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**“Corporate Liquidity Risk under principal-agent problems &  
linkage with the global Financial Crisis of 2007-2009”**

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**Διατριβή υποβληθείσα προς μερική εκπλήρωση  
των απαιτήτων προϋποθέσεων  
για την απόκτηση του  
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## **ABSTRACT**

In this Thesis, I attempt to approach, and possibly explain, liquidity risks that crystalized during the global financial crisis, from the point of view of principal-agent and adverse selection problems. The global financial crisis has been considered by many commentators and academics as a consequence of a “serial contamination of balance sheets”. Starting from the balance sheets of the over-indebted households in the U.S., moving into the balance sheets of banks (subprime crisis) and other financial institutions and, finally, the problems reached to the balance sheet of sovereign, such as Ireland and the UK. In the latter case, induced liquidity shocks to banks have led to liquidity problems translating into solvency problems. Common in these situations are frictions in the financial intermediation process, well addressed in the theoretical and empirical literature, which also offers valuable insights for policy response.

In particular, the investment plans of firms are tied to liquidity and financing facilities provided. Liquidity problems, that may arise, could be aggregate or idiosyncratic. In case of aggregate liquidity shocks the official sector can intervene to mitigate their impact. Through monetary and fiscal policy, the official sector provides and regulates the liquidity in the financial system. In case of non-aggregate liquidity problems, firms have other mechanisms to finance their projects and official sector interference may not be warranted. Banks and other financial intermediaries can provide the necessary liquidity through pre-committed credit lines and finance-as-you-go policies. However, moral hazard problems and asymmetric information may lead to second-best outcomes.

## **Keywords**

Liquidity risk, Aggregate shock, Non-aggregate shock, Asymmetric Information, Principal-agent problems, Moral Hazard, Bank Credit lines, Cash holdings, Pledgeability, Global financial Crisis, Asset price bubbles.



## **1. Introduction**

Firms have liquidity needs in order to fund their investment plans, their assets and satisfy their obligations in a timely basis. So, firms maintain cash savings and other liquid assets, or set up credit facilities with financial intermediaries in advance, such as pre-arranged credit lines with banks. According to Keynes (1936), the funding liquidity position of a firm determines its advantage to undertake valuable investment projects when such opportunities arise.

During the realization of an investment project, the firm may face a liquidity shock. The liquidity shock can be explained as an excess investment cost or as a smaller payback than the firm had expected. The shock may be experienced by isolated firms, i.e. non-aggregate liquidity shock, or the shock may be generated and dispersed throughout the economy and a vast number of firms have to deal with liquidity shortage, in which case the liquidity shock is aggregate. The access to liquidity sources may be difficult due to frictions in the financial system. These frictions are provoked by asymmetry in information and principal-agent problems. Specifically, before the realization of a transaction, the problem of “adverse selection” may arise and, after its realization, the problem of “moral hazard” may appear.



*Figure 1: Venn diagram that shows the relationship between the main notions that will be analyzed in this MSc Thesis (source: author).*

The “adverse selection” problem refers to the undesired outcomes in market transactions due to the asymmetry in information that the counterparties have ex ante



about the quality of the interested product or service. That information asymmetry implies the ignorance of the true cost of the product or service and the true risk of the transaction. So, under conditions of asymmetric information, it is more likely to exchange products of bad quality. In our case of interest, the adverse selection problem refers to funding firms with low probability to success and keeping out firms with better probabilities to accomplish an investment project.

Principal-agent problems in economic relationships may arise when the one part delegates duties to the other. In these cases, agency problems can be provoked due to a conflict between the objectives of the principal and the agent. After the realization of an economic transaction, moral hazard can lead the agent to act through private incentives and be more risky, as the potential costs will not burden only the party taking the risk. Also, due to moral hazard, the agent may not put the appropriate “effort” to accomplish the objectives of the agreed deal. These problems arise because the risk taken by the agent and his effort made cannot be fully observed by the principal. For example, in case of a firm searching for funds, the external investors cannot measure the exact risk taken and the effort that the firm puts in order to realize an investment project. The threat of “moral hazard” is generated by the incomplete markets and contracts.

The frictions in the financial system, as they are mentioned above, provoke problems to the firms having access to liquidity. The financial crisis started at 2007 is an example of an aggregate liquidity shock. The funding sources were limited for a considerably large number of firms and financial institutions. The official sector had to interfere in order to alleviate the consequences of the crisis and provide the necessary liquidity.

In order to examine the corporate liquidity under principal-agent problems, a literature review was conducted. The main article, on which the discussion of this dissertation is focused, is the seminal paper of Holmström and Tirole: “Private and Public Supply of Liquidity” published in the Journal of Political Economy at 1998. The selection of this particular article has been made due to the fact that it incorporates the factor of moral hazard in providing the firms with liquidity.

In chapter 2, I discuss the market for liquidity. In particular how the demand for liquidity arises and what are the main constraints to generate liquidity, i.e. how the



supply meets the demand for liquidity. In chapter 3, I elaborate on the Holmström and Tirole's (1998) seminal paper on the market for funding liquidity and relate it to market liquidity. In particular, I discuss how in the Holmström and Tirole model moral hazard problems impact on the pledgeability of assets and lead to liquidity problems when liquidity shocks arise. In chapter 4, I discuss extensions to Holmström and Tirole's model, mainly through the Almeida et al. (2004) article and I introduce the reader to the notion of cash flow sensitivity of cash. The latter is identified by Almeida et al. as an appropriate measure of firm illiquidity susceptibility to liquidity shocks and it is particularly relevant to the non-financial sector. Chapter 5 discusses liquidity problems faced by credit institutions, using as a basis of discussion the paper by Pagratis (2007) and introduce central bank liquidity. In chapter 6, I study the case of the global financial crisis of 2007-2009 as an example of an aggregate liquidity shock. The conclusions of this dissertation are included in chapter 7.



## **2. Market for Liquidity**

### **2.1 Demand for Liquidity**

First of all, it is crucial to comprehend why firms have liquidity shortages and, therefore, a demand for liquidity is created. According to the dominant financial theory in corporate finance, a firm can issue claims equal to the full value of its expected returns of an investment project; and hence the necessary funds for the project's realization would be arisen. This classical idea is generated by the model of Arrow-Debreu (1954) for general equilibrium. In contrary to that, Holmström and Tirole (1998) consider that a firm cannot issue claims equal to the full value, but only up to a partly equal amount of its expected returns' value. This is due to frictions, such as moral hazard problems that may arise during the investment process. So, firms cannot fund every investment project that has positive NPV<sup>1</sup>. Additionally, Tirole (2010) incorporates the whole meaning of the liquidity problems that firms face into the observation that there is a timing difference between the revenues inflows and the expenditures outflows. Also, Almeida et al. (2004) state that firms plan their liquidity management strategy and choose in what project to invest, taking into consideration of their present and future profitability. Their choice has to be very careful in cases of liquidity shortages.

In order to confront limited liquidity, firms have to design their liquidity management strategy. According to Tirole (2010), there are two types of decisions that firms have to make aiming to plan their insurance over possible liquidity shortages in the future: the “finance as you go” policy and the “liquidity hoarding” policy. As Tirole (2010) explains, the “finance as you go” policy means that every time there is lack of liquidity, the firm has to address to external investors, corporations of other financial institutions to find the funds needed. Nevertheless, asymmetry in information, moral hazard and adverse selection problems, make this policy choice inappropriate in some cases.

On the other hand, “liquidity hoarding” policy refers to the ex-ante financial planning of the firms. More precisely, when firms choose the “liquidity hoarding” policy, they can either directly keep cash savings or other liquid assets in order to use

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<sup>1</sup> NPV: abbreviation for the Net Present Value.





them in case of a liquidity shock, or they can indirectly find liquidity through pre-arrangements, such as credit lines with banks. However, there is a trade-off in this financing policy choice, as well. For example, holding liquidity implies opportunity cost of funds because firms forego other illiquid investments, yet with higher expected returns. And pre-arranged credit lines with banks also imply cost, for example, in the form of usage/drawdown and maintenance fees of such credit lines. For these reasons the financial management planning should be designed carefully and it will be examined in the forthcoming chapters.

Demand for liquidity should be considered in touch with factors affecting liquidity supply. The measures and the actions that have to be followed per case of the possible liquidity constraints are discussed in the below chapter taking into account the principal agent problems that arise.

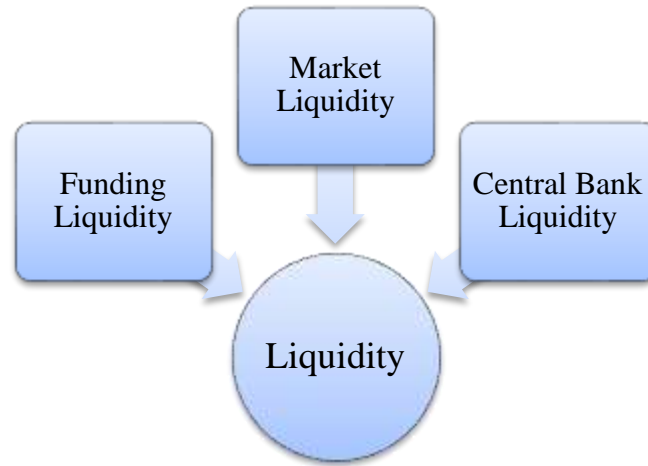
## 2.2 **Liquidity supply**

Tirole (2010) argues that liquidity is a very important notion, concerning the function of an economy, and it cannot be measured, or easily explained, by a single statistic. In order to get the meaning of liquidity clarified, Tirole (2010) presents the example of a bank, which needs extra funds to finance an investment project, to expand or to accomplish an acquisition or, even, to cover its losses. The bank while trying to reach its liquidity needs proceeds into actions that modify both sides of its balance sheet. The liability side of the balance sheet is associated with funding liquidity and the asset side with the market liquidity.

Funding liquidity needs are met by the issuance of new securities, diluting old claims to the firm. In Tirole's (2010) example, the bank could issue new equity, bonds, wholesale deposits and other securities. Except from the new securities' issuance, the credit line arrangements can be considered as funding liquidity. The credit lines are a very common tool that firms have in order to pump liquidity. Market liquidity can be considered as the liquidity found by a firm through markets, i.e. a firm's selling or pledging its assets aiming for further borrowing and securitization solutions. The two types of liquidity are not strictly distinct, but they are correlated as any financial transaction has multiple impacts in a firm's balance sheet. As Nikolaou (2009) adds, there is a third type of liquidity: the central bank liquidity that is the



liquidity provided by the official sector to the whole financial system in cases of aggregate liquidity shocks and it will be examined in following chapters.



*Figure 2: The three types of liquidity according to Tirole (2009) and Nikolaou (2009). (source: author)*

Firms undertake investment projects during which they may face liquidity shocks and they need further capitals to fund their plans. Hence, the examination of the ways to provide liquidity is necessary.

### **3. The Holmström and Tirole (1998) model**

Holmström and Tirole (1998) present a dynamic moral hazard model which divides time in three periods. They start with date 0 ( $t=0$ ) when the project is decided and the contract is signed between the firm and the interested external investors. Then, there is date 1 ( $t=1$ ) when a liquidity shock arises. The shock may be aggregate or not. During this time, it has to be decided whether the required extra funds will be deposited, hence the project will be continued, or there will be no further financial aid, and hence the project will be discarded. If the project will continue, we will pass at date 2 ( $t=2$ ) and the investment plan yields in an outcome which is subject to a moral hazard dilemma.

The model tries to explain both cases of exogenous and endogenous supply of liquidity. Moreover, in order to understand this model we have to take into consideration the type of the liquidity shock that the firms have to confront with, i.e. aggregate uncertainty or not.

#### **3.1 Non-aggregate liquidity shock**

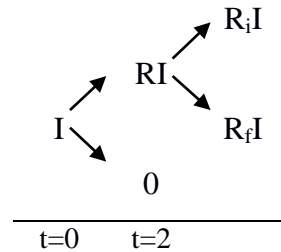
##### **3.1.1 Partial equilibrium model of liquidity demand by a single firm**

The simplest case to begin with, is that of an individual firm following an investment project in an environment with non-aggregate uncertainty. Also, in this case, the supply of liquidity is considered exogenously determined. The assumptions that have to be made to analyze the model of Holmström and Tirole (1998) are:

- there are three time periods.
- two types of agents (the firms and the investors), who are risk neutral. The firms may be considered as entrepreneurs and the investors as consumers.
- there is a unique good that circulates, named “cash” and it has zero rate of return, that means more cash is available than demanded by the firms.
- the technology used by the firm is stochastic and has constant returns to scale. So, for an investment equal to  $I$  returns  $RI$  in case of success and 0 in case of failure.



- $I$  are invested at  $t=0$ , at  $t=1$  there is a liquidity shock and an additional  $\rho I > 0$  amount of cash is needed.
- $\rho I$  distributes accordingly to a cumulative function  $F$  and a density function  $f$ .



*Figure 3: The initial investment  $I$  ( $t=0$ ) returns either  $RI$  or  $0$  ( $t=2$ ), and if returns  $RI$ , the returns are divided in  $R_iI$  and  $R_fI$  (source: author).*

### **3.1.1.1 The investment project's timeline**

So, at  $t=0$  the firm decides for an investment plan and puts an amount  $I$  of cash. At this time, if the firm cannot cover the investment by itself, it addresses to external investors and they sign a contract. To be more specific, at the beginning, the firm has an available amount of cash, which can be invested, equal to  $A$ . If the investment project needs more initial funds, meaning that  $I-A > 0$ , the external investors will have to cover them. It is assumed that the firm has limited liability. The contract has to describe fully how and at which level the external investors are interfering. Also, the contract has to predict what will happen at date  $t=1$ , in case of a liquidity shock; and, finally, at date  $t=2$ , who and in which proportion reaps the proceeds.

At date  $t=1$ , the firm needs extra cash equal to  $\rho I$ , in order to realize the project. This extra amount is needed to cover cost overruns or operating expenses during date  $t=1$ . If plan is continued, it pays off at date  $t=2$ , and returns  $RI$  if it succeeds or  $0$  if it fails.

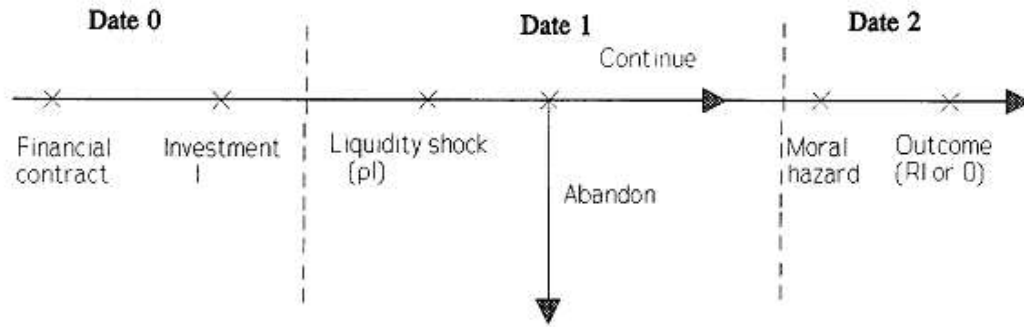


Figure 4: Timeline of the events during an investment plan (source: Holmström & Tirole, 1998)

### **3.1.1.2 The moral hazard factor and limited pledgeability of the firm's cash flows**

If the investment project continues at date  $t=2$ , it is subject to moral hazard. The “effort” put by the firm cannot be observed. A firm can put high effort for the project to be accomplished, and as Holmström and Tirole (1998) say, the firm “behaves”. In this case, the probability of success is high, denoted as  $p_H$ . Otherwise, a firm can put low effort, or “shirk” according to Holmström and Tirole. Then, the probability of success is low  $p_L$ , but the firm gains a positive private benefit equal to  $BI$ . Note that  $p_H - p_L \equiv \Delta p > 0$ . It can be observed, that the extra amount of cash needed and the firm's private benefit are both proportional to the initial investment  $I$ .

To find out the optimal liquidity supply and how it will be done, in their model, Holmström and Tirole (1998) consider that the project will be continued only if the liquidity shock is under a certain level. This level is a threshold equal to  $\tilde{p}$ , meaning  $p \leq \tilde{p}$ . If the project continues and succeeds, it will return  $R$ . The returns will be divided in  $R_i$  for the investors and  $R_f$  for the firm.  $R_i$  can be explained as debt to the investors (if there are any), or as equity to the firm's owners (if there is no debt). Taking into account the above, in order to find the optimal liquidity supply, the model tries to specify the quantities of  $I$ ,  $\tilde{p}$  and  $R_i$ . Also, it is assumed that the project has a positive net present value only if the firm “behaves”.



