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Financial Contagion
or
Interconnectedness?
A Review of Financial Literature.

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Introduction.

The purpose of this work is to analyze why and how financial crises, particularly the East Asian crisis in 1997 and the American financial crisis in 2007, are able to spread in other countries all over the world. Why did crises spread? For the financial contagion or because of the simple interconnectedness between countries? It is possible to say that the East Asian crisis is an example of the financial contagion between countries because the crisis spread from Thailand to Russia, then to Brazil and finally to the USA with the collapse of Long Term Management Capital (LTCM). But the crisis of 2007 may be an example of a very strong interconnectedness between countries because they were very linked each other both financially and economically. Even if, there is a particular aspect in the crisis that may be explained by contagion: the propagation of the crisis from the subprime mortgage market to other markets that do not have connection to the first one.

The first chapter explains what the financial contagion is and what are the most important channels for the transmission of contagion in the financial system. Furthermore, it illustrates the different types of contagion deepening the shift contagion: it is the most interesting and important type of contagion between countries in the financial market.

In this chapter, there is also the analysis of the model developed by Allen, Babus and Carletti (2013): they created a model in which asset commonality and short-term debt of banks interact to generate system risk and they studied two structures (clustered and unclustered structures) in relation with the contagion among banks.

The second chapter analyzes the East Asian Crisis that started in 1997 with the currency crisis in Thailand. This crisis spread to others vulnerable Asian economies like Indonesia and South Korea: these two countries mainly were affected by this crisis because they were connected particularly with the Thai economy. Also China is examined due to its capacity to reduce the economic damages during the Thai crisis. At a later stage, in this part there are the IMF interventions made to contain the crisis but the crisis spread first to Russia and then to America. It was a domino effect because Russia was affected by its commercial exposition to East Asian economies and this caused financial problem in Brazil, where a currency crisis broke out in 1999, and also in the USA with the collapse of LTCM that had very huge financial bet towards Russia interest rates.

The next to last chapter considers the American financial crisis in 2007 due to the huge losses in the subprime mortgages market. These losses caused the collapses of a large number of financial institutions, like Lehman Brother. It analyzes the main markets where investors put their capitals: asset-backed commercial paper market (ABCP), money market fund (MMF) and the sale and repurchase agreement market (REPO). This part wants to examine the main events of the crisis and the causes that led to the collapse of many banks and financial institutions. Then, it introduces the European crisis owned in the first moment to the events in the American financial crisis but then it turned into a sovereign debt crisis because European countries had to face with their very huge levels of debt.

Finally, the last chapter examines the linkages between ABCP, MMF and REPO markets to understand the possible causes of the contagion in the American financial market and why the crisis spread so fast in these market. Moreover, it tries to explain the transmission of the crisis from the USA to Europe and the possible causes of that. At the end, analyzing the work of Scott (2011) and Yellen (2013), there are the possible solutions to keep under control the financial system and to be able to solve a crisis in the future. To conclude, there is an application of Forbes and Rigobon's model to study the relationship between CDS Market and Interbank Market for five European Countries (Italy, Germany, France, Portugal and Spain). Moreover, the same model is used to analyze the relationship between Italian Interbank Market and the other Interbank Market of these Countries. The aim of this analysis is to see if there is financial contagion in the market or if these markets are interconnected each other.

1. The Financial Contagion: an overview.

The **financial contagion** is a situation in which a shock, that initially was about a single economic entity (financial institution, economic variable, economic sector or country), propagates to other economic entities rapidly and in a uncontrolled way. Therefore countries go through, in the same time or soon after, the speculative pressures on the exchange rate, the outflows of capital, the reduction of stock prices and a widespread deterioration in key macroeconomic variables¹.

The contagion occurs when the propagation of shocks during a crisis increases systematically from that observed during normal times. The variance of returns during a crises are caused by increases in the idiosyncratic shock of one country, usually the country where the crisis originated even if it is difficult to understand. This generates a general crisis and it spreads from one corner of the world to the rest of the economic system in an exceptional manner. Healthy sectors and countries could be affected by the contagion and this is favored by the economic integration and the big increase of commercial trade and financial transactions: in a single word, the contagion is favored by the globalization.² This phenomenon makes the economic system very susceptible and we saw that the financial market adapts itself to global dimension, especially in recent years. Equity, currency and banking crisis make real costs for the country in which they occur and these crises can spread in the rest of the world: for this reason a financial contagion increases costs significantly for the international community.

The financial contagion has traditionally been examined in emerging countries since assets in these markets are particularly volatile and crises occur frequently. On the contrary, in developed countries assets are less volatile than in emerging markets because they are more transparent and efficient but, in recent years, we saw that contagion can be possible also in these countries. The developed countries are highly interdependent in all states of the world and a financial crisis manages to emphasize this feature.

The definition of “contagion” is not universally accepted. Some economists think that if there is a shock in one country and it is transmitted to another country, this transmission constitutes contagion even if there are no significant changes in cross-market relationships. Other economists believe that it is impossible to define contagion based on simple tests of changes in market conditions. They argue that it is necessary to identify

¹ See Zaghini (2000).

² See “Dizionario di Economia e Finanza”, Treccani.

how a shock is transmitted across other countries and only when this mechanism is clearly defined, it constitutes a form of contagion.³

The countries with the weak economic fundamentals and the heavy exposure to certain financial agents can all increase the risk of sudden spillover and they are more exposed to the crises. The main problem is that the reasons about the country's vulnerability are still unknown. Furthermore, the financial and specific measures at the national level are useful to reduce the risks and manage their impact but the volatility in the financial market will not disappear.⁴

The main factors that could lead to a financial crisis and then to a following spread in other countries are:

- *symmetric shocks* because, at the beginning, they affect a single country but they could determine a general deterioration of market conditions;
- *real and financial spillover*, whose importance is much greater if the links between countries are significant. The transmission of the crises occurs both directly and indirectly through market competition;
- *residual factors* which are the basis of irrational behavior like panic or herd behavior and they cause the transition from a stability period to a turmoil period.

There are three crises which led to the study of transmission channels between financial markets and they are: the *Tequila Crisis* (Mexico) of 1994-95, the *Asian Flu* of 1997 and the *Russian Virus* of 1998. Many people think that contagion occurred during the East Asian and Russian crisis: in July of 1997 a currency crisis in Thailand quickly spread throughout East Asia and then on to Russia and Brazil. In fact, after the devaluation of the Russian ruble the Brazilian stock market fell by over 50%. This is an example of contagion because Russian and Brazilian economies are located in separate geographic regions, they have different structures and they have virtually no direct linkages through channels such as trade. Even developed markets in North America and Europe were affected, as the relative prices of financial instruments shifted and caused the collapse of Long-Term Capital Management (LTCM), a large U.S. hedge fund. This is a form of contagion because these global repercussions are started in the relatively small Thai economy and then they are developed in the rest of the economic system.

3 See Forbes and Rigobon (2001).

4 See Forbes and Claessens (2001).

1.2 Channels For Financial Contagion.

it is necessary to understand the mechanisms and the channels through which shocks are transmitted across different countries: in few words, it is necessary to understand what contagion is. When there is a shock in one country, investors receive information about it and later they optimally alter their investment portfolios. But they also hedge the changes in their macroeconomic exposures by rebalancing in other countries and this process generates the idiosyncratic risk across the financial market and it spreads in the entire system causing the increase of the correlation.

Economically, the main sectors which can link more countries to each other and therefore they may lead to a diffusion of a financial shock in the entire system are⁵:

1. *real sector*: it is the sector in which there is production of goods and services and it could be affected by financial market for three reasons:
 - the price of assets could affect national wealth and hence aggregate demand;
 - the liquidity of financial markets and the asset prices are able to influence the business desire and the ability to raise money for investment: this could change the aggregate demand now and the aggregate supply in the future;
 - the aggregate demand in one country could be conditioned by the monetary, fiscal and exchange rate policies;
2. *financial sector (markets)*: in a world with complete and perfect markets, the asset prices depend only on the covariance between cash flows and consumption and in this perfect world there is no place for the financial intermediaries. But if markets are imperfect, the financial intermediaries have an important role because they lend funds (banks), they underwrite securities issues (investment banks) and they provide liquidity in the markets (securities brokers/dealers). In this way, the prices and the liquidity of a financial market are potentially affected by the position of these financial intermediaries and the risks that they assume;
3. *financial institutions (banks)*: they usually take deposits and extend loans to financial and non financial firms. The bank's assets and liabilities potentially depend directly on the real sector of each country, because if a country is in recession there are no investments to do and they depend also on the prices and liquidity of financial markets as these values fluctuate with market prices;
4. *non-bank financial market participants*: they take funds from general public for investing it in financial markets. Their ability to take funds depends on their financial

⁵ See Pritsker (2000).

position, market prices and the public willingness to invest money: in a turmoil or in a period of recession, people are not so much interested to invest their savings and they have a few confidence in financial institutions.

The economic literature explains how shocks in a financial market are transmitted to others. There are four separated channels of financial market contagion.⁶

The first, and at the same time the most intuitive one, is the correlation information channel: if there are common macroeconomic influences between countries that determine asset values because of real linkages, consequently financial markets are related to each others. The information participants trade on in one country are unconditionally correlated with the value of real assets in another country. In this case, there is correlated information because the market is imperfect and so there is information asymmetry and this causes a real effect from a country to another one. Moreover, government policies can inadvertently introduce new real linkages in the financial markets and this could cause contagion among financial markets.

Another channel for financial contagion involves financial market participants responding to a shock that influences them by rebalancing across markets and then they could transmit the shock. An example of this is a liquidity shock that requires a market participant to generate additional cash, or to invest additional funds (like margin calls).

A liquidity shock is correlated across market and so it could create contagion. Participants might rebalance their portfolios because they follow portfolio strategies aimed to have a return and for this reason their actions depend on past price movement. In this way, they could altering their position in the other financial markets and so they could cause contagion.

The next to last channel that could explain financial market contagion is cross-market rebalancing. In this case, a form of contagion occurs through the cross-market hedging because financial investors respond to financial shocks by readjusting their hedges to macroeconomic risks. This mechanism could transmit shocks between two different countries even if they do not share macroeconomic risk factors and soon after, the shock could spread in a third country who has a similarities features with the others.

The final channel for contagion is connect with wealth shocks. If there is a wealth shock, investors could decide to change their portfolio holdings and they could choose to move towards a less risky portfolios. This behavior is able to create contagion in the same way of a correlated liquidity shock. The main difference between them is: in a correlated

⁶ See Kodres and Pritsker (1999).

liquidity shock investors are forced to liquidate their assets and in the contrary, in a wealth shock investors are free to decide if it is better to liquidate their assets or not.

Analyzing these main channels for financial contagion, it is important to say that more public information may improve market functioning and reduce, consequently, unnecessary form of contagion across financial markets.

1.3 Different Types Of Contagion.

In economy, there are three main typologies of contagion and the model used for explain them is:

$$X_{i,t} = \alpha_i + \beta_i X_t + a_t \gamma_i + \varepsilon_{i,t} \quad ^7$$

where:

- $X_{i,t}$ is the vector of stock prices in different countries;
- a_t is a shock linked to fundamental variables that influence all countries;
- $\varepsilon_{i,t}$ is an idiosyncratic shock and it is independent of other shocks.

The typologies are:

- **fundamentals-based contagion (interdependence):** the contagion is the transmission of global or local shocks across countries through economic fundamentals (spillover effect ⁸): these shocks have an impact beyond the amount channeled through the usual commercial, financial and institutional ties between markets. So the contagion, in according with this definition, could be confirmed also in absence of risks because it is a public performance of the interdependence of the countries.⁹ Actually, this could not be considered as a public performance of contagion because it reflects the normal interdependence between market economies. So, shocks are transmitted between countries through real or financial connections. These forms of co-movements would not usually constitute a form of contagion but if they occur during a period of financial crisis and their effects are significant, they may expressed a form of financial contagion. In the model, this is represented by a_t and X_t and the direct effect is in γ_i and in β_i .
- **restricted contagion :** the contagion's the transmission of global or local shocks between countries through mechanism that not include economic fundamentals. it is known, also, as "excessive of co-movements" and it seems to be due to forms of irrational operators like financial panic, herd behavior, increase of risk aversion and loss of confidence. ¹⁰ In this case market operators implement, previously, financial measures to optimize their financial portfolio and in the same time they have to

⁷ See Forbes and Rigobon (1999), Pristker (2001), Pericoli and Sbracia (2001).

⁸ **Spillover effects** are externalities of economic activity or processes that affect those who are not directly involved. They are those variables in every economic that cannot be adjusted by a single policy monitored by the government.

⁹ See Calvo and Reinhart (1996), Pristker (2000).

¹⁰ See Claessens, Dornbusch and Park (2001), Masson (1998).

hedge the changes in their macroeconomic risk exposures by rebalancing. These precautionary measures produce a correlation between stock return in the short term. In fact, the adjustment of a portfolio of an international investor, following the crisis in a country, may lead to a reduction in investment in other market because the stock returns are historically related. In this case, there is the problem of asymmetric information: if an informed investor decides to reduce significantly his portion invested in a specific country because of a sudden margin call to cover other markets, an uninformed one will imitate the behavior of the first investor and the second one could generalize an unjustified flow of capital.¹¹ This is the proof that financial market are irrational and more regulation is needed. In the model, this is measured by the correlation of idiosyncratic shock $\varepsilon_{i,t}$ and there are no explanations for this type of contagion

- **shift contagion:** this type of contagion is when the correlation of the stock prices, during a crisis, changes compared with the correlation during a period of stability. In the model, this type of contagion is explained by significant changes in cross-market linkages and so by β_i and γ_i (i.e: structural break): this is because of changes in the underlying model.¹² For example, the changes could involve a devaluation of the exchange rate, a drop in asset prices, the capital flows or a debt default. This typology not only clarifies that contagion arises from a shift in cross market linkages, but it also avoid taking a stance on how this shift occurs.¹³

Economists still do not know in a precise way what factors and what mechanisms could generate a financial contagion across the world markets. The main typologies explained above are useful to try to understand why a crisis could spread from one country to another. In the following section, there is the explanation of the most important definition of contagion, in according with the majority of the economists that deal with this topic.

11 See Calvo's model (1999).

12 See Forbes and Rigobon (1990).

13 See Forbes and Rigobon (1999).

1.4 The “Shift Contagion”.

In financial world, the “shift contagion” is the most sensible definition about the contagion because it clarifies how it arises from a shift in cross-market linkages. Cross-market linkages could be measured in different way: correlation in asset returns, the probability of a speculative attack or the transmission of shock or volatility.

Also, the correlation is an important variable for these studies because an high correlation indicates if there is a form of contagion or if it is only a normal interdependence between the market. If two markets are highly correlated after a financial shock, it is shift contagion only if the correlation between the two markets increases significantly.¹⁴ As I said previously, if the correlation does not increase in a significant way it is not contagion but only the continuation and the intensification of a cross-market interdependence that exist also during a stability period. This is important for the policy makers too because they have to distinguish between a stability period and a crisis to make the right decisions about a monetary policy.

There are three mainly reasons for use a so restrictive definition like “shift contagion”:

1. if the financial market correlation increases, it is not useful diversify stock portfolios to reduce risks of financial assets. International diversification should reduce the portfolio risk and increase expected returns. This type of contagion is useful to evaluate the effectiveness of diversification to reduce the risks during a crisis. A less stringent definition of the contagion does not explain this effect because it does not focus on how the shocks are transmitted across market.
2. it is useful to evaluate efficacy and the role of monetary policies and the potential effectiveness of international institutions: policy makers are worried about the transmission of a financial shock from a country to another because this could lead to a financial crisis in the second one even if the economic fundamentals in it are good and the country is strong. Their actions could be justified if it is not possible an endogenous adjustment process: a short term loan, for example, could prevent the crisis in another country. But if the shock hails from the normal interdependence between countries, their actions could worsen the situation and the natural endogenous adjustment process could be obstructed. Only the shift contagion could justify IMF intervention and the dedication of large sums of money to save funds and countries.

¹⁴ See Forbes and Rigobon (2001).

3. it is helpful to perceive mechanisms of shock transmissions across markets: theories that predict a change after the shock (*crisis contingent*) and others that are the continuation of existent mechanisms (*non crisis contingent*). The existence of this type of contagion suggest that shocks are propagated via crisis-contigent channels and the increase of co-movement between asset returns during crises must be driven by changes in the structural transmission of shocks across countries, rather than just a change in size of underlying shocks.

Moreover, the definition of shift contagion supports the crisis-contingent theories because there is no evidence of contagion in non crisis-contingent theories. The first ones explain why the transmission mechanisms change during a crisis and they want to understand why the cross-market linkages increase a lot after a financial shock. On the other hand, the non crisis-contingent theories say that the transmission mechanisms are the same during a crisis and during a stability period.¹⁵

For the crisis-contingent theories, there are three mechanisms to understand why shocks spread internationally:

1. *the multiple equilibria*, when a crisis broke out in one country, investors change their expectations and they shift from a good equilibrium to a bad one. This is also because they have a bias behavior: investors tend to reconstruct the past events in their mind;¹⁶
2. *the endogenous liquidity* because a crisis in one country could reduce the liquidity in the financial market. As a consequence, investors are forced to sell their assets and to recompose their portfolios to be able to operate in the market;¹⁷ A liquidity shock leads to an increased correlation in asset prices;
3. *the political economic* which could lead to a political contagion because the central bank presidents and the policy makers want to maintain their country's fixed exchange rates but they do not consider that an exchange rate crisis could transmitted the shock across other countries.¹⁸

To summarize, the definition of “*shift contagion*” is useful in evaluating the effectiveness of international diversification, justifying intervention and differentiating between various transmission mechanisms.¹⁹ Furthermore, it is an useful definition for testing contagion in a simple way.

15 See Forbes and Rigobon (2001).

16 See Mullainathan (1998).

17 See Valdes (1996).

18 See Drazen (1998).

19 See Forbes and Rigobon (2001).

1.5 Banking Contagion and Systemic Risk.

The contagion in the banking system occurs when there is the risk that financial difficulties at one or more banks spillover to a large number of another banks or the financial system as a whole.²⁰ There are two main channels which are able to explain banking contagion:

- *information channel*, in which there is the distinction between the pure contagion and the noisy contagion. The first one occurs when negative information about one bank adversely affects all other banks even if they have nothing in common with the first bank. The noisy (or firm specific) contagion refers to the situation when the failure of one bank reveals a bad signal regarding other banks with common characteristics.²¹ The big problem in the financial system is that there are information asymmetries and bad interpretations of signals in the markets;
- *credit channel* because there are a lot of linkages between banks in the interbank funding market and in the payment system and for this reason, if a bank fails there is the problem about the knowledge of the size of bilateral position of each bank. Market participants do not know which banks have unsatisfied claims against the failing bank and so this could generate a general loss of confidence in the interbank market.²²

Nowadays, all banks are connected each others because one single institution can not access to the full range of available capital and investment opportunities in the entire economic system. The interconnectedness facilitates the risk sharing but at the same time, it amplifies existing market frictions, information asymmetries and other externalities. The systemic risk arises from the complexity and the interconnectedness that characterize the financial system. At the same time, some economists are agree to say that some degrees of interconnectedness is vital to the optimal functioning of a financial system and as a consequence, it is useful to find a way to preserve the benefits of it and to manage the potentially harmful side effects.²³

The problem in the banking system is the presence of the systemic risk: it is the situation where many financial institutions fail as a result of a common shock, like the collapse of residential or commercial real estate values, or a contagion process. In a bank system, it

20 See Schoenmaker (1996).

21 See Aharony and Swary (1983).

22 See Schoenmaker (1996).

23 See Yellen (2013).

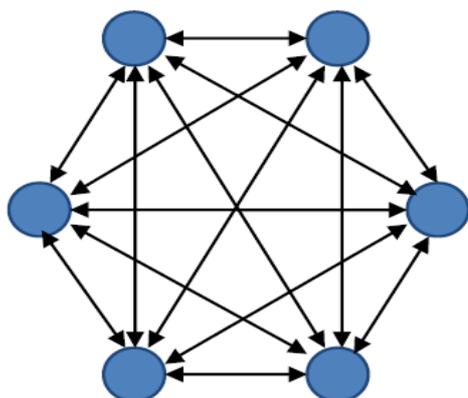
arises through liquidity²⁴ and it could create a domino effect because one bank's problems could spread to others and this is a potential failure of the entire economic system.

