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Sérgio Lagoa, Emanuel Leão, and Ricardo Barradas,

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Risk management, the subprime crisis and financialisation: the role of risk management in the generation and transmission of the subprime crisis

Sérgio Lagoa[1], Emanuel Leão[1], and Ricardo Barradas[1,2]

Affiliations of authors: [1] Instituto Universitário de Lisboa (ISCTE-IUL), DINAMIA'CET-IUL, Lisboa, Portugal, [2] Higher School of Communication and Media Studies and Higher Institute of Accounting and Administration of Lisbon (Polytechnic Institute of Lisbon), Lisboa, Portugal

Abstract: Over time the financial sector has gained greater relevance in the economy, a phenomenon that some call financialisation. Contrary to the mainstream view, financialisation literature emphasises that risk management by financial corporations will not be socially efficient in a context of deregulated markets and will ultimately lead to an increase of aggregate risk and crises. To assess the validity of such claim, in this paper we review the literature on risk management during the Subprime crisis. These failures fall into three categories: technique and methodology, corporate governance and strategy, and regulation and external factors. These failures can be interpreted in the light of the financialisation perspective, which is therefore a valuable approach when addressing regulatory changes in the financial system.

Key words: risk management, financial crisis, financialisation.

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Contact details: Corresponding author: Sérgio Lagoa, Instituto Universitário de Lisboa (ISCTE-IUL), 1649-026 Lisboa, Portugal. sergio.lagoa@iscte.pt, tel: +351213903436, fax: +351217903933.

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1. Introduction

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In most developed countries, the financial sector has seen a growth in employment, value added, visibility and power. Some authors call this phenomenon financialisation (Epstein, 2005), which is characterised by features such as (i) a large development of financial markets, (ii) de-regulation of the financial system and of the economy in general, (iii) the emergence of new financial institutions and markets, (iv) and the appearance of a culture oriented to the individual, the market and rationalism.

Some authors see the growth of finance and financial deregulation as essentially beneficial given that the financial sector stimulates economic growth and financial markets guide the efficient allocation of resources (e.g. IMF, 2006:51). For example, securitisation allows risk to be spread to institutions that are better equipped to deal with it.

In contrast, the literature on financialisation highlights the negative consequences of that phenomenon, such as: firms aim to maximise their short-run financial value at the cost of sustainable productive investments; economic and social public policies are pushed into accepting market mechanisms in all areas of life, sometimes with deleterious consequences for efficiency and equity; and growing areas of economic and social life are exposed to the volatility and crises that often characterise financial markets.

This paper is concerned with the implications of both visions of finance for risk management. The mainstream view argues that as finance grows, risk management becomes more efficient and therefore ensures the diversification and control of risk. When divided and packaged into securities, risk is diversified and reduced. In contrast, the financialisation approach is sceptical about the financial sector's capacity to manage risk effectively. As finance expands and new financial institutions and markets emerge, the pressure for short-run profit and growth, and the deregulation of financial markets leads to more risk and ultimately to crises. Firms tend to ignore their long-run survival and other social values.

We review the literature to assess the role of risk management in the Subprime crisis in order to conclude which of the two aforementioned visions prevails. It should be noted that

the simple fact a crisis has occurred does not mean necessarily that the mainstream view is wrong. Even if risk management is perfectly executed, great losses may be incurred due to bad luck or to unforeseeable risks.

The financial literature provides no single definition of risk management. In one of the broadest definitions, risk management is defined as the identification and management of a corporation's exposure to financial risk (Kaen, 2005).

Due to the strong development of financial products and services in the last years, risk management gained a great prominence in most financial corporations. Voinea and Anton (2009) point out that risk management has become more used in the beginning of the nineties, due to the increased volatility of international financial markets, financial innovations (namely, the emergence of new financial derivatives), the growing role played by financial products in the process of financial intermediation, and the substantial losses incurred by corporations without sophisticated risk management systems. According to the authors, many of the most famous corporate losses of the 1990s (Enron and WorldCom, Orange County, Barings bank, among others) could have been avoided if corporations followed good risk management practices.

When analysing risk, it is useful to classify it into four types according to the level of knowledge and uncertainty: "Known Knowns", "Known Unknowns", "Unknown Unknowns", Unknowns Knowns - Table 1 (Jorion, 2009; Hughes, nd). In the first category, risks are correctly identified and measured, the distribution of total profits and losses is well recognised. However, losses can occur due to the combination of bad luck or due to excessive exposure. In the second category ("Known Unknowns") risks are correctly identified, but they are measured inaccurately. The third category ("Unknown Unknowns") contemplates risks that are not considered in most scenarios because they are simply unknown. Finally, the last category ("Unknowns Knowns") encompasses the risks that were forgotten. The major room of manoeuvre for improvement in risk management is in the categories "Known Unknowns" and, especially, "Unknown Knowns".

Beyhaghi and Hawley (2011) add that financial institutions can face four groups of different risks: market, credit, liquidity, and operational. Market risk results from the effect on portfolios of unexpected market fluctuations. Credit risk is associated to the likelihood of a counterparty failing to repay its obligation to the financial institution. Liquidity risk is related to the possibility that a financial institution will be unable to sell an investment without incurring a significant cost, or the risk of being unable to finance current operations in the market. Finally, operational risk is linked to losses arising from operational inadequacies within the organisation resulting from failures in processes, people, technical systems and/or fraudulent activities. These authors warn that the complexity of the investment world and the diversity of financial products and services have hampered the accurate identification of all risks by financial institutions.

Table 1 – Risk categories

Category	Meaning	Examples
Known Knowns	Risks we know about now and can predict and quantify with reasonable accuracy now	Current Volatility Short-term inflation Secular demographic factors Expected default rates
Known Unknowns	Risks we know about now, but cannot predict the timing of and/or quantify accurately now	Corporation/industry demise Long-term inflation Changes in consumer tastes Actual default rates
Unknown Knowns	Risks we forgot we knew about	Risks associated with universal banking Portfolio correlations in bear markets
Unknown Unknowns	Risks we cannot know about now	Terrorist attacks of September 11 Madoff fraud Arab uprisings 2011

Source: Based on Hughes (nd)

Most corporations used the Value-at-Risk (VaR) methodology to measure the risk of losses on a specific portfolio of financial assets (market risk). Indeed, for a certain portfolio, probability and time horizon, VaR is defined as a threshold value (e.g., in euros) such that the probability that the market-to-market loss on the portfolio over the given time horizon exceeds that value is the defined probability level (normally 5% or 1%, assuming normal distribution and no trading in the portfolio).

According to Stulz (2009), the role of risk management is to identify, monitor and manage the risks faced by a corporation, and to communicate them to senior management (and/or to the Board of Directors). He adds that the main role of risk management is to ensure that top management knows and understands the probabilities associated with possible outcomes of the corporation's strategy before it makes decisions to commit capital.

Lang and Jagtiani (2010) consider that models of modern risk management should guarantee three features. Firstly, they should take into account the unexpected losses, as well as accurately measure the expected losses. Secondly, they must view all risks in a portfolio perspective, taking into account correlations among assets and the concentration of exposures to common risk factors. Thirdly, they should develop measures of "tail risk" for assessing capital's needs.

Voinea and Anton (2009) note that there are two different approaches to the risk management process: the traditional and the Enterprise Risk Management (ERM). In the traditional approach, risk is segmented and compartmentalised, different risks are delegated to specialised employees who use specific instruments to tackle them. In the ERM approach, all risks are assembled in a strategic and coordinated framework and a specific entity has a general view of risk.

The remainder of the paper is organised as follows. Section 2 discusses the origin of the Subprime crisis. Section 3 addresses the main risk management failures occurred during the crisis, and Section 4 puts forward the lessons and recommendations that can be drew from the analysis of those failures. Section 5 concludes.

2. The Origin of the Crisis

In this section, we address the causes of the crisis to contextualise the failures in risk management. In the end of 2007, the international economy was hit by the collapse of the subprime credit segment in the US. Several factors contributed to this crisis. During the first years of the new millennium and after the 'dot.com' bubble, economic robustness, low interest rates, political pressures to promote house ownership, lower construction costs, population growth, and low risk awareness of consumers and financial institutions, favoured the increase of loans to high-risk households in the US. These households were unable to meet normal credit and/or documentation requirements for ordinary mortgages; they became known as NINJA loans (borrowers with "no income, no job and no assets"). These loans were fundamentally short-term and could be re-negotiated depending on the valuation of the property, with an increase in the house's price allowing an increase in the loan. There was a practice of aggressive lending by many banks, which granted credits at predatory rates to those who were not in a comfortable position to honour their obligations over time (Rötheli, 2010).