More specifically,

$$\max_{\tilde{\rho}} \left\{ F(\tilde{\rho}) p_H R - 1 - \int_0^{\tilde{\rho}} \rho f(\rho) d\rho \right\} > 0 > \max_{\tilde{\rho}} \left\{ F(\tilde{\rho}) p_L R + B - 1 - \int_0^{\tilde{\rho}} \rho f(\rho) d\rho \right\} \quad (1)$$

$\Downarrow$   
 Net present value  
with high effort

$\Downarrow$   
 Net present value  
with low effort

The first part of this inequality shows the net present value of the investment project, if the firm (agents) puts high effort to realize the project. It has positive value and it is maximized when  $\tilde{\rho} = \rho_1 \equiv p_H R$ . As long as the expected returns are higher than the extra funds needed, the firm can continue the project. Holmström and Tirole (1998) call  $\rho_1$  first-best threshold. However, as the firm has to be motivated by a private incentive in order to “behave”, the second-best solution has to be found. Due to moral hazard, the firms cannot pledge their cash flows in their entirety to outside investors. So, the following constraint has to be set

$$(\Delta p) R_f I \geq BI \quad (2)$$

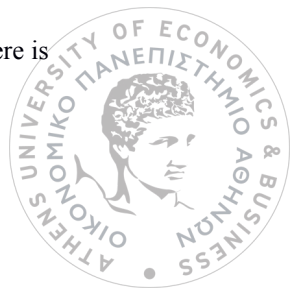
Solving the above constraint to the minimum amount of returns, which goes to the firm in order to be motivated, it is found  $R_f = R_b \equiv B/\Delta p$ ; assuming that  $R_f$  is such that the rest  $R - R_b$  is not enough to satisfy the investors’ expected cost for their investment. Also, assuming that the investors don’t require any returns<sup>2</sup>, the model puts the following constraint

$$F(\hat{\rho}) \rho_0 < 1 + \int_0^{\hat{\rho}} \rho f(\rho) d\rho \quad \text{for all } \hat{\rho} \quad (3)$$

and  $\rho_0$  is defined as the date-1 pledgeable per-unit return,  $\rho_0 \equiv p_H (R - R_b)$ . Similarly, this condition can be approached as the amount of equity that makes the liquidity shock threshold the most beneficial for the outside investors, i.e.

$$F(\rho_0) \rho_0 < 1 + \int_0^{\rho_0} \rho f(\rho) d\rho$$

<sup>2</sup> Because the investors’ time preference is zero, cash has zero rate of return due to the fact that there is more cash available than demanded.



Taking into consideration the assumption of zero rate of return and for a value of liquidity shock equal to  $\hat{\rho}$ , the following constraint implies the investors' break even.

$$F(\hat{\rho}) p_H(R - R_f)I \geq I - A + I \int_0^{\hat{\rho}} \rho f(\rho) d\rho \quad (4)$$

This constraint implies that the “pledgeable expected income”, which the investors have ex ante, has to surpass the investors' expected outlays. This constraint, combined with the inequality (3), sets a ceiling to the investment that can be made by the firm named “investment capacity”. Because of the investors' break even constraint, it is extracted that the net utility of the firm is equal to the social surplus of the investment project, as it is shown in the equation below:

$$U(\hat{\rho}, I) \equiv [F(\hat{\rho})\rho_1 - 1 - \int_0^{\hat{\rho}} \rho f(\rho) d\rho] I \equiv m(\hat{\rho})I \quad (5)$$

In the right part of the equation, Holmström and Tirole (1998) present the marginal return on a unit of the initial investment, denoted as  $m(\hat{\rho})$ . So, the second-best solution gives the maximum  $I$ . In this solution, forced by (4), it is best to have  $R_f = R_b$ , and we get the investment capacity  $I$ :

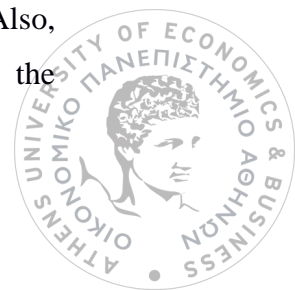
$$I = k(\hat{\rho})A, \quad (6a)$$

where

$$k(\hat{\rho}) \equiv \frac{1}{1 + \int_0^{\hat{\rho}} \rho f(\rho) d\rho - F(\hat{\rho})\rho_0} \quad (6b)$$

The coefficient  $k(\hat{\rho})$  is the equity multiplier and the maximum leverage ratio can be reached if  $\hat{\rho} = \rho_0$ . The equity multiplier is greater than 1 ( i.e.  $k(\hat{\rho}) > 1$  ) because it is assumed that  $I - A > 0$ , as the firm borrows the missing initial funds (  $I - A$  ) that needs at  $t=0$ .

The following step, as Holmström and Tirole (1998) notice, is that the second-best threshold has to be found beyond which the firms can continue the investment project. One first approach would be if we consider that the firm continues the project as long as  $\rho \leq \rho_1$ , which means as long as the project is worth to continue ex post. Also,  $\rho_1$  maximizes the  $m(\hat{\rho})$ , i.e. the per-unit profit of investment. If we plant the



relationship (6) into (5) and divide by  $F(\hat{\rho})$  we figure the second-best threshold  $\rho^*$ .  $\rho^*$  gives the minimum value of the expected per-unit cost of total expected investment, i.e.

$$\rho^* \text{ minimizes } \frac{1 + \int_0^{\hat{\rho}} \rho f(\rho) d\rho}{F(\hat{\rho})} \quad (7)$$

So, Holmström and Tirole (1998) conclude that the second-best threshold has to be between:

$$p_H(R - R_b) = \rho_0 < \rho^* < \rho_1 = p_H R \quad (8)$$

The interval in which  $\rho^*$  belongs, has lower value equal to  $\rho_0$ , because otherwise (if  $\rho < \rho_0$ ) the project would be ex post preferable to be continued; and it has upper value  $\rho_1$ , because above  $\rho_1$  the project has negative NPV and an ex post Pareto correction could be done (if the investors compensated the firm for leaving the project). Also,  $\rho_0$  maximizes the investment that can be made as given by  $k(\rho_0)$ . On the other side,  $\rho_1$  gives the maximal value of the ex post social surplus. As it can be derived, at the second-best solution, there is a trade-off between the level of the investment (at  $t=0$ ) and the extra funds provided (at  $t=1$ ). The model concludes that the firm, taking into account the incentive compatibility constraint, is credit rationed ex post and ex ante.

To conclude, the second best solution implies that in this partial equilibrium model, a firm in order to realize an investment project (if liquidity shock that has to confront is below  $\rho^*$ ) has two possible answers. The first solution requires from the firm the possession of an initial capital  $A$ , the external investment  $I-A$  and access to an irrevocable credit line of  $\rho^*I$ . The other solution is to initially invest an amount of  $(1+\rho^*)I$  and keep a  $\rho^*I$  available amount in liquid during the project.

It is useful to present the findings of Holmström and Tirole's (1998) model assembled as below<sup>3</sup>:

- A firm which has initial funds  $A$  invests  $I$  equal to  $k(\rho^*)$ .

<sup>3</sup> Holmström and Tirole, (1998), proposition 1.





- The project continues if the liquidity shock is under  $\rho^*$ .  $\rho^*$  varies between  $\rho_0 = p_H(R-B/\Delta p)$  and  $\rho_1 = p_H R$ .
- If the project fails, the returns are 0. Otherwise, the firm's payback is  $R_f = (B/\Delta p)I$  and the investors'  $R_i = (R-B/\Delta p)I$ .
- The firm can raise an amount of  $I-A$ , as initial external investment and have a credit line of  $\rho^*I$  as the project goes. Alternatively, firm can have  $(1+\rho^*)I$  as initial capital with the covenant that it reserves  $\rho^*I$  in liquid.

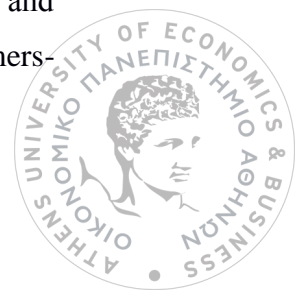
### **3.1.2 General equilibrium model of liquidity demand**

The general equilibrium model is the extension of the simple case of a single firm. Now, there are more firms that have liquidity problems simultaneously, although there is not aggregate liquidity shock. In this case, the supply of liquidity is endogenously determined. To begin with the analysis of this model, it is necessary to define the assumptions set by Holmström and Tirole (1998). In order to facilitate the approach, Holmström and Tirole consider that there is a continuum of firms which is consisted of a representative-unit firm.

The structure of the model is the same as before,

- there are three time periods.
- two types of agents (the firms and the investors) and they are risk neutral.
- the technology used by the unit firm is stochastic and has constant returns to scale.  $I$  is invested at  $t=0$ , at  $t=1$  there is a liquidity shock and an additional  $\rho I > 0$  amount of cash is needed.
- $\rho I$  distributes accordingly to a cumulative function  $F$  and a density function  $f$ .

However, as it can be noticed, the assumption according to which the only good that exists is “cash”, it is dropped. Now, there are also other assets that can cover the liquidity needs. The only way to circulate and transfer wealth privately is by issuing or buying other firms' private claims. The unit firm has initial capital  $A$  at date 0 and no further afterwards. In the same way as in the previous analysis, the consumers-



investors have no time preference and their expected utility in terms of consumption is  $E[c_0 + c_1 + c_2]$ . Additionally, consumers expect zero rate of return from the assets that they have in their possession. This suggestion results from the fact that the total amount of these assets is larger than the total demand for investment.

In this model, as far as there is a non-aggregate liquidity shock and a continuum of firms,  $F(\rho)$  represents the ex-ante probability of a firm facing a liquidity shock beyond  $\rho$ .  $F(\rho)$  is also the real proportion of firms that actually anticipated a liquidity shock under  $\rho$ . Now, because the supply of liquidity is endogenous, we cannot rely on credit line agreements or holding cash. From the assumptions made, it is derived that the extra funds needed, at date 1, are given by the type

$$D \equiv \left[ \int_0^{\rho^*} \rho f(\rho) d\rho \right] I \quad (9)$$

This  $D$  amount of liquidity has to be covered by other financial assets, such as the issuance of more securities or the purchase of other firms' shares.

There are two ways that firms can follow in order to provide themselves with the acquired liquidity. The financial market is the first way and the financial intermediaries are the second one. Holmström and Tirole (1998), at first, try to analyze the role of the financial markets. So, they suppose there are no intermediaries. The maximum amount that a firm can raise through a financial market is equal to its market value and can be computed by  $p_H (R - R_b)I = \rho_0 I$ . The amount  $\rho_0$  shows that there is a part of  $R_b I$  which stays to the firm as an incentive to "behave". The model implies that financial markets are not efficient if  $\rho$  belongs to the interval  $(\rho_0, \rho^*]$ . More generally, the financial markets cannot serve sufficiently the purpose of produce liquidity.

The total amount of the external securities available in the market can be considered to be gathered in a single portfolio. At date 1 this portfolio has value  $S_1$ . Taking into account the number of firms that continue the project  $F(\rho^*)$  and the actual value of the external claims, the portfolio is  $S_1 = V_1 - D$ ,

$$\text{where} \quad V_1 = F(\rho^*) \rho_0 I \quad (10).$$

So,



$$\begin{aligned}
S_1 &= V_1 - D \\
&= [F(\rho^*)\rho_0 - \int_0^{\rho^*} \rho f(\rho) d\rho] I = I - A
\end{aligned}
\tag{11}$$

### **3.1.2.1 The moral hazard factor**

The role of the moral hazard, which is defined by  $B$ , could be more understandable by the following thought. Let assume that a part of the stock portfolio described above is held by the firms at equally divided amount of shares; and name this part of the stock portfolio  $\alpha$ , with  $0 \leq \alpha < 1$ . Firms can overpass liquidity shocks  $\rho$  and continue their investment projects if

$$\rho I \leq \rho_0 I + \alpha S_1 \tag{12}$$

In order to  $\rho_0 I + \alpha S_1$  be equal to  $\rho^* I$ , for an  $\alpha < 1$ , we have the following constraint:

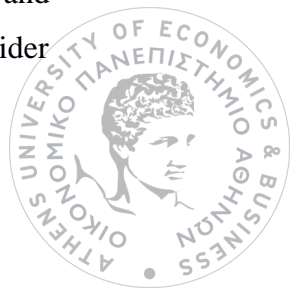
$$\rho^* + \int_0^{\rho^*} \rho f(\rho) d\rho < [1 + F(\rho^*)] \rho_0 \tag{13}$$

This process of thinking conduct Holmström and Tirole (1998) to the conclusion that if the moral hazard is extended and so the bribe  $R_b$  is large, the firm cannot serve its extra liquidity needs at date 1 even if it dilutes itself. The problem is not that the value of the firm is small and the liquidity offered by this mean is low, but the diffusion of this liquidity isn't enough. This argument comes from the fact that, in the aggregate, firms with small liquidity problems (where  $\rho < \rho_0$ ) hold more shares of the index than necessary. On the other hand firms with high liquidity problems cannot reach their needs as they cannot raise funds above  $S_1$  in total.

### **3.1.2.2 Financial intermediaries**

In cases in which the financial markets are an inefficient way to reach the social optimum, the productive sector can address to financial intermediaries, such as banks. The intermediaries could function like liquidity pools for the firms. Also, they offer insurance for the risk taken by the firms. Their main role is to subsidize firms that face high liquidity needs by exploiting their market value, with those facing lower liquidity needs.

Holmström and Tirole (1998) examine the functions of these intermediaries and explain why they are playing their role of cross funding well. To do so, they consider



the whole continuum of firms as a united unique firm, like a conglomerate. According to the second best solution this single firm will continue the project if  $\rho \leq \rho^*$ . Its value at date 1 is  $F(\rho^*)\rho_0 I$  and the funds needed then is  $D$ . As it can be observed  $F(\rho^*)\rho_0 I - D = S_1$ , with  $S_1 > 0$ . This means that the economy-sized conglomerate can reach the necessary liquidity, as implied by the second best solution.

In order to explain the role of the financial intermediary, the model assumes a hypothetical environment of a single intermediary. As long as the private sector can raise funds up to  $S_1 + D > D$ , the intermediary can provide the demanded liquidity. So, at date 0, the intermediary issues claims for the external investors and the earnings of this action go to buying all the external claims of the productive sector's firms. If firms succeed the second-best solution, the market value of the investment portfolio of the intermediary will be  $S_1$ . In order to do so, the intermediary takes the commitment to every firm to arrange a credit line up to  $\rho^* I$  and finance-them-as-they-go. With the aid of the credit lines, firms can continue their projects undertaken in cases when  $\rho \leq \rho^*$ .

To summarize their conclusions Holmström and Tirole (1998) underline that the optimum level on the productive sector cannot be reached in every case by the financial markets. The financial markets can be inefficient because they cannot prevent cases of strong firms keeping excessive liquidity and not subsidizing to firms that need it. Hence, valuable liquidity might be lost. An intermediary, so, takes this role, to coordinate the liquidity by cross-subsidizing firms through loans and credit line arrangements. Their final conclusion is that there is no need for the government to interfere by issuing further securities, because the private sector can reach the optimum level by itself and the government securities should be harmonized with the market rate of interest -which is zero- and they would add no value to the private sector<sup>4</sup>.

### **3.2 Aggregate liquidity shock**

According to Holmström and Tirole's model (1998), in case of pure aggregate liquidity shock in the economy, the private sector cannot be self-provided with the

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<sup>4</sup> Holmström and Tirole (1998), Proposition 2



necessary liquidity. The liquidity supply is endogenous and, because all firms face the same liquidity problems at the same time, there is no way for cross-subsidization. As long as each firm needs extra funds equal to  $\rho I$  and its value is  $\rho_0 I$  (at date 1), the total demand is larger than the total liquidity supply, when  $\rho_0 < \rho < \rho^*$ . When this case appears, even an intermediary could not be helpful, as the higher liquidity which it can provide is up to the ex post value of the productive sector; and the ex post value of the productive sector is limited to zero because of the aggregate uncertainty. Now, the important role of raising the appropriate liquidity needed and regulating it is assigned to the official sector. The advantage that the official sector has, in contrary to the other private economic actors, is consisted to the fact that the official sector can proceed to further endowments than date 0 through tax revenues, as it is assumed in the model. It is assumed that there are no losses of taxation.

### **3.2.1 Government Bonds**

The official sector can provide the necessary liquidity by issuing government bonds. The government can issue one- period bonds equal to  $(\rho^* - \rho_0)I$  at date 0 at the market rate of interest, which, as it is explained above, is zero. The bonds' price is the nominal price; hence there is no liquidity premia<sup>5</sup>. In this case of aggregate liquidity shock, the private sector's optimum can be achieved, when the external investors supply the amount of  $(1 + \rho^*)I - A$  to every firm at date 0 and agree with each firm to buy government bonds equal to  $(\rho^* - \rho_0)I$ . Otherwise, a financial intermediary can provide a credit line to each firm equal to the amount of  $(\rho^* - \rho_0)I$ , supported by the purchase of matched value government bonds. In this case, firms can issue new claims and find the lacking  $\rho_0 I$  for their investment projects. As long as the productive optimum is getting reached, Holmström and Tirole (1998) conclude that the issuance of the government bonds leads to the increasing of the aggregate product and investment level. To be more specific, the aggregate investment includes the initial "investment of date 0 and the expected value of date 1 reinvestments", and although

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<sup>5</sup> If the government sells the bonds at a higher price (nominal price +  $q$ , with  $q > 1$ ) than the par one, then it sells them at liquidity premia. The exact definition of liquidity premia is the amount  $q - 1$ .



the investment of date 0 decreased<sup>6</sup>, after the bond issue, the total investment increases<sup>7</sup>.