There is two network to explain bank linkages:

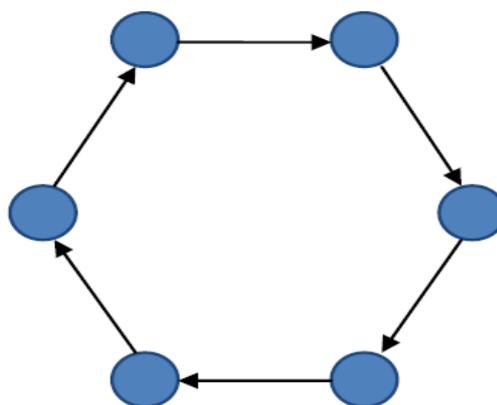
- *the complete network* where all banks lend to and borrow from all other banks and in this case banks benefit from diversification and so a liquidity shock in one bank do not cause the bankruptcy of another bank;
- *the incomplete network* where each bank borrows from only one neighbor and lends to only one other neighbor and in this case there is no diversification, so a liquidity shock in one bank can cause liquidity problems to other interconnected bank.

The figures (*Figure 1*) to explain these networks are²⁵:

A. Complete Network



B. Incomplete Network



(Figure 1: Complete and Incomplete Network²⁶)

Diversification is good for each banks individually because it could reduce the systemic risk but, at the same time, it could lead to generate an higher systemic risk if banks' investments become more similar.²⁷ For this reason, analyzing the entire banking system, it may be optimal to limit the use of diversification and it is useful to take advantages of it.

Allen, Babus and Carletti (2013) developed a model to analyze how banks interact each others to generate systemic risk, using asset commonality and short term debt. The

24 See Allen and Gale Model (2000).

25 See Yellen (2013).

26 Source: Federal Reserve Board staff .

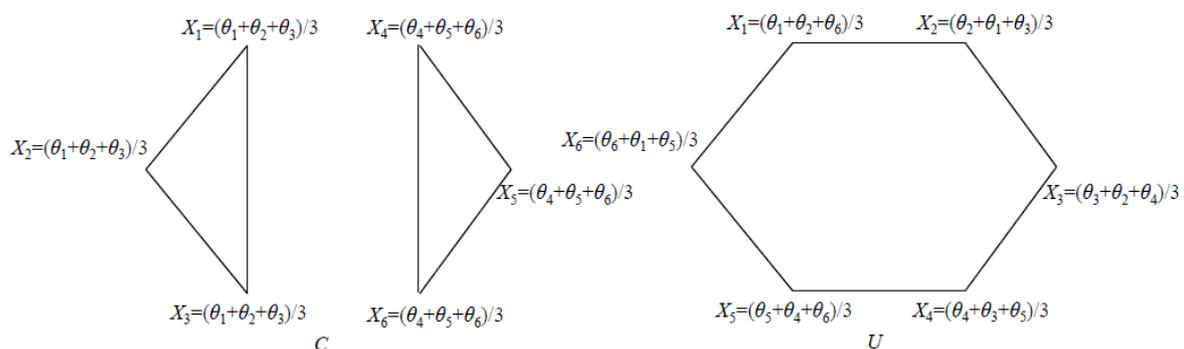
27 See Shaffer (1994), Wagner (2010) and Ibragimow, Jafee and Walden (2010).

funding maturity structure is useful to understand the linkages between banks and systemic risk: in the case of *short term debt*, banks are linked through information: at the intermediate date, investors receive a signal of the bank's future solvency and they decide their behavior according to the composition of their asset structures. In the *long term debt*, on the contrary, interim information plays no role and the composition of asset structures are not important for systemic risk. The main problem is that banks assets are opaque and so the market receives information on bank overall solvency rather than on the precise value of a single bank assets.²⁸

In this model, the authors analyze the behavior of six banks and each of them optimally exchanging projects with two other banks to share the risks and to diversify their portfolio. In this way, they could exploit the advantages of diversification in terms of lower default probability. There are two possible asset structures:

- *clustered asset structure*, where banks are connected in two clusters of three banks each: in every cluster, banks hold the same portfolio but every cluster is independent from the other one;
- *unclustered asset structure*, where banks are connected in a circle and each of them could swap projects only with two neighboring banks. In this structure, none of them holds the same portfolios and so all portfolios are different.

The following figure (*Figure 2*) shows the structure: the clustered one and the unclustered one. It shows the return of portfolios (X_i) and the returns of the investment projects (Θ_i).



(Figure 2: Clustered (C) and unclustered (U) structures.)²⁹

28 See Flannery, Kwan and Nimalendran (2004).

29 See Allen, Babus and Carletti (2013).

In this model, systemic risk arises from the investors responses to the information in the market: if there are good news, the banks are solvent in the final date and the investors decide to roll over their debt but if there are bad news in the banking market, investors do not roll over their debt and they may decide to withdraw their funds. In this case, all banks are forced into bankruptcy and the failure of spillover is a source of systemic risk. The withdrawal of liquidity by investors could generate a general sense of panic because all the other investors may see this behavior in a negative way and so even they may withdraw their fund too (herding effect).

As the clustered structure has more roll over risk than the unclustered one, the systemic risk in the first one is higher above all when there are bad information about banks' future solvency in the economic system. Furthermore, in the clustered structure banks hold identical portfolios and so defaults occur in group. In the contrary, in the unclustered one defaults are more scattered: this shows that there is more systemic risk in a concentrated structure than in dispersed one because in the first one banks are more correlated to each others.

Allen, Babus and Carletti (2013) show also that the asset structure is important to measure systemic risk: when investors hold short-term debt, banks are linked each others through information and so the use of short-term debt may lead to information contagion among financial institutions. For all these reason, a failure of a single bank could lead to the failures of other banks and so the bankruptcy of a bank is expected to increase the systemic risk in the entire economic system.

To summarize, it is important to understand the structures that there are in a bank: in this way, it is possible to understand the mechanisms that are within the banking system and which can be the possible corrections to be able to prevent the failure of a single bank. As a consequence, it could be easier to avoid the spread of banking contagion in the entire economic system. it is useful to focus on the prevention of bank failures and this may be a way to keep under control systemic risk within the financial system in general. To do this, banks must know their customers very well: a good information is necessary to be able to manage the crises within the banks themselves.

2. The Asian Flu and The Russian Virus.

2.1 The Asian Flu.

The impact of the East Asian Financial Crisis is much more global than the other financial crises in the previous years of 1990s. The financial crisis in Thailand has had a profound impact on the capital market of the countries in the North of Asia and also it caused a significant drop in the global growth because the crisis spread all over the world with big effects for some economies like Russia and Brazil.

The East Asian countries had an economic boom based on exports and they were sustained by foreign investments. These economies were characterized by their high rates of capital accumulation and private savings, their strong cooperation between the Government and the private sector³⁰ and prudent fiscal policies. These countries were admired as the most successful emerging market economies because of their rapid growth and the striking gains in their population living standards.³¹ They were seen as a models for many other countries. One of the main causes of the crisis was that foreign investors underestimated the underlying economic weakness of these countries because of their big success. The crisis broke out in Thailand where the growth was not completely real and its effects spread to South Korea and Indonesia, which had a healthy and solid economy but at the same time they were vulnerable and so the effects of the crisis were unexpected and strong.

Several factors³² contributed to the deterioration in the sentiment by foreign and domestic investors:

- an accumulation of overheating pressure for example in a large external deficit and in a stock prices in the market: these were not real but inflated;
- the unsustainable level of pegged exchange rates of these countries which complicate the action of monetary policies and encourage foreign investors to an excessive exposure;
- the presence of an inadequate supervision of financial system that lead to a deterioration in the quality of banks' loan portfolios: this inadequate supervision caused a lot of problem about the transparency in the financial system;
- the rapid capital account liberalization that allowed domestic banks and firms to

30 See Dua (2007).

31 See IMF in Finance&Development (1998).

32 See IMF in Finance&Development (1998).

borrow as much as they wanted abroad, where interest rates were lower. But these loans were short-term debts and so the creditors could called them back at any time. For this reason, when the exchange rate collapsed this was a big problem.³³

The common features in East Asian countries during the crisis were: the collapse of domestic demand, the reduction of investments because firms did not have enough liquidity to invest, the reduction of consumption (natural consequence after the loss of jobs) and the increase of unemployment rate.

Later the Thai crisis spread also in the East Europe, above all in Russia where the crisis highlighted the problem with the balance sheet. The competitiveness between Russian and East Asian countries was an important factor for contagion.³⁴

In fact, this is an example of a global contagion because also the countries of both North and South America had economic problems: there was the collapse of an important hedge Fund, the Long Term Capital Management (LTCM), and the crisis in Brazil. The contagion from East Asian to Brazil may have been caused by foreign investors panicking after the Russian crisis and their speculation against the Brazilian currency. About the East Asian Flu, some economists argued that in the medium term fundamental linkages were important in transmitting the crisis but in the short term these fundamentals did not explain the spread of the crisis and the large economic contractions. For these reasons they said that this is a perfect example of “shift contagion”.³⁵

In the following chapter, there are the explanations of the Asian Flu: first how the crisis broke out in Thailand and in the other East Asian economies (Indonesia, South Korea and China). After, there are the causes of the Russian Crisis, the collapse of LTCM and the explanation of International Monetary Fund (IMF)'s intervention.

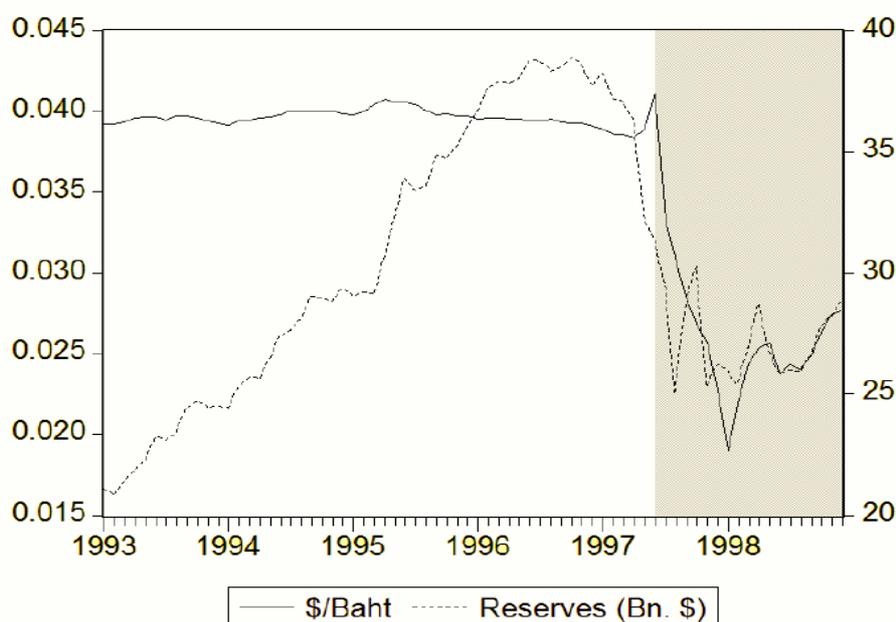
33 See Grozdev (2010).

34 See Forbes (2000).

35 See Claessens and Forbes (2001).

2.1.1 The crisis in Thailand in 1997.

The Thai crisis began in the first days of July 1997, when the local currency (the Baht) was depreciated a lot. (Figure 3) Historically, the Baht was fixed to the U.S dollar and traded about 25 Baht to the dollar. Thailand had a very huge foreign debt and so Thai Government decided to float its Baht after the speculative positions to the country's foreign reserves linked with the activities of many hedge funds. In this way Thai Government wanted to stimulate export revenues but this was not a success because a lots of plungers took advantages from the weakness of the Baht and they caused the bankruptcy of many Thai firms and also many foreign investors retired their capitals, putting banks in difficulty.



(Figure 3: Baht and Foreign Exchange Reserves in Thailand.³⁶)

The crisis was born in the financial sector but it had consequences in the real economy and for the society: after the crisis there was a deep recession and the unemployment increased a lot. One positive thing about the crisis is that exports increased after the depreciation of the currency but at the same time there was a development of the speculation.

Before the crisis, Thailand (like the other East Asian economies) had a sustainable growth, the poverty fall down and the per capita income increased. Government policies were oriented to a strong saving and precise investments to reduce the gap between the Asian

³⁶ See Dua (2007).

economy and the Western countries. Furthermore, the redistribution of wealth improved the life conditions of the citizens. For all these reasons, all financial investors and institutions were very surprised when the Thai crisis broke out.

The main causes of the crisis were³⁷:

- I. the sustained depreciation of the currency, that was anchored to the dollar. The problem raised when dollar was appreciated in the market and so the products of Thailand and Indonesia became more competitive but the exports fall down when the dollar was excessively appreciated. This led to a following liquidity problem in the financial market. The depreciation of the Baht highlighted the effect of contagion because it caused the panic among financial investors: they were worried that other countries could depreciate their currencies to encourage exports and so they were able to reduce the cost of their debt and the cost of their imports. Consequently, investors decided to withdraw their capitals from countries where there was the risk of a possible depreciation of local currencies;
- II. the massive short-term borrowing abroad by the private sector (firms and banks): Thailand and the others Asian Economies affected by the crisis, allowed the private sector to access to external finance in an unlimited way, without any type of restrictions. But banks and firms over borrowed and they were not able to give all the loans back.

The main problem linked with the currency was that foreign investors invested in securities markets and these investments established a close relationship between the currency and the equity market. This was destabilized because a currency crisis easily led to a stock market collapse and, on the contrary, a bearish mood in the equity market easily translated into a currency crisis. Initially in Thailand, in then in the other Asian economies, there was a failure of free capital market to produce an optimal global allocation of capital. There was no instrument to restrict capital inflows and contain their impact on macroeconomic and monetary conditions and it was difficult to control the entire financial system because especially the foreign capitals were prevailing in the economy. The situation got worse with the depreciation on the Baht because international banks became wary of extending new loans in Asia: they were worried about Asia's long-term prospects and about what the other investors were doing.³⁸

37 See Akyuz (1998).

38 See Sachs (1998).

2.1.2 The Crisis in Indonesia, South Korea and China.

The crisis in Thailand influenced also the other East Asian economies, in particularly Indonesia, South Korea and China.

In Indonesia during the month of June 1997, there was not a presentment that a crisis will break out because the inflation was low, the country had good exchange reserves and the bank sector was working well. Furthermore, Indonesia usually was able to resist to financial storms and so foreign investors initially kept confidence in this ability.

A lot of Indonesian firms had debts in U.S dollar and from August 1997, the Indonesian rupiah got stronger in comparison with the U.S dollar: in this case their debt levels got down and the firms did not have so much problems. But, in the following month, the rupiah started to float and it began to depreciate significantly: in September 1997 it and the Jakarta Stock Exchange touched a historical low and from June 1997 to January 1998, Indonesian rupiah lost almost 30% of its value. Furthermore, Moody's downgraded Indonesia's long term debt to "junk bond". The most serious problem was about the Indonesian firms: after the depreciation of the rupiah and the consequent appreciation of the U.S dollar, their cost of the debt increased a lot and they did not have the necessary liquidity to pay back their creditors. Clearly, new foreign investors were scared to put their money in Indonesian firms. In December 1998, the exchange rate was: 8000 rupiah for 1 U.S dollar: it is not a surprise that during 1998, Indonesia lost almost 13,5% of its GDP.

The crisis in South Korea was more surprising because the main policy was to maintain stable the local currency (the South Korean won) and its depreciation (about 34,01%) in 1997 was a departure from this type of policy. Suddenly, the inflation increased a lot. The loans from international banks was almost always subject to government approval and guarantee³⁹ but, despite this, the bank sector had a lot of non-performing loans: because of a weak financial supervision, the risk was concentrated on banks.⁴⁰ The purpose of the policy towards industrialization was to avoid the excessive competition and create benefits from scale economies⁴¹, but South Korean firms did a lot of foreign investments because in the first years of 1990s the U.S dollar was weak but after 1995 it began to be stronger and the foreign investments of South Korean firms became dangerous and risky. Consequently, there was not enough liquidity in the market and so a lot of firms went bankrupt or some of them were acquired by larger firms also because foreign creditors did

39 See Sachs (1998).

40 See Kihwan (2006).

41 See Sachs (1998).

not want to help South Korean firms and they started to withdraw their funds from South Korea and the situation got worse. For this reason, the Government decided to use its foreign currency reserves to help firms to honor their short term obligations and so the reserves decreased in a dangerous way⁴². However, this crisis did not affect so much real sector because the South Korea GDP grew a lot from 1997. In the contrary, the financial market felt the effects of the crisis because for example, during 1997, the Seoul Stock Exchange fell down from 4% to 7%. It was a liquidity crisis due to serious mismatched in maturity and in currency of the financial sector in the economy.

China was affected by the crisis in a marginal way because it did not have a very strong relationship with Thailand. But the crisis showed the vulnerability of some elements of its economic system and the economic and financial conditions got worse.

In this Asian country, there was a decreasing of economic trend and the unemployment increased, even if the growth rate remained stable around 7%-8%. Its exports towards Thailand, South Korea and Indonesia slowed down but its structure of exports was more differentiated and so China was not affected so much by the crisis. Its advantage than the other Asian economies was about the amplitude of its economy: Chinese economy was able to exploit the scale economies also because the cost of labor was low and so it was more competitive than the others. Also there was an increment of the public spending: in this way the policy makers would to accelerate the investments in infrastructures and to stimulate banks to extend their loans to real estate sector. At the same time, Chinese Authorities decided to maintain stable the relationship between the dollar and the yuan (the Chinese currency) to avoid new speculations against the dollar. Furthermore, there was the fear that a depreciation of the dollar could produce other depreciation of the other local currencies. Policy makers decided to make an expansive monetary policy: they reduced the interest rates to encourage the lending activity of banks. The crisis emphasized that the financial system was not stable for the presence of non-performing loans and the real estate markets were not adequately supervised.

42 See Kihwan (2006).

2.2 Policy Responses and The IMF's Intervention.

An adequate policy response for the East Asian countries affected by the financial crisis had to arrange two main problems⁴³: it should help to restore confidence after the turmoil in the currency and the asset markets, so the foreign investors wanted to invest again in the Asian countries, and it should correct the underlying fundamentals, so countries will become stronger and they will be able to resist to another financial storm. Furthermore, it was necessary to roll over countries' loans and to raise global growth so East Asian economies was able to earn the foreign exchange to pay off their debts.

In every East Asian country affected by the crisis of 1997, the Government decided to loosen both fiscal policies and monetary policies to be able to stimulate the domestic demand and to facilitate the reorganization of banks and firms. Monetary policies were focused in a reduction of interest rates to reinforce also the investments request. But at the same time, there was the risk that very low interest rates would cause a situation of in the currency markets and so the Government would not be able to reorganize the financial market in an optimal way.

But, the scope and the severity of the collapse involved in this crisis that an outside intervention became urgently needed. Since July 1997, IMF⁴⁴ organized financial bailouts totaling more than 100 billion dollars of public funds in Indonesia, South Korea and Thailand.⁴⁵ The IMF wanted to support reform programs in Indonesia, Thailand and South Korea. The problem in these three countries was that the Authorities' initial hesitation in introducing reforms and taking measures to restore confidence and these measures caused a worsening of the crisis by the decline in currency and stock markets.

At the beginning, IMF tried to contain the crisis with a loan to Thailand of 20 million dollars to clean up the national deficit and restore the confidence in the foreign exchange markets and also in the foreign investors. But all these measures increased the foreign speculations and also the capital withdraws from Thailand.

IMF deepened the sense of panic because of its proposal: high interest rates, budget cuts and immediate bank closures. For these reason the panic spread to all of East Asian economies. A high interest rate was useful to restore confidence in the local currency but countries had to make it more attractive to hold domestic currency and so it was necessary

43 See See Akyuz (1998).

44 **IMF** (International Monetary Fund) is an international organization that was initiated in 1944 at Bretton Woods. This organization works to foster global monetary cooperation, secure financial stability, facilitate international trade, reduce te poverty in the world, promote high employment and sustainable economic growth. Its headquarters are in Washington D.C in U.S.A.

45 See Sachs (1998).

to have high interest rates.

There were four mainly strategies⁴⁶ used by IMF to support program in Indonesia, South Korea and Thailand:

- I. *monetary policies*: it would be able to resist to the excessive currency depreciation because the consequences were damaging for domestic inflation and for the balance sheet of domestic financial institutions; in this way, the confidence would be restored and interest rates could be allowed to return to more normal levels;
- II. *the financial sector* was too weak and there was the urgency to restructure and to recapitalize it; furthermore in the banking sector, depositors needed to be protected by adverse events generated by a crisis;
- III. *governance* must be improved and the transparency needed to be reinforced to create a better economic system: for this goal, political lenders must send clear signals;
- IV. *fiscal policies*: they had to focus on the restructuring and recapitalizing banking system and public resources would need to minimize the social costs of a crisis and strengthen social safety nets.