For banking institutions, the subprime credit segment was quite profitable due to its high interest rates. The rapid growth of that credit segment was driven by the need of banks to increase profits and the securitisation process. On the one hand, banks were pressured by financial markets to raise profits, since share prices depend on the growth of dividends. Therefore, financial institutions used the relatively unexplored subprime segment to increase their profits.

On the other hand, US banking institutions bundled the subprime mortgages into portfolios and repackaged them in tranches of different risk classes and returns (see Figure 1), through securitisation operations using new financial instruments (Asset Backed Securities (ABS), Residential Mortgage Backed Securities (MBS), Commercial MBS or Collateralised Debt Obligation (CDO)).[1] In a strategy of risk immunisation and diversification and in order

[1] ABSs correspond to securities whose value and income payments are derived from and collateralized (or "backed") by a specified pool of underlying assets. The pool of assets is typically a group of

to obtain financing (in a context of low savings and deposits), US banking institutions sold these products all around the world to banks, mutual funds, pension funds, and state institutions, among others. Investors from many countries were attracted by these securities, given their high returns and good ratings. This process is commonly referred to as the originate-to-distribute model. The idea was that by dividing risk and packaging it in securities, the overall risk would be diversified. This proved a mistake and facilitated the worldwide spread of the crisis (Crotty, 2009), also eased by the growing international integration of financial markets.

The mortgage market became financialised and increasingly facilitated financial global investments (Aalbers, 2008). Instead of focusing on easing households financing, this market was used to transfer money to the financial sector. The subprime market was busted by the use of credit scoring, risk-based pricing and securitisation, allowing risky loans to be seen as a way of getting high yields, instead of something to be avoided. The techniques to assess risk and the large apparent liquidity of ABS market lead to the explosion of mortgage and consumer credit in general (Langley, 2008). The excess risk taking by financial institutions meant that the long-term sustainability of the financial accumulation was threatened.

Through securitisation, US banks removed credit risk from their balance sheets, creating an incentive for generating more credit regardless of its quality. Lang and Jagtiani (2010) claim that the originate-to-distribute model allowed converting illiquid loans into liquid securities, reducing the incentives of mortgage originators to carefully screen borrowers. Because bank managers were being remunerated by the short-run performance of banks,

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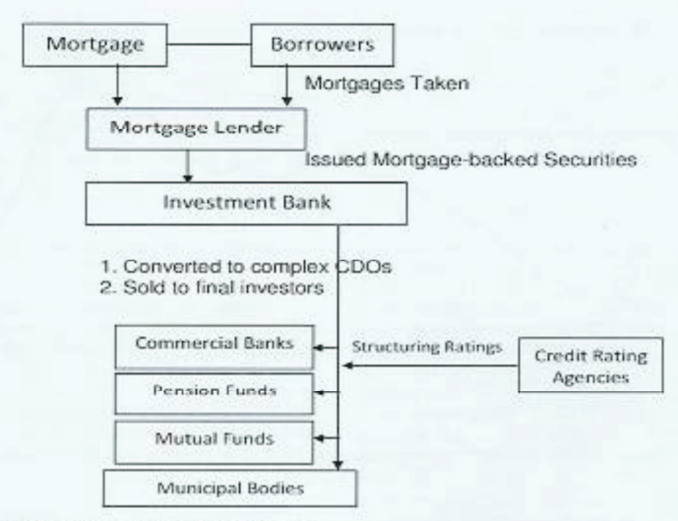
small and illiquid assets that are unable to be sold individually. Residential MBSs consists in securities whose cash flows come from residential debt such as mortgages, home-equity loans and subprime mortgages. Commercial MBSs are mortgage-backed securities secured by the loan on a commercial property. CDOs are ABSs backed by a portfolio of fixed-income assets, typically split into different risk classes, or tranches. Interest and principal payments are made in order of seniority, so that junior tranches offer higher coupon rates. For simplicity we will refer only to ABS.

they were not really concerned with the quality of what they were selling to customers (Nelson and Katzenstein, 2011).

Figure 1 – The process of subprime lending



Source: Based on Gupta *et al.* (2010)

Nelson and Katzenstein (2011) emphasise that the rise of house prices and the low mortgages default rate in the preceding years were crucial for banks to aggressively pursue a strategy of securitisation and for investors to snap up these securitised products. Moreover, participants in this market expected that the expressive growth in house prices would continue unabated in the coming years. The existence of a nationwide crisis in the house market was a rare event in US history of the twentieth century, and market participants were anticipated at most a regional fall in house prices. With strong growth in house prices, even if some families defaulted, banks could sell the house to pay the mortgage without any loss. Lang and Jagtiani (2010) refers that the bursting of the housing market bubble was one important explanation for the crisis.

Crotty (2009) emphasises that the demand for securitised products was strong not only due to the upward trend in the housing market, but also due to the fact that buyers could borrow money cheaply, returns were high and the products had high credit ratings.

Accordingly, credit rating agencies also played an important role in this process, providing very positive credit ratings (at the level of investment grade) to MBSs or CDOs (Lang and Jagtiani, 2010), which according to Crotty (2009) were illiquid, non-transparent and too complex. In many cases, credit rating agencies certified these products with the status of "triple-A" rating. White (2009) suggests that favourable ratings were important for at least two reasons. Firstly, it meant that financial products could more readily be bought by institutional investors, who were governed by strict internal rules of minimum credit ratings for their investments. Secondly, due to high ratings, buyers trusted the products they were buying, despite their returns were higher than comparably rated corporate bonds.

Gupta *et al.* (2010) also emphasise that very often the structuring and issuance of these products was done together by investment banks and credit rating agencies, leading to "moral hazard" by the latter. It would be difficult for those agencies to assign a low rating for a product that they had helped to design. The authors further suggest that credit rating agencies made huge profits with these structured products, which was a big incentive for them to collaborate in the success of those products. Moreover, if one agency had given a more realistic low rating to these securitised products, while others had not, it would had lower profits than their competitors (Crotty, 2009).

Kirkpatrick (2009) adds that the large volume of ratings assigned by credit rating agencies originated an expressive commercial pressure to meet the needs of customers and to undertake credit ratings rapidly. This pressure led to poor assessments by rating agencies, with the majority of them based on insufficient historical data.

Good ratings helped to increase the demand for CDOs. However, some investment banks retained part of the subprime structured products on their balance sheets, especially the super-senior tranches of CDOs (with lower interest rates). Banks earned a generous income retaining the CDOs, since these products paid high interest rates and were financed with money market funds at low interest rates (Kashyap, 2010). Such a strategy was highly profitable also because the yield curve was positively sloped.

That excessive maturity transformation was mentioned by Hellwig (2008) as an important systematic risk factor. According to Kashyap (2010), the breakdown of incentives and risk control systems were the main factors that contributed to this strategy. Hellwig (2008) argues that the large engagement of banks in that maturity game is related to the fact that investments were done through conduits and Special Investment Vehicles (SIVs), which were separate legal entities. This lead banks to underestimate their commitment to deliver liquidity to those ventures. Banks were giving support to these vehicles but did not affect any capital for that purpose. The larger risk was in conduits that earned profits from holding assets, whereas SIVs profited from the sale of assets.

Crotty (2009) points five other reasons that explain why banks kept subprime ABSs in their portfolios. First, they maintained them to persuade potential investors that these products were safe. Second, they retained them because they could hold these products off-balance-sheet without further capital reserve requirements. Third, they kept them due to the scant regulation, in a context where regulators also believed on the hypothesis that these products could be sold quickly. Fourth, they preserved them to maintain sales dynamism in periods where was difficult to sell the safest and senior tranches. Finally, they held them due to bankers' incentive to generate high profits in the short-run, despite the high risk involved.

Acharya and Richardson (2009) still argue that most of banks retained the subprime ABSs because they yielded high profits and required small amounts of capital, as some were hold off-balance sheet. The overall perception that these products had a low risk, as proved by the high ratings, also favoured their retention by investment banks.

Banks used high levels of leverage to constitute portfolios, making them very vulnerable to any slight change in the price of securities. It is clear that the increase in leverage was potentiated by mortgage securitisation (Adrian and Shin, 2010). Capital ratios decreased to very low levels, without proper action from regulatory authorities (Larosière et al, 2009).

The Senior Supervisors Group (SSG) (2009) adds that the excessive leverage and reliance on short-term funding were the result of risk governance weaknesses, misaligned incentives,

incomplete risk management reports, limitations or unintended consequences of regulatory requirements and ineffective market discipline, as we will see in more detail latter.