In a framework where there is neither cross-shareholding nor financial intermediation and, moreover, firms cannot liquidate their investments fractionally, Holmström and Tirole (1998) analyze firms' reaction to the selling of government bonds at higher price. This means that the bonds are being sold with liquidity premium  $q-1 > 0$ . If we take into consideration that the maximum dilution of the private sector at date 1 is  $\rho_0 I$ , then the appropriate adjustment to the external investors' participation constraint gives

$$F(\hat{\rho})\rho_0 I \geq I - A + \left( \int_0^{\hat{\rho}} \rho f(\rho) d\rho \right) I + (q-1)(\hat{\rho} - \rho_0) I \quad (14)$$

So, each firm's net utility function is given by

$$U_f(\hat{\rho}, q) \equiv m(\hat{\rho}, q) k(\hat{\rho}, q) A \quad (15)$$

The term  $m(\hat{\rho}, q)$  gives the marginal profit per unit of investment and it is equal to

$$m(\hat{\rho}, q) \equiv F(\hat{\rho})\rho_1 - 1 - \int_0^{\hat{\rho}} \rho f(\rho) d\rho - (q-1)(\hat{\rho} - \rho_0) \quad (16).$$

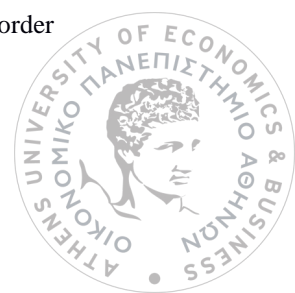
Also, Holmström and Tirole (1998) define the term  $k(\hat{\rho}, q)$  as the equity multiplier and is equal to

$$k(\hat{\rho}, q) \equiv \frac{1}{1 + \int_0^{\hat{\rho}} \rho f(\rho) d\rho + (q-1)(\hat{\rho} - \rho_0) - F(\hat{\rho})\rho_0} \quad (17).$$

The objective, according to the model, of each firm is to minimize the expected cost per unit of effective investment over  $\hat{\rho} \geq \rho_0$ , by finding the appropriate threshold  $\rho^*(q)$ , i.e.

<sup>6</sup> The initial investment decreases because the firms are obligated to keep more of their funds in order to cover their liquidity needs of date 1.

<sup>7</sup> Holmström and Tirole (1998), Proposition 3.



$$\rho^*(q) \text{ minimizes } \frac{1 + \int_0^{\hat{\rho}} \rho f(\rho) d\rho + (q-1)(\hat{\rho} - \rho_0)}{F(\hat{\rho})} \quad (18).$$

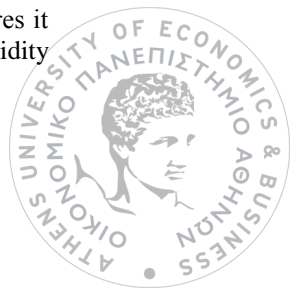
After these modifications, the constraint (8) changes into a more general form of

$$\rho_0 < \rho^*(q) + \frac{q-1}{f(\rho^*(q))} < \rho_1 \quad (19).$$

Moreover, in the interest of testing the generalized applicability of the above equilibrium state, Holmström and Tirole (1998) allow the firms issuing and trading securities in financial markets. They start with the issuance of a single security, which is considered as equity. In this case, it is figured out that the equilibrium collapses. Holmström and Tirole (1998) point the “free-ride” phenomenon to be responsible for that. To clarify this statement, they develop the following thinking process. They assume, in contrast, that the introducing of the financial markets for securities trading does not shake the equilibrium. They note that the securities have to be trading at par value or, otherwise, the investors don’t buy them. However, in that case, firms would turn to shares, instead of government bonds, for liquidity; the shares would be a cheaper way to find liquidity<sup>8</sup>. According to the conclusion derived is that the equilibrium state, which is described before, collapses as long as the government sells the bonds with liquidity premium. This happens because the liquidity premium’s existence converts liquidity into a “public good” with the “free-ride” consequences.

When the government bonds are being sold with a liquidity premium, the best choice, that firms have to follow for handling their liquidity needs, changes. Holmström and Tirole (1998) adjust their model to incorporate this modification. They assume that the government bonds, which the private sector holds and it manages to diffuse the funds suitably, have value equal to  $(\hat{\rho} - \rho_0)I$ . In that case, all firms can survive the liquidity shock when  $\rho \leq \hat{\rho}$ . However, when the liquidity shock is above  $\hat{\rho}$ , i.e.  $\rho > \hat{\rho}$ , some firms cannot survive a liquidity shock that high. To save some firms from closing, the partial liquidation at the industry level is allowed.

<sup>8</sup> As it is mentioned, in Holmström and Tirole’s (1998) model, the ex post value of each firm is  $(\rho^*(q) - \rho)I > 0$ , when there are no financial markets and  $\rho$  belongs to the interval  $(\rho_0, \rho^*(q)]$ . This value includes the value of the excess amount of government bonds it has and the value of the other firms’ shares it holds; these shares allow the firm to confront liquidity shocks without the burden of a liquidity premium.





Following this argument, a portion of  $(\hat{\rho} - \rho_0) / (\rho - \rho_0)$  of firms are allowed to continue their activities. The height of  $\rho$  determines whether this private sector's decision is optimal or not. To study how  $\rho$  affect the private sector's optimal choice, Holmström and Tirole (1998) set  $zI$  to be the value of the government bonds that private purchases and  $\lambda(\rho, z)$  to be the fraction of the firms that continue when the liquidity shock is  $\rho$ . Then, beginning with the return of the per unit investment made by the entrepreneurs,  $p_H R_b = \rho_1 - \rho_0$ , Holmström and Tirole (1998) conclude to the private sector's optimal policy by maximizing the following objective function under the (i) and (ii) constraints:

$$\begin{aligned} \max_{I, \lambda(\cdot)} \quad & I \int_0^{\infty} \lambda(\rho, z) (\rho_1 - \rho_0) f(\rho) d\rho, \\ \text{s.t. (i)} \quad & I \int_0^{\infty} \lambda(\rho, z) \rho_0 f(\rho) d\rho - I \left[ \int_0^{\infty} \lambda(\rho, z) \rho f(\rho) d\rho + (q-1)z \right] \geq I - A, \\ \text{(ii)} \quad & 0 \leq \lambda(\rho, z) \leq \min \left\{ 1, \frac{z}{\rho - \rho_0} \right\}. \end{aligned} \quad (20)$$

With  $\lambda$  being the Langrangian multiplier for the budget constraint, the best  $\lambda$  is:

$$\lambda(\rho, z) = \begin{cases} \min \left\{ 1, \frac{z}{\rho - \rho_0} \right\}, & \text{if } \rho \leq \bar{\rho} \equiv \frac{\rho_1 + (\delta-1)\rho_0}{\delta} \\ 0 & , \text{ if } \rho > \bar{\rho}. \end{cases} \quad (21)$$

Then, getting the first order condition Holmström and Tirole (1998) get:

$$\int_{\rho_0+z}^{\bar{\rho}} \frac{\partial \lambda(\rho, z)}{\partial z} [(\rho_1 - \rho_0) + \delta(\rho_0 - \rho)] f(\rho) d\rho - \delta(q-1) = 0 \quad (22)$$

From the above analysis, the model concludes that the values of  $\rho$ , which gives the private sector the choice of partial liquidation, are the  $\rho$  that make  $0 < \lambda(\rho, z) < 1$ . The reason why the private sector applies partial liquidation is that this policy means the best use of the government bonds. According to that, only when the ex post opportunity cost of the bonds is zero, i.e.  $q = 1$ , the private sector is fully protected against liquidity shocks. So, Holmström and Tirole (1998) conclude that if  $\rho \leq \hat{\rho}$  all the firms can continue their activities, if  $\hat{\rho} < \rho \leq \bar{\rho}$  only the fraction  $(\hat{\rho} - \rho_0) / (\rho - \rho_0) < 1$





of the firms can continue and if  $\rho \geq \bar{\rho}$  no firm can continue. This solution is more efficient than in case of firms acting independently<sup>9</sup>.

The attempt to implement the previous conclusions related to the optimal strategic plan of the private sector has to take into consideration two issues, according to Holmström and Tirole (1998). Specifically, the first issue is referring to the partial liquidation policy. As it is found before, the private sector needs to purchase government bonds of value more than  $(\hat{\rho} - \rho_0)I$ , in the aggregate. Because of that, the financial markets cannot lead to partial liquidation as it described previously. So, the intermediation is inevitable to succeed the partial liquidation in the industry level, instead of the firm level, where the partial liquidation is not achievable. It is useful to note that the intermediary is necessary only if the partial liquidation cannot be achieved in the firm level; and the intermediary's important role, in this case, is to handle economically the government bonds. The second issue that it is worth to be mentioned is the problem of the "free-riding". To solve this, Holmström and Tirole (1998) suggest that the answer is the issuing of multiple securities, either in case of intermediation or not. The free-riding phenomenon is caused due to the fact that some firms try to cover their liquidity needs by holding shares of other firms that hold expensive government bonds and taking advantage of them. The benefit that the "free-riders" gain is an externality, which firms want to internalize. Therefore, price discrimination is optimal to be applied. This can be achieved by issuing multiple securities which would be trading at par and with a liquidity premium. Hence, Holmström and Tirole (1998) based on the idea of Gorton and Pennacchi (1990), conclude that the price discrimination would allow the investors to auto-arrange themselves according their liquidity needs and how valuable for them is the satisfaction of these needs.

### **3.2.2 Multiple securities**

A way to get the model clarified, as far as the issuing of multiple securities are concerned, Holmström and Tirole (1998) set an environment of an industry equilibrium which allows partial liquidation at the firm level without the existence of intermediaries. Beginning with this analysis, it is assumed that firms invest an amount equal to  $I$ ; and that they cannot withstand a liquidity shock above  $\bar{\rho}$ . Moreover, firms

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<sup>9</sup> Holmström and Tirole (1998), Proposition 4.



are divided into 2 types, depending on the types of the securities they hold and at what prices they purchased the securities. So, there are “type-1” firms equal to the part  $\alpha$  of the firms. These firms buy  $(\bar{\rho}-\rho_0)I$  government bonds at price equal to  $q$  and they have no shares of other firms. At date 0, these firms issue equity traded at par value and debt, which matures at date 1 and has nominal value  $(\bar{\rho}-\rho_0)I$  at price  $q'$ . This price  $q'$  is such that make the firms indifferent between choosing being a firm of “type-1” or “type-2”. Furthermore, “type-1” firms are obligated to dilute their equity before they sell the government bonds they hold for cover their liquidity needs. Also, they are committed to sell government bonds of value up to  $(\rho-\rho_0)I$ , when the liquidity shock is  $\rho$ , before they settle their debt. These commitments mean that the equity has no liquidity premium when  $\rho$  approaches  $\rho_0$  and, also, that the debt's worth becomes  $(\bar{\rho}-\rho)I$  when  $\rho$  falls to the interval  $[\rho_0, \bar{\rho}]$ . The remaining part of  $1-\alpha$  of the firms are the “type-2” firms. These firms hold no government bonds and buy all the debt issued by the “type-1” firms.  $\alpha$  can be found from the equation:

$$\alpha (\bar{\rho} - \rho^{\hat{}}) = (1-\alpha) (\rho^{\hat{}} - \rho_0) \quad (23).$$

Holmström and Tirole (1998) continue their analysis by reminding that there is no liquidation at any firm if  $\rho \leq \rho^{\hat{}}$ . Assuming that  $\rho_0 \leq \rho \leq \rho^{\hat{}}$ , a “type-2” firm holds debt claims of value equal to  $\alpha(\bar{\rho}-\rho_0)I / (1-\alpha) \geq (\rho-\rho_0)I$ . So, “type-2” firms, by diluting their initial investors and by selling their debt claims, can survive a liquidity shock equal to  $\rho I$ . Nevertheless, if the liquidity shock is  $\rho^{\hat{}} \leq \rho \leq \bar{\rho}$ , there is a party liquidation of the “type-2” firms, but not of the “type-1” firms. “Type-2” firms, which are partly liquidated, can keep using  $\lambda_2$  of their assets, with  $\lambda_2(\rho I) = \lambda_2(\rho_0 I) + \frac{\alpha}{1-\alpha}(\bar{\rho}-\rho)I$ . Then, these firms can use  $\lambda_2(\rho_0 I)$  of their assets as pledgeability to find new external investors. The total quantity of assets of all firms of both types that are not liquidated is  $\lambda$  and equal to  $\lambda = \alpha + (1-\alpha)\lambda_2 = (\rho^{\hat{}} - \rho_0) / (\rho - \rho_0)$  and the total demand for government bonds is  $\alpha(\bar{\rho}-\rho_0)I = (\rho^{\hat{}}-\rho_0)I$ . Finally, Holmström and Tirole (1998) conclude that the optimal policy can be followed by issuing multiple corporate securities in case when the partial liquidation is possible at the firm level. On the other hand, when this is not possible and the partial liquidation can be realized only in industrial level, intermediaries are responsible for issuing multiple securities, in order the “free-riding” problems be avoided.



A further studying of the above model reveals that the solution of partial liquidation is optimal, only for the private sector but not at social level. In this solution, it is assumed that the government issues non-contingent bonds. The impact of this solution can be improved if the government issues state-contingent bonds, as it is considered by Holmström and Tirole (1998). The state-contingent bonds prevent the economy, in the aggregate, from excess liquidity and costly transfers, caused by the unnecessary reinvestments and tax imposing. However, this solution is not used in reality. The explanation of this, is the fact that there is no efficient, certain and quantitative state in order to identify when firms truly need more liquidity. Moreover, because there are many and often unpredictable cases that cannot be taken into consideration, the state-contingent bonds are not an applicable policy to serve the liquidity providing. Mainly, the state-contingent bonds have to be recognized as the origin for adapting a more adjustable and discretionary measure aiming at an active government policy. Nevertheless, the policy applied in reality is also associated with the political purposes of the government. Therefore, the government does not only take care for the liquidity creation but, above all, it seems to manage the diffusion of liquidity.

### **3.3.3 Liquidity policy insights**

The conclusions from all this extended analysis, which are derived, can give some loose principles for the official sector to plan its optimal liquidity management policy. The Holmström and Tirole (1998) model leads, usually, to the following strategic tactics. When the liquidity shocks are high and the liquidity needs are intense, then the government should issue bonds at increased value and proceed to the appropriate tax adaptation; hence, it could be said that a loose fiscal policy is seems to be adopted. On the contrary, when the liquidity shocks are smooth and the liquidity needs are not so high, there is no necessity for issuing bonds of increased value.



#### **4. Further discussion on liquidity constraints**

As it intuitively have been argued by Keynes (1936), the funding restriction that a firm has, determines the importance of the liquidity in its balance sheet. Access to funding usually from financial markets and other intermediaries, depends on the firm's credit standing. A firm's cash flows are highly correlated with the pledgeability of its assets. Furthermore, Tirole (2010) observes that a firm's pledgeability is related to the firm's way of organization, meaning that a well-organized corporate governance framework favors the pledgeability and, hence, the refinancing ability of the firms. However, as it is shown by Holmström and Tirole's (1998) analysis, the pledgeability of a firm's cash flows is limited due to frictions such as moral hazard problems. All these factors have to be taken into consideration to construct the firm's liquidity management strategy.

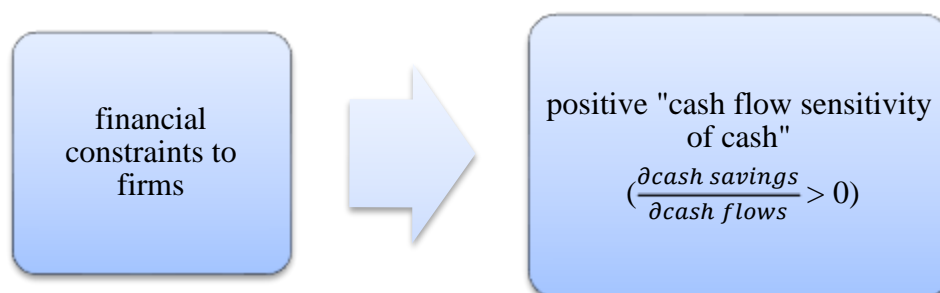
Inspired by Keynes's argument (1936), one other approach of the liquidity management is the Almeida et al.'s (2004) contribution, who examine how the liquidity management and firm's financial strategy are affected by the financial constraints that may arise. In order to measure this effect, they use the notion of "cash flow sensitivity of cash", in the concept of the firm's tendency to save cash out of its receiving cash flows. Having liquidity insurance against future liquidity shortage, firms, as it is already mentioned, keep cash holding instead of using it in the present time. This behavior has added cost because it is possible to prevent the firm from undertaking a profitable project. The liquidity management, thus, is has to be planned optimally in accordance with the firms' choice between present and future investments' profitability. Only if firms have unlimited access in funding sources and they are financially unconstrained, their liquidity management strategies are not determined by this choice.

The "cash flow sensitivity of cash" is an instrument for measuring the firms' financial constraints. Almeida et al. (2004) use this tool to empirically test and figure the relation that describes the link between the "cash flow sensitivity of cash" and the firm's liquidity management strategy. According their findings, there is a positive relation for the financially constrained firms. More precisely, when firms have limited access to fund sources, they tend to keep cash out of their cash inflows. On the other



hand, in the case of the financially unconstrained firms there is no determined and systematic relation demonstrated.