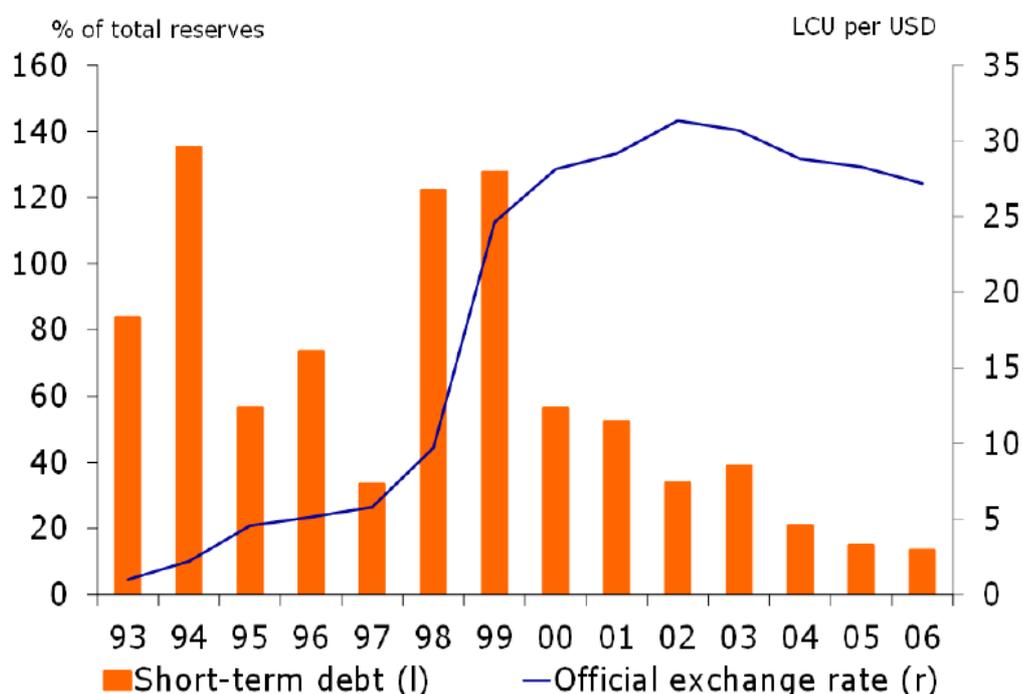
After the IMF's intervention in East Asian Economies, these countries improved their economic performance in a positive way. To these days, the main benefits⁴⁷ from this intervention are: first of all, East Asian Economies are monitored after the crisis and also they received many advices from the IMF, the countries were analyzed during time and so the Fund could focus on their vulnerabilities and potential spillover. Then, the Fund can assist them in the process of transformation and smooth integration into the global economy: for this reason they have a technical assistance and training. Finally, IMF wants to improve its lending capacity and also it wants to find ways to further enhance its lending facilities in these emerging economies.

46 See IMF in Finance&Development (1998).

47 See Grozdev (2010).

2.3 The Russian Virus.

In 1997, Russia's economy growth was positive for the first time since the formation of the Russia Federation in 1991⁴⁸. The main causes of the Russian crisis and its default in 1998 were: an artificially high fixed exchange rate between the ruble and the others foreign currencies, a chronic fiscal deficit combined with a fragile fiscal policy, that caused a huge increase in the short term maturity end (Figure 4), and the impossibility of the Russian Government to control the public expenditures.



(Figure 4: the increase of Short-Term debt in 1999⁴⁹)

Following the East Asian financial crisis, there was a decline in demand for crude oil and non ferrous metals: these events contributed in the decrease of foreign reserves and the situation of Russian economy got worse. As a consequence, the external trade deteriorated by 18% because of a drop in international prices, GDP per capita fell down, unemployment soared and global investors decided to liquidated their capital from Russian financial market.⁵⁰

The Asiatic crisis affected the Russian economy in another way because financial investors began to realize that Russia's fundamentals were weak and they decided to

48 See Van de Wiel (2013).

49 Source: World Bank.

50 See Baig and Goldfajn (2000).

withdraw their funds. So, from 1997, the domestic interest rate increased a lot due to the deterioration in the balance of payments and also there was a large loss of external reserves: the stock prices decreased a lot and the Russian bond spreads reached 2000 basis point⁵¹. For all these reasons, investors did not trade these instruments in the market and they continued to withdraw their capitals.

Subsequently international reserves⁵² dropped in a precipitous way, the ruble was allowed to float in the market and the inflation in Russia was approximately 84% and the welfare costs grew in a considerable way. On August 17, 1998 Russian Government decided to devalue the ruble and in the same time it defaulted the domestic demand and declared a moratorium on payment of foreign creditors.



(Figure 5: The depreciation of the Russian ruble⁵³)

The figure (Figure 5) shows that ruble collapsed in a very dangerous way between July 1998 and August 1998 but on the other side, this currency recovered quickly.

51 See Baig and Goldfajn (2000).

52 **International Reserves** are used to support the local currency when there is the risk of depreciation. For this reason, they decrease a lot in Russia, but also in Brazil as we could see later.

53 Source: Adviseonly.com

During 1998, the Russian banking sector was affected by withdrawals by depositors and the following sovereign debt default inflicted losses on Russia's already weak banking sector⁵⁴. Many banks were not so developed and they based their income on the exploitation of arbitrage on the market, so they were not able to withstand the problems caused by a financial crisis. In this way a large number of Russian banks (i.e. Inkombank, Oneximbank and Tokobank), that had invested heavily in Treasury Bills and had extensive foreign currency exposure, collapsed: the access to international capital markets got worse and the trade financing was disrupted.⁵⁵ Moreover, a lot of deposit holders lost their savings.

But there were other problems linked with the Russian economy: it was not a dynamic system and there were not big companies that could give an impulse to the economy of this country. The Government was not able to provide the necessary economic infrastructures, including transportation, energy and public utilities. Furthermore, the fiscal system was not equal and so this increased the problems linked with the income inequalities.

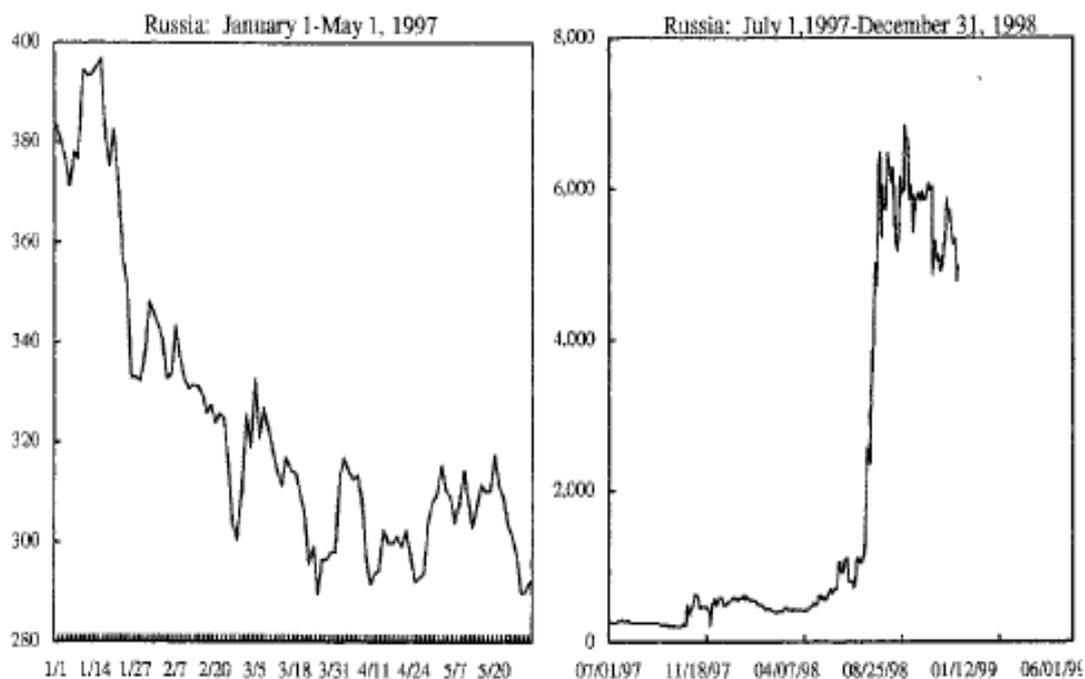
After all these events, the confidence towards Russian financial markets by foreign investors collapsed and also the domestic investors did not trust in banks because of their collapses.

In the following figure (Figure 6), there is the movements of Credit Default Swap⁵⁶ during 1999 and it explains how the risk of default was very high: the value of CDS raised a lot in that year and so also the return associated at these instruments was very high, but at the same time also the risk raised a lot.

54 See Van de Wiel (2013).

55 See Baig and Goldfajn (2000).

56 A **Credit Default Swap (CDS)** is a derivative contract in which one party, the protection “seller,” agrees to insure another party, the protection “buyer,” from default on an underlying bond or index of bonds in exchange for a fee. Notional amounts do not reflect the economic exposure in these markets, which is a small fraction of the notional value, but the growth noted here is indicative of the growth in exposure. (Yellen 2013).



(Figure 6: CDSs spread of Russia)

Later on the Russia crisis, IMF provided \$4,8 billion to raise the Russian economic system and to regain access to the international financial markets⁵⁷. Moreover, the Government decided to define restrictions on the currency market to increase the international reserves and banks did not give loans to private firms so they were forced to rely on their own financial resources. But these measures were not so good to raise the economy because, for example, the firms were not able to grow up without loans from banks.

Despite these problems, Russia recovered from its financial collapse very quickly and this is due to two main factors: the prices of raw materials on the market began to raise in 1999-2000 and so Russia returned to being competitive and the domestic demand recovered exploiting the benefits from the depreciation of the local currency.

⁵⁷ See Van de Wiel (2013).

2.3.1 The Contagion to Brazil: the Brazilian Currency Crisis in 1999.

In Brazil, factors that led into a crisis were linked to the globalization and the liberalization in the economic system combined with a weak governance and an ineffective regulation. Excessive high and unstable domestic interest rates were the result of the Brazilian Government attempts to sterilize inflows and defend the interest rate and its stabilization program from continuous external shocks like East Asian crisis and Russian virus.⁵⁸ The following imagine (Figure 7) shows the fall of Brazilian GDP after the financial crisis in East Asia (c) and the default of Russia (d).



(Figure 7: The fall of GDP growth⁵⁹)

The collapse of GDP in Brazil and the following currency crisis showed that these events were the result of the decline of confidence from economic agents in the government's capacity to sustain the prevalent economic policy and the weak of IMF's capacity to deal with international financial crisis. In particular, IMF's help was not able to restore confidence on the financial markets that Brazil was able to defend its currency.⁶⁰

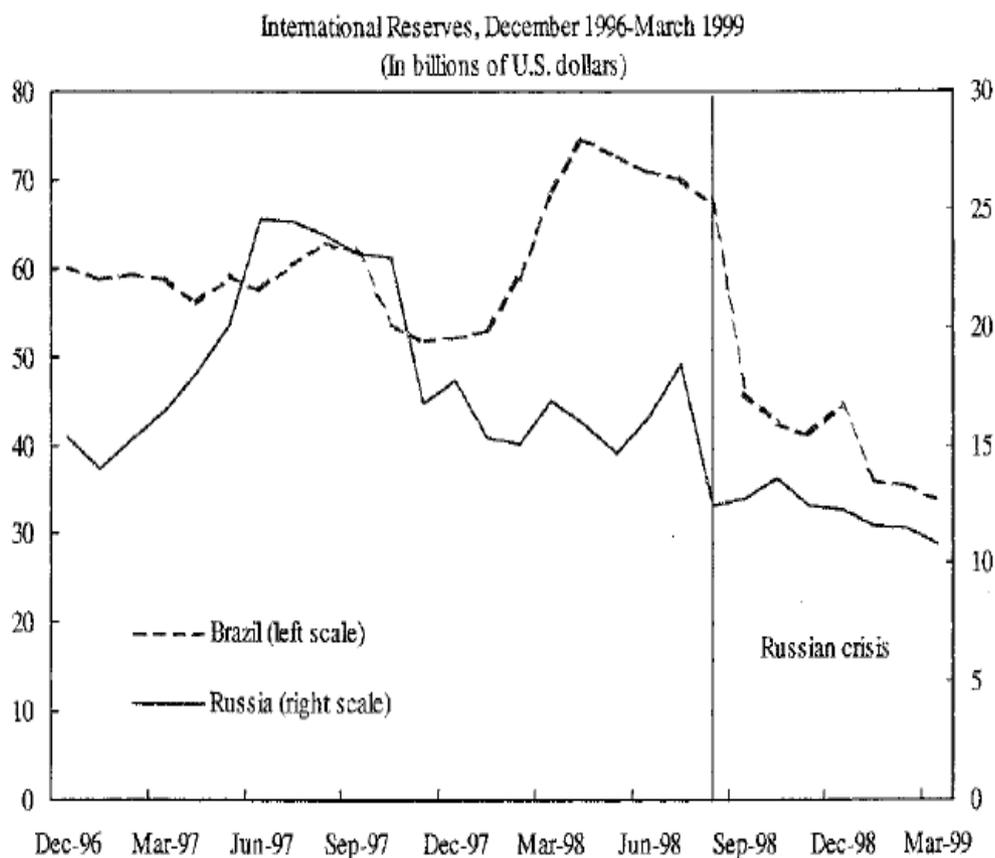
Furthermore in this country, the local currency (the real) was anchored to the U.S Dollar since 1994: this meant that the Brazilian Government could use the Central Bank to buy reals and using reals to buy dollars, whichever was necessary. But at the same time, the

58 See Palma (2012).

59 Source: Macrometrica.

60 See Rogrigues de Paula and Alves (2000).

monetary policy in Brazil must be parallel with the monetary policy in U.S.A.⁶¹ This created a high inflation rate and after the default of Russia, the situation got worse because the impact on the exchange market was extreme. In August and in September, the demand for U.S. Dollar increased a lot and consequently the loss of international reserves was substantial (Figure 8)⁶². The Brazilian Government decided to raise interest rates to keep investors and their capital in Brazil but they did not do this. Consequently, the real devalued a lot because the fiscal weight was too high.⁶³



(Figure 8: Brazilian international reserves⁶⁴)

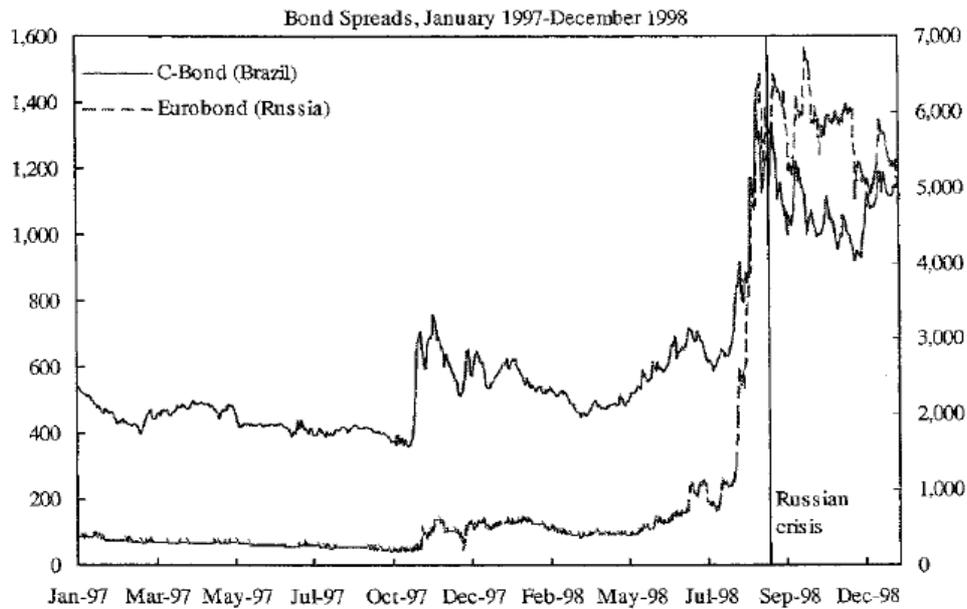
The contagion to Brazil was evident when the price of Brazilian Bonds spreads increased a lot during the financial storm on 1999 but this meant that the risk linked to them increased a lot (Figure 9).

61 See Gruben and Kisers (1999).

62 See Baig and Goldfajn (2000).

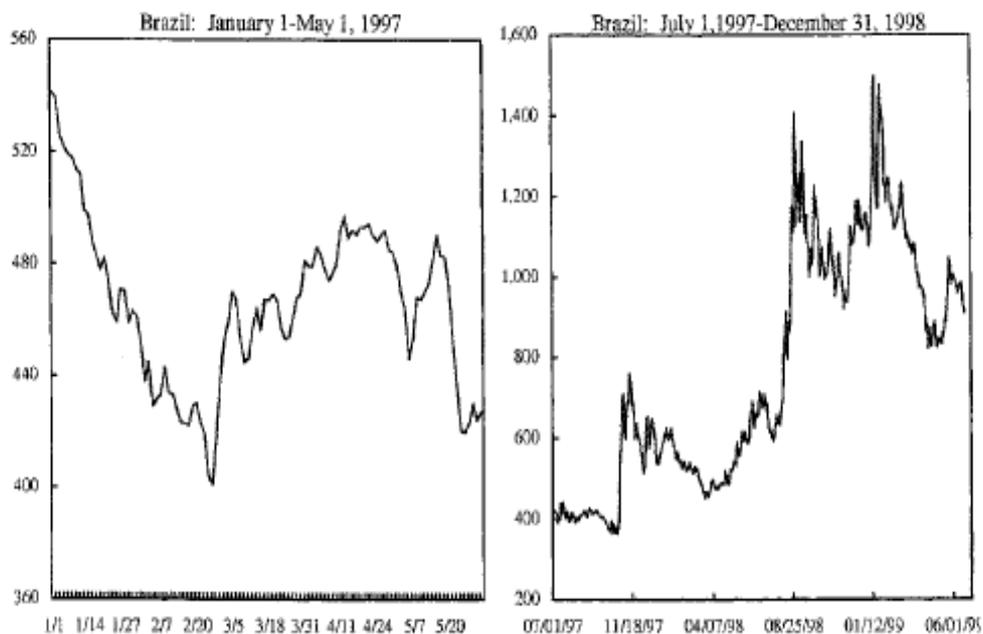
63 See Gruben and Kisers (1999).

64 Source: Bloomberg



(Figure 9: Brazilian Bonds⁶⁵)

Moreover, the next figure shows the movements of Credit Default Swap spreads before and after the currency crisis. When the value of a CDS grows up, this means that the default risk of the country is very high: during 1998, the risk of Brazilian default was very high and so the value of the CDS referred to this country raised a lot (Figure 10).



(Figure 10: CDSs spreads of Brazil⁶⁶)

65 Source: Central Bank of Brazil

66 Source: Bloomberg.

After all these negative events, investors of Brazilian market decided to sell their positions in reals to cover their huge losses in the other financial markets due to the crisis in East Asian and in Russia stock markets. In fact, the Russian moratorium produced large losses for a lot of financial institutions but also it led them to sell assets in emerging markets to raise funds and this created an outflow of capital from those markets. This affected Brazil in a particular way because the Brazilian financial market was the largest and the most liquid of the emerging markets and it played a very important role in global arbitrage strategies. Furthermore, Brazil and Russia had economic features in common: a large growing public sector deficit, a exchange-base stabilization policy, real appreciation and rising foreign deficits sustained by large short-term capital inflows based on interest rate differentials and vulnerability to commodity price declines.⁶⁷

The IMF and the World Bank decided to allocate in Brazil respectively \$18 billion and \$ 4,5 billion: these funds contributed to improve the situation in a marginal way because the bond spreads continued to be high. The best decisions arrived at the end of 1999, when the Cardoso's Government realized political and economical reforms that were very similar to those undertaken by the East Asian countries affected by the crisis: restrictive policies of demand to conserve the competitive advantage earned with the devaluation of the real and to push exports. The results were good: the inflation returned lower and the Brazilian economy restarted to grow up in a quick way.

There are similarities and differences⁶⁸ between Brazil, Russia and East Asian Economies during the crises:

- the intervention in the exchange markets and the IMF's initially intervention led to lost confidence and to the collapse of the local currency in each country;
- in East Asian Economies and in Russia the crisis caused a breakdown of both banking and financial system and a lot of bankruptcies in the private sectors. On the contrary, in Brazil there were only isolated banking insolvencies because Brazilian banks were healthy and the corporate sector was not highly indebted to the banking system. Moreover, Brazilian banks knew that the real was appreciated in the currency market and they expected a possible devaluation, so the depreciation of this currency was not a surprise for them;
- in Brazil, the Government and the Central Bank were most exposed in foreign currency market than East Asian Economies and Russia.

