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LOW INTEREST RATES, OFF BALANCE SHEET ACTIVITIES AND BANK RISK-TAKING: EVIDENCE FROM U.S. COMMERCIAL BANKS

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General Introduction

The question about the soundness of the financial system was a main motivation for this work. The recent financial crisis has inspired many researchers, regulators and policy makers to develop and intensify research on financial and banking stability. During the last four years and specifically after the crisis of 2007, concerns were about the policies, the procedures and the actions that should be taken in order to insure the strength of the financial and the banking system. Still, a logical preliminary and essential stage was to understand the factors that contribute to financial distress and to determine the gaps in the system that could constitute incentives for market participants to increase specific risk positions. Many views have been presented to explain the causes of the financial crisis: risky subprime lending, flagrant and predatory lending practices, increase in the mortgage debt, growth in trading activities, lack of bank capitalization, lack of bank liquidity, unregulated derivatives… This research study focuses particularly on two of the potential and widely discussed culprits of this instability: the first concern the possible relation between policy rates and bank risk-taking incentives and the second investigates bank off balance sheet activities and their implication on bank soundness. Accordingly this thesis is divided in two main parts:

In **the first part** I study the transmission channel of monetary policy through the risk-taking channel. One of the comments that drawn the attention of many researchers but also sparked a lot of controversy is the one that has been addressed to the stance of monetary policy. On the aftermath of the financial crisis many commentators shed the light on the possible link between monetary policy and the perception and pricing of risk by economic agents. The long period of low policy rates applied during the pre-crisis boom period is suspected to be a factor that increased bank optimism and appetite for higher risk positions. Accordingly, a loose monetary policy will not only increase credit demand and lending as described by the traditional transmission channels, but more importantly will result to lending to riskier profiles. **The first chapter** of this first part is devoted to introduce and to present a better understanding of the risk-taking channel, to present the different theoretical foundations that back up this channel and to discuss the potential difficulties related to empirical evidence. In **the second chapter** I present a

first empirical study of the risk-taking channel. Using qualitative data from a loan survey on U.S. commercial banks' lending standards, I contribute to the literature by studying the influence of policy rates on the lending practices of sixty U.S. commercial banks. In particular the study investigates the impact of the interest rates on the willingness of banks to lend, the easiness and the degree of requirements when granting credit. This first study provides evidence of a positive association between a low level of policy rates and lax lending practices. Still, further intuitive questions could be concerned about the weight of the risk-taking channel and the importance and the role that it played in the recent financial crisis. An increase in the bank risk-taking could be quite logical and beneficial. Banks are required to channel savings to creative investments and not only to secure assets, accordingly it is logical to question the importance of the increase in the bank risk-taking, to consider the way this increase in the risk-taking materialize and ideally consider the extent to which the increase in the risk at the individual bank level due to lax monetary policy, create macro instability and lead to global financial crisis. **In the third chapter**, I further explore these questions by investigating the possible impact of loose monetary policy on bank behaviour for the U.S. commercial banking system during the period 2001/2010. The objective is not to determine the weight of the risk-taking channel in the recent crisis, but more modestly, to look through U.S. banks' financial statements for a link between a long period of low policy rates and different measures reflecting bank riskiness. Also the objective is to address quantitatively how much a low level of interest rates environment impact several financial ratios reflecting banks assets composition, loans riskiness and bank balance sheet expansion. The results presented in this chapter strengthen previous comments: the risk-taking channel is reflected in an increase in the risk-taking behaviour characterised by higher risky investments and increase assets expansion (ex-ante risk measures) during the whole pre-crisis boom period (2001Q1/2007Q2). The materialization of risk reflected into lower loan quality (ex-post risk measures) is only detected in the post-crisis bust period (2007Q3/2010Q4). A main implication of this study is to shed the light on the problem of valuing risk and the problem of predicting ex-ante imbalances: when the risk-taking was increasing during the upswings of the boom period, the materialization of these risks is only performed during recessions.

In the **second part**, I turn to a following topic and investigate the off balance sheet (OBS) activities of the U.S. commercial banking system. OBS activities, which can range from simple guaranties and commitments contracts to more sophisticated derivative products, were also seen as main factor that contributed to recent financial imbalances. Specifically by stimulating the last lending boom and enabling banks to increase their operational funding, OBS activities contribute to a standard maturity mismatch and a liquidity crisis (Farhi and Tirole 2009, Gorton and Metrick 2009). The second part is divided in two chapters: The main focus of **the first chapter** is to shed the light on the different types of items presented off the balance sheet on a bank financial statement and to review the potential advantages and risks related to each activity. This first chapter also examine for the specific case of the U.S. commercial banks, the weight of OBS activities in their business model. In the **second chapter**, I present my empirical contribution investigating to what extent different types of OBS activities could impact bank riskiness and bank failure during the period 2001-2010.

Part 1 The Risk-Taking Channel of Monetary Policy

Chapter 1 Interest Rates and Bank Risk-Taking

Abstract

What is the link between interest rates and the perception and pricing of risk? How could the level of policy rates impact the way economic agents, specifically banks, measure, evaluate, perceive and price the risk? How important is the possible relation between monetary policy and risk-taking commonly named the risk-taking channel of monetary policy? The purpose of this first chapter is to introduce, to provide the theoretical foundations and to provide a review of literature of a relatively new transmission channel widely discussed on the aftermath of the crisis the so-called risk-taking channel.

1. Introduction

There is a great interest in the current literature on whether central banks should take into consideration financial and banking imbalances when setting monetary policies. Until recently, the dominant viewpoint among central banks and other policy authorities reposed on three forms of "pre-established harmony". First, macroeconomic stability can be achieved by monetary policy, which pursues low and stable inflation. Second, financial stability can be achieved by pursuing a micro prudential approach (specifically using the capital adequacy regulation). Third, financial institutions with a sufficient capital position can easily raise liquidity in financial markets (Shirakawa 2009). Yet, the current experience shows a need to a review for for such claims. During the last two decades, monetary policy succeeded to maintain stable and low inflation, still, the recent financial crisis has shown that monetary policy is not neutral from financial stability perspectives: not only financial imbalances can be produced during benign economic conditions, but also, and more importantly, benign economic conditions such as low level of inflation accompanied with low level of interest rates and excess liquidity, could be responsible for increased optimism and lead to unusual incentives of risk-taking.

In the aftermath of the crisis, many economists discussed the possible connection between the low level of rates that have been applied during the pre-crisis period and the perception and the appetite for risk specifically in the banking industry. The expansionary monetary policy that has been applied by many central banks in the world during the pre-crisis period and the low level of interest rates that prevailed during this same period has been claimed to be an element that produced a change in the behaviour of banks and an increase in their risk tolerance. It is widely known that easy monetary conditions and low-cost credit are a classical ingredient of financial crisis: low interest rates contribute to an excessive expansion of credit and, hence, to boom-bust-type business fluctuations (Gambacorta 2009). However the criticism that have been addressed to monetary policy following the crisis, shed the light on a new way where central banks policies are transmitted to the real economy: not only a loose monetary policy will increase credit demand and lending as described by the traditional transmission channels, but more importantly it will result to lending to riskier profiles (Apel and Claussen (2012)). These comments have been conceptualized theoretically in

a new transmission channel called "the risk-taking channel" defined as the possible impact of changes in policy rates on either risk perceptions or risk-tolerance (Borio and Zhu 2008). Accordingly, the degree of risk in the bank's portfolios, the pricing of assets, and the price and non-price terms of the extension of funding, will be influenced by the level of policy rates. The partisans of this new channel argue that when the increase in the risk-taking is high enough this could lead to financial instability. Even if these comments produced controversial reactions from the economic society, they draw attention on a new factor that could impact the attitude, the acceptance and the tolerance toward risk of the different economic agents and most importantly of those who are in charge of valuing and pricing risk (rating agencies and banks).

The remainder of this chapter is as follows: in the second section, I present the traditional ways monetary policy impact real economy and introduce the risk-taking channel, in the third section I discuss the difficulties that prevailed the empirical assessment of the risk-taking channel and in the fourth section I present a review of the empirical evidence on this issue.

2. The risk-taking channel

2.1 Monetary policy and the real economy: The traditional transmission channels

The mechanisms through which monetary policy impact economic agents behaviour and the real economy are known as the monetary policy transmission mechanisms. It is widely accepted that central banks, by controlling monetary aggregates such as interest rates, money supply and bank credit including the exchange rate, influence many aspects of the real economy[1]: consumption level, investment level and consequently economic output, unemployment and inflation… However before the crisis of 2007, the previous literature on the monetary policy transmission mechanisms rarely mentioned the possible implications of monetary policies on financial risks. Conventionally the transmission mechanisms have been categorized into the three following main channels: the interest rate channel, the asset price channel and the credit channel.

First, according to the interest rate channel, monetary policies influence economic output via their impact on the different level of rates. More specifically it describes the

[1] Bernanke and Gertler (1995) and Christiano, Eichenbaum, and Evans (1999)

impact of policy rates on the decision of economic agents to consume and to invest. When central banks increase money supply through a reduction in the level of policy rate, real interest rates and capital costs decline causing private domestic demand to expand. This is because when real interest rates and capital costs decline, it becomes more profitable for a company to invest and to borrow. Also it becomes more profitable for consumers to consume and to borrow and less beneficial for them to save. Accordingly, via the interest rate channel, an expansionary monetary policy permits the economy to grow at a higher pace.

Monetary policy is also transmitted to the real economy through the price of assets such as currency and foreign exchange prices, equity prices and house prices. The foreign exchange channel describes how the decisions of central banks affecting currency prices are transmitted to the real economy. For example, an expansionary monetary policy leading to currency depreciation makes domestic goods cheaper than foreign goods. This leads to a rise in net exports and consequently to a rise in economic output. Monetary transmission mechanisms also operate through the equity and the house prices. The expansionary monetary policy effects of lower interest rates, makes bonds less attractive than stocks and result in increased demand for stocks, which bids up stock prices. Conversely, interest rate reductions make it cheaper to finance housing, causing real estate prices to go up. Because equity and house are strongly related to financial wealth, an appreciation of equity and house prices increase through the wealth-effect the level of consumption and consequently the economic output.

Finally, the credit channel is a channel in which banks play a major role. This channel specifically describes how monetary policy impact economic performance via its impact on credit demand and credit supply. Monetary policy can affect the wealth and the balance sheet of borrowers in several ways: an expansionary monetary policy by lowering the interest rate boosts asset prices and increase the collateral value of potential borrowers. Also, in the case where borrowers have outstanding loans, a decrease in the level of rates by decreasing interest expanses enhance the expected cash flows and decrease the borrower probability of default. In both cases, the asymmetric information and the adverse selection problem between banks and borrowers decrease and banks become more willing to extend credit and lending. It should be noted that according to the credit channel, the increase in the willingness of banks to extend credit

following an expansionary policy is due to the enhancement of the borrowers net worth and not to a change in the lending standards or the perception of risk. Accordingly a bank could extend credit to a borrower that was qualified as risky in the past but not anymore due the change in the borrowers net worth.

2.2 Monetary policy, economic conditions and financial imbalances

As already mentioned, before the crisis of 2007, the earlier literature on the monetary policy transmission mechanisms rarely revealed the possible implications of monetary policy on financial risks. Prior to the crisis, few authors shed the light on the association between benign economic conditions and the build up of financial imbalances. Minsky (1982) insists on the fact that rising and stable economy is a contradiction in term. He presents the "paradox of tranquillity" stating that a fast growing free market economy will necessarily transform itself into a speculative booming one. He explains his view by the fact that a succession of periods with validated expectations of sales growth and high profitability will necessarily induce overly optimistic expectations. Andrew Crockett[2], in a speech delivered in September 2000, presents the common patterns of financial instability: he first talk about an extended phase during which economic conditions are favourable, this first phase is normally associated with a boom in assets prices fed up by easy credit and cheap liquidity. In turn, the asset boom increases borrowers net worth and accordingly bank lending and bank leverage. Concerning the bust phase, he argues that whether originated by an asset price correction or a spontaneous slowdown of the investment boom, the transition from the boom period to the bust period and the timing of downswings is exceedingly hard to predict. Also Borio and Lowe (2002) present the common indicators that constitute possible seeds of financial imbalances. The authors specifically shed the light on the role of sustained rapid credit growth combined with large increases in asset prices in increasing the probability of an episode of financial instability.

Accordingly, before the financial crisis, economic analysis linked an increase in both credit expansion and assets valuation to probable bubble burst and crisis. After the crisis, these comments have been further specified, and the role of monetary policies

[2] The general manager of the Bank for International Settlements and Chairman of the Financial Stability Forum

through the policy rates has been explicitly mentioned, suggesting that a change in bank risk appetite and a change in bank risk perception is potentially a new channel through which monetary policy is transmitted to the real economy.

2.3 The risk-taking channel: The theories

In 2008, Borio and Zhu introduceed the risk-taking channel and defined it as the channel through which monetary policy impacts bank risk perception and risk valuation. A first intuitive question is to know how could low level of interest rates impact banks behaviour and perception for risk? And why could the risk pricing change during times of expansionary monetary policies and stable economic conditions? The theories on the risk-taking channel presented either a search for yield, an optimism for future expectations or a decrease in the cost of funding and an increase in leverage as arguments of the causes underlying the increase in the risk-taking following periods of low rates and expansionary monetary conditions.

On the first hand, the search for yield argument related the increase in the risk-taking behaviour, during periods when low interest rates prevail, to a conscious act according to which economic agents in general and banks in particular will prefer to replace lower yielding assets such as government securities and invest in higher yielding but riskier assets. Rajan (2005) explained the search for yield phenomenon and presented many examples on the ways periods of low interest rates create managerial incentives for more risk-taking. He first explain that to avoid default on their commitments, insurance companies which entered into fixed rate commitments could have no alternative choice than to seek higher yielding but riskier projects if the interest rates fall bellow the promised rate. "*This phenomenon, known as risk shifting (see, for example, Jensen and Meckling (1976)), tends to induce participants to ignore collective downside risks (including illiquidity) since their attention is focused on the upside, the only circumstances under which they survive. Of course, if risk free interest rates start moving back up, insurance companies can meet their obligations without taking undue risk. Thus they have an incentive to search for risk when interest rates are low, and to become more conservative when they are high*". In another example, Rajan (2005) relates the search for yield and the risk-shifting hypothesis with the compensation structure of the financial

institutions managers. For more explanation, when a large portion of the remuneration of these managers depends on the return of the institution and is related to nominal target, the incentives of banks managers to take more or less risk will be influenced by the profit expectations. When the interest rates are at a low level, and specifically when the risk free rate is low, the search for higher return through riskier projects is logical for managers to reach the minimum return and they will be more willing to increase the institution profitability in order to increase their own reward. Finally, habit formation could also be an element that induce agents to search for yield: when economic agents are accustomed to generate a specific level of profit rates, a decrease in the general level of rates could push them to seek the level of rate they are already used to, which is possible through a higher level of risk. Besides, incentives for more risk-taking and appetite for risk may intensify in competitive environment with higher pressures on profits. In association to the search for yield aspect of the risk-taking channel, Michalak (2012) argues that "*a continuously increasing competitive pressure in banking markets in combination with a credit expansion may force banks to increase profit margins by softening their lending standards and increasing their risk exposure to fulfil capital market expectations*".

A second argument of the risk-taking channel is related to an unconscious increase in the risk-taking behaviour due to optimistic expectations: when the economy experience a long period of benign economic environments associated with low risks and expansionary monetary conditions, the evaluation of risk by banks could be influenced by the current situation. Accordingly, optimistic future expectations could induce less awareness and a biased perception and evaluation of current risk. The optimism of banks could also be due to the increase in assets prices and the collateral values: periods of monetary expansion during which low levels of interest rates prevail, are also associated with an increase in assets prices. The increase in collaterals value, the enlargement of the cash flow expectations and the decrease in price volatility lead to an increase in the net worth of both borrowers and banks. As a result, banks could be more willing to increase lending, to extend credit and to lax lending conditions during these specific periods. Furthermore, the transparency of the communication policies and the reaction function of the central bank is another element that increases the risk-taking channel (Borio and Zhu 2008). When the reaction of central banks is predictable,

future uncertainty decreases creating an "insurance effect" and leading to a reduction in risk premium and to more risk-taking.

Finally, lax lending practices and monitoring processes could also be explained by the decrease in the cost of funding (Dell'Ariccia and Marquez, 2006) and the increase in bank leverage: on one hand, lower level of interest rates by decreasing banks cost of funding could decrease their incentives to screen borrowers and induce lax lending policies. On a second hand, in an environment of low level of rates, it becomes cheaper for banks to use leverage and short term funding in order to fund their activities. Giving that bank incentives to lever and to take on asset risk are complementary, the more levered a bank, the greater its limited liability and the less it has to lose from risky loans. Bruno and Shin (2013) present an additional explanation of the risk-taking channel from an international context, making a clarification on how monetary policy in advanced economies may impact leverage and real exchange rates in capital flow recipient economies. The authors argue that low level of interest rates in developed economies encourage banks in recipient economies to take advantage of lower dollar funding costs by increasing lending to domestic entities. The increased capital inflow appreciates the recipient economy's currency, which improves the balance sheets of borrowers in the recipient economy and leads to an amplified capital inflow resulting in an amplified risk-taking.

2.4 The risk-taking channel: The risk implications

The risk-taking channel describes a change in banks' behaviour following a period of lax monetary conditions and available liquidity. These changes in bank risk aversion could be translated in several ways:

- *Lax lending practices*

A first change in the bank behaviour according to the risk-taking channel could be detected through a change in the bank lending policies and standards. Traditionally banks perform an important role of limiting asymmetric information and adverse selection problems in the economy by screening out applicant borrowers that do not meet satisfactory lending standards (Dell'Ariccia and Marquez 2006). The benefit for

such a screening is for the bank to limit their exposure to borrowers' default and therefore increasing their profitability. When the bank fail to perform this task, the amount of risky loans increase resulting in weaker balance sheet and higher exposure to default. As presented above, the causes of lax lending behaviour associated with the risk-taking channel could be explained by the general enhancement in the conditions of borrowers due to the increase in their wealth or to the bank optimistic expectations for future conditions. Also, since the screening processes are costly, the lax lending practices could be related to the reduction of bank loans return: Dell'Ariccia et al. (2010) explain that a reduction in the policy rates is reflected in a reduction of the interest rate on bank loans which in turn reduces the bank's gross return conditional on its portfolio repaying. This could reduce the incentives for the bank to monitor and to screen borrowers and could result to lax lending practices. Whether caused by conscious or unconscious decisions, lending practices and monitoring effort are not observable and accordingly are not easy to detect and to measure, however their impact will be reflected sooner or later in the quality of the bank balance sheet and the bank loans portfolios.

- *Risk shifting toward riskier investments*

The risk-taking channel could also operate through a risk-shifting behaviour. As mentioned previously, due to search for yield and to optimistic future expectations, low risk investments could be less appealing and banks could turn to riskier projects and investments, which generate higher returns. Investment in risky projects in itself is not a problematic issue if their relative riskiness is well identified and adequately priced. The role of banks is not limited in financing secure assets; banks should also channel savings to creative investments. However, the risk-taking channel shed the light on the building of imbalances partly due to risk shifting. The problem lies in the fact that banks acquiring and holding assets, which entail exposure to greater credit risk, may not fully appreciate or demand proper compensation for potential losses specifically when the economic conditions are accommodative.

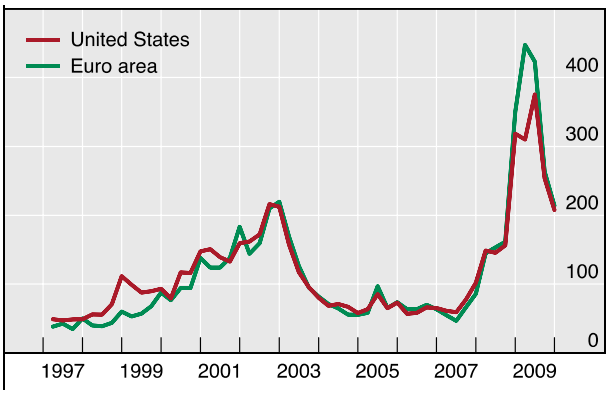
- *Decrease in the price of risk*

Another way the risk-taking behaviour may materialize is through the pricing of risk. An essential element in the bank risk management is the risk-return pricing. The risk-

return settings presume that the rate that borrowers pay for credit depend on their solvency and net worth's. Accordingly the pricing of loans should be linked to risk rating or credit quality, and borrowers presenting strong financial position should be priced low whereas those placed in high credit risk category should be priced high. Banks have the responsibility to predict and to measure the expected probability of default of loans. The latter is derived from the past behaviour of the loan portfolio and the history of the borrowers repayments and loan loss provisions. Banks build historical database on the portfolio quality and equip themselves to price the risk. Of course elements such as the value of collateral, perceived value of accounts, future business potential, portfolio/industry exposure and strategic reasons may also play important role in pricing. The risk-taking channel supposes that, during monetary expansions, economic agents and specifically banks will under-price the risk premium. Therefore, the risk-taking channel supposes that during expansionary monetary conditions not only banks will change the non-price term of lending such as the guarantees required, the amount of credit and the loan covenants but also the price conditions of credit will be influenced by the level of interest rates and banks will apply lower spread even for riskier profile. Traditionally, the risk pricing of a specific borrower could be revised following changes in rating or in the value of collaterals over time. Still, the risk-taking channel supposes that the decrease in the loan pricing exceed the increase of the borrowers worthiness or in other words, the increase in the risk-taking is not adequately priced. In this area Ioannidou et al. find that a decrease in the US federal funds rate prior to loan origination raises the monthly probability of default on individual bank loans. They also find that initiating loans with a subprime credit rating or loans to riskier borrowers with current or past non-performance become more likely when the federal funds rate is low. However, they find that while an increase in the hazard rate has a positive impact on the loan rate, the component of the hazard rate that is explained by monetary policy has no impact or even has a negative effect on the loan rate. Consequently the authors conclude that during expansionary monetary times "*banks take more risk and they do not seem to price it properly"*. Graph 1 shows the evolution of the spread on risky (BBB rated firms) relative to less risky borrowers (AAA rated firms). It could be noticed that BBB rated firms always pay more than AAA rated firms, however the spread narrowed significantly

in both the euro area and the United States during the period of very low interest rates (see Gambacorta (2009)).