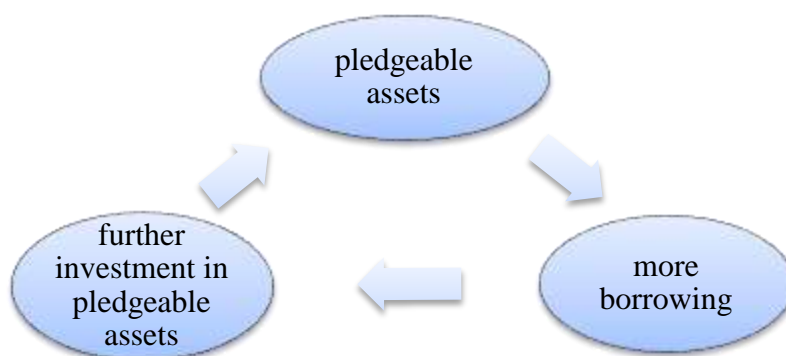
Moreover, Almeida et al.'s (2004) model, found a linkage between the “cash flow sensitivity of cash” and the business cycle. It is found that the liquidity demand, as it is shown by the cash sensitivity in cash flows, depends on the type of the business cycle the firm is in. The phase of the business cycle influences the total amount of liquidity that the firms demand. As Almeida et al. (2004) observe, the business cycle is an exogenous variable and the changes in the liquidity demand have an exogenous shock's effects. The effects are referring both to the amount of current cash flows and the investment opportunities, future and present, as well. This approach is an expansion of the model's perspectives towards a macroeconomic level of analysis. For example, during a recession cycle of the economy, the model implies that the financially constrained firms should increase their proportion of cash savings out of their cash inflows. But, the model has no indications of what the financially unconstrained firms should systematically do. Summarizing the contribution of Almeida et al. (2004), it is worth to mention that the innovative introduction of their model is that it examines the marginal tendency of “save/disburse funds out of cash flow”, instead of examining the total amount of firms' cash.



*Figure 5: The “cash flow sensitivity of cash” is positive when firms have financial constraints, according to Almeida et al. (2004). (source: author)*

In this direction of studying and understanding the financing frictions that firms confront, Almeida and Campello (2007) use the notion of a credit multiplier. The

credit multiplier implies the fact that the pledgeability of a firm's assets supports its credit capacity, which allows more investment in pledgeable assets (figure 6). In order to capture and measure pledgeability of assets, Almeida and Campello (2007) introduce the idea of assets' tangibility. So, they suggest that tangible assets increase the possibilities of external financing because tangible assets are more easily valued in cases of default and can be pledged more easily.



*Figure 6: Shows the credit multiplier which Almeida and Campello (2007) use to “identify the impact of financing frictions on corporate investment”. (source: author)*

Furthermore, empirical elements led Acharya et al. (2012) to expand Holmström and Tirole's (1998) model by underlying the fact that credit lines are not an absolutely reliable instrument for firms to survive liquidity shocks. Acharya et al. (2012) take a step further and connect the theory already proposed with the real empirical elements referring to the use of credit lines versus cash savings in order to manage liquidity risk. They began with the hint suggested by Suffi (2009) that the credit lines don't seem to be appropriately committed to the firms that needed them. However, if firms show evidence of high liquidity risk, the financial intermediaries, in order to protect themselves, they monitor and often interrupt the credit line agreement.

As it has been shown above, theory proposes that the credit lines provided by banks are a more sufficient and convenient tool, than cash holdings, for firms to be secure when illiquidity appears. Nevertheless, according to the empirical elements, a practical problem of credit lines has been found. That is “illiquidity transformation”

according to which firms have motives to take excessive risk and make the liquidity risk higher. As long as banks are aware of this signaling, they activate their control mechanism and can revoke the credit arrangement. Usually, banks tend to stop the credit line when firms need it at most. The bank monitoring in order to prevent “illiquidity transformation” behavior by firms is costly both for the banks themselves and for firms also. This cost is consisted of the direct cost of monitoring by the banks and the indirect cost of firms leaving investment projects away.

More precisely, Acharya et al. (2012) build a model that extend Holmström and Tirole’s (1998) model in two main dimensions. The first main point of interest, in this model, is the revocation of credit line as a tool of monitoring. So, at first, it is assumed that firms are up to illiquidity transformation after the credit line agreement. The second point is that the future investment opportunities are a significant factor in firms’ liquidity management strategy. Their strategy depends on their hedging needs, referring to the linkage between the chance of new investments and the available cash flows. Also, the model studies two connections by using empirical statistical data; the connection between liquidity risk and liquidity management, and the connection among hedging needs, liquidity management and credit lines arrangements and revocations.

The second parameter that model examines, the probable investment opportunities, has impact on the credit line monitoring and revocation in two ways. A revocation of a credit line can be very costly, because the interruption of the credit line means both the potential abandonment of a project and the loss of the chance for new investment projects, as well. This observation implies that the cost of the revocation threatens more the firms that act in environments with low cash flows, where the credit lines have higher probabilities to be abrogated. Second, despite of the fear for bank monitoring, the illiquidity transformation behavior can be limited by the existence of the investment opportunities. The second observation has louder effect on cases of firms that are present in economies with high cash flows.

As it has been shown in the Holmström and Tirole’s (1998) model, there is limited pledgeability of firms’ cash flows and, as a result, they cannot borrow infinitely. The firms have to plan their liquidity insurance strategy by finding the optimal choice between cash holdings and credit lines. More precisely, the choice has

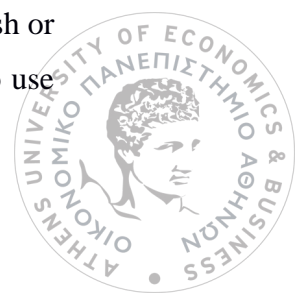




to be made in order to balance the insurance provided by credit lines and the cost of the having these credit lines arrangements. If the total cost of credit lines is too high, the firms turn to the solution of cash holdings against liquidity shocks and, also, they keep the opportunities for further investments open.

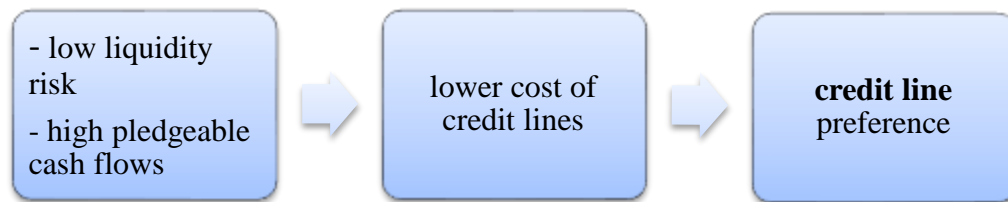
Complementarily, the liquidity management strategy has to be planned according to each firm's special hedging needs. If there is high correlation between firm's cash flows and its future investment opportunities, Acharya et al. (2012) consider that this firm has low hedging needs. On the contrary, if cash flows and future investment opportunities are not tightly connected, the relative firm has high hedging needs. It is useful to mention, how the firms' hedging needs affect their liquidity management decisions according to Acharya et al. (2012). Firstly, the cost of credit lines use rises as the probability of the credit line being revoked getting higher; a situation that concerns more the firms with high hedging needs as their future investment opportunities are more likely to be met in environments with low cash flows and hence their credit lines more likely to be revoked. In addition, there is a second way in which hedging needs affect the firms' liquidity management. Firms with low hedging needs have motives to seek investment opportunities in environments with high cash flows, as their investment opportunities are highly and positively correlated with the available cash flows. Acharya et al.'s model (2012) implies that if a firm has high hedging needs and decides to use a credit line, the credit line usually isn't a perfectly committed insurance tool. In contrary, if a firm has low hedging needs, the credit line could be perfectly committed. This observation would be beneficial to be taken into consideration by the contract theory in order to more complete credit line contracts be composed.

According to Acharya et al. (2012), the probability of appearance of the liquidity shock has impact on the cost of the credit lines arrangement. For example, if a firm has higher probability to face a liquidity shock, the cost of bank monitoring is higher than the firm's cost with low probability of liquidity shock. Furthermore, for the first firm the cost is higher because of the threat of credit line revocation, as well. Hence, the firms that have high probability to confront a liquidity shock tend to use cash instead of monitored credit lines in order to have liquidity insurance. Moreover, the amount of the pledgeable cash flows is another factor that affects the choice of cash or credit line use. As the pledgeable cash flows of a firm shrink, the firm prefers to use

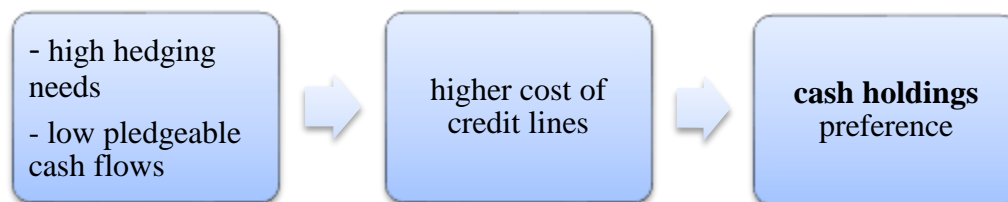




cash holdings for insurance rather than a credit line. In the same way as above, the decrease of the amount of the cash flows that can be pledged means the increase of the probability for a liquidity shock, the increase of the cost of the bank monitoring and so the increase of the cost of the credit line use; and as a result, the firm tends to prefer cash holdings for liquidity insurance.



*Figure 7.a: Firms prefer to use credit lines instead of cash holdings for liquidity insurance when they face low liquidity risk or/and high pledgeable cash flows, according to Acharya et al. (2012). (source: author)*



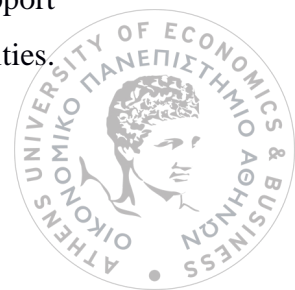
*Figure 7.b: Firms prefer to keep cash holdings instead of credit lines for liquidity insurance when they have high hedging needs or/and low pledgeable cash flows, according to Acharya et al. (2012). (source: author)*

In addition to the above analysis, Diamond and He (2012) introduce the notion of the debt overhang, which depends on the debt maturity structure, and how this structure is related to costs of the credit lines. Nevertheless, the debt overhang can be considered as a factor that has to be taken into account for the choice of the debt maturity structure. According to Diamond and He's (2012) analysis, the debt overhang can be described as the burden of the debt that follows the debt amount, meaning, for example, the loss of future investment opportunities or the lack of undertaking ability of even positive NPV investment projects. Additionally, Tirole (2010) mentions that the debt overhang can be considered as that some of the

debtholders have incentives to free ride and benefit from the debt structure rearrangement. Diamond and He (2012) declare that the credit lines, in the most cases, have a longer term of time horizon. This is the reason why, in periods of limited liquidity, the credit lines reduce the environment of uncertainty for the firms by preventing all the cash flows earned from the firms' investment projects to be spend directly for the debt repayment purposes.

Furthermore, although it is not in the interest of this dissertation, it is useful to mention that the financial institutions, usually, have a variety of offering tools except from the credit line arrangements, which they provide to the firms in order to carve their financial strategy and liquidity insurance. An example of these banking tools is the factoring contract between a bank and a firm. The factoring contract can assist a firm with a basket of services that are complementary to other liquidity providing arrangements, such as the credit lines or the firms' loans. More precisely, a factoring contract can be described by a combination of the following financial services: a firm can arrange with the bank for taking care of the firm's demands by its credited clients, for the accounting supervision and payment of these demands. Also, a firm can take the amount of its demands by the bank in a prearranged price for the service and then the bank demands this value by the firm's clients. Nevertheless, depending on the type of the factory contract and the relative details that are customized to each firm's needs, can provide an insurance cover to protect these demands. According to Sopranzetti (1998), the optimal contract can be designed by taking into account the financial position of the firm and its credit quality. However, although the singing of a factoring contract can be helpful, its use only as a liquidity management tool can be more costly than beneficial. Other examples of bank services that the firms can use to facilitate their finance and liquidity position by submitting a pre-arranged commission to the bank are the forfaiting and the leasing contracts. A forfaiting contract is consisted of a firm's demands' concession to a financial intermediary to take care for them and relieve the firm of the relative risk taking. A leasing contract is the assistance of providing assets to the firm for usage and the repayment for them take place under usually favorable conditions for the firms, instead of losing valuable funds by purchasing these assets from the beginning and not invest them.

To sum up, the firms are relied on their liquidity management strategy to support their ability, not only to realize, but also not to miss investment opportunities.



Holmström and Tirole (1998), through their model, created a strong basis for the understanding what problems the liquidity shocks provoke and how they can be confronted, as the above mentioned relationship obliges. The firms, in order to plan their liquidity management, use a variety of bank products that provide helpful services. However, in the previous discussion banks are considered as financial intermediaries. But, banks are also corporates that have to plan their liquidity management policy too. In the below chapter, this is the exact next discussion that will be unfolded.



## **5. The case of Credit Institutions**

The analysis taken place in the previous chapters is about the corporate liquidity issues. In this part, the case of banks and how they behave is going to be discussed. Banks are firms themselves that aim at profit maximization and, thus, they can anticipate liquidity shortages as well. The case of banks is distinct, because the official sector can intervene by taking the appropriate for each time measures.

The Holmström and Tirole's (1998) model can be adapted to the case of banks using the analysis that Pagratis (2007) has contributed. According to Pagratis (2007), there is a threat of banking overinvestment actions that can provoke liquidity shortages. Nijsskens and Eijffinger (2010) agree and add that a bank institution without a regulation program imposed holds too much liquid assets and takes too much risk compared to the socially best solution. In order to minimize these troublesome situations, a central official institution has to take actions and interfere to regulate the available liquidity.

Moreover, Acharya and Naqvi (2010) are in accordance with the statement that the banks have incentives to take excessive risk driven by moral hazard. In their analysis, they notify that the banks suffer from random deposit withdrawals, which can cause liquidity shortages, provoking further costs to the financial institutions. The available deposits that the banks have are the main funding sources for the economy's investment projects. Acharya and Naqvi (2010) consider that the previously mentioned costs can be translated, for example, to fire sales or to the costs related to their liquidity management planning through access to financial markets. To anticipate these costs, the banks hold cash and, equivalently, liquid assets. In this direction, the remaining part of the deposits is devoted to the banks' investment and lending activity.

In Pagratis' (2007) model, the role of the central official institution has been given to the central bank. The main objective that the central bank tries to accomplish is the amelioration of the social welfare. This objective the central bank tries to reach it through using its "Lender of Last Resort"<sup>10</sup>. However, Nijsskens and Eijffinger (2010) express the trade-off between the implementation of the LOLR solution and

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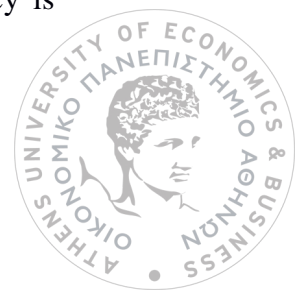
<sup>10</sup> In the following analysis the abbreviation LOLR will be used instead of the whole name "Lender of Last Resort".



the appearance of moral hazard problems that the LOLR arises. These moral hazard problems that provoked by the LOLR or other bailout mechanisms and affect the macroeconomic environment will be discussed with more in the second part of this dissertation.

In order to derive useful conclusions about how the banks plan their investments and design a liquidity management strategy it is necessary to describe the environment of Pagratis' (2007) model. More specifically, in this model there are three agents; these are a bank, a continuum of bank depositors and the central bank. The central bank regulates liquidity and plays the role of LOLR. All the agents are risk neutral and the analysis that is taking place is divided in three time periods, following the structure of Holmström and Tirole's (1998) model. In contrary to the assumption that Holmström and Tirole (1998) made referring to the exogenous liquidity shock, Pagratis (2007) considers that the liquidity shock is endogenously determined "on the basis of an information-induced bank run". By this assumption, Pagratis' (2007) model can derive indications about the impact of the LOLR policy combined with the measures for the liquidity regulation to the importance of the liquidity shock, and the opposite. Pagratis' (2007) model differentiates also in the point of the credit lines. While Holmström and Tirole (1998) do not burden the credit lines with charge, Pagratis (2007) denotes that they are constrained due to the liquidity regulation.

According to the model, only the bank can provide loans and the investments that are undertaken are financed by issuing equity and using the available deposits that have been trusted with. Pagratis (2007) also notes that the bank aiming at protecting its paying ability and ensuring its solvency, it keeps securities with no risk but also with no returns. The investment that the bank undertakes, related to the loan providing, is illiquid and the returns are not received until date 2. The probability of the successful realization of this loan investment depends on the existence of risk factors, which are defined as systemic shock. It is worth mentioned that in an economic environment where the parts, and especially the depositors, are fully and completely informed the systemic shock could not appear, as it is defined above, and there is no utility for the LOLR policy. However, an economic environment with full information to the agents is not feasible in reality and hence the LOLR policy is



useful. In this case, the systemic shock means liquidity problems that are provoked by the depositors' choice between keeping their cash secured in the banks or withdraw it.

The LOLR policy is an official sector's safety net to stand off risks arising from the maturity mismatch of bank assets and liabilities which could lead to self-fulfilled bank runs as Diamond and Dybvig (1983) describe. To achieve this role, the central bank assigns some liquidity criteria, measured by the proportion of liquid assets to deposits, according to which the banks can be protected. This ratio is adjustable to the particular goals that the official sector desires to accomplish. More precisely, the central bank can demand by the banks to reserve a specific proportion of these liquid riskless assets to deposits to succeed its scope of welfare maximization. Moreover, by these requirements the central bank manages to assure the banks from deposition withdrawals realized in not appropriate timing, usually too early, and also, the central bank distributes the costs of LOLR policy among the banks. Furthermore, the central bank, by this policy, seems to act like providing the banks with extra funds in emergency conditions judging by the causes of the liquidity problems and the returns that go back to the central bank after the LOLR policy implementation.

