W_t that follows that $Cov[dP_t dW_t] = E[dP_t dW_t] = 0$. Once the crisis has risen up, jump process diminishes by a certain percentage j, S_t oscillates pursuant the GBM but it could endures a reduction $1 - j$ of its original value with a probability λdt because of the crisis effect has been inserted. Successively, the process keeps to oscillate until another shock happens. If the size of the jump was unitary, the quantitative easing project value would fall to zero.
Let's start the construction of the pattern determine the likelihood a first banking "freezing" will be borne in the impeding time interval $(T,\ T + dt)$. Remembering that the density function of a variable $T \sim Poisson(\lambda)$ is: $P(T = {}_T) = \frac{\lambda^T}{T!}e^{-\lambda}$, the probability will be:

$$P((T + dT) - T = 1) = \lambda T e^{-dT}$$

The expected time up to the jump will occur is:

$$E[T] = \int_0^\infty T f(T) dT = \int_0^\infty T \lambda T e^{-dT} dT = \frac{1}{\lambda}$$

Passing to the dynamic optimization, let suppose that dP_t can be diversified, i.e. non-systematic, more easy to manage. A risk-free rate can be exploited which implies that $\mu = r$ and $\gamma = r - \mu$, the payout rate. Exploiting Bellman equation and Itô Lemma again:

$$\frac{\sigma^2}{2} S_t^2 H(S_t) dt + (r - \gamma) S_t H(S_t) dt - \lambda \left(H(S_t) - H[(1 - j)S_t]\right) dt - rH(S_t) dt = 0 \rightarrow$$
$$\rightarrow \frac{\sigma^2}{2} S_t^2 H(S_t) + (r - \gamma) S_t H(S_t) - (r + \lambda) H(S_t) + \lambda H[(1 - j)S_t] = 0$$

Value matching and smoothing-past conditions remains the same. The guess solution is still $H(S_t) = A_1 S_t^\beta$, however the SODE is more complicated since it is resolvable by numerical methods:

$$O(\beta) := \frac{\sigma^2}{2} \beta(\beta - 1) + (r - \gamma)\beta - (r + \lambda) + \lambda(1 - j)^\beta = 0 \tag{4.20}$$

If the price S_t goes to 0, i.e. when the jump $j = 1$, the above equation can be solved analytically and the positive root higher than 1 will have the form:

$$\beta_1 = \frac{1}{2} - \frac{(r-\gamma)}{\sigma^2} + \sqrt{\left(\frac{1}{2} - \frac{(r-\gamma)}{\sigma^2}\right)^2 + 2\frac{(r+\lambda)}{\sigma^2}}$$

The quantitative easing optimal threshold will be influenced by the mean of the jump stochastic process being embedded in the solution of the equation just computed.
I have performed a simulation for the case of $j = 1$. The parameters assume the values: $r = 3\%$, $\sigma = 60\%$ (a high volatility has been chosen due to we suppose to work into trading venues upset), trading costs $c = 0.75\%$, $\gamma = 0.01$.
When λ varies, the root of $O(\beta)$, S_{T^*}, and constant A_1 are estimated. The underneath table summarizes the outcomes simulated.

λ	β_1	S_{T^*}	A_1
0.00	1.05	1.64	0.93
0.05	1.25	0.38	1.02
0.10	1.40	0.26	1.23
0.20	1.66	0.19	1.81
0.30	1.87	0.16	2.61
0.50	2.22	0.14	5.09
0.60	2.37	0.13	6.89
0.70	2.51	0.12	9.18
0.90	2.76	0.12	15.69
1.00	2.88	0.11	20.18

Table 4.3: Results of Optimal Quantitative Easing Model with Jump Process.
Author's elaboration.

A small increment of the mean arrival rate drives a consistent fall of the threshold, while the positive root growths slightly. When the mean arrival rate increases, the value of the call option $H(S_t)$ narrows which implies that the critical threshold S_{T^*} is reduced. The expected time until public bond prices jump feels the modification of λ. When the parameter augments, the doldrums will be increasingly imminent due to $E[T] = 1/\lambda$ and the rescuer will rapidly proceed with the plan.