In the Introduction we saw that the financialisation of the economy incentivises firms to increase debt. Investment banks were not as exception, as they look to pay fewer taxes by using debt rather than equity and increase leverage to magnify return on equity (Palley, 2007).

The systemic risk was also increased by the procyclicality introduced in the system by credit ratings, margin calls, and CDSs spreads (Turner, 2009). For instance, the increase in securitisation meant that investors were increasingly trusting in simple rules based on ratings (e.g. hold only investment grade bonds), which increased the risk of simultaneous sell by several of them.

Voinea and Anton (2009) also recognise many of the factors referred to above as responsible for the crisis, namely the boom of the real estate market in the US, the increased innovation in financial products and services, and their growing complexity (which allowed the transfer of risks associated with mortgage loans via securitisation), and financial market speculation (e.g. predatory lending practices). They add that other elements have also played an important role in the crisis, particularly the inappropriate mechanisms of regulation and supervision of international financial markets, the increasing intricacy of financial systems, and poor risk management practices.

Furthermore, Rötheli (2010) claims that there are several explanations for this crisis. Firstly, he criticises the monetary policy steered by the Federal Reserve (Fed) since 2002. According to him, the Fed fixed the federal funds interest rates markedly below the predictions of the Taylor Rule, which illustrates that the US monetary policy was too expansionary during that time. After 2001, the Federal Reserve was concerned with the deflationary effect of the bursting of the 'dot-com' bubble. In this regard, Foo (2008) also reiterates that the extraordinary cycle of low interest rates in the Greenspan's era was determinant for the overheating of the US housing market.

Secondly, he refers that the sophistication, complexity and globalisation of financial markets played a central role. Thirdly, he points that one important element in the crunch was the "credit cycle", which describes the tendency to excessively increase credit supply during expansions and to decrease it excessively during recessions. He adds that in the years preceding the Subprime crisis, most banks lent at low interest rates and with lax terms, taking excessive risks due to over-optimism. This excessive lending was fed by the behaviour of younger professionals (who tend to underestimated the risk of default), the existence of compensation schemes that related bankers' bonuses to short term profits of banks, and the strong competition between banks that lead to riskier lending in order to gain market share and increase profits (this opinion is shared by Nelson and Katzenstein, 2011; and Ashby, 2010).

The growth of credit was also fostered by the large availability of funds that financed directly banks on the markets and increased the demand for securitised products. The abundance of funds is related with two factors. On the one hand, there was a long-term tendency characterised by the shift in the distribution of income from wages to profits, as many authors have stressed in the financialisation literature. This meant that the income of the very rich increased and they started looking for places to invest it, and they ended up mainly in Hedge funds. Large sums of capital looked went to financial markets looking for an opportunity to get better returns than investing in productive sectors. These funds searching for large and quick profits created a pressure for bank managers to disregard risk considerations in order to make large profits from satisfying the huge demand for high yield financial assets.

Income inequality created the conditions that allowed the financial crisis, working through both the supply side and mostly by the demand side of financial assets (Lysandrou, 2013). There was a demand for a large quantity of high return financial products. Banks responded by creating MBSs and CDOs. MBSs are less opaque than CDOs, because the latter have many layers while the former no. But since banks did not have enough assets to construct MBSs, they turned to CDOs. Latter they turned to synthetic CDOs that are created

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quickly and without the need of a commercial banks supplying mortgages. CDOs proved an ideal product for investors, because the market was apparently deep and secure. CDOs were constructed with several assets, where subprime loans played a central role. Income inequality also worked on the supply side of financial products, by offering the opportunity to make loans to poor households. These households faced with lower wages and higher living costs had difficulty in meeting their obligations towards banks, but even relatively more wealthier households faced difficulties in periods of increasing interest rates and asset prices fall (Langley, 2008).

On the other hand, there was a large amount of funds arriving to the US from Europe, China and East Asia due to the US current account deficit. These funds pushed interest rate down and increased the demand for financial products. Especially the European funds were invested in risky assets. Joining these funds coming from abroad there was the funds from non-financial firms, which devoted a growing share of their financial resources to invest in financial markets.

The Subprime crisis gave its first signs in the summer of 2007 when the rate of default of subprime loans started to increase considerably, due to the increase in interest rates by the Fed and the reversal in the upward trend of US house prices in 2006. Kirkpatrick (2009) also adds that default rates of the subprime segment intensified in that period due to the resetting of some interest rates from their low initial levels, the so-called "teaser" interest rates.

According to Rötheli (2010), the crumble in the US housing market was disastrous also for banks because most of the credit contracts did not require further collateral (like future income or other assets) beyond the house itself. Households could walk away from a house with a negative equity without any further financial responsibilities.

Besides, Leão (2009) points out two other consequences of the increase of the default rate of subprime loans. Firstly, banking institutions began selling the houses that were used as collateral, intensifying the decline of house prices, with further negative repercussions in

terms of private consumption and investment. Secondly, the value of securitised products felt expressively, and they started to be called "toxic financial products".

White (2009) stresses that the fall in prices of CDOs and MBOs illustrates that the initial ratings for these structured products proved to be excessively optimistic. In this regard, Nelson and Katzenstein (2011) confirm that after the collapse of the subprime crisis the three main credit rating agencies downgraded large quantities of securitised products that they had initially regarded as relatively safe assets. For instance, they show that actual default rates for collateralised debt obligations of mortgage-back securities exceeded bank's projections by around 20,115 per cent on average.

The decline in the price of ABSs generated distrust between banks, because these "toxic financial products" were spread across the global financial system, without their exact location being known. Voinea and Anton (2009) recognise that doubts concerning ratings' quality and price formation caused a strong exit of investors from the ABS market, massive price falls and the total loss of liquidity of the market during the summer of 2007.

As a result of the fall in the ABS market, some important financial institutions faced insolvency problems and they were rescued by governments (Bear Sterns, Freddie Mac and Fannie Mae in the US and Northern Rock in the UK are important examples).[2] In September 2008, the bankruptcy of Lehman Brothers put in question the "too big to fail" assumption and generated a climate of panic, leading to substantial instability in the international financial markets, visible in the rise of volatility and in the sharp drop in prices of the main cyclical assets such as shares and commodity prices.

After the third quarter of 2008, as the crisis became stringer, many banks failed in Europe and in the US, which determined a generalised loss of confidence in financial institutions (Kirkpatrick, 2009). Without trust between banks, interbank money markets dried up, mainly in longer maturities, which led to a liquidity shortage with direct effects in the reduction of banking credit and in the rise of interest rates for households and

[2] Northern Rock failed due to liquidity problems.

corporations. Even larger non-financial firms were unable to finance themselves in the money market.

The constant need of investment banks to refinance the portfolios of subprime ABSs proved tricky. The deterioration of the housing market and the consequent increase of the perceived risk of securitised products made it more difficult to roll over short-term loans against these assets (which were given as collateral). As such, banks were forced to sell the ABSs that they could no longer finance, leading to a strong fall in the value of these assets, which eroded banks' capital and worsened funding difficulties. Banks were forced to sell assets at low prices also to cover margin calls, reduce risk and contain losses.

At the same time, many investors hedged the ABSs through the use of Credit Default Swaps[3] (CDS). AIG was one of the main insurers of ABSs, guaranteeing billions of dollars. Crotty (2009) explains that this hedging strategy made individual investors safer, but made the financial system riskier. The absence of minimum capital requirements for insurance companies issuing CDSs created an incentive for the creation of large amounts of these products. During the crisis, faced with significant defaults, insurance companies did not have enough capital to fulfil their obligations. In fact, when losses hit ABSs, AIG (and others insurers) were not able to pay its commitments and rapidly entered in difficulty. The absence of a central entity ensuring the payments of CDSs in case of failure of the insurer created even more uncertainty in the markets.

CDSs played another important role in the crisis by facilitating the speculation that bond prices would decrease. Besides allowing leveraged positions, those financial instruments are more advantageous to investors that speculate in the decrease of prices than to investors that speculate in the increase of prices (Soros, 2009). Their effect was to increase even more the financing costs of distressed financial institutions.

[3] Credit Default Swaps are derivatives products that allow a party to insure an eventual loss from a loan default by paying a fee. They are financial swap agreements, according to which the seller (insurer) will compensate the buyer in the case of default or other credit event. Until recently, it was not necessary to actually own the security being 'insured'.

In general, derivatives take to an unprecedented extreme the separation between asset ownership and direct ownership of a tangible or intangible asset (Wigan, 2009). In the case of CDSs, investors can be exposed to CDOs without incurring the risk of the subprime market. This reduces the incentive to monitor the quality of the underlying assets of CDOs. CDSs also give the confidence that risk is controllable in a scientific manner, leading investors to underestimate the true risk of their positions (Wigan, 2009).