Additionally, Pagratis (2007) clarifies that the cost of the LOLR policy has to be taken into consideration. The LOLR policy has obvious functional costs in order to be planned and applied. The banks are encumbered with the additional cost of the liquidity regulation requirements. In an economic environment of asymmetric information the moral hazard, that characterizes the principal agent relationships, justifies the incentive that the banks have of free-riding on the liquidity insurance provided by the LOLR policy. This free-riding due to moral hazard threat by the banks can provoke the limited raise of the deposits, as it is analyzed in the model of Dewatripont and Tirole (1994). Furthermore, according to Pagratis (2007), its implementation implies indirect costs because of the liquidity regulation restrictions and the losses of not undertaking investment projects. So, there is a trade-off in the total social welfare between the benefits of the regulation aiming at preserving liquidity and the losses of the restrictions. Pagratis (2007) focuses on this trade-off in solving the maximization of the social welfare beyond the constraint that the expected cost of LOLR implementation is zero.

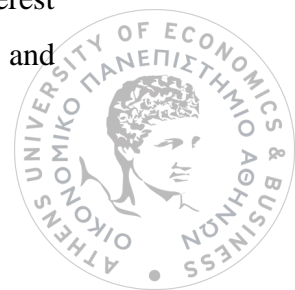
The analysis of Pagratis (2007) led to the interesting and useful conclusion that the profits of the bank, the leverage ratio and the amount of deposits influence the



desirability and the efficiency of the LOLR policy in maximizing the social welfare. In further details, the LOLR policy is more desirable and effective as a bank's capital is increasing. This positive relation between the LOLR effectiveness and the amount of a bank's capital is caused by the fact that the capital accommodates insurance against financial losses and allows the central bank to provide this insurance under its budget pressure. Moreover, the LOLR policy is more efficient when a bank has low leverage ratio of bank deposits to bank equity, because when the leverage is low a bank undertakes less positive NPV investment projects. So, according to Pagratis (2007), an LOLR policy implementation affects the insurance provided to the banks and increases the marginal expected return from an investment project; and, hence, the banks tend to invest to more positive NPV investment projects. Also, the level of the risk that a liquidity shock has influences the desirability of the LOLR. Pagratis (2007) found that the asymmetry in information among the depositors and the amount of the deposits make the liquidity shock riskier and the LOLR insurance more desirable. Finally, it is found that the higher per unit expected return of the loan that a bank invests makes the liquidity shock riskier, as well. In these cases the LOLR policy has more probabilities to ameliorate the total welfare of the economy.

Summarizing the findings that Pagratis' (2007) analysis has reached to, reveals the impact of both the asymmetry in information among the agents of the economic environment and of funding constraints imposed to the banks, also. Under these conditions, the liquidity regulation implemented by the central bank, leads the proportion of the bank liquid assets to the bank deposits at a higher level than if the banks acted by their own. The relatively higher amount of liquid assets allows the banks to confront a liquid shock by providing themselves with the necessary liquidity. In addition to that, Pagratis (2007) underlined that the liquidity requirements the central bank imposes to the banks, protect them by the early deposit withdrawals, as it is already mentioned, and balance the excess risk taken by the banks, as well.

Concluding, in the direction of reducing the risk of the moral hazard that coexists with the bailout programs, it is useful to mention the idea of Eijffinger (2008), according to which it is introduced that the threat of a potential cost in case of usage of the bailout aid would deter the banks from excess risk taking. Additionally, the social cost of an official sector's intervention, such as the imposing of low interest rates, can be very high, as Diamond and Rajan (2012) explain that "banks and



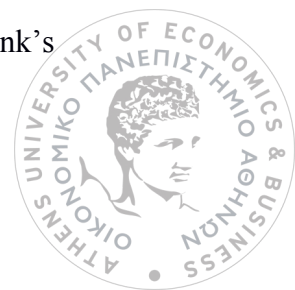


depositors do not internalize the costs of interest rate intervention”. In order to aid the central bank to fulfill its objectives, Nijskens and Eijffinger (2010) in their model, they added a fiscal authority which functions complementarily with the central bank as a regulator to protect the financial systemic stability. According to Nijskens and Eijffinger’s (2010) model, in the fiscal authority’s competences is the “bank closure decision” and the “capital injection” in case of solvent banks. The conclusions extracted from this model clarify that there is a trade-off the risk taking and the investments’ undertaking. More precisely, Nijskens and Eijffinger (2010) found out that when the fiscal authority is easy with the required rescue terms, meaning a low demand on repayment, the moral hazard is diminished trading-off the willing for investments. On the other hand, a demand on repayment that a tight fiscal authority leads to higher level of investment but endures the moral hazard.

### **5.1 Case study - Northern Rock**

The UK bank “Northern Rock” was a clear case of a financial institution facing a liquidity shock. That was the first case of bank run in the European financial system provoked since the onset of the global financial crisis in 2007. This particular bank failed because of a combination of changing liquidity conditions in money-markets. The structure in its balance sheet and the maturity mismatch which it characterized it allowed the market conditions to have a great impact on the bank’s credit standing. In order to rescue Northern Rock, the Bank of England applied a bailout program to provide it with liquidity. Next, we present key facts and policy response to the Northern Rock case and consider it in light of the theoretical discussion in previous sections.

To be more specific, before October 1997, the Northern Rock financial institution was a “mutual-fund building society”. After that time it transformed to a “stock-form” UK bank. This fact meant that the nature of the bank’s assets changed. Mainly, from 1999 and afterwards the funding of the bank was based and highly depended on securitized notes. The structure of the bank’s balance sheet is shown in the following chart of figure 8 and indicates a good capitalization but also the increasing tendency of holding securitized assets until 2007. The bank was growing rapidly and there was a notably management of funding assets of long term maturity. Despite the bank’s





effort for diversification of its financing sources, a significant part of them consisted of securitized notes and secured loans, meaning that if the trade of the securitized notes would become difficult, the bank would anticipate serious funding and liquidity problems. However, it has to be noted that Northern Rock was not highly exposed to sub-prime borrowers and its increasing share in the market of mortgage loans was of good quality and uninfluenced by the US sub-prime crisis until July 2007.

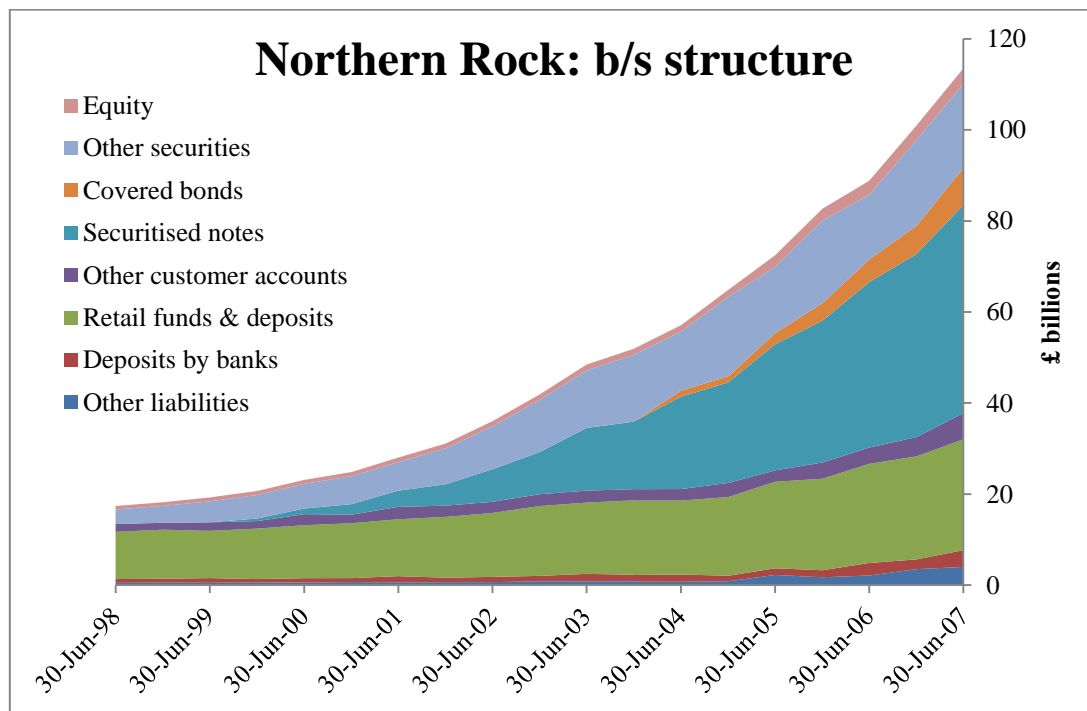


Figure 8: Northern Rock: balance sheet growth and liability structure from June 1998 until June 2007 according to Northern Rock Interim and Annual Report's data. (source: Financial Stability Report's Overview, October 2007, Bank of England)

The bank's rapid growth and the structure of its balance sheet didn't affect the markets' perspectives according the CDS<sup>11</sup> measure, which indicated a stable credit spread. On the contrary, because there was a worrying about the existence of opportunities for further growth due to the bad global financial climate, the price of Northern Rock share began to fall. From August of 2007, the environment of increased uncertainty, the increasing funding costs and the shortening of the maturities made the share price to decrease sharply.

<sup>11</sup> Abbreviation for Credit Default Swaps.



The official sector that monitored the situation of the financial system in UK was represented by tripartite authorities, consisted of the Bank of England, the FSA and the HM Treasury<sup>12</sup>. In mid-August, while Watching Northern Rock's CDS spread rising and its share price falling, the authorities began to discuss about the probability in which Northern Rock would face liquidity shock due to difficulties in funding or borrowing caused by securitization inefficiencies. The maturity mismatch strategy was hard to be followed as the maturities in the balance sheet were shorter and shorter. The vulnerable state of the bank meant lack of incentives in the private sector to keep financing the bank and find a market solution. According the official sector's estimation, the threats to the UK financial system were serious and the risk of contagion was very high. This is the reason why the authorities had to find out a rescue plan to provide Northern Rock with the necessary liquidity.

The FSA suggested that Northern Rock was solvent and, so, in mid-September of 2007, the authorities announced the implementation of the LOLR policy. In the framework of the LOLR policy, Northern Rock and other credit institutions facing liquidity problems would be favored with financial facilities during that crisis period. Although the LOLR policy implementation meant new funding sources and sent positive signaling to the markets, it meant also the confirmation of liquidity problems and led to bank run. To limit the deposits' withdrawals in a mass and uncontrollable scale, the government announced the guarantee of the Northern Rock's existing and renewed deposits. Finally, on 11 October of 2007, Northern Rock asked the Bank of England to give it the opportunity to find a solution by February of 2008. During that time the Treasury would provide Northern Rock with the necessary liquidity.

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<sup>12</sup> Abbreviations for the Financial Services Authority and Her Majesty Treasury.



## **6. Financial Crisis of 2007-2009**

### **6.1 Historical overview**

As Tirole (2010) mentions, the occidental economic environment is characterized by massive liquidity shortage and the markets are frozen; the financial institutions and the, generally, the firms, seeking for liquidity, sell part of their assets at fire sales prices; a contagion of the problems and inefficiencies among the economic sectors is characterizing the economic scene; a large number of cases of insolvencies and bailouts programs are commonly met phenomena.

To begin with the examination of the causes of the financial crisis of 2007 it is useful to cite the main historical events that signify the commencement of a severe recession. The symptoms seem that began to appear in the occidental economies and, more precisely, they arose in the American economy at first. As Acharya and Richardson (2009a) observe, there was a tremendous increase of credit and asset prices. Characteristically, the US debt to national income was in 2007 five times greater than it was in 2002. The initial indications show that there were serious instabilities and problems in the whole financial system occurred in the loans' field, where mortgages couldn't be repaid in a vast scale. More generally, the credit growth was galloping, as it was indicated by the mortgages, and mainly the sub-prime loans, the easy financing of Leveraged Buy Outs<sup>13</sup> and the increased tendency of low-rated bonds, characterized as toxic bonds ex-post. With these instabilities and the firms' default, as some of them couldn't survive the race, the macroeconomic risk was really high, as Acharya and Richardson (2009b) observe. This aggregate risky situation led the Federal Reserve to decrease the interest rate, which finally reached the bottom of 1%. At that point, argue Acharya and Naqvi (2010), was the time when the financial institutions had in practice almost unlimited access to liquidity, allowing them to grow their balance sheets many times.

Then the agency problems, both inside and outside the banks, caused the financial bubble to explode. At first, the financial institutions that had supported their financing capacities into "mortgage backed up securities" were in front of hard difficulties. This fact was the issue that triggered the reveal of liquidity issues and an oversized surplus in the supply in the real estate sector, resulting in price decreasing, while in the

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<sup>13</sup> Known as LBOs.



preceded years there was a great increase in the house prices, almost with a pace of 11% per year. The asset price bubble that was growing during the early 2000s in the real estate sector burst loudly. However, there was an asset price bubble occurred to the real equity prices also, according to Barrell and Davis (2008). The liquidity shortage damaged the bank sector which needed support by the official government sector. The governments started to confront an increasing budget deficit. The troubles moved to the European countries via the globalized interaction of economies. As Barrell and Davis (2008) mention, there was a large turn to nationalization of banks across US and Europe during 2008. And the domino fall began. But, what caused all these financial market inefficiencies and provoked all these problems?

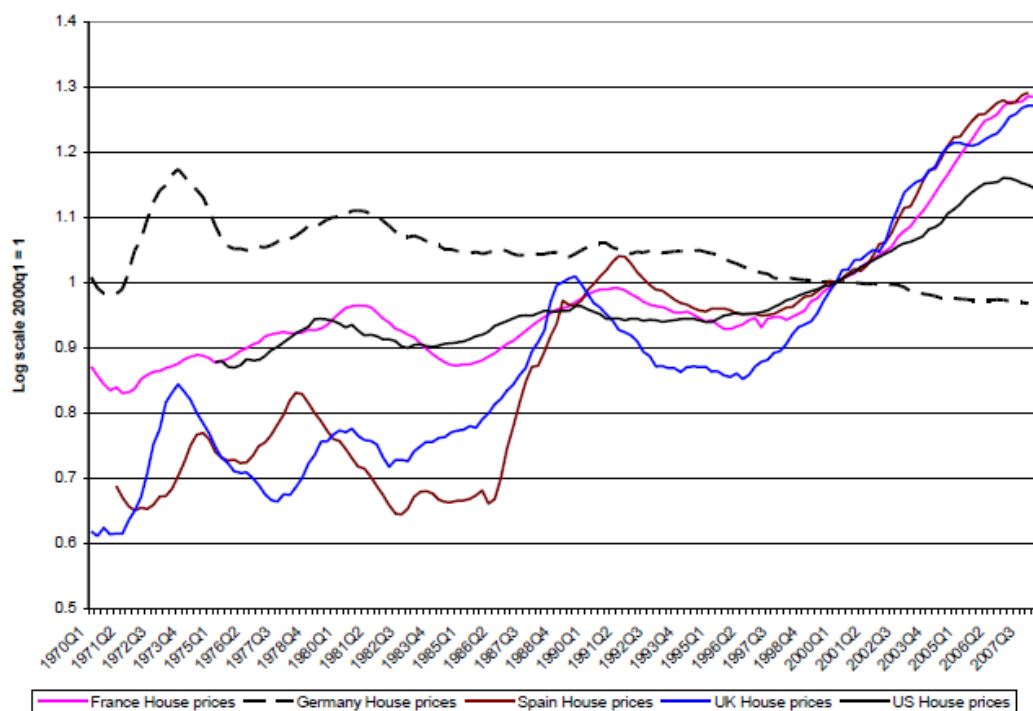
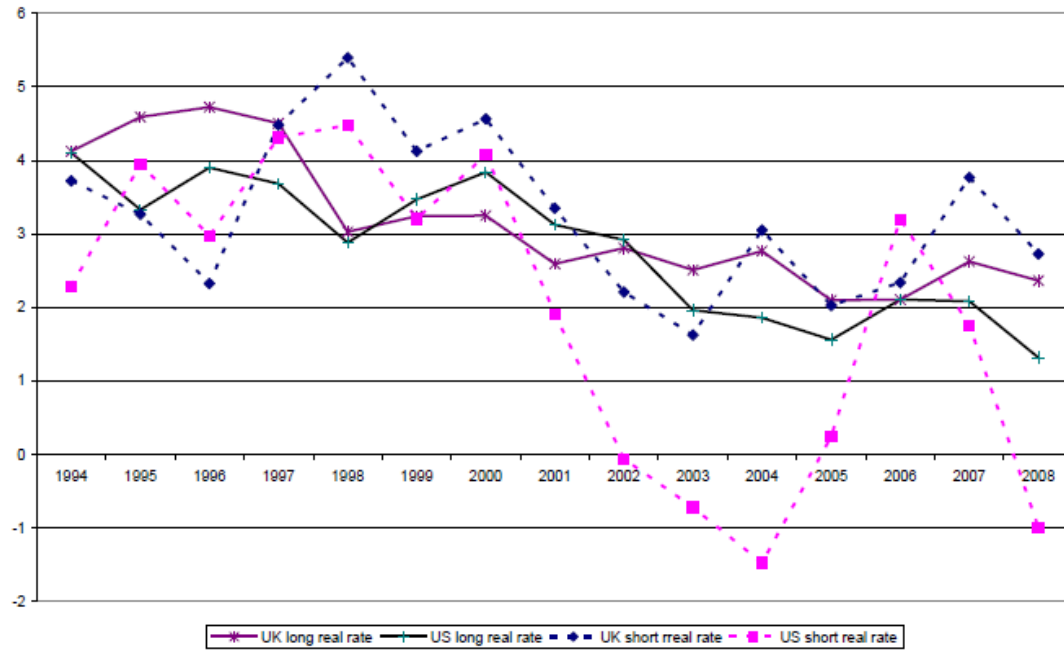


Figure 8: There was a great increase in the house prices in early 2000s. (source: Barrell and Davis, 2008)



*Figure 9: The real interest rates in the UK and the US were very low and contributed to the asset price bubbles' creation. (source: Barrell and Davis, 2008)*