Graph 1 : Difference between the corporate bond rates paid by BBB- and AAA-rated firms, in basis points



Source: Gambacorta (2009)

- *Increase in lending*

Finally, the change in bank behaviour according to the risk-taking channel could be reflected in an increase in bank asset expansion and liquidity creation. Benign economic conditions associated with low level of interest rates and abundant liquidity, reduce the risk of bank run and deposit withdrawals. In such conditions, and when banks' liquidity and net worth improve, banks have incentives to relax their lending policies and to increase their credit and liquidity risk-taking (Steven Ongena, José-Luis Peydró). Basically, the activity of lending to customers represents an essential function of banks (Diamond 1984, Bhattacharya and Thakor 1993). However, excessive credit expansion and liquidity creation have also been found to be an element that created many imbalances and preceded both national and international crisis (Cottarelli, Dell'Ariccia, and Vladkove (2005), Demirguc-Kunt and Detragiache(1998), and Kaminsky and Reinhart (1999)). In this area, the U.S. mortgage crisis has specifically shed the light on the link between loan growth and subsequent loan losses.

3. Challenges of empirical evidence

The difficulties related to empirical evidence on the risk-taking channel could be due to several factors: assessing monitoring processes and the appetite for risk, disentangling the impact of interest rates on outstanding and new loans, balancing opposite forces… In the following I discuss some of these difficulties.

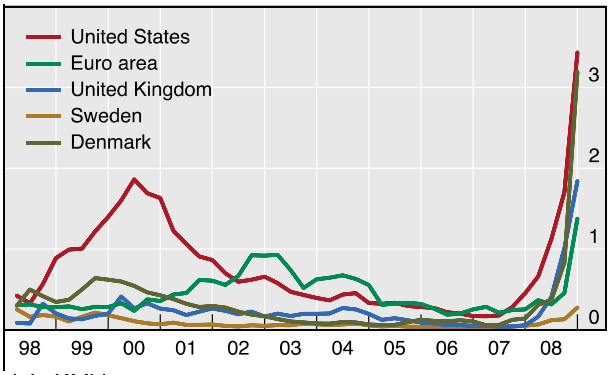
- *Assessing Monitoring Processes*

According to the theories underlying the risk-taking channel, the incentives of banks to screen borrowers could decrease during period where low level of interest rates prevail and banks may relax lending standards and monitoring processes during these specific period. In the banking literature, it is well known that monitoring processes are hard to observe, accordingly testing empirically such hypothesis is not a straightforward issue.

- *Ex-ante and ex-post risk measures*

Another difficulty related to empirical evidence concern the materialization of risk. During good economic performance associated with abundant liquidity and low interest rates, the general economic environment may influence the perception of risk. Also risky projects or risky borrowers may have good performance. Measures of risk based on performance or profitability may assign high ratings even for riskier portfolios. Thomas Woods (2010) argue that "*at time when housing prices were consistently rising thanks to the fed's cheap credit policy, these mortgages were performing well and the rating agencies therefore made the superficial decision to rate them high*". As a result, and as long as we are in the ascendant phase of the economic cycle, and as long as the risks do not materialize, an accommodative monetary policy will be more associated with lower materialization of risk. The evolution of the expected default frequencies as presented in graph 2 reflects this specific idea.

Graph 2: Expected default frequency of banks Over a one-year-ahead horizon; averages by country or group of countries



Sources: Altunbas et al (2009); Moody's KMV

The decrease in the expected default frequency as noticed in graph 2 during 2000 till the eve of the crisis should not be interpreted as a decrease in the real risk banks were affording. The central banker Andrew Crockett (2000) declares: "*The received wisdom is that risk increases in recessions and falls in booms. In contrast, it may be more helpful to think of risk as increasing during upswings, as financial imbalances build up, and materialising in recessions".* The difficulty in this point is to choose an adequate variable that reflects the ex-ante risk taken by financial institutions.

- *Disentangling the impact on outstanding and new loans*

If the risk-taking channel predict a negative association between interest rates and the riskiness of new loans, the impact of low interest rates is however beneficial for the outstanding loans. Accordingly, one of the challenges to assess the RTC is to disentangle the impact of low policy rates on new loans from the outstanding loans. This problematic is specifically of concern when data from financial statements are used to test the risk-taking channel. Studies based on loan level data could be beneficial to deal with this issue.

- *Assessing loose monetary policy and low interest rates*

Another main issue when testing empirically the risk-taking channel is how to represent the loose monetary policy and what variables to use for assessing the too low level of

interest rates. Do we have specific level or a cut off point of interest rates that permit to evaluate the stance of monetary policy? Another question to be considered is which interest rates are important for the risk-taking channel that could influence bankers decision to take more or less risk?

One of the most used "monetary policy loosening" variables when testing empirically the risk-taking channel was the overnight policy rate (federal funds rate, EONIA, the 3-month interbank rate, Spanish overnight rate, German overnight rate). Low level of "short term" interest rates could have direct implication for banks: First, given that banks rely mostly on short term funding, low overnight policy rates may be crucial for risk-taking more than low long-term rates. Second, banks finance themselves at short maturity, lend at longer maturities and earn a spread on the difference. Since long rates are less sensitive than short rates to shifts in the central bank's policy rate, low short-term rates by increasing the yield curve slope may induce banks to soften lending standards (Adrian, Estrella and Shin, 2010).

Furthermore, some empirical studies investigate the influence of longer maturity rates on bank-risk taking for example by using the ten years government bond yield. Low long-term interest rates could also be associated with an increase in bank risk-taking for example by inducing banks to search for higher profitability (search for yield). In some sense, it is important to question which maturity rate is responsible for the increase in risk-taking and in assets price' bubbles in order to determine the implication of central banks' decisions on financial stability. Since the aftermath of the crisis, the active debate about whether the imbalances were caused by central bank interest rate policy being set too low for too long or by global savings glut hypothesis, is still open and inconclusive. Bernanke argued: "*the low long-term rates were due to a savings glut by which the current account surpluses around the world caused the increased demand of U.S. mortgage securities*". Greenspan (2010) also insisted that it is the low long-term rate induced by geopolitical changes that provoked a home price bubble.

Levels or changes in nominal/real short-term or long term interest rates were used by different empirical studies. The logic underlying the use of one or another of these measures was not discussed. The impact of a loose monetary policy on bank risk-taking is captured by studying the sign of the coefficient from panel regressions between the interest rate variable and the risk-taking measure. Accordingly the sign permitted to

discuss how an increase or a decrease in the level (or the change) of interest rate impact risk-taking. However, these indicators do not answer the question of how a "loose monetary policy" and how "too low interest rates" impact banks behaviour. Also a low interest rate may be due to the fact that the general level of interest rates is low and not to an expansionary monetary policy. It would be useful to dispose of a reference rate or an indicator that permit to specify a neutral monetary policy and to compare it to the applied policy rate. Some studies investigate these specific issues by using the deviation of the short interest rate from a Taylor rule[3] rate or from the natural interest rate. Finally, some studies take in considerations the duration of the period during which interest rates were low and investigate "the too low for too long" hypothesis, using for example the number of quarters during a specific number of years during which the interest rates were low in comparison to a Taylor rule rate or to a natural rate.

Empirical difficulties could be associated with some of these variables. For example, the impact of a change in the level of interest rate (or a negative deviation from a reference rate) on the risk-taking measures is not always a spontaneous relation. If we accept that a decrease in the level of interest rate or a negative deviation from a reference rate produce an unavoidable impact on bank risk behaviour, different risk measures do not permit to immediately internalize this increase in risk-taking. Suppose that a decrease in the level of rates will push banks to lax lending practices and to lend to riskier profile: it may be logic to find a direct impact between the level of interest rates and a measure reflecting instantaneous lending standards or a measure reflecting the riskiness of the new investments, however it would be much more difficult to see such impact using proxies from bank balance sheet data. Consider for example some of the credit risk proxies such as the non-performing loans: even if we suppose that a decrease in the level of interest rate will be associated with higher risk-taking and higher lending to riskier profile, the risk will rarely materialize in the same period i.e. the new risky loans may still be performing several months before the default event occur.

[3] Appel and Claussen (2012) argue «it is still problematic to interpret this as a measurement of how expansionary monetary policy is as the Taylor rate is typically based on a constant, long-term real interest rate »

4. Literature review: Selective empirical findings

A summary of the main empirical findings of the previous studies conducted in this area is presented in Tables 1.1, 1.2 and 1.3. These empirical studies could be divided into different categories according to their methodology for testing this question: a couple of studies test the risk-taking channel using a loan level dataset (see table 1.1), another set of studies use bank lending surveys (see table 1.2), and finally a last category base the empirical work on bank balance sheet data (see table 1.3).

4.1 Loan level empirical studies

Concerning the loan level studies on the risk-taking channel, historical data for each loan did permit to evaluate the loan risk profile. Jimenez, Ongena, Peydró and Saurina (2010) dispose of detailed monthly information for new and outstanding commercial industrial and financial Spanish loans during the period 1984 till 2006. Using this database and as a measure of ex-ante loan risk, they apply discrete choice models (Probit models) to analyse whether a loan is granted to a borrower with good or bad credit history[4] and alternatively with or without credit history. In addition, they calculated a loan default probability that is normalized per time period[5]. They found that when interest rates are low, banks give more loans to borrowers with either a bad or no credit history. They also found that during expansionist monetary conditions banks grant more loans with substantially higher probability of default rate. On the contrary, they found that lower interest rates imply lower hazard rates for the outstanding loans.

Another study that also used loan level data is the one by Ioannidou, Ongena and Peydro (2009). The latter explored the impact of the federal funds rate on the riskiness and the pricing of new bank loans granted in Bolivia between 1999 and 2003. Using respectively the loan default probability, the loan rating and the loan spread as proxies of loan riskiness, they found that relaxing monetary conditions increases the probability of default on the individual bank loans: "*initiating loans with a subprime credit rating or loans to riskier borrowers with current or past non-performance become more likely when the federal funds rate is low*". Concerning the price of risk, the authors finds that higher

[4] Depending on default on another loan in the previous 6 months

[5] The dataset used include loan repayment information: not only whether the loan is overdue or not but also when it defaults. The authors use this information to construct for each loan a default probability.

hazard rate imply higher risk premium, however the component of the hazard rate that is explained by monetary policy has no or even a negative effect on the loan rate. The authors conclude that the excess in the risk taking explained by expansionary monetary policy is not taken in consideration in the price of the loan.

Furthermore, Delis, Hasan and Mylonidis (2012) using the pricing of newly issued syndicated loans in the U.S. during the period 1988/2010 investigate the link between monetary policy and bank lending standards: "*loan spreads would allow us to investigate whether banks tend to relax their lending standards (i.e. fund riskier investments and charge higher spreads) in the event of a monetary policy loosening*." The results of the study show a negative significant association between different monetary policy measures and loan spreads. The authors conclude that the increase in spreads following loose monetary policy can be interpreted as an increase in the risk premium banks demand on risky investments, accordingly banks act instantaneously to increase their risk through their new loan deals. Differently from the study of Ioannidou et al. that presents evidence of association between the additional risk caused by the expansionist policies and the price of risk, Delis et al. present evidence of an increase in loans riskiness through a higher loans spread following an expansionist policy, however they do not discuss whether this spread is underpriced or not.

All in all these studies resume that lower level of rates are affecting the behaviour of banks in term of lending practices. When rates are low, banks grant more credit for borrowers' with bad or no credit history, which represent riskier profile, also banks do not seem to adequately price the additional risk. This is not the same for the outstanding loans which is quiet logic knowing that lower rates increase the borrowers' net worth (so decrease the risk) first by decreasing the amount of interest to be paid and second by increasing the value of collateral presented by the borrower.

4.2 Empirical studies based on lending surveys

Even if detailed loan level information permit to test more precisely the hypothesis of the risk taking channel, and permit to answer more precisely questions like "do low rates lead to more lending to riskier borrowers?" or "are default rates influenced by the stance of monetary policy?" the availability of such information is scarce. Another

category of study tests this issue using a more global method using country level data. Maddaloni and Peydro (2009) employ a measure of risk based on the answers from the euro area bank lending survey[6]. The net percentage of banks in each country that have tightened their lending standards in each quarter (Q4 2002 – Q1 2009) is used as proxy of risk. The latter, even if based on qualitative information, permits to address directly the research question and to evaluate the appetite and the tolerance of banks for risk. It is important to say that the problem of separating between the outstanding and the new loans does not arise in this case since the questions used in the survey concern only the lending standards for new loans. In Maddaloni et al.'s study (2009), the objective is to know whether banks change their lending standards, to whom these changes are directed and how standards are adjusted. They found that softening of lending standards is associated with low overnight rates (EONIA). Besides too low interest rates for too long induce more softening in the lending standards. Low overnight rate is found to have stronger impact on standards than longer maturity rates. Based on the answer of banks to the lending survey, the authors also found that banks in expansionary monetary conditions, soften their lending standards through lower loan margins, lower collateral and covenant requirements, longer loan maturity and larger loan size. Finally they found that high securitization[7] and weak banking supervision amplify the effect of the risk taking channel even more[8].

Another study based on lending surveys is performed by Nicolò, Dell'Ariccia, Laeven and Valencia (2010). The latter used a measure of ex-ante risk based on the answer from a quarterly survey on the terms of business lending of a stratified sample of about 400 banks in the U.S. Specifically, the average internal risk rating assigned to loans by the bank and the average relative spread between loan rates and the effective federal funds rate are used as ex-ante risk measures and are regressed on the real federal funds rate

[6] The survey is addressed to senior loan officers of a representative sample of euro area banks and is conducted four times a year. The sample group participating in the survey comprises around 90 banks from all euro area countries and takes into account the characteristics of their respective national banking structures.

[7] This country level variable is proxied by the ratio of the volume of all the deals involving asset-backed securities and mortgage-backed securities in each quarter, as reported by Dealogic, normalized by the outstanding volume of loans.

[8] In 2010 a new version of the article has been presented. The latter include the US data in addition to the initial European dataset. I was not aware of this notion when my article (Chapter 2 of the thesis) was accomplished. Specifically the study in chapter 2 did not aim to contest the results of the mentioned study. Although using different data period and different specifications, I obtain some contradictory results. The latter will be mentioned in chapter 2.

over the period 1997/2008. The authors found that following a decrease in the real interest rate both the average internal risk rating and the loans spread increase, indicating a higher investment in risky loans.

4.3 Empirical studies based on bank balance sheet data

A last category of studies uses bank balance sheet information to construct proxies of bank riskiness. Delis and Kouretas (2010) utilize the risk assets (bank assets except cash, government securities and balances due from other banks) and the non-performing loans ratio as proxy of the risk taking behaviour of European banks during the period 2001-2008. They found strong negative relationship between bank risk taking and interest rates. Specifically a decrease in the level of rates increases both the proportion of risky assets and the non-performing loans in banks balance sheet. A relation that is stronger for banks that engage in non-traditional banking activities (higher volume of off-balance sheet items) but weaker for banks with higher levels of capitalization.

Also Altunbas, Gambacorta and Marques-Ibanez (2009) and Gambacorta (2009) both employ the expected default frequency (EDF) of listed banks operating in the European Union and the United States as a measure of risk-taking, a measure qualified as a "forward-looking indicator"[9]. A main remark concerning this proxy is that the evolution of the expected default frequency of banks from 1998 till 2008 as presented in Altunbas et al. (2009) and Gambacorta's articles (2009), permit to notice that this "forward" looking indicator of credit risk visualize a decrease in the credit risk for all the period beginning from 2000 till mid 2007, it is only from late 2007 that this measure begin to increase. Altunbas et al. (2009), using quarterly balance sheet information for listed banks operating in the European Union and the United States during the period 1998-2008, regress the quarterly change of the EDF for each bank in each quarter on changes in the monetary policy indicator, the Taylor rule gap[10] and other control variables. They find that the impact of changes in the short-term rate on banks' risk is positive: lower interest rates reduce the credit risk of outstanding loans. Besides, they

[9] The EDF is a forward-looking indicator of credit risk computed by Moody's KMV, which builds on Merton's model to price corporate bond debt.
[10] The deviation of the policy rate from the Taylor rule rate.

found that too low interest rates and negative deviation from policy rule rate are inducing an increase in the bank risk taking. Using approximately the same dataset, Gambacorta (2009) present a complementary study. The latter test whether low interest rates over an extended period[11] cause an increase in banks' risk taking. Gambacorta (2009) regress the change in the EDF during the crisis period (Q2 2007–Q4 2008)[12] on the number of consecutive quarters with interest rate below a policy rule rate implied by a Taylor rule in the six years prior to the crisis (Q2 2001–Q2 2007). The author shows that low interest rates over an extended period cause an increase in banks' risk-taking.

De Nicolò, Dell'Ariccia, Laeven and Valencia (2010) investigate the relation between the real interest rates and bank risk-taking for the case of the U.S. commercial banks during the period 1997/2008. Using the total risk weighted assets as measure of risky assets, they found that decrease in the real federal funds rate increase the proportions of risky assets in the bank balance sheet. On the contrary, Delis, Hasan and Mylonidis (2012) using the same dataset over the period 1990/2008, found that the impact of a change in the real federal funds rate on bank risk (risk-weighted assets and Zscore) differs across specifications and lag dimensions: "*the first lag of the change in the federal funds rate indicates that softer monetary conditions actually decrease bank risk-taking, The positive impact, however, turns negative when further lags of the change in the federal funds rate are considered*." The authors conclude that low interest rates for short periods enhance the quality of existing loans portfolio however low interest rates for prolonged period of time implement degradation in the quality of loans.

[11] The number of consecutive quarters with interest rate below a policy rule rate implied by a Taylor rule in the six years prior to the crisis.

[12] During this period the expected default frequency was obviously increasing and did access its highest value in the fourth quarter 2008

Table 1.1 Selected Empirical Studies: Evidence From Loan Level Dataset

Authors	Country /Data frequency	Monetary policy measure	Risk measure proxy	Econometric methodology	Results
Ioannidou, Ongena and Peydrò (2009)	Bolivia (dollarized country) Monthly loan level data 1999/2003	Simultaneously: - US federal funds rate in the month prior to loan origination - US federal funds rate during the life of the loan until default or repayment	Loan level information and detailed information, on a monthly basis on all outstanding loans granted by any bank operating in the country - Loan default normalized per unit of period (hazard rate, the time to default of an individual loan as a measure of its risk) - Internal credit ratings of past borrower non performance: the probability of initiating new loans to borrowers with a subprime rating and credit history problems 1. A dummy Current NPLτ -1 that equals one if any of the borrower's outstanding loans in the month prior to the loan initiation is nonperforming, and equals zero otherwise, 2. A dummy Past Default τ -1 that equals one if in the month prior to the loan initiation the borrower has a prior loan default (i.e., if it has ever defaulted on a loan in the past) and equals zero otherwise 3. A dummy Subprime that equals one if the bank's own internal credit rating indicated that at the time of loan origination the borrower had financial weaknesses that rendered the loan repayment doubtful and, therefore, was subprime 4. Time to default equals the actual time to default or in case of repayment set equal to 96, in months	Duration models, Probit and OLS estimations.	- A decrease in the US federal funds rate prior to loan origination raises the hazard rate on the individual bank loans - A decrease in the federal funds rate over the life of the loan lowers the hazard rate. - Loans with a subprime credit rating or loans to riskier borrowers with current or past non-performance also becomes more likely when the federal funds rate is low, but banks do not seem to price this additional risk.