As recognised by Jawadi (2010), international authorities reacted quickly, in order to limit bankruptcies, reinforce confidence, contain the recessionary pressures and mitigate liquidity problems. Against this background, most of international governments presented various rescue packages for their banking systems, and central banks provided further support measures, like aggressive cuts of interest rates and the implementation of liquidity facilities.

In conclusion, we saw several factors responsible for the Subprime crisis. At the top is usually found the wrong incentives of the several players in the CDOs market (Rötheli, 2010; Kashyap, 2010), including bank managers (Nelson and Katzenstein, 2011) and credit rating agencies (Lang and Jangtiani, 2010; Gupta et al. 2010).[4] The production of CDOs, which proved excessively complex and opaque, was facilitated by the bubble in the real estate market (Voinea and Anton, 2009; Nelson and Katzenstein, 2011). Other commonly pointed causes for the crisis include the excessive leverage of households and banks (Hellwig, 2008), the US monetary policy (Foo, 2008; Rötheli, 2010), deregulation, international imbalances related with a high US current account deficit, the large amount of funds seeking higher return, which ultimately is linked with functional income distribution.

3. Risk Management failures

[4] For simplicity we will refer to the three types of ABSs (Residential MBSs, Commercial MBSs, and CDOs) only ABSs.

Haubrich (2001), Jorion (2009) and Stulz (2009) note that even when risk management is flawlessly executed, it does not guarantee that big losses do not occur. There can be an unlucky one-in-a-hundred event or an overly risky business decision. Haubrich (2001) adds that risk management may break down when optimal private levels of risk are not socially optimal. The question that we would like to address is whether there was a failure of risk management during the subprime crisis or if it was simply a case of bad luck or bad business decisions.

We have organised the weaknesses of risk management identified in the subprime crisis literature into three categories: methodology and technique, governance and strategy, and regulation and external factors.

3.1 Methodology and technique

Stulz (2009) states that the risk management process involves five stages: identification, measurement, communication, monitoring and management of risks. Problems have arisen in each one of these stages. The first type of failure results from using inappropriate risk metrics. If risk managers evaluate risk with measures that are ill-suited to the corporation's strategy, risk management will almost certainly fail.

During the subprime crisis, banks, credit rating agencies and international regulators employed sophisticated risk management metrics, and VaR (Value-at-Risk) was the most widely adopted model (Stulz, 2009; Nelson and Katzenstein, 2011). Since VaR models are not meant to reveal the distribution of the losses that exceed the VaR limit, they are of little use if risk managers want to understand potentially catastrophic losses with a low probability of occurring (Stulz, 2009).

Crotty (2009) and Nelson and Katzenstein (2011) argue that VaR systematically underestimates low-probability events because it is based on the Gaussian distribution, which under-represents these high-cost events in distribution tails. Extreme and unlikely events with serious consequences or "black swans" make the distribution more skewed

(Taleb, 2007). Social events are impossible to model with the normal distribution due to social contagion and feedback loops. The VaR model is adequate for normal times, but performs poorly in crises.

Stulz (2009) notes that top risk management should not focus primarily on daily VaR but on long-run indicators of risk. Moreover, daily VaR implicitly assumes that assets can be sold quickly or hedged and, therefore, a corporation can essentially limit its losses within a day. But this may not occur at a time of low liquidity like the subprime crisis.

Nelson and Katzenstein (2011) advocate that the failures of the VaR methodology were determinant in creating and exacerbating the subprime collapse. Firstly, VaR was calculated on the basis of very short time series data (often less than 12 months), which did not include any serious crises. According to Lang and Jagtiani (2010), corporations chose more sophisticated and complex models with larger data elements and covering a shorter period in detriment of models covering longer periods but with fewer data elements. Therefore, there was an under-valuation of risk. Moreover, it was believed that old ABS data were not relevant given the changes in the mortgage market in the previous two decades.

The risk of structured subprime products (CDO and MBS) was assessed assuming that house prices would grow forever, clearly underestimating risk (SSG, 2008). Based on the available historical data, it was difficult for risk managers to estimate the losses arising from a wide housing market as this had only occurred in the 1930s (Crotty, 2009; Nelson and Katzenstein, 2011). This is a good illustration of the fact that statistical techniques of risk management are useful tools when there is a lot of data and when it is reasonable to expect future returns to have the same distribution of past returns (Stulz, 2009).

In addition, VaR models did not capture well the behaviour of new structured debt products when severe shocks hit markets and liquidity decreases (SSG, 2008). A major difficulty with these products is that there are no historical data to assess their risk and firms have to use proxies (e.g. corporate bonds rated Aaa), which proved wrong. Some firms assumed

incorrectly that the historical return volatility of corporate bonds rated Aaa could proxy the returns' volatility of senior tranches of CDOs.

Nelson and Katzenstein (2011) also claim that the wide adoption of VaR models amplified the crisis by inducing "similar and simultaneous behaviour by numerous players". Risk measured by VaR models rises at times of increased volatility and, in an attempt to reduce risk, investors start selling, thus amplifying the crisis (The Economist, 2008).

In fact, VaR has difficulty in capturing systemic risk since it assumes that each firm's actions do not affect the market outcome (Stiglitz 2009; Turner, 2009). However, in a situation where all firms behave in a similar way, the risk will be much higher than the model predicts. It is equally disturbing that the VaR assessment of risk may be lowest precisely when systemic risk is at its highest level, as in the spring of 2007.

Hellwig (2008), Crotty (2009) and Jackson (2010) also criticise the VaR hypothesis that future asset price correlations will be similar to those of the past. Crotty (2009) adds that securities that were kept off the balance sheet were not included in VaR estimations, ignoring the possibility that the risk from these securities may come back onto the balance sheet (Jackson, 2010).

Lang and Jagtiani (2010) and Beyhaghi and Hawley (2011) agree that the use of sophisticated but untested models of risk management was a key element of the crisis and led to many corporations underestimating risks and engaging in excessive risk taking. The Subprime crisis was the first real "laboratory" to assess the accuracy and efficacy of many quantitative models.

Ashby (2010) demonstrates that many financial institutions failed to adopt adequate stress and scenario testing and some showed an excessive reliance on quantitative tools. Banks that made stress tests used very weak assumptions; they never considered a full freezing of the money market (Larosière et al, 2009) and overestimated the advantages of diversification in a crisis (SSG, 2008).

Several reasons are advanced for the overconfidence in quantitative risk models and under-utilisation of qualitative approaches. Firstly, a culture had emerged that focused on

the market and quantification. Another factor was the need to use rules of thumb in the presence of uncertainty (Nelson and Katzenstein, 2011). Finally, Lapavitsas (2011) shows that as banks increased credit to households and information technology improved, they started to use sophisticated statistical techniques of credit scoring to assess households' risks due to the large number of households and the relative small size of each transaction. As a result risk assessment started to be based less on 'relational' methods, even in the case of credit to corporations. In addition, due diligence on marketed loans was usually subcontracted to external institutions as credit rating agencies. The result of this was a smaller ability of banks to evaluate risk qualitatively.

A side effect of quantitative risk models is that they give the impression that organisations are protected against risk, ultimately leading to professionals being overconfident, with an elimination of critical reasoning (Hellwig, 2008; Nelson and Katzenstein, 2011). Nevertheless, they had already failed in other situations like the East Asian crisis of 1997-98 and in the Russian sovereign debt default in 1998. On the other hand, Nelson and Katzenstein (2011) argue that uncertainty is irreducible and unquantifiable, and the mathematical treatment of risk does not make sense, as past events cannot robustly make predictions of future events. By definition, things that are unpredictable cannot be anticipated (Turner, 2009).

The subprime crisis required a more qualitative approach to risk (Voinea and Anton, 2009; Nelson and Katzenstein, 2011). Sophisticated statistical models could not substitute qualitative judgments on the nature of the housing market boom, the presence of irrational exuberance and the problems around moral hazard and adverse selection in the subprime credit market and securitisation process (Lang and Jagtiani, 2010). This analysis should have taken into account that the economy becomes unstable at times of economic growth due to the excess of optimism (Lakonishok et al, 1995) and the emergence of speculators (Minsky, 1994). Traditional tools in credit risk management like industry analysis were also absent from the CDO market study (SSG, 2008). A traditional tool in credit risk management like industry analysis was also absent from the CDOs market's study (SSG, 2008).

