The Evolution of Shadow Banking:
The case of US Investment Funds

Master of Science in Banking & Finance

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Preface:

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In line with the indications of International Hellenic University, I declare that the particular dissertation is original, apart from citations and references linked to prior research. The following research has been conducted under the supervision of Professor Kyriaki Kosmidou, between August 2016 and December 2016.

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Abstract:

Shadow banking is commonly characterized as the answer of the modern financial industry to regulatory arbitrage. The main objective of the paper is to underline the magnitude of fragility that lies beneath the sector by analyzing both theoretically and empirically its evolution. The study highlights its complex structure, basic components and numerous implications accompanied with its function. Precisely, the size and role of investment funds sector is examined since its' growth possess several vulnerabilities. Based on an existing methodology and using data from the United States, regarding the period 2002-2015, the study identifies a statistically significant relationship between specific sectors of investment funds and money demand. The main empirical findings provide robust evidence that investors run towards various sectors of investment funds and still constitute to the rise of shadow banking.

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1. Introduction

The intense impact that the financial crisis had on economies worldwide, is commonly linked with universally interconnected and advanced financial markets. Until recently, traditional banks have been subject to criticism and stricter regulations imposed by authorities. Banks were accused of incurring too much risk through leverage and by participating in riskier activities. Even though banks are expected to better manage market fluctuations and potential losses in the future, still there are parts of the financial system which are exposed to the same degree of risk as before the crisis, and therefore create instability in the financial sector.

Banks as a response to constant pressures caused by higher capital requirements, are expected to become more integrated and larger in scope, probably leading to greater systemic risk. Excessive risk actions could threaten the stability of the financial sector, if appropriate actions are not taken to properly monitor and regulate the core of financial institutions. Furthermore, stricter regulations could also encourage banks to move their activities out of the regulated banking sector, thus creating a regulatory arbitrage. Bank activities that were previously conducted by regulated banks, could partially move to the unregulated shadow banking sector. In line with Subramanian (2013), shadow banking has become the focal point for the financial system at the grass root level[1]. In general, shadow banks are less regulated than traditional banks and, until recently, experienced much less attention from the public.

Without any doubt, those institutions carry out an important role in the credit intermediation process by providing liquidity and transferring risk between market participants. Whereas, the growing activity in this non-regulated sector has exposed the entire financial system to a higher degree of systemic risk. Consequently, the enhanced fragility in the financial sector is caused by close interconnection and dependence among shadow banks at a first stage, and secondly between traditional and shadow banks. The growing importance of further examining the negative effects of shadow banking, has been made apparent over the recent years. Therefore, it is crucial to understand, the different parts of shadow intermediation process as well as the different components that engage in the sector.

Furthermore, the recent market failures justify the need for regulation and supervision of the particular sector. Given that, current changes in accounting and capital requirements are expected to reduce incentives by banks to engage in types of arbitrage activities, this will

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[1] According to Subranian (2013), recognized examples of shadow banking institutions include Bear Stearns and Lehman Brothers.

provide strong incentives for credit intermediation to be funded outside from the traditional banking system. In particular, negative externalities can result in terms of neglected risk by investors permitting the buildup of systemic risk. For instance, during the pre-crisis period several banks moved their riskier activities in vehicles that were not consolidated with them, but eventually those institutions were forced to carry these risks across their balance sheets.

According to prior estimations, the shadow banking sector amounted around $60 trillion in 2014, which signifies the necessity for deeper investigation, in terms of the potential consequences on the real economy. Above all, the public sector has repeatedly played the role of the lender-of-last-resort, in order to shield the real economic activity. Directing to achieve a stable growth of the economy, we need to focus on the systemic evolution of shadow banking system by addressing the risk associated with it. Besides, shadow banking may be well positioned in lending and financing more assets in the future, which could possibly lead to even greater expansion, due to regulatory arbitrage[2] In that context, my analysis aims to empirically identify if shadow banking continues to grow rapidly after the recent financial crisis and to contribute as an early warning in order to avoid a possible collapse of the sector.

Motivated by the above reasoning, my research intends to support the ongoing assessment concerning the need for increased regulation of the sector. Moreover, this study identifies gaps and areas, which can improve future work on shadow banking. Initially, the first part of the research includes a theoretical outline, by identifying how has its structure evolved and highlight the associate implications in the financial system. Secondly, due to the existence of regulatory arbitrage, the main section of my investigation, is directed towards the empirical examination of identifying a relationship between the development of shadow banking and money demand in US. Therefore, utilizing quarterly data from 2002 until 2015 the aim of the study is to identify if the investment fund sector plays a significant role in driving the growth of shadow banking.

The following approach is merely based on a paper by Sunderam (2014), which thoroughly analyzed the relationship between ABCPs[3] and money demand using data prior to the crisis. Another study that motivated my examination, was conducted by Doyle et al. (2016), and

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[2] The new Basel III guidelines will have the effect of doubling the amount of core equity that a typical big bank holds as a proportion of its assets. Meaning that, shadow banking sector may try to finance assets that the banks either cannot fund or will not fund because of the new guidelines.

[3] According to Luttrel et al (2012), ABCP: Asset Backed Commercial Papers could be defined as a short-term debt instrument financed by a specified pool of assets which is issued by corporations and financial institutions to cover short-term financing needs.

explores the risks and vulnerabilities in the investment fund sector, which according to the authors poses potential threats and should be closely monitored. In terms of the hypothesis under examination, a regression analysis is implemented in order to examine if there is a significant connection between the development of investment funds and money creation. The specific hypothesis is based on Sunderam's (2014) model which states that, investors treat shadow banking activities and Treasury bills as substitutes. Hence, when demand for Treasury bills is high, as reflected by low Treasury bill yields, the demand for shadow banking intermediary services is increased as well. The hypothesis that my analysis empirically seeks to identify is that, investment funds growth is positively related to money demand. Regarding the main findings of the empirical study, my analysis indicates the existence of a statistically significant positive relationship between selected investment funds and money demand.

The rest of the paper is organized as follows: The following chapter presents the theoretical literature on the topic under examination. Chapter 3 provides a detailed analysis regarding the broad concept of shadow banking by analyzing its definition, size, structure and components. Next, chapter 4 investigates the benefits and implications of investment funds, while chapter 5 introduces the hypothesis under examination and the empirical analysis. Chapter 6 presents a discussion regarding the role of supervisors. Finally, chapter 7 presents the main limitations aside with directions for future research and the main conclusions.

2. Literature Review

As a starting point, my analysis explores previous findings of several academics and researchers based on the broad topic under examination. It is crucial to initially comprehend the concept under investigation, which would definitely allow for a better appraisal of the empirical findings. Primarily, one of the first approaches towards the examination of the shadow banking was conducted by Gorton and Metrick (2010). The authors, discussed reasons for enhanced regulation and monitor of the whole financial sector. Next, an assessment on regulatory reforms relating to shadow banking and macroprudential policy is provided by Hanson et al. (2011). Besides, Adrian and Ashcraft (2012), review the fundamental reasons underlying the existence of shadow banking, by mapping this unknown environment and explaining its activities. Pozsar et al. (2012), identified the institutional features of shadow banking and compared those characteristics with the traditional banking system. Next, a study by Rixen (2013), investigated why regulation nowadays is relatively weak and reviewed the impact of recent regulatory measures on the sector.

Furthermore, various researchers have already set a theoretical base on the subject of shadow banking, that future researchers could deliver progress and development. For instance, Samuel et.al (2011), reviewed the fire-sale and credit-crunch effects that are associated with shadow banking system. Claessens et al. (2012) discussed appropriate set of regulations that could probably lead to the shrinking of the system and in parallel maintain its useful economic functions. Recent studies by Grochulskiy and Zhangz (2015), investigated the impact of shadow banking on optimal liquidity regulation, while Plantin (2015) identified that stricter regulations, lead to the creation of regulatory arbitrage which eventually increases systemic risk. With the intention to recommend better supervision strategies, other investigations include numerous papers conducted by pivotal institutions like the Financial Stability Board (FSB) and the International Monetary Fund (IMF)[4].

Considering the various geographical areas, a variety of papers focused primarily on the US financial system prior to the crisis, where researchers analyzed the structure and entities of the shadow banking system. With respect to Europe, an assessment of the shadow banking sector is provided by Bouveret (2011), while the functioning of special purpose vehicles in European

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[4] Financial Stability Board: Shadow Banking: Scoping the Issues (2011),
  Financial Stability: Board Strengthening Oversight and regulation of Shadow Banking (2013),
  Financial Stability Board: Global Shadow Banking Monitoring Report (2015),
  International Monetary Fund: Shadow Banking Economics and Policy (2012).

banking systems is carefully described by Thiemann (2012). Moreover, given that China is unquestionably the new key actor in the banking area, studies conducted by Cieślik (2014) and Liang (2016) examined the developments and implications of Chinas' shadow banking sector towards financial stability.

Finally, regarding the subject of modeling and econometrically analyzing the impact of shadow banking, a little examination has been conducted to date, since the majority of literature review appraise the concept from its theoretical perspective. However, significant effort to empirically explore the subject of shadow banking are the following studies. Calmes and Theoret (2010), utilized Canadian data considering the period 1988-2010 and identified a positive impact that off-balance-sheet activities have on banks returns. Next, Gennaioli et.al (2013), presented a model which identified that shadow banking system is broadly exposed to crises and periods of illiquidity in the market. Additionally, Chernenko and Sunderam, (2014) empirically examined the lending behavior of mutual funds that helped to the transmission of distress across borrowers during the crisis. Gertler et.al (2015), investigated the growth and breakdown of wholesale banking, and revealed the transmission mechanisms of the crisis to the real sector. Eventually, Kessler and Wilhelm (2013), analyzed the topic of data scarcity in terms of shadow banking activities, which is considered to be a major drawback of the aforementioned investigations, and definitely a clear explanation for the lack of adequate number of empirical investigations on the subject under scrutiny.

3. Shadow Banking

In this initial part of my analysis, the concept of shadow banking is carefully divided into various sections, in order to provide a complete theoretical background that could eventually introduce the empirical section. Hence, the following discussion includes the examination of concepts like the definition of shadow banking and the complicated components that contribute to its functioning. Next, its structure, size and implications are examined which are accompanied by a closing section on the topic of regulatory arbitrage.

3.1. Definition

The necessity for better understanding the functions and threats that lurk in the shadow banking system, directed the G20 Summit by the end of 2010 to assign on the FSB the oversight and report of the system. Until now, the FSB has repeatedly published several reports on the topic using quantitative and qualitative information. Taking into consideration the confusion around a concrete classification, a relatively general definition is the following:

"*The system of credit intermediation that involves entities and activities outside the regular banking system*".

Financial Stability Board (2011)

Furthermore, according to literature review, the term was initially introduced by Paul McCulley[5] in 2007 at FED's annual symposium. Thus, it is relatively an emerging term that is not yet identified, since most of the activities are still unknown. Even though the term is widely used in the media and in policy discussions, there is no clear commonly agreed definition. Hence, from the perspective of Federal Reserve Bank the term could be broadly described as:

"Market-based credit intermediation containing entities and transactions outside the traditional banking system, which provide credit through long-term illiquid activities with short-term borrowing from liquid funds".

Luttrel et al. (2012),

In general, shadow banks rely on short-term market funding and are subject to less- regulation than the traditional banking system. Notable, examples that engage in the credit intermediation process, include:

- Investment Banks,

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[5] Paul Allen McCulley is an American economist and former managing director at PIMCO.

- Finance Companies,
- Special Purpose Vehicles,
- Hedge Funds,
- Money Market Mutual Funds,
- Real estate investment trusts,
- Commercial Paper Issuers and
- Insurance Companies.

The aforementioned components of the system are explicitly being analyzed in following section of the paper. However, the exact meaning of other puzzling concepts mentioned in the definition, like credit intermediation, securitization and wholesale funding should be defined as well at this initial stage of the study. By credit intermediation process, we describe the role of the middleman between counterparties in a financial transaction. The fundamental credit intermediation chain is depicted in Figure 1 below, in which funds are transmitted through the different steps of the chain[6].

Figure 1: Credit Intermediation Chain
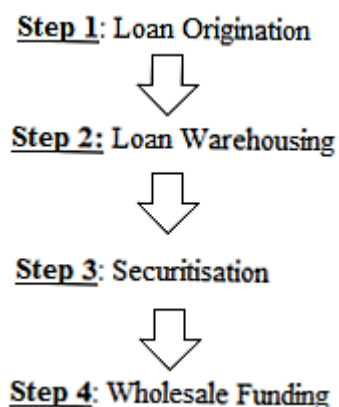
Subsequently, in line with FSB by securitization we define the process of pooling various types of debt and packaging that debt into securities that are eventually sold to investors. Finally, the last step of the chain includes the wholesale funding which refers to huge, short-term borrowings from sources other than demand deposits that are used by financial intermediaries to finance their operations.

3.2. Magnitude

An important feature that motivated my research is definitely the size of the shadow banking system. Various researchers provide different estimations regarding the real size. As a starting point, it is commonly accepted that the evolution of shadow banking outside the regulated sector has expanded over the past years. Specifically, the system developed sharply before the

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[6] Usually when a financial services company accepts deposits and lends to borrowers.

crisis, rising from $26 trillion in 2002 to $62 trillion in 2007. Subsequently, the size of the system deteriorated marginally in 2008, but amplified afterwards to reach $66 trillion in 2011 and $71 trillion in 2012. Nowadays, the debate under examination is between two broad approaches.