4.3.2.3 Real Option Game - The Preemption Game

This paragraph of the final chapter will prove how competition among a central bank and a large investment bank destroys the chance to wait before investing in public bonds in form of a bailout for a country which is really suffering from a banking crisis. Let impose a continuous compounding and discrete time evolution where the two players can invest now $t = 0$, tomorrow $t = 1$, or not pursue the project. The trading cost c are equivalent to 80 dollars for a call option written on a public bond, the risk-free interest rate r is set to 3%, the initial price of bonds is $S_0 = 100$ \$. At t_1, the price can go up or down and it becomes $S^+_{t_1} = 150$ or $S^-_{t_1} = 70$. The option value at t_1 can be $H(S_{t_1})^+ = (S^+_{t_1} - c)^+ = (150 - 80)^+ = 70$ or $H(S_{t_1})^- = (S^-_{t_1} - c)^+ = (70 - 80)^+ = 0$ with probability q and $1 - q$. To price the call option at t_0, we use the binomial tree model. The risk.neutral probability will be equal to:

$$q = \frac{e^{r\Delta t} - d}{u - d} = \frac{e^{0.03} - 0.7}{1.5 - 0.7} \simeq 0.413$$

u and d are the width of the upward and downward jump of the underlying. Thus, the price of the invest at time 0:

$$\begin{aligned} H(S_0) &= e^{-r}\{q(H(S_{t_1})^+) + (1 - q)H(S_{t_1})^-\} = \\ &= e^{-0.03}\{(0.413 \cdot 70) + (0.587 \cdot 0)\} \simeq 28.056 \end{aligned} \tag{4.21}$$

NPV at the start is the difference amid $S_0 - c = 20$. Since the value of the call is higher than NPV, the best strategy is wait and invest tomorrow if the option's value surges. The preemption effect makes sure that the financial institution which moves firstly will yield the total share of the market. We are in the game theory context with four scenarios. If central authority and investment bank enters contemporaneously into the market at t_0, they split it with payoffs which will be NPV/2. When one of the players enter and the other one wait, the leading entity has the utter quota of the market, the payoff will coincide with (NPV/2;0) or vice versa. Both banks can decide to postpone the project, so they enter at t_1 and the expected return will be equivalent to $H(S_0)/2$.

		Central Bank	
		Wait	Invest
Investment Bank	Wait	(14.028,14.028)	(0,20)
	Invest	(20,0)	(10,10)

Table 4.4: The Nash Equilibria of the Preemption Game.
Author's elaboration.

The two banks prefers to invest albeit there are strategies with better returns (they do not know the choice of the other gamer), a play similar to Prisoner Dilemma, a classic example of incomplete information game in Economics literature.

Conclusions

My work has led us to the conclusion that sovereign bonds are greatly employed to try to restore the public debt. The investor cannot lend money without a guarantee that the borrower will honor the repayment in the future. Certainly, go long on these securities comports the bearing of some risks automatically, one need only think that the debtor could not comply with all coupon payments, and the principal at the maturity date.

The evidence from this study suggests that banks held public bonds during the Global Financial Crisis due to the sharp rise in bond yields up to the middle of the meltdown, and the idea behind it stems from the price-interest rate relation, that is when interest rates growth, bond's prices decline. The crisis behavior made this kind of debt instrument very cheap and appealing for financial institutions, so much so that their businesses were substantially relocated to government bonds. The hope of help nations more shocked by the financial hurricane, but above all, huge gains from buying obligations at minimum costs now to resell them at higher prices changed the placement of banks inside sovereign bond markets with larger shares. In general, the financial sector of every nation holds mostly the number of public bonds, in whom banks and central banks are the principal buyers of them.

My research provides a blueprint for a new way to investigate the core of banks attitude at the end of the previous decade. Banking crash will inevitably be an issue that the major authorities have to monitor systematically using stress tests. The threat of a next bubble is not an utopia as long as the "cleaning" mechanism will not wipe out the entire traces leaved by the previous crisis. Eurozone suffered from what the U.S.A. created with its real estate collapse. Australia and India, as well as some developing or emerging countries, endured less the allure of the recession.
I aware that my analysis may have three limitations. The first is the no presence of any developing states which would have contributed to better explain the public bonds phenomenon. The second is the limited number of countries available which are, excluding the U.S., all European. The inclusion or ulterior AM countries might deliver robuster results, such as Japan which was very distressed at the epoch even for the "Lost Decades" not completely overcome. These limitations are evidence of the difficulty of collecting data for the whole variables and combining them efficiently.