Another important failure in the subprime crisis was that some risks were overlooked. Jorion (2009) notes that the crisis exposed serious flaws in risk models, namely in the risk categories "known unknowns" i.e. risks identified but measured inaccurately (model risk and liquidity risk) as well as "unknown unknowns", namely forgotten risks (structural and regulatory changes in capital markets and contagion). Regarding the category of model risk, he notes that the failure of risk management derived from ignoring some important known risk factors, i.e. basis risk between cash bonds and CDS (see also SSG, 2008), and due to errors in the mapping process which consists of replacing positions with exposures on the risk factors.

In relation to liquidity risk, Jorion (2009) argues that management does not usually account for this due to its complexity and the difficulty of reducing it to simple quantitative rules. He adds that liquidity risk encompasses both asset liquidity risk (the price impact of large asset sales) and funding liquidity risk (when a corporation cannot meet cash flow or collateral needs). Consequently, financial corporations generally did not anticipate the liquidity constraints during the subprime crisis (Voinea and Anton, 2009), or the fact that credit risk problems could turn into liquidity problems (Larosière et al., 2009).

Reputational risk was also underestimated. During the financial turmoil, banks felt obliged to supply liquidity to conduits and SIVs in order to maintain their reputation (SSG, 2008). Conduits and SIVs proved to be a source of systemic risk that was largely ignored due to their lack of transparency (Hellwig, 2008). Banks owning such vehicles did not incorporate them into quantitative models, also because they did not have the required information.

Similarly, Jorion (2009) claims that it is difficult to account fully for counterparty risk, and consequently most scenarios failed to consider it. He stresses that we need to know not only our counterparties, but also our counterparty's counterparties. This risk became increasingly important due to the use of derivatives to invest and hedge positions. The counterparty risk and the regulatory risk were "unknown unknowns" outside most scenarios. An example of regulatory risk was the sudden prohibition of short sale operations that damaged hedging strategies during the 2008 crisis. Structural changes in

the market like the transformation of investment banks into commercial banks, with the corresponding decline in leverage, are also important factors of risk.

Lang and Jagtiani (2010) and Sabato (2009) also argue that any explanation for the mortgage crisis is incomplete if it does not consider why corporations took extremely concentrated positions in the mortgage market despite the basic principle of diversification.

More fundamentally, according to Beyhaghi and Hawley (2011) and Williams (2011), risk management failed due to its unrealistic theoretical assumptions. They criticise key assumptions of the modern portfolio theory and risk management as for instance the efficient market hypothesis, the rationality of investors; the neglect of herding and seasonal habits of investors; the absence of asset bubbles, symmetric information; the use of popular market indices as a proxy for market portfolios; the existence of unlimited liquidity and unlimited capital; among others.

Williams (2011) agrees with Beyhaghi and Hawley (2011)'s view and describes how the field of finance has gone from a study of practical matters in the 1950s to a discipline based on constructs at odds with reality. Finance research is based on unrealistic assumptions, sometimes assume equilibrium instead of proving it, ignore evidence, assume rationality of market participants, and fit statistical models to uncertainty. The consequence has been the construction of a field of knowledge that deceives practitioners and has contributed to the emergence of financial crises.

They even argue that the generalised use of these theoretical assumptions led to feedback loops and deceived practitioners, which paradoxically made risk management contribute to the increase of risk. González-Páramo (2011) stresses that banks were overconfident about the efficiency of markets and the ability of financial innovations to spread risk. Crotty (2009) notes that, in some cases, risks were transferred to clients who were not able to understand them fully, thereby increasing systemic risk in international financial markets.

The violation of the financial theory's assumptions could originate unintended consequences given its widespread adoption. They even argue that the generalised use of those theoretical assumptions has led to feedback loops and deceived practitioners, which

paradoxically made risk management to contribute to the increase of risk. González-Páramo (2011) stresses that banks had overconfidence in the efficiency of markets, and in the ability of financial innovations to spread risk. Crotty (2009) notes that, in some cases, risks have been transferred to clients who were not able to understand them fully, thereby increasing systemic risk in international financial markets.

Risk management has become a key activity for all financial corporations, functioning as a prerequisite for their own profitability and survival. The wide acceptance of this view has led to the emergence of new regulation and recommendations on corporate governance in order to prevent bankruptcies, losses, and scandals. Some examples are the "Cadbury Report" by the London Stock Exchange in 1992, the "Principles of Corporate Governance" by the OECD in 1998, the "Sarbanes-Oxley Act" in the USA in 2002, the introduction of KonTrag in Germany in 1998, and above all the Basel Agreements.

An interesting aspect is that the evolution of financial products outpaced the evolution of risk management (Voinea and Anton, 2009) and the regulators' capacity to adapt (González-Páramo, 2011). Structured financial products were extremely complex, with several layers of MBS making risk evaluation difficult (Larosière et al, 2009). Firms did not anticipate that losses could affect even the super-senior tranches of CDO (SSG, 2008).

This complexity contributed to the lack of transparency of the MBS and CDO markets (Crotty, 2009) that was amplified by the securitisation process (Stiglitz, 2009). Moreover, the unclear situation of certain financial institutions raised doubts about the dimension and location of credit risk and undermined confidence in the system (Larosière et al, 2009).

3.2 Governance and the strategic level

The subprime crisis is also explained by failures in corporate governance that did not safeguard excessive risk taking. Some authors emphasise that the lack of implementation of Enterprise Risk Management (ERM) made it difficult to prevent risks (Kirkpatrick, 2009). In the ERM approach, all risks are assembled in a strategic and coordinated framework and a specific entity has an overview of the risk. Three main weaknesses in the insufficient implementation of such a strategy have been reported. Firstly, the disaggregated vision of risk was a key problem (Sabato, 2010; Lang and Jagtiani, 2010). By trying to create an independent risk management function, organisations isolated it from the overall investment process and thus limited its ability to influence the main decisions (Flaherty et al., 2013). Moreover, financial innovation associated with the subprime market was developed by isolated departments and they were not integrated in the general business model, which implied that firms had no perception of their aggregate risk (The Economist, 2008). The disaggregated vision of risk also resulted from an inadequate and fragmented infrastructure that made effective risk identification and measurement difficult (SSG, 2009). In some cases, this problem was clearly associated with the poor integration of data that had resulted from corporations' multiple mergers and acquisitions.

Secondly, Kirkpatrick (2009), SSG (2009) and Sabato (2010) say that the failure of risk management in most international banks was in part due to the lack of a defined capital allocation strategy by the board, with the delineation and imposition of a level of acceptable risk and suitable risk metrics, where risk tolerance (minimum expected return and the maximum acceptable risk) and risk appetite (desired expected return and desired acceptable risk) are clearly defined and are used to assess group's divisions. There was also a failure in the definition of suitable risk metrics by the board (Kirkpatrick, 2009).

Thirdly and finally, the figure of Chief Risk Officer (CRO) was not sufficiently important at board level (Lang and Jagtiani, 2010), and risk management was considered a support function (KPMG, 2009).

Failures in reporting risk and communication between risk management staff and senior management were also common in financial institutions and information was not provided

with sufficient regularity (Ashby, 2010; Lang and Jagtiani, 2010). Nevertheless, KPMG (2009)'s survey reports that communication across units of the organisation did not play a major role in the crisis.

This meant that the board and senior management did not know the overall exposure of companies to risk, which was also aggravated by the fact that they did not fully understand the new structured products (Larosière et al, 2009; Turner, 2009). The board also failed to have proper control over business line managers due to inadequate internal risk control and auditing (Larosière et al, 2009; SSG, 2009; Lang and Jagtiani, 2010), namely there were delays in the identification, limitation and treatment of losses and frauds (Jawadi, 2010).

The reasons for excessive risk taking by traders can be found in the inadequate supervision by regulators, in arrangements that favoured risk takers at the expense of control personnel (SSG, 2009), and complicity between managers and traders that can represent fraud (Jawadi, 2010). The complicity between managers and traders to take excessive risk has to be understood in the context of an irrationally exuberant market. In a situation where prices were growing exponentially, investors may have found profitable to stay in the market and take the risk, and get out of the market before the bubble burst. For some banks that did not happen, also because the decline in prices has affected unexpectedly the super-senior tranches of CDOs and dried up liquidity suddenly.

It should also be noted that compensation arrangements were not associated with the strategy, risk appetite and long-term interests of corporations (Kirkpatrick, 2009; KPMG, 2009). They were skewed to maximise same year results, disconnected from risk, as they did not take into account the true economic profits with the deduction of all appropriate costs (SSG, 2009). Remuneration schemes favoured high risk/high return investments (Acharya and Richardson, 2009; Crotty, 2009; Kashyap, 2010). Lang and Jagtiani (2010) focus on the fact that managers were given incentives to increase the profitability of their business lines rather than consider the corporation's overall risk position. Structured products were adequate for business line managers to produce large gains with individual

positions that looked to have low risk. This is the basic principal-agent problem that risk management control is meant to address.