67 See Rogrigues de Paula and Alves (2000).

68 See Rogrigues de Paula and Alves (2000).

2.3.2 The collapse of Long Term Capital Management.

The Long Term Capital Management (LTCM) was a great hedge fund management firm⁶⁹ directed by important people of the world economic scenario. It was founded in 1994 by J.W. Meriwether, the former vice-chairman and head of bond trading at Salomon Brothers (another important American hedge fund), with equity of \$1,3 billion. Members of LTCM's board of directors included M.S. Scholes and R.C. Merton, who shared the 1997 Nobel Memorial Prize in Economic Sciences. This fund required a minimum investment of \$10 million and no withdrawals for five years.⁷⁰

The particular features of this hedge fund was that it utilized the “*convergence trading*”: this is a specific strategy that utilizes derivative instruments and bonds for hedging purposes and it exploits market anomalies to earn money.

For this reason, LTCM had a financial model that allowed to take advantages of fixed income arbitrage deals, studying interest rate curves in the market. It wanted to have high returns underwriting speculative positions on the movements of interest rate spreads and on the volatility of market prices. Usually, it had long positions in bonds that it considered undervaluated and short positions in bonds that were overvaluated. Differences in the the bonds' price are minimal and so to earn money, it was necessary to use financial leverage⁷¹ in a considerable way to increase the return. For this reason, LTCM had capitals for \$2,2 billion but at the same time it had loans from banks of \$125 billion and so the use of financial leverage was very high (approximately 55 times). It used financial leverage to multiply the potential profits and, clearly, losses.⁷² This fund bet a lot in derivative instruments and in this way it assumed a lot of risky positions in the financial market.

In the spring of 1998, the East Asian Financial crisis broke out, it spread to the other Economies of the world and banks and securities firms began to unload their risky and illiquid: as a consequence, LTCM went in difficulty because of its risky positions in the market. The situation got worse when the Russian Government decided to devalue the Russian rouble.

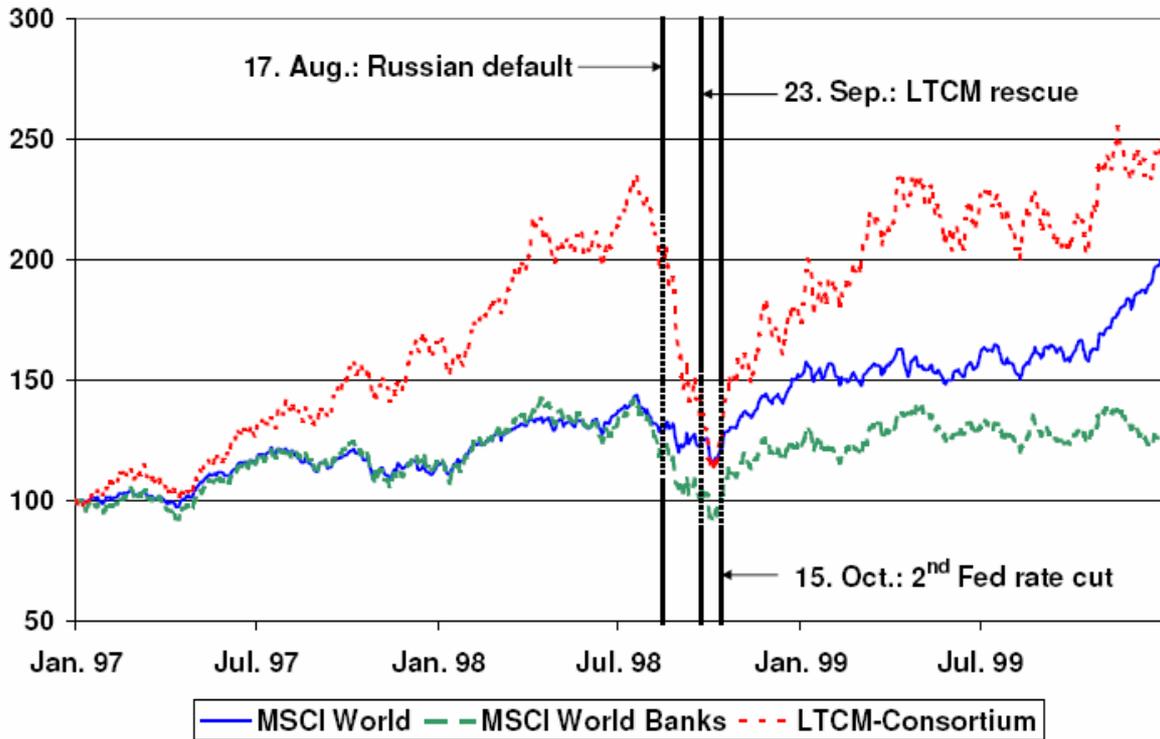
69 A **hedge fund management firm** is an investment fund that can operate in every financial markets and with every financial instruments and, in particular, it could open short positions and it has an unlimited use of leverage and of derivative instruments. It can pursue investment ad speculative strategies that are not open to other institutional fund managers and it can avoid the costs associated with regulatory oversight. Hedge Funds grow a lot in the recent years mainly for their attractive performance in the market.

70 See Edwards (1999).

71 **Financial Leverage:** the use of various financial instruments or borrowed capital, such as margin, to increase the potential return of an investment.

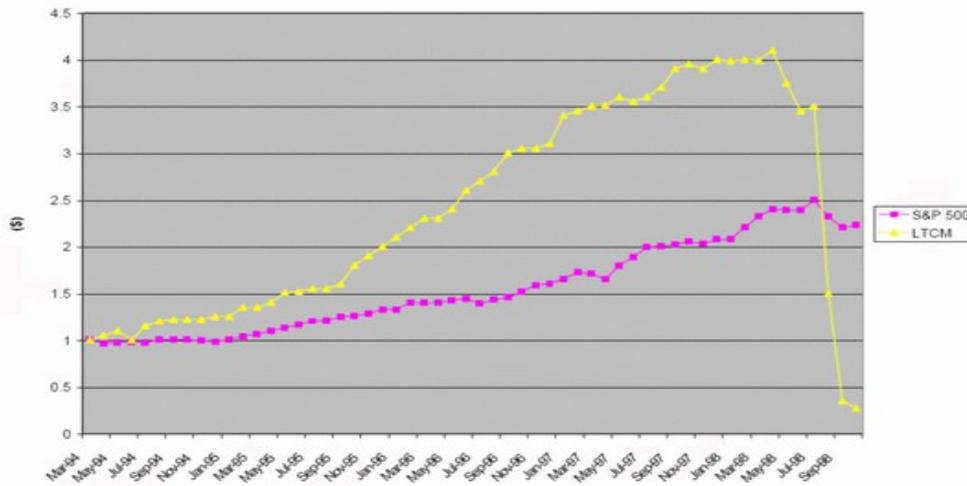
72 See Lenzner (1998).

The following figure (Figure 11) shows the market trend during the Russian default and the collapse of Long Term Capital Management:



(Figure 11: Russian Default and the Collapse of LTCM⁷³)

On September 2, 1998 the partners of LTCM said to their investors that there was a loss about 52% and consequently on September 23, 1998 the Federal Reserve convened the exponents of the most important banks of the world to speak about the bad situation of LTCM: it had a lot of debts with banks and securities firms and it continued to lose money in the market because of its speculative positions. (Figure 12)



(Figure 12: S&P 500 and the Collapse of LTCM⁷⁴)

73 Source: Finanzaonline.com

74 See Lowenstein (2001).

The FED believed that the collapse of this hedge fund could destabilize the global financial markets because of two main factors⁷⁵:

- in those years (1997-1998), the financial system was very weak because of the East Asian crisis and its contagion around the world with the default of Russia;
- the LTCM was involved in derivative contracts and so it was important to avoid a formal default because these derivative positions were a statutory exception in the bankruptcy code and so the potential losses would be very huge.

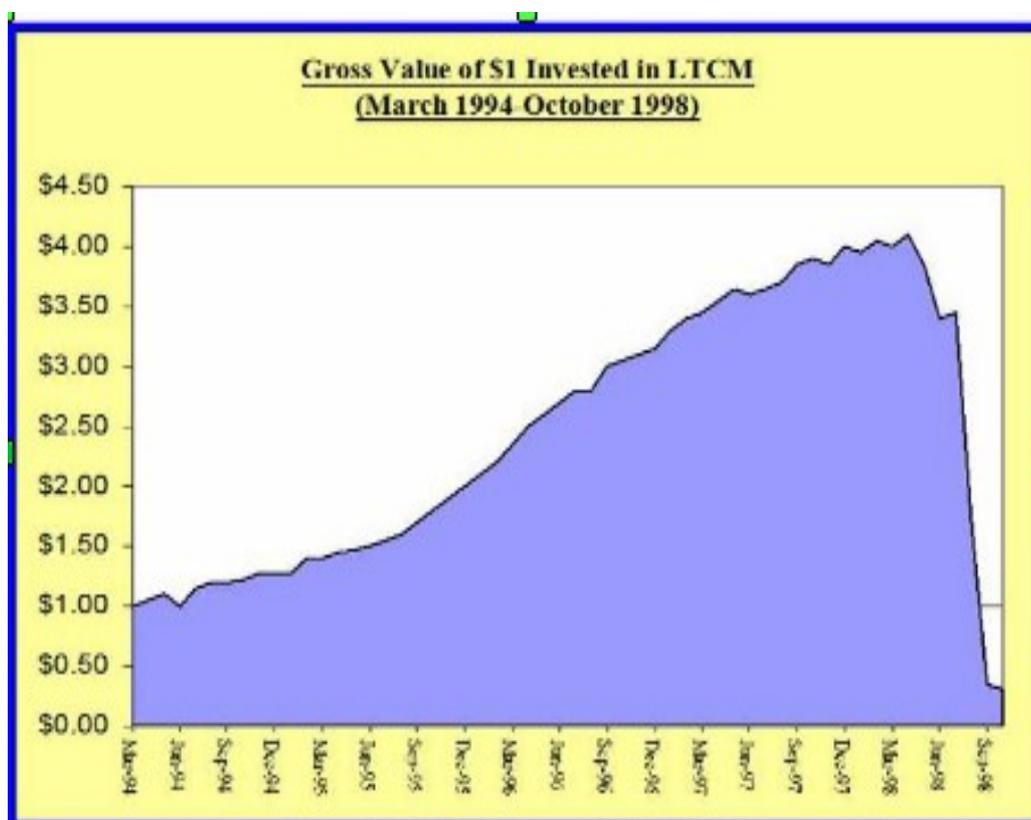
For these reasons, the FED with the main world banks (i.e: Goldman Sachs, Merrill Lynch, J.P. Morgan, Société Generale, Morgan Stanley, Lehman Brothers) organized a bailout of \$3,625 billion to avoid a wider collapse in the financial market. In the same time, the Fed decided to reduce the interest rate by 0,25% bringing it to 5.25% to face the liquidity crisis in the American market but the banks were all related with each others and so the danger of hyperinflation was very high.

The main cause that led to the collapse of LCTM was linked to bet too risky in derivative markets and also the financial models used in this fund were not able to forecast the systematic “storm” that occurred in East Asia and in Russia on 1997-1998. Financial investors were in panic and decided to invest in U.S. Treasury Bills and Bund: these decisions emphasized the difference between interest rates in the market and this led to huge losses. The worse bet was against Russia: LTCM invested in Russian interest rates but they collapsed and the losses were huge. The fund managers utilized the financial leverage and they continued to invest in the market to recover the losses but they led to the collapse of the hedge fund. Furthermore, banks extended credit and traded with LTCM without any information about what this hedge fund was doing in the financial market.⁷⁶ This behavior proved that banks took too much risk and they did not have the capital and the skills needed to deal with a possible adverse event in the market.

⁷⁵ See Edwards (1999).

⁷⁶ See Edwards (1999).

The figure (Figure 13) shows that the Long Term Capital Management recorded a net loss of 44% of investments: its capital decreased from \$4.8 billion to just over \$660 million. As a consequence, it closed its activity in early 2000.



(Figure 13: The rise and fall of LTCM⁷⁷)

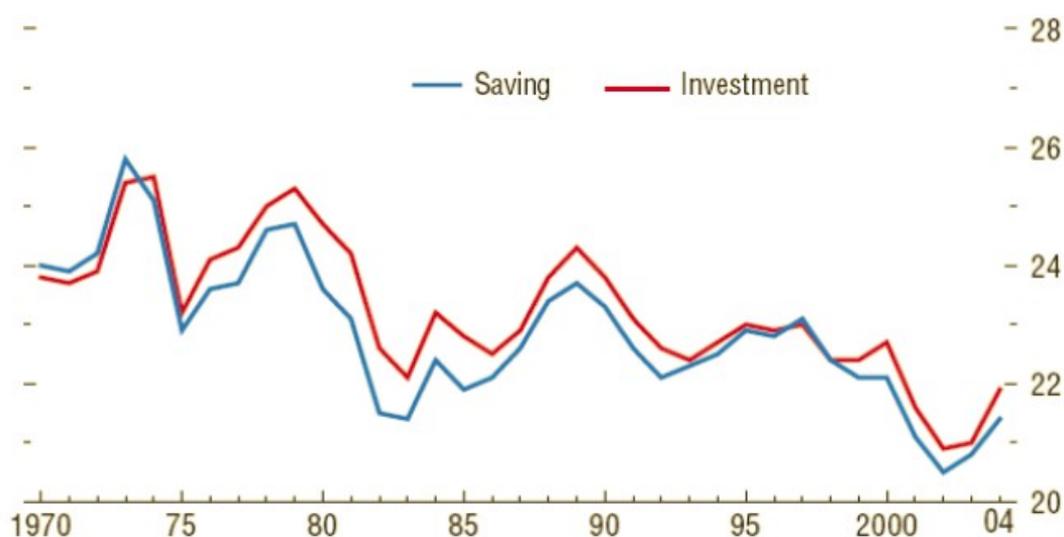
The collapse of LTCM is a perfect example of the interconnectedness of the markets in the economy: it shows that if there is a problem in one market, all other markets will be adversely affected because they are all linked together. Furthermore, this event suggests that in the financial market nothing is safe and stable: financial price movements are not predictable but they follow a random walk because the financial system is composed by casual and unpredictable movements and they are not computable by mathematical models. In this world, every investor is exposed to the uncertain events.

⁷⁷ See Lowenstein (2001).

3. The 2007-2008 Subprime Crisis.

In the early 2000s, the Government of the United States stimulated “easy mortgages” for the purchase of houses: the loans exceeded the value of the houses and the interest rates were very low. Banks held a lot of portfolios full of this type of mortgages: these “products” were processed through financial engineering and sold on the market as new financial products. They were considered a good form of investment to diversify portfolios. The rating agencies certified these products but they did not give the right level of risk and toxicity, and then these new financial instruments ended up in banks and financial institutions around the world. Financial intermediaries added value to the products but did not certify the risk in the right way and as a consequence, in 2007 these “new financial creations” were equal to 13 times the global GDP.⁷⁸

In the following imagine (Figure 14) is described the relationship between the investments and the savings among American people: in the years before the crisis, the USA was saving less that it was investing and so there was a deficit in the current accounts.⁷⁹



(Figure 14: Savings and Investments⁸⁰)

The USA had a very fast economic growth in the last 15-20 years: the demand for consumer goods was increasing and American households consumed much more than what they were able to produce. All this had been facilitated by globalization that allowed the debt to other states and the monetary policy of the Fed that kept interest rates low. From 2000 to 2005, the prices for private houses in the U.S. nearly doubled: American

78 See Billio (2014).

79 See Taylor (2009).

80 Source: World Economic Outlook, IMF Sept. 2005.

families had to pay their mortgages with a worth bigger than the property and they were not able to pay interest and amortization.⁸¹ Since the houses did not have sentimental value, they leave them to the banks and as a result the system collapses.⁸²

As a consequence, the “Real Estate Bubble” burst, the subprime crisis started and in the financial market there was a chain reaction due to derivative instruments created from mortgages and sold on the world market. One of the main problems was due to the transparency in the market because of the wide presence of CDO (Collateral Debt Obligation): this is a financial instrument created by an issuer first forming a portfolio of loans, either by lending money directly or by buying debt securities in the market place. Once the portfolio is formed, the CDO issuer sells tranches based on the cash flows scheduled to be generated by the underlying loans. The main advantage of issuing CDOs is that it allows the issuer to make loans repackaged them and then sell them to third parties. In this way the issuer distributed the risk of its CDO.⁸³ Since, financial institutions could distribute their toxic products in the banks all over the world, the crisis spreads throughout the rest of the economic system.

The financial crisis of 2007/2009 began in early August, 2007 with runs in several short-term markets formerly considered safe. During the first half of 2007, problems in the subprime market became increasingly visible and included the failure of several subprime originators.⁸⁴ The first signals of the crisis occurred in *February, 2007* when **HSBC** and **New Century Financial Corporation** announced heavy losses in their subprime portfolios. In *June, 2007* one of the main brokers of **Bear Stearns** announced some difficulties in two hedge funds that worked with subprime mortgages. Soon after, it started to sell their securities. The Bear Stearns was the first bank that occurred in huge losses in the beginning of 2007: it was a world investment bank and the pioneer of the subprime mortgage securitization. Its stock price in the Stock Exchange lost its value from \$170 (at the beginning of 2007) to \$3,17 (on March, 17 2008). The FED decided to save it from bankruptcy with a credit line of \$30 billion in favor of J.P. Morgan that bought this intermediary paying \$2 per share (less than 10% of the market value of previous days). They were afraid that the failure of this bank would cause an excessive impact on the global financial system. After a few months, **American Home Mortgage Investment Corporation** declared its bankruptcy and as a consequence of all these bad events, the

81 See Schowitz (2007).

82 See Billio (2014).

83 See Longstaff (2008).

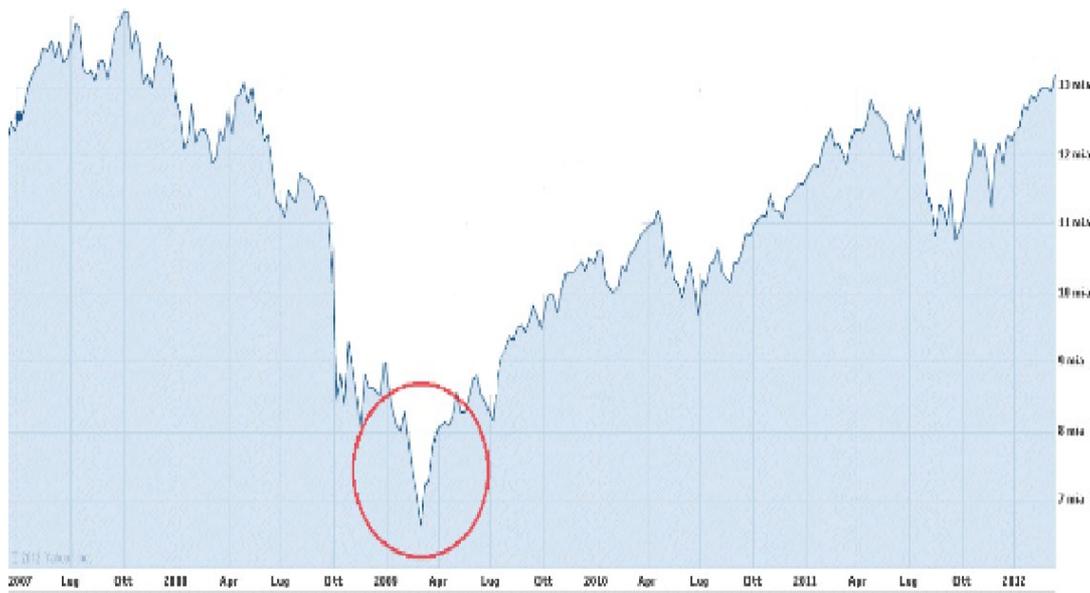
84 See Gorton and Metrick (2012).

FED decided to cut the discount rate on *17 August, 2007*.

In *March, 2008* also **American International Group (AIG)**, the biggest American insurance company, reported a loss of \$3,5 billion in the fourth quarter of 2007 due to the devaluation for \$11,12 billion in derivatives and securities linked to the subprime mortgages. It was the first provider of fixed rate annuities but it was also heavily exposed to mortgage-backed structured products. AIG used the CDSs as insurance on risky assets and for this reason, it maintained high margins of reliability to the rating agencies but it was exposed to derivatives of \$441 billion and \$57,8 billion were junk bonds. Subsequently, the rating agencies downgraded AIG and this caused a liquidity crisis.