Authors	Country /Data frequency	Monetary policy measure	Risk measure proxy	Econometric methodology	Results
Jiménez, Ongena, Peydró and Saurina (2009)	Spain Quarterly loan level data 1984/2006	Alternatively - Quarterly averages of German and Euro overnight interest rates dated in the quarter prior to loan origination - Quarterly average of Spanish overnight interest rate - The change in the INTEREST RATE (robustness)	- A dummy RECENT BAD CREDIT HISTORY equals one if the borrower was overdue during the last six months on another loan and equals zero otherwise. - A dummy NO CREDIT HISTORY equals one if the borrower never received another recorded loan before and equals zero otherwise - Default =1 if there is default, i.e, if three months after the date of maturity or the date of an interest payment, the debt balance remains unpaid; =0 otherwise. - Time to default: The number of quarters to default	Probit models and Duration models	- Low interest rates imply that banks grant more loans to borrowers that had a recent bad credit history, i.e., a non-performance of a loan during the last six months. - Low interest rates also correspond to banks granting more loans to borrowers that have NO CREDIT HISTORY - lower short-term interest rate prior to loan origination implies that banks grant loans with a higher hazard rate - a lower short-term rate during the life of the loan implies a lower loan hazard rate
Delis, Hasan and Mylonidis (2012)	USA Syndicated loans from 1988q3-2010q2	- The measure of unanticipated monetary policy shocks, constructed using the methodology proposed by Romer and Romer (2004) - The change over the previous quarter of the real federal funds rate (federal funds rate minus the CPI inflation rate)	The pricing of newly issued syndicated loans measured by the loan spread charged, as an ex-ante proxy of distress risk. The loan spread charged is the amount the borrower pays in basis points over LIBOR for each dollar drawn down. It adds the spread of the loan with any annual (or facility) fee paid to the bank group. The variable is calculated for each syndicated loan.	OLS estimations	- Loan spreads increase with monetary policy expansion which can be interpreted as an increase in the risk premium banks demand on risky investments - Following a monetary expansion, banks act instantaneously to increase their risk through their new loan deals

Table 1.2 Selected Empirical Studies: evidence from lending surveys

Authors	Country /Data frequency	Monetary policy measure	Risk measure proxy	Econometric methodology	Results
Maddaloni and Peydro (2011)	- Euro-area data (2002q4-2009q2) - And U.S. data (1991q2 - 2008q3)	- Overnight rates (EONIA) - Taylor-rule residuals - Quarterly average of long-term (10-year) national government bond yield - Number of consecutive quarters in which the Taylor-rule residuals were negative since 1999:Q1 for the EU analysis and since 1991:Q1 for the U.S. analysis	- The net percentage of banks reporting a tightening of standards for loans to non-financial corporations over the previous quarter	GLS Panel regressions and OLS time series regressions	- Low short-term rates soften lending standards rather than low long term interest rates - The persistence of very accommodative monetary conditions contributes to the softening of lending standards - The impact of (current) low monetary policy rates on the softening of lending standards is amplified by too low for too long monetary policy rates - Higher securitization leads to softer lending standards for mortgages
Nicolò, Dell'Ariccia Laeven and Valencia (2010)	U.S. quarterly data over the period 1997/2008	The real federal funds rate	- The average internal risk rating assigned to loans by the bank (from the U.S. Terms of Business Lending Survey) - The average relative spread between loan rates and the effective federal funds rate (from the U.S. Terms of Business Lending Survey)	Simple OLS regressions (time series)	- Real interest rates are negatively associated with the two ex ante measures of bank risk taking - The negative effect of the policy rate on risk taking is less pronounced when bank capital is low

Table 1.3 Selected Empirical Studies: evidence from balance sheet dataset

Authors	Country /Data frequency	Monetary policy measure	Risk measure proxy	Econometric methodology	Results
Delis and Kouretas (2010)	16 Euro area countries. Annual data 2001-2008	- Annual average of the three months interbank rate - Annual average of 10 years government bond yield - Bank level rate (interest income to total customer loans)	- Risk assets to total assets (total assets except cash, government securities and balances due from other banks) - Non performing loans to total loans	Panel regressions using instrumental variables and GMM estimators	Negative relation between bank risk and interest rates
Delis, Hasan and Mylonidis (2012)	The USA Quarterly data 1985 Q1-2010 Q2 Robustness 2001Q3/2010Q2 And 2001q3-2005q4	- Lag 1, lag5, lag9 and lag13 of Δ federal funds, Δ federal funds rate is the change over the previous quarter of the real federal funds rate (federal funds rate minus the CPI inflation rate) - Lag 1, lag5, lag9 and lag13 of Monetary policy shock The measure of unanticipated monetary policy shocks, constructed using the methodology proposed by Romer and Romer (2004)	- The change over the previous year (four quarters) of the ratio of risky assets calculated as total assets minus cash and short-term securities) - The Z-index (roa+ea)/σ(roa), where roa is the ratio of the return on assets (i.e. profits before tax over total assets), ea is the ratio of total equity to total assets and σ(roa) is the variance of roa over 12 quarters - Spread over LIBOR: Describes the amount the borrower pays in basis points over LIBOR for each dollar drawn down. It adds the spread of the loan with any annual (or facility) fee paid to the bank group. The variable is calculated for each syndicated loan. Data are from Dealscan	Panel regressions using fixed effects and OLS estimator with robust standard estimator	Low policy rates decrease the riskiness of banks' overall loan portfolios in the short term (lag1 and lag5), and then significantly increase it in the medium term (lag9 and lag 13).
De Nicolò, Dell'Ariccia, Laeven and Valencia (2010)	Quarterly data over the period 1997–2008 of the U.S. bank holding companies	The real federal funds rate	- Risk-weighted assets to total assets (from call reports)	Least squares (OLS) regressions with fixed effects	Monetary policy easing will increase risk taking, but less so for poorly capitalized banks

Authors	Country /Data frequency	Monetary policy measure	Risk measure proxy	Econometric methodology	Results
Altunbas, Gambacorta and Marques Ibanez (2010)	Listed banks operating in the EU and the USA Quarterly data 1999 –2008	- Simultaneously the change in the short-term nominal federal rate (ΔMP) and the deviation from the Taylor rule rate - In addition, one lag of the previous variables has been introduced	- Quarterly changes in EDF (expected default frequency) an indicator of bank riskiness	Panel regressions using the GMM estimators	- The effects of changes in the short-term monetary policy rate on banks' risk are positive. The overall quality of a loan portfolio indeed increases (banks' EDFs decrease) if interest rates are lowered.
Gambacorta (2009)	600 listed banks in EU and USA The model relates the change in the riskiness of a given bank during the crisis period (Q2 2007–Q4 2008) to the macroeconomic conditions and bank-specific characteristics over the six years prior to the crisis (Q2 2001–Q2 2007)	- Number of consecutive quarters with interest rate below both the natural rate and the rate implied by a Taylor rule in the six years prior to the crisis	Variation of the expected default frequency (ΔEDF) during the crisis period (2007 Q2 –2008 Q4)	Cross section, OLS	- Positive and significant link between the number of consecutive quarters in which interest rates have been below the benchmark and changes in the EDF of individual banks

Chapter 2 U.S. Banks Lending Survey: a Qualitative Approach[13]

Abstract

Using data from "The Senior Loan Officer Opinion Survey" of sixty U.S. commercial banks during the period 1997 till 2011, this chapter investigates whether the level of interest rates influences banks' lending standards for business firms. Based on the answers of the senior loan officers concerning the easing or the tightening of lending policies, the results in this chapter show that low levels of both short and long term rates are associated with lower percentage of banks reporting a tightening in lending standards and higher percentage of banks reporting an easing in standards suggesting that banks lax lending practices during period of low rates. All the terms of loans are found to be eased when lower rates are applied. Finally, this chapter also shows that changes in lending standards due to low policy rates are more pronounced for banks with higher market-power and mitigated with better quality of supervision.

[13] This chapter draws the contribution of N. Ziadeh Mikati " The Risk Taking Channel of Monetary Policy: Lessons from the U.S. Bank Lending Standards ", *Economies et sociétés*, Série "Hors-Série", HS, n°45,5/2012, p.887-914

1. Introduction

In the search for explanation of the credit crisis, one remarkable argument is that interest rates were too low for too long, a factor suspected to have affected the appetite of bankers for risk. For instance, John Taylor (2008) argued that government's monetary policy actions, by deviating from historical precedents and principals for setting interest rates, caused prolonged and worsened the financial crisis. The argument seems to be that low levels of policy rates by affecting the asset prices and spurring the collaterals' value (so the borrowers' net worth), influence the behaviour of banks in term of lending practices and risk-taking and thus were a suspicious cause of the crisis. Based on the answers of the senior loan officer opinion survey on bank lending standards, this study investigates why do banks change their lending politics and whether these changes could be related to the stance of monetary policy.

A first intuitive question is to know what monetary policy could have to do with bank riskiness and financial stability. According to the pre-crisis consensus, financial stability is not a matter of monetary policy, the first target of monetary policy being price stability. Monetary policy could also pursue other targets such as economic growth and employment. However, after the financial crises, the risk-taking channel has been introduced as the channel through which monetary policy impacts the appetite of financial institutions for risk. This channel may operate via several mechanisms: the effect of low rates on asset prices and valuations, the search for yield effect (Rajan 2005) and the effect of low interest rates on bank leverage and cost of funding.

John Taylor (2008) is one of the first to shed the light on the probable connection between monetary policy, particularly the extremely low level of interest rates, and the financial crisis. Accoding to his study, boom and bust in real asset prices could have been avoided had the federal fund rate been higher. Previous works have rather insisted about the effect of economic cycles on bank risk than insisting on monetary policy's effects. For example, Salas and Saurina (2002) model non-performing loans ratio as a function of both macro and micro variables, they found that lagged credit growth has a positive and significant impact on ex-post credit risk measures. Asea and Blomberg (1998) found with bank level variables that the probability of collateralization increases (tighter lending practices) during contractions and decreases (more lax lending practices) during expansions in the United States.

A growing body of empirical evidence support the risk-taking channel. The objective of this study is to investigate the link between monetary policy and bank risk-taking specifically the bank lending practices in the United States. Using quarterly data from the senior loan officer opinion survey on bank lending standards, I analyse whether the level of policy rates could have affected the standards of lending for 60 large commercial domestic U.S. banks during 1997 till 2011.

Furthermore, there have been debates concerning which maturity rate is responsible for the assets' price fluctuation. Several critics have been addressed to the argument that monetary policy could have had a relationship with the financial crisis. Specifically the argument is that asset prices and real estate prices are influenced by long term rates. Alan Greenspan (2010) argued that "*no one employs overnight rates such as the federal funds rate to determine the capitalization rate of real estate*"[14], he also argued that due to high correlation between long and short rates "*regressions with home prices as the dependent variable would have seemingly worked equally as well with either long term rates or overnight rates as explanatory variable*". In this study I also investigate the association between longer maturity rates and lending standards.

Moreover since the argument of the deviation of the federal rates from historical precedents[15] was widely used as a proof of loosening monetary policy, I evaluate whether the deviation of the overnight federal fund rate from the Taylor policy rule rate could have influenced the banks' risk aversion. And finally I address the "too low for too long" hypothesis and investigate the association between the length of the period during which monetary policy is loose and lending practices.

For the remaining part I proceed as follow: in section 2, I present the senior loan officer opinion survey and the dataset used, I turn in section 3 to the relation between lending standards and different measures of interest rates, in section 4 I present how banks change lending terms, section 5 investigates the role of market power and supervision and finally I conclude in section 6.

[14] Greenspan A. (2010), The crisis
[15] Taylor J. (2008)

2. The Senior Loan Officer Opinion Survey Dataset

This study investigates the risk-taking channel of monetary policy for the U.S commercial banks during the period Q1 1997 till Q1 2011 using the senior loan officer opinion survey on bank lending standards[16]. Given that the comments of loosening monetary policy were specifically addressed to the U.S. federal reserve system, the choice of U.S. banks permit to test the hypothesis for banks that perform in this specific environment, in other words they are directly concerned with the research question. Initiated by the Federal Reserve, this survey is conducted quarterly since 1964. The reporting panel consists of up to 60 large domestically chartered commercial banks[17]. The sample of banks are representative of the U.S. commercial banks since the assets of the panel banks account for about 67% of the total assets at domestically chartered institutions[18]. The survey consists of 20 questions designed to measure changes in credit standards and terms on bank loans for enterprises and household. In addition, the survey asks banks about the perceived changes in the demand for bank credit. For purpose of this study, I only use the questions related to the changes in lending standards and the changes in lending terms. Concerning the changes in lending standards, banks are specifically asked about how they have changed their lending standards for a specific type of loans during the last three months[19]. The bank chooses one of five answers: tightened considerably, tightened somewhat, unchanged, eased somewhat and eased considerably. The quarterly reports show, for each question, the number of banks that have chosen each one of these five multiple choices.

Based on these answers I construct three proxies reflecting the changes in lending policies: the net percentage of banks tightening lending standards during each quarter calculated as the difference between the percentage of banks tightening somewhat or considerably their lending standards and those easing somewhat or considerably their standards during the past three months. The higher this measure is the more vigilant the

[16] Quarterly reports are available on the federal reserve website: http://www.federalreserve.gov/boarddocs/snloansurvey/

[17] To ensure adequate geographic coverage, the survey panel of domestic banks spans all Federal Reserve Districts, while balancing the need to keep it heavily weighted toward very large banks.

[18] According to the federal reserve: "Supporting Statement for the Senior Loan Officer Opinion Survey on Bank Lending Practices (FR 2018; OMB No. 7100-0058)"

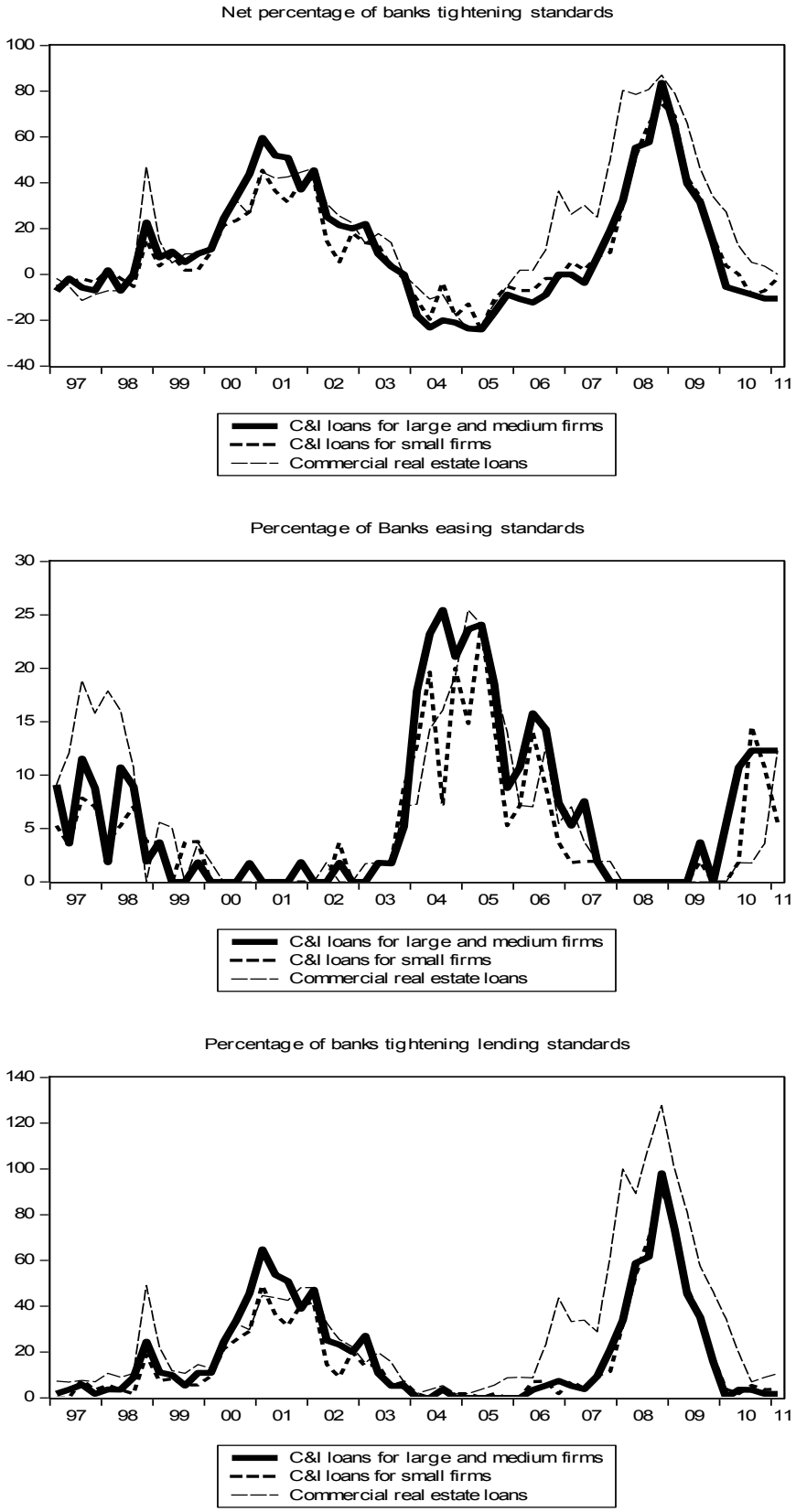
[19] As a result the report of January asks about standards during October, November and December. For this reason I merge the data collected from each report with the data of the previous quarter for the explanatory variables.

banking system is, in term of lending practices. Furthermore, two other proxies are used to reflect lending practices: the percentage of banks tightening standards constructed as the sum of the percentage of banks answering "tightened somewhat" and "tightened considerably" with a weighting 2 for the latter[20] and the percentage of banks easing lending standards calculated as the sum of the percentage of banks answering "eased somewhat" and "eased considerably" with a weighting 2 for the latter.

Figure 1 outlines the net percentage of banks tightening standards for each one of the three types of commercial loans: commercial and industrial loans for large and medium firms, commercial and industrial loans for small firms and commercial real estate loans. According to this graph, the net percentage of banks tightening standards began to decrease since the first quarter 2001 for the three types of loans. Also figure 1 shows that the net percentage of banks tightening standards have turned to be negative on the third quarter of 2003 indicating that the number of banks easing lending standards has exceeded the number of those tightening standards. This situation has persisted till the year 2006 for the standards of the commercial real estate loans and till the second quarter 2007 for the C&I loans. For more details I present in chart 2 and 3 (figure 1) the evolution of the percentage of banks that have eased their lending standards and those which have tightened their lending standards. The evolution of these two variables also shows that the percentage of banks tightening standards began to decrease since the first quarter 2001 while the percentage of banks easing lending standards began to increase. All in all the evolution of the three proxies of risk (figure 1) presume that banks before the crisis were adopting relatively more lax lending practices.

[20] I multiply by two the percentage of banks answering "tightened considerably" to give them a stronger weight than those who answer "tightened somewhat"

Figure 1: The Evolution of Banks' Lending Standards



3. Interest Rates and Lending Standards

I turn now to look at the relation between interest rates and bank lending standards. I test the relationship between monetary policy and bank risk by investigating three points: first I am concerned whether the level of overnight policy rates during the period 1997-2011 could have affected the bank lending policies during the same period, second I test the effect of long term rates and finally I check whether a divergence from a policy rule rate could have pushed banks to lax their lending practices. In order to test these hypotheses I run OLS time series regressions using quarterly data over the period 1997 Q1 - 2011 Q1:

$$LS_t = \alpha_1 + \alpha_2 IR_t + \alpha_3 Controls_t + \varepsilon_t$$

LS represents the changes in lending standards, it is proxied respectively by the net percentage of banks tightening standards, the percentage of banks easing standards and the percentage of banks tightening standards for each type of loans. *IR* is the interest rate variable. Since I am dealing with U.S. banks I employ the quarterly average of the overnight federal fund rate as proxy of the short-term policy rate. Second, I test the impact of longer maturity rates on lending practices using the ten years government bond yield. I also test the argument given by Taylor (2008) that a deviation of policy rate from a rule policy rate are inducing risky behaviour from banks, I use for this purpose the difference between the policy rate and the policy rule rate as implied by Taylor (1993). Finally I investigate the "too low for too long" hypothesis and investigate the association between the number of quarters during which real rates are negative and lending practices.

I control for the GDP growth, the inflation rate and the house price index. The level of the GDP growth potentially affects the riskiness of a bank as same as the respond of central banks. In fact during recessions, economic agents are more exposed to liquidity shortage and banks are more rigorous in term of credit granting. Also during such periods, central banks could lower rates to combat recession and promote employment. As a result during recession which potentially is accompanied with lower rates banks could be riskier not because of a choice the bank made but rather due to a change in the condition of the borrowers' net worth. In this study, I control for the improvement in the borrower's net worth using the GDP growth, I expect a negative relation between

this variable and the tightening of bank lending standards. Also the house price index is another variable that could influence the bank's lending practices. During the boom period, this is when house prices are at a high level, and when collateral are more valuable, one can argue that banks are more willing to grant new credit and more lenient with their lending standards. I control for the improvement in collateral value using the house price index. Finally I control for the inflation level using the consumer price index. Data on the federal fund rate, the ten years government bond yield, the inflation rate and the GDP growth are obtained from the Federal Reserve website and the OCDE database. The house price index is obtained from the federal housing finance agency (quarterly HPI Reports). Table 1 and 2 review the definition and the descriptive statistics of the different variables used in the study.

3.1 Lending Standards and Federal Fund Rates

I first test for the relation between lending practices and short-term policy rates using the quarterly average of the overnight federal fund rate[21]. The evolution of these two variables as outlined in figure 2 permit to notice a positive association. For more explanation, it could be noticed that a decrease in the federal rate is followed by a decrease in the net percentage of banks tightening lending standards. Figure 2 shows that the increase in the level of the federal rate during Q2 1999 till Q3 2000 has been followed by an evolution in the same direction of the net percentage of banks tightening lending standards. The same could be said for the period of expansionary monetary policy that have persist from the fourth quarter 2000 till the third quarter 2004, this period have also been followed by a lower percentage of banks tightening lending standards.

Table 3 reports the results obtained by regressing each one of the lending standards variables on the explanatory variables, particularly the federal fund rate. The previous remark of a positive relation between interest rates and bank risk aversion is proved. Specifically, the results show a positive significant relation between the net percentage

[21] Alternatively I use the real federal fund rate calculated as the difference between the overnight federal fund rate and the CPI inflation, the results are quite similar and are available upon request.