According to the SSG (2009), another main problem associated with compensation practices was that they were driven by the need to attract and retain talent and often did not integrated with the corporation's risk control.

Hellwig (2008) adds that employees were concerned with their careers and peer pressure as well as remuneration. Anyone that doubted a new and profitable business like the MBO would not be well regarded by colleagues.

Freeman (2010) defends that the huge monetary rewards given to high-level managers in financial institutions, instead of leading them to improve products offered, made them redistribute rents from consumers to firms, make high-risk investments and misreport financial returns. The link between short run stock price evolution and managers' remunerations was one way through which financialisation aligned corporations with financial markets interests, as we saw in the introduction. This was a fundamental factor, among others, driving the tendency for short-termism is business decisions (Orhangazi, 2008:74).

The top management of commercial banks was interested in increasing assets and profits, which meant they had to increase credit. Since good borrowers already had credit, the only alternative was to increase credit to less creditworthy clients: the subprime segment (Adrian and Shin, 2010).

Finally, Ashby (2010)'s survey stresses human and cultural weaknesses such as ego, greed, and "disaster myopia". It can be concluded from KPMG (2009)'s survey that risk culture was one of the elements of risk management that most contributed to the crisis.

3.3 Regulation and external factors

External conditions also made risk management more difficult and created incentives for excessive risk taking. The assignment of incorrect ratings by rating agencies led banks

towards excessive risk. More generally, the incentives of all agents in the securitisation chain were misaligned. Banks also did not perform appropriate due diligences and relied excessively on external ratings (González-Páramo, 2011).

Hellwig (2008) and Ashby (2010) found that competitive pressures prevented financial institutions from staying out of the most profitable risky activities.

Sabato (2009) points out that the poor regulatory framework based on the belief that banks could be trusted to regulate themselves was one of the main sources of the subprime crisis. The lack of regulation can also be explained by the capture of regulators by the financial sector. The financial sector donates money to political parties, does strong lobby, and regulators end up working or lobbying for the sector they regulated. Probably, this was the reason why Governments and regulators did not strength regulation and did not act in face of information indicating that something was wrong on the mortgage market. Freeman (2010) claims that Governments experimented laissez-faire capitalism by deregulating financial markets.

Indeed, Basel II trusted in banks' own models to assess some important risks like market and credit risks. Ashby (2010)'s interviewees (risk managers from a range of financial institutions) indicated the presence of significant regulatory failures in design (for instance, Basel II and its focus on capital requirements) and implementation (namely, supervisors' capacity to make effective judgements). One of the main criticisms of Basel II was the incentive to use credit securitisation and shadow banking organisations to reduce regulatory capital. The regulatory framework was lax and almost non-existent in the shadow banking system (Crotty, 2009). Since they were trusting in capital regulation, regulators around the world had not efficiently monitored risk management functions and did not prevent highly concentrated risk.

Hellwig (2008) highlights other perverse effect of capital regulation. Banks were able to use quantitative risk management models to economise regulatory, thus exacerbating the insufficiency of capital that amplified the crisis.

Dowd (2009) and Lang and Jagtiani (2010) emphasise that large financial corporations were not given appropriate incentives to worry about "tail-risk" due to the government's "too big to fail" policy. The largest banks were financed at lower rates than their true risk justified and this allowed them to expand risky activities even further (Moss, 2009). Panageas (2009) develops a model where the possibility of bail out by outside stakeholders allows firms to choose high volatility investments while net worth is high.

Monetary policy also played a role by mitigating the fall in asset prices, especially after the burst of the internet bubble, which prevented the market re-assessing the importance of risk (Gonzáles-Páramo, 2011).

Kirkpatrick (2009) stresses that there were gaps in accounting standards and regulatory requirements, e.g. the absence of commonly accepted accounting principles for risky products that would ensure a clear and comparable disclosure in annual reports. Banks have used different valuation methods for the same financial asset, which contributed to the scarce transparency in the financial industry. Better accounting standards, greater transparency about risks and products would have facilitated the working of market discipline, which did not play a major role in limiting risk taking by banks (Turner, 2009). Moreover, Kirkpatrick (2009) recognises that the division of responsibilities between the different supervisors was not very clear.

Best (2010) is sceptical that other financial crises will be avoided by providing the market with better and more information about financial instruments because the true risk of some instruments is impossible to calculate and it is unclear whether the market has the ability or interest in making appropriate use of that information.

4. Risk Management Recommendations

Many lessons can be learnt and recommendations made by identifying the faults in risk management. Once again we group these into three broad areas: methodology and technique; governance and strategy; and regulation and external factors.

4.1 Methodology and technique

One main lesson from the crisis is that some types of risks cannot be overlooked and others must be taken particularly seriously. Even though liquidity, counterparty and regulatory risks are difficult to measure, banks should be aware of them; they should have capital buffers to prevent them, and they should not be so big that they lead to bankruptcy (Jorion, 2009). [5] Since liquidity is a risk factor that can generate very high volatility of returns, risk managers should monitor it on all their securities, even on those that appear very liquid (Golub and Crum, 2010). Nevertheless, since banks cannot have enough capital to service a systemic collapse of the financial system, the role of risk manager of last resort rests on the regulator (Jorion, 2009).

Concentration risk also warrants a watchful eye, mainly where there are new financial products like the subprime securities that were largely untested (CRMPG, 2008; Foo, 2008; Jackson, 2010).

Golub and Crum (2010) also stress that corporations should adapt to the increasing importance of policy or regulatory risk, because changes in policy often result in a structural break in the covariance of economic variables. In many markets policy risk surpasses the risk arising from economic fundamentals.

Golub and Crum (2010) argue that corporations should acknowledge that market risk can change dramatically and they should be very vigilant about investments that require continuity in risk appetite or the ability to foresee risk appetite and volatilities. Foo (2008) claims that investors should take into account that excessive demand for financial products may lead prices to move away from fundamentals. Another important message of the crisis

[5] Regulatory risk is the risk deriving from changes in government intervention.

is that risk cannot be seen in a static environment (The Economist, 2008). In the presence of a systemic event, things hitherto taken for granted disappear when all investors start selling and panic sets in.

A comprehensive view of all risks must be adopted to capture the interaction between different types of risks leading to compounding effects (González-Páramo, 2011). For example, liquidity risk during the crisis interacted with market risk and both reinforced each other.

The use of a less quantitative approach to risk is also commonly recommended. Risk management is a task for experienced professionals and not machines (Jorion, 2009) and risk models should support and not drive decision making (KPMG, 2009). Effective risk management needs mainly good reasonable decisions, naturally based on quantitative data that is clear for top managers and other stakeholders to understand.

Other tools of risk analysis are suggested that complement quantitative models. Stulz (2009) concludes that the probabilities of large losses cannot be measured very precisely and corporations should therefore rely less on these estimates and pay more attention to the implications of such losses on their profitability and survival. Instead of depending on traditional measures of risk, based on stable returns and correlations, they should construct forward-looking scenarios that make more use of expert views (SSG, 2008; Jorion, 2009) and stress tests (Ashby, 2010; Jackson, 2010), especially to assess situations of contagion (CRMPG, 2008) and policy risk (Golub and Crum, 2010). Institutions are required to consider the new types of risk; notably, risk plans should lead and not lag behind business development (Accenture, 2013). A more critical and deeper approach that goes beyond the available technology is also necessary when analysing risk (CRMPG, 2008). The very nature of extreme events or "black swans" mean they cannot be predicted, but their impact can be minimised if, for example, potential areas in which extreme events may occur or where failure is highly costly are identified (Taleb, 2007). Instead of looking comfort in historic regularities, risk managers should be alert for new risks different from the past. The most important lesson of the subprime crisis is that financial crises are more

common than previously thought, and they may be different from past crises (Gónzalez-Páramo, 2011).

Improvements should be made to some technical aspects of quantitative analysis used by banks and regulators that failed during the crisis (Stiglitz, 2009). For example: risk models should be flexible enough to adapt to changes in market conditions, use other than normal distributions, be aware that correlations may change in crises, use longer samples that include serious crises (or use qualitative analysis when this is not possible), include off-balance-sheet securities in the models' estimates of risk, and not over-rely on untested models. In short, we can conclude that although quantitative models are an important tool for banks and regulators to assess risk, their application needs to be improved and they should be complemented with qualitative tools, analyses and expert views. Gónzalez-Páramo (2011) indicates that the problem is not the risk measures and models used *per se*, but the lack of understanding of their limitations. Unlike natural sciences which have fundamental laws, economics and finance study a system composed of human interactions. Golub and Crum (2010) stress that investors in securitised products should look beyond data in order to develop a deeper and direct understanding of the underlying assets; this includes the behaviour, incentives and practices of all players involved in the securitisation process (borrowers, originators, credit rating agencies, and investment banks). In the Subprime crisis the risk of ABS started in the bottom of the chain, with incentives and practices of lenders (example: adjustable lending rates) creating a level of risk that was not anticipated by investors.