Another possible source of error is the treatment of missing data. Sophisticated multiple imputation techniques for panel data might have produced more consistent estimators of marginal effects of the explanatory variables for the fixed effects models adopted. Nevertheless, advanced missing value management does not fit the scope of the thesis.

The findings of the empirical analyses support the thought that the percentage of bondholding is climbed after the final quarter of 2007. The portion of public bonds kept by banks in their portfolios is improved by 2.071 percentage points where the best participant of the growth is the UK, with an increase of 7.465 percentage points. The upshot of this is the possibility that yields stayed flat in the economic boom, pushing then UK banks to invest in the national debt. The nominal rates give a benefit of 0.356% of holding more public bonds on average, the private sector weight is lower and equal to 0.039%, while the upturn of debt issuance has got a marginality close to zero. The unemployment rate is meaningful at the country level, with a beta converges to -2%. This result was not expected. However, it is probable that the reason for this is that a positive variation of the number of unemployed declines the return of bonds. No statistical correlation has been detected from the two entities running the experiments. The variable loses significance when financial crisis dummy is iterated with the other quantitative regressors of the model. Sovereign default correlates negatively with the holding of government debt which is significant at 5% and 10% when we control for time or ”two ways” effect respectively. This latter accounts for the unique Greek default in 2012. The picture is thus still incomplete. Gennaioli et al. (July 2014) paper is a useful approach to the sovereign risk as the author’s focus was to search how it impacts on the bank’s balance sheet, namely, the percentage of government bonds in their assets.
The aversion of nations to issue new debt after the interbank markets stopping amounts to -0.4% on average, whereas sovereign bondholding looks to benefit the public securities by 0.017% across the crisis period, the assistance is slighter when trading is carried out in normal conditions, set to 0.013%.
Results so far have been very encouraging, and further work needs to be done to establish whether the present findings can be extended to many other countries to confirm or refute the theory of financial crisis-banks public bondholding nexus spotted.

Appendix - Non Parametric Regression

Let's shed light on non-parametric techniques, in particular, additive models which have been exploited in a R package to reach resample estimates for missing information.
Let's start with the comprehensive (homoschedastic) regression:

$$Y_t = f(X_t) + a_t,\ a_t \sim IID(0,\sigma^2) \tag{1}$$

$f(\cdot)$ delineates function links response variable to regressors. When $f(X_t) = \beta_0 + \beta_1 X_t$, one refers to linear regression. If such a function is known and sets to $f(X_t) = f(X_t,\theta)$, there is a non linear parametric regression. If f is unknown, one uses smooth non-parametric non-linear regression whose shape is not specified. The term "smooth" stands for derivable. The choice to select one of these specifications depends initially from scatterplot of Y_t against X_t, along with range of X, the number of observations N, and σ.
Let's pay attention on non-parametric regression. The architecture of the model is equation (1) where the bridge between the dependent variable and regressors is not linear. A method to estimate it are smoothing splines. *Spline* is a polynomial in intervals function useful to approximate a specific function that one knows its value in certain knots. The problem of knots selection is bypass with smoothing splines method, this latter searches for $f(x)$ which minimizes the sum of squared of residuals with a penalization regarding irregularity that f shows:

$$D(f,\lambda) = \sum_{t=1}^{N}[Y_t - f(X_t)]^2 + \lambda \int (f''(x))^2 d_x \tag{2}$$

$f(x)$ must be derivable until the second grade with continuous derivatives. The former component of equation (2) measures proximity of the function respect to data, while the other one the degree of irregularity, λ can be thought as a smoothing parameter which penalizes f if irregular and it tends to raise when f growths. If $\lambda = 0$, there are no penalties for f irregularity, consequently one could employ any functions which interpolates data. On the opposite, penalty is extreme when $\lambda = \infty$, i.e. $f''(x) = 0$ and $f(x) = \alpha + \beta x$. For simplicity's sakes, I do not report the proof, even though one can demonstrate that a solution of (2) is a natural cubic spline whose knots are $X_t, t = 1,...,N$.