At a later stage, in *July 2008* the FED and the U.S Government decided to intervene for the bailout of **Federal National Mortgages Association (Fannie Mac)** and **Federal Home Loan Mortgage Corporation (Freddie Mac)**. They were two government agencies in the form of private company active in the secondary mortgage market with guarantees for \$5,2 billion and securitization: they lost almost \$14 billion. In *September* of the same year, Freddie Mac and Fannie Mac were placed under temporary receivership and after that they were nationalized. In the same time, SEC (Securities and Exchange Commission) imposed restrictions about short selling.

On *15 September, 2008* the American financial system seemed to collapse: it is the Black Monday because the Dow Jones Index touched the lowest level since September, 2001 closing in fall of 500 points (Figure 15).



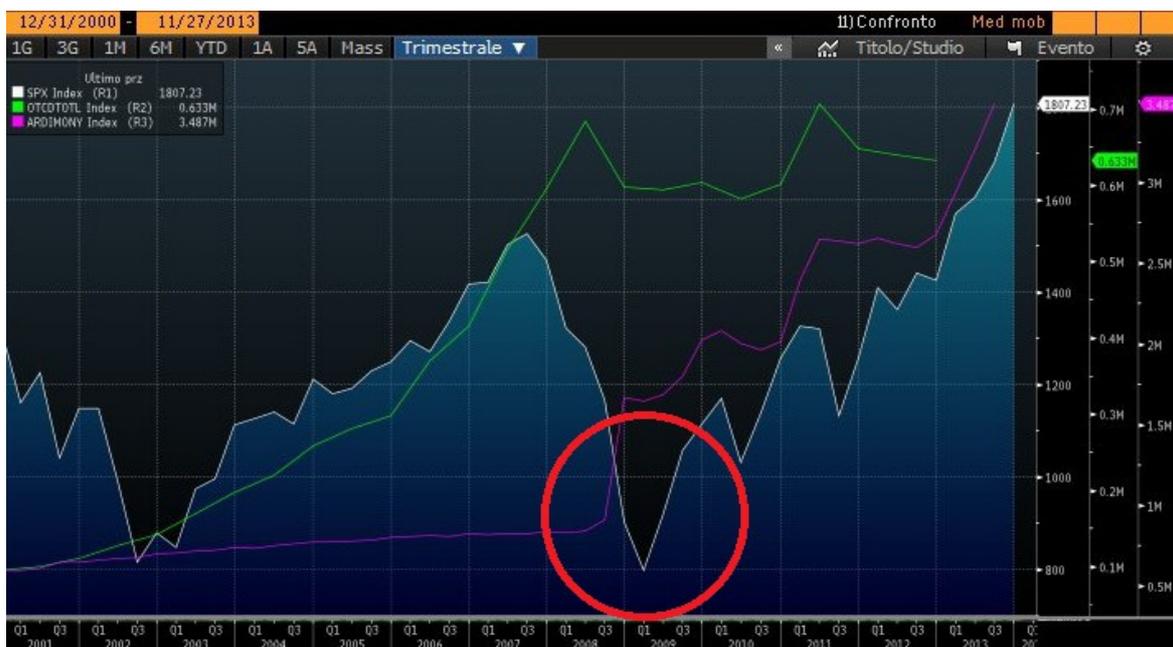
(Figure 15: The collapse of Dow Jones⁸⁵)

85 Source: Yahoo Finance.

Lehman Brothers declared a deficit of over \$600 billion and it went bankrupt. It was a company that dealt with financial services on the global economic system and it was one of the major players in the market for U.S. Government bonds.

Simultaneously, Bank of America bought out **Merrill Lynch** for \$50 billion and the stock price of AIG collapsed after the request for a loan to the FED that announced a plan for the rescue of the American insurance company based on a loan of \$85 billion for a year. Furthermore, the common stocks of Goldman Sachs and Morgan Stanley collapse in the New York Stock Exchange and then they decided to change themselves for investment banks into commercial banks. In the financial market, the assets of Lehman Brothers were purchased by Barclays and Nomura Holding, a Japanese society that bought the assets in Asia, Middle East and Europe. At the end of September 2008, **Washington Mutual** (the biggest Savings and Loans of America) reported a loss of \$19 billion and then it declared bankruptcy.

In those days, the Standard&Poor Index lost 8.7%: its value was not so low for 1987. (Figure 16). This index allows the evaluation of U.S. companies with the highest capitalization that are traded in the American financial market. In this way, in the imagine it is possible to see the loss of purchasing power of Americans and, consequently, for the rest of the world.



(Figure 16: The Collapse of S&P Index⁸⁶)

86 Source: Bloomberg.

After all these negative events the prices across a lot of asset classes and commodities fell drastically, the cost of corporate and bank borrowing rose substantially and financial market volatility rose to very high levels. As a consequence, the panic spread in the entire financial market.⁸⁷ The losses in subprime mortgages or the prospect of such losses after house prices started to decline were a trigger for the crisis but they could not explain the crisis itself. In the financial market, there was systemic vulnerability due to changes, especially in the short-term debt like repurchase agreements and commercial paper: these markets had growth a lot in the years before the crisis and they were big and unregulated. It is possible to say that this financial crisis was a systemic event because banks became insolvent and the crisis spread in the global economic system: cash was lent out and the loans were illiquid. Furthermore, it is right to say that there was a “**contagion**” because the crisis started in the subprime housing assets and then it propagated to non-subprime assets that had no direct connection to the housing market.

Some economists gave five reasons to explain the crisis⁸⁸:

- *macroeconomic developments and leverage*: there was a high and excessive use of the leverage by households and firms. This caused losses in the financial system and a lot of high leveraged banks became insolvent. The high level of debt in financial and non financial firms increased the likelihood of their bankruptcy, causing problems to banks and creditors;
- *behavioral factors, like speculation and optimism* in the years before the crisis: driven by optimism, firms decided to increase their level of debt to finance purchases of assets but when a fall in asset prices occurred, they were not able to dominate their high levels of debt;
- *shift to liquidity and safety*: the demand for liquid and safe asset caused a sentiment of fear between financial investors. Furthermore, they were concerned about the solvency of their banks;
- *management failure*: bank managers were worried about their profits and advantages. They did not pay attention to the risks for the banks and the possible future course of interest rates;
- *institutional weakness*: the financial regulatory was weak and the lack of the efficiency of the economic system caused the outbreak of the crisis.

87 See Ivashina and Scharfstein (2008).

88 See Ostrup, Oxelheim and Wihlborg (2009).

3.1 The Asset-Backed Commercial Paper (ABCP) Market.

The Asset-Backed Commercial Paper is a short-term investment vehicle with a maturity that is typically between 90 and 180 days. The security itself is normally issued by a bank or other financial institution. This instrument is generally used for short-term financing needs.⁸⁹ Normally, the commercial paper⁹⁰ is not collateralized but this is a form of collateralized commercial paper that allows financial institutions to borrow a low cost in order to create assets that form the collateral. ABCP is a form of securitization⁹¹ and it is issued by a conduit where there is a Special Purpose Vehicle (SPV⁹²) that the defined the assets to be purchased and the ABCP papers to be issued and the owner of the conduit receives nominal dividend payments. The SPV does not have any employees and so fees are normally payed to a bank. For investors, ABCP programs are less transparent and its performance depends on the skill of bank adviser. During normal times, ABCP yields are higher than yields on traditional unsecured CP (approximately 75 basis points greater).⁹³ it is thought to be a very liquid financial instrument because investors could liquidate their position as often as every day with no price impact.⁹⁴

Banks put ABCP in the financial market to finance holdings and also they provided guarantees for the ABCP to reduce the default risk and lower the cost of issuance. Usually, banks used this approach to boost leverage and take risks at a lower cost than Government rules otherwise permit. There are a lot of similarities between banks and ABCP programs: they issued liquid short-term debt to finance illiquid and long-term assets, they issued debt that is high-rated, collateralized and short-term and finally they are more vulnerable in a financial turmoil period because of the problems of withdrawals from investors. So, ABCP are like banks but without explicit deposit insurance.⁹⁵

In the years before the crisis, banks and other financial institutions did not sell the mortgages or mortgage-backed securities directly into the financial market but they used “shadow banks” for issuing commercial paper. As a consequence, there was a mismatch between the long-term maturity of assets (mortgages) and the short-term maturity of the

89 See Investopedia.

90 A **commercial paper** (CP) is an unsecured promissory note issued by a business for a specific amount of dollars and with a maturity in a specific date. it is a lower cost alternative to bank loans as a mean of short-term financing and it is similar to Treasury Bill because is typically issued at a discount: the buyer pay less than face value and receives face value at maturity.

91 A **securitization** is off-balance sheet financing for banks and other financial intermediaries.

92 it is a legal entity.

93 See Anderson and Gascon (2009).

94 See Covits, Liang and Suarez (2009).

95 See Covits, Liang and Suarez (2009).

liabilities (ABCP).⁹⁶ Furthermore, the commercial bank advisers to ABCP conduits discovered arbitrage opportunities in the securitization of asset-backed securities and collateral debt obligation and so they started to bring to the market ABCP conduits without liquidity and credit enhances: in the market there was not the liquidity necessary to pay back the investors.⁹⁷ At the beginning, investors thought that ABCP was a very low-risk security but after the start of the crisis they became aware about their risks and so the trading in the ABCP market dried up. They became wary about the risks of the underlying assets and they were worried that banks which provided liquidity would be unable to support them.

In 2007, the ABCP was the largest short-term debt instrument in the financial market and the most of it was issued to U.S dollar and sold to risk-averse investors (Figure 17). The figure shows that the ABCP market grew up in a significant way in the years preceding the financial crisis and then it collapsed when the sub-prime mortgage crisis broke out.



(Figure 17: The rise and the collapse of ABCP market⁹⁸)

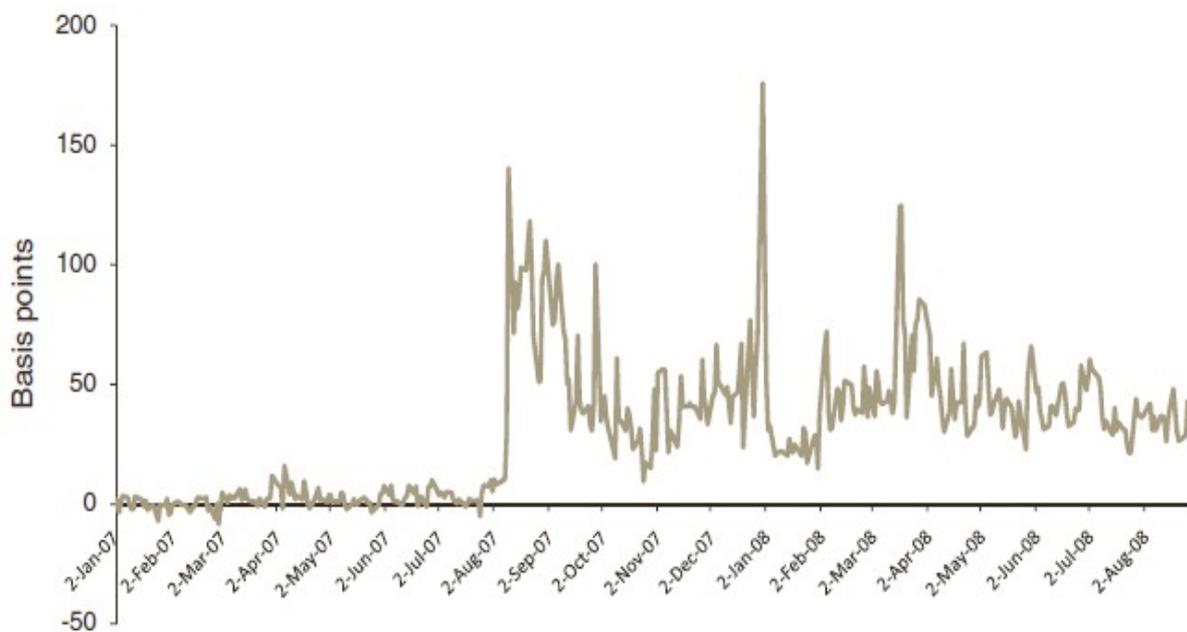
96 See Acharya and Schnabl (2010)

97 See Anderson and Gascon (2009).

98 Source: Acharya and Schnabl (2010)

The triggering event that causes the collapse of ABCP market was the declaration of bankruptcy of **American Home Mortgage Investment Corporation** on August 6, 2007. After this event, many ABCP programs began to encounter difficulties to roll-over their paper and so they defaulted. Then⁹⁹: on July 31, 2007 two **Bear Stearn's** hedge funds that had invested in sub-prime mortgages filed for bankruptcy and in the same days, **BNP Paribas** suspended withdrawals from its three investment funds because of its inability to assess the value of the mortgages and other investments held by the funds. Moreover, on September, 16 2008 The **Reserve Primary Fund** lowered its share price below \$1: this is due to its exposure to Lehman Brothers securities.

After these negative events, many investors lost their confidence in the financial market and they became reluctant to purchase ABCP and its total values fell by 37% from \$1.18 trillion in August 2007 to \$745 billion in August 2008. They started to think that the collateral backing ABCP might be of a lower quality than they initially thought. Moreover, investors were reluctant to roll-over ABCP and so the yields on new issuers soared and the market plummeted. As a consequence the spread on overnight ABCP increased a lot: from 10 basis points to 150 basis points¹⁰⁰ (Figure 18). Some firms failed outright because their ABCP matured and it could not be rolled over. Furthermore, banks had a very big problem of liquidity because its cost raised up and it was very high but simultaneously the asset prices plunged.¹⁰¹



(Figure 18: The Spread on ABCP market raised up)¹⁰²

99 See Kacperczyk and Schnabl (2009).

100 See Kacperczyk and Schnabl (2009).

101 See Acharya and Schnabl (2010)

102 Source: Kacperczyk and Schnabl (2009).

Of course, the policy makers were worried about the impact of the ABCP collapse on the real economy and so the FED started purchasing commercial paper on October, 26 2008 and its action promptly stabilized the market. By early January 2009, the FED owned paper worth \$357 billion (22,4% of the market). Through the year 2009, it reduced its holdings and in October 2009 the FED held only \$40 billion of commercial paper.

There are three possible explanations¹⁰³ for the collapse of ABCP market during the financial crisis of 2007:

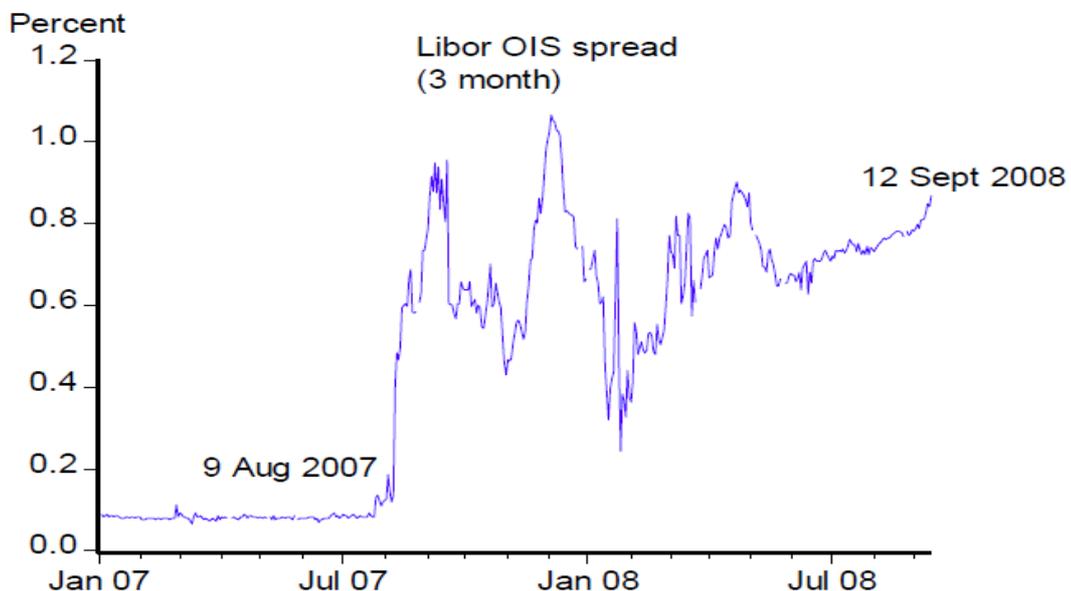
- *substitution to other sources of financing*: investors learned that ABCP was collateralized by assets for which liquidity in the secondary market could suddenly disappear and when Lehman Brothers went bankrupt, they understood that also big financial institutions could collapse, causing the default of supposedly safe commercial paper. So, investors decided to require high return to compensate the bigger risk and the cost of ABCP raised up. Furthermore, they started to ask for more information and consequently the spread on ABCP increased to compensate the costs of information. During the collapse of ABCP market, the primary source of alternative financing was the sponsoring financial institutions that used bank deposits, certificates of deposit or even financial instruments to replace financing from ABCP market;
- *adverse selection* between ABCP issuers and investors: if there was not the right information between them, the market would be freeze;
- *institutional constraints*: the ABCP market after the collapse of Lehman Brothers became too risky and the decrease in demand, also due to the more stricter Government rules, contributed to its decline.

¹⁰³See Kacperczyk and Schnabl (2009).

3.2 The Money Market Fund (MMF).

The Money Market Funds (MMF) promise to pay back 100% to the investors on demand. In the period before the start of the crisis, funds were able to meet the demand of these investors and this market grew up in a dramatic way to exceed \$4 trillion. The MMF increased a lot after the collapse of Asset-Backed Commercial Paper (ABCP) market because investors started to run to the Money Market since they thought it was a safer market: the collapse of ABCP market caused huge losses in this market but they were absorbed by MMF sponsors, like asset management firms, and so investors lost nothing.

On August 9/10, 2007 there was a dramatic change in conditions in the Money Market where financial operators buy and sell short-term securities. In the following figure (Figure), it is possible to see the trends of three month LIBOR and the three month Overnight Index Swap (OIS¹⁰⁴). The spread jumped to unusually high levels and remained high ever since. A lot of loans in the economy were indexed to LIBOR¹⁰⁵ and an increase in the spread caused an increase for the costs of these loans.¹⁰⁶ The crisis led rapidly to a massive decline in the market values of large portfolios of highly rated asset-backed securities held by many financial institutions. (Figure 19)



(Figure 19: The LIBOR-OIS spread during the first year of the crisis.¹⁰⁷)

104The **three month Overnight Index Swap (OIS)** is a measure of what the markets expect the Federal Fund rates to be over three month period comparable to three month Libor. The difference between LIBOR and OIS is due to things other than interest rate expectations, such as risk and liquidity effects.

105The LIBOR is the rate paid on unsecured interbank loans that are not tradable in the financial market.

106See Taylor (2009).

107Source: Taylor (2009).

The OIS contracts have little credit risk exposure and if the spread between LIBOR and OIS becomes wide, there is an apparent arbitrage opportunity in the market: in this case, banks did not take advantages from this situation because of the counterparty risk.

In August 2007, it became clear that the financial market was not able to solve the subprime crisis on its own and the problem spread beyond the USA's borders. It started to be a lot of liquidity problems around the world and Central Banks with Governments decided to come together to prevent further financial catastrophes.

The FED started to cut the interest rate: the discount rate was reduced from 1% to 1,5%: in this it wanted to help the American economy to raise up. Furthermore, the US Government decided to allocate \$700 billion to purchase distressed assets, in a particular way mortgage securities.¹⁰⁸ Since the Government put liquidity in the market, the overnight interest rate fell down and so the spread between three month LIBOR and the three month Overnight Index Swap decreased. At the same time, the short-term interbank rates moved up: it seemed that banks demanded more liquidity or they were reluctant to lend to each other, perhaps because of the panic about the losses on subprime mortgages.

But the most dangerous event occurred on September 15, 2008 Lehman Brothers collapsed and in the following day, The Reserve Fund announced its huge losses due to that bankruptcy: it lowered its share price below \$1 because of its huge exposure. It was a large Money Market fund with \$65 billion of asset under management and its losses were almost \$785 million due to holdings of Lehman Brothers¹⁰⁹. After these events, the rapid exodus from Money Market began, investors decided to withdraw their money and these funds needed to raise liquidity and so they were forced to sell assets aggressively.

Then, investors decided to invest in Treasury Bill and others Government Securities because of their liquidity, transparency and their lower risk: investors demanded for having immediate access to their cash holdings and these funds were the most liquid in the Money Market. Furthermore, they were transparent and since the risk of default increased a lot during the crisis, investors were inclined to find a portfolio with high level of transparency. After the crisis the total investments held in the Money Market fell down to \$3,288 trillion.

¹⁰⁸See Singh (2009).

¹⁰⁹See Kacperczyk and Schnabl (2009).