Banks that did well in the 2008 crisis avoided many of the above mentioned mistakes (SSG, 2008). Resilient banks had a firm-wide risk perspective, a cooperative organisational structure of risk management, shared information across departments, and developed in-house expertise. This leads us to the importance of Governance issues.

4.2 Governance and strategy

The technical and methodological issues in risk management are undoubtedly important, but even the best techniques will be misused in the absence of the right governance and incentives. KPMG (2009) and Ashby (2010) suggests the need to improve risk governance and create a risk culture through the widespread adoption of the ERM approach to ensure that all employees understand and are involved proactively in the risk management process. The board needs to set realistic limits on risks that fit the institution's culture and risk aversion and that are the foundation of the system of controls within the organisation (see also SSG, 2008). Ashby (2010) recommends the creation of a culture of prudence and security.

Risk governance also implies the need to increase the importance organisations give to risk-related matters. Managers should become more risk aware, give careful consideration to the risks associated with their strategic decisions, manage risk for longer horizons, take a comprehensive view of all risks, and be prepared to react rapidly and determinedly when they believe firms are exposed to excessive risk (Stulz, 2009; Ashby, 2010). Thus, risk managers should build contingency hedging plans that can be implemented quickly if the corporation wants to reduce its risk in a short period.

It is necessary to build stronger relations between all levels of the organisation, including the business lines, audit committee, internal audit and board of directors (KPMG, 2009). Reliable quantitative and qualitative information should move between them in a timely manner.

Walker (2009) and Jackson (2010) defend the introduction of a board of risk separate from the board of directors and independent from the audit committee; its role would be to oversee and guide the directors on current and future risk exposures. The Walker Report also recommends having a CRO that participate in risk management and control with a firm-wide perspective and independence from business units. In this regard, Aebi *et al.* (2012) conclude that banks with the best performance during the subprime crisis were those where the CRO reported directly to the board of directors and not to the CEO. These authors conclude that banks should prepare for a future financial crisis by improving the

quality of risk management practices, namely having CEO and CRO at the same level and responding to the board of directors. This improvement could lead to better performance during crises, but to a lower performance in a non-crisis environment.

According to the Accenture (2013) survey of 446 financial and non-financial organisations around the world, some progress has already been made as they nearly all have a CRO (though some may not have a formal title); it also reports that nowadays risk management plays a much bigger role in business decisions.

Even though several authors propose that financial firms should adopt an ERM of risk, this approach is not free of criticism. Power (2009) suggests that ERM uses a control-based approach and cannot appreciate the risk of the organisation's interconnectedness with the economy. Power (2009) argues in favour of Business Continuity Management (BCM), which is a hybrid approach to risk management, developed in recent years, and includes IT and emergency management professionals among others. It uses non-accounting knowledge to shed light on the interconnected characteristic of economic life.

Risk can only become more relevant in an organisation if the effectiveness of risk control frameworks is improved, namely through more accurate and timely risk reports (Ashby, 2010) and greater independence between traders and risk controllers (Jawadi, 2010). Risk limits are especially important in new lines of business, where the measurement of risk is more imprecise (The Economist, 2008). In support of this recommendation, Ellul and Yerramilli (2010) show that more effective risk controls reduced the risk of US bank holding companies during the subprime crisis.

The improvement in risk management is also fundamentally related to a stronger long-term investment in high-quality professionals and technology (Golub and Crum, 2010; Accenture, 2013). Each corporation should ensure it has a team of professional risk managers with substantial subject matter expertise, practical experience and strong communication skills, as well as the appropriate technology and infrastructures to develop suitable risk metrics. KPMG (2009) adds that banks need to improve risk expertise at senior levels, because it is crucial for more robust and informed business decisions.

Regarding in-house knowledge on credit risk, Golub and Crum (2010) add that corporations should recognise that financial certification is useless during systemic shocks. Instead, they must rely more upon their own credit analysis, surveillance and due diligence capabilities to understand investments, or avoid investing in certain classes of risky assets (Gónzalez-Páramo, 2011).

Given that good professionals can make bad risk decisions when faced with the wrong incentives, changes in the remuneration system are often recommended. Crotty and Epstein (2009) indicate that the elimination of the widespread bad incentive structures and moral hazard in the financial system is key to avoiding a future crisis. In particular, the top management of bailed out institutions should also be strongly penalised. Incentives should be based on long-term shareholder interests (Crotty and Epstein, 2009; KPMG, 2009; Walker, 2009; Ashby, 2010; Jackson, 2010), without asymmetries in the treatment of gains and losses (Stiglitz, 2009). Walker (2009) and Rötheli (2010) suggest that compensations should take into account the risk assumed, with salaries and bonuses linked to risk measures and not only to profitability. KPMG (2009)'s survey indicates that the main priority of risk managers in terms of remunerations is to make more use of risk-adjusted measures and a greater use of long-term indicators to remunerate performance.

4.3 Regulation and external factors

A change in regulation is also essential to promote a safer financial system. Gualandri *et al.* (2009) note that it is necessary to rethink the Basel Accord in order to take the relation between solvency and liquidity into account. They agree that good liquidity risk management helps lower the probability of insolvency and that a bank's capacity to obtain liquidity in severe market conditions depends directly on the adequacy of its capital. These authors, SSG (2008) and González-Páramo (2011) propose the development of more robust, standardised and rigorous stress testing and contingency funding plans to minimise the losses when financial strains occur.

The maximum leverage ratios of investment banks should also be reduced to make them less vulnerable to changes in market risk. More generally, in booms regulators should be aware of the risk of rising leverage in the financial system (Stiglitz, 2009). The creation of counter-cyclical capital requirements to restrict the growth of financial assets in good times has been proposed by Crotty and Epstein (2009). These proposals have already been addressed in Basel III. In Canada, a strong regulatory control of capital implied that Canadian banks were better capitalised than US counterparts before and during the subprime crisis, thus contributing to a better performance of banks in Canada during this crisis (Seccareccia, 2013).

Gualandri *et al.* (2009) also recommend greater harmonisation and coordination of national liquidity regimes and supervision practices, especially for the large banks and financial conglomerates. The global financial infrastructure and policy response should be changed to better address counterparty risk, avoid contagion effects (González-Páramo, 2011) and maintain public trust in banks by reacting strongly to crises (Foo, 2008). The rescue of problematic banks by authorities is defendable to avoid public panic and social turmoil. Changing the treatment of large banks is another topic on the reform agenda not only because bailouts normally prove too expensive for the tax payer (Rötheli, 2010) but also due to the moral hazard caused by the existence of "too big to fail" banks (González-Páramo, 2011). Rötheli (2010) proposes introducing limits on the size of individual banks or the practice of special supervision for large banks. In our view, the latter option is probably the most realistic and with fewer social costs given the role large banks play in innovation and price reductions. But Stiglitz (2009) supports the break-up of large banks due to both the "too big to fail" issue and competition problems. Such proposals have to take into consideration that more competition may imply banks have greater incentives to undertake risky activities. Canada's case study shows that low competition between banks may promote more financial stability (Seccareccia, 2013). In Canada, an environment of low competition between banks, with considerable profits from traditional banking activities,

did not create the incentive to go to the business of risky new financial products and to increase excessively leverage.

Any future bailouts of banks should be funded by financial institutions (Crotty and Epstein, 2009). A scheme similar to the insurance deposit scheme for commercial banks should be created for the other financial institutions.

Stiglitz (2009) and Rötheli (2010) adds that central banks should be more concerned with financial market stability (including asset bubbles) and its impact on growth and employment, and make use of other tools to guarantee it (e.g. the practice of credit targets on credit crunches or the monitoring of credit aggregates during expansions). The formation of a Financial Markets Stability Authority to monitor the stability of the entire financial system is crucial (Stiglitz, 2009). It is crucial the creation of a Financial Markets Stability Authority, which main concern would be the stability of the entire financial system (Stiglitz, 2009).

The shadow banking system and investment banks must also be adequately regulated, and off-balance-sheet vehicles should be subject to adequate capital requirements that eliminate regulatory arbitrage (Crotty and Epstein, 2009). Similarly, increases in the capital required for some securitised assets should be placed on the agenda and reputational risk (associated with conduits and SIVs) should be addressed (SSG, 2008).