The first part of the discussion claims that, it has reached its' peak in 2008 just before the collapse of the ABCPs market, and afterwards it faces a constant decline or remains stable. In that context, a relatively conservative estimation is provided by the FSB which argues that the shadow banking system has decreased since the onset of the crisis and has remained at around 25% of its' previous magnitude. Generally speaking, its' aggregate size according to the FSB is around half the size of the traditional banking system. On the other side, plethora of researches argue that even though its size dropped dramatically after the financial crisis, it continues to grow rapidly and today is significantly bigger than prior to 2008.

Figure 2 below illustrates, that the greatest proportion of the system at the end of 2014 is attributed in the United States (40%). In terms of the European area an aggregate measurement including core countries like Germany, France, United Kingdom, Ireland and Netherlands amount for the 32% of the global shadow banking system. During the four-year period that Figure 2 depicts, we observe that the distribution among various countries has remained relatively constant. By the year 2008, the size of US shadow banking equaled the size of the US traditional banking system and continued to grow further. In China, the permanent inflation has brought shadow banking to face a sharp increase, from 2% in 2010 to 8% in 2014. In line with a study made by the People's Bank of China in 2010, the shadow lending expanded $10 trillion, which counts for the 45% of the total lending activities of the Chinese economy.

Figure 2: Allocation of Shadow Banking Among Countries

Note: CA = Canada; CN = China; DE = Germany; EMEs ex CN = Argentina, Brazil, Chile, India, Indonesia, Mexico, Russia, Turkey, Saudi Arabia, South Africa; FR = France; IE = Ireland; JP = Japan; KR = Korea; NL = Netherland; UK = United Kingdom; US = United States.
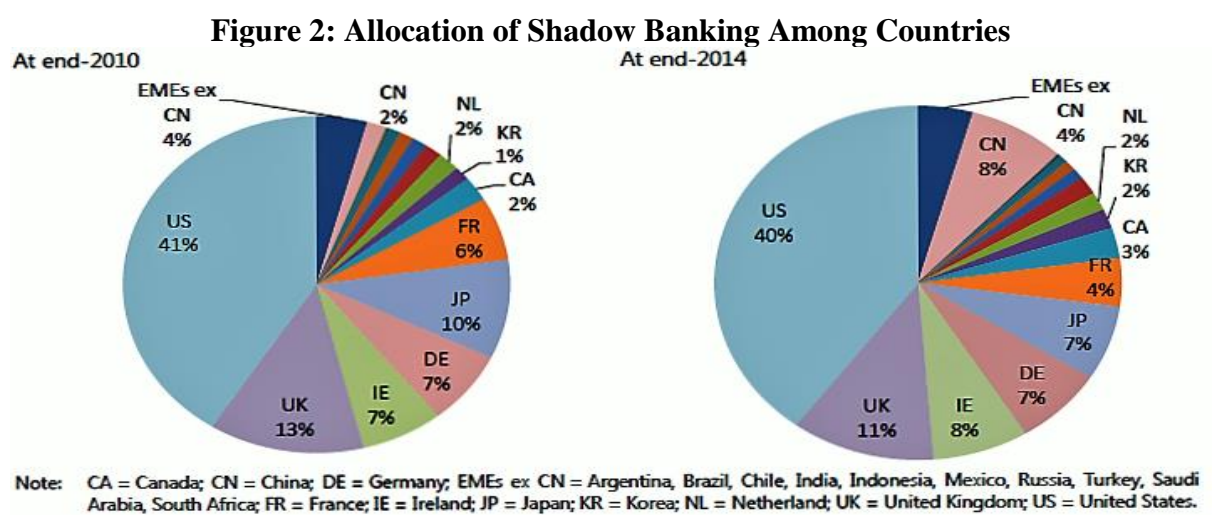
Source: FSB, "Global Shadow Banking Monitoring Report (2015)"

Moreover, an influential study by Fiaschi et al. (2014) argues that the shadow banking system is bigger than the aforementioned estimations of FSB. According to the authors, monitoring and regulation based on a detailed classification of financial activities is unlikely to keep pace with the rate of innovations in the financial industry. Hence, alternative estimations based on different approaches came to question previous findings. Their estimations regarding the real magnitude of shadow banking reveal a sharp rise in shadow banking activity after 2010. The authors, in contrast to FSB findings, claim that shadow banking activity is approximately $100 trillion and not around $71 trillion as FSB states. The particular difference is straightforward at Figure 3 below.

Figure 3: Size of Shadow Banking System
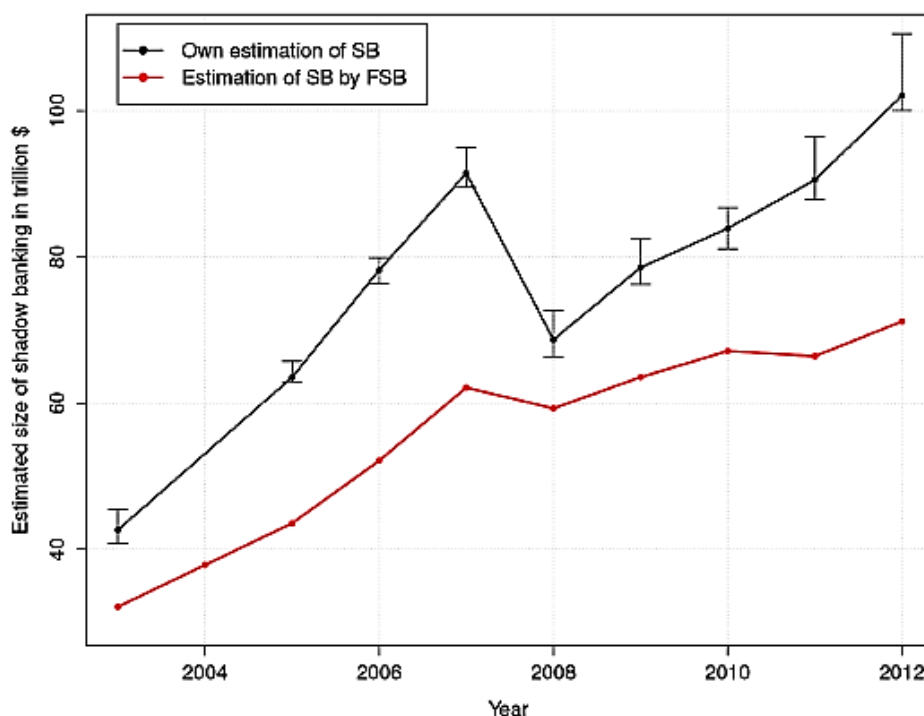
Source: Fiaschi et al. (2014)

According to the authors, the rise was mainly driven by the concept of regulatory arbitrage, which reflects the answer of modern financial industry to regulation. Thus, during the period following the global financial crisis, the shadow banking system continued to grow, although at a slower pace. In overall, it might not be mistaken to assume that following the huge regulation attempts, the system grew even bigger. The main difference between the two estimations is attributed to the fact that, the FSB includes in measurement, components which are known to have played a major role in the crisis and their decline after 2010 reflects a decrease of shadow banking size. The authors argue that FSB approach omits shadow banking

activities which definitely contribute to systemic risk awareness. In conclusion, a central idea of my analysis is that components, other than those contributing to the "Great Recession"[7], are still related to the constant growth of shadow banking, and that regulators should swift their attention towards those concealed threats. Precisely, the size and role of the recent expansion on the investment fund sector is examined since its' growth possess potential vulnerabilities.

3.3. Structure

The shadow banking system had escaped regulation primarily because it did not accept traditional bank deposits from public. To state it differently, it comprises a complex network of transactions which transformed the credit intermediation process in the majority of the developed countries. For instance, in United States shadow banking normally contains bank subsidiaries or associates which have a close linkage with the traditional banking system. Hence, shadow banking activities managed to escape regulatory guidelines and supervision. In that way, according to Kessler and Wilhelm (2013), the various components of the system are able to involve in higher credit, market and liquidity risk. The particular swift in modern financial industry occurred in 1999 by the limitation of financial markets supervision and the repeal of Glass-Steagall Act[8]. These adjustments introduced a period known as the deregulation of the banking sector, which made the structure of shadow banking extremely complex and finally led to the burst of the financial crisis in 2008. The particular section of my research refers to this puzzling structure and aims to highlight the most important features of it.

3.3.1. Credit Intermediation

Likewise, with the traditional banking system, the shadow banking system conducts credit intermediation. Yet, unlike the traditional banking system, credit intermediation is completed through a chain of non-bank financial intermediaries in a multi-step procedure. As already mentioned in Figure 1, the shadow banking system decomposes the simple process of deposit-funded lending into a more complex procedure. The new process could be described as a wholesale funded, securitization-based lending (Pozsar et al. 2012). In that way, shadow banking transforms risky, long-term loans (such a subprime mortgages) into seemingly credit-risk free, short-term instruments that are issued by various components of the system (like Money Market Mutual Funds that are examined in the empirical part).

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[7] For a detailed analysis on the topic see: Verick & Islam (2010), The Great Recession of 2008-2009: Causes, Consequences and Policy Responses.
[8] Glass-Steagall Act in 1933 was the answer of regulators towards the Great Depression and prohibited the combination of deposit and lending activities with investments.

Credit intermediation contains three separated transformations which are depicted in Figure 4 below. First, credit transformation which is the enrichment of the credit quality of debt issued by the intermediary. For instance, a hypothetical bank may carry out credit transformation by lending to AA borrowers while issuing AAA liabilities. Secondly, maturity transformation refers to the use of short-term deposits to fund long-term loans. And finally, liquidity transformation refers to the use of liquid instruments to fund illiquid assets. (Adrian & Ashcraf, 2012)

Figure 4: Credit Intermediation Components
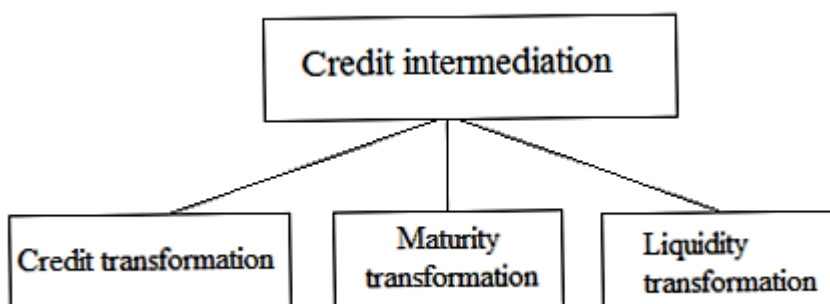
Subsequently, in line with classical textbook depiction, Figure 5 below illustrates the process of the traditional on-balance-sheet intermediation. In this simplified figure, we can observe the role of banks as an intermediate in order to direct funds from depositors towards borrowers through deposits and loan creation.

Figure 5: Traditional Credit Intermediation Process
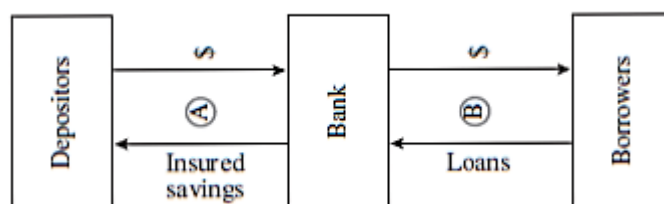
Source: Gordon & Metrick (2010)

In contrast to the traditional banking system, where the entire procedure of credit intermediation occurs via a sole institution, shadow credit intermediation is implemented through a chain of several nonbank financial intermediaries in a multistep procedure. According to Gordon & Metrick (2010), the complexity of this process could be summarized in the five steps illustrated in Figure 6 below. The specific figure portrays the transactions between banks, borrowers, institutional investors, retail investors and special purpose vehicles.

Figure 6: Shadow Credit Intermediation
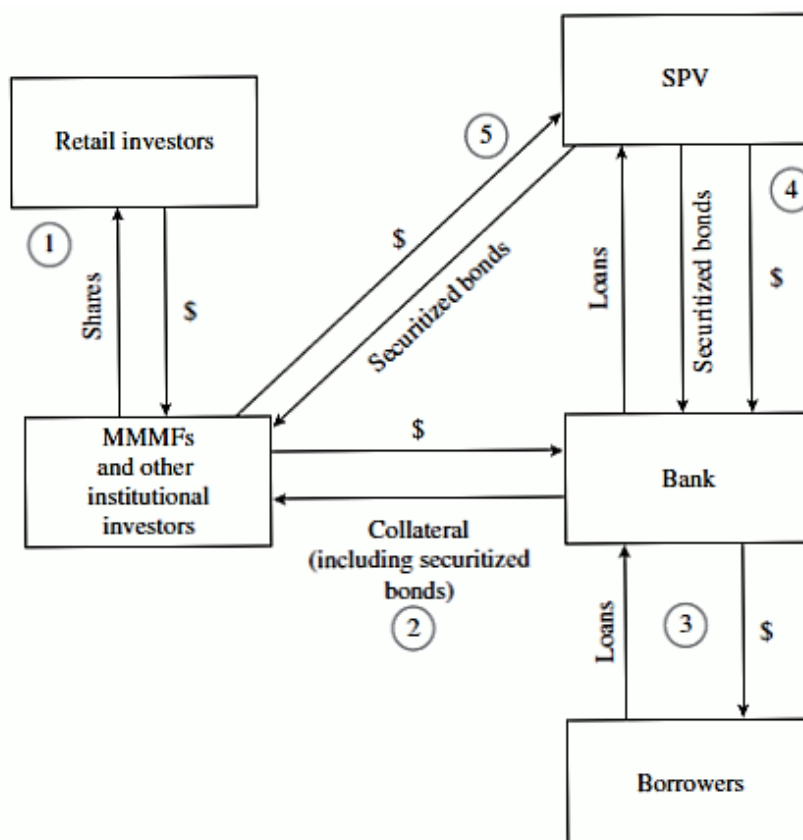
Source: Gordon & Metrick (2010)

Precisely, Step 3 in Figure 6 corresponds to step A in Figure 5, but with one significant alteration. Aiming to achieve safeguard similar to the case of deposit insurance, institutional investors accepts collaterals from banks. Actually, this transaction takes the form of a repurchase agreement. Specifically, the institutional investor deposits $X and receives some asset from the bank as collateral. Next, the bank agrees to repurchase the same asset at some future time, which commonly is the following day for $Y[9].