Table 1: Definition of Variables

Variables	Description	Period	Data Source
Net Percentage of Banks Tightening Lending Standards	The difference between the percentage of banks that have "tightened considerably" or "tightened somewhat" their lending standards and those which have "eased somewhat" or "eased considerably" their lending standards	Q1-1997 to Q1-2011	Quarterly reports of the Senior Loan Officer Opinion Survey on Bank Lending Practices Authors' calculation
The Percentage of Banks Tightening Lending Standards	The sum of the percentage of banks tightening standards considerably and those tightening standards somewhat (a weighting of 2 is given to the percentage of banks tightening standards considerably)	Q1-1997 to Q1-2011	Quarterly reports of the Senior Loan Officer Opinion Survey on Bank Lending Practices Authors' calculation
The Percentage of Banks Softening Lending Standards	The sum of the percentage of banks softening standards considerably and those softening standards somewhat (a weighting of 2 is given to the number of banks softening standards considerably)	Q1-1997 to Q1-2011	Quarterly reports of the Senior Loan Officer Opinion Survey on Bank Lending Practices Authors' calculation
The Change In The Term of Loans	Banks assign a number between 1 and 5 using the following scale: 1=tightened considerably, 2=tightened somewhat, 3=remained basically unchanged, 4=eased somewhat, 5=eased considerably The change in term of loans is the average of these answers for each quarter	Q1-1997 to Q1-2011	Quarterly reports of the Senior Loan Officer Opinion Survey on Bank Lending Practices Authors' calculation
Federal Fund Rate	Quarterly average of the Overnight Federal fund rate	Q4-1996 to Q4-2010	Federal Reserve Website
Longrate	Quarterly average of the ten years government bond yield	Q4-1996 to Q4-2010	Federal Reserve Website
Taylor residuals	Residual of time series regression of the federal rate on GDP growth and inflation	Q4-1996 to Q4-2010	Authors' calculation
Taylor Gap	The difference between the federal rate and the one implied by Taylor rule	Q4-1996 to Q4-2010	Authors' calculation
GDP Growth	Growth rate of the Gross Domestic Product compared to the same quarter of previous year	Q4-1996 to Q4-2010	OCDE Database
Inflation	Quarterly growth of the consumer price index on the same period of the previous year	Q4-1996 to Q4-2010	OCDE Database
HPI	House price appreciation from the same quarter one year earlier (%)	Q4-1996 to Q4-2010	Federal Housing Finance Agency -Quarterly HPI reports

Table 2: Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std, Dev,	Observations
LS_1	11,54	5,36	83,64	-24,07	25,76	57
LS_2	10,97	3,70	74,55	-24,07	22,25	57
LS_3	20,26	13,79	87,04	-23,64	28,01	57
LS_eased_1	6,28	1,89	25,45	0,00	7,49	57
LS_eased_2	4,65	1,92	24,07	0,00	5,87	57
LS_eased_3	5,89	1,92	25,45	0,00	7,15	57
$LS\_tightened_1$	18,78	8,93	98,18	0,00	22,60	57
$LS\_tightened_2$	16,47	7,14	90,91	0,00	20,62	57
$LS\_tightened_3$	29,75	19,64	127,78	1,75	29,67	57
Federal rate	3,29	3,50	6,52	0,12	2,13	57
Long rate	4,67	4,63	6,69	2,73	1	57
Taylor Gap	-1,01	-1,23	5,38	-5.51	2,09	57
Inflation	2,40	2,36	5,30	-1,62	1,22	57
HPI	3,81	5,92	9,60	-8,36	4,98	57
GDP Growth	2,51	2,92	5,38	-4,11	2,11	57

LS_1 The **net** percentage of banks **tightening standards** for approving applications for **Commercial and industrial loans** (Standards for **large and medium** firms)

LS_2 The **net** percentage of banks **tightening standards** for approving applications for **Commercial and industrial loans** (Standards for **small** firms)

LS_3 the **net** percentage of banks **tightening standards** for approving applications for **Commercial real estate loans**

LS_eased_1 the **percentage** of banks **easing** standards considerably and those easing their standards somewhat (a weighting of 2 is given to the percentage of banks easing standards considerably), this variable concern the **C&I** loans for **large and medium firms**

LS_eased_2 same as LS_eased_1 this variable concern the **C&I loans for small firms**

LS_eased_3 same as LS_eased_1 this variable concern the Commercial real estate loans

$LS\_tightened_1$ the **percentage** of banks **tightening** standards considerably and those **tightening** their standards somewhat (a weighting of 2 is given to the number of banks easing standards considerably), this variable concern the **C&I** loans for **large and medium firms**

$LS\_tightened_2$ Same as $LS\_tightened_1$, this variable concern the **C&I loans for small firms**

$LS\_tightened_3$ Same as $LS\_tightened_1$, this variable concern the **Commercial real estate loans**

Figure 2: The Evolution of the Net Percentage of Banks Tightening Standards (left axis) and the Federal Fund Rate (right axis)

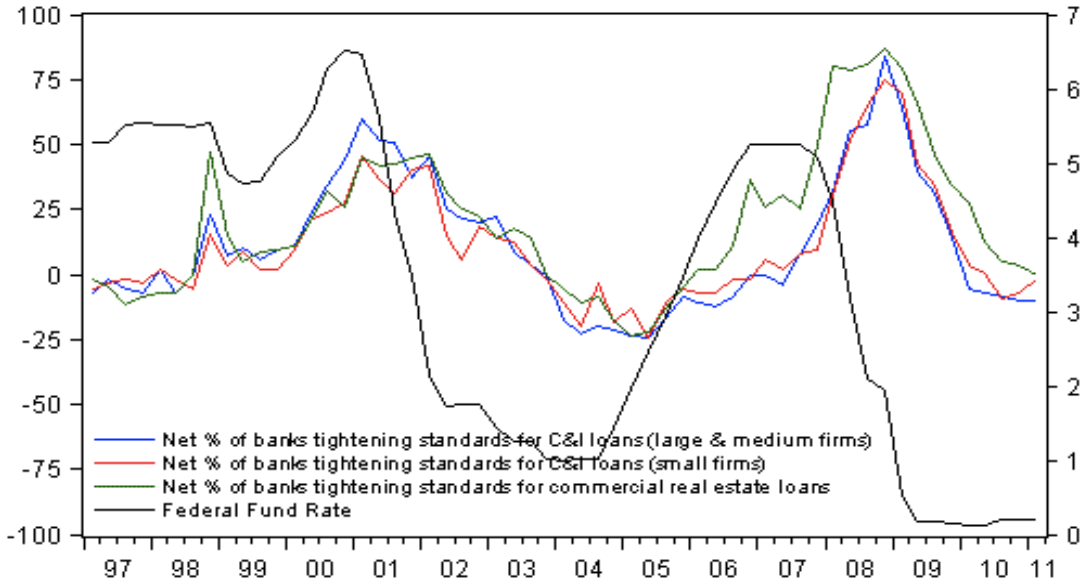


Table 3 The overnight federal funds rate and bank lending standards (Q1 1997: Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	4.259905	7.496714	18.415737	6.544343	4.854714	3.971423	11.402953	12.750122	26.056212
	[0.7204]	[1.6345]	[3.5745]***	[3.3751]***	[3.1998]***	[1.9650]*	[2.2730]**	[3.0622]***	[5.6429]***
Federal rate (t)	5.309638	3.508903	4.863136	-2.209699	-1.596638	-0.885454	3.151499	1.928984	3.931554
	[3.5876]***	[3.0565]***	[3.7713]***	[-4.5531]***	[-4.2046]***	[-1.7504]*	[2.5099]**	[1.8510]*	[3.4018]***
GDP growth (t)	-8.382904	-7.291326	-9.420762	1.685039	1.345185	1.555355	-7.230194	-6.345397	-9.208854
	[-5.0178]***	[-5.6267]***	[-6.4722]***	[3.0759]***	[3.1382]***	[2.7239]***	[-5.1012]***	[-5.3941]***	[-7.0589]***
Inflation (t)	6.508563	6.624430	7.505340	0.611824	0.197779	-0.055266	8.126999	7.818984	10.473037
	[2.7991]***	[3.6729]***	[3.7047]***	[0.8024]	[0.3315]	[-0.0695]	[4.1198]***	[4.7756]***	[5.7680]***
HPI (t)	-1.250070	-1.487668	-2.237897	0.341180	0.312091	0.277504	-1.142993	-1.437730	-2.960337
	[-2.0101]**	[-3.0840]***	[-4.1301]***	[1.6730]	[1.9559]*	[1.3056]	[-2.1663]**	[-3.2832]***	[-6.0958]***
Observations:	57	57	57	57	57	57	57	57	57
R-squared:	0.5027	0.5987	0.6806	0.3681	0.3690	0.2462	0.5348	0.6151	0.7713
F-statistic:	13.1392	19.3960	27.7013	7.5745	7.6027	4.2467	14.9464	20.7710	43.8444

Table 3 shows the result of an ordinary least square time series regression. The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (the difference between the % of banks that reported a tightening in their standards and those who reported an easing) in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the percentage of banks answering "eased somewhat" and "eased considerably" with a weighting 2 for the latter), in the last three regressions the dependent variable is the percentage of banks reporting a tightening in their lending standards (the percentage of banks answering "tightened somewhat" and "tightened considerably" with a weighting 2 for the latter). T statistics are in brackets. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

of banks tightening lending standards and the federal fund rate[22]. This result is robust for the three types of commercial loans. When using the second proxy of risk: the percentage of banks easing standards as dependent variable, I also find a negative significant relation with the federal fund rate. This implies that lower rates increase the number of banks reporting an easing in lending standards, a result that also holds for the three types of loans. Finally, the percentage of banks tightening standards is positively affected by the level of federal funds rate: lower level of federal rate imply lower number of banks answering "tightened somewhat" or "tightened considerably". In addition it could be noted that the responsiveness of tightening standards to a change in interest rate is more important than the responsiveness of easing standards for the three types of loans. For example a decrease in 1% in the federal rate increases the percentage of banks reporting an easing in lending standards by 2.2% compared to a 3.5% decrease in the percentage of banks reporting a tightening in their lending standards. This is due to the fact that the number of banks characterizing their changes in lending practices by "tightened somewhat" or "tightened considerably" is relatively higher than the number of those characterizing their changes by "eased somewhat" or "eased considerably". On the other hand table 3 shows that a change in the federal fund rate is associated with a change in lending practices for all the types of loans. Although it could be remarked that the responsiveness of banks through easing standards due to the level of federal rate is more striking for C&I loans compared to commercial real estate loans. Similarly, the responsiveness of banks through tightening standards due to a change in federal fund rate is more striking for commercial real estate loans compared to C&I loans.

Turning to the control variables the results show that higher level of GDP growth implies more lax lending policies. For example, an increase in 1% in the GDP growth push 1.68% of banks to ease their standards and decrease the percentage of banks reporting tightening in lending standards by 7.23% for C&I loans for large and medium firms. An increase in price inflation is found to have a positive effect only on the tightening in lending standards, but have no significant effect on the number of banks reporting an easing in their standards. House price index is also found to be significant

[22] These results are similar to those presented by Maddaloni and Peydro (2010), even that in their specification they introduce at the same time the long and the short rate and they do not control for the appreciation of the collateral value.

for the tightening decision: an increase of 1% in house prices decreases by 1.14% the percentage of banks reporting a tightening in lending standards for C&I loans for large and medium firms (respectively 1.43% for C&I loans for small firms and 2.9% for commercial real estate loans) but will have no effect on those who reported an easing in their standards. Finally it is good to notice that the effect of house price is more prominent for commercial real estate loans than for the C&I loans (-2.9% to compare with -1.14% and -1.43% table 3)[23]

3.2 Lending Standards and Long Term Rates

I turn now to test whether longer maturity rates are associated to bank lending practices. Results reported in table 4, show that a decrease in the level of the ten years government bond yield are significantly associated with lower tightening and higher easing in lending practices. These results are statistically and economically significant for the three proxies of bank risk taking and for the three types of loans. Furthermore the impact of longer maturity rate is found to be more relevant in comparison with the impact of the short term federal fund rate: the impact of an increase of 1% in the long rate is double the impact of an increase of 1% in the federal fund rate for C&I loans for large, medium and small firms. For more explanation an increase of 1% in the long rate is associated with an increase of 12.19% in the net percentage of banks tightening standards for C&I loans compared to 5.3% for a 1% change in the federal rate, also it is associated with a decrease of 4.5% of banks easing standards compared to 2.2% for a 1% change in federal rate. This same reasoning is applied for the banks' standards toward commercial real estate loans[24]. For the rest of the control variables, I find the same association as previous regressions: higher level of GDP growth are significantly associated with higher percentage of banks easing standards, and significantly lower percentage of banks tightening standards for all types of loans. In addition higher levels

[23] I also introduce the retardation of the federal rate in the main equation and test the relation between lending standards and the federal fund rate of previous quarters. The results of such specification show that the federal fund rates of previous quarters has a same impact on the lending practices, also this impact is found to be even stronger for previous level of federal funds rate. Results for these specifications are available upon request.

[24] These results are contradictory to those presented in the study of Maddaloni and Peydro. They found that lower long rates significantly lead to tighter lending policies. These disparities may be due to differences in the choice of the sample period and regression specifications. In their specification, they regress the lending standards on both the long and the short rate. Given the high correlation between long and short rate (75%) I introduce each one of these variables separately.

Table 4 The long-term rate (ten years government bond yield) and bank lending standards (Q1 1997: Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	-36.852745 [-2.6806]***	-20.924119 [-1.9731]*	-3.659683 [-0.2818]	21.544573 [4.6038]***	16.248719 [4.5120]***	8.795521 [1.8328]*	-15.689454 [-1.3570]	-5.471498 [-0.5700]	8.034820 [0.6996]
longrate(t)	12.190185 [3.7504]***	8.380180 [3.3424]***	7.128132 [2.3219]**	-4.526558 [-4.0912]***	-3.414630 [-4.0105]***	-1.506365 [-1.3277]	7.932482 [2.9018]***	5.279976 [2.3266]**	5.807944 [2.1390]**
GDP growth (t)	-8.983606 [-5.2350]***	-7.769750 [-5.8697]***	-8.956861 [-5.5261]***	1.797725 [3.0776]***	1.462761 [3.2541]***	1.523269 [2.5429]**	-7.761845 [-5.3781]***	-6.777479 [-5.6565]***	-8.845192 [-6.1702]***
Inflation (t)	8.267747 [3.7094]***	7.776691 [4.5233]***	9.244891 [4.3915]***	-0.137663 [-0.1814]	-0.339196 [-0.5810]	-0.365367 [-0.4696]	9.148996 [4.8807]***	8.431037 [5.4177]***	11.877921 [6.3794]***
HPI (t)	-1.554767 [-2.4948]**	-1.698372 [-3.5331]***	-2.400629 [-4.0785]***	0.452232 [2.1319]**	0.396481 [2.4288]**	0.313143 [1.4395]	-1.343933 [-2.5642]**	-1.572960 [-3.6150]***	-3.093200 [-5.9417]***
Observations:	57	57	57	57	57	57	57	57	57
R-squared:	0.5117	0.6103	0.6314	0.3314	0.3542	0.2280	0.5512	0.6284	0.7430
F-statistic:	13.6207	20.3622	22.2732	6.4449	7.1314	3.8391	15.9632	21.9816	37.5881

Table 4 shows the result of an ordinary least square time series regression. The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (this is the difference between the % of banks that reported a tightening in their standards and those who reported an easing in their standards), in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the sum of the % banks answering eased somewhat and eased considerably with a weighting 2 for the latter), in the last three regression the dependent variable is the percentage of banks reporting a tightening in their lending standards(the sum of the banks answering tightened somewhat and tightened considerably with a weighting 2 for the latter). The T statistics are in brackets *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

of inflation are significantly associated with higher percentage of banks tightening standards, but have no effect on those easing their standards. Finally the effect of lower house price index is more significant statistically and economically on the percentage of banks tightening standards than on those easing standards.

3.3 Lending Standards and The Deviation From a Policy Rule Rate

In this section I test whether the deviation of the policy rate from a benchmark could be a factor that influences banks' lending standards. For judging the position of the monetary policy, I employ the Taylor rule policy rate as benchmark rule rate[25], I than calculate the deviation of the federal rate from the Taylor policy rate[26]. A negative gap implies an expansive monetary policy (this is when the policy rate proxied by the federal rate is lower than the Taylor rule rate). If a negative divergence from a policy rule increases bank risk taking, I expect a positive relation between the gap and the banks' risk aversion. In table 5a I regress the different proxies of risk on the Taylor gap[27] and the control variables. However I do not include the consumer price index because the latter is highly correlated with the Taylor gap (81%).

In contrast to what is expected, results shown in table 5a suggest that a negative deviation of the federal rate from the policy rule rate is pushing banks for more vigilance: a decrease in the Taylor gap is associated with an increase in the percentage of banks reporting tighter lending standards for the three types of loans. However I do not found any significant association between the deviation from the Taylor rule rate and the percentage of banks easing standards. These results disagree with the hypothesis that interest rates below the prescription of the Taylor rule, are associated with larger imbalances and more risk taking. On the contrary they suggest that negative deviations from the explicit Taylor rule rates are pushing banks for more vigilance.

[25] Taylor rule is a function of an equilibrium real interest rate (2%), the actual inflation rate, the average output gap and the gap between actual inflation and the implicit inflation target (2%): $i_t = \pi_t + r_t^* + 0.5(\pi_t - \pi_t^*) + 0.5(y_t - \bar{y}_t)$

[26] Taylor rule gap calculated as the difference between the federal rate and the Taylor rule rate

[27] Maddaloni and Peydro (2010) employ the Taylor-rule residual calculated as the residuals of the regression of the federal funds rates on GDP growth and inflation.

Table 5a The Taylor rule Gap and bank lending standards (Q1 1997: Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	25.135699 [5.4408]***	25.164882 [7.1674]***	40.233213 [9.5560]***	3.399005 [2.2799]**	2.149686 [1.8688]*	2.228993 [1.6260]	30.917817 [8.2641]***	29.412379 [9.8745]***	51.095673 [13.1704]***
Taylor gap (t)	-3.271625 [-2.1270]**	-3.531334 [-3.0209]***	-3.468714 [-2.4746]**	-0.567211 [-1.1428]	-0.354986 [-0.9269]	0.016080 [0.0352]	-4.393905 [-3.5276]***	-4.450277 [-4.4876]***	-5.193460 [-4.0208]***
GDP growth (t)	-4.488457 [-2.6041]**	-4.365852 [-3.3329]***	-5.590718 [-3.5592]***	0.569012 [1.0230]	0.495838 [1.1554]	1.067085 [2.0864]**	-4.268907 [-3.0584]***	-4.107714 [-3.6964]***	-5.431521 [-3.7525]***
HPI (t)	-1.481075 [-1.9391]*	-1.787441 [-3.0792]***	-2.482529 [-3.5664]***	0.231234 [0.9381]	0.234944 [1.2354]	0.262272 [1.1572]	-1.541088 [-2.4915]**	-1.873985 [-3.8054]***	-3.406433 [-5.3108]***
Observations:	57	57	57	57	57	57	57	57	57
R-squared:	0.2976	0.4560	0.5065	0.1358	0.1608	0.1976	0.4014	0.5442	0.6265
F-statistic:	7.4855	14.8059	18.1308	2.7753	3.3847	4.3517	11.8482	21.0940	29.6313

Table 5a shows the result of an ordinary least square time series regression. The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (this is the difference between the % of banks that reported a tightening in their standards and those who reported an easing in their standards) , in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the sum of the % banks answering eased somewhat and eased considerably with a weighting 2 for the latter), in the last three regression the dependent variable is the percentage of banks reporting a tightening in their lending standards (the sum of the banks answering tightened somewhat and tightened considerably with a weighting 2 for the latter). The T statistics are in brackets *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

I investigate further this issue using another tool. Specifically Maddaloni and Peydro (2010) employ the Taylor-rule residuals calculated as the residuals from the regression of the federal funds rates on GDP growth and inflation. This regression reflects an implicit policy rule and analyses the average reaction of central banks during a specific period towards the evolution of inflation and output. As a result the residuals will include information about whether monetary policy is being expansionary (negative residuals) or restrictive during each quarter relatively to the whole period. Maddaloni and Peydro found that lower residuals are associated with less tightening of lending practices. I rerun the regressions using the Taylor-rule residuals. Results in table 5b show a similar assumption: lower Taylor-rule residuals lead to less tightening and more easing in lending standards. As a result, Taylor residuals and Taylor gap are not equivalent. When I plot the evolution of both variables (Figure 3), some contradictions could be noticed: during the period 1999Q1: 2001Q4 federal rates and Taylor residuals were relatively high, although comparing to the Taylor rule they were too low (negative Taylor gap), the same thing for the year 2009, interest rates were at a low level while they were too high compared to the Taylor rule (positive Taylor gap). To conclude on this point, it is rather the low level of policy rates and their negative deviation from the implicit policy rule (negative residuals) that will induce lax lending practices, and not the deviation of interest rates below the prescription of the explicit Taylor rule.

3.4 Lending Standards and the "too low for too long hypothesis"

Many commentators insisted on the fact that monetary conditions were accommodative for too long. I investigate the impact of the persistence of loose monetary policy on bank lending standards by employing the number of quarters in the previous 12 quarters during which the level of real interest rate is negative. Results are presented in table 5c, and provide additional evidence that low interest rates applied for a long period of time are also associated with higher percentage of banks easing lending standards and lower percentage of banks tightening standards.

Table 5b The Taylor rule residuals and bank lending standards (Q1 1997: Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	10.209537	11.429125	23.864718	4.068928	3.066096	2.979145	14.934999	14.912586	30.461332
	[1.9403]*	[2.7872]***	[5.1933]***	[2.3244]**	[2.2137]**	[1.5672]	[3.2630]***	[3.8775]***	[7.2767]***
Taylor Residuals (t)	6.35957	4.424673	5.695452	-2.399895	-1.728413	-1.097986	4.042677	2.691474	4.583538
	[4.8491]***	[4.3292]***	[4.9726]***	[-5.5005]***	[-5.0068]***	[-2.3174]**	[3.5437]***	[2.8078]***	[4.3930]***
GDP growth (t)	-6.034461	-5.74329	-7.267507	0.703307	0.635726	1.164386	-5.841056	-5.498985	-7.467705
	[-4.2737]***	[-5.2194]***	[-5.8936]***	[1.4972]	[1.7105]*	[2.2826]**	[-4.7557]***	[-5.3283]***	[-6.6478]***
Inflation (t)	8.628007	8.024128	9.447107	-0.271274	-0.440336	-0.408552	9.383836	8.587348	12.042928
	[4.1430]***	[4.9442]***	[5.1943]***	[-0.3916]	[-0.8033]	[-0.5430]	[5.1801]***	[5.6417]***	[7.2688]***
HPI (t)	-1.116043	-1.396045	-2.116919	0.288794	0.274317	0.254639	-1.059759	-1.383801	-2.86282
	[-1.9357]*	[-3.1070]***	[-4.2042]***	[1.5056]	[1.8075]*	[1.2225]	[-2.1131]**	[-3.2837]***	[-6.2413]***
Observations:	57	57	57	57	57	57	57	57	57
R-squared:	0.5728	0.652	0.7243	0.4413	0.4295	0.2765	0.5799	0.6437	0.7961
F-statistic:	17.4278	24.36	34.1572	10.2688	9.7877	4.9691	17.9463	23.487	50.7529

Table 5b shows the result of an ordinary least square time series regression. The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (this is the difference between the % of banks that reported a tightening in their standards and those who reported an easing in their standards) , in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the sum of the % banks answering eased somewhat and eased considerably with a weighting 2 for the latter), in the last three regression the dependent variable is the percentage of banks reporting a tightening in their lending standards (the sum of the banks answering tightened somewhat and tightened considerably with a weighting 2 for the latter). The T statistics are in brackets *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