The possible explanations¹¹⁰ for the increase of LIBOR spread were:

- *counterparty risk*: during the crisis, banks became more reluctant to lend to other banks because of the perception that the risk of the default increased. Inter-bank lending in the LIBOR market was very unsecured. Furthermore, the quality of the securities that banks owned got worse: the continue decline in the housing prices in the global economy contributed to increase the skepticism that banks had towards each others. If banks or traders did not trust in the others, this increased the dispersion in the market and as a consequence, also in the overnight market the volatility increased;
- *liquidity risk*: traders in one bank were reluctant to expose the traders' bank's funds during a period of turmoil because there were worried that those funds might be used to cover the bank's own shortfalls. Also individuals and non-banks were worried about the stability of financial system: the interest rate on CDSs followed the LIBOR and this meant that everybody in the financial market was exposed to the crisis. A CDS is a measure of the probability that a financial institution might default on their debt: during the first period of turmoil, the CDS rates increased a lot. Furthermore, banks needed liquidity to make sure that their own balance sheet was good for the end of year financial reports;
- *expectations of future interest rate changes*: for example, if there were expectations of dealing overnight rate, this would cause term LIBOR rates to decline as well and so all interest rates were equal in the market. In February 2008, the spread decrease significantly and this was due to expectation of future interest rate cuts.

The crisis in the Money Market encouraged prime managers of this market to release current information on fund holdings and issue statement to investors. The main problem was that if the Money Market was not functioning well, this influences had an impact on the availability and the cost of credit to business and household. Furthermore, it jeopardized the effectiveness of monetary policy. For these reasons, policy makers had to find the way to take under control the crisis in the Money Market and also to protect investors.

¹¹⁰See Taylor and Williams (2007).

3.3 The REPO (Sale and Repurchase Agreement) market.

The REPO market is a very large, short-term market that provides financing for a wide range of securitization activities and financial institutions and the REPO rate is one of the most important Money Market rates. The REPO market is the primary source of funds for the securitized banking system and it is type of short-term investment widely used by Money Market Fund portfolio managers and shareholders.¹¹¹

A REPO is a sale of a security combined with an agreement to repurchase the same security at a specific price, at the end of the contract¹¹². Economically, it is a collateralized deposit in a bank: the depositor or lender puts money in a bank for a short-term, usually overnight, and the bank promises to pay REPO rate on the deposit of money. To ensure the safety of the deposit, the bank provides a collateral for the depositor. Generally, the depositors are large institution investors, Money Market Funds, non financial firms, states or municipalities and other large investors. Banks need a collateral because the size of deposits are too big and they are not able to ensure it: if the bank fails, the depositor could sell the collateral to recover the value of the deposit.¹¹³

From 2002 to 2007, the International Monetary Fund estimated that the total outstanding REPO in the U.S. Market was almost between 20% to 30% of U.S. GDP in each year. The majority of these REPOs were backed by safe securities issued by U.S. Treasury or other government agencies. Only about 10% were collateralized with riskier assets such as securitized subprime mortgages.

During the crisis, net REPO financing provided to U.S banks and broker-dealers fell by about \$1,3 trillion: this meant that the panic spread in the financial market and this led investors to be afraid of something quite safe.

One of the main cause of this huge loss was the changes in the LIBOR-OIS spread that was strongly correlated with changes in credit spreads and REPO rates for securitized bonds: there was a higher uncertainty about the bank solvency and lower values for REPO collateral. Furthermore, REPO market decreased during the crisis because of the concerns about the credit worthiness of counterparties and the ability to realize the value of the collateral¹¹⁴.

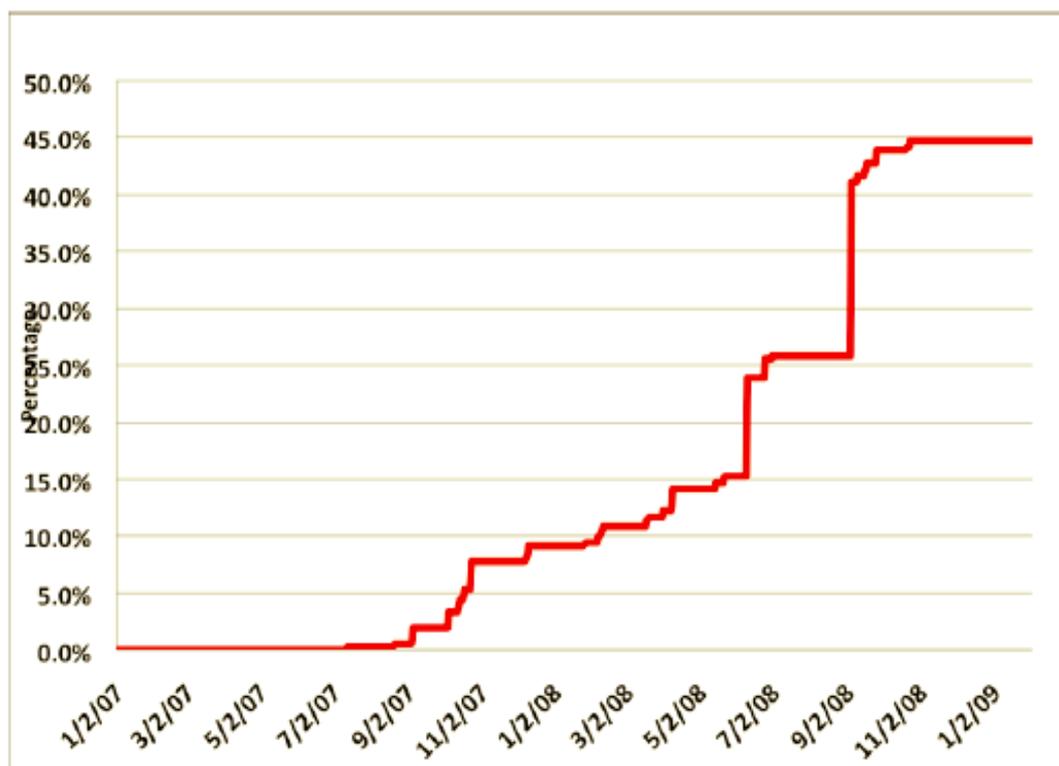
111 See Gorton and Metrick (2012).

112 See Gorton and Metrick (2009).

113 See Gorton and Metrick (2012).

114 See Hordahl and King (2008).

About this, there was an increase in REPO haircuts¹¹⁵ because of concerns about the liquidity in the market for the bonds used like a collateral for the REPO transactions (Figure 20).¹¹⁶



(Figure 20: The REPO-Haircut Index¹¹⁷)

In this case, the haircut rate was an average haircut for collateral used in REPO transactions: this index raised from almost zero in the first months of 2007 to nearly 50% at the peak of the crisis in late 2008. When the LIBOR-OIS spread increased, there was a fall in the value of collateral used in REPO transactions and so the haircut rate increased. The lenders would begin to fear for the stability of the banks and the possibility that they might need to seize and sell collateral. As a consequence, the borrowers were forced to raise REPO rates and haircuts and this growth could drive the banking system to bankruptcy. Furthermore, the raise in REPO haircuts caused the runs from the REPO market because a lot of traditional REPO investors decided to withdraw their funds and so they reduced the quantity of financing available in the financial market.

After the rescue of Bear Stearns in March 2008, thanks to the rapid takeover by J.P. Morgan Chase assisted by the liquidity from the FED, the activity in REPO market became

115 The **REPO haircut** is the difference between the amount of the deposit and the value of the underlying asset. (Gorton and Metrick 2012)

116 See Gorton and Metrick (2009).

117 Source: See Gorton and Metrick (2009).

more concentrated in only the highest quality collateral and consequently, this market died up. Interest rates started to be more volatile, the guarantees became more conservative and the margin requirements rose a lot.

Moreover, there was the problem that was difficult to obtain funds with maturities longer than one month. The situation got worse with the collapse of Lehman Brothers in September 2008 because investors became totally unwilling towards the REPO market.

3.4 The FED Responses To The Financial Crisis of 2007/2008.

The losses linked with the subprime mortgages led to the bankruptcy a lot of American financial institutions and shook investor confidence in credit markets: as a consequence, the financial market was fragile and vulnerable. So, the highest priority for the policy makers was to promote a global economic recovery and to do this, they have to ensure the necessary liquidity to markets in the economic system and to monitor the systemic risk in the financial system and so it was possible to reduce the negative effects that could occur during a crisis. The FED responded in a aggressive way to the financial crisis of 2007 by cutting the discount rate (the rate at which the FED lends to depository institutions) and easing the monetary policy. These policies helped to support employment and incomes during the first year of the crisis but then the financial turmoil became more intensive and so these policies were non sufficient and so the FED decided to cut the target for the federal funds of an additional 100 basis point. But this monetary policy was not without risks because there was the problem of inflation and so the Committee had to ensure the price stability. Furthermore, the FED worked to support the functioning of credit markets and to reduce financial strains by providing liquidity to the private sector: this is a way to reduce the systemic risk in the financial market¹¹⁸.

Towards the ABCP market, the FED and the Treasury introduced programs to enhance liquidity in two different way: by reducing extension that is the risk that an investor will not repay maturity Commercial Paper in a timely fashion and by reducing the risk of redemption at Money Market Funds that hold Commercial Paper. The FED proposed three different programs¹¹⁹:

- **Money Market Investor Funding Facility:** this program was approved by the FED on October 21, 2008 and it authorized some special purpose vehicles to purchase bank debts or Commercial Paper forcibly sold into the market as a result of a run on a bank or money fund. This program expired on October 30, 2009 because of its inactivity;
- **ABCP Money Market Mutual Fund Liquidity Facility:** it is created on September 19, 2008 and it allowed Money Market Funds indirect access to the FED discount window via a depository financial institution. In the first moment, banks had to sell ABCP to an eligible depository institution and so it was possible to borrow at the

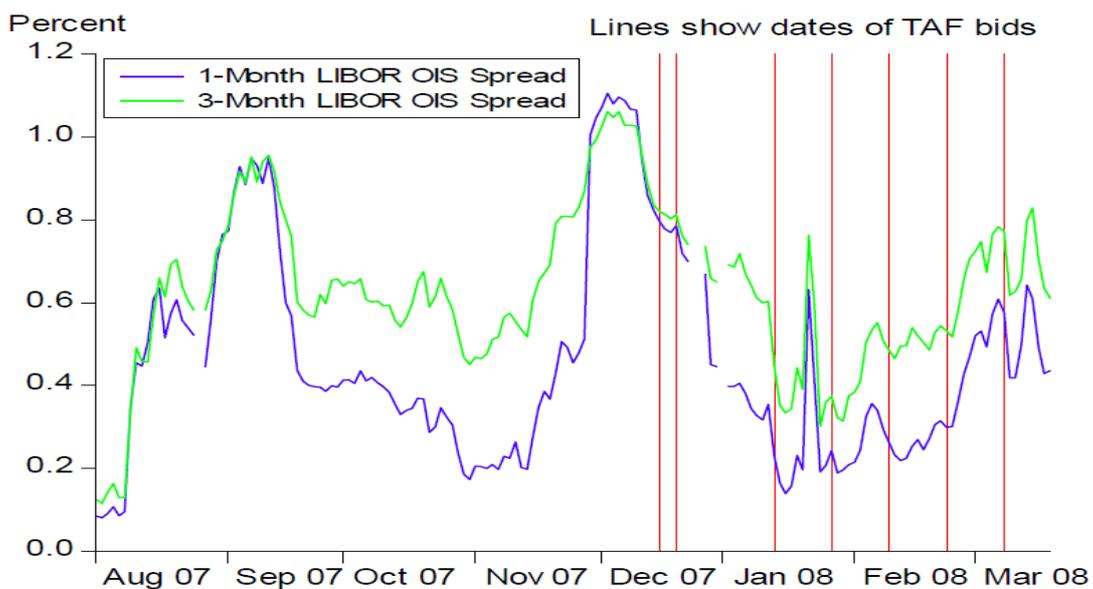
118 See Bernanke (2009)

119 See Anderson and Gascon (2009).

discount window. It went on until February 1, 2010;

- **Commercial Paper Funding Facility:** the events that occurred in the financial market in the middle of September 2008 made investors hesitant to purchase assets with maturities longer than a single day. The FED proposed a special purpose vehicle that purchased assets with longer maturity using its funds and so the papers were held to maturity. The first purchase occurred on October 27, 2008 and this was the most active program of the Federal Reserve and for this reason it lasted until February 1, 2010 (like the previous one).

In the Money and in the REPO Market, policy makers had to look for policies that were able to increase the resiliency in this market since it was very susceptible to runs. To reduce the spread between LIBOR and OIS in the Money Market, the FED decided to introduce the **Term Auction Facility (TAF)**: the purpose was to provide liquidity directly to financial institutions at a longer duration. In this way, the FED believed to drive down the spread between the rates in the market and it wanted to encourage more discount window borrowing. The TAF was announced on December 12, 2007 and it allowed financial institutions to make bids for term borrowing from the FED with a very short-term maturities (almost 28 days).¹²⁰ The following figure shows the dates of TAF bids and it is possible to see that this instrument was useful at the first moment: the auctions were oversubscribed and the spread between LIBOR and OIS decreased a lot. But soon after the spread rose again to high levels. (Figure 21)

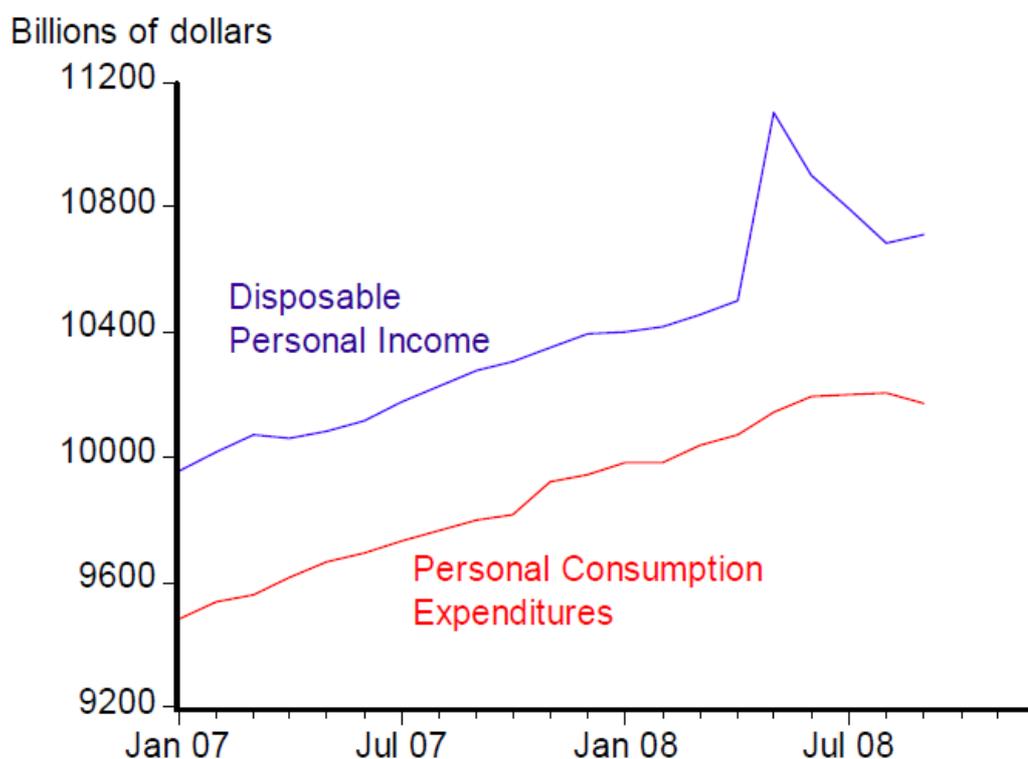


(Figure 21: The dates of the TAF and the reaction of the spread)

¹²⁰See Taylor and Williams (2007).

Furthermore the TAF did not increase the amount of liquidity in the Money Market: any increase in liquidity that came from banks borrowing from the FED using the TAF would be offset by open market sales of securities by the FED to keep the total supply of reserves from falling rapidly. During, a turbulent period, the FED had to sell securities to keep the interest rates on the right target.¹²¹

The FED decided also to put **temporary cash infusions** in the market:it send cash for over \$100 billion to individuals and families in USA and so they would have more money to spend. In this way, the FED wanted to rise up the consumption and the economy but people spent were little and the consumption did not rise up as the policy makers had been hoped¹²². (Figure 22)



(Figure 22: Disposable Income and Consumption¹²³)

Furthermore on March 11, 2008 it was introduced the **Term Security Lending Facility** (TSLF). It was the period when Money Market became severely impaired and so this program was specifically designed to address dislocations in Money Market by exchanging Treasury securities for less liquid and somewhat lower quality collateral held by market participants. In this was, this program was able to fight the stress in the Money Market.¹²⁴

¹²¹See Taylor and Williams (2007).

¹²²See Taylor (2009)

¹²³Source: Taylor (2009)

¹²⁴See Hrung and Seligman (2011)

To summarize, it was necessary a stronger supervisory and regulatory system under which gaps and unnecessary duplication in coverage were eliminated. In the first years of the financial crisis, there was the need to clarify the supervisory authority and to have adequate powers to curb the excessive leverage and risk-taking. Also, the policy makers had to minimize the market uncertainty and to provide the public as much information as possible: in this way, investors could restore their confidence towards the economic system and they could stop to withdraw their funds from the markets. The supervisory authorities should develop the capacity to increase surveillance of the financial system a a whole and for this reason, it was necessary to revisit capital regulations, accounting rules and other aspects of the regulatory regime to ensure that they did not induce excessive procyclicality in the financial system and in the economy¹²⁵.

¹²⁵See Bernanke (2009)

3.5 The Crisis In Europe: From A Financial Crisis To A Sovereign Debt Crisis.

In the middle of 2007, in U.S. the credit risk premiums increased and there was a big decline in prices on mortgage-backed securities. The direct exposure of European financial firms to U.S. mortgage related financial products was the first channel for the spread of the crisis to U.S.A to Europe. In August 2007 two German Banks, **IKB Deutsche Industriebank** and **Sachsen Landesbank**, collapsed due to losses on mortgage exposure in the U.S. market.¹²⁶ They had provided credit guarantees more than three times their equity capital in order to issue ABCP of the risk free variety. So, German banks were unable to fulfill promises under these guarantees and they were rendered insolvent. Furthermore, also the **Deutsche Bank** admitted that had lost €1,7 billion for its exposure of subprime mortgage assets and the **Union Bank of Switzerland** (UBS) suffered particularly large losses. A lot of other European banks suffered significant losses because their credit guarantees to outside investors required them to pay off maturing ABCP at par, independently of underlying asset values¹²⁷. In Europe, ABCP issuance had fallen to an estimated \$347 billion: a decline of 28,8% from December 2006 and of 37.7% from July 2007.¹²⁸ The problem of liquidity and the fear of bank insolvency accentuated the problems in the European financial market.