Normally, the total amount of deposit will be lower than the value of the asset used as collateral, and the specific difference is called a "haircut." Gorton and Metrick (2010) provide an example of the particular term: If an asset has a market value of $100 and a bank sells it for $80 with an agreement to repurchase it for $88, the repo rate is 10 percent (= [88 − 80]/80) and the haircut is 20 percent ([100 − 80]/100). Besides, if the bank defaults on its agreement to repurchase the asset, the investor keeps the collateral.

The shadow banking intermediation chain is depicted in Figure 7 below, by directing loans after origination towards the wholesale funding. The initial loan moves through the shadow

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[9] The percentage (Y − X)/X is called the repo rate and is analogous to the interest rate on a bank deposit.

banking chain and appears as wholesale funding provided by intermediaries and investors. The interesting step that transfers this funding outside form banks' balance sheets is captured in step 4 at Figure 6, where loans are pooled and securitized. The central source of funding that supports the credit intermediation process is based on securitization which is another important feature of shadow banking structure.

Figure 7: Shadow Chain of Credit Intermediation
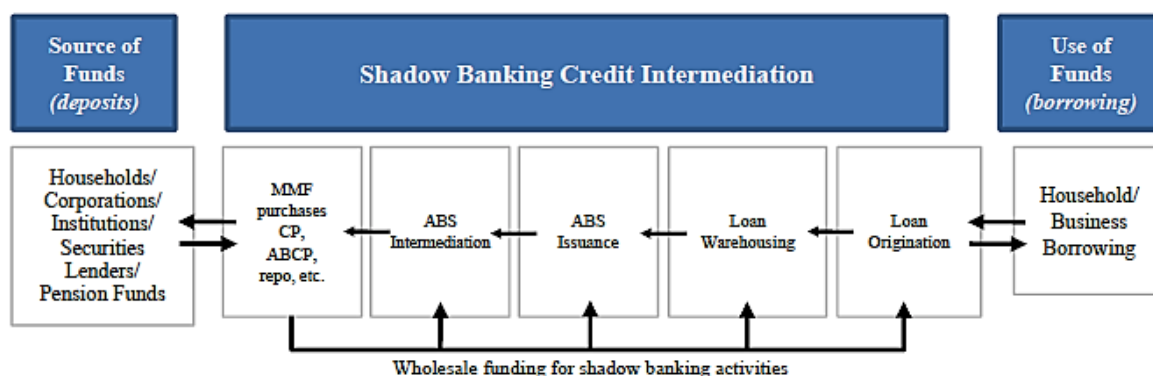
Source: Luttrel et al. (2012)

3.3.2. Securitization

Prior to the recent financial crisis, securitization has played an important role in the formation of shadow banking system. Most of the times, banks involved in securitization are definitely riskier, which is motivated by the higher profits. In that context, securitization permits credit originators to sell pools of credit to other institutions, thus transferring credit risk and increasing the liquidity available in the market. The particular process is a part of financial engineering, which involves pooling various debt obligations into a single security, and selling pieces of the consolidated debt as securities to different investors. According to Luttrell et al. (2012), each security is linked with the risk exposure of the entire group rather than any sole obligation, and in that way the corresponding asset value is securitized by its collateral.

Therefore, the main benefit of securitization is diversification, since a single loan default has a small impact on the whole security. In that way, diversification is accomplished by the separation of the security into several pieces called trances. Next, trances are classified hierarchically, with the bottom floor trances yielding higher gains and bearing higher risk. In contrast, top floor trances are accompanied by lower risk and lower yield. The particular securitization process in the case of Mortgage Backed Securities[10] (MBS) are depicted in Figure 8.

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[10] MBS: Tradable securities that represent claims on the cash flows from underlying mortgage loans.

Figure 8: Securitization
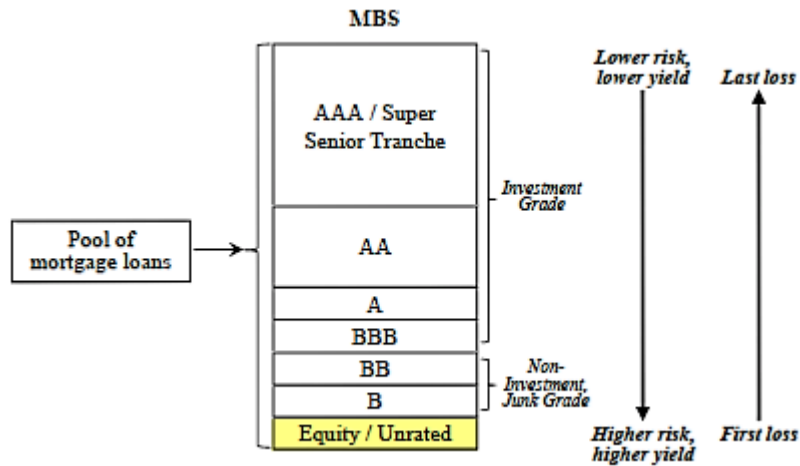
Source: Luttrel et al. (2012)

The above mentioned procedure can be combined to generate a structured credit product. For instance, the well-known CDOs[11] are secured by loans, bonds or ABSs. Figure 9, illustrates the combination of MBS that generate the final product known as a Collateralized Mortgage Obligation (CMO).

Figure 9: Combined Securitization
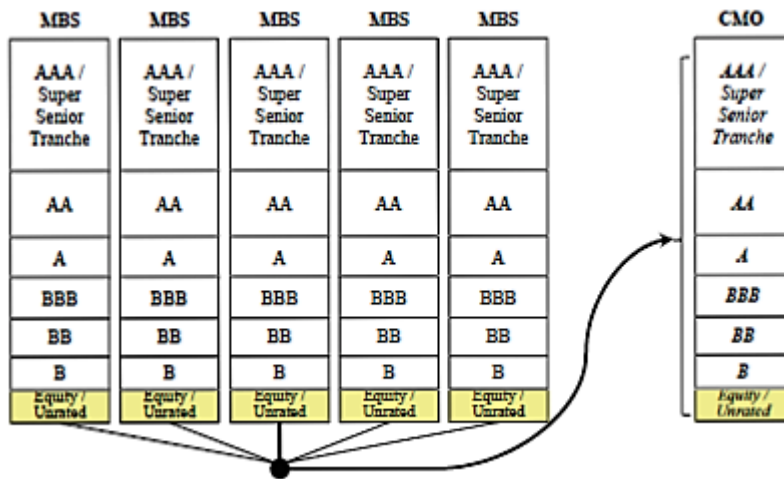
Source: Luttrel et al. (2012)

In general, securitization supports the issuance of new structured credit products that are funded in short-term debt markets. The key idea underlying the specific procedure is that

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[11] Collateralized debt obligation (CDO): A financial instrument that entitles the purchaser to cash flows from a portfolio of fixed income assets, which normally include bonds, loans, mortgage-backed securities, or other CDOs. (Luttrell et al. (2013)

throughout this process, shadow banking participants manage to convert assets of diverse credit quality into new investment-grade securities. In summary, the route of steps described for the case of MBS and CMO above, accounts for any collateralized claims on pools of loans, mortgages, or receivables. Hence, the new security can be pooled, divided into tranches, rated, and finally achieve the ultimate goal which is diversification of credit risk.

3.4. Components

The particular section of my research includes the most important components of shadow banking system. It contains features that have already played a crucial role in the recent financial crisis. Notable examples are the Asset Backed Commercial Papers, Repurchase agreements, Money Market Mutual Funds and Special Purpose Vernicles.

3.4.1. Asset-Backed Commercial Papers (ABCPs):

Asset-backed commercial papers are short-term liabilities aiming to finance long term assets. These are usually issued by special purpose vehicles (SPVs), which are controlled by large commercial banks. Due to their construction, ABCPs have become one of the main parts of shadow banking, since they provide liquidity and cost less than regular bank funding. According to Claessens et al. (2012), during the crisis, the greatest amount of leverage growth in wholesale banking was attributed mainly on ABCPs short-term borrowing. The reason behind that significant increase was that maturity transformation could be achieved efficiently. However, that was exactly the same reason for making the shadow banking system extremely fragile.

Figure 10: ABCPs Total Financial Assets
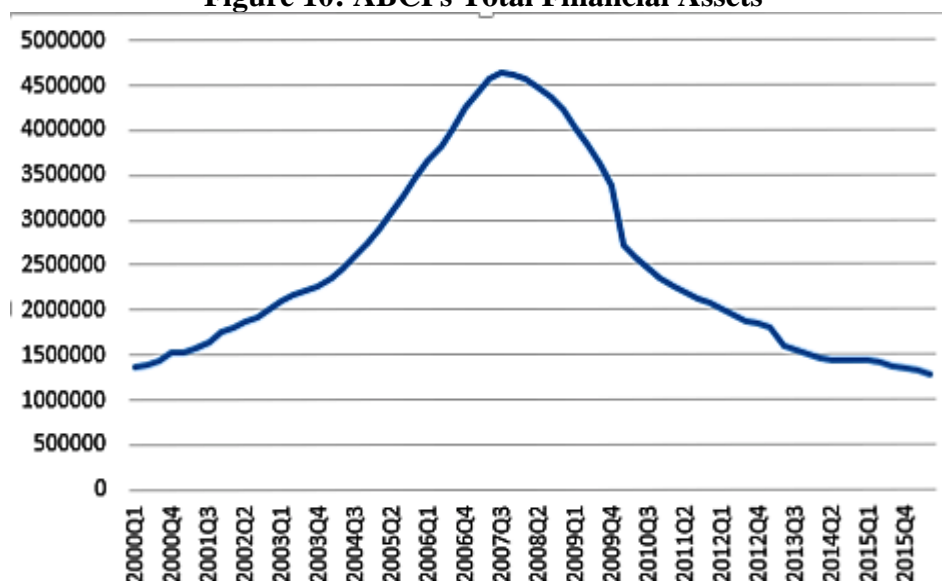
Source: Z1 Flow of Funds

In Figure 10 above, we observe the astonishing growth of the particular market until its peak of \$4.6 trillion in July 2007, accompanied by a sharp decline to \$2.5 trillion the following years. This sudden reduction continued until its current level, which is approximately \$1.5 trillion.

3.4.2. Repurchase Agreements (Repos):

Short-term repurchase agreement refers actually to sale of securities accompanied by an agreement that the seller will buy back the securities at the end of the agreement period. The repo contract permits both sides to individually impose the end of the agreement, in case of a bankruptcy filing by any party. For instance, a depositor, could end its repo if a bank faces insolvency problems by selling the collateral. Besides, tri-party repo is a repo agreement with a protector bank acting as an intermediary between the two parties of the repo. The tri-party construction guarantees that mutually the borrower and the lender are secured against the default of the other, since the collateral remains at the third party ownership.

One crucial factor which explains the increased use of repos, is the fast development of pension funds and mutual funds. These entities hold cash mainly for earning interest safely, and in parallel maintain the choice to use their cash any time. During the past decades, the particular entities have increased in size and become a significant part of the financial environment. According to Gorton and Metrick (2010), between 2002 and 2007 the size of Repo markets globally, grew with an annual rate of 25%, and reached its peak in mid-2008[12]. Eventually, it is no surprising why the usage of repos is in the core of the financial system, since repos are usually met all over the financial transactions. For instance, repos could be used to hedge derivative positions, take short positions in securities market[13], and frequently act as a way to increase leverage by hedge funds.

3.4.3. Money Market Mutual Funds (MMMFs):

Money market funds mostly invest in low-risk investments and pay dividends in the form of short-term rates. Therefore, MMMFs are an alternative choice of investors to bank savings account. However, the major difference is that they are not federally insured like normal deposits. Those funds usually invest in state securities, commercial papers, certificates of deposit or other highly liquid securities. The concept underlying their existence is that, they

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[12] Approximately \$10 trillion in US market and \$11 trillion in Euro repo market.
[13] By using a repo, a market participant can sell a security that she does not own by borrowing it from another party in the repo market.

attempt to keep their net asset value (NAV) at a constant $1.00 per share. That unique characteristic permits MMMFS to be an alternative selection to demand deposits. At the begging of 1970s, investors altered their preferences from demand deposits towards MMMFs.