Figure 3: Federal Rate, Taylor Gap and Taylor residuals

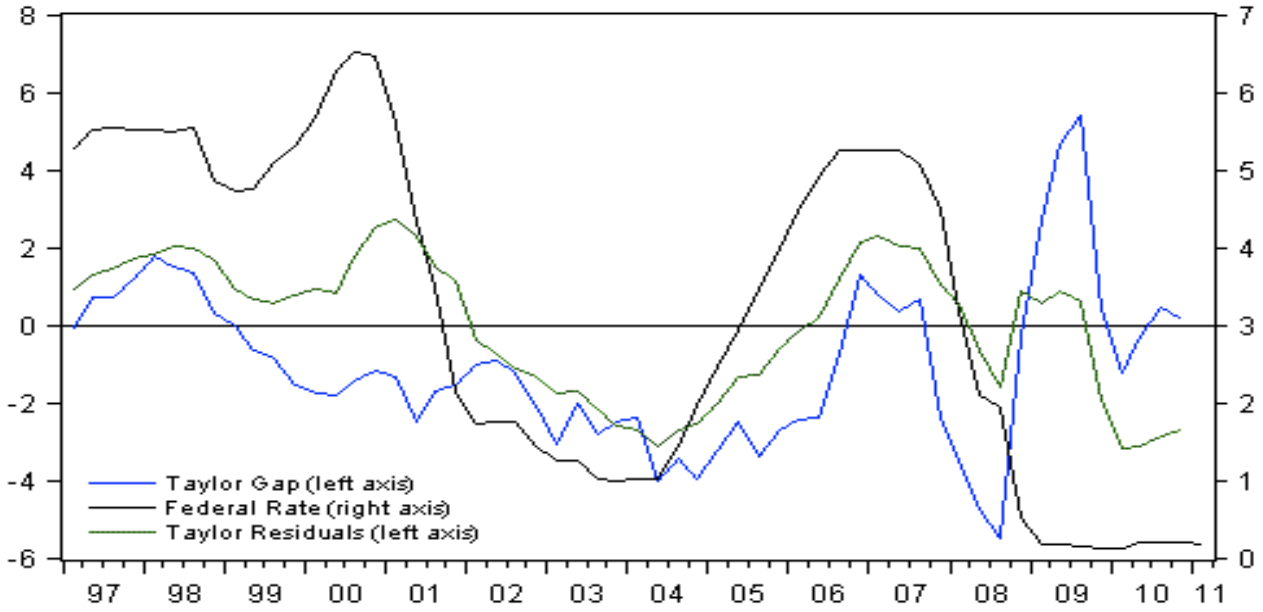


Table 5c Too low for too long interest rates and bank lending standards (Q1 1997: Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	23.582621	21.148214	33.015684	-0.233103	0.077408	0.180962	24.534666	22.047914	37.656123
	[6.3221]***	[6.9752]***	[7.3163]***	[-0.1568]	[0.0606]	[0.1026]	[6.7734]***	[6.8883]***	[8.8894]***
QUARTER_NEGATIVE	-4.658915	-3.385761	-3.189204	1.499055	1.041471	0.974625	-3.343869	-2.485184	-2.507551
	[-10.8111]***	[-9.6661]***	[-6.1174]***	[8.7287]***	[7.0556]***	[4.7821]***	[-7.9908]***	[-6.7208]***	[-5.1239]***
GDP growth (t)	-8.232261	-7.343993	-8.748126	1.404186	1.121577	1.628287	-7.427770	-6.683806	-8.629987
	[-8.5048]***	[-9.3345]***	[-7.4707]***	[3.6401]***	[3.3828]***	[3.5569]***	[-7.9024]***	[-8.0472]***	[-7.8509]***
Inflation (t)	11.675963	10.238320	11.539282	-1.253497	-1.122998	-1.045178	11.569233	10.210211	13.688377
	[8.2206]***	[8.8686]***	[6.7157]***	[-2.2145]**	[-2.3083]**	[-1.5560]	[8.3883]***	[8.3777]***	[8.4865]***
HPI (t)	-0.787866	-1.154842	-1.910715	0.188060	0.205171	0.182791	-0.817042	-1.199109	-2.702139
	[-2.0344]**	[-3.6688]***	[-4.0783]***	[1.2185]	[1.5467]	[0.9980]	[-2.1727]**	[-3.6085]***	[-6.1442]***
Observations:	57	57	57	57	57	57	57	57	57
R-squared:	0.8090	0.8307	0.7635	0.6415	0.5680	0.4456	0.7659	0.7804	0.8142
F-statistic:	55.0489	63.8063	41.9599	23.2629	17.0950	10.4497	42.5350	46.2047	56.9726

Table 5c shows the result of an ordinary least square time series regression. The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (this is the difference between the % of banks that reported a tightening in their standards and those who reported an easing in their standards), in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the sum of the % banks answering eased somewhat and eased considerably with a weighting 2 for the latter), in the last three regression the dependent variable is the percentage of banks reporting a tightening in their lending standards (the sum of the banks answering tightened somewhat and tightened considerably with a weighting 2 for the latter). Quarter _negative is the number of quarters in the previous 12 quarters during which the real rate is negative. The T statistics are in brackets *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively

Table 6 The federal fund rate and the terms of loans (C&I loans for large and medium firms) (Q1 1997: Q1 2011)

	Maximum size of credit lines	Costs of credit lines	Spread of loan rates over the bank's cost of fund	Loan covenants	Collateralization requirements	Premium charged on riskier loans
C	2.876486 [47.7174]***	2.851903 [29.2707]***	2.858439 [22.1920]***	2.869933 [41.6398]***	2.820835 [56.1623]***	2.675492 [24.8688]***
Federal rate (t)	-0.035840 [-2.3754]**	-0.058649 [-2.4050]**	-0.065810 [-2.0413]**	-0.027125 [-1.5724]	-0.016725 [-1.3305]	-0.072875 [-2.5526]**
GDP growth (t)	0.081723 [4.7985]***	0.115096 [4.1812]***	0.136108 [3.7402]***	0.079765 [4.0963]***	0.059949 [4.2247]***	0.088126 [2.7436]***
Inflation (t)	-0.037874 [-1.5978]	-0.063427 [-1.6555]	-0.063580 [-1.2553]	-0.049315 [-1.8196]*	-0.024965 [-1.2640]	-0.044091 [-0.9850]
HPI (t)	0.009841 [1.5522]	0.023789 [2.3215]**	0.027673 [2.0428]**	0.011584 [1.5981]	0.007306 [1.3830]	0.028516 [2.4129]**
Observations: R-squared: F-statistic:	57 0.4491 10.5959	57 0.4444 10.3988	57 0.3893 8.2883	57 0.3982 8.6017	57 0.4045 8.8304	50 0.3883 7.1408

Table 6 shows the results of an ordinary least square time series regression. The dependent variable is the change in the term of loans reported by banks for C&I loans for large and medium firms. Banks assign a number between 1 and 5 using the following scale: 1=tightened considerably, 2=tightened somewhat, 3=remained basically unchanged, 4=eased somewhat, 5=eased considerably. The change in term of loans is the average of these answers for each quarter (higher value reflect an easing and lower value a tightening). The T statistics are in brackets. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

4. Interest Rates and the Terms of Loans

This section examine how do banks tighten or ease their lending standards by analysing the terms and conditions of loans. The senior loan officer opinion survey asks banks about the change in the terms of loans during the past three months[28]. Specifically banks are asked about how they did change each one of the maximum size of credit lines, the cost of credit lines, the spread of loan rates over the banks' cost of fund, the loan covenants, the collateral requirements and the premium charged on riskier loans[29]. Every bank assigns for each term a number between 1 and 5[30]. Higher value indicates an easing and lower value a tightening. The quarterly reports of the senior loan officer opinion survey only show the average number that have been assigned for each one of these terms. I regress each one of these variables on the federal rate, the GDP growth, the inflation rate and the house price index. Table 6 shows the result for C&I loans for large and medium firms. Based on these results, it could be noticed that the level of the federal rates significantly influences the terms of loans towards large and medium firms. Specifically with an expansive monetary policy, banks soften almost all the terms of loans: they fund higher size of credit lines, they apply lower cost on credit lines, lower spread and lower premium rates for riskier loans.

5. Further investigations

Some questions could be asked about the role of many elements such as market power, the use of untraditional mortgage products, the role of supervision in affecting the risk-taking channel. In this section I address some of these issues.

- T*he role of market competition*

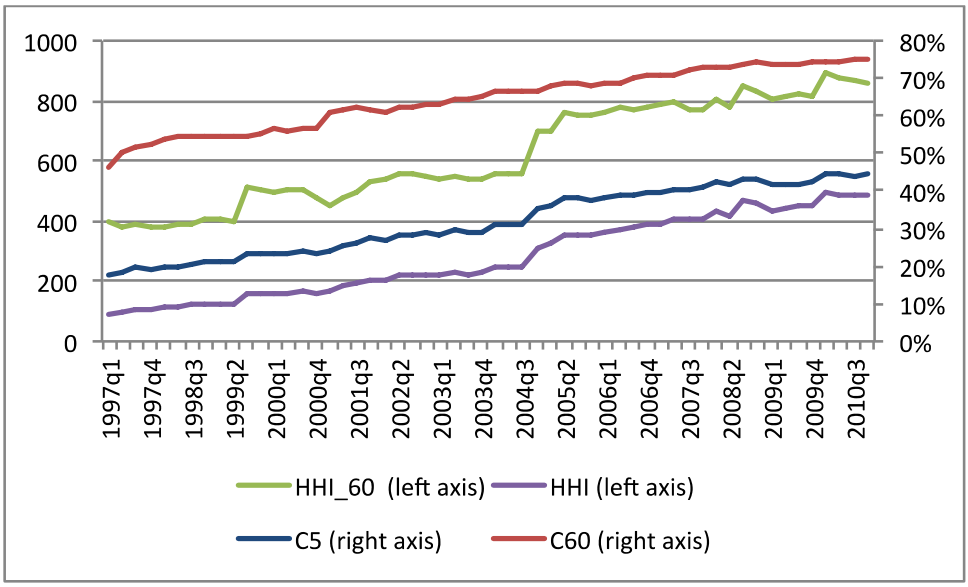
As previously mentioned in chapter 1, incentives for more risk-taking and appetite for risk may intensify in competitive environment with higher pressures on profits (Michalak (2012)). Accordingly, bank competition could play an intensifying role in the risk-taking process associated to low policy rates. Also Brissimis et al. (2012) argue that "banks with high market power should have easier access to uninsured finance, which would make their

[28] The survey asks this question for C&I loans. It does not consider this issue for commercial real estate loans
[29] Beginning from the fourth quarter 1998, banks are asked about the premium charged on riskier loans.
[30] Each bank assign a number between 1 and 5 using the following scale: 1=tightened considerably, 2=tightened somewhat, 3=remained basically unchanged, 4=eased somewhat, 5=eased considerably.

lending less dependent on central bank funding and therefore on monetary policy shocks". They also argue that since high market power is usually associated with higher profits, the search-for-yield mechanism of the risk-taking channel may be less potent for the most competitive banks.

The senior loan officer opinion survey does not reveal information about the identity of banks participating in the survey. Only the number of banks that chose each one of the multiple choice answers is presented without knowing any further details about the identity of the banks. Still, according to the survey description, the questions are addressed to 60 large banks in the United States that account for about 67% of the total assets of all commercial banks (FED definition of the survey). Based on this information, I collect data from the quarterly call reports of the U.S commercial banks during the period 1997-Q1 till 2010-Q4 in order to measure the degree of competition in the U.S. commercial banking system and to reflect the evolution of the concentration of the largest 60 commercial banks. Specifically, the share of assets held by the 60 largest banks "C60" (alternatively the largest 5 banks "C5") and the Hirschman-Herfindahl Index "HHI" calculated as the sum of squared market shares in terms of total assets of all U.S. commercial banks (alternatively HHI_60 calculated as the sum of squared market shares in terms of total assets of the 60 largest U.S. commercial banks), are used to take into consideration the degree of concentration in the banking system. The evolution of these 4 measures (figure 4) shows that the U.S. commercial banking system has become more and more concentrated: the 60 biggest banks which accounted for 50% of the market-share in 1997, have in 2010 more than 75% of the market-share.

Figure 4: Concentration and HHI of U.S commercial banking system



I investigate the role of market competition in affecting the risk-taking channel by introducing alternatively the different variables of market concentration to the baseline equation. One problematic when introducing this type of variable is the high correlation between each one of them and the interest rate measure (correlation between 55% and 65%). In fact, banks may be more willing to lend when the cost of funding is low, accordingly monetary policy may impact asset expansion and probably banks market-share ratios. In order to address this issue I proceed to an orthogonalization of C60, C5, HHI and HHI_60. Table 7 shows the results where the market concentration of the 60 largest banks (C60) is used as measure of market power (results of estimations using alternative measures are presented in appendix 1 tables 7A, 7B and 7C). The conclusion associated to the interest rate variable is still valid: lower level of interest rates is associated with more lax lending practices. Also bank market power is significant in affecting lending standards: an increase in the market power of the 60 largest commercial banks is associated with more lax lending practices. The coefficient of the interaction between the overnight federal funds rate and market concentration is positive indicating that higher market power amplify the impact of low short-term rates on the softening of lending standards. All in all, the results suggest that low policy rates are associated with softer lending practices for the 60 largest banks. Also when the market power of these banks increases, their risk-taking intensifies.

Table 7 Market Concentration (C60), overnight federal funds rate and bank lending standards (Q1 1997: Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	-0.5527	3.5917	17.9381	7.8804	6.0274	4.0361	7.6084	9.7953	25.9527
	[-0.10]	[0.87]	[3.68]***	[4.49]***	[4.35]***	[2.01]**	[1.61]	[2.50]**	[5.69]***
Federal rate (t)	6.3944	4.3730	5.1716	-2.5435	-1.904	-0.9573	3.9695	2.5276	4.0606
	[4.79]***	[4.25]***	[4.26]***	[-5.82]***	[-5.52]***	[-1.92]*	[3.38]***	[2.59]**	[3.58]***
GDP growth (t)	-9.6939	-8.4844	-7.8183	1.8019	1.4253	1.0320	-8.5225	-7.5488	-8.0899
	[-5.67]***	[-6.44]***	[-5.03]***	[3.22]***	[3.22]***	[1.61]	[-5.66]***	[-6.04]***	[-5.56]***
Inflation (t)	11.6120	10.6871	9.3293	-0.916	-0.9335	-0.6405	12.0942	11.0574	11.9792
	[5.02]***	[5.99]***	[4.43]***	[-1.21]	[-1.56]	[-0.74]	[5.93]***	[6.53]***	[6.08]***
HPI (t)	-3.2204	-2.9451	-4.4601	1.1391	0.9262	0.9890	-2.4635	-2.3837	-4.6045
	[-3.91]***	[-4.64]***	[-5.95]***	[4.22]***	[4.35]***	[3.21]***	[-3.39]***	[-3.96]***	[-6.57]***
C60 (t)	-5.7056	-4.2654	-5.7271	2.2395	1.7946	1.7986	-3.8751	-2.744	-4.0894
	[-3.42]***	[-3.31]***	[-3.77]***	[4.09]***	[4.15]***	[2.87]***	[-2.63]**	[-2.25]**	[-2.88]***
LAG_FED* C60 (t)	0.8496	0.6108	1.1738	-0.3807	-0.3172	-0.3661	0.5264	0.3270	0.8115
	[2.48]**	[2.32]**	[3.77]***	[-3.40]***	[-3.58]***	[-2.85]***	[1.75]*	[1.31]	[2.78]***
Observations:	56	56	56	56	56	56	56	56	56
R-squared:	0.65	0.72	0.75	0.55	0.55	0.36	0.65	0.71	0.81
F-statistic:	15	21.13	25.06	10.13	10.03	4.54	14.85	19.73	34.45

Table 7 shows the result of an ordinary least square time series regression. **C60** is the share (in %) of assets held by the 60 largest commercial banks The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (the difference between the % of banks that reported a tightening in their standards and those who reported an easing in their standards), in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the sum of the % banks answering eased somewhat and eased considerably with a weighting 2 for the latter), in the last three regression the dependent variable is the percentage of banks reporting a tightening in their lending standards (the sum of the banks answering tightened somewhat and tightened considerably with a weighting 2 for the latter). The T statistics are in brackets *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

- *The role of supervision*

The objective of prudential regulation and supervision is to ensure a safe and sound banking system in which banks are capable of serving in the best possible manner the banking needs of their customers. Accordingly, it could be argued that strong supervision context may reduce the impact of the risk-taking channel. Maddaloni and Peydro (2010) investigate this issue for the European banks. Based on the dataset of Barth et al. (2006) they construct a "capital stringency index" that measures the supervision quality of bank capital in the different European countries. They find that the impact of low monetary rates on the softening of standards for mortgage loans is amplified when supervision standards for bank capital are weak. For the case of the United States, the different surveys by Barth et al. (2000, 2003, 2007 and 2012) do not show significant differences in the answers. Accordingly, a measure of supervision quality based on these surveys for the U.S. case, presents no significant time variation.

In an attempt to evaluate the evolution of the quality of bank supervision and to create a variation on the role of supervision in the U.S. settings, I look at the evolution of operational expenses, under the "supervision and regulation" category, of the main U.S. authorities responsible of supervising banks. The idea is that larger budget and expenses intended to finance supervision may imply more intense determination to control the financial system. In the United States, the office of the comptroller of currency (OCC) and the central banks are the main responsible of this task. Therefore, I collect data from the reports on the "current budgeted expenses of the Board of Governors and the Federal Reserve Banks". The latter mentions the annual amount expended by Federal Reserve Banks on financial institutions supervision and regulation. Also, I collect data relative to "Statements of Net Cost" from the annual reports of the OCC, which include the same type of information. Data relative to the cost of supervision and regulation by the OCC is only available since 2003[31]. Consequently, I only serve with the central banks budget of the supervision to construct the supervision index "*Supervision/TA"*. The latter, calculated as the amount expended by Federal Reserve Banks to supervise and regulate financial institutions over total assets of the 60 largest commercial

[31] Before 2003, the office of thrift supervision (OTS) chartered, supervised, and regulated all federally chartered and state-chartered savings banks and savings and loans associations. OTS did not receive a government budget and were paid by the banks they regulate.

banks. This measure takes into consideration both the evolution of central banks supervision expenses and at the same time the evolution of the size of the banking system.

Figure 5: budget for supervision and regulation

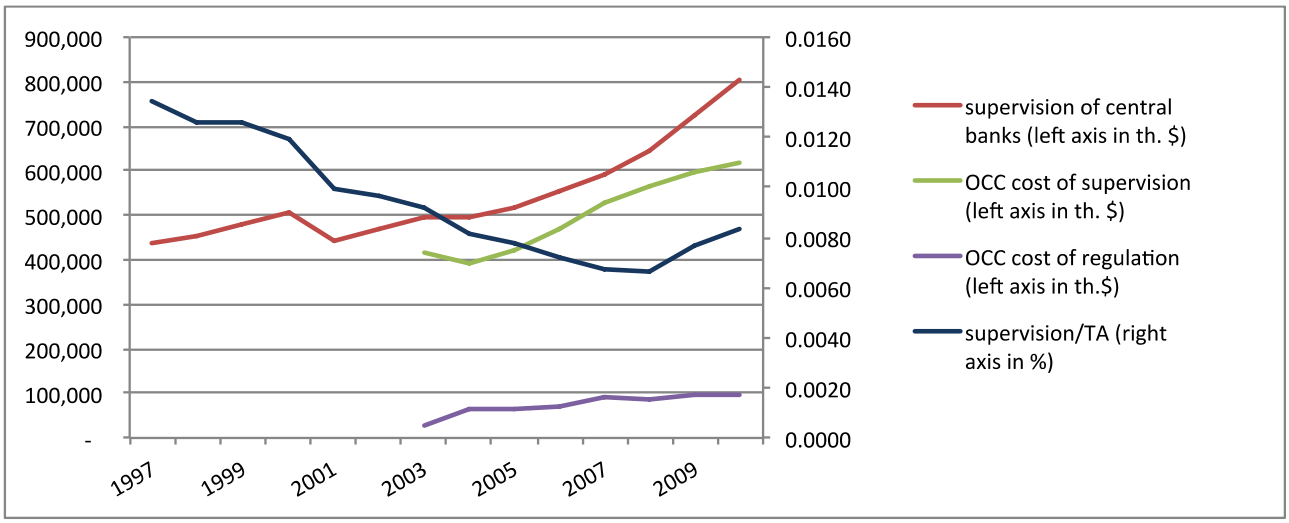


Figure 5 shows that supervision expenditures increase during the period 1997-2010 still these amounts are decreasing compared to the evolution of the size of the banking sector (*Supervision/TA).* Table 8 includes the supervision index to the estimation. Results always suggest that lower level of interest rates is associated with more lax lending practices however the relation is statistically less prominent. The results also suggest that higher expenses related to financial institutions control are associated with more tightening and less easing in lending practices. This is consistent with the view that regulators may be able to make banks behave in a safer manner. Also, the coefficient of the interaction term between the overnight rate and the supervision index suggest that higher expanses related to financial institution supervision decrease the impact of overnight rates on lending practices. This may be interpreted as an evidence that strong supervision context reduce the impact of the risk-taking channel.

Table 8 Central Banks supervision, overnight federal funds rate and lending standards (Q1 1997:Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	-98.1266	-52.5322	-102.0835	92.0575	66.2045	72.4504	-5.0226	19.3334	-6.1252
	[-1.79]*	[-1.22]	[-1.97]*	[5.85]***	[5.03]***	[3.81]***	[-0.10]	[0.49]	[-0.13]
Federal rate (t)	13.0282	5.5596	28.1633	-15.9918	-11.6985	-13.5400	-3.8366	-7.9178	9.8467
	[1.20]	[0.65]	[2.74]***	[-5.13]***	[-4.48]***	[-3.59]***	[-0.40]	[-1.02]	[1.03]
GDP growth (t)	-11.7122	-9.9210	-9.1683	2.4708	1.9379	1.6215	-9.9728	-8.5537	-8.8610
	[-6.46]***	[-7.00]***	[-5.35]***	[4.76]***	[4.46]***	[2.58]**	[-6.31]***	[-6.59]***	[-5.54]***
Inflation (t)	12.3327	10.9579	8.9879	-1.5337	-1.2916	-1.1322	12.1007	10.8695	10.8601
	[4.82]***	[5.48]***	[3.72]***	[-2.09]**	[-2.11]**	[-1.28]	[5.43]***	[5.93]***	[4.81]***
HPI (t)	-1.4961	-1.5326	-3.1996	0.8357	0.6433	0.7825	-0.8688	-1.0976	-3.3388
	[-2.15]**	[-2.81]***	[-4.85]***	[4.18]***	[3.85]***	[3.24]***	[-1.43]	[-2.20]**	[-5.42]***
Supervision/TA (t)	11915.9760	6948.6324	14327.3384	-10059.4742	-7192.7784	-8117.8632	1800.3244	-865.1722	3935.9731
	[1.85]*	[1.38]	[2.35]**	[-5.45]***	[-4.65]***	[-3.64]***	[0.32]	[-0.19]	[0.69]
LAG_FED*Supervision/TA	-1191.9696	-470.8369	-2733.6349	1670.3622	1211.4916	1495.7479	563.4018	927.7552	-729.2368
	[-0.96]	[-0.49]	[-2.33]**	[4.70]***	[4.07]***	[3.48]***	[0.52]	[1.04]	[-0.67]
Observations:	56	56	56	56	56	56	56	56	56
R-squared:	0.62	0.69	0.71	0.63	0.58	0.41	0.63	0.70	0.78
F-statistic:	13.34	18.29	20.40	14.04	11.49	5.62	13.70	18.84	28.65

Table 8 shows the result of an ordinary least square time series regression. **Supervision/TA**= the amount expended by Federal Reserve Banks to supervise and regulate financial institutions over total assets of the 60 largest commercial banks (in%). The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (the difference between the % of banks that reported a tightening in their standards and those who reported an easing in their standards), in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the sum of the % banks answering eased somewhat and eased considerably with a weighting 2 for the latter), in the last three regression the dependent variable is the percentage of banks reporting a tightening in their lending standards (the sum of the banks answering tightened somewhat and tightened considerably with a weighting 2 for the latter). The T statistics are in brackets *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

6. Conclusion

Monetary policy has many channels through which it influences economic variables. Recently "the risk-taking channel" has been introduced as the channel through which monetary policy impacts the risk aversion of financial institutions. Many analysts confirmed that this channel is a possible explanation of the latest financial crisis, arguing that too low level of interest rates have pushed banks to more risk-taking and to lax lending practices. Using different measures for assessing the loosening of monetary policy, and using data based on qualitative survey for assessing lending standards, I test in this present chapter the association between banks' lending standards and interest rates. The "senior loan officer opinion survey" for U.S. banks provided relevant proxies of bank lending practices. Using this dataset, I find evidence that the level of federal funds rate affects the banks' lending standards for all the types of loans. Low policy rates, low long-term rates and too low for too long rates all are relevant determinants for more lax lending policies. Finally, the degree of bank market share and the quality of supervision are important elements that impact the relation between interest rates and bank behaviour.