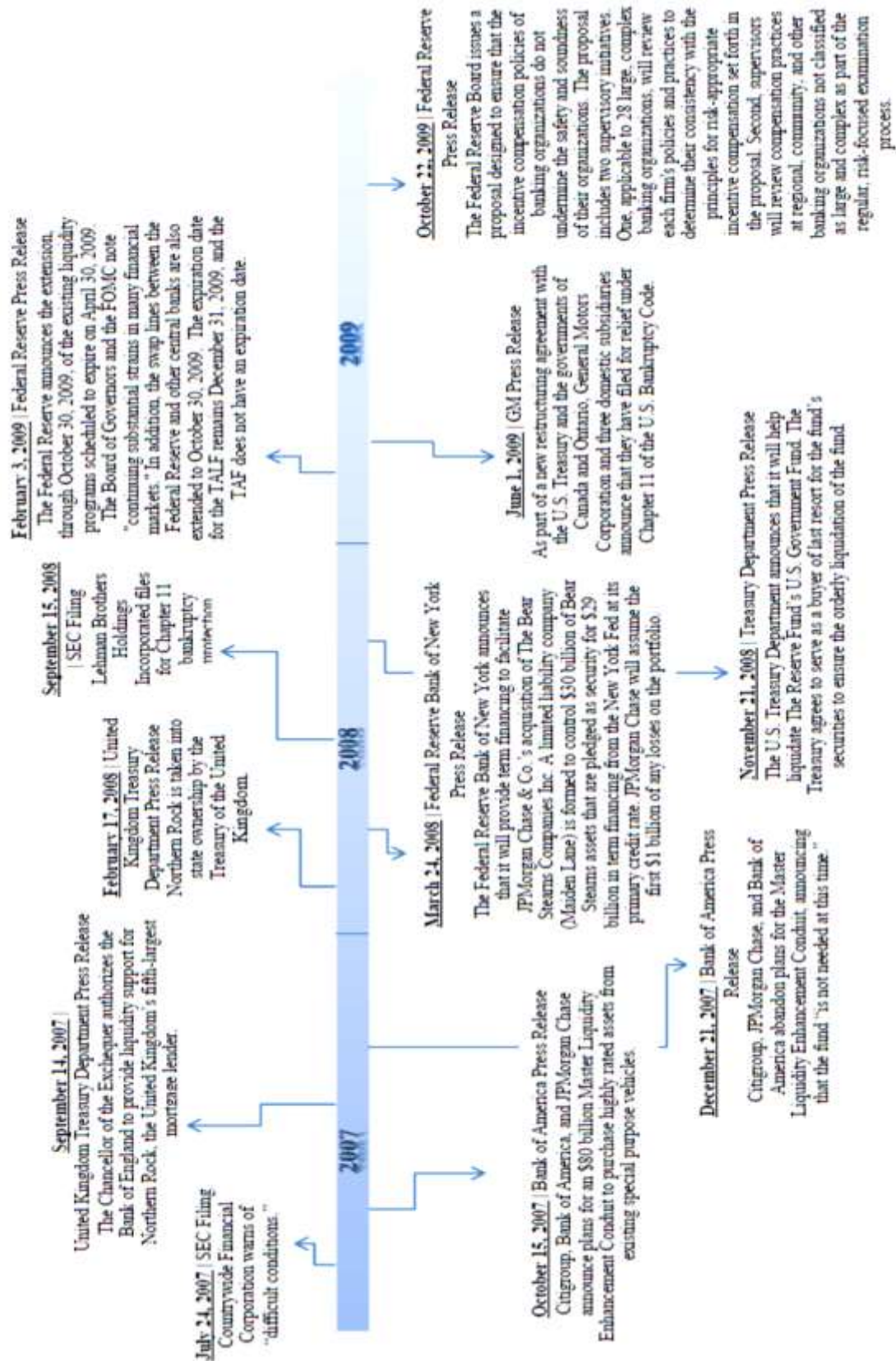


Figure 10: Timeline of some important facts that meant the beginning of the Financial Crisis of 2007-2009, as they are cited by the Federal Bank of St. Louis in <http://timeline.stlouisfed.org/index.cfm?p=timeline#>. (source: author)



## **6.2 Causes of the Financial Crisis 2007-2009**

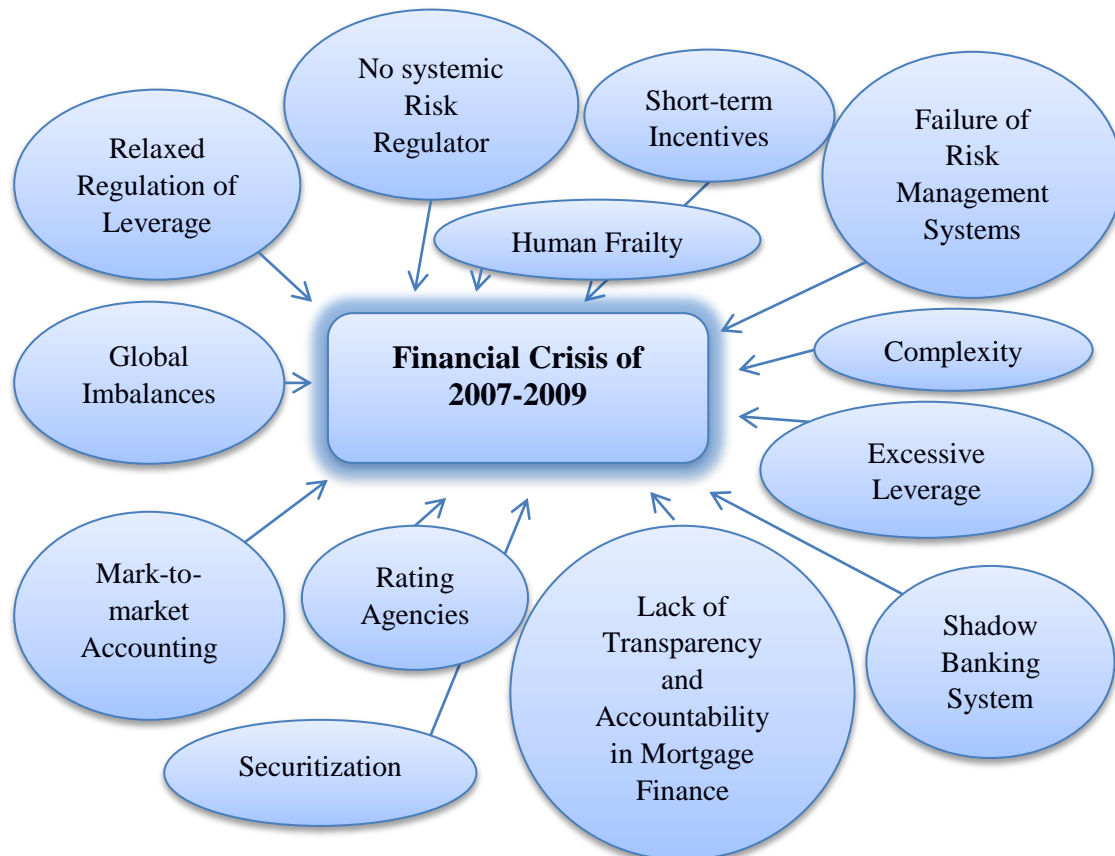
The symptoms of the global financial crisis, which began at 2007, are easy to be perceptual. The deeper reasons, though, of the financial market failures have to be sought more carefully and they originate long before the indications appeared. The whole institutional framework that describes the environment of the economic activity of that time allowed for excess risk taking, as the monetary policy was too loose, Dowd (2009) argues. Goldstein and Razin (2013) consider the coordination failures of the economic system' actors, the asymmetry in information: adverse selection and moral hazard problems, the risk shifting, the heterogeneity among the beliefs of the economic actors over same financial facts and the fragility of the institutes related to the monetary and exchange rate arrangements responsible for provoking the financial crisis. Acharya and Naqvi (2010) consider that the availability of plenty of liquidity during the previous years provoked an asset price bubble that turned to be harmful for the whole economic system. In the same direction, Barrell and Davis (2008) consider the low interest rates and the high profit margin responsible for the bubble.

Farhi and Tirole (2012) underline that individuals and institutions, which can be more easily influenced by economic and political situations, had been left to be tightly dependable on the liquidity's availability and the general market conditions. More precisely, the subprime borrowers were greatly connected with the interest rate conditions, as far as their ability for repayment and refinance are concerned. The banks, meaning the commercial banks to distinct them from the investment banks, have been significantly pledged in order to meet their conduits' demand. Also, the banks had to face a decrease to the total amount of their deposits and they relied on further securitization conducive to find new cash. Barrell and Davis (2008) agree with this argument as well. In addition to that, Farhi and Tirole (2012), observe that the investment banks, meaning the broker-dealers, managed to be more powerful factors in the economy and to obtain greater market share. This empowerment, simultaneously, meant the augmented reliability on the market financing.

To be more specific in the analysis, for this dissertation's framework, some of the main causes of the financial crisis, according to Dowd (2009) and Jickling (2010), are: the relaxed regulation of leverage, the no systemic risk regulator, the short-term incentives, the failure of financial risk management systems, the complexity of the



financial instruments, the human frailty, the excessive leverage, the shadow banking system, the lack of transparency and accountability in mortgage finance, the interfering of rating agencies, the mark-to-market accounting, the global imbalances, the securitization.



*Figure 11: Some of the main causes of the Financial Crisis of 2007-2009, according to Jickling (2010). (source: author)*

According to the economic policy in US, the Securities and Exchange Commission, allowed the investment companies and banks to reach high leverage ratios. These very high ratios allowed the possibility of high earnings, but extremely augmented the losses in case of failure of the investment project. As Jickling (2010) observes there was no authority to regulate all “the systemically important financial institutions”. Barrell and Davis (2008) also consider that there were regulatory inefficiencies and that there was augmented risk due to the high leverage ratios. As it is mentioned, the Fed is the systemic risk regulator, but according to Jickling (2010), it had no



jurisdiction in supervising matters related with investment banks, hedge funds, nonbank derivatives dealers and other similar financial institutions or instruments. However, as it is observed by Davis and Karim (2008), the central banks alerted for the importance of “macroprudential surveillance” over the financial institutions. Moreover, the incentives of the economic players were short-term oriented. During the last years, not only the way in which the modern firms organize their corporate governance, but also the organization of the occidental economies in a whole favored the short-termism of the incentives. In the meanwhile, in Europe, although the banks have to satisfy prudential requirements like the “International Convergence of Capital Measurement and Capital Standards” framework, known as Basel II<sup>14</sup>, defines, the LOLR didn’t manage to fulfill its objectives efficiently, as Nijskens and Eijffinger (2010) consider, because the banks have the incentive to take excess risk and then be rescued by a bailout program in case of failure. Also, the next regulation system referring to the banks, the Basel III<sup>15</sup>, as a continuation and a modernization of Basel II, dictates even more prudential requirements.

Furthermore, there was an inefficient system of risk management in the financial network and caused a failure. The main factor, according to Jickling (2010), of this risk management failure is the separation of the risk analysis in market risk and credit risk. This distinction in the risk analysis was not suitable for complex financial products. Nevertheless, the complexity of many financial products and instruments was an additional reason for the financial crisis. The complexity, as Jickling (2010)

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<sup>14</sup> As it is defined by the Bank for International Settlements (<http://www.bis.org/publ/bcbs109.htm>): “Basel II aims to build on a solid foundation of prudent capital regulation, supervision, and market discipline, and to enhance further risk management and financial stability”.

<sup>15</sup> As it is defined by the Bank for International Settlements (<http://www.bis.org/bcbs/basel3.htm>): “Basel III is a comprehensive set of reform measures, developed by the Basel Committee on Banking Supervision, to strengthen the regulation, supervision and risk management of the banking sector. These measures aim to:

- improve the banking sector's ability to absorb shocks arising from financial and economic stress, whatever the source
- improve risk management and governance
- strengthen banks' transparency and disclosures.

The reforms target:

- bank-level, or microprudential, regulation, which will help raise the resilience of individual banking institutions to periods of stress.
- macroprudential, system wide risks that can build up across the banking sector as well as the procyclical amplification of these risks over time.

These two approaches to supervision are complementary as greater resilience at the individual bank level reduces the risk of system wide shocks”.



mentioned, had influenced the situation in three ways. Firstly, the investors seem not to understand completely the risk that they were taking and, as a result, they were unable to have clear judgment about their investment. Also, because of this complexity, the regulation was difficult and, in many cases, puzzled. Moreover, Barrell and Davis (2008) consider that some of these financial products were new and too innovative and they hadn't been "stress tested". In response to that, the results of these financial products under the real circumstances of the financial crisis were a failure. In addition to that, the "human frailty" is another reason of the financial dysfunction as behavioral finance notes. The investors do not always adapt the rationally optimal alternative as the theoretical models assume or dictate. In contrary, Jickling (2010) recognizes that people often have "bounded rationality" and "limited self-control" that lead them to excessively risky or faulty decisions associated with their investments.

Studying what provoked the financial crisis it is inevitable not to underline the excessive leverage for the majority of the investors. The extreme leverage ratios are caused by the mispricing of the risk and the whole credit bubble of the financial system. In combination with the low interest rates and the plenty amounts of capital in early 2000s, which didn't return enough, the investors resorted to borrowing in order to fund their investments and enlarge their earnings. Another significant factor, which is connected with the banking sector that played important role in the financial crisis, is that banking function was obscure. The shadow banking system, Jickling (2010) declared, meant that risky actions that before took place inside the banking system started to be realized by other institutions, which they were outside of the reach of the official regulation system. More specifically, as Di Iasio and Pierobon (2012) explain the shadow banking is a way for the economic actors to find external investing sources who obtain liquid debt securities connected with illiquid assets, such as mortgages. As Di Iasio and Pierobon (2012) argue, through these shadow banking practices, the financial sector manage its liquidity insurance policy and avoids the use of costly sovereign debt securities. Simultaneously, the lack of transparency and of accountability in mortgage finance makes the things even more complicate. Although the mortgages were a tool to manage the risk as it works like collateral for credit, the mortgages became a problem themselves. The market participants (such as lenders, brokers, individuals from rating agencies, realtors) could trade mortgages or mortgage



backed up securities, without having the full responsibility about the fortune of these mortgages, passing the concern of the mortgages' fortune to the next part of the transactions' chain. This transfer of responsibility and of the toxicity of certain securities caused the collapse of the whole system they were part of, i.e. loan mortgage, banks.

Further argumentation, related to the inefficiencies of the banks, is associated with the agency problems and they are already cited by Acharya and Naqvi (2010) in the previous chapter. More specifically, the agency problems that are raising moral hazard dilemmas and adverse selection can be allocated inside a financial institution and outside the corporation, as well. Acharya and Naqvi (2010), aiming to clarify the inside bank agency problems, point out that the bank employees (loan officers) acted by personal incentives, as their compensation was depending on the loans' volume that they provided, instead of having been motivated to act based on their contribution to the long term profitability. Acharya and Naqvi (2010) suggest that in periods when the macroeconomic risk is high, the depositors tend to avoid investing and not to spend large amounts of their bank accounts and, so, they leave the banks with plenty of liquidity. Thus, the outside banks agency problems are referring to the lack of bankers' incentives to reduce the risk due to excessive loan providing, because their payoffs are not so in stake as they do not have liquidity problems.

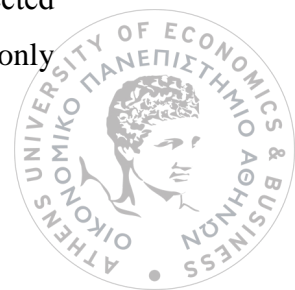
Additionally, the interference of the rating agencies confused the economic environment in many cases. The rating agencies, like all the market participants of that time, underestimated the risk of many securities. The assignment to rating agencies the valuation of financial securities or institutions is accompanied with the principal – agent problems, as well. The incentives and the interest of the rating agencies were subjective and conflicted to the main purposes and, also, in many cases the economic models they used were not the appropriate ones. These facts, in addition to the ineffective regulation, led the rating agencies to intensify the market failure. Furthermore, the significant impact of the rating agencies' estimations implies that the financial markets relied excessively on these evaluations that gave the rating agencies too much power to modify investment decisions. This empowerment of the rating agencies is favored by the legitimate framework and finance regulations, which required the accomplishment of rating related criteria.



Jickling (2010) consider the mark-to-market accounting responsible for the certain problematic situations. The mark-to-market accounting is referring to the accounting system that is based on the assets or liabilities pricing according to their current market prices. This accounting system, in contrary to the historical cost accounting, adjusts the values on firms' or institutions' balance sheets depending on the market. Also, it has to be noted that the market value of an asset is highly correlated with the human frailty, which is mentioned above, and the optimistic or pessimistic predictions for the price based on the related information revealed, according to Jickling (2010). However, this dependence on the market conditions makes the estimated values imprudent and unreliable in cases of great market price variations or sudden changes. Jickling (2010) is skeptic about the mark-to-market accounting as it overestimated the losses in the banking sector at the beginning of the recession and, as a result, a disturbance and a doubt feeling on the banking system are created. This fact seemed to exaggerate the problem and provoked great mistrust to the economic system as it relied deeply on the banks. Complementarily, Barrell and Davis (2008) consider that the mark-to-market pricing influenced deeply and in short term the securitized loans and, as a result, the market liquidity and, of course, the financial institutions and their solvency.