Figure 11: MMMFs Total Financial Assets
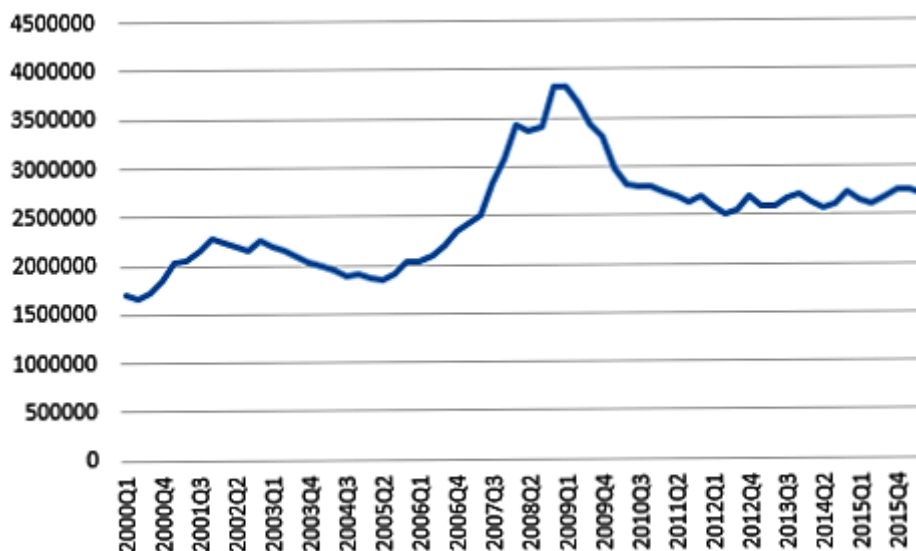
Source: Z1 Flow of Funds

In line with Figure 11 above, MMMFs faced a sharp increase after 2005, given that their assets grew from $1.8 trillion in the 2nd quarter of 2005, to reach their peak at $3.8 trillion in 2008. The exact size of MMMFs made them one of the most important financial sectors over the last decades. Chernenko and Sunderam (2014), examined the lending behavior of MMMFs that engaged to the transmission of distress across borrowers. Based on the authors, the regulation of the particular section requires them to invest solely in high-quality securities which bear low credit risk. However, this have possibly attributed to the creation of a mistaken sense of safety among investors. The idea underlying this is that, banks are obliged by the law to pay for deposit insurance, however "*the promise to pay $1 per share costs the MMMFs nothing*". During the crisis, FED was obliged to act as a lender-of last resort and backup the existence of MMMFs sector.   However, an important aspect that is constantly leading to regulatory arbitrage is that after the recent financial crisis MMMFs have implicit, cost-free government backing, leading them to a superior position over insured demand deposits. This is the exact reason for including MMMFs in the empirical analysis that follows in chapter 5.

3.4.4. Special Purpose Vehicles (SPVs):

Another significant component of shadow banking is the well-known special purpose vehicles. Typically, securitization works by selling huge portfolios of loans to SPVs, which are basically legal entities that issue rated securities linked to the loan portfolios. Figure 13 below, illustrates how SPVs contribute in the functioning of securitization.

Figure 12: Special Purpose Vehicles
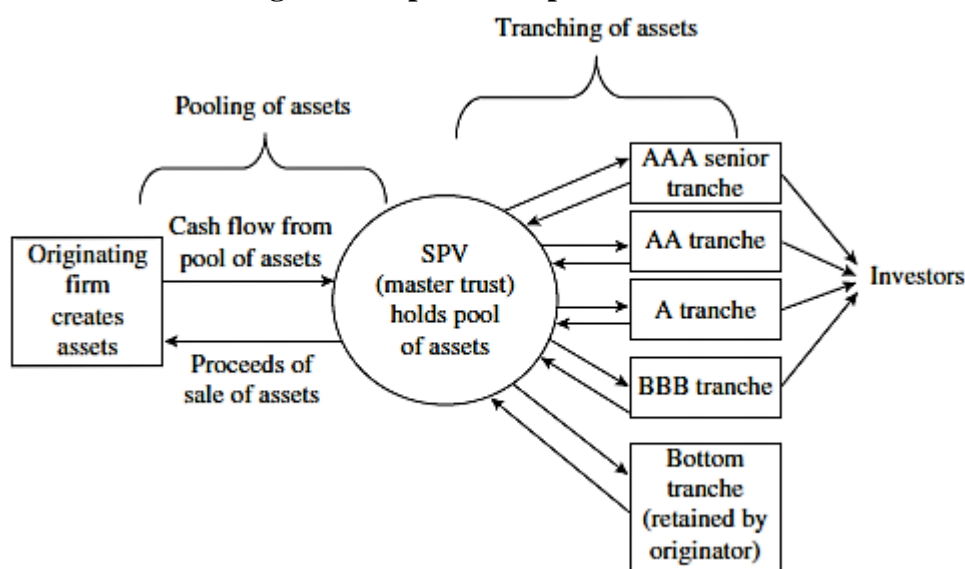
Source: Gorton and Metrick (2010)

At the left of Figure 12, an originating company borrows money to a number of borrowers. Next, couple of these loans pooled into a single portfolio, which are finally sold to a SPV. Next, the SPV funds this process by selling securities in the capital markets. As already mentioned, these securities are categorized into tranches, which are ranked by seniority and rated accordingly. Ultimately, with the contribution of SPVs, securities move away from the balance sheet of the company and achieve to be traded in the market through off-balance sheet transactions.

Actually, such a vehicle has a unique purpose for being created, which is the acquisition and financing of specific assets. Based on Thiemann (2012), the rules governing SPVs are set down in advance and carefully define their activities. The major feature of those SPVs is that they do not have employees and physical location. Other reasons justifying the growth of the particular component is related to bankruptcy issues. First, SPVs are not affected by the insolvency of the originating company and secondly SPV on its' own is created so that it can never become legally bankrupt. It is straightforward, that their complex existence could reduce bankruptcy cost, fact that eventually proved illusionary for market participants. Finally, during the crisis

banks were forced to bring these vehicles back on their balance sheets despite their bankruptcy-remote design (Luttrel et al. 2012). In summary, while SPVs were effective mechanisms of wholesale funding prior to the crisis, eventually they contributed in the transmission of the financial crisis in a remarkable way.

3.5. Benefits

Shadow banking is not only a dark and distrustful system that functions outside the regulatory environment. In fact, apart from the associated dangers, shadow banking activities set up an important role in the financial system and its benefits should not be underestimated. Most of the times, shadow banks have lower cost of funding compared to traditional banks. For instance, when shadow banks borrow in the commercial paper market, their cost of financing is usually lower. Additionally, those banks also tend to have higher financial leverage[14], since they exploit increasing profits in boom periods. Compared to traditional banking, the major benefit of shadow banking system is that it functions at a lower cost of transactions for the majority of its operations. Interestingly, FSB states that there are several advantages accompanied with the functioning of shadow banking system. Moreover, Sinha (2013), claims that shadow banking system, plays a crucial role in providing access to financial services, enhancing competition, liquidity and diversification among the sector.

In addition, Perotti (2012) argues that shadow banks by some means complete traditional banks while adding economic strength as they contribute in the resilience of the financial system to exogenous shocks. Even though that may sound quite contradictive, the author claims that during the crisis, shadow banking acted as a backup during the panic, given that a run on the system has been observed. In summary, apart from the unquestionable implications that are accompanied with the functioning of shadow banking system, the majority of academics and researchers agree that it constitutes as an alternative funding for the real economy, which is merely beneficial when traditional banking is under distress.

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[14] Level of borrowed funds compared to their own funds.

3.6. Implications

Aside from the positive features attributed to the shadow banking system, its' functioning could easily trigger hazards and eventually lead to systemic risk. This could deliver various implications, mainly due to its complexity, cross jurisdictional nature and interconnectedness with the banking system. First of all, significant source of risk is attributed to liquidity risk since, shadow banks could easily be exposed to their creditors, due to maturity mismatch. Secondly, shadow banks do not face regulatory limitations on borrowings, leading them to become extremely leveraged. Furthermore, this situation transmits instability from the financial system towards the real economy, making leverage risk another important implication of the system. Eventually, another drawback is the linkage of shadow banking with the traditional banking sector. Meaning that, under periods of uncertainty, when lack of confidence is spread across the financial system, contagion risk is threatening the function of the global economy.

Subsequently, the securitization process through the mid-2000s involved trillions of dollars of securitized products. For example, according to Szunke (2014) that has explicitly examined the role of shadow banking in the creation of instability prior to the crisis, 75% of total financial turnover on a global scale, was related to transactions involving derivatives. It is straightforward, what consequences a collapse of such a market could have on the real economy[15].Theoretically, the separation of risk occurring through securitization allocates risk to those who are willing to take it, resulting in more effecient risk pricing. Besides, securitization permits loan issuers to sell pools of debt to other investors, therefore relocating credit risk. In practice however, the process became unexpectedly complex since speculation altered the functioning of the system. Eventually, the period that financial engineering boomed, provided cheap but mispriced credit. The risk of this vulnerable growth was mainly undertaken by unsophisticated investors that were unaware of the above-mentioned risks, which proved catastrophic for the global economy.

3.6.1. Regulatory Arbitrage

A major implication that is explicitly discussed below, refers to the concept of regulatory arbitrage. Normally, banks are regulated and monitored to guarantee the stability of the financial system. Following the financial crisis, authorities and regulators have profoundly strengthened their supervision towards traditional banks. Consequently, aiming to escape the

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[15] Nowadays, the particular market is considered as an indicator to measure systemic risk in the banking sector.

high cost of regulation, credit intermediation has moved towards the shadow banking sector. Despite the fact that, shadow banks played an important role prior to the crisis, nowadays they are used as an alternative to traditional banking due to stricter regulations on the latter. Thus, the linkage between traditional and shadow banks, is an essential concern that must be considered by regulators. According to several analysts, regulatory arbitrage is one of the dominant factors supporting the role of shadow banking. European Central Bank considered regulatory arbitrage as one of the main risks accompanied with shadow banking system.

Moreover, a recent study by Harris et al. (2014) examined the efficiency of banks capital regulations when banks face competition from the shadow banking system. The authors argue that, the competition between traditional banks and shadow banks is expected to lessen the efficacy of capital regulations. Furthermore, the authors claim that, after an increase in banks capital requirements, banks are forced to switch from safe investments to risky ones in order to cover those regulatory requirements. The particular paper, highlights the relationship between regulation and the run towards shadow banking due to regulatory arbitrage.

Various regulations applied to banks are constantly avoided by moving components of the credit intermediation chain towards shadow banks. Hence, transferring of risks played an important role in the development of the crisis and according to several analysts, still plays a significant role in the financial stability. Based the theoretical analysis that was thoroughly presented in the first part, regulatory arbitrage is the main reason that motivated investors towards the functioning of investment funds, which is analyzed in detail in the next chapter.

4. Investment Funds

The particular section focuses on the motivation for including the broad category of investment funds in the empirical part of my study. As a starting point, the following analysis is mainly based upon two recent papers that deal with the broad concept of investment funds. Namely, the first study conducted by Doyle et al. (2016), highlights the link between investment funds and potential adverse impacts on the whole financial system. Next, Vershinina et al. (2016) discusses the major benefits and drawbacks of investment funds sector.

Under regular conditions, investment funds offer significant intermediation services to the real sector and at the same time contribute in boosting liquidity and diversification of market risk. On the other side, its quick growth encompasses several threats that stimulates the need for better monitor and supervision. Specifically, investment funds involvement in the capital market is constantly growing and has not been affected by the recent financial crisis. Thus, the risk of massive fire sales in the sector might be proven distrustful in the upcoming period. Investment funds mainly deal with concepts like synthetic leverage and liquidity transformation, which automatically makes them source of systemic risk. The broad concept of investment funds includes categories such as:

- Money Market Funds
- Bond Funds
- Equity Funds
- Exchange Traded Funds
- Multi Assets funds
- Direct Investment Funds
- Real Estate Funds
- Mortgage Funds
- Index Funds
- Loan Funds
- Commodity Funds
- Hedge Funds
- Long-Term Direct Investment Funds

According to Doyle et al. (2016), vulnerabilities within the investment fund sector are growing and it is crucial to examine their linkage with the real economy. In that context, my paper utilizes available data and aims to draw definite conclusions on the sector's contribution to systemic risk. The above mentioned threats, could easily spread towards the banking sector since their asset value growth is 40% bigger compared 2009. Besides, the increasing presence of investment funds on capital markets, makes them vulnerable to unexpected changes in asset prices. Meaning that, even a small, insignificant event could possibly trigger a huge sale of assets.

The authors argue that the foremost concern, is towards the demandable equity in open-end funds[16] that could certainly generate a fire sale. Increased risk-taking is apparent in the sector, since capital allocation has gradually moved from lower to medium and finally to high risk level of investments. In particular, during the period 2013-2015, investment funds alerted their asset allocation from lower towards higher yield level of debt securities, and at the same time the average maturity increased by nearly a year.

At the beginning of 2010, investment funds held approximately 10% of all debt securities outstanding. Nowadays, the particular proportion has reached 12%, meaning that a significant risk among the sector is potential liquidity shortages during turmoil periods. Therefore, a negative liquidity spiral could be sustained under such liquidity conditions, since initial asset price alterations would upsurge and trigger repeated margin calls in the market[17]. During the past five years, significant market events led to persistent periods of distress which supported the alternation of investment policies. For example, the constant sovereign debt-sustainability concerns in the European Union resulted large outflows from the region during 2011[18]. Despite the fact that, asset managers should follow the demand for large outflow requests, managers on their own might have reasons to sell-off assets, as well. For instance, managers might wish to adjust their portfolios in a timely manner, aiming to be covered from future outflows.