In September 2007, depositors started massive withdrawals from the British Bank **Northern Rock** which had relied on the wholesale financing market and it was taken over by the British Government in February, 2008. After these events, European Central Bank (ECB) started to increase the lending facilities to help European banks. Moreover, the Bank of England and other Central Banks decided to lower their policy rates. In September 2008, a lot of European financial firms had to be supported through the injection of capital from government: the financial group **Fortis** was taken over by the Benelux government and BNP Paribas. **Dexia**, the worldwide leader for credit lines to local groups, was affected by the problems of its American subsidiary Financial Security Assurance (FSA) and it was helped by the France and Belgium governments with €6 billion. Moreover, **Hypo Real Estate**, a holding society that controlled three German banks, collapsed because of the bankruptcy of its subsidiary **Depfa** (an Irish society) and the German government allocated €15 billion for its rescue. During the autumn of 2008, in Denmark and in Sweden a lot of smaller banks filled for bankruptcy. ECB decided to put in the market the liquidity necessary to allow banks to solve their problems. Furthermore, ECB distributed packages

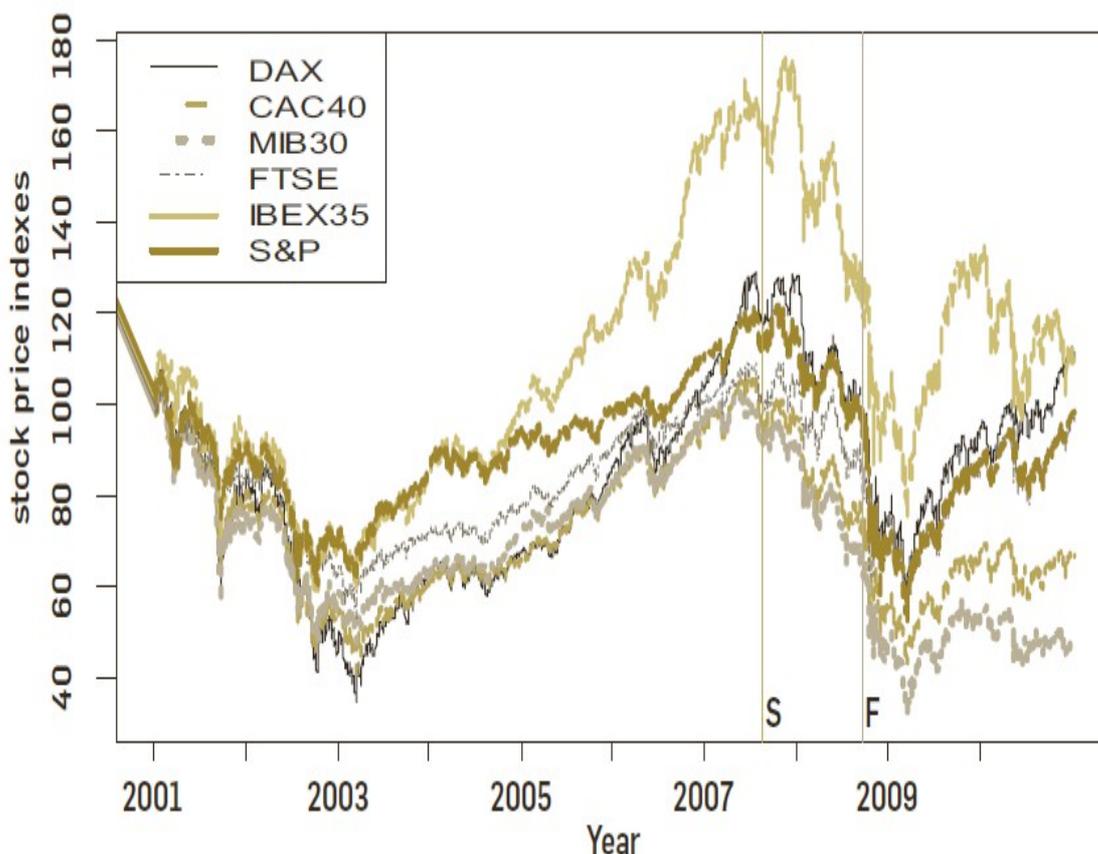
126 See Ostrup, Oxelheim and Wihlborg (2009).

127 See Acharya and Schnabl (2010).

128 See Fitch Ratings (2008).

for banks and other financial institutions like government guarantees for debt obligations, lending facilities for the purchase of Commercial Paper and government injections of capital to banks.¹²⁹

In the following figure (Figure 23), it is possible to see that there was a rapid increased in the prices in European stock market the years before the crisis and then when the supprime crisis started, in August 2007, they began to fall down¹³⁰.



(Figure 23: Evolution of Stock Price Indexes¹³¹)

On October 6, 2008 there was the black Monday for Milan, London, Paris and Frankfurt (the main European Stock Exchanges) lost respectively: 8,24%, -7,85%, 9,04% and -7,07%. As a consequence, on November 11, 2008 ECB decided cut the interest rates by 0,5% and the Bank of England reduced it by 1,5%. In the beginning of 2009, the German government subscribed a capital increased of **Commerzbank** for €10 billion and in the same period, the Irish government announced the nationalization of **Anglo Irish Bank**. The United Kingdom decided to reduce again the interest rate by 50 basis points: it was

129See Ostrup, Oxelheim and Wihlborg (2009).

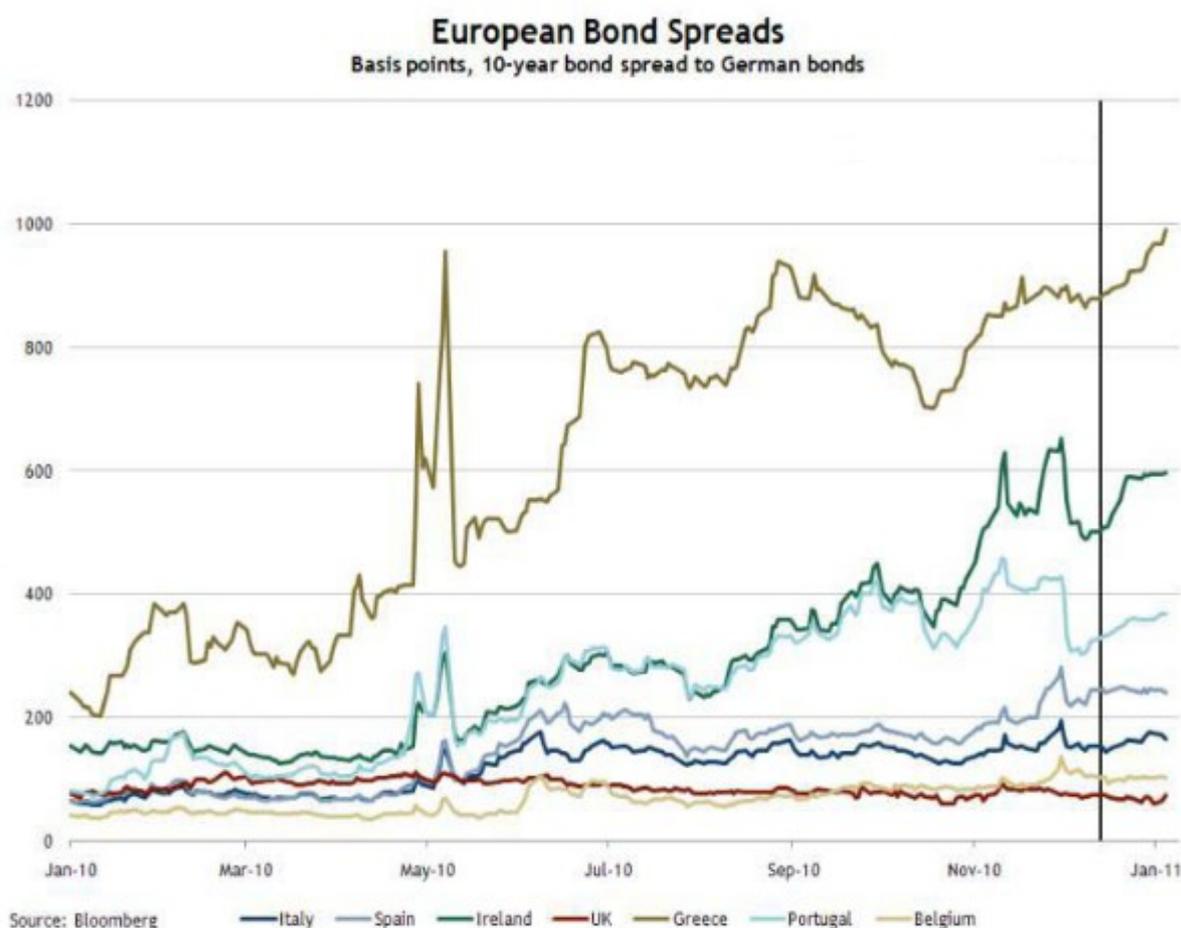
130See Munoz, Marquez and Sanchez (2011)

131Source: Munoz, Marquez and Sanchez (2011)

the historical low.

From May 2009, the financial crisis turned into a sovereign debt crisis: in Greece, the budget deficit rose from 3,7% to 12,7% in relation to GDP and so the agency rating Fitch decided to downgrade the rating on the public debt. Moreover, the unemployment rate in the European Union rose the unprecedented level: almost 9,7%. After few months, Fitch downgraded again the Greek sovereign debt and in those days the Athens Stock Exchange lost almost 6% and the spread between Greek and German government bonds was about 220 basis points: it was intended to increase. The Greek government presented a plan that included the reduction of debt ratio and the growth of GDP. To do this, cuts were necessary in the public balance sheet. The situation got worse in first month of 2010, when Portugal, Spain and Italy had to face with the same problems of Greece.

In the following figure (Figure 24), it is possible to see that the spread in relation to German government bonds increased a lot from 2010:



(Figure 24: The European Spreads Increase¹³²)

¹³²Source: Bloomberg.

It is possible to say that the crisis turned into a sovereign debt crisis because of the increase in the government deficit and in debt levels of a lot of Eurozone countries. As a consequence, the rating agencies decided to downgrade them because the probabilities of their debt repayments were very low and this caused a loss of confidence in the entire financial market. ECB decided to put again liquidity in the economic system to influence the short-term interest rates in the interbank money market. The intervention of IMF and the introduction of **European Financial Stability Facility** (EFSF) in the middle of 2010, did not change the problems: the spread remained very high and the situation of Italy, Spain, Portugal, and Greece got worse. The EFSF was a program created to safeguard the financial stability in Eurozone by providing financial assistance to Euro Area Members who were in troubles¹³³.

¹³³See Missio and Watzka (2011).

4. Interconnectedness or Contagion?

4.1 The Relationship Between ABCP, MMF and REPO During The Financial Crisis.

During the years before the financial crisis, the rise of MMF boosted in an indirect way the growth of Commercial Paper market because it allowed small investors to have access to CP investments that were lower cost than other investments. In this way, both MMF and CP grew up to unprecedented levels.

In the middle of 2007, a lot of financial institutions failed because of their exposition towards the subprime mortgages. This caused a direct effect on the ABCP market programs because investors were in panic and they started to withdraw their funds from the Money Market because the majority of the asset-backed commercial papers were held by investors in this market. As a consequence, asset prices in the market started to rise to high levels and the interbank market was very slow to recover from the shock.

Investors understood that the ABCP market was not so safe that they thought and so they changed their preferences: they started to allocate their capital in Treasury Bills because they were the safer assets in the entire market. ABCP and MMF matured together and so each market completed the other one but at the same, if one market collapsed also the other one could collapse at later stage. Furthermore, both ABCP and MMF are closely dependent of REPO market because the rise in the haircuts during the crisis caused wide and heavy pressure among financial investors and intermediaries.

In the financial crisis of 2007, there were too many links between financial markets and financial market participants and this caused a domino effect because when a market was in troubles, new problems arose in other markets: investors were panicked and they began to withdraw their capital from one market to another and they put them in the market which they deemed less risky. Moreover, also banks were very interconnected each other and so the bankruptcy of one bank caused the bankruptcy of another one: for this reason a large numbers of banks asked for help to governments.

The financial innovation increased the connections that linked borrowers and lenders in the entire economic system.¹³⁴

It is true that interconnectedness could be a source of strength for banks and financial institutions in general because it allows them to diversify systemic risk and it provides liquidity and investment opportunities to savers but at the same time, there are negative aspect to consider like externalities: they could be no significant during a normal period but

¹³⁴See Yellen (2013).

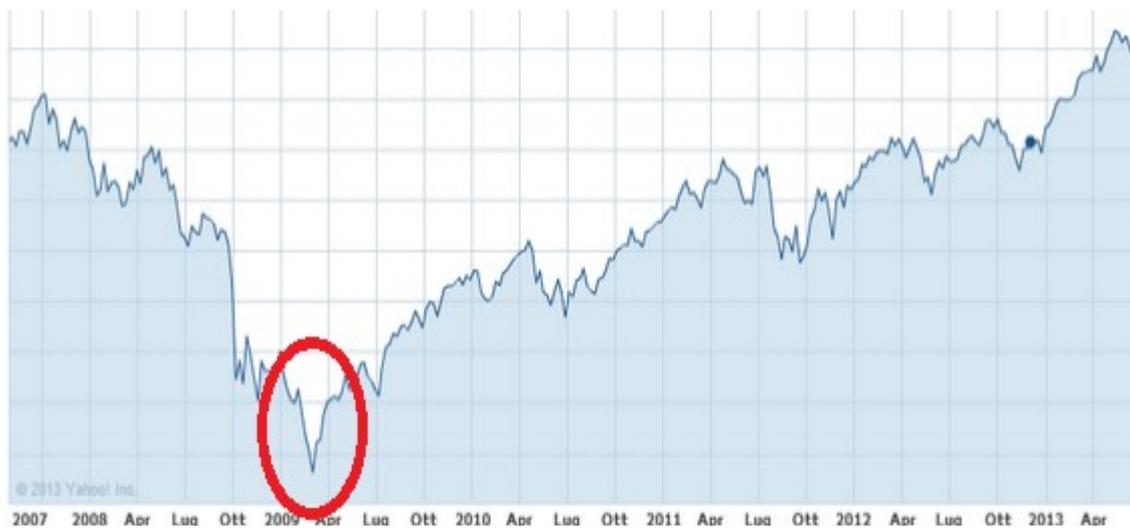
they could be devastating during a turmoil period.¹³⁵

Usually, investors think optimistically to the gains that can be derived from their investments and they do not deal with a possible negative shock in the economic system and when this happens, as in 2007, are in panic and they are not able to handle problems that may arise. The interconnectedness between the ABCP, MMF and REPO markets accentuated the problems that arose from the initial collapses in the economic system.

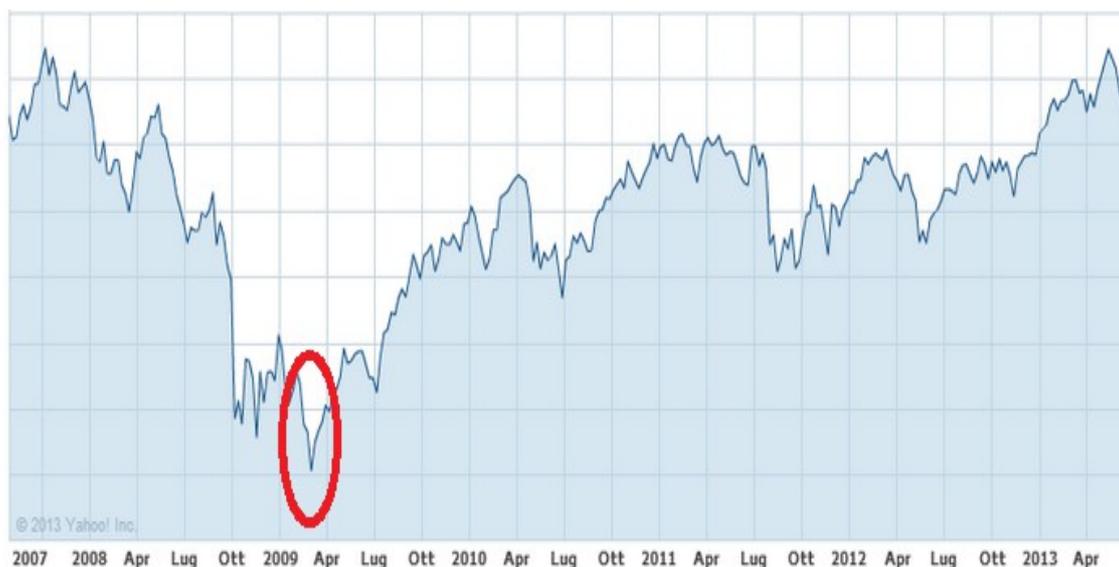
¹³⁵See Yellen (2013).

4.2 The Crisis Spread To Eurozone: Why?

In the following two figure (Figures 25 and 26), it is possible to see that the American Index *Dow Jones* and the European Index *FTSE 100* were very interconnected each other during the financial crisis of 2007/2009. Soon after the collapse of the first one in the end of 2009, also the second one collapse in the same period. This is a proof that global financial markets are highly correlated each others in an indissoluble way. This is due to the globalization: in the years before 2007, toxic financial products were packaged and then they were distributed to the worldwide economic system and at the end, it was not possible to understand which assets were good and which were bad and dangerous. This means that if one market collapses, the entire economic system will collapse.



(Figure 25: Dow Jones¹³⁶)



(Figure 26: FTSE 100¹³⁷)

136Source: Yahoo Finance

137Source: Yahoo Finance

Some economists tried to explain the possible channels for the spread of the crisis from the American markets to the Eurozone¹³⁸:

- *sales channel*: all countries related to the level of trade with the USA has been affected by the decline of exports from European to the American countries. This was due to the economic and financial liberalization and the expansion of the international trade;
- *monetary policy*: the transformation of the real estate crisis into a financial crisis was due primarily to the decision of the FED and the Central Bank of the European Union for the lowering of interest rate because banks and financial firms increased even more their high level of debt;
- *exchange rate*: the origin of the real estate crisis, being American, promoted the depreciation of U.S. Dollar. As a consequence, in the market there was a decrease in the yield of U.S assets and a decline in the stock prices. The investors decided to invest in the U.S market because it was less expensive and this caused an appreciation of floating exchange rate currency regime, like Euro.

Furthermore, sovereign markets in the Eurozone were strongly correlated each other and so when Greece started to have problems, this caused a domino effect towards the other countries which were linked with the Greek economy. Spain, Portugal and Italy were very vulnerable and they were the first European countries to be affected by the sovereign debt crisis of Greece. Moreover there were common country fundamentals and direct links between countries' banking system: these features caused an increase in co-movements in the economic system.¹³⁹

138See Jebri, Jilane and Liouane (2013).

139See Buchholz adn Tanzer (2013).

4.3 The Possible Solutions To Contagion.

A lot of economists have developed possible solutions to try to contain the financial contagion. There are four major strategies¹⁴⁰ to defray the social costs of systemic risk and contagion:

- **capital requirements:** the basis rational for capital requirements is that there is a strategic reserve of resources for every financial institution that fortifies it against a future possible shock. Some economists argue that is the reason whereby Lehman Brothers collapsed on the middle of September 2008: it did not have any reserves and so it was not able to avoid the bankruptcy. For this reason, it is useful to have capital standards that are able to absorb large losses and to internalize the costs of an economic distresses (like a crisis) without the need of a public support: in the crisis of 2007, a lot of financial institutions asked helps to the FED and the Treasury because they did not have the liquidity necessary to face their huge losses. Capital requirements are important to lower the risk of contagion by reducing the likelihood of bankruptcies and collapses: they could reduce the possibility that a financial institution could fail but it is important to say that they are not able to prevent contagion because the amount of capital might be insufficient to cover losses and short-term debt holder might not pay so much attention to an institution's solvency;
- **liquidity requirements:** they ensure the existence of high quality assets that can be sold to meet sudden withdrawals in financial markets: firms are able to have availability of temporary liquid assets but they can not fight against a form of contagion in the market. During the crisis of 2007 and especially after the Lehman Brother's collapse, the demand for liquidity in the market increased a lot: financial institutions started to sell their long assets but they were illiquid and so institutional sellers had to accept a lot of discounts on many of the sales. As a consequence, the asset prices fell down dramatically and this caused other withdrawals from the investors. At the end, investors lost completely their confidence in the towards the entire financial market. In these years, capital ratios were inadequate because financial firms and institutions took more and more risks than they could sustain with their own capital;
- **resolution procedures:** they impose losses on the debt and equity holders of financial institutions that are being wound down. They threaten short-term holders because their losses could provoke contagion. From the perspective of systemic

¹⁴⁰See Scott (2011).

risk in the financial system, their main function is the protection of short-term creditors of financial institutions and so these procedures are able to limit the effects of a contagion in the economic system;

The basis objectives common to these three strategies are the loss imposition and the avoidance of government support. These are important conditions to limit the moral hazard and to minimize the systemic risk in the financial system. They have a common regulatory purpose because they impose losses on debt and on equity holders so the public support for financial problems do not become necessary. Furthermore, they provide mutually reinforced against and so they want to minimize the failure of financial system.

There are another strategy that implied the presence of the government: it is the government guarantee of liabilities and his type of guarantee supplies short-term creditors with a layer of formal protection that differs in a fundamental way from the probabilistic safety offered by capital, liquidity and resolution. This is a possible way to absorb the possibility of losses but in the same time they do not eliminate the risk for a short-term creditor.¹⁴¹

Moreover, governments responded to the financial crisis by reducing the systemic risk in the market but this is not sufficient. In the recent years the G-20¹⁴² works to improve the capital and the management of liquidity risk in the banking system: higher capital requirements are necessary for global systemically important banks. This is useful to limit the risks derived by the most interconnected institutions who have a great potential to impose negative externalities: highly interconnected firms can transmit shocks widely and this can cause panic and fear in the entire economic system. A financial shock, like the bankruptcy of Lehman Brothers on September 15, 2008, added stress in the economic system in a particularly unwelcome time: it imposed unnecessary costs on the global society. There are other measures to manage interconnectedness and systemic risk, for examples countercyclical capital buffers, liquidity requirements, large exposure rules, deductions from capital for equity investments in banks and increased capital charges for exposures to large financial institutions.

¹⁴¹See Scott (2011).

¹⁴²It is a group of twenty finance Ministers and Central Bank Governors of the major economies in the world. The members are 19 individual countries (Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russian Federation, Saudi Arabia, South Africa, Turkey, United Kingdom, United States)and the European Union.