A factor of great importance, as Smaghi (2008) observes, that contributed to the Financial Crisis, from a macroeconomic point of view, is the global economic imbalances. The financial flows seem to have an orbit from the west to the east developed countries. During the previous years, there is a tendency according to which the east countries, such as China and Japan, appear large economic surpluses in contrast to the west countries, (with Germany and other north European countries to be an exception) like U.S., UK and other south European countries, to deal with severe economic deficits.

To conclude, another main cause of the financial crisis, according to Jickling (2010), is the securitization. Jickling (2010) considers the securitization as an enhanced “originate-to-distribute” model; according to which, as the lenders had the intention to selling the loans to others from the beginning, instead of hold them until they mature, they are not as careful as it would be required and they pass the risk to other investors or institutions. Also, the securitization during crises' time is connected with the problem of adverse selection. The securitized loan market collapses, as only



the bad and toxic securities remain to back up the loans. This idea was at first introduced and described accurately by Akerlof (1970), who argued that the sellers are fully informed about the quality of their products and since there is a doubt about the quality the “good-sellers” tend to leave the transaction and market turns to be of low quality and freezes.

Summarizing the analysis of what caused the global Financial Crisis of 2007-2009, it can be derived that the transactions among the whole economic system were risky. That risk failed to be managed in an effective way, though. The factors that are mentioned in this chapter are a part of a very complicated net of causes, but they are the highlighted causes of the reasoning behind this multisided phenomenon. Moral hazard was an important factor in the problems of the financial crisis as all the transactions are characterized by asymmetry in information among the related parts. In addition to that, the shortage of liquidity is obvious that is the major problem of the Financial Crisis.



### **6.3 Moral Hazard & the role of Liquidity in the Financial Crisis**

As it is mentioned, the majority of the transactions that take place in an economic network involve relationships between principals and agents. This kind of relationships, though, means the existence of moral hazard that is mainly provoked by the conflict of interests between the involved parts and the incompleteness of the contract that describes their relationship. In a microeconomic point of view the agency theory, the contract theory and the corporate governance try to eliminate the effects of moral hazard. This chapter has as main objective to examine how these microeconomic inefficiencies impact the whole financial system and aggravate crucial aggregate macroeconomic issues, provoking a financial crisis of international scale.

The distressing case of the Global Financial Crisis of 2007-2009, is a real case of an aggregate liquidity shock as it has been described in Holmström and Tirole's (1998) analysis. A very large portion of firms anticipate serious liquidity problems at the same time and they cannot serve each other by cross subsidizing their investment plans. As it has been argued in the previous section of this dissertation, it is essential for the official sector to intervene and regulate the scarce liquidity.

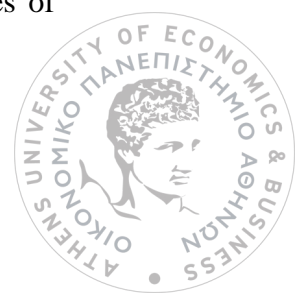
The official sector, as it is mentioned by Pasten (2010), can be focused on a certain long term economic policy or it can have no commitment on a certain plan and designs more direct and short term policy measures. In the first case, the official sector, as Pasten (2010) supports, has no incentives to proceed into rescue policies. On the contrary, when the official sector is short term oriented, the bailout measures are inevitable. In the second case, the financial institutions are aware of the official sector's willing to rescue them in case of a liquidity management failure and, driven by moral hazard powers, they hold less liquidity. Pasten (2010) expands this syllogism and argues that if there are more than one "distress state" and the economic actors have knowledge of that, they all would be intent to be driven in the same "distress state" during an equilibrium phase. This conclusion is derived from the fact that the larger the number of the financial institutions facing the same problematic situation is the more certain and larger is the bailout program. Pasten (2010) observes that the ex-ante limited liquidity holding by the financial institutions and the ex-post necessity of large bailouts' implementation by the official sector reduced the level of



the social welfare. By developing this reasoning Pasten (2010) explains the phenomenon of collective moral hazard.

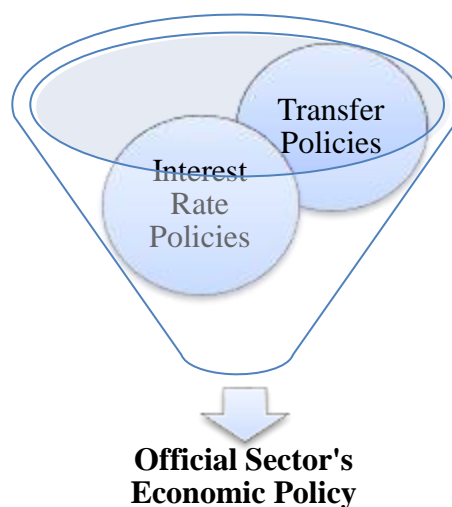
The official sector, under the form of central banks and treasuries, in the direction towards alleviating the problems of the financial crisis, did deeply interfere in multiple levels and in crucial matters. This interference is, historically, almost unique as it is realized in such large scale for the first time in the case of the global financial crisis of 2007-2009, as Farhi and Tirole (2012) mention. It has to be notified that the official sector's interference is realizing under informational asymmetries constraints. Farhi and Tirole (2012) are in agreement with Pasten's (2010) allocation on the anticipation according which the financial crisis of 2007-2009 is provoked by aggregate liquidity risk combined with the phenomenon of collective moral hazard. In their analysis, Farhi and Tirole (2012) classify the relative measures taken, mostly in accordance with the official sector's objective of refinancing the financial institutions, in two categories. The first type of measures is characterized by the general term of "interest rate policies". The second kind of the interfering actions is grouped under the term of "transfer policies".

Farhi and Tirole (2012) alert that the in practice distinction between the two categories may be confusing. So, in order to do this categorization of the implemented policies, Farhi and Tirole (2012) use criteria, according to which the measures aiming to low the borrowing costs for the financial institutions are referred as the "interest rate policies" and the measures aligned with the attempt to increase the net value of the banks, while keeping directly untouched the banks' borrowing costs, are associated with the "transfer policies". To be more accurate in the analysis for the measures taken by the official sector, it is useful to give some examples of the above mentioned grouped policies as they have been clarified by Farhi and Tirole (2012). Some examples of "interest rate policies" are: the Fed's intention to decrease down to zero the inter-banking interest rate (Fed Funds rate), according to which the financial institutions lend and borrow funds aiming to cross balancing their balance sheets. Other examples of the relative measures taken are the extension of the "debt guarantees" for the banks and the acceptance of assets of doubtful quality as collateral for loans, usually combined with haircutting. At the same time, the recapitalizations of the banks or the purchasing of legacy assets at generous prices are examples of "transfer policies".





However, the public policy that is consisted of numerous and various measures like the above mentioned, cannot be accurately and perfectly targeted or efficiently specified for every particular case where the intervention is necessary. On the contrary, Farhi and Tirole (2012) argue that the measures affect the whole economy and some of them may have conflicted results. In some cases, the measures try to alleviate a particular financial problem, but in macroeconomic point of view, they affect other factors like a chain reaction with trading-off consequences. For example, as Farhi and Tirole (2012) cite, the aid offering to the financial institutions by decreasing the above mentioned inter-banking interest rate facilitates the banks' situation by favoring their financial position as far as their choice of maturity mismatch is concerned, but this action has further impacts to the economy. Similarly, Diamond and Rajan (2008) note that by decreasing the economy's interest rate can prevent some problems, such as bank runs and fire sales. However, at the same time, the lower interest rates raise the possibility of moral hazard and motivate the banks to not to keep enough liquidity.



*Figure 12: The measures that the official sector takes while it craves its economic policy can be distinguished into two categories according to Farhi and Tirole (2012): the interest rate policies and the transfer policies. (source: author)*

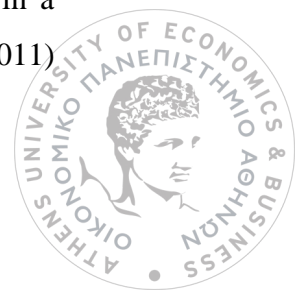
In a microeconomic level, the maturity mismatch can be defined as the firms' and banks' inclination to fill in the equation of their balance sheet by keeping less short



term assets than short term liabilities and, simultaneously, medium and long term assets are more preferable than the correspondent liabilities. It is important to note that the relative choice of their maturity mismatch position gives information about their, liquidity capacity. However, if the economy is observed as an entity, and not only as an aggregation of its parts, the expanding notion of the maturity mismatch in a macroeconomic level of analysis, it can be noticed that it characterizes the economic situation during the financial crisis as its symptoms are briefly described in chapter 6.

Farhi and Tirole (2012) introduce that a favorable measure that is classified as an “interest rate policy”, means a support to the financial institutions which implies a flow of utility from the consumers to the banks. The banks enjoy a larger tranche of the savings’ yields pie than the consumers. In addition to that, there are other costs, such as current and deferred costs that tend to be fixed. These current costs can be provoked by letting unworthy investment project to be realized and the deferred costs by allowing the extended use of maturity mismatch or official sector’s loss of trustworthiness. The utility flow can be considered as a variable cost due to volume depending attitude which is associated with the refinancing procedure. The portion of the fixed to the variable costs modifies the balance sheets’ maturity mismatch choices. These choices influence the official sector’s policy planning because the maturity mismatch position indicates the risk taken by the firms or banks and implies different level of central bank interference.

While sketching an economic policy, Almeida et al. (2011) note that it is useful to take into account the impacts of the credit cycles and, more accurately, the credit crises. As credit cycles can be considered the modifications of the economic actors’ ability to access credit. The credit cycles, on the other hand, and specifically the periods of decreased creditability, can be examined by the studying of the debt maturity synthesis of the firms, as Almeida et al.’s (2011) analytical model suggests. The conclusions that can be derived from the debt maturity structure’s examination can be used as complementary tools to the observations of the firms’ leverage ratios in order to comprehend the way of the problems, caused by the credit and liquidity shocks, are diffusing over the firms’ sector. Moreover, Almeida et al. (2011) observe that the financial and credit crisis of 2007 had influenced deeply the firms’ financial and investment behavior of 2008, notifying that the crisis showed its impacts in a short period of time. In a microeconomic level, the model of Almeida et al. (2011)



implies that the financial management of the firms should be aware of the importance of the firms' debt maturity structure as it has great influence on the firms' investment ability. Similarly, Diamond and He (2012) suggest that the debt maturity structure influences the default decisions, as well. The debt maturity has impacts on the firm's pledgeability and credit capacity. Summarizing Diamond and He's (2012) argument, both investment and default decisions are highly depending on the firm's debt maturity relatively to the firm's equity and the credit line arrangements.

Back to a macroeconomic point of view, the regulatory system of the economy has to be as tight as possible in order to be efficient and avoid the regulatory arbitrage. More specifically, an inefficient and loose regulatory system allows to the economic actors to take advantage of the holes in the system and bypass the rules that should follow in order to let the measures function properly and accomplish their goals. These regulatory opportunities and, also, the mistaken reliability of the investors on securitization or funding liquidity lead them to choose maturity mismatch. This strategy choice, according to Farhi and Tirole (2012), involves further risk corresponded with the management of the investors' liquidity insurance, which increases the tendency of the other economic actors to take relatively more risk for their liquidity matters, as well.

Aiming to give an analytical model of the previous mentioned factors of liquidity risk, maturity mismatch, moral hazard, excess risk taking and systemic bailouts, Farhi and Tirole (2012) build an economic environment with macroeconomic uncertainty as there is aggregate liquidity shock and the liquidity shocks that the economic actors face are correlated. In this environment the firms and the banks choose their maturity mismatch plan by deciding for the level of their short term debt obligations and for their whole liquidity management strategy. Farhi and Tirole (2012) notice that the economic actors' choice of the maturity mismatch level depends on the amount of the short-term debt they issue. The larger the amount of the issuance of the short-term debt is, the more extended is the use of "maturity mismatch" tool. More precisely, according to Farhi and Tirole (2012), although the short-term debt issuance allows the banks to increase their leverage ratio and undertake more investment plans, it increases their refinancing risk in front of a possible liquidity shock.

The interference of the official sector, as it is already declared, results in a social welfare rearrangement. Farhi and Tirole (2012) consider that the official sector,



mostly by the interest rate policies, attempts to “maximize a weighted average of consumer surplus and banking stakeholders’ welfare”. For example, in case of an aggregate liquidity shock if the official sector applies a loose interest rate policy, meaning the imposing of a lower interest rate, allows the troubled financial institutions to borrow more and enables a chance of refinancing. However, the loose interest rate policy has as a result the flow of the consumers’ utility to the banking stakeholders’ and other bank attached interested parts’ utility, as it already mentioned. Additionally, the refinancing of the bank institutions can provoke an adverse selection and fund unworthy investment projects by draining funds from other much healthier and profitable projects and by losing future investment opportunities. Also, Farhi and Tirole (2012) observe that a loose interest rate policy can provoke future costs, such as future serious liquidity problems to the financial institutions or damage to their credit ability or encourages the increase of their risky leverage ratio. Summarizing, a loose interest rate policy increases the chances for future financial crises. The official sector’s intervention in financing regulation is worthy if the liquidity shock is aggregate and, so, the number of the troubled entities is large enough, as Farhi and Tirole (2012) declare. The demand of a large portion of troubled firms and financial institutions is important for the benefit to exceed the relative cost of the measures’ implementation.

In their analysis, Farhi and Tirole (2012), support the idea that in the financial crisis of 2007-2009 the official sector, despite the fact that it provided the financial institutions with liquidity, it hadn’t many efficient alternatives for economic policy making. Farhi and Tirole (2012) insist that the central authorities should build a more solid and prudential net of regulatory rules and requirements *ex ante*. They, also, declare that these prudential requirements should be demanded not only in a microeconomic stage, like the Basel II sets, but also in a macroeconomic level. This argument originates from the necessity to take into account the maturity mismatch choices of the whole financial system. In this direction, according to Farhi and Tirole’s (2012) analysis, a basic problem in the process of carving the optimal regulation strategy is the need to overview the banks as a united entity due to the fact that the banks aggregated use the maturity mismatch policy widely and the risk they take is excess and correlated. So, their perception on the optimal regulation is the idea



of satisfying the suitable liquidity requirement or being prudent with their short-term debt issuance.

Moreover, because the financial regulation is costly, Farhi and Tirole (2012) clarify that it is useful for the official sector to decide which financial institutions are of that great importance that it is worthy to rescue with their bailout programs. More often, these financial institutions are referring to large banks that play a significant role in the payment and credit system or there is a tight linkage between them or they are deeply connected with the central banks. In their model, Farhi and Tirole (2012) continue their analysis by relaxing the assumption of correlated liquidity shocks among the banks and let them to decide upon the level of the correlation. They found out that the banks tend to choose to maximize the correlation among the shocks due to the fact that if they are correlated they respond better to the bailout policy.

Because of the interest rate policies' costs described above, Farhi and Tirole (2012) observe that the transfer policies are preferable in cases they are available. The transfer policies are more suitable to protect and reinforce the economic actors who have a strategically important role. Also, in their model, the direct transfers to the financial institutions by the official sector are allowed. In contrary to that the interest rate policies are more likely in cases of real borrowing needs as it is a "market-driven" solution.

Farhi and Tirole (2012) follow the same reasoning to the transfer policies as it has been done to the interest rate policies. More precisely, they take into account the maturity mismatch choices, the firms and banks' liquidity positions and come to a conclusion according to which, the optimal regulatory and bailout policy is the implementation of a combination of the two types of policies. An amalgam of interest rate policies and transfer ones can allow the official sector apply a more efficient economic policy in the aggregate. It can use its available "weapons" against the financial crisis in a more accurate way by choosing the corresponding measure in accordance with the kind of the inefficiency and the symptom it tries to cure.

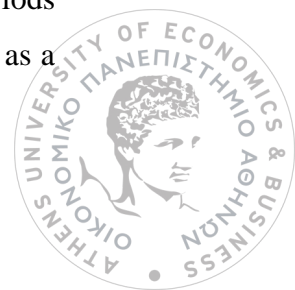
In contrary to Farhi and Tirole's (2012) analysis, Pasten (2010) emphasizes on the necessity of a long term financial policy's implementation and a pack of "six wedges" that have to be taken into consideration, during the examination and the design of an efficient the financial policy and a bailout program, are introduced. The



analysis of the parameters that consist the financial policy carving can be helpful in order to reach a more socially efficient solution than targeting to improve only one factor each time. Pasten (2010) defines the “wedges” as “key variables” that a small change of them can modify the effect of a bailout plan and it is noted that there can be a relation among the wedges.

To be more specific, Pasten (2010) introduces as “key variables” the following factors: the liquidity wedge, the size wedge, the pledgeability wedge, the evaporation wedge, the discounting wedge and the continuation wedge. The “liquidity” one is referring to the available liquidity that the financial institutions hold, the “size” is associated with the level of the investment project’s riskiness; the “pledgeability” measures the entrepreneurs’ credit rationing, the “evaporation” takes into consideration the liquidity premia during a financial crisis; the “discounting” is referring to the official sector’s time perspective and the “continuation” to the future costs due to policy related changes. All these factors can be considered as complementary measures in the disposal to the official sector plan designers for the socially optimal financial policy. So, concluding, Pasten (2010) declares that the appropriate modification towards improvement of these six wedges can lead to a socially preferable bailout program by increasing the ex-ante liquidity holdings by the financial institutions and the ex-post decreasing of the necessary amount for the official sector’s bailout intervention.