In line with Canofari et al. (2014), herding among fund managers and the unsophisticated actions of noise traders is a key concern related to the investment funds sector. Particularly, under distress periods, additional characteristics could possible exaggerate herding behavior among asset managers, such as, performance benchmarking or the constant growth of passive investments. In overall, as Figure 13 highlights, investment funds turn out to be a crucial constituent of the financial system and still maintain a relatively steady proportion of its total share[19]. Based on the figure below, investment funds sector confronted diverse drifts throughout the period 1975-2015. The sector faced two sudden drops during the dot-com crunch and the recent subprime crisis. However, it recovered and nowadays continues to grow even further. In particular, Figure 13, underlines the magnitude of fragility that lies beneath the sector. In other words, the global economy is being threatened by an unexpected and

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[16] Types of investment fund are mainly categorized in open-end, closed-end, exchange-traded and interval.

[17] In terms of systemic risk, it is has not yet empirically explained, how fund managers act under such risky market situations and how their actions affect market prices and liquidity.

[18] European high-yield institutional funds faced outflows larger than 15% of their total assets.

[19] According to Botta et al. (2015), the corresponding proportion counts from 30% to 35% of the total financial system.

uncontrolled sell-off in investment fund assets that could be provoked any time in the future. As a final point, investment funds have ultimately converted to a major component of the financial system, and its existence seems to be constantly growing over the recent years.

Figure 13: Investment Funds
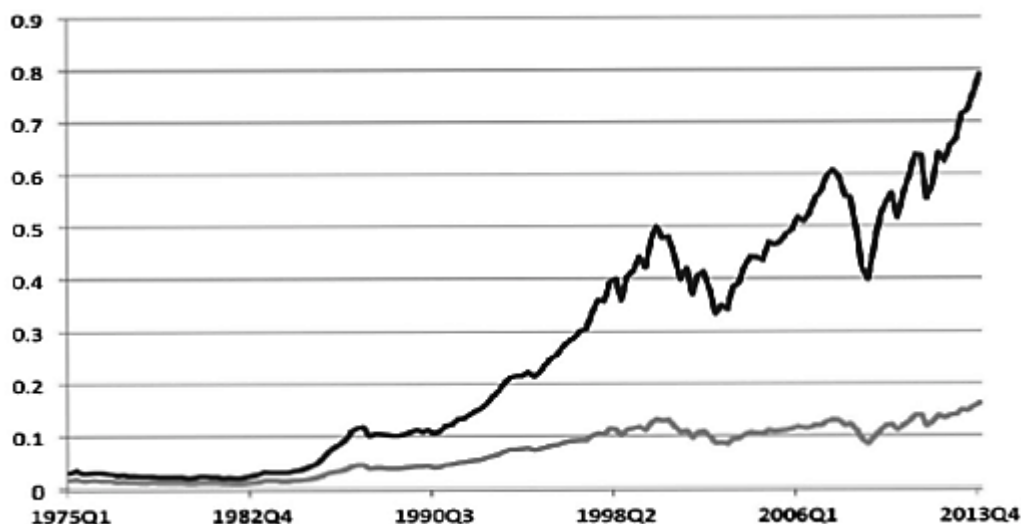
Source: Botta, et al. (2015)

4.1. Advantages of Investment Funds

Definitely, the huge grow of the investment funds sector is supported by several advantages. Below, based on Vershinina et al. (2016), my analysis denotes a couple of significant benefits that are usually met in the particular sector.

The most important characteristic that any investor seeks to achieve is risk diversification among various investments. Thus, by selecting to invest in the particular funds, investors manage to reduce the existing investment risk by allocating their funds in different countries worldwide. The comparative advantage of investment funds is that they normally offer an established asset pool, comprising by several billions. Besides, ceteris paribus, a management company can invest assets accumulated within an investment fund in different entities, and achieve risk reduction. Obviously, an individual investor can achieve diversification as well, though, under this scenario its effectiveness is considerably lesser than in the investment fund case.

Secondly, as a general rule, investment funds are controlled by management companies, which accumulate, process and examine huge amount of information. These companies, control a vast amount of minor investments, in one big portfolio and eventually achieve to reduce costs per unit of invested capital (economies of scale). Another advantage is that investment funds are

available to anyone, no matter their educational background or market experience[20]. Finally, investment funds allow investors to choose the optimal investment strategy depending on several factors, such as different geographical regions, currencies, time to maturity, risk and expected return.

4.2. Vulnerabilities of Investment Funds

On the other hand, investment funds encompass numerous of disadvantages that actually make the sector as one of the most unsafe components of the financial system. First of all, vulnerabilities may arise under the form of liquidity transformation or increased leverage that are analyzed in detail below. Additionally, a major vulnerability of the sector, is that it encompasses sub-sectors like hedge funds that are broadly unregulated, since they are referring solely to sophisticated investors. Those professionally managed funds engage in risky investments and contribute in the expansion of systemic risk. In the case of hedge funds, tracking of the original credit and counterparty risk is a relatively complex process. The complexity arises throughout the credit risk transferring, since hedge funds are less transparent and more complex than most other financial entities.

For instance, in 1998 Long Term Capital Market and Amaranth Advisors faced liquidity problems through runs on funds' repos and other types of short term financing. Despite the fact that, both funds had reported positive equity, ultimately they were unable to meet margin calls on their short-term funding[21]. Additionally, during the global financial crisis, this type of runs occurred again. More specifically, in 2007 hedge funds controlled by Lehman Brothers and Bear Stearns faced troubles meeting margin calls and funding at short-term. Even though the possible losses in the sector are burdened by fund investors, as in many cases in the past, social costs linked with liquidity transformation and leverage proved distressing for the real economy. Below, three particular vulnerabilities of investment funds are explicitly analyzed. Namely, liquidity transformation, leverage and run risk.

Liquidity transformation: A basic function of investment funds is to perform liquidity transformation, which is expected to deliver a positive return. Investors are able to invest in less liquid-high yielding assets, and at the same time retrieve their funds at short-term. However, liquidity transformation bears a financial stability risk comparable to the traditional

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[20] Even though that might be included in the drawbacks of the sector as well.
[21] Long Term Capital Market is a popular example of shadow banking institution, which had to be bailed out by FED and 16 other financial institutions. Supervisors and big market participants worried that a probable fall of LTCM could bring down the whole financial system.

run-risk on deposits. The particular threat might not be apparent, until a sudden event forces the majority of investors to convert their shares simultaneously.

The resulting consequences would be, increasing yield spreads in the underlying securities and asset liquidation cost accompanied by incapability to sell fund shares. The specific consequences would probably lead investors, to maximize their utility functions by "escaping" a troubled fund. Nevertheless, this namely first-move advantage is expected to trigger uncertainty among investors, which could eventually result into greater cost for the financial system (Doyle et al. 2016). In the long run, during turmoil conditions, investment funds are expected to require more liquidity, fact that could generate a domino effect.

Leverage: Normally, leverage in the investment fund sector is produced synthetically by utilizing derivatives, repurchase agreements and securities. Derivatives or securities financing transactions produce provisional liabilities, which are materialized if any position bears losses or margins are raised. The aforementioned liabilities contribute to the growing of risk, since they are not disclosed on companies' balance sheets. An important difference between investment funds and traditional banking sector is that investors can request their equity at a short-term. Besides, equity is considered as a less stable source of funding in the sector which adds risk on the whole financial system. According to Bengtsson (2013), massive outflows could impact the leverage ratios and consequently funds might be forced to sell assets[22]. The negative feature in the case of investment funds, is that leveraged funds has to sell greater proportion of assets compared to unleveraged funds. In terms of the leverage magnitude, the larger it is, the greater is its contribution to increased instability throughout the financial system.

Run risk: In the past, investment funds have repeatedly been accused for fueling financial bubbles, mainly through herding behavior. The aftermath of a run in the particular sector would be a direct contagion to the traditional banking sector. Definitely, investors have various reasons to run on a troubled fund. According to Davis (2003), there is a great possibility that institutional investors might need direct public sector rescues in the future. Regarding the case of the recent financial crisis, the run on investment funds occurred and in turn contributed to runs on various credit and money markets[23]. Broadly speaking, run risk is defined as the risk

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[22] In order to meet the previous level of leverage.
[23] The Primary Fund in United States, gained market share by investing in higher-yielding papers, including Lehman Brothers notes. In mid-September 2008 a run on the fund was triggered and within four days, investors had redeemed 97% of the fund shares. (Davis, 2003).

that a significant amount of investors would like to liquidate their assets simultaneously. The process which generates the specific risk involves demandable liabilities, asset liquidation costs and creation of first-move advantages.

Regarding the topic of a run risk due to demandable liabilities, the key characteristic is that investment funds are primarily equity-financed and encompass relatively low leverage. Hence, despite the fact that investors already know their claims could be retrieved in a short-term by the existing assets, their motivations to run on these entities is increased as well. In other words, the accompanied asset liquidation could generate a run risk. Next, regarding the asset liquidation cost, investors would prefer to redeem their holdings earlier than others, given that, fund managers need to adjust their portfolios by liquidating assets. In this context, adjustment costs produced by the sale of assets, will normally be reflected by a fund's NAV and would be finally borne by the fund's shareholders. Consequently, investors would have increased incentives to exchange shares quickly compared to others and a speculative run on the fund might be triggered.

In the light of the aforementioned paragraphs, investment funds entail various vulnerabilities, hence attracting much attention in terms of regulation and supervision. In the following chapter I develop the hypothesis that my empirical analysis seeks to answer, in terms of the function of investment funds accompanied by the empirical specification and main results.

5. Empirical Analysis

5.1. Hypothesis Stating

Based on previous literature, and precisely on a paper provided by Sunderam (2014), the empirical part of my study, attempts to identify a relationship between the growth of investment funds and money demand. Therefore, the hypothesis under examination is based on Sunderam's (2014) model which states that, investors treat shadow banking activities and Treasury bills as substitutes. In other words, when demand for Treasury bills is high, as reflected by low Treasury bill yields, the demand for shadow banking services is high as well. The hypothesis is that shadow banking system replies to this demand by a constant growth in the whole investment fund sector:

H1. Investment funds growth is positively related to T-bills demand.

Given that, an increase in money demand, would directly lower Treasury bill yields, low yields on Treasury bills are expected to forecast growth in investment funds NAV. In contrast, if investment funds and T-bills are substitutes, an increase in Treasury bill supply, by increasing T-bill yield, is expected to lower the magnitude of investment funds expansion. In line with the author, low yields on Treasury bills should be associated with the growing of shadow banking activities. In this context, the succeeding results are expected to provide robust evidence that investors run towards various sectors of investment funds and eventually constitute to the growth of shadow banking until nowadays. The reason for analyzing the relationship between investment funds and money demand is that, recent regulatory arbitrage conditions in the financial market, led specific parts of the shadow banking system to grow even further (Bengtsson, 2013). Therefore, attempts to understand the origins of an imminent crisis, might be proven beneficial on terms of future regulations.

5.2. Data and Empirical Specification

The aim of the particular study is to capture a relationship between investment funds growth and money demand in terms of a time series analysis. Therefore, the aggregate database includes various series retrieved from Z1 Flow of Funds statistics[24], which are provided by the U.S. Federal Reserve System. Based on the availability of data, my analysis implements quarterly observations regarding the period 2002Q1 to 2015Q4. The role of dependent variable plays each time a selected series from the investment funds sector. The first dependent variable comes from L.121 series, which is the total financial assets of Money Market Mutual Funds.

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[24] Data available at: https://www.federalreserve.gov/datadownload/Choose.aspx?rel=Z.1

Next, total financial assets of Mutual Funds (L.122), total financial assets of Closed-End Funds (L.123) and finally the total financial assets of Exchange-Traded Funds (L.124) were obtained, as well. Those series are specified as the dependent variable in each of the following regressions, while the independent variable each time is a constant series that was generated in order to reflect money demand. Finally, regarding the dependent variables, given that my hypothesis investigates a linkage between the growth of those funds and money demand, a new series were generated corresponding to the growth of the particular investment funds.

Next, on the right hand side of each regression and in line with Sunderam (2014), I retrieved from Bloomberg terminal, the quarterly Treasury bill yield and the quarterly Overnight Index Swap (OIS) rate of US. Paraphrasing author's argument, the OIS rate reflects the anticipated average of the federal funds rate in a given term. In general, OIS rate corresponds to an ideal baseline for the overall level of short term interest rates. Finally, the spread between Treasury bill minus OIS (Tbill-OIS), is expected to capture the information in Treasury bill about the money premium. The author has proved that, by implementing the Treasury bill-OIS spread as an explanatory variable, we achieve to strip out variation in the Treasury bill yield driven by changes in the overall level of short-term interest rates, (Sunderam, 2014). Figure 14 depicts the graphical representation of the similar route that the two series follow.