These measures are able to avoid a future financial crisis. Furthermore, it is important to make reforms in the OTC Derivatives¹⁴³ Market to improve transparency and decrease counterparty exposure among market participants but at the same it is important to pay attention at these reforms because they could increase financial costs for the economic system. In this market, the systemic risk could cause economy-wide implications and so it is useful to find measures to mitigate it like central clearing mandates, minimum margin standards and data reporting requirements to keep under control the market. In this way, the market and the financial institutions are able to evaluate market risk and financial stability and they are able to monitor and to respond to risk and to a financial crisis.

144

143They are privately negotiated contracts between a pair of counterparties to exchange future cashflows that depend on the performance of an underlying asset or benchmark index.

144See Yellen (2013)

4. 4 An Empirical Example: The Forbes And Rigobon's Model.

In the financial literature, there are a lot of economists that have developed some models to explain the financial contagion based on the correlation or the covariance between two different market. Forbes and Rigobon (1999) created a model that compare two different stock markets and they said that a significant change in the variance-covariance matrix during the crisis period would indicate that there is a shift in cross-market linkages and so there is contagion in the entire market. But if this change is not so significant, this is simple interconnectedness between the markets.¹⁴⁵

The model starts with the linear regression between the returns of two different markets (y_t and x_t)¹⁴⁶:

$$y_t = \alpha + \beta x_t + \varepsilon_t$$

where:

$$E[\varepsilon_t] = 0 \quad E[\varepsilon_t^2] < \infty \quad E[x_t \varepsilon_t] = 0$$

Both of these two variables are exogenous and the assumptions are necessary to obtain the right results from this model. Furthermore, it's necessary to divide the data in two different groups: one for the stability period (l) and one for the turmoil period (h). The

OSL estimates are consistent and efficient and $\beta^h = \beta^l$, and by construction:

$$\sigma_{xx}^h > \sigma_{xx}^l \quad \beta^h = \frac{\sigma_{xy}^h}{\sigma_{xx}^h} = \frac{\sigma_{xy}^l}{\sigma_{xx}^l} = \beta^l$$

and that implies that

$$\sigma_{xy}^h > \sigma_{xy}^l$$

This means that the cross-market covariance is higher in the second group (that is the period of crisis) than in the first group of data (that is the period of stability) and this increase is directly proportional to the increase in the variance of x_t .

¹⁴⁵See Forbes and Rigobon (1999).

¹⁴⁶All the formulas are in Forbes and Rigobon (1999).

As a consequence, it's necessary to calculate the correlation coefficient between the two markets with this formula:

$$\rho = \frac{\sigma_{xy}}{\sigma_x \sigma_y} = \beta \frac{\sigma_x}{\sigma_y}$$

In this way, it's possible to compare the correlation coefficient of the two markets in two different period of time:

$$\rho^h > \rho^l.$$

This indicates that the correlation is higher and it increases because of the increase of the variance in one market. This is the standard, unadjusted correlation coefficient and so it's necessary to calculate the adjusted correlation coefficient to understand if there is contagion between the two markets or if there is only interconnectedness. In the financial world, an high volatility means that there is high correlation between the two variables, but this doesn't mean that there is financial contagion.¹⁴⁷

To adjust the correlation coefficient, it's necessary to use this relation:

$$\rho_t^u = \rho_t \sqrt{\frac{1 + \delta_t}{1 + \delta_t \rho_t^2}}$$

where there are both the unadjusted (ρ_t^u) and the adjusted correlation coefficient (ρ_t) and δ_t is the relative increase in the variance of x_t which is the market under crisis:

$$\delta_t \equiv \frac{\sigma_{xx}^h}{\sigma_{xx}^l} - 1$$

It's useful to calculate the adjusted correlation coefficient because in a financial market there are a lot of incorrect behaviors.

In this way, the model it is able to say if there is contagion in the market or if there is only interconnectedness between the market because of the crisis. If the model considers only the unadjusted correlation coefficient, it could incorrectly lead to the conclusion that there

¹⁴⁷See Bohl and Serva (2005).

is contagion in the financial system even if it's not true.¹⁴⁸

At a later stage, it's necessary to control if the increase of the correlation coefficient is significant or not: if it's significant there is financial contagion in the market but if it's not significant, it means that markets are closely linked each other. To do this, it's useful to verify these hypotheses:

$$H_0 : \rho \geq \rho_t^h$$

$$H_1 : \rho < \rho_t^h$$

where ρ is the correlation coefficient during the full period and the second one is the correlation coefficient for the turmoil period. The critical value for the t-test is 5%: if the statistic is greater than 1,65 there is financial contagion in the market, on the contrary the value indicates no contagion.¹⁴⁹

148See Forbes and Rigobon (1999).

149See Forbes and Rigobon (1999).

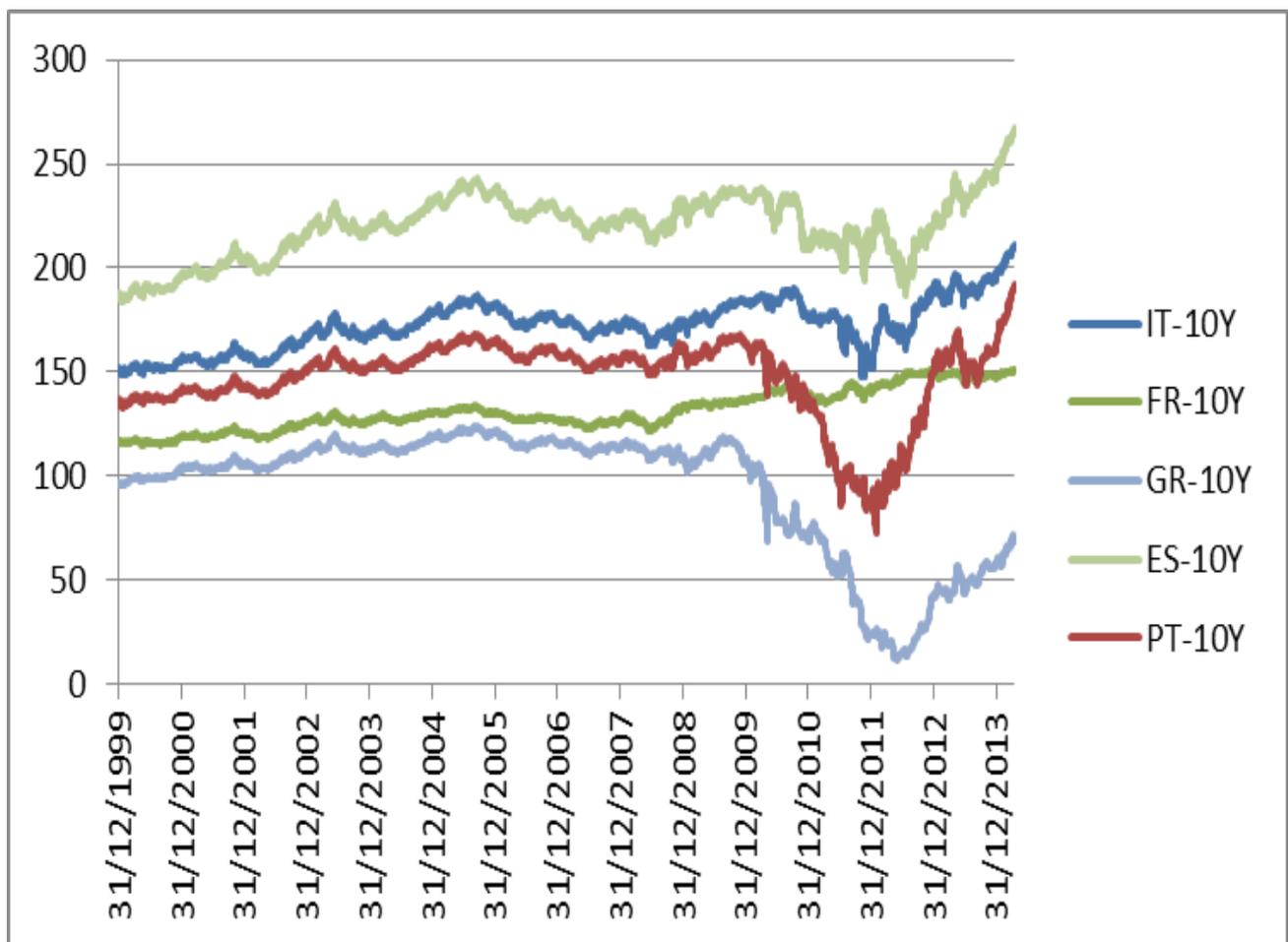
4.4.1 An Application Of Forbes and Rigobon's Model: The Relation Between CDS Market And Interbank Market In Europe.

In this work, the Forbes and Rigobon's model is used to analyze the relationship between the CDS Market (10 years CDS) and the Interbank Market in five different European Countries: Italy, France, Portugal, Germany and Spain.

In a second moment, it's explained also the relationship between the Italian interbank market with the other European interbank market of the same Countries.

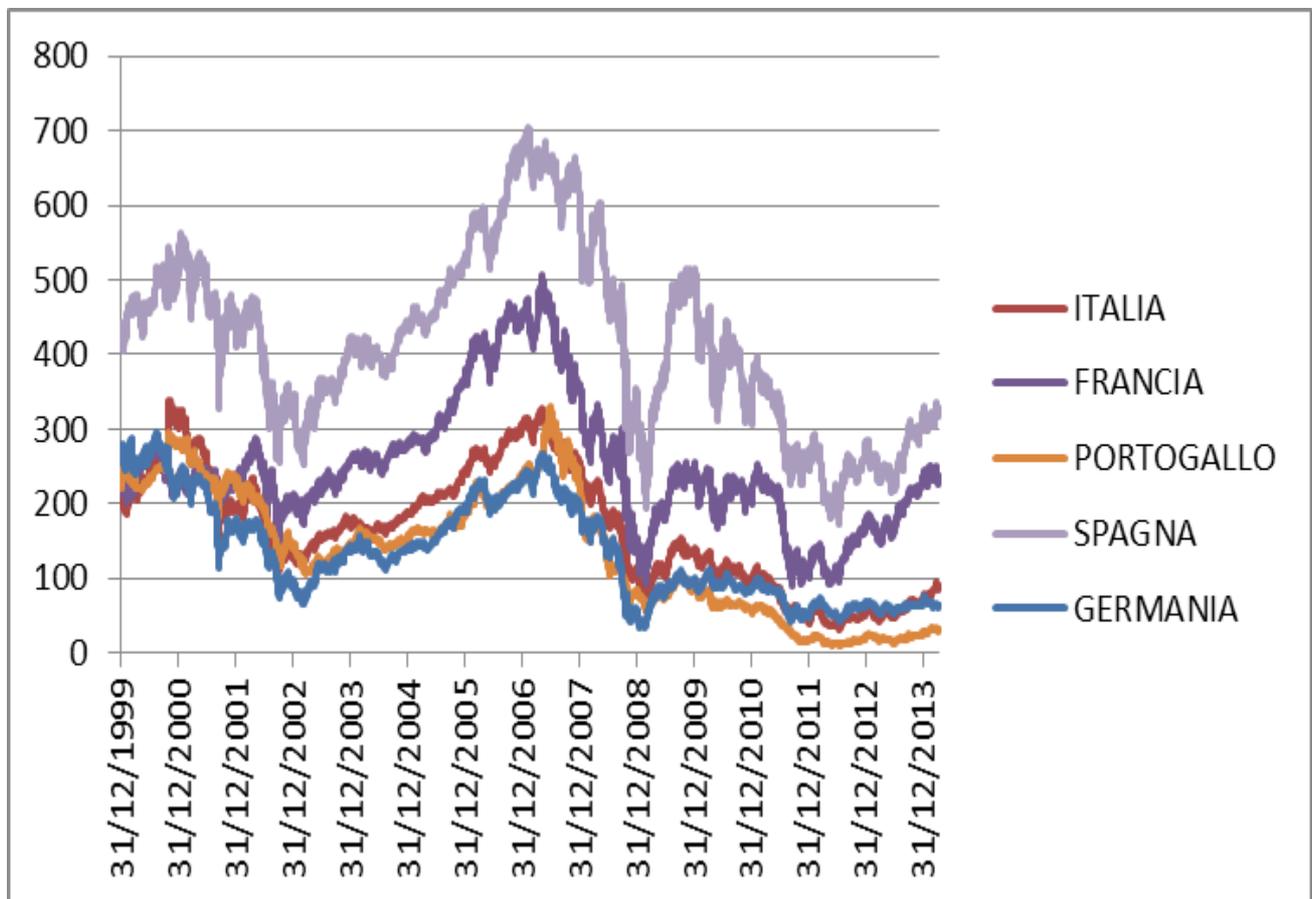
In the following graphics, there are the trend of European CDS (the first one) and the European interbank market (the second one). The period considered goes from the end of December,1999 to the middle of April, 2014.

Analyzing the graphics, it's possible to say that after the American crisis of 2007/2008 the prices of 10years CDS are more volatile than the period before the crisis.



(Figure: European CDS market)

In the next graphic, it's possible to see that the Interbank Market is more volatile than the CDS Market and it collapsed when the crisis broke out in the middle of 2008. European banks are facing a period characterized by low growth, made worse also by the sovereign debt crisis.



(Figure: European Interbank Market)

At first step, it's necessary to divide the full period in two different set: one that represent the stability period (before the crisis) and one for the turmoil period. So, for the following analysis the data are divided in this way:

- for the stability period, it's considered the period from the beginning of 2001 to the end of 2006. The idea is to not influence the results with the Information Technology Bubble that broke out in America from 1999 to the end of 2000;
- for the turmoil period, it's examined the interval from the beginning of 2007, when the financial market began to be influenced by the first tied up banking problems linked to the subprime mortgages, to the middle of 2014.

In this way the variance of the first data set is lower than the variance of the second one, according with the Forbes and Rigobon's model.

Then, it's indispensable to calculate the returns of CDS Market and the Interbank Market to be able to compute the variance.

The following table (*Table 1*) summarizes the values of the variance and the correlation coefficients (unadjusted and adjusted) for each Country and for each period considered.

	STABILITY		CRISIS			FULL		
	Var	ρ_t	Var	ρ_t (U)	ρ_t (A)	Var	ρ_t (U)	ρ_t (A)
ITALY		0.0129315		-0.06698812	-0.215726		0.054626903	-0.1771765
CDS	2.4E-06		2.217E-05			9.8E-06		
INTERBANC	0.0004608		0.0005067			2.9E-05		
FRANCE		0.0106506		0.035442215	0.1102168		0.019940635	0.06224297
CDS	2.222E-06		2.272E-05			9.3E-06		
INTERBANC	0.0009533		0.0002031			9.64E-06		
PORTUGAL		0.0125807		-0.0033129	0.0039608		0.001478847	-0.0017681
CDS	1.182E-09		8.267E-08			8.27E-08		
INTERBANC	0.000443		0.0002715			2.57E-07		
GERMANY		0.0146402		-9.0536E-05	-5.407E-05		0.001194491	-0.0007134
CDS	2.533E-06		7.101E-06			9.62E-05		
INTERBANC	5.673E-05		0.0003969			0.001214		
SPAIN		0.0017554		-0.06285698	0.2095179		0.044992858	-0.1514607
CDS	1.853E-06		1.601E-05			8.59E-06		
INTERBANC	0.0010865		0.0003213			2.36E-06		

(Table 1: Variance and Correlation Coefficients)

According to Forbes and Rigobon's model, it's easy to see that the variance of both markets during the turmoil period is higher than the variance during the stability period. So during the subprime crisis, the risk in the financial market increased a lot because there was more uncertainty within the market itself. The table shows that these two markets are not highly correlated with each other, but in spite of this what happens in a market affects

also the other.

Now, it's necessary to understand if this increase in the variance in the market generates financial contagion in the markets or if they are closely linked to each other. The following table (*Table 2*) shows the statistic test utilized to understand if the increase of the variance is significant or not. The statistic test is necessary to understand if in the market there is financial contagion or simple interconnectedness between the two different Market for each European Country.

	unadjusted			adjusted		
	TEST-T			TEST-T		
ITALY	1.7617942	C		1.1317706	N	
FRANCE	-1.9528366	C		-1.4178507	N	
PORTUGAL	2.3086686	C		1.5678342	N	
GERMANY	-1.3896315	N		-1.0260249	N	
SPAIN	2.2553093	C		1.6314901	N	

(Table 2: T-Static)

The results indicates that:

- if it's considered the unadjusted correlation coefficient, there is financial contagion between the CDS Market and the Interbank Market in every Country except for Germany where there is no contagion also in this case;
- but if it's utilized the adjusted correlation coefficient, the analysis shows that there is no financial contagion but only interconnectedness between the two markets because the values of t-statistic are smaller than 1,65 and so it's accepted the null hypothesis of no contagion.

It's possible to say that when an economic phenomenon goes to modify the general equilibrium inside a determined financial market, this could influence also the others markets. In this case, when the subprime crisis spread in 2008, it influenced the Interbank Market in a negative way and inevitably, the CDS Market suffered for the crisis.

The following table (*Table 3*) shows the relationship between the Italian Interbank Market increase a lot from the stability period to the turmoil period: during a crisis, these markets are more linked each other than a calm period.

	STABILITY		CRISIS			FULL		
	Var	ρ_t	Var	ρ_t (U)	ρ_t (A)	Var	ρ_t (U)	ρ_t (A)
FRANCE								
INTERBANC	0.0009533	0.566702	0.00020312	0.815919	0.975270289	9.6353E-06	0.752509265	0.96299111
PORTUGAL								
INTERBANC	0.000443	0.415056	0.00027152	0.573914	0.642240435	2.5738E-07	0.537972355	0.60659676
GERMANY								
INTERBANC	5.673E-05	0.5537906	0.00039689	0.765625	0.579341848	0.00121442	0.702609724	0.50794244
SPAIN								
INTERBANC	0.0010865	0.6785948	0.00032127	0.826058	0.980479407	2.3636E-06	0.778412703	0.97303692

(Table 3: The relationship between the Italian Interbank Market and the other European Interbank Market)

As the previous analysis, in the following table (*Table 4*) it's possible to see if the increase of the variance it's statistically significant or not and so it could be able to say if there is financial contagion in the European Interbank Market or if these markets are closely interconnected each other.

At first stage, it seems to have financial contagion between the Italian Interbank Market and all the other ones. But when the correlation coefficient is adjusted, it's possible to see that the test-t decreases a lot and so there is no evidence of financial contagion between the markets considered.

	unadjusted TEST-T	C	adjusted TEST-T	N
FRANCE	-2.78667	C	-1.57664	N
PORTUGAL	-2.55092	C	-1.64863	N
GERMANY	-1.72745	C	-1.27789	N
SPAIN	-1.69011	C	-1.52661	N

(Table 4: Statistic Test)

To summarize, it's possible to say that with the two set of data considered in the analysis, there is no evidence of financial contagion in both of analysis. The subprime crisis of 2008 has highlighted the fact that the European financial market (as well as the financial markets around the world) are very close to each other so that the negative economic phenomena are transmitted very easily from one market to another.

Conclusion

It is very difficult to understand what financial contagion is mainly because of its problematic interconnections between markets and financial institutions in the financial market. There is contagion when the correlation in the market increases a lot and this phenomena does not occur during a period of financial stability. If there is not this increase in the correlation, it is simple interconnectedness between the markets and the countries. The contagion and also the interconnectedness between countries is due to the globalization because nowadays, economic market has a global dimension and countries are more vulnerable towards an economic shock. The Thai crisis of 1997 is an example of contagion because the crisis has affected economies that were not directly connected with Thailand, like the Brazilian economy and the Long Term Capital Management. During the crisis of 2007, it is possible to say that there is a form of contagion between the specific market because the crisis began in the subprime mortgage market and it propagated to other market (ABCP, MMF and REPO) that had no direct connection with the housing assets. But there was a high level of interconnectedness between economies and countries that were linked each other both on financial and economic level. When there is a shock in the financial system or in general, in the economic system, there is a domino effect in the market: when a financial institutions or a bank collapses, as a consequence there is another one which collapses. For example, when Lehman Brothers declared its bankruptcy on September 15, 2008, the entire financial system collapsed in the following days. The failure of financial institutions during the crisis of 2007 was due to the high use of leverage: they were not longer able to support their budgets. Both investors and financial institutions were too much optimistic in the years before the financial crisis because they continued to use leverage and they continued to invest unabated in the financial market.

Analyzing the crisis in Thailand and the one in America, it has emerged that investors are in panic very easily as soon as they received news that they may incur a loss: as a consequence, they immediately begin to withdraw their funds from the markets. Moreover, in the second case, the crisis was exacerbated by panic in banking system and for this reason the crisis went wrong because of the withdrawals from ABCP, MMF and REPO markets. The interventions of IMF, FED and ECB did not keep under control the crisis and they did not able to resolve it. Concluding, it is right to say that the first financial crisis of the 21st century has not yet ended and it is difficult to find clear explanations about it.

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