Appendix1

Table 7A Market Concentration (C5), overnight federal funds rate and bank lending standards (Q1 1997: Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans-Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	-1.0682	3.1848	17.9944	7.7201	5.9098	3.9645	6.9288	9.2579	25.9089
	[-0.21]	[0.83]	[3.64]***	[4.31]***	[4.21]***	[1.94]*	[1.58]	[2.55]**	[5.73]***
Federal rate (t)	6.3008	4.3125	5.2606	-2.4948	-1.8805	-0.9647	3.9128	2.4847	4.1441
	[5.02]***	[4.53]***	[4.29]***	[-5.61]***	[-5.40]***	[-1.90]*	[3.60]***	[2.76]***	[3.70]***
GDP growth (t)	-10.3196	-8.8624	-8.4147	1.8971	1.5049	1.2222	-9.071	-7.8455	-8.4453
	[-6.58]***	[-7.44]***	[-5.49]***	[3.41]***	[3.46]***	[1.93]*	[-6.67]***	[-6.97]***	[-6.02]***
Inflation (t)	11.8327	10.8999	9.1670	-0.7087	-0.7864	-0.5272	12.5118	11.4243	11.9689
	[5.51]***	[6.68]***	[4.37]***	[-0.93]	[-1.32]	[-0.61]	[6.72]***	[7.42]***	[6.24]***
HPI (t)	-2.7487	-2.6813	-4.0712	0.9507	0.7953	0.8231	-2.1512	-2.2481	-4.432
	[-3.80]***	[-4.88]***	[-5.76]***	[3.71]***	[3.96]***	[2.81]***	[-3.43]***	[-4.33]***	[-6.86]***
C5 (t)	-2.9881	-2.3893	-3.4102	1.1947	1.0068	0.9812	-2.0135	-1.5582	-2.6225
	[-3.03]***	[-3.19]***	[-3.54]***	[3.42]***	[3.67]***	[2.46]**	[-2.35]**	[-2.20]**	[-2.97]***
LAG_FED*C5 (t)	0.2537	0.2016	0.6717	-0.1724	-0.1591	-0.1924	0.1003	0.0564	0.4923
	[1.18]	[1.23]	[3.19]***	[-2.26]**	[-2.66]**	[-2.21]**	[0.54]	[0.36]	[2.55]**
Observations:	56	56	56	56	56	56	56	56	56
R-squared:	0.69	0.76	0.75	0.53	0.54	0.33	0.69	0.75	0.81
F-statistic:	17.77	25.59	24.07	9.36	9.52	4.03	18.47	24.33	35.11

Table 7A shows the result of an ordinary least square time series regression. **C5** is the share (in %) of assets held by the 5 largest commercial banks The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (the difference between the % of banks that reported a tightening in their standards and those who reported an easing in their standards), in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the sum of the % banks answering eased somewhat and eased considerably with a weighting 2 for the latter), in the last three regression the dependent variable is the percentage of banks reporting a tightening in their lending standards (the sum of the banks answering tightened somewhat and tightened considerably with a weighting 2 for the latter). The T statistics are in brackets *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

Table 7B Market Concentration (HHI_60), overnight federal funds rate and bank lending standards (Q1 1997: Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	-0.9226	3.3460	18.5312	7.4638	5.7055	3.6736	6.8273	9.2312	26.1777
	[-0.18]	[0.88]	[3.72]***	[4.01]***	[3.95]***	[1.77]*	[1.60]	[2.59]**	[5.81]***
Federal rate (t)	6.2577	4.2909	5.3425	-2.4676	-1.8728	-0.961	3.8962	2.4723	4.2348
	[5.01]***	[4.53]***	[4.32]***	[-5.35]***	[-5.22]***	[-1.87]*	[3.67]***	[2.80]***	[3.79]***
GDP growth (t)	-10.6282	-9.0671	-8.868	1.9938	1.5950	1.2946	-9.3043	-7.9683	-8.8258
	[-6.92]***	[-7.78]***	[-5.83]***	[3.51]***	[3.62]***	[2.04]**	[-7.12]***	[-7.33]***	[-6.42]***
Inflation (t)	11.6863	10.7714	8.9238	-0.5025	-0.6413	-0.3289	12.5654	11.4329	11.9169
	[5.51]***	[6.70]***	[4.24]***	[-0.64]	[-1.05]	[-0.38]	[6.96]***	[7.61]***	[6.28]***
HPI (t)	-2.4631	-2.4949	-3.8394	0.8047	0.6943	0.7259	-1.9962	-2.158	-4.3032
	[-3.58]***	[-4.79]***	[-5.63]***	[3.17]***	[3.52]***	[2.56]**	[-3.41]***	[-4.43]***	[-7.00]***
HHI_60 (t)	-0.116	-0.0967	-0.1413	0.0432	0.0385	0.0376	-0.0819	-0.0661	-0.1135
	[-2.73]***	[-3.00]***	[-3.36]***	[2.76]***	[3.16]***	[2.15]**	[-2.27]**	[-2.20]**	[-2.99]***
LAG_FED* HHI_60 (t)	0.0043	0.0043	0.0269	-0.0052	-0.0055	-0.0075	-0.0005	-0.0007	0.0200
	[0.44]	[0.59]	[2.81]***	[-1.47]	[-1.98]*	[-1.89]*	[-0.06]	[-0.10]	[2.31]**
Observations:	56	56	56	56	56	56	56	56	56
R-squared:	0.69	0.76	0.74	0.5	0.51	0.31	0.71	0.76	0.81
F-statistic:	18.07	26.12	23.54	8.14	8.57	3.71	19.85	25.6	35.57

Table 7B shows the result of an ordinary least square time series regression. **HHI_60** is the sum of squared market shares in terms of total assets of the 60 largest U.S. commercial banks The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (the difference between the % of banks that reported a tightening in their standards and those who reported an easing in their standards), in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the sum of the % banks answering eased somewhat and eased considerably with a weighting 2 for the latter), in the last three regression the dependent variable is the percentage of banks reporting a tightening in their lending standards (the sum of the banks answering tightened somewhat and tightened considerably with a weighting 2 for the latter). The T statistics are in brackets *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

Table 7C Market Concentration (HHI), overnight federal funds rate and bank lending standards (Q1 1997: Q1 2011)

	Net percentage of banks tightening lending standards			Percentage of banks easing lending standards			Percentage of banks tightening lending standards		
	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans	C&I loans- Large and medium firms	C&I Loans - Small firms	Commercial real estate loans
C	-0.2142	3.8914	19.3583	7.2992	5.5286	3.6006	7.4383	9.6451	26.9711
	[-0.04]	[1.02]	[3.86]***	[3.97]***	[3.81]***	[1.71]*	[1.72]*	[2.70]***	[6.02]***
Federal rate (t)	6.4595	4.4478	5.2475	-2.5016	-1.8776	-0.9296	4.0802	2.6371	4.1923
	[5.15]***	[4.69]***	[4.22]***	[-5.47]***	[-5.21]***	[-1.78]*	[3.79]***	[2.97]***	[3.77]***
GDP growth (t)	-10.4453	-8.9411	-8.6256	1.9700	1.5621	1.3230	-9.1218	-7.8632	-8.5461
	[-6.73]***	[-7.61]***	[-5.60]***	[3.48]***	[3.50]***	[2.05]**	[-6.85]***	[-7.16]***	[-6.20]***
Inflation (t)	11.6234	10.7408	8.8709	-0.5617	-0.6516	-0.3777	12.4377	11.3928	11.8388
	[5.47]***	[6.68]***	[4.21]***	[-0.73]	[-1.07]	[-0.43]	[6.82]***	[7.58]***	[6.28]***
HPI (t)	-2.8911	-2.8272	-4.09	0.9266	0.7703	0.7298	-2.3443	-2.4445	-4.598
	[-3.90]***	[-5.04]***	[-5.56]***	[3.43]***	[3.61]***	[2.36]**	[-3.68]***	[-4.66]***	[-6.99]***
HHI (t)	-0.1705	-0.1399	-0.1931	0.0618	0.0521	0.0445	-0.123	-0.0996	-0.1645
	[-2.90]***	[-3.15]***	[-3.31]***	[2.89]***	[3.09]***	[1.82]*	[-2.44]**	[-2.40]**	[-3.16]***
LAG_FED* HHI (t)	0.0086	0.0076	0.0369	-0.0074	-0.0073	-0.0083	0.0023	0.0012	0.0299
	[0.65]	[0.76]	[2.83]***	[-1.53]	[-1.92]*	[-1.52]	[0.20]	[0.13]	[2.56]**
Observations:	56	56	56	56	56	56	56	56	56
R-squared:	0.69	0.76	0.74	0.51	0.51	0.3	0.7	0.76	0.82
F-statistic:	17.94	26.07	23.31	8.5	8.44	3.44	19.2	25.49	36.05

Table 7C shows the result of an ordinary least square time series regression. **HHI** is the sum of squared market shares in terms of total assets of of all U.S. commercial banks. The dependent variable is the net percentage of banks reporting a tightening of credit standards for the first three regressions (the difference between the % of banks that reported a tightening in their standards and those who reported an easing in their standards), in the next three regressions the dependant variable is the percentage of banks easing their lending standards (the sum of the % banks answering eased somewhat and eased considerably with a weighting 2 for the latter), in the last three regression the dependent variable is the percentage of banks reporting a tightening in their lending standards (the sum of the banks answering tightened somewhat and tightened considerably with a weighting 2 for the latter). The T statistics are in brackets *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

Chapter 3 Too Low for Too Long Interest Rates, Bank Risk-Taking and Bank Capitalization: Evidence From U.S Commercial Banks

Abstract

This chapter investigates whether the length of the period during which low interest rates are applied impacts banks behaviour in term of investment choices, monitoring processes and asset expansion. Using data from the quarterly call reports of almost all the U.S. commercial banks over the period 2001/2010, the results show that during the pre-crisis period 2001Q1/2007Q2, longer periods of negative real rates are associated with asset expansion with a move towards riskier assets. For the post-crisis period 2007Q3/2010Q4, longer periods of low rates are associated with the materialization of risk reflected into higher credit risk ratios. Furthermore, differentiating undercapitalized, adequately capitalized and well capitalized banks, longer periods of low policy rates impact more intensely the risk-taking for both adequately and undercapitalized banks during the period that preceded the breach of the capital regulation. Looking at the period that follows the event of breach of the capital regulation, undercapitalized banks do not retrench from risk taking, quite the opposite, they gamble for resurrection and a longer period of low rates continue to be associated with an increase in risk-taking. For the adequately capitalized banks, next to the breach of the capital regulation these banks continue to take risk following a longer period of low policy rates but at a much lower trend compared to the other well-capitalized banks.

1. Introduction

The issue of whether interest rates impact banks' behaviour is widely discussed in current literature. Many economists cited the low level of policy rates that has been applied for a long period of time as a main cause of abundant liquidity that exacerbated bank risk-taking (Taylor, 2009; Adrian and Shin, 2009; Borio and Zhu, 2008). This new transmission channel of monetary policy known as risk-taking channel (Borio and Zhu, 2008) is defined as the possible impact of changes in policy rates on either risk perceptions or risk-tolerance. Accordingly, the degree of risk in the bank's portfolios, the pricing of assets and the price and non-price terms of the extension of funding, will be influenced by monetary conditions. The theoretical basis underlying the risk-taking channel could be resumed as follows: too low level of interest rates for too long, specifically when applied during a period of strong economic performance and price stability, may generate excessive optimism about economic prospects and asset prices may increase. A benign economic environment associated with cheap liquidity, increase the optimism of bankers which translates into lax lending practices and lower premium risk rates. Furthermore, falling interest rates might generate incentives to invest into risky activities according to two scenarios: first, in an environment of low rates, the profitability for a bank from investing in low risk assets such as securities and government bonds is low. Banks are thus more willing to invest in riskier assets, which generate higher returns (search for yield). Second, in an environment of low level of rates, it becomes cheaper for banks to use leverage (short term funding) to fund their activities. Giving that bank incentives to lever and to take on asset risk are complementary, the more levered a bank, the greater its limited liability and the less it has to lose from risky loans.

If the theoretical basis of the RTC could be discussed with some easiness, the empirical evidence is more challenging. There are many reasons explaining the difficulty for empirical evidence of the RTC. First, this channel proposes that during a period of low policy rates, banks incentives to screen borrowers decrease. A first difficulty is the empirical detection of bank screening/monitoring specifically when using the data from financial statements. Second, according to the balance sheet channel of monetary policy, a low level of rates produces a positive impact on the outstanding loans and borrowers' net worth. At the same time, the risk-taking channel suggests that during long period of expansive monetary policy, banks grant new credit for riskier profile without pricing the additional risk. Lack of loan level data makes it hard to disentangle the effect of a long period of low rates on the outstanding

loans and the new loans. And third any attempt to examine the link between bank assets riskiness and the level of policy rates suffer from a potential myopic bias related to the evaluation of risky assets.

Taking into consideration these difficulties, I extend the research on the risk-taking channel by empirically investigating the impact of too low for too long interest rates on bank riskiness. Using data from the quarterly call reports of the U.S. commercial bank's and using a variable reflecting the time dimension of the monetary loosening, this chapter contributes to the risk-taking channel literature mainly in two ways: Frist, I try to answer separately each one the theoretical hypothesis presented in related literature by choosing risk measures that respond to each one of the hypothesis underlying the RTC. I specifically study the impact of a too long period of low policy rates on investment choices, bank monitoring processes and bank asset expansion. Second, I differentiate well-capitalized, adequately capitalized and undercapitalized banks and investigate whether bank specific capital characteristics influence banks behaviour following a long period of monetary expansion.

The results propose that banks substitute risk free and low risk assets with high-risk assets and also expand liquidity creation following a long period of low rates. Concerning their impact on bank monitoring processes, the results in this study do not confirm the negative impact of loosening monetary policy, the results propose that a long period of low rates is favourable for the existing loans specifically for the pre-crisis period.

While differentiating undercapitalized, adequately capitalized and well-capitalized banks, this paper presents evidence that a longer period of low policy rates impacts more intensely the risk-taking for both adequately and undercapitalized banks during the period that preceded the breach of the capital regulation. Also, for undercapitalized banks, looking at the period that follows the event of undercapitalization these banks do not retrench from risk taking, quite the opposite they gamble for resurrection, and a longer period of low rates continue to be associated with an increase in risk-taking. For adequately capitalized banks, in the period that follows the breach of the capital constraint these banks continue to take risk following a longer period of low policy rates but at a much lower trend compared to well-capitalized banks.

The chapter proceeds as follows: I first present the hypothesis tested in section 2, the dataset, the variables and the econometric specification are presented in section 3, I discuss

the results in section 4, I present several robustness checks in section 5 and finally I conclude in section 6.

2. Hypotheses

Hypothesis 1: *a substitution effect toward riskier assets is produced following a long period of low interest rates*

The risk-taking channel first supposes that during environment of low policy rates, banks become less risk-averse and their appetite for risk increases. According to Rajan (2005) lower interest rates on risk free investments could push banks to invest more in higher yielding investments that are also riskier (assets substitution). Consequently banks will substitute the riskier assets for those less risky. I use different categories of risk-weighted assets to test this hypothesis and I expect a long period of low interest rates to have a decreasing impact on low risk weighted assets and an increasing impact on high risk weighted assets.

Hypothesis 2: *too low for too long interest rates induce a reduction in monitoring processes translated into lower quality loans and higher credit risk ratios.*

The risk-taking channel emphasizes the relation between the incentives of banks to screen borrowers and the level of interest rates. Specifically it has been argued that banks, lax lending practices and reduce monitoring processes during period of low policy rates. Explanations of such impact have been justified by a decrease in the cost of funds (Dell'Ariccia and Marquez, 2006), a decrease in the bank's gross return conditional on bank's portfolio repaying (Dell'Driccia et al., 2010) and an increase in bankers' optimism during good economic performance associated with cheap liquidity. Dell'Ariccia et al. (2010) argue that when monetary easing produce a reduction of interest rates on bank loans, the bank see its return from the loan repaying reduced which in turn decrease banks' incentives to monitor. These claims suggest that because monitoring is a costly action, banks faced to a reduction of return following a loose monetary policy, decide to decrease their costs by lowering the monitoring processes. As a result the riskiness of bank portfolio tends to increase. Also empirical evidence from loan level data show that when rates are low, banks grant more credit to riskier profile specifically to borrowers' with bad or no credit history, and banks do not seem to adequately price the additional risk they take (Ioannidou et al., 2009; Jimenez et al., 2010). By screening and sorting out applicant borrowers that do not meet satisfactory

lending standards, banks perform an important role of limiting adverse selection problems in the economy. Failure to perform this function leads to riskier portfolios and weaker balance sheets with potentially negative consequences for credit market stability. Accordingly, I expect monetary easing for an extended period of time to have a negative impact on the quality of bank's loan portfolio.

Hypothesis 3: *too low for too long policy rates induce an increase in asset expansion*

When monetary policy is more expansive, banks' liquidity and net worth improve, allowing banks to relax lending standards and to increase money creation and asset expansion. Valencia (2010) argues that a decrease in the risk free rate increases the profitability of lending: the lower the interest rate, the more attractive it is to lend more. I hypothesize that a longer period of low rates will influence the amount of liquidity created by a banking institution. In this area, Rauch et al. (2009) find strong negative relation between liquidity created by German banks and monetary policy tightening. However, they do not find any bank specific factors, such as financial performance or size, to have an influence on liquidity creation. Berger and Bouwman (2009) find for the U.S. case, that the effect of monetary policy on bank liquidity creation is significant only for small banks. While Berger and Bouwman (2009) use time series analysis to test this relation, I employ panel data analyses as complementary evidence on the impact of too low for too long interest rates on bank level liquidity creation.

Hypothesis 4: *the impact of a long period of low rates on bank risk behaviour differs according to the degree of bank leverage and bank capitalization.*

"If banks' incentives were at the centre of the workings of the risk-taking channel, it would be expected that individual bank characteristics would have a major impact on how the risk-taking channel operates" (Dell'Ariccia, Laeven, Marquez, 2010). Dell'ariccia et al. propose a theoretical model of the risk-taking channel that take into consideration banks' characterizations. Specifically they hypothesise that the impact of monetary policy changes on bank monitoring is related to the balance of three forces: interest rate pass-through risk shifting and leverage. The model differentiates the impact of interest rates on bank risk-taking according to the degree of bank's capitalization. When capital is endogenously determined, and when banks can adjust their capital holdings in response to monetary policy changes,

monetary easing lowers the cost of banks liabilities. Accordingly, when the rates on deposit decrease, the benefit from holding capital decrease and leverage becomes an optimal choice to increase profitability. If banks are unrestricted to adjust their level of capital, monetary policy easing affects bank monitoring through the additional channel of an increase in leverage. Once bank leverage is optimally chosen, to maximize profits, monitoring will always increase with the monetary policy rate: lower policy rate imply more leverage and more risk taking. However when bank capital structure is fixed exogenously, specifically in situations where banks face constraints for example when their desired capital ratios are below regulatory minimums for capital regulation, the effects of monetary policy changes on bank monitoring and, hence, portfolio risk critically depend on a bank's leverage: a monetary easing will lead highly capitalized banks to monitor less, while the opposite is true for poorly capitalized banks. Dell'ariccia et al. explains the difference in bank behaviour by the follow: If we look at the bank liability side, under limited liability protection, a fully levered bank faces no losses in case of failure. By lowering the cost on bank deposit, a policy rate cut increases the expected return on a bank loans. Fully levered banks willing to increase this effect have incentives to decrease the riskiness of the portfolio choosing safer portfolios for which there is a higher probability the bank will have to repay depositors. In contrast, for a bank fully funded by capital, the effect of a decrease in the cost of its liabilities will, all other things equal, increase the expected net return uniformly across portfolios and have little or no effect on the bank's risk choices. Consequently, the model propose that risk-shifting problem could operate via the liability side of bank balance sheet and that this effect depends on the degree of limited liabilities protection afforded to the bank: a monetary easing will lead highly capitalized banks to monitor less, while the opposite is true for poorly capitalized banks. Borio and Zhu(2008) agree on this principle, they argue that in the case where the bank face a significant threat of a breach of the minimum capital requirement, a bank will tend to retrench from risk-taking. They present however an exception case where the bank gamble for resurrection in a context of lax supervisory standards.

3. Data, Variables and Econometric Specification

This section first describes the dataset used and the specification to construct the sample. It further presents the dependent variables reflecting the different proxies of bank risk measures, the main explanatory variable reflecting the too low for too long measure in addition to other control variables.

3.1 Data collection and definition of sample

I collect quarterly financial data from the quarterly consolidated report of condition and income that each insured commercial bank in the U.S. submits to the Federal Reserve. These data are available online via the Federal Reserve website. Therefore, I was able to construct a large unbalanced panel dataset, with quarterly income statement and balance sheet data over the period Q1-2001/Q4-2010 representing a total of 331,714 bank quarter observations for 10,524 U.S. commercial insured banks. To ensure that the dataset contains true viable commercial banks, I follow the methodology used by Berger and Bouwan (2009) and I keep a bank if it present all the following specifications: 1) the bank has loans outstanding, 2) the bank has commercial real estate and commercial and industrial loans outstanding, 3) the bank's total deposit is not null, 4) the bank has a positive equity capital, 5) the bank is not a very small bank specifically the bank's total assets exceed $25 million, 6) the unused commitments do not exceed four times total assets, 7) and finally bank's total consumer loans do not exceed 50% of total assets. I also exclude the 2.5% highest and lowest values of some bank level variables used in the regressions. These exclusions let me with a final dataset of 295,294 bank quarter observations for 9,677 banks.