Figure 14: T-bill and OIS rate
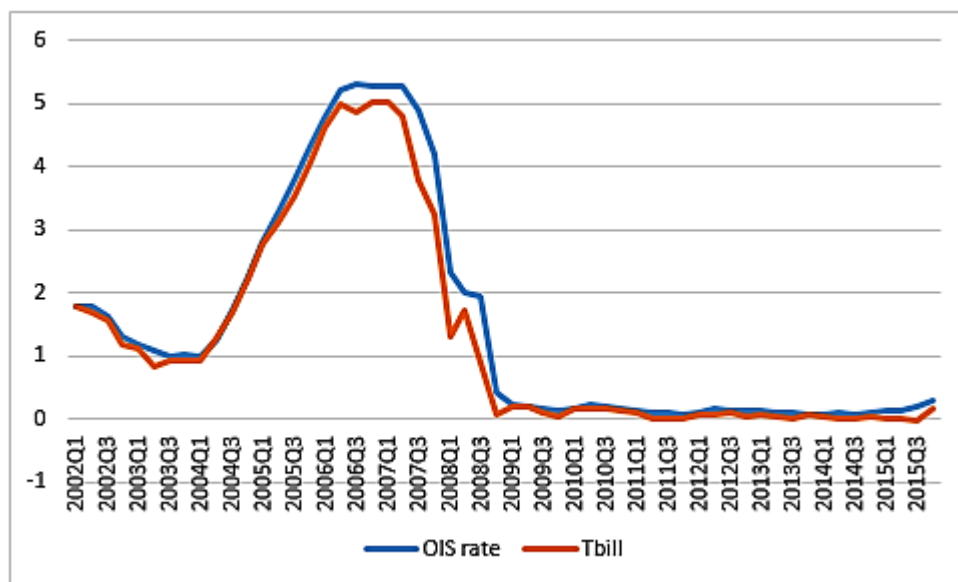
Source: Bloomberg

Finally, the four equations below correspond to the four regressions that were implemented with the usage of E-views statistical package.

- GMMMF $= \alpha + \beta *(\text{T-bill} - \text{OIS}_t) + \varepsilon t$ **(1)**
- GMF $= \alpha + \beta *(\text{T-bill} - \text{OIS}_t) + \varepsilon t$ **(2)**
- GCEF $= \alpha + \beta *(\text{T-bill} - \text{OIS}_t) + \varepsilon t$ **(3)**
- GETF $= \alpha + \beta *(\text{T-bill} - \text{OIS}_t) + \varepsilon t$ **(4)**

,where GMMMF in equation (1) represents the growth of Money Market Mutual Funds, GMF in equation (2) is the growth of Mutual Funds. Next, GCEF in equation (3) reflects the growth of Closed End Funds and GETF in equation (4) stands for the growth of Exchange Traded Funds. Table 1 below, illustrates the summary of descriptive statistics considering the four dependent variables and the spread between T-bill and OIS rate. In the bottom of the table, it is also included the correlation of each dependent variable with the independent variable. As we can derive from Table 1, GMMMF has a negative and significant correlation with the explanatory variable. The following two correlation values of GMF and GCEF are positive and significant as expected, while the last observation (0.065738) signifies that there no significant correlation between the growth of Exchange Traded Funds and money demand.

Table 1: Descriptive Statistics

	Tbill-OIS	GMMMF	GMF	GCEF	GETF
Mean	-0.180734	0.004322	0.020668	0.012589	0.062812
Median	-0.086833	-0.00595	0.0281	0.017825	0.063175
Maximum	0.012	0.12591	0.17131	0.14314	0.26078
Minimum	-1.103333	-0.10015	-0.20454	-0.199	-0.11685
Std. Dev.	0.257853	0.045218	0.069807	0.055284	0.086266
Skewness	-2.587494	0.78193	-0.669948	-1.29644	0.264072
Kurtosis	8.843456	3.717169	4.258034	7.358498	2.923278
Jarque-Bera	142.1618	6.906645	7.881935	60.01222	0.664585
Probability	0	0.03164	0.019429	0	0.717277
Sum	-10.1211	0.24202	1.1574	0.70497	3.5175
Sum Sq.Dev.	3.656853	0.112456	0.268016	0.1681	0.409299
Observations	56	56	56	56	56
Correlation with Tbill-OIS	1	-0.66101	0.291456	0.451239	0.065738
t-Statistic		-6.473287	2.238961	3.715719	0.48412

5.3. Empirical Findings

As an initial step, my analysis began by checking the series under examination for stationarity at levels. The five series were all stationary compared to their critical values, on at least 5% level of significance. Hence there was no need to continue by taking the first or even the second

differences in our sample[25]. Next, Table 2 illustrates the aggregate empirical results, after running the four regressions with the Ordinary Least Squares (OLS) method.

Table 2: Regressions Output

	(1)	(2)	(3)	(4)
	GMMMF	**GMF**	**GCEF**	**GETF**
Constant	-0.016628***	0.034929***	0.014796**	0.066787***
	(0.005605)	(0.01103)	(0.006517)	(0.014219)
Tbill-OIS	-0.115916***	0.078904**	0.080692***	0.021993
	(0.017907)	(0.035241)	(-0.029649)	(-0.045429)
R-squared	0.436934	0.084947	0.203617	0.004321
N	56	56	56	56

Note: Table 2 presents the four regressions as specified in section 5.2. The dependent variable in equation (1) is the growth of Money Market Mutual Funds (GMMMF). The dependent variable in equation (2) is the growth of Mutual Funds (GMF). The dependent variable in equation (3) is the growth of Close-End Funds (GCEF). The dependent variable in equation (4) is the growth of Exchange Traded Funds (GETF). The explanatory variable in all the four equations is stable and is reflected by the difference between Treasury bill yield and Overnight Index Swap (Tbill-OIS). Standard errors are reported in parenthesis. The date spans from 2002Q1-2015Q4. Notation of ***, ** and * denote statistical of significance at the 1, 5 and 10 percent levels, respectively.

Regarding the first column of Table 2, the value of (-0.11592) indicates that, if money demand in US increases by 1% the growth of MMMFs is expected to decrease approximately by 11.5%. The particular finding is statistically significant at 1% level. Moreover, the specific result is not surprising at all, if we have a second look on Figure 11, which refers to MMMFs. The graphical representation indicates that following the crisis the particular component of shadow banking has faced a run and did not continue to jeopardize the financial system. Hence, the negative relationship between the specific series and money demand is by some means rationale, since MMMFs are not anymore treated as an alternative choice to demand deposits.

Sunderam (2014) has proved that a potential positive relationship between shadow banking components (which in the particular case are selected series of investment funds sector) and money demand is a relatively worrying indicator, in terms of financial stability. Therefore, considering the period under examination, it is obvious from Table 2 (see columns 2 and 3), that the growth of Mutual Funds and Closed End Funds are positively and statistically significant related with money demand. Precisely, if money demand in US increases by 1%, growth of MFs and CEFs are expected to increase by 7.8% and 8% respectively[26]. The particular findings are highly distressing, since those results prove that specific parts of the shadow banking system continue to grow in terms of their total financial assets. Sunderam

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[25]The complete tables of Dickey Fuller test are included in the Appendix, (page I).

[26] The complete tables of regressions are included in the Appendix, (page III).

(2014) in his paper identified a positive statistically significant relationship between ABCPs and money demand when he examined pre-crisis data (2002-2007). The particular finding highlights that the above results in terms of MFs and CEFs indicate a highly vulnerable environment. In terms of R^2 analysis, the value of 0.43 in the first column, signifies that money demand explains approximately 43% of the growth in MMMFs. Similarly, money demand explains 8.5% of Mutual Funds and 20% of Close-End Funds variation.

Finally, as it is apparent in Figure 15 below, Exchange Traded Funds faced a huge expansion after the recent financial crisis, which justifies the reason for including the particular fund in the empirical analysis. Still, findings after regressing equation (4) indicate that there is no statistical significant relationship between the particular series and money demand (4th column of Table 2).

Figure 15: Exchange Traded Funs: Total Financial Assets
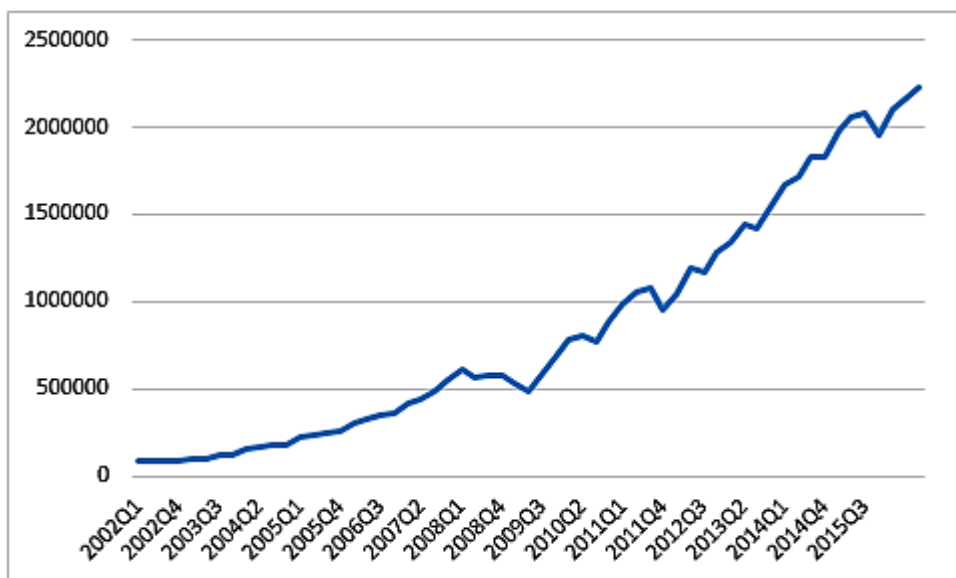
Source: Z1 Flow of Funds

Next, the existence of Autocorrelation and Heteroscedasticity in all regressions were tested, by implementing the Breusch-Godfrey LM Test and White Test respectively[27]. The empirical findings in terms of Heteroscedasticity indicate that OLS assumption of residuals constant variance is validated, since we failed to reject the null hypothesis of no Heteroscedasticity (Homoskedasticity) in all regressions. Besides, in terms of autocorrelation, in three out of four cases we failed to reject the null hypothesis of no autocorrelation, meaning that error terms are uncorrelated and findings are constituent with Gauss Markov theorem. However, in equation

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[27]The complete tables of Breusch-Godfrey and White tests are included in the Appendix, (pages V and VII).

(3), the issue of autocorrelation is identified, which violates the OLS assumption of no error terms correlation. In order to solve the particular problem, the "Durbin Two-Step Method" was implemented, which provided us the correct output depicted in Table 2. Finally, the Chow Breakpoint test was implemented to check if a break-point exists in the level of the series. The null hypothesis in this case is a structural stability, meaning that, by rejecting the null hypothesis we identify a structural break in the sample. According to the empirical findings, we fail to reject the null hypothesis since the F-test value is greater than the critical value and in addition p-value is close to zero[28]. The particular findings are apparent as well in Figure 16 below which illustrate the results of the CUSUM test, apart from the 4th regression (GETFs), in which the results carry no interpretation since results are statistically insignificant. Precisely, the red dotted line indicates no alternation in coefficient sign at 5% level of significance.

Figure 16: CUSUM Test

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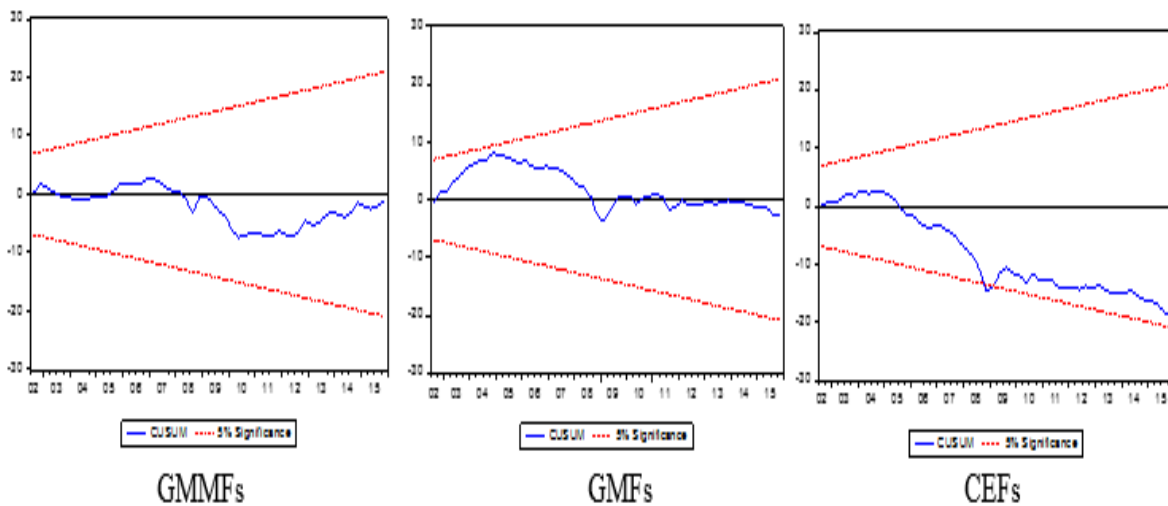
[28] The complete tables of Chow Breakpoint test are included in the Appendix, (page IX).

6. Discussion

Following the empirical part, a discussion based on the treatment of regulatory authorities towards shadow banking system is analyzed, accompanied by suggestions in terms of factors aiming to mitigate the risk of investment funds.