As it is already mentioned in the relative chapter 6 referring to the crisis’ causes, a further examination of the causes can lead to the enlightening conclusion that Acharya and Naqvi (2010) derived, according to which, the banks in an environment with enough liquidity can trigger the creation of asset price bubbles. For this reason, Acharya and Naqvi (2010) insist that the optimal monetary policy implemented by the official sector via the central banks, is consisted of an adjustable liquidity supply. In periods of excessive availability of liquidity to the banking sector, a central bank should apply a tight monetary policy in order to prevent the excess risk taking by the financial institutions and the consequences of the asset price bubbles. On the contrary, in periods with limited access to liquidity, the implemented monetary policy should be expansionary aiming to facilitate the investment process. Acharya and Naqvi (2010) clarify that an attempt of a loose monetary policy during periods with high macroeconomic risk could provide the banks with even more liquidity; as a



result to give incentives of excess risk taking due to moral hazard and make the problems of credit crises and asset price bubbles even worse, aggravating the financial crisis. It is worth mentioning that Berger and Bouwman (2012) examine how the impact of the applied monetary policy varies depending on the size of the banks and the general economic conditions. To be more specific, Berger and Bouwman (2012), through their research, derived that the monetary policy influences the liquidity creation solely in case of the small sized banks under normal economic conditions. On the contrary, when the economic conditions are unstable all banks are less affected by the monetary policy measures.

Concluding, it is useful to cite the main ideas which structured the analysis in this chapter. As it has been examined previously, in this thesis' framework, the moral hazard in principal agent relationships played an important role in the availability and the circulation of liquidity. The financial crisis of 2007-2009 was a severe case of aggregate liquidity shock and unprecedented intervention of the official sector was inevitable as Holmström and Tirole's (1998) model predicts. Due to the vital importance of the implementable policy, there was an effort to set the fundamental bases on which a socially optimal monetary policy should be built. In this effort the model of Farhi and Tirole (2012) had mainly contributed. However, many alternatives or supplementary theories and economic models focus on this research field. A brief review of this literature is presented in the following chapter.



## **6.4 Review of the Financial Crises' Theories and Models**

As the Financial Crisis of 2007-2009 was one of the most severe and the massive economic crises since the Great Recession of 1939, economic and financial theory leaned over and tried to answer “why did this happen?” and “how it can be resolved?”. More specifically, in the previous sections, there was an analytical overview of the symptoms and the causes of the financial crisis, focusing on the agency problems due to moral hazard and the liquidity problems.

In a more general framework, following the analytical process of Goldstein and Razin (2013), who summarize the explanatory theories of global financial crises, the facts happening during the crises can be grouped in six categories; the banking crises, the national currency and single currency area crises, the credit frictions, the market freezes, the asset bubbles and the sovereign debt crises.

According to Goldstein and Razin (2013), through the examination of the banking crises, the conclusion derived is that the instability on the banking sector is mainly caused by the tendency of the banks to finance their long term liabilities via their short term deposits. This maturity mismatch of bank's debt and claims' structure increases the risk taking by the banks and augments the risk of bank runs. The risk of the bank runs are examined by Chatterji and Ghosal (2007) and Diamond and Rajan (2001). Additionally, due to the crises in the banking sector, the inter-bank market collapse and these problems are examined by Santos (2009) and Kharroubi and Vidon (2009). The findings of the analysis mentioned above complete the whole picture referring to the problems in the banking sector and all the relevant analysis done in the previous chapters; in chapter 5 relative to the banks, in chapter 6 relative to the causes of the financial crisis the moral hazard and the liquidity in such periods.

In general, other causes of the financial crises can be searched into the currency instabilities and the exchange rate arrangements. One of the official sectors' objectives is to maintain a stable environment for the economies to grow and develop. More precisely, the exchange rate stability contributes in the facilitation of the interaction and the trade among the countries in a globalized environment, and in the global investment planning, too. As Goldstein and Razin (2013) observe, this economic stability depends on the financial and monetary arrangements, meaning a “fixed-exchange rate regime”. As far as the modern economies are concerned, the





stability is trying to be protected by the monetary unionizing of countries or regions. Nevertheless, in periods of crises these arrangements are fragile and can influence the debt crises and the whole banking sector. Allen and Gale (2000) connect the financial fragility with the contagion state and argue that the frequency of these phenomena' and their level of noise depend on the tightness of the interregional claim relations. The currency crises and their prevention can be confronted by the monetary policy. Krugman (1999) introduces and examines the linkage of the differences in the currencies and the problems they cause in a globalized economy. Moreover, during a financial crisis it is observed that there is a flow of capitals to the economies with major currencies. Kolher (2010) notes, that in the case of the financial crisis of 2007-2009, though, there was not a similar tendency of flow to the major currencies, meaning the US dollar, the Japanese yen and the Swiss franc. Relatively to the currency instabilities and the exchange rates and to the aforementioned in chapter 6 global imbalances, in a macroeconomic framework, the interest rate policies and the political objectives have created a difference in the dynamics between the emerging economies and the developed ones.

The imbalances in the global scene are deeply associated with the problems provoked the crisis of 2007-2009. As it is an important factor of the crises and is relative to the liquidity in which we are interested in, it will be examined in a more detailed way. There is a financial fragility that is highly connected to this globalized economic interaction. In favor to this argument several researchers have studied deeper the net capital flows from the occidental to the emerging economies of the world and vice versa. Specifically, Krugman (2009), Dunaway (2009) and Dewatripont et al. (2009) contribute in this argumentation. On the other hand, another group of researchers suggest that the global imbalances are an important factor of the crisis but they may be overestimated. More precisely, Borio and Disyatat (2011) underline the significance of the excess elasticity of the global monetary and financial system instead of the excess savings' amount proportionally to the investments in the emerging economies. Moreover, it is commonly argued that the part of the word of the developed economies that are firstly and strongly affected by the global imbalances is the US. Cabarello and Krishnamurthy (2009), refer to the US inflows of "toxic" securities come from the emerging countries which they wanted to secure their capitals in "safe" and "riskless" investments. Additionally, Obstfeld and Rogoff





(2009) point out the easiness with which US borrowed capital and funds from the emerging economies and especially from China under a very low interest rate. This situation deeply contributed in the creation of the asset price bubble, as well.

In contrary to the ideal economic environment where the markets are complete, the reality is characterized by frictions that hinder the economic function. So, ideally, the access to credit has to be easy and unobstructed in order the firms to find liquidity and fund their investment projects. However, this access is limited by several factors that are analyzed extensively by Holmström and Tirole (1998). Allen and Carletti (2008), also, analyze the role of liquidity in financial crises. In the same context, Berger and Bouwman (2012) supplement on the bank liquidity creation and connect it with the implemented monetary policy. In a macroeconomic scope of analysis, Eggertsson and Krugman (2011) pinpoint the role of the credit frictions in this macroeconomic level. The scarce liquidity and the limited access to credit and other funding sources lead to market freezes as it is analyzed above.

The facts of a financial crisis that can be characterized as asset bubbles according to Goldstein and Razin's (2013) classification can be reviewed through risk shifting and heterogeneity in the economic actors' beliefs. Acharya and Naqvi's (2010) analysis also contributes significantly in the examination of asset bubbles.



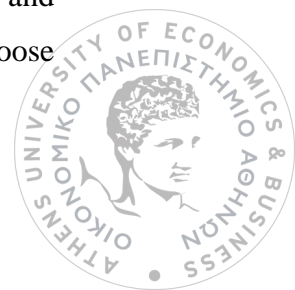
## **7. Conclusions**

Liquidity is necessary for a firm in order to finance its investment projects and meet its obligations. The assurance of the firms' access in funding sources and capital markets is necessary in order to survive a potential liquidity shock and to reinforce their profitability. Aiming to fulfill their liquidity needs, the firms carve a financial management policy by choosing the optimal combination of the available funding tools. The firms, correspondingly to their needs, goals and capacities, choose to borrow from other firms or financial institutions and arrange credit lines, following a "finance-as-you-go" policy or keep cash holdings for liquidity insurance as a "liquidity hoarding" policy. Nevertheless, due to moral hazard, there is limited pledgeability of a firm's assets and this fact puts a ceiling on its borrowing ability in order to fund its investment plans. The firms have to be motivated with an appropriate bribe, such as a high enough compensation, in order to be committed and make the adequate effort to fulfill the investment projects undertaken.

Financial institutions are financial entities that aim to make profits via their activities too, similarly to any other firm in the globalized market. However, banks are distinguished case of corporations. They are financial intermediaries that their main role is to finance other firms and provide liquidity through loans or credit lines. Because of this important role, the banks are related to the official sector and they are regulated by official sector's authorities. The official sector can intervene when it is needed, in order to aid the financial institutions when cases of emergency arise.

Having as a main tool of analysis the model of Holmström and Tirole (1998), the liquidity shortage can be distinguished into two categories. When the liquidity problems are anticipated by a small number of firms, the liquidity shock is non-aggregate. The isolated firms that seek for liquidity they can fulfill their needs by cross-subsidization without the interference of the official sector. On the contrary, when the phenomenon of liquidity shortage is massive, the liquidity shock is aggregate and the private sector cannot auto-supply itself with the necessary liquidity. In that case, the official sector's interference is inevitable in order to reach the optimal social welfare level. The official sector can provide liquidity through bond issuance.

The financial crisis of 2007-2009 is an example of aggregate liquidity shock and it appeared in the occidental word, where the economic authorities followed a loose



monetary policy during the precedent years. Before the crisis, the financial authorities had lowered too much the interest rates in their attempt to boost the investments but they let an abundant liquidity to circulate in the financial system. This increased amount of available liquidity led to an asset price bubble creation. The access to liquidity was facilitated by the ease with which the banks provided loans. The bank managers conducted by personal incentives over-provided loans. The credit and the asset bubble burst and combined with other inefficiencies caused the problem of the crisis. Two of these factors that led to the crisis, and were pinpointed in this dissertation, are collective moral hazard and the securitization.

Hence, all these problems led to contagion, serious massive illiquidity, market freezes and insolvencies and bailout programs. Therefore, the recent global financial crisis of 2007-2009 can be considered as an example of a typical aggregate liquidity shock. A notably large number of firms anticipated liquidity problems. Hence, the official sector did have to interfere and regulate the scarce liquidity. The official sector via central banks and Treasuries take measures and design a monetary policy to alleviate the crisis' problems and restore the stability, the economic competitiveness, the social welfare and reinstate the cycle of development and growth.

The official central sector intervenes in the function of the financial system by a monetary policy implementation. Depending on the objectives the official sector desire to fulfill, adopts measures of “interest rate policies” and “transfer policies”. Additionally, it applies rescue programs for systemic bailouts and launches LOLR mechanism when it is necessary to relieve the banking sector. However, the moral hazard arises from the behalf of the banks as they continue to take excessive risk and expect to be rescued by a bailout. That is why the regulatory authority has to be tight and the existence of macroprudential surveillance, like Basel III, is essential.

The whole analysis, taken place in the previous sections, explains why the financial crisis of 2007-2009 was so damaging and why the official sector via central banks injected unprecedented amounts of liquidity in order to boost investment undertaking by imposing radical measures. The economic science by using theories and models is trying to understand, explain and propose resolutions to remedy the problematic situations. The contribution of the present dissertation in this effort is an ambitious synthesis of a significant part of the available research and related literature



to understand and underline the importance of liquidity to an economic system in an uncertain and asymmetrically informed environment.

Although the main scope of this dissertation was holistically developed upon specific points, views and objectives, it is useful to specify essential areas that this dissertation is not covering due to its purposes or due to the analysis framework that follows. As the main prism through the analysis has been made was the agency and moral hazard problems, other areas can also be proposed as further work analysis and as a wider research of the liquidity matters in the economy. More precisely, an analysis on the liquidity models' effects can be conducted, after a specific multi-criteria diversification of the models, in order to specify their effectiveness on a similar crisis situation as the 2007-2009 one. A further proposal is to examine the liquidity problems taking into account other externalities and market frictions in the financial systems in order to alleviate more efficiently the problems of an economy in crisis, or even prevent them by exploiting the experience of the current historical situation. Even though particular points of the Holmström and Tirole's (1998) analysis have been empirically tested, such as the effectiveness of the credit lines in liquidity management, other parameters can be econometrically tested using real data of the recent crisis. Hopefully, the current thesis that provides an adequate theoretical basis on liquidity matters, mainly due to moral hazard, and linked with the financial crisis of 2007-2009, it will be an valuable asset for future and further research on the specific field of economic science.



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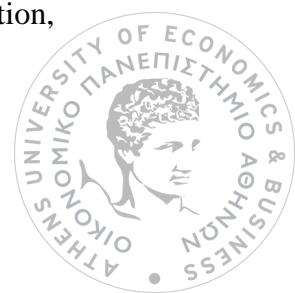
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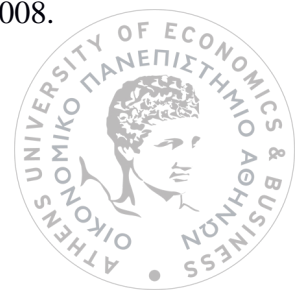
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# APPENDIX

## Basel Committee on Banking Supervision reforms - Basel III

Strengthens microprudential regulation and supervision, and adds a macroprudential overlay that includes capital buffers.

Capital					Liquidity
Pillar 1		Pillar 2		Pillar 3	
Capital	Risk coverage	Containing leverage	Risk management and supervision	Market discipline	Global liquidity standard and supervisory monitoring
<p><b>Quality and level of capital</b> Greater focus on common equity. The minimum will be raised to 4.5% of risk-weighted assets, after deductions.</p> <p><b>Capital loss absorption at the point of non-viability</b> Contractual terms of capital instruments will include a clause that allows – at the discretion of the relevant authority – write-off or conversion to common shares if the bank is judged to be non-viable. This principle increases the contribution of the private sector to resolving future banking crises and thereby reduces moral hazard.</p> <p><b>Capital conservation buffer</b> Comprising common equity of 2.5% of risk-weighted assets, bringing the total common equity standard to 7%. Constraint on a bank's discretionary distributions will be imposed when banks fall into the buffer range.</p> <p><b>Countercyclical buffer</b> Imposed within a range of 0-2.5% comprising common equity, when authorities judge credit growth is resulting in an unacceptable build up of systematic risk.</p>	<p><b>Securitisations</b> Strengthens the capital treatment for certain complex securitisations. Requires banks to conduct more rigorous credit analyses of externally rated securitisation exposures.</p> <p><b>Trading book</b> Significantly higher capital for trading and derivatives activities, as well as complex securitisations held in the trading book. Introduction of a stressed value-at-risk framework to help mitigate procyclicality. A capital charge for incremental risk that estimates the default and migration risks of unsecured credit products and takes liquidity into account.</p> <p><b>Counterparty credit risk</b> Substantial strengthening of the counterparty credit risk framework. Includes: more stringent requirements for measuring exposure; capital incentives for banks to use central counterparties for derivatives; and higher capital for inter-financial sector exposures.</p> <p><b>Bank exposures to central counterparties (CCPs)</b> The Committee has proposed that trade exposures to a qualifying CCP will receive a 2% risk weight and default fund exposures to a qualifying CCP will be capitalised according to a risk-based method that consistently and simply estimates risk arising from such default fund.</p>	<p><b>Leverage ratio</b> A non-risk-based leverage ratio that includes off-balance sheet exposures will serve as a backstop to the risk-based capital requirement. Also helps contain system wide build up of leverage.</p>	<p><b>Supplemental Pillar 2 requirements.</b> Address firm-wide governance and risk management; capturing the risk of off-balance sheet exposures and securitisation activities; managing risk concentrations; providing incentives for banks to better manage risk and returns over the long term; sound compensation practices; valuation practices; stress testing; accounting standards for financial instruments; corporate governance; and supervisory colleges.</p>	<p><b>Revised Pillar 3 disclosures requirements</b> The requirements introduced relate to securitisation exposures and sponsorship of off-balance sheet vehicles. Enhanced disclosures on the detail of the components of regulatory capital and their reconciliation to the reported accounts will be required, including a comprehensive explanation of how a bank calculates its regulatory capital ratios.</p>	<p><b>Liquidity coverage ratio</b> The liquidity coverage ratio (LCR) will require banks to have sufficient high-quality liquid assets to withstand a 30-day stressed funding scenario that is specified by supervisors.</p> <p><b>Net stable funding ratio</b> The net stable funding ratio (NSFR) is a longer-term structural ratio designed to address liquidity mismatches. It covers the entire balance sheet and provides incentives for banks to use stable sources of funding.</p> <p><b>Principles for Sound Liquidity Risk Management and Supervision</b> The Committee's 2008 guidance <i>Principles for Sound Liquidity Risk Management and Supervision</i> takes account of lessons learned during the crisis and is based on a fundamental review of sound practices for managing liquidity risk in banking organisations.</p> <p><b>Supervisory monitoring</b> The liquidity framework includes a common set of monitoring metrics to assist supervisors in identifying and analysing liquidity risk trends at both the bank and system-wide level.</p>
<p>In addition to meeting the Basel III requirements, global systemically important financial institutions (SIFIs) must have higher loss absorbency capacity to reflect the greater risks that they pose to the financial system. The Committee has developed a methodology that includes both quantitative indicators and qualitative elements to identify global systemically important banks (SIBs). The additional loss absorbency requirements are to be met with a progressive Common Equity Tier 1 (CET1) capital requirement ranging from 1% to 2.5%, depending on a bank's systemic importance. For banks facing the highest SIB surcharge, an additional loss absorbency of 1% could be applied as a disincentive to increase materially their global systemic importance in the future. A consultative document was published in cooperation with the Financial Stability Board, which is coordinating the overall set of measures to reduce the moral hazard posed by global SIFIs.</p>					

Source: Bank for International Settlements, 2013