Table 1 Descriptive statistics over the period Q1 2001 – Q4 2010

Variable	*Mean*	*Median*	*Maximum*	*Min*	*Std.Dev.*	*Observations*
TA (th.$)	*1,284,818*	*127,951*	*1,790,000,000*	*25,065*	*23,826,753*	*289,242*
Deposits/TA	*82.37*	*84.02*	*91.93*	*41.99*	*7.33*	*280,812*
TLTA	*64.44*	*66.74*	*89.48*	*11.05*	*14.78*	*286,167*
EQTA	*10.67*	*9.73*	*32.33*	*6.40*	*3.42*	*280,513*
ROA	*0.22*	*0.24*	*0.64*	*-0.68*	*0.19*	*274,624*
TII	*88.89*	*90.18*	*99.13*	*52.50*	*6.79*	*280,613*
0%RWA	*3.42*	*2.01*	*21.39*	*0.00*	*3.76*	*275,977*
100%RWA	*53.57*	*54.52*	*84.94*	*15.17*	*15.32*	*278,747*
RWA	*67.72*	*68.71*	*97.46*	*17.62*	*10.92*	*262,030*
LIQUIDITY	*26.99*	*24.58*	*99.61*	*0.00*	*14.99*	*294,397*
CRELOANS	*15.34*	*13.40*	*89.51*	*0.00*	*11.10*	*290,395*
LLR	*1.38*	*1.26*	*3.50*	*0.53*	*0.52*	*274,958*
LLP	*0.12*	*0.05*	*1.03*	*-0.02*	*0.21*	*288,911*
NPL	*1.14*	*0.66*	*7.29*	*0.00*	*1.35*	*286,865*
NNI	*10.85*	*9.83*	*33.41*	*0.87*	*32.53*	*273,106*
Inefficiency	*35.16*	*34.84*	*58.36*	*13.97*	*10.17*	*273,106*
LC_ON	*26.22*	*27.64*	*95.36*	*-96.58*	*17.83*	*289,235*
LC_OFF	*6.63*	*5.40*	*251.92*	*-10.12*	*7.05*	*289,235*
LC_ALL	*32.85*	*33.64*	*313.12*	*-94.49*	*21.18*	*289,235*
QUARTER_NEGATIVE	*4.97*	*4.00*	*12.00*	*0.00*	*3.52*	*294,500*
REAL	*-0.04*	*0.00*	*3.31*	*-3.36*	*1.53*	*294,500*
GDP_GROWTH	*1.71*	*2.26*	*4.14*	*-4.11*	*1.94*	*294,500*

All variables are in % except for TA

TA= total assets in thousands of $; Deposits/TA= deposits/total assets; TLTA= total loans and leases over total assets; EQTA= equity over total assets; ROA= net income over total assets; ROE= net income over total equity; TII= total interest income over total income; 0%RWA= total assets 0% risk weighted over total assets; 100%RWA= total assets 100% risk weighted over total assets; RWA= (0% total assets 0% risk weighted+20%* total assets 20% risk weighted+50%* total assets 50% risk weighted+100%* total assets 100% risk weighted) over total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS= Commercial real estate loans over total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; NNI= total non interest income over total income; Inerfficiency=total interest expenses/total interest income; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; REAL= the real federal funds rate (federal funds rate minus the CPI inflation rate); GDP_GROWTH= Growth rate of the Gross Domestic Product compared to the same quarter of previous year*

3.2 Bank risk measures

I use different measures to evaluate bank riskiness. I am specifically interested in variables reflecting the riskiness of assets, the quality of monitoring processes and the expansion of banks balance sheet. Therefore, I employ the three following categories of measures:

- ***Risk weighted assets***

Quarterly Call reports provide information about the riskiness of banks' assets. Specifically, the quarterly reports include information about the assets grouped by risk-weighted categories (0%, 20%, 50% and 100%). Each bank when reporting the different composition of its balance sheet, should also provide information about the amount of assets that are 0% risk weighted (alternatively 20%, 50% and 100%) and which do not present any risk. 0% risk weighted assets specifically include all cash-on-hands securities issued by U.S. governments or the OECD in addition to other risk free assets. Appendix 1 shows composition details of each one of these variables as defined by the FED. Using these information I calculate the following ratios:

$$0\%RWA = \text{Total assets 0\% risk weighted} / \text{total assets}$$

$$100\%RWA = \text{Total assets 100\% risk weighted} / \text{total assets}$$

$$RWA = [0*(\text{total assets 0\% risk weighted}) + 20\%*(\text{total assets 20\% risk weighted}) + 50\%*(\text{total assets 50\% risk weighted}) + 100\%*(\text{total assets 100\% risk weighted})] / \text{total assets}$$

A higher percentage of 0% risk weighted assets (*0%RWA)* reveals a lower risk position, whereas a higher percentage of 100% risk weighted assets (*100%RWA)* and a higher percentage of risk-weighted assets (*RWA*) reveal a higher risk position. The use of such measures is helpful since they summarize an ex-ante risk measure accordingly they permit a forward looking on how the bank is managing the portfolio, specifically in term of risk position. Based on the search for yield hypothesis, following a decrease in the policy rates, low return on risk free assets push banks to invest in higher yielding assets, which are at the same time riskier. If such a claim is operative, I expect that too low for too long interest rates to be associated with less proportion of 0% risk weighted assets in a bank's balance sheets and higher proportion of 100% risk weighted assets.

Figure 1 presents the evolution of the aggregate mean of each one of these variables. According to the upper graph, the percentage of 0% risk weighted assets decreased

significantly during the period 2001 till 2008. Specifically, during the first quarter 2001, on average 4.95% of a bank total assets were 0% risk weighted. However this percentage has undergone a steady decrease and reached its minimum value (2.46%) during the first quarter 2008. Alternatively, the middle graph in figure 1 shows an increase in the 100% risk weighted assets which constituted 50.11% of total assets during the first quarter 2001 and increased continuously till the third quarter 2008 during which 100%RWA reached an average of 56.73%. Globally these graphs reflect the fact that banks were investing more in risky assets during the period preceding the crisis.

The categorization of assets depending on the level of risk could be assessed on irrelevant banks estimations, specifically it is good to know whether the weightings 0%, 20%, 50% and 100% are completely objective and well precise by the law or whether these weightings are subject to banks choice and to internal bank ratings. To address this issue, I perform robustness check using the ratio of commercial real estate loans to total loans as proxy of high-risk assets and the liquidity ratio as proxy of low risk assets.

- ***The quality of the bank' loans portfolio***

The performance and riskiness of bank' loans portfolio could be evaluated through a number of ratios commonly used in the bank risk literature such as the non-performing loans ratio, loan loss provisions ratio and loan loss reserves ratio. Such ratios could also give an idea about the bank monitoring processes since "large proportion of nonperforming loans may signal that a bank used fewer resources than usual in the initial credit evaluation and monitoring of its loans "(Mester (1996)).

Non performing loans= (loans past due 90 days + non accrual loans) / total loans and leases

Loan loss reserves= allowance for loan and lease losses / total loans and leases

Loan loss provisions= provisions for allowance for loan and lease losses / total loans and leases

Figure 2 presents the evolution of the aggregate mean of these variables during the whole period Q1-2001 till Q4-2010. The evolution of the three variables is almost similar. It could be noticed that during the pre-crisis period, the evolution of these variables was stable and even decreased until 2007 when the consequence of the risk-taking started to materialize. It is good to notice that compared to the previous measure of risk, the information presented is to

Figure 1 *Aggregate mean of risk weighted assets categories (respectively 0%RWA; 100%RWA and RWA)*

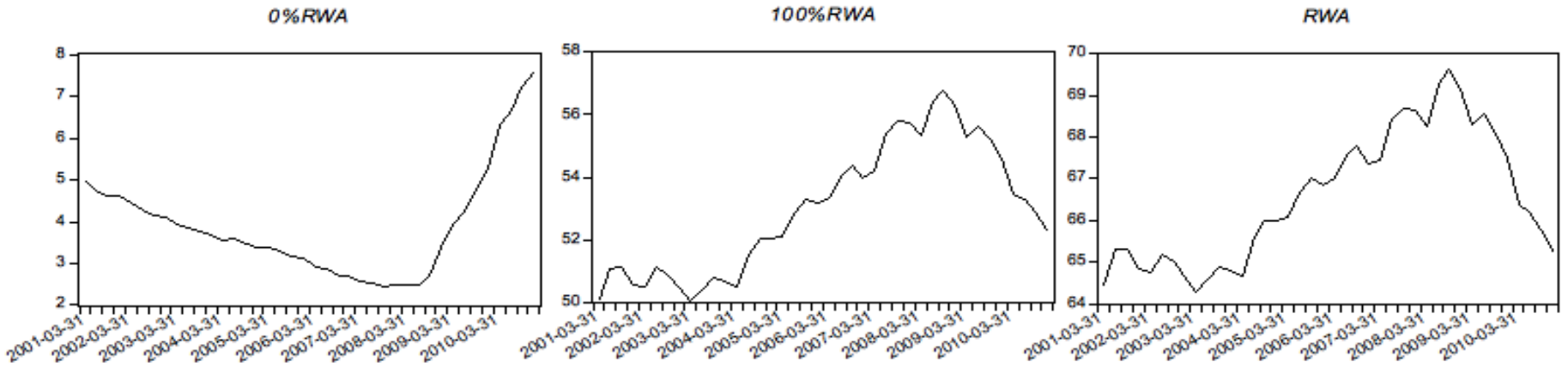
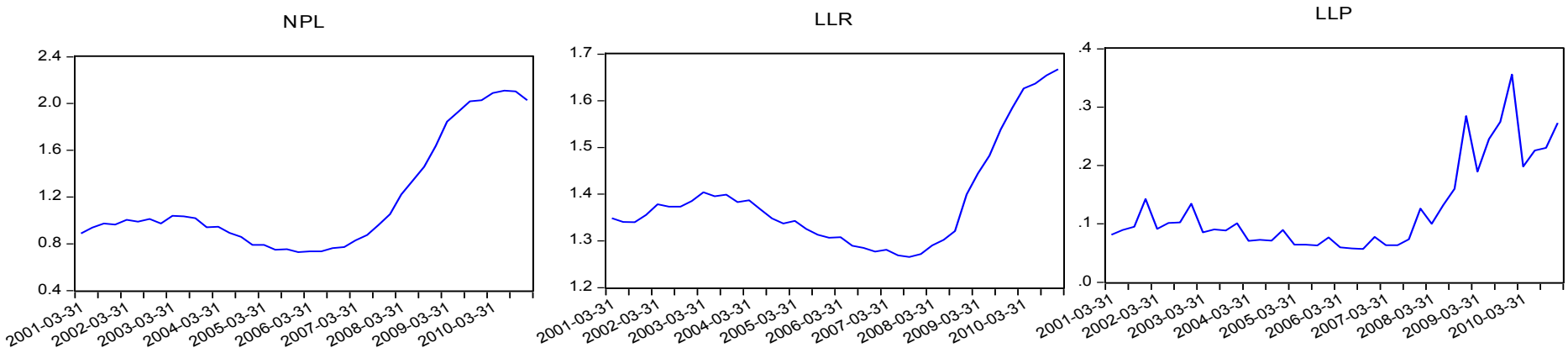


Figure 2 *Aggregate mean of bank' loans portfolio riskiness respectively NPL, LLR and LLP*



some extent contradictious: during the same period when 100% risk weighted assets were increasing and 0% risk weighted assets decreasing the riskiness of the banks' loans, proxied by the NPL, LLR and LLP, was decreasing.

- ***Bank liquidity creation***

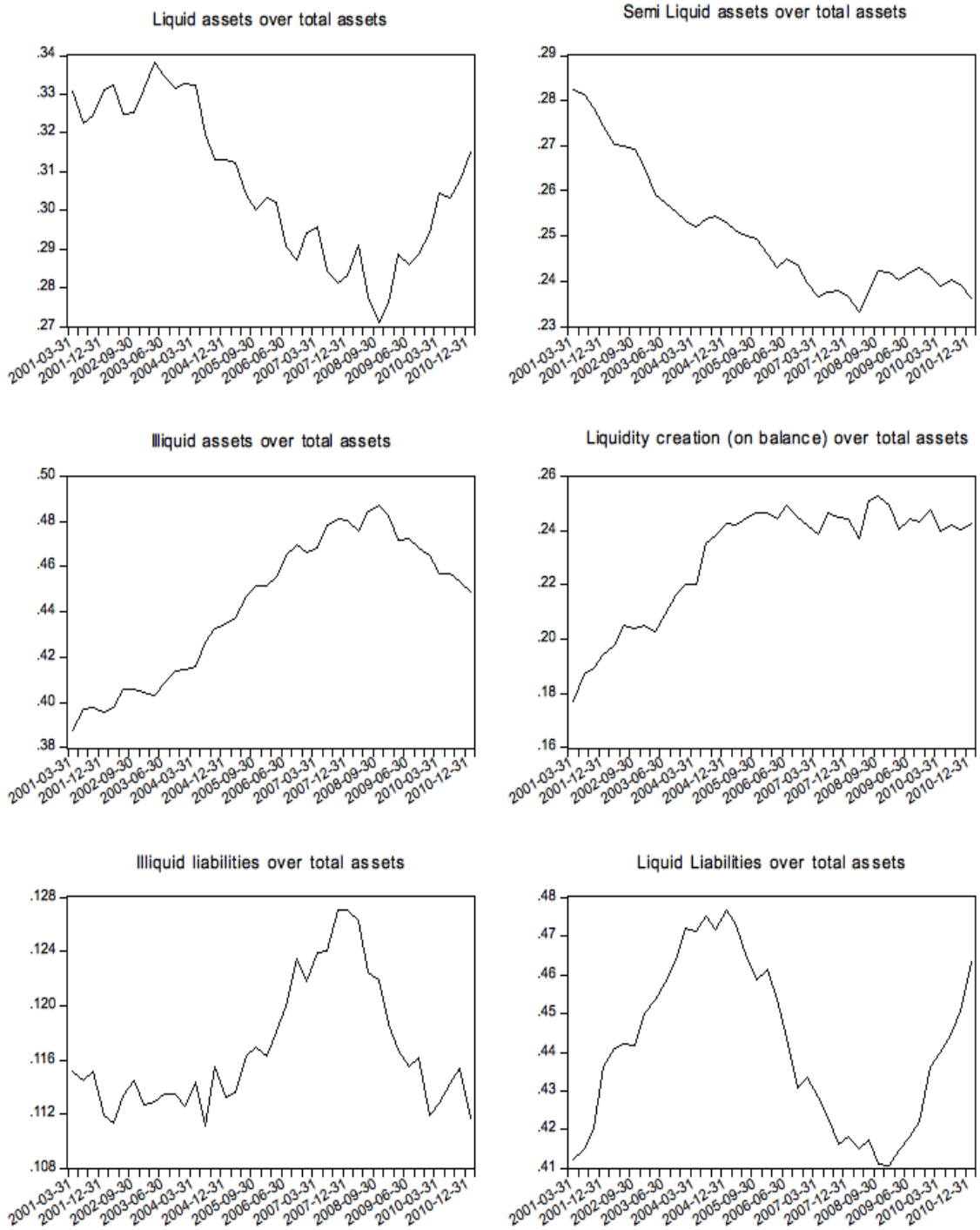
The third category of risk variable reflects bank balance sheet expansion. In 2007 Berger and Bouwman proposed a comprehensive measure of liquidity created by financial institutions. After classifying assets, equity and off balance sheets items into liquid, semi liquid and illiquid items, liquidity creation occur when illiquid assets are transformed to liquid liabilities and liquidity is destroyed when liquid assets are transformed to illiquid liabilities or equity. The intuition is that banks financed in large part by liquid deposits and that holds mostly illiquid loans (and thus a small proportion of liquid assets) performs a significant amount of money creation. According to hypothesis 3, I expect that a longer period of low level of rates to be associated with an increase in the liquidity created by banks.

On balance sheet liquidity creation = 1/2(illiquid assets + liquid liabilities) + 0*(semiliquid assets + semiliquid liabilities) – 1/2*(liquid assets + illiquid liabilities + equity)*

Off balance sheet liquidity creation = 1/2(illiquid guarantees and off balance items) + 0*(semiliquid guarantees) - 1/2*(liquid guarantees + liquid derivatives)*

The composition of liquid, semi liquid and illiquid assets and liabilities is detailed in appendix 2. Figure 3 shows the net decrease in liquid and semi liquid assets in favour of illiquid assets, which increases by 10% during the period that preceded the crisis. Consequently, banks were investing less in liquid assets (such as securities and government loans) and were financing long-term loans. In the liability side, a modest increase by almost 1.2% in illiquid liabilities could be noticed. For the whole period we remark a net increase in the liquidity created by banks. For robustness issues, I use alternatively the quarterly growth of bank total loans as measure of bank asset expansion.

Figure 3 *Aggregate mean of liquid assets, semi liquid assets, illiquid assets and liquidity creation over total assets*



3.3 Too low interest rates for too long measure

To examine empirically the influence of a long period of low level of policy rates on bank risk-taking, an indicator of "too low for too long" interest rates is looked-for. A number of empirical studies provided evidence that the impact of policy rates on bank riskiness have contradictory short and long term effect. For example, Altunbas et al. (2010) find that the effects of changes in the short-term policy rate on banks' risk are positive. The overall quality of a loan portfolio indeed increases (banks' EDFs decrease) if interest rates are lowered. Delis and al. (2012) use simultaneously the lag 1, lag 5, lag 9 and the lag 13 of the change in the real federal rate. They found that low policy rates decrease the riskiness of banks' (proxied by the Z-index and the change in the risk assets) overall loan portfolios in the short term (lag1 and lag5), and then significantly increase it in the medium term (lag9 and lag13). They conclude that holding policy rates low for a short period of time may improve the overall quality of banks' loan portfolios, but holding interest rates low for a prolonged period of time could substantially increase the risk of loan default over the medium term. Considering these issues, I use a variable that account for the time dimension of monetary loosening and construct a quarterly variable reflecting the number of quarters in the previous three years during which the real policy rate is negative. In figures 4 and 5, I plot the evolution of this variable in addition to the evolution of the real federal rate for the period 2001/2010.

Figure 4 *The evolution of the real federal fund rate during the period 1990/2010*

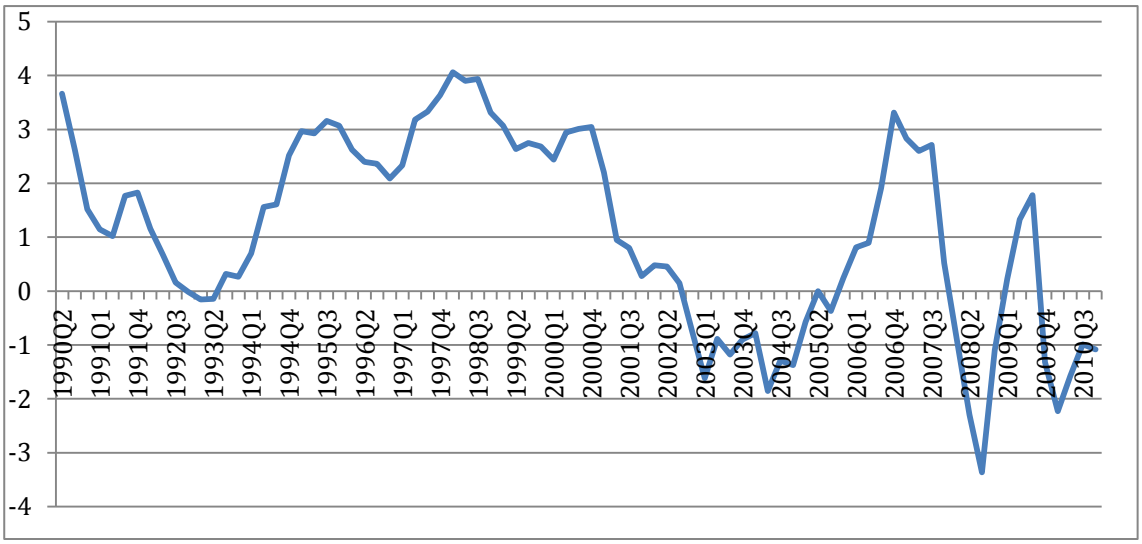
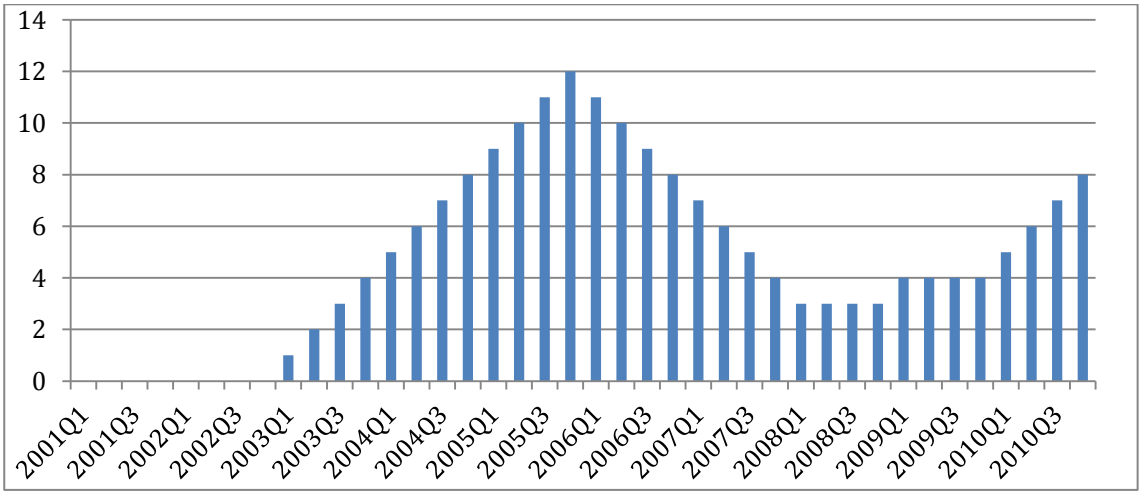


Figure 5 *The number of quarters in the last 3 years during which the real federal rate is negative*



3.4 Control variables

Bank riskiness depends on many variables specific to individual bank characteristics and to macroeconomic conditions. In addition to the monetary policy indicator, I include the following control variables in the estimations: *SIZE, EQ_TA, ROA, INEFFICIENCY, NII,* and *GDP_growth.* The natural logarithm of total assets is used as proxy for bank size. In bank risk literature the size of a financial institution play a significant role in the determination of the bank business model and bank risk strategy. The literature however, discusses a contradictory impact of bank size on bank riskiness. On a first hand, given that the failure of a big bank could trigger an economy-wide recession, larger banks have more probability to be bailed out when faced to failure risk. Accordingly, in failure model estimations based on effective bank failure, one could expect that the probability of bank failure to decrease with the size of bank (TBTF concept). Because of moral hazard problem, larger institutions may pursue acquisitions and growth and increase the riskiness of their assets; accordingly larger banks may be more engaged in higher risk assets. On the other hand, the bank literature discusses the diversification and the strategic advantages of the large size banks: larger banks profit from scale economy (Wheelock and Wilson, 2009; Feng and Serilitis, 2009; Hughes et al., 2001; McAllister and McManus, 1993), and they have better risk management and diversification strategies (Demsetz and Strahan, 1995) which associate larger banks with lower risk. I also control for bank capitalization using the ratio of total equity to total assets. Bank capital plays a critical role in the safety and soundness of individual banks and the banking system. Higher equity ratio represents a cushion against unexpected losses; hence, banks with higher capital ratio face a lower probability of default. Concerning their impact on risk-taking incentives: owners of a bank with high equity ratio have more to lose in case of a failure, therefore they may have more incentives to be prudent, to invest in safer assets (Calem and Rob, 1999; Repullo, 2004; and Morrison and White, 2005) and to screen borrowers (Holmstrom and Tirole, 1997; and Dell-Ariccia and Marquez, 2006, Barth, Caprio and Levine, 2004). Following Delis and Kouretas (2010) and Delis et al. (2011) I also include the ratio of the total expenses over total income as measure for managerial efficiency and the ratio of non-interest income to total income as measure of non-traditional activities. Technically efficient banks may be more capable in managing risks and in transforming bank inputs into bank profits. Accordingly a positive relation is expected between inefficiency and bank risk. Concerning the non-traditional activity ratio, on the one hand increasing income

from non-interest activities could generate diversification benefits and therefore reduce banks' risk. On the other hand, non-interest incomes are known to be highly volatile which could be translated into higher risk (Stiroh and Rumble, 2006). Finally, at the macro level I control for the improvement in economic condition and the borrower's net worth using the GDP growth.