6.1. Regulatory Delusion

Throughout the literature review on the broad topic of shadow banking, a paper conducted by Fein (2003), treated its existence with a completely unconditional way. The following part of my thesis, highlights some facts of the specific paper that are in contrast with the mainstream approach towards shadow banking. The author claims that, shadow banking exists as an integral part of the regulated banking system. The particular claim, is supported by the fact that, main entities of shadow banking system accomplish a beneficial function in the financial system (Fein, 2013). In addition, those activities could increase efficiency, rise the supply of credit to the real sector, offer greater risk diversification and finally boost market competition.

In that context, regulators massively permitted those functions which allowed big banking organizations to convert into "leaders" in the shadow banking system. What is interesting here, is that prior to the crisis, supervisors accepted the abovementioned benefits, yet they currently include them in the shadow banking system. Somehow, proportion of the blame should also be directed towards regulatory authorities, since they did not adequately understand the risks of those activities. The author states that, the delusion among banking regulators, that shadow banking system is separated than the regulated banking system, is a feature that might be proven disastrous. Still, what is surprising, is that supervisors continue to mislead themselves with the idea that shadow banking is a system outside the regulated banking sector. In the past, regulators failed to perceive that, large commercial banks had become the largest shadow banks, and according to Fein (2013), they have not fully grasped the conversion of traditional banks into shadow banks. Based on this perceptive, the former Treasury Secretary of FED, highlights the whole debate regarding shadow banking regulation in a modest still inspired parallelism.

"Imagine building a national highway system with two sets of drivers. The first group has to abide by the speed limit, wear seatbelts, and buy cars with anti-lock brakes. The second group can drive as fast as they choose with no safety features and without any fear of getting pulled over by the police. Imagine both groups are driving on the same roads. That system would inevitably cause serious collisions, and drivers following the rules of the game would inevitably

get hit by drivers who weren't. A system like that makes no sense. We would never allow it on the roads, so why do we allow it in our economy?"

<div align="right">

Timothy Geithner (2010) [29]

</div>

Therefore, the precise meaning of the above statement is that, there is no need to blame for the financial crisis on entities outside the regulated banking system. In contrast, the direction should be towards the view that shadow banking is an integral part of the regulated banking system. Besides, economists at the Federal Reserve Bank of New York, such as Adrian and Ashcraft (2012), or Pozsar and Adrian (2012) have started to treat shadow banking as part of the regulated banking system. Actually, they have recognized banking organizations as the main "drivers" of the shadow banking system. Finally, according to Fein (2013), authorities need to recognize shadow banking, not as parallel to and discrete from the traditional banking system, but as the same source of systemic risk.

It is crucial to recognize that, the theoretically separated banking systems are closely associated since securitization, credit intermediation, liquidity supply and investment markets are vital features for the functioning of the traditional banking system. In this context, Figure 17 below presents the most recent available data in terms of the 10 biggest banks in the world. The reason for including the particular figure is, to highlight the possible consequences that could arise in a future turmoil scenario. Counting only for the top banks of the world in terms of their asset value, it is easy to suspect that traditional banks comprehend unregulated activities as well.

<div align="center">

Figure 17: Biggest banks in the world.

</div>

<div align="center">
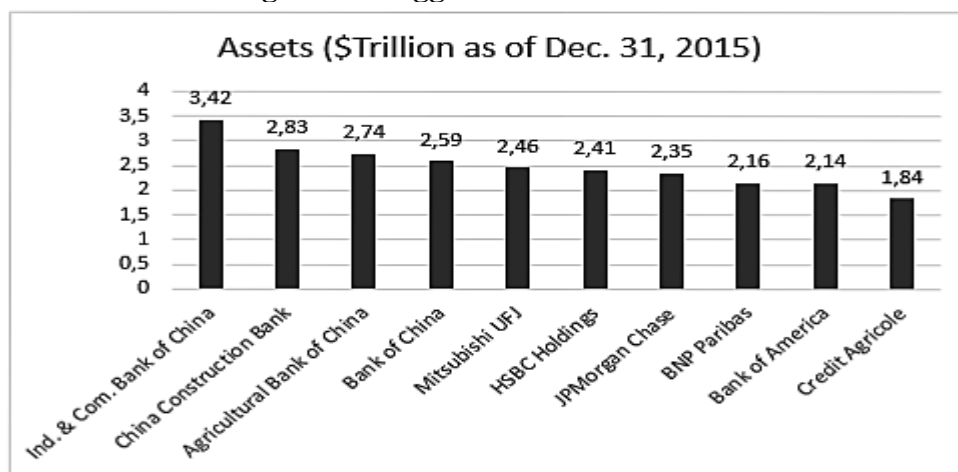
Source: Bloomberg Database

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[29] Former American central banker who served as Secretary of the Treasury. Statement at a hearing on Public Policy Issues Raised by the Report of the Lehman Bankruptcy Examiner, (April 20, 2010).

In summary, there is no question that shadow banking is a major reason that provoked the recent financial crisis. However, it is apparent that regulators misjudged the evolution of financial risks within the regulated banking system and at the same time, allowed large banking organizations to enter into shadow banking activities with insufficient capital, liquidity and supervisory oversight. Above all, the crisis in the shadow banking system was a crisis of the regulated banking system and adequate measures should be implemented immediately in order to avoid a future collapse.

7. Concluding Remarks

7.1. Suggestions

Specific factors that could possibly mitigate the accompanied risk in the broad investment fund sector are mentioned in prior examinations. For instance, Agarwal and Naik (2004), examined the systematic risk exposures of investment funds. The authors argue that, under any adverse situation, funds could trigger a contagion effect. Still, this scenario could be mitigated by sufficient risk management and leverage restrictions. Besides, sufficient liquidity management systems, provide the opportunity to better monitor liquidity risk and to guarantee that the liquidity outline of investments conforms to its underlying requirements. Additionally, liquidity management tools could be utilized from fund managers for issues in which an investment fund comes upon liquidity shortfall.

Next, in line with Lehecka and Ubl (2015) who analyzed potential indicators that could identify systemic risks related to investment funds, little evidence supports the efficiency of liquidity management tools throughout episodes of huge redemptions. In that context, liquidity regulation has been proved efficient during calm periods, while historical data do not indicate the same effectiveness throughout stress periods. According to Fung and Hsieh (2001), who analyzed the risk in investment strategies, funds exposure should never overcome funds' total NAV. Besides, NAV of each fund should be annually disclosed and reported. Next, similarly to the traditional banking sector, stress-tests at institutional and systematic level need to be established as well. Considering further complex investment strategies, the approach of value at risk should be definitely imposed. Precisely, funds need to disclose once a year data refereeing to the lowest, highest, and average value at risk estimations.

In summary, regulators should impose restrictions on liquidity transformation, accompanied by prudential measures aiming to safeguard the resilience of the sector to shocks and the contagion of investment fund distress to other financial institutions. The most important goal

among national authorities, would be the avoidance of regulatory arbitrage by the implementation of supplementary supervisory tools towards the shadow banking system.

7.2. Limitations

As already mentioned, the financial data utilized in my research were retrieved from Flow of Funds statistics, which is provided by the U.S. Federal Reserve System. The main limitation in the particular database has to do with off-balance sheet statistics and other segments that are not included in the regulatory framework. As more elaborate data regarding various financial institutions and their activities will be accumulated, an enhanced examination of the sector will be possible in the future. However, until then, deeper examinations need to be conducted in order to assess shadow banking structure and exposure. Additionally, data regarding hedge funds and derivatives are absent from the aforementioned database. Given that derivatives reflect risks related to the securities which could possible affect other fractions of the financial system, an ideal database would include such source of exposure.

In summary, the connections between shadow banking and traditional banking sector are not suitably captured in Flow of Funds statistics. The empirical findings presented in chapter 5 were primarily based on quarterly observations, however data availability on more frequent observations, such as monthly or even weekly, would definitely deliver superior results. Undoubtedly, it is suggested that future studies should incorporate series containing more frequent data that are not yet disclosed by various financial institutions. Finally, taking into consideration the aforementioned limitations, future research based on an enhanced database would be in a place to deliver further evidence on the subject of shadow banking.

7.3. Conclusions

The global financial system is constantly evolving towards a sophisticate and complex direction. Prior to 2008, the existing system allowed large institutions to take on excessive risks without effective constraints. In that context, shadow banking operated alongside and grew to be almost as big as the traditional banking system. The delusion among banking regulators, that the two sectors should be treated differently, is a feature that might be proven disastrous in the future. Aiming to achieve a stable growth of the economy, we need to focus on the systemic evolution of shadow banking by addressing the potential risks associate with its function, and eventually derive particular policies. Moreover, a financial incident in any country may trigger series of reactions that could jeopardize the financial stability of the entire world.

The particular investigation adds the role of investment funds and fills the particular gap in academic literature. Investment funds functioning increase interconnectedness between sectors of the financial system, and its quick growth encompasses several threats that stimulates the need for efficient supervision. Specifically, due to the concept of regulatory arbitrage investors run towards this unregulated sector of the system. Meaning that, investment funds involvement in capital markets is constantly growing over the recent years. Therefore, the risk of massive fire sales in the sector might be proven distrustful in the upcoming period.

Despite the fact that little empirical evidence exists regarding the subject under scrutiny, my analysis reflects alarming findings. Prior research, has proved that a potential positive relationship between shadow banking components and money demand is a relatively worrying indicator, in terms of financial stability. Based on the empirical outcome, regarding the period 2002-2015, money demand is positively and statistically significant related with the growth of Mutual Funds and Close End Funds. Thus, the particular study merely identifies that shadow banking still continues to grow rapidly. On the other side, empirical findings suggest that the sector of Money Market Mutual Funds s is negatively affected with money demand, meaning that investors do not continue treat the specific funds as an alternative investment to banking deposits.

In conclusion, highly interconnectedness among financial institutions could easily trigger a domino effect. Aiming to avoid such a scenario, regulators should impose restrictions on the functioning of investment funds, accompanied by prudential measures aiming to safeguard the resilience of the sector to shocks. Finally, it is clear that, the current framework of the global economy has triggered a new rational among regulators, in terms of what actions should be taken in advance, and ultimately achieve to prevent any adverse impacts on the side of the real economy.

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Appendix

Table 3: Stationarity Tests in All Series (GMMMF, GMF, GCEF, GETF, T-bill-OIS)

Null Hypothesis: GMMMF has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=10)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.490802	0.0006
Test critical values:		1% level	-3.555023	
		5% level	-2.915522	
		10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GMMMF)				
Method: Least Squares				
Sample (adjusted): 2002Q2 2015Q4				
Included observations: 55 after adjustments				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
GMMMF(-1)	-0.552963	0.123132	-4.490802	0
C	0.002997	0.005567	0.538255	0.5927
R-squared	0.275633	Mean dependent var	0.000892	
Adjusted R-squared	0.261965	S.D. dependent var	0.04789	
S.E. of regression	0.041141	Akaike info criterion	-3.507914	
Sum squared resid	0.089709	Schwarz criterion	-3.43492	
Log likelihood	98.46764	Hannan-Quinn criter.	-3.479687	
F-statistic	20.1673	Durbin-Watson stat	2.024161	
Prob(F-statistic)	0.000039			

Null Hypothesis: Tbill-OIS has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=10)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.216995	0.0242
Test critical values:		1% level	-3.555023	
		5% level	-2.915522	
		10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(Tbill-OIS)				
Method: Least Squares				
Sample (adjusted): 2002Q2 2015Q4				
Included observations: 55 after adjustments				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Tbill-OIS(-1)	-0.32355	0.100575	-3.216995	0.0022
C	-0.060695	0.031721	-1.913423	0.0611
R-squared	0.163366	Mean dependent var		-0.001879
Adjusted R-squared	0.14758	S.D. dependent var		0.208217
S.E. of regression	0.19224	Akaike info criterion		-0.424463
Sum squared resid	1.958671	Schwarz criterion		-0.351469
Log likelihood	13.67273	Hannan-Quinn criter.		-0.396235
F-statistic	10.34906	Durbin-Watson stat		2.346939
Prob(F-statistic)	0.00221			

Null Hypothesis: GMF has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=10)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.580359	
Test critical values:		1% level	-3.555023	0
		5% level	-2.915522	
		10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.				

Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GMF)				
Method: Least Squares				
Sample (adjusted): 2002Q2 2015Q4				
Included observations: 55 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GMF-1)	-0.740155	0.132636	-5.580359	0
C	0.015209	0.009654	1.575376	0.1211
R-squared	0.370101	Mean dependent var	-5.51E-05	
Adjusted R-squared	0.358216	S.D. dependent var	0.085712	
S.E. of regression	0.068665	Akaike info criterion	-2.483465	
Sum squared resid	0.24989	Schwarz criterion	-2.410471	
Log likelihood	70.29528	Hannan-Quinn criter.	-2.455237	
F-statistic	31.14041	Durbin-Watson stat	1.900349	
Prob(F-statistic)	0.000001			

Null Hypothesis: GCEF has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=10)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.793789	0.0051
Test critical values:		1% level	-3.555023	
		5% level	-2.915522	
		10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.				

Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GCEF)				
Method: Least Squares				
Sample (adjusted): 2002Q2 2015Q4				
Included observations: 55 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GCEF(-1)	-0.429298	0.113158	-3.793789	0.0004
C	0.005078	0.006415	0.791578	0.4321
R-squared	0.213566	Mean dependent var	-0.000536	
Adjusted R-squared	0.198728	S.D. dependent var	0.051716	
S.E. of regression	0.046293	Akaike info criterion	-3.271953	
Sum squared resid	0.113583	Schwarz criterion	-3.19896	
Log likelihood	91.97872	Hannan-Quinn criter.	-3.243726	
F-statistic	14.39283	Durbin-Watson stat	1.854868	
Prob(F-statistic)	0.000382			

Null Hypothesis: GETF has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=10)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-8.330614	0
Test critical values:		1% level	-3.555023	
		5% level	-2.915522	
		10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GETF)				
Method: Least Squares				
Sample (adjusted): 2002Q2 2015Q4				
Included observations: 55 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GETF(-1)	-1.134138	0.136141	-8.330614	0
C	0.071211	0.01451	4.907754	0
R-squared	0.56699	Mean dependent var		0.000205
Adjusted R-squared	0.55882	S.D. dependent var		0.131109
S.E. of regression	0.087085	Akaike info criterion		-2.008188
Sum squared resid	0.401937	Schwarz criterion		-1.935194
Log likelihood	57.22518	Hannan-Quinn criter.		-1.979961
F-statistic	69.39913	Durbin-Watson stat		1.977348
Prob(F-statistic)	0			

Table 4: Regressions Output (GMMMF, GMF, GCEF, and GETF)

Dependent Variable: GMMMF				
Method: Least Squares				
Sample: 2002Q1 2015Q4				
Included observations: 56				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Tbill-OIS	-0.115916	0.017907	-6.473287	0
C	-0.016628	0.005605	-2.966807	0.0045
R-squared	0.436934	Mean dependent var		0.004322
Adjusted R-squared	0.426507	S.D. dependent var		0.045218
S.E. of regression	0.034243	Akaike info criterion		-3.8756
Sum squared resid	0.06332	Schwarz criterion		-3.803266
Log likelihood	110.5168	Hannan-Quinn criter.		-3.847556
F-statistic	41.90344	Durbin-Watson stat		1.777911
Prob(F-statistic)	0			

Dependent Variable: GMF				
Method: Least Squares				
Sample: 2002Q1 2015Q4				
Included observations: 56				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Tbill-OIS	0.078904	0.035241	2.238961	0.0293
C	0.034929	0.01103	3.166576	0.0025
R-squared	0.084947	Mean dependent var	0.020668	
Adjusted R-squared	0.068001	S.D. dependent var	0.069807	
S.E. of regression	0.067392	Akaike info criterion	-2.521527	
Sum squared resid	0.245249	Schwarz criterion	-2.449193	
Log likelihood	72.60276	Hannan-Quinn criter.	-2.493483	
F-statistic	5.012948	Durbin-Watson stat	1.589118	
Prob(F-statistic)	0.0293			

Dependent Variable: GCEF*				
Method: Least Squares				
Sample: 2002Q1 2015Q4				
Included observations: 56				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Tbill-OIS*	0.080692	0.029649	2.721601	0.0087
C	0.014796	0.006517	2.270164	0.0272
R-squared	0.120623	Mean dependent var	0.006741	
Adjusted R-squared	0.104338	S.D. dependent var	0.045915	
S.E. of regression	0.043453	Akaike info criterion	-3.399199	
Sum squared resid	0.101962	Schwarz criterion	-3.326865	
Log likelihood	97.17758	Hannan-Quinn criter.	-3.371155	
F-statistic	7.407111	Durbin-Watson stat	1.796584	
Prob(F-statistic)	0.008726			

Dependent Variable: GETF				
Method: Least Squares				
Sample: 2002Q1 2015Q4				
Included observations: 56				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Tbill-OIS	0.021993	0.045429	0.48412	0.6303
C	0.066787	0.014219	4.697078	0
R-squared	0.004321	Mean dependent var	0.062812	
Adjusted R-squared	-0.014117	S.D. dependent var	0.086266	
S.E. of regression	0.086873	Akaike info criterion	-2.013685	
Sum squared resid	0.407531	Schwarz criterion	-1.941351	
Log likelihood	58.38319	Hannan-Quinn criter.	-1.985642	
F-statistic	0.234372	Durbin-Watson stat	2.287924	
Prob(F-statistic)	0.630258			

Table 5: Autocorrelation Tests

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.1609	Prob. F(2,52)	0.3212
Obs*R-squared	2.39353	Prob. Chi-Square(2)	0.3022

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2002Q1 2015Q4
Included observations: 56
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Tbill-OIS	-0.005564	0.01828	-0.304401	0.762
C	-0.001087	0.005647	-0.192537	0.8481
RESID(-1)	0.122619	0.137866	0.889409	0.3779
RESID(-2)	-0.186756	0.141082	-1.323738	0.1914
R-squared	0.042742	Mean dependent var	-1.13E-17	
Adjusted R-squared	-0.012485	S.D. dependent var	0.03393	
S.E. of regression	0.034142	Akaike info criterion	-3.847853	
Sum squared resid	0.060614	Schwarz criterion	-3.703185	
Log likelihood	111.7399	Hannan-Quinn criter.	-3.791765	
F-statistic	0.773934	Durbin-Watson stat	1.958425	
Prob(F-statistic)	0.513854			

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.606347	Prob. F(2,52)	0.2104
Obs*R-squared	3.258506	Prob. Chi-Square(2)	0.1961

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 11/18/16 Time: 20:15
Sample: 2002Q1 2015Q4
Included observations: 56
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Tbill-OIS	0.002791	0.035651	0.078279	0.9379
C	0.000701	0.010974	0.063905	0.9493
RESID(-1)	0.233344	0.138444	1.685477	0.0979
RESID(-2)	-0.12934	0.141507	-0.91402	0.3649
R-squared	0.058188	Mean dependent var	-8.81E-18	
Adjusted R-squared	0.003852	S.D. dependent var	0.066776	
S.E. of regression	0.066648	Akaike info criterion	-2.510048	
Sum squared resid	0.230979	Schwarz criterion	-2.36538	
Log likelihood	74.28134	Hannan-Quinn criter.	-2.45396	
F-statistic	1.070898	Durbin-Watson stat	2.048603	
Prob(F-statistic)	0.369519			

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.3179	Prob. F(2,52)	0.7291	
Obs*R-squared	0.676437	Prob. Chi-Square(2)	0.713	
Test Equation:				
Dependent Variable: RESID				
Method: Least Squares				
Sample: 2002Q1 2015Q4				
Included observations: 56				
Presample missing value lagged residuals set to zero.				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Tbill-OIS*	0.000921	0.030552	0.030161	0.9761
C	0.000139	0.006617	0.02108	0.9833
RESID(-1)	0.106436	0.13914	0.764958	0.4478
RESID(-2)	-0.041853	0.142771	-0.293146	0.7706
R-squared	0.012079	Mean dependent var	-2.21E-18	
Adjusted R-squared	-0.044916	S.D. dependent var	0.043056	
S.E. of regression	0.044013	Akaike info criterion	-3.339923	
Sum squared resid	0.100731	Schwarz criterion	-3.195255	
Log likelihood	97.51785	Hannan-Quinn criter.	-3.283836	
F-statistic	0.211933	Durbin-Watson stat	2.006464	
Prob(F-statistic)	0.887688			

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.602452	Prob. F(2,52)	0.5512	
Obs*R-squared	1.268202	Prob. Chi-Square(2)	0.5304	
Test Equation:				
Dependent Variable: RESID				
Method: Least Squares				
Sample: 2002Q1 2015Q4				
Included observations: 56				
Presample missing value lagged residuals set to zero.				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Tbill-OIS	-0.002135	0.046025	-0.046379	0.9632
C	-0.000499	0.014342	-0.034772	0.9724
RESID(-1)	-0.138417	0.138989	-0.995891	0.3239
RESID(-2)	0.043616	0.141721	0.307758	0.7595
R-squared	0.022646	Mean dependent var	1.07E-17	
Adjusted R-squared	-0.033739	S.D. dependent var	0.086079	
S.E. of regression	0.087519	Akaike info criterion	-1.965164	
Sum squared resid	0.398301	Schwarz criterion	-1.820496	
Log likelihood	59.02458	Hannan-Quinn criter.	-1.909076	
F-statistic	0.401634	Durbin-Watson stat	1.980435	
Prob(F-statistic)	0.752406			

Table 6: Heteroskedasticity Tests

Heteroskedasticity Test: White			
F-statistic	1.167118	Prob. F(2,53)	0.3191
Obs*R-squared	2.36232	Prob. Chi-Square(2)	0.3069
Scaled explained SS	3.184732	Prob. Chi-Square(2)	0.2034

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample: 2002Q1 2015Q4
Included observations: 56

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.00069	0.000451	1.528395	0.1324
Tbill-OIS	-0.003567	0.003916	-0.910837	0.3665
Tbill-OIS^2	-0.002081	0.003699	-0.56257	0.5761
R-squared	0.042184	Mean dependent var	0.001131	
Adjusted R-squared	0.00604	S.D. dependent var	0.001943	
S.E. of regression	0.001937	Akaike info criterion	-9.603284	
Sum squared resid	0.000199	Schwarz criterion	-9.494783	
Log likelihood	271.892	Hannan-Quinn criter.	-9.561219	
F-statistic	1.167118	Durbin-Watson stat	1.419357	
Prob(F-statistic)	0.319133			

Heteroskedasticity Test: White			
F-statistic	0.703649	Prob. F(2,53)	0.4993
Obs*R-squared	1.448495	Prob. Chi-Square(2)	0.4847
Scaled explained SS	2.140184	Prob. Chi-Square(2)	0.343

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample: 2002Q1 2015Q4
Included observations: 56

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002651	0.001846	1.436296	0.1568
Tbill-OIS	-0.018995	0.016014	-1.186161	0.2408
Tbill-OIS^2	-0.017401	0.015126	-1.150423	0.2551
R-squared	0.025866	Mean dependent var	0.004379	
Adjusted R-squared	-0.010894	S.D. dependent var	0.007878	
S.E. of regression	0.007921	Akaike info criterion	-6.786603	
Sum squared resid	0.003325	Schwarz criterion	-6.678102	
Log likelihood	193.0249	Hannan-Quinn criter.	-6.744537	
F-statistic	0.703649	Durbin-Watson stat	1.57984	
Prob(F-statistic)	0.499339			

Heteroskedasticity Test: White				
F-statistic	2.142354	Prob. F(2,53)		0.1274
Obs*R-squared	4.188616	Prob. Chi-Square(2)		0.1232
Scaled explained SS	8.803883	Prob. Chi-Square(2)		0.0123
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 2002Q1 2015Q4				
Included observations: 56				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002109	0.000609	3.464101	0.0011
Tbill-OIS*	0.011065	0.006618	1.671959	0.1004
Tbill-OIS*^2	0.016903	0.008377	2.017847	0.0487
R-squared	0.074797	Mean dependent var		0.001821
Adjusted R-squared	0.039883	S.D. dependent var		0.003906
S.E. of regression	0.003828	Akaike info criterion		-8.241026
Sum squared resid	0.000777	Schwarz criterion		-8.132525
Log likelihood	233.7487	Hannan-Quinn criter.		-8.198961
F-statistic	2.142354	Durbin-Watson stat		2.134994
Prob(F-statistic)	0.127434			

Heteroskedasticity Test: White				
F-statistic	0.081769	Prob. F(2,53)		0.9216
Obs*R-squared	0.172264	Prob. Chi-Square(2)		0.9175
Scaled explained SS	0.150747	Prob. Chi-Square(2)		0.9274
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 2002Q1 2015Q4				
Included observations: 56				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007969	0.002388	3.337177	0.0016
Tbill-OIS	0.006055	0.020717	0.292254	0.7712
Tbill-OIS^2	0.00411	0.019568	0.210013	0.8345
R-squared	0.003076	Mean dependent var		0.007277
Adjusted R-squared	-0.034544	S.D. dependent var		0.010074
S.E. of regression	0.010247	Akaike info criterion		-6.271586
Sum squared resid	0.005565	Schwarz criterion		-6.163085
Log likelihood	178.6044	Hannan-Quinn criter.		-6.229521
F-statistic	0.081769	Durbin-Watson stat		1.824949
Prob(F-statistic)	0.921601			

Table 7: Chow Break Tests (GMMMFs, GMFs and GCEFs)

Chow Breakpoint Test: 2008Q4			
Null Hypothesis: No breaks at specified breakpoints			
Varying regressors: All equation variables			
Equation Sample: 2002Q1 2015Q4			
F-statistic	6.050008	Prob. F(2,52)	0.0043
Log likelihood ratio	11.71525	Prob. Chi-Square(2)	0.0029
Wald Statistic	12.10002	Prob. Chi-Square(2)	0.0024

Chow Breakpoint Test: 2008Q1			
Null Hypothesis: No breaks at specified breakpoints			
Varying regressors: All equation variables			
Equation Sample: 2002Q1 2015Q4			
F-statistic	3.92147	Prob. F(2,52)	0.0259
Log likelihood ratio	7.866865	Prob. Chi-Square(2)	0.0196
Wald Statistic	7.84294	Prob. Chi-Square(2)	0.0198

Chow Breakpoint Test: 2007Q4			
Null Hypothesis: No breaks at specified breakpoints			
Varying regressors: All equation variables			
Equation Sample: 2002Q1 2015Q4			
F-statistic	5.768684	Prob. F(2,52)	0.0055
Log likelihood ratio	11.22153	Prob. Chi-Square(2)	0.0037
Wald Statistic	11.53737	Prob. Chi-Square(2)	0.0031