Therefore:

$$f(x) = \sum_{j=1}^{N} \beta_j N_j(x) \tag{3}$$

$N_j(x)$ bases of natural cubic splines. Minimum problem imposes by (2) is equivalent to minimize:

$$D(f,\lambda) = (Y - N\beta)^T(Y - N\beta) + \lambda\beta^T\Omega\beta \tag{4}$$

N the matrix whose j column collects $N_j(x_i)$, $i = 1,...,N$, $[\Omega]_{jk} = \int N_j''N_k''(x)d_x$. β which minimizes (4) has the following pattern:

$$\hat{\beta}^{SMOOTH} = (N^TN + \lambda\Omega)^{-1}N^TY$$

from which, one obtains:

$$\hat{f}^{SMOOTH}(x) = \sum_{j=1}^{N} \hat{\beta}_j^{SMOOTH} N_j(x)$$

Indicating $\hat{f}^{SMOOTH}(x) = (\hat{f}^{SMOOTH}(x_1),...,\hat{f}^{SMOOTH}(x_N))$, it follows that:

$$\hat{f}^{SMOOTH}(x) = N(N^TN + \lambda\Omega)^{-1}N^TY = S_\lambda Y$$

S_λ smoothing matrix and $\hat{f}^{SMOOTH}$ linear smoother of Y. Let $DF(\lambda) = tr(S_\lambda)$, where $tr(\cdot)$ denotes trace of a matrix, in other words, the sum of values placed in the principal diagonal. Hence:

$$\hat{\sigma}^2 = \frac{\sum_{j=1}^{N}(Y_j - \hat{f}^{SMOOTH}(X_j,\lambda))^2}{n - DF(\lambda)}$$

To compute the estimator of λ, one tries to minimize *Prediction expected error* (PSE_λ) defined as $PSE_\lambda = E[(Y_t^T - \hat{f}_\lambda(x))^2]$, $\hat{f}_\lambda(x)$ smoothing spline estimator of λ using Cross-validation (CV) or generalized cross-validation (GCV). CV consists of assessing the generalization of statistical results to an independent database (not known), being helpful to avoid overfitting problem since the aim is to define a dataset to valuate the model in the training phase. In the predictive environment, a model is given a database of known data on which training is conducted (training database), and a database of unknown data against which the model is tested (testing database). Given that we not know $f(x)$ and Y_t are available, one must think to minimize the mean squared error (MSE) respect to h. MSE is generally represented by the following formula:

$$MSE = E[(f(x) - \hat{f}(x))^2]$$

One must avoid overfitting, that is the model is adapted for some aspects inside the sample which in turn are not structural of the phenomenon analyzed, so that another sample will not

represent them. Therefore:

$$CV(h) = \sum_{j=1}^{N} (Y_j - \hat{f}_{\lambda}^{-j}(X_j))^2$$

$$GCV(h) = \frac{(1/n)\sum_{j=1}^{N} Y_j - \hat{f}_{\lambda}(X_j))^2}{\left(1 - \frac{DF(\lambda)}{n}\right)^2}$$

$\hat{f}_{\lambda}^{-j}(X_j)$ fitted for all observations less j-th data. Let's generalize the theory to mutual explicative variables. Let's suppose that the regression is composed by two regressors, say, X and Z. Thereby:

$$Y_t = f(X_t, Z_t) + a_t$$

One must estimate f in correspondence to point $p = (x,z)$. Problems occur, especially *course of dimensionality*, i.e. with increased p points scatter very fast. To compensate the leap of spacing, the numerousness sample should be n^p, which make computation of f onerous and quasi impossible. Efficacy statistical instruments are *Additive models* assuming that: $f(X_{1,t},...,X_{p,t}) = f_1(X_{1,t}) + ... + f_p(X_{p,t})$ where the functions are univariate and estimable with the methods we have seen so far. The deficit of the approach surrounds identification. To overcome that, one can rely on the subsequent form called *additive model*:

$$Y_t = \mu + \sum_{i=1}^{p} f_j X_{j,t} + a_t \tag{5}$$

in whom $\mu = E[Y_t]$, $E[f_j X_{j,t}] = 0 \, \forall j = 1,...,p$. This model is less restrictive than OLS regression where all partial functions must be linear and simultaneously more restraining than non-parametric regression. To compute estimators, backfitting algorithm permits estimation of every f_j. Let's suppose that such functions are well-defined with splines: $f_j(X) = \sum_i \beta_i S_i \equiv f_j(\beta_j, X)$ and $E[Y_t] = 0$. The target is to arrive at betas which make minimum the following expression:

$$\sum_{t=1}^{N} [Y_t - f_1(X_{1,t}, \beta_1) - ... - f_p(X_{p,t}, \beta_p)]^2 \tag{6}$$