In addition, Rötheli (2010) defends more transparency and greater regulation of off-balance-sheet products (like loan guarantees, loan commitments and derivatives). Although the initial goal of these products was to manage risk, their use can increase risk in the presence of insufficient internal control. The accounting and disclosure of off-balance-sheet vehicles and products should be clearer; during the recent financial crisis, knowing which banks had the so called "toxic products" was a major problem (SSG, 2008; Kirkpatrick, 2009). Shareholders and risk managers must also collaborate to improve the functioning of financial markets by producing better information (Rötheli, 2010).

However, Stiglitz (2009) and Ashby (2010) stresses that capital rules naturally lead to regulatory arbitrage in banks, and therefore these rules cannot replace close supervision

of bank practices. Ashby (2010) recalls that capital regulation may have negative effects on the quality of risk management and financial innovation, and that regulators should find a balance between hard rules and flexible good practices.

Rötheli (2010) also recommends a reform of credit rating agencies in order to eliminate the tendency towards the underestimation of risks due to conflicts of interests. Measuring the accuracy of ratings would be a good solution. Stiglitz (2009) argues that rating agencies should be carefully regulated and that the government should create a rating agency.

Crotty and Epstein (2009) defend that any financial product that is too complex to be sold in an exchange should be prohibited. Confining financial products to exchanges would increase transparency and efficiency of the economy, reduce counterparty risk, and limit the size of the market of these products (Stiglitz, 2009). Regulatory agencies should also monitor the creation of new financial products closely and apply a "regulatory precautionary principle" to assess whether a new product should be allowed in the market in light of its systemic impact (Crotty and Epstein, 2009).

Jackson (2010) advocates that the lack of standardised structures or documentation in mortgage securitisation made search costs very high, which increased the reliance on ratings. At the same time, the standards of due diligence declined over time. According to Crotty and Epstein (2009), banks that create complex structured products should be required to undertake due diligence to evaluate the risk of each underlying mortgage; the ultimate ownership of the mortgage should be clear and it should be impossible for this to be done externally by rating agencies. This would clarify the risk of complex products and make their production less profitable. Moreover, the bank originating the mortgage should retain at least a 20% equity share (Stiglitz, 2009).

Price setting in the MBS market should also be made clearer (Voinea and Anton, 2009). Accordingly, the ECB and market participants already promoted an initiative to disclose information on each loan on the European ABS market (Gónzalez-Páramo, 2011). At the bottom of the chain, predatory credit and usury practices should also be banned by regulation and supervision. Variable rates in mortgages, where the interest rate can

increase substantially after an initial period of low interest, should also be prohibited especially for low-income individuals (Stiglitz, 2009).

5. Concluding remarks

This paper discusses the role of risk management in the context of the subprime financial crisis. There is no doubt that several macroeconomic factors have to be taken into account in order to understand the crisis; these include the increase in house prices, the high demand of financial products from international investors, the Fed's low interest rate policy, and regulation errors. However, the behaviour of financial corporations was at the core of the crisis; not only were they too optimistic and took excessive risk without making a correct appraisal of risk across the subprime securitisation chain, but they also created complex financial products with little transparency and used CDS that made the financial system riskier.

The reasons for financial institutions' failure to manage risk appropriately are intriguing, because this is one of their main roles in the economy. We organised the explanations for this failure into three main groups: technique and methodology, corporate governance and strategy, and regulation and external factors. At the technical level, risk models showed several limitations; when dealing with new and complex products in particular, qualitative judgments were largely ignored and several important risks were overlooked (namely liquidity, counterparty, and systemic risks). Another major shortcoming was the inappropriate risk governance structure that gave little importance to risk matters and was characterised by a fragmented vision of risk, poor monitoring and auditing, wrongly designed incentives, and cultural weaknesses. Regulators and external forces also failed to fulfil their role correctly due to a lack of efficient monitoring by regulators, the incorrect design of Basel II on some key aspects, the "too big to fail" protection, poor accounting standards, and insufficient market discipline.

Given the shortcomings identified, the literature proposes recommendations to improve risk management. From the methodological and technical perspective, it is important to pay more attention to certain risks. Qualitative models, scenarios analysis and stress tests should complement quantitative analysis; and quantitative analysis needs to be improved. Regarding governance, institutions should have a strategic approach to risk, be concerned with their long-term survival and align their remunerations schemes accordingly; the risk governance structure should be strengthened. Finally, regulation must be changed to avoid a future crisis. The Basel Agreement and prudential regulation must be reassessed, reforms made to credit rating agencies; the transparency and regulation of off-balance-sheet products and vehicles must be increased, the "too big to fail" effect addressed and improvements must also be made to the structure of markets, and monetary policy awareness of asset price bubbles must be raised.

Even though much still needs to be done, many of the aforementioned recommendations have already been undertaken by regulators around the world. Basel III is probably the most relevant step towards stronger regulation, with a reinforcement of capital requirements, and the introduction of new liquidity requirements. The Basel Committee on Banking Supervision also issued new regulations in 2013 on risk data aggregation and risk reporting that were applicable to systemically important banks at the global and domestic levels. Measures have also been taken to increase the trade of derivatives in organised and transparent markets. Furthermore, the EU started debating a proposal to limit bankers' bonus in 2012 (Leão and Leão, 2012). Other important measures are the introduction of a resolution framework for international financial firms, and procedures to deal with banks of systemic importance (Giustiniani and Thornton, 2011).

Our discussion supports the financialisation perspective of risk management in the crisis. Large non-financial firms, previously a major source of profit for banks, have started to raise funds directly on the markets (Lapavitsas, 2011). As a result, and in a context of deregulation of the financial system, the banking system has gone through a deep restructuring process with the emergence of the shadow banking system, the move from

traditional banking to fee-generating banking grounded on the originate-and-distribute model, and the increase of lending to households rather than to firms (Stockhammer, 2010).

One of the conduits of financialisation is the alignment between corporate interests and financial markets interests (Palley, 2007). This is done by making managers' remunerations dependent on corporations' stock price evolution, and through the encouragement of debt. This has negative implications for risk management since managers focus on the short run behaviour of the share price and take excessive leverage. More generally, the rise of short-termism is related with the growth of institutional investors, changes in governance control, and the prominence of finance in the economy (Orhangazi, 2008: 74).

The increase in the share of profits in income (with the reverse decrease of the wages' share) led to the arrival of a growing volume of capital on financial markets in search of high returns. Faced with this pressure and abundant capital, banks paid less attention to risk and were more concerned about obtaining high returns.

The need to increase profits in the short run led to the creation of complex mortgage backed securities, without proper risk assessment, which ultimately gave rise to the crisis. The fact that regulators trusted in the self-regulation and market discipline of financial institutions also proved to be misguided as neither of the mechanisms were sufficient to foster a sustainable approach to risk. Simultaneously, risk taking by financial institutions increased systemic risk and volatility in the economy. Cultural aspects associated with ego, greed and over-confidence in both markets and quantitative tools also play a part in explaining the crisis.

We can therefore conclude that the shortcomings in risk management identified during the subprime crisis should be interpreted by using the broad concept of financialisation as this will foster the design of more effective regulations that prevent further crises.

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THE ABSTRACT OF THE PROJECT IS:

The research programme will integrate diverse levels, methods and disciplinary traditions with the aim of developing a comprehensive policy agenda for changing the role of the financial system to help achieve a future which is sustainable in environmental, social and economic terms. The programme involves an integrated and balanced consortium involving partners from 14 countries that has unsurpassed experience of deploying diverse perspectives both within economics and across disciplines inclusive of economics. The programme is distinctively pluralistic, and aims to forge alliances across the social sciences, so as to understand how finance can better serve economic, social and environmental needs. The central issues addressed are the ways in which the growth and performance of economies in the last 30 years have been dependent on the characteristics of the processes of financialisation; how has financialisation impacted on the achievement of specific economic, social, and environmental objectives?; the nature of the relationship between financialisation and the sustainability of the financial system, economic development and the environment?; the lessons to be drawn from the crisis about the nature and impacts of financialisation? ; what are the requisites of a financial system able to support a process of sustainable development, broadly conceived?'

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THE PARTNERS IN THE CONSORTIUM ARE:

Participant	Participant organisation name	Country
1 (Coordinator)	University of Leeds	UK
2	University of Siena	Italy
3	School of Oriental and African Studies	UK
4	Fondation Nationale des Sciences Politiques	France
5	Pour la Solidarite, Brussels	Belgium
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