The algorithm begins from primary values of $\beta_2,...,\beta_p$ and minimize (6) with regard to β_1. Once considers next $\hat{\beta}_1,...,\beta_3,...,\beta_p$ and makes minimum the aforementioned formula respect to β_2, then $\hat{\beta}_1, \hat{\beta}_2,...,\beta_4,...,\beta_p$ is taken into account to compute $\hat{\beta}_3$ up to achieve all estimator of betas. One $(\hat{\beta}_1, \hat{\beta}_2,...,\hat{\beta}_p)^T$ vector is available, the procedure initiates again to calculate β_1 until a stability criteria is reached for functions f_j.

Figure 3.5 uses *Local Regression* (LOESS), or *Nearest Neighbors*, a variant pf the *Local Polynomial Regression* which will be described hereafter, to fit the data. The corresponding

lines are therefore drawn by this type of non-linear regression. The original model is (1) again, where $f(x)$ is a smooth function. Let the function be derivable in the point x_0 as many times as necessary. Using Taylor expansion, $f(x)$ can be approximated around x_0 by the polynomial:

$$f(x) = f(x_0) + f^{'}(x_0) + \frac{f^{''}(x_0)}{2!} + ... + \frac{f^{p}(x_0)}{p!} + rest$$

Then:

$$f(x) \approx \sum_{j=0}^{p} \beta_j (x - x_0)^j$$

in whom

$$\begin{aligned} \beta_0 &= f(x_0) \\ \beta_1 &= f^{'}(x_0) \\ &\vdots \\ \beta_p &= f^{p}(x_0) \end{aligned}$$

The local polynomial is estimated by *Weight Least squares* (WLS) method as:

$$\min_{\beta} \sum_{i=1}^{n} \left(Y_t - \sum_{j=0}^{p} \beta_j (x - x_0)^j \right)^2 K_h(X_t - x_0)$$

h stand for the bandwidth. The estimator will be obtained by the following expression:

$$\hat{\beta}(x) = (X^T W X)^{-1} X^T W Y \tag{7}$$

where $W = diag(K_h(X_t - x_0))$. Local estimator of $f(x_0)$ will be equal to:

$$\hat{f}(x_0) = \hat{\beta}_0(x_0)$$

The complete function is computed by varying x.
To implement (7) p,h, and K must be selected. p is usually low for both theoretical and practical reasons. Fan and Gujbels (1996) suggest to estimate $f^p(x)$ with a polynomial of a grade equals to $p + 1$. For instance, if the goal is to calculate $f^{'}(x)$, $p = 2$. K coincides usually with Epanichnikov kernel: $K(u) = \frac{3}{4}(1 - u^2)$, $|u| < 1$. The choice of h is critical because:

$$\begin{aligned} h \to 0 \qquad & \hat{f}(X_t) \to Y_t \\ h \to \infty \qquad & \hat{f}(X_t) \to parametric\ estimate\ with\ a\ polynomial\ of\ grade\ p \end{aligned}$$

When h goes to zero, there is overfitting problem

Concerning CV:

$$CV(h) = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{f}_{h,-i}(X_i))^2$$

$\hat{f}_{h,-i}(X_i)$ is the local polynomial estimator of $f(\cdot)$ without the $i-th$ observation (Y_i, X_i). The non-parametric local regression seen so far uses a constant h. LOESS considers a floating h which varies along the X axis, in particular, it depends on the degree of dispersion of data. The method expresses the smoothing parameter as a fraction of observations, with which is possible to estimate the ordinate exploiting a fraction s of data only, called span. Higher s, less local the regression is.
Parameters are estimated through equation (7) using the portion s of the data. Let $X_1, \ldots, X_n$ be observations, x the point whereby the regression will be computed, and $r = [s_n]$. The bandwidth h_x is defined as the twice of the r-th ordinary statistics of $|X_t - x|, \forall\, t = 1, \ldots, n$. It is worth noting that h is affected by x now. LOESS applies the tricube function to the observations around x which makes this method robust against outliers.

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