3.5 Econometric model

To test the different hypotheses, I estimate the following empirical model:

$$Risk_{i,t} = \alpha_1 + \alpha_2 QUARTER\_NEGATIVE_t + \alpha_3 C_{i,t\_1} + \alpha_4 M_{t-1} + u_i + \varepsilon_{i,t}$$

Where $Risk_{it}$ is the level of risk for the bank i at quarter t. $C_{i,t-1}$ represents a set of bank level control variables, M_{t-1} is the macroeconomic variable which is common to all banks, $QUARTER\_NEGATIVE_t$ is the number of quarters in the last 12 quarters during which the real federal rate is negative and u_i are the individual fixed effects. All equations are estimated using the fixed effect estimator. T-statistics are corrected for heteroskedasticity following White's methodology. All bank level variables are included with a lag of one quarter.

4. Empirical results

4.1 The impact of too low for too long rates on bank asset riskiness

In table 1, I present the impact of too low for too long interest rates on bank risk-taking for the pre-crisis period 2001Q1/2007Q2. The results show that an increase in the number of quarters during which the real federal rate is negative, is associated with higher risk positions. Specifically concerning the first hypothesis dealing with the categories of assets according to their risk weightings, I find that banks decrease their 0% risk weighted assets and increase their 100% risk weighted assets when real rates are too low for too long, generating a general increase in the total risk weighted assets RWA. Specifically an increase of one standard deviation of the low rates measure, increase the 100%RWA by 6% of its mean, and decrease the 0%RWA by 12% of its mean. Overall the RWA increase by 8% of its mean. For robustness issues, and to address the possible bank subjectivity and moral hazard problem while categorizing assets in the different risk categories, I perform robustness check using the ratio of commercial real estate loans to total assets as proxy of high-risk assets and the ratio of liquid assets including cash, due from depository institutions and securities as

proxy of risk free assets. The results propose a significant association between a long period of low real interest rates and the proportion of real estate loans in a bank balance sheet. In harmony with the risk shifting view, an increase of one standard deviation of the low rates measure increases CRELOANS by 7.9% from its mean. Furthermore, liquid assets decrease by 5.5% from its mean following an increase in one standard deviation of the low rates measure.

Concerning the other control variables, as expected bank size is positively associated with assets' riskiness, specifically an increase in the size of banks increase significantly the proportion of 100% risk weighted assets and the proportion of real estate loans, and decrease the liquidity holding. These findings suggest that larger banks choose to invest in higher risk assets. Excepted its impact on CRELOANS, cost inefficiency is found to be associated with higher risk positions: lower 0%RWA and LIQUIDITY, higher 100%RWA and RWA suggesting that banks with higher ratio of total expenses to total income (higher inefficiency) choose to increase their investments in risky assets relative to less risky assets. I also found that non-traditional income variable is significant in determining the riskiness of assets however the sign is not definite. Finally economic conditions are also found to impact bank investment choices: specifically higher economic growth rate are associated with lower risk positions. Overall this first set of results is consistent with the first hypothesis and show that a substitution effect toward riskier assets is produced following a long period of low interest rates.

Table 1: The effect of too low for too long real rates on banks assets' riskiness, over the period 2001Q1/2007Q2

*This table shows the results of panel fixed effect regressions. ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*
C	*16.6584*	*-11.1936*	*25.6889*	*84.1346*	*-12.8311*
	*[30,12]****	*[-5,60]****	*[17,06]****	*[49,61]****	*[-9,06]****
QUARTER_NEGATIVE (t)	*-0.1187*	*0.2734*	*0.2438*	*-0.2309*	*0.2301*
	*[-56,80]****	*[46,59]****	*[52,69]****	*[-42,22]****	*[63,91]****
SIZE (t-1)	*-0.6473*	*3.3658*	*2.2305*	*-2.8104*	*1.5066*
	*[-21,74]****	*[31,43]****	*[27,66]****	*[-30,80]****	*[19,82]****
EQ_TA (t-1)	*-0.0366*	*-0.0016*	*-0.1078*	*-0.1674*	*-0.0622*
	*[-8,81]****	*[-0,11]*	*[-9,41]****	*[-12,68]****	*[-6,93]****
INEFFICIENCY (t-1)	*-0.0121*	*0.038*	*0.0353*	*-0.0779*	*-0.0209*
	*[-11,92]****	*[13,38]****	*[15,63]****	*[-28,77]****	*[-11,41]****
NII (t-1)	*-0.0067*	*-0.0783*	*-0.0706*	*0.0664*	*-0.0213*
	*[-3,84]****	*[-14,70]****	*[-16,81]****	*[13,37]****	*[-6,06]****
GDP_GROWTH (t-1)	*0.0487*	*-0.3413*	*-0.2873*	*0.4203*	*-0.137*
	*[5,81]****	*[-15,46]****	*[-16,41]****	*[20,00]****	*[-9,97]****
Observations:	*158873*	*160723*	*152851*	*165282*	*165282*
R-squared:	*0.71*	*0.89*	*0.87*	*0.89*	*0.91*
F-statistic:	*42.77*	*147.63*	*117.77*	*148.76*	*184.41*
Std. dep. Var.	*3.39*	*15.16*	*10.78*	*14.63*	*10.73*

4.2 The impact of too low for too long rates on bank monitoring processes

In table 2, I extend the study and investigate whether a too long period of negative real rates impacts bank monitoring processes and investigate whether this relation could be detected empirically using the different proxies of bank loans performance. One problem when studying the impact of loose monetary policy on monitoring processes using usual loan performance proxies is the time dimension problem: on a first hand the impact of monetary policy on bank loan riskiness is different for the outstanding loans and for the new loans: while a decrease in policy rates is suggested to impact negatively the selection of future borrowers (RTC), for the outstanding loans, a decrease in the policy rate translated into a decrease in the lending rate enhance the borrower's net worth by decreasing the debt burden.

Accordingly, disentangling the impact of policy rates on the two categories of loans is of concern. On the other hand, the proxies used for assessing loans quality are backward looking indicator; at a quarter q the level of non-performing loans do not reflect necessarily the level of risk taken by the bank and the quality of monitoring processes during the same quarter. In fact these loans have been granted during different past periods specifically many quarters before they became non-performing, the act of default if happened in quarter q, could be partly explained with variables related to the quarter during which the loan was arranged. If we take for example the level of the non-performing loans of a bank in the aftermath of the subprime crisis, it will be unfair to explain this level of risk with variables related only to the same year of the crisis. I analyse the results taking in consideration these two limitations. The proxy of monetary looseness used in this study addresses partly the time dimension problem by taking into consideration the negative real rates over an extended period of time.

Overall, the results in table 2 show that an extended period of low policy rates is associated with an increase in the borrower net worth. Specifically results show that an increase of one standard deviation of *Quarter_negative* decrease the NPL by 1% from its mean and decrease the LLP by 10.3% from its mean, overall the reserve for loan losses also decrease by 4.3%. These results are in harmony with the balance sheet channel of monetary policy: an extended period of negative real rates has a beneficial effect on the outstanding loans translated into lower non-performing loans ratio. These results do not provide evidence of a decrease in the monitoring processes during expansionary monetary periods as argued by the risk-taking channel and accordingly these results do not confirm hypothesis 2.

Table 2: The effect of too low for too long real rates on banks loan quality, over the period 2001Q1/2007Q2 This table shows the results of panel fixed effect regressions. ****, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*NPL*	*LLR*	*LLP*
C	*-2.6413*	*2.4117*	*-0.0196*
	*[-13,13]****	*[33,72]****	*[-0,58]*
QUARTER_NEGATIVE (t)	*-0.0311*	*-0.0084*	*-0.0047*
	*[-37,54]****	*[-30,75]****	*[-33,83]****
SIZE (t-1)	*0.1955*	*-0.051*	*0.009*
	*[18,14]****	*[-13,31]****	*[4,97]****
EQ_TA (t-1)	*-0.0019*	*0.0062*	*-0.0005*
	[-1,32]	*[11,18]****	*[-1,97]***
INEFFICIENCY (t-1)	*-0.001*	*-0.0045*	*-0.0008*
	*[-2,74]****	*[-35,40]****	*[-13,72]****
NII (t-1)	*0.0055*	*0.0019*	*-0.0006*
	*[7,32]****	*[7,50]****	*[-4,86]****
GDP_GROWTH (t-1)	*0.0131*	*0.0031*	*-0.0013*
	*[4,26]****	*[3,09]****	*[-2,76]****
Observations:	*164511*	*159663*	*165282*
R-squared:	*0.55*	*0.77*	*0.27*
F-statistic:	*22.43*	*60.37*	*6.79*
std dep var	*1.06*	*0.47*	*0.14*

4.3 The impact of too low for too long rates on bank assets expansion

Table 3 reports the results of a too low for too long real rates on bank liquidity creation and loan growth. In accordance with hypothesis 3, results show a positive significant association between a long period of loose monetary policy and bank asset expansion. Specifically an increase of one standard deviation of the too low for too long measure increases the on balance sheet liquidity creation by 6% from its means. Also, the off balance sheet liquidity creation increase by 3.6%. Overall total liquidity creation increase by 6.3%. Alternatively, employing the growth rate of total loans as an indicator of asset expansion gives a similar result: an expanded period of low real rates is associated with higher loans' growth rate.

Regarding to other control variables, the size variable is associated with higher liquidity creation ratios, which is consistent with the fact that larger banks are responsible for the major part of the total liquidity created (berger and bouwman 2009). Inversely, an increase in bank size is associated with lower loan growth ratios, this could be explained by the fact that large banks are more diversified and more active in volatile trading and off-balance sheet activities. The effect equity ratios on on-balance sheet liquidity creation and loan growth ratio is negative, this is consistent with the view that regulators may be able to make banks safer by imposing higher capital requirements. Results also show a negative significant association between inefficiency and liquidity creation proposing that banks that are more capable in transforming input into returns are those who create more liquidity and loans.

Table 3: The effect of too low for too long real rates on banks liquidity creation over the period 2001Q1/2007Q2 This table shows the results of panel fixed effect regressions. ****, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*29.2399*	*3.4387*	*32.6787*	*62.9528*
	*[14,18]****	*[4,29]****	*[13,45]****	*[15,97]****
QUARTER_NEGATIVE	*0.3163*	*0.0753*	*0.3916*	*0.1806*
	*[53,24]****	*[32,45]****	*[57,58]****	*[18,69]****
SIZE(t-1)	*0.4063*	*0.1496*	*0.5559*	*-2.6408*
	*[3,67]****	*[3,43]****	*[4,26]****	*[-12,29]****
EQ_TA(t-1)	*-0.5922*	*0.0373*	*-0.555*	*-0.3475*
	*[-40,20]****	*[5,72]****	*[-31,48]****	*[-13,42]****
INEFFICIENCY(t-1)	*-0.1244*	*-0.0045*	*-0.1288*	*-0.0638*
	*[-42,44]****	*[-3,75]****	*[-37,94]****	*[-11,24]****
NII(t-1)	*0.0027*	*0.005*	*0.0077*	*-0.0275*
	[0,50]	*[1,72]**	*[1,19]*	*[-2,94]****
GDP_GROWTH(t-1)	*-0.4008*	*-0.0501*	*-0.4509*	*-0.1672*
	*[-17,97]****	*[-5,65]****	*[-17,65]****	*[-4,30]****
Observations:	*165278*	*165278*	*165278*	*138995*
R-squared:	*0.92*	*0.86*	*0.92*	*0.47*
F-statistic:	*208.04*	*109.99*	*220.35*	*14.41*
std dep var	*18.26*	*7.19*	*21.92*	*10.57*

4.4 Bank capitalization and the Risk taking channel

Previous results showed that a prolonged period of negative real rates is associated with shifting toward riskier assets and with asset expansion. I further investigate whether banks characteristics, specifically differences in banks capitalization, impact the relation between a long period of low interest rates and bank riskiness as proposed by Dell'Ariccia et al. (2010). Therefore, in harmony with the FDIC classification, I differentiate three categories of banks: under-capitalized banks for which the total risk-based capital ratio is lower than 8%, adequately capitalized banks for which the total-risk based capital ratio is between 8% and 10% and well capitalized banks those for which the total risk-based capital ratio is greater than 10%. I create two dummy variables *undercap* and *adcap* that represent the first two categories of bank' capitalization. *Undercap* takes the value of 1 in the quarter during which the total risk- based capital ratio is lower than 8%, and *adcap* takes the value of 1 in the quarter during which the total risk-based capital ratio is greater than 8% but lower than 10%. According to this classification, 98% of banks' level observations have a total risk-based capital ratio greater than 10% and therefore are well capitalised. I first consider the impact of an extended period of low interest rates on bank behaviour by differentiating bank level observations for which the total risk based capital ratio is under 8% or between 8% and 10%. Alternatively, I consider the behaviour of these banks for each the whole period that precede and follow the event of the breach of the capital regulation (the breach is considered to be 8% for the case of undercapitalized banks and between 8% and 10% for the adequately capitalized banks).

I begin with the first objective and run equations by introducing to the baseline model the two dummy variables *undercap* and *adcap*. To measure the impact of too low for too long interest rates on the risk-taking for the three categories of banks, I introduce two interaction variables by multiplying the variable reflecting the loosening of monetary policy and each one of the dummy variables. According to hypothesis 4, it is expected that for banks facing capital constraints, this is specifically the case of undercapitalized and adequately capitalized banks, the impact of a long period of low rates should be less pronounced compared to highly capitalized banks.

Results are shown in table 4. Concerning well capitalized banks, the impact of a long period of low policy rates is similar to previous assumption: specifically well capitalized

banks increase asset expansion and investments in risky assets following a longer period of low policy rates, also, results provide no evidence on a loosening in monitoring processes.

Concerning undercapitalized and adequately capitalized banks and looking at the sign and the significance associated to the monetary policy indicator, I find that the positive relation between a long period of low real rates and the risk-taking reflected by the assets riskiness measures still operative for the different categories of banks. Also, for both adequately and undercapitalized banks, the magnitude of the effect of a too long period of loose monetary policy specifically on the asset riskiness is greater: A one standard deviation increase in the number of quarters during which the real rate is negative increases the CRELOANS by 21.5% from its mean in the case of undercapitalized banks and by 7.8% in the case of adequately capitalized banks and 7.2% for well-capitalized banks. Similar analysis also applied for the RWA and the 100%RWA.

Furthermore, if we look at the asset expansion measures, we notice that a one standard deviation increase of the number of quarters during which the real rate is negative increases the on balance sheet liquidity creation by 6% for the highly capitalized banks, it also increases it by 4.5% from its mean for the adequately capitalized banks, liquidity creation by undercapitalized banks also increases but the coefficient is not statistically significant. Also for adequately capitalized banks, a negative coefficient associated with the loan growth measure is detected following a long period of low real rates.

All in all concerning the quality and the riskiness of assets there is a clear risk substitution effect toward higher risk assets following a long period of low rates for all types of banks. Specifically for banks facing capital constraints (undercapitalized banks) this impact is much more pronounced. In contradiction with Dell Ariccia et al. (2010), these results provide no evidence that constrained banks retrench from risk taking following a period of monetary loosening.

Table 4 The effect of too low for too long real rates for undercapitalized, adequately capitalized and well-capitalized banks during 2001Q1/2007Q2

*This table shows the results of panel fixed effect regressions. ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE and the dummy variables; ADCAP= dummy variable takes the value of 1 if total risk based capital ratio is greater that 8% and lower than 10% and 0 otherwise; UNDERCAP: dummy variable that takes the value of 1 if the total risk based capital ratio is lower than 8% and 0 otherwise; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*16.8961*	*-12.1447*	*24.9072*	*84.6414*	*-12.8264*	*-2.6099*	*2.4421*	*-0.0411*	*27.9811*	*3.3224*	*31.3035*	*60.1628*
	*[30,47]****	*[-6,08]****	*[16,54]****	*[49,85]****	*[-9,05]****	*[-12,95]****	*[34,02]****	*[-1,21]*	*[13,56]****	*[4,16]****	*[12,89]****	*[15,22]****
QUARTER_NEGATIVE	*-0.1191*	*0.2744*	*0.2446*	*-0.2313*	*0.23*	*-0.0311*	*-0.0084*	*-0.0046*	*0.3181*	*0.0754*	*0.3935*	*0.1837*
	*[-56,95]****	*[46,83]****	*[52,94]****	*[-42,31]****	*[63,87]****	*[-37,62]****	*[-30,98]****	*[-33,82]****	*[53,63]****	*[32,37]****	*[57,92]****	*[19,04]****
UNDERCAP	*-0.0896*	*2.0317*	*0.6706*	*-0.6563*	*-2.546*	*1.3639*	*-0.1536*	*0.3835*	*1.7167*	*-0.6072*	*1.1096*	*-0.3674*
	[-0,22]	*[1,30]*	*[0,61]*	*[-0,51]*	*[-1,34]*	*[2,81]****	*[-1,20]*	*[4,42]****	*[1,10]*	*[-1,31]*	*[0,64]*	*[-0,11]*
ADCAP	*-0.5958*	*2.8748*	*2.2381*	*-1.6498*	*0.0124*	*-0.0935*	*-0.0776*	*0.0587*	*3.5689*	*0.3678*	*3.9367*	*6.5942*
	*[-9,63]****	*[12,46]****	*[13,30]****	*[-9,45]****	*[0,07]*	*[-3,18]****	*[-6,67]****	*[7,51]****	*[16,56]****	*[3,17]****	*[15,21]****	*[15,12]****
*UNDERCAP*QUARTER_NEGATIVE*	*-0.1194*	*0.2962*	*0.2318*	*0.0064*	*0.4526*	*-0.1087*	*0.0408*	*-0.0062*	*-0.1114*	*0.1025*	*-0.0089*	*0.0413*
	[-1,51]	*[1,05]*	*[1,14]*	*[0,03]*	*[1,61]*	*[-1,35]*	*[1,44]*	*[-0,39]*	*[-0,47]*	*[0,82]*	*[-0,03]*	*[0,07]*
*ADCAP*QUARTER_NEGATIVE*	*0.0441*	*0.027*	*-0.0132*	*-0.0721*	*0.0175*	*0.003*	*0.0047*	*-0.0007*	*-0.0889*	*0.0111*	*-0.0778*	*-0.3451*
	*[4,22]****	*[0,66]*	*[-0,45]*	*[-2,40]***	*[0,58]*	*[0,66]*	*[2,51]***	*[-0,58]*	*[-2,41]***	*[0,51]*	*[-1,70]**	*[-5,67]****
SIZE (t-1)	*-0.6584*	*3.4062*	*2.2645*	*-2.8306*	*1.5064*	*0.194*	*-0.0524*	*0.0099*	*0.4618*	*0.1544*	*0.6162*	*-2.5091*
	*[-22,07]****	*[31,80]****	*[28,09]****	*[-30,98]****	*[19,81]****	*[17,98]****	*[-13,63]****	*[5,47]****	*[4,17]****	*[3,55]****	*[4,72]****	*[-11,65]****
EQ_TA (t-1)	*-0.039*	*0.0139*	*-0.0961*	*-0.1771*	*-0.0621*	*-0.0021*	*0.0059*	*-0.0002*	*-0.5751*	*0.0393*	*-0.5358*	*-0.3196*
	*[-9,36]****	*[0,97]*	*[-8,36]****	*[-13,39]****	*[-6,91]****	*[-1,50]*	*[10,57]****	*[-0,62]*	*[-39,02]****	*[6,01]****	*[-30,37]****	*[-12,34]****
INEFFICIENCY (t-1)	*-0.0121*	*0.038*	*0.0351*	*-0.078*	*-0.0209*	*-0.001*	*-0.0045*	*-0.0008*	*-0.1245*	*-0.0045*	*-0.129*	*-0.0647*
	*[-11,83]****	*[13,38]****	*[15,59]****	*[-28,80]****	*[-11,42]****	*[-2,71]****	*[-35,39]****	*[-13,80]****	*[-42,58]****	*[-3,76]****	*[-38,07]****	*[-11,42]****
NII(t-1)	*-0.0066*	*-0.0787*	*-0.0709*	*0.0665*	*-0.0213*	*0.0055*	*0.0019*	*-0.0006*	*0.0023*	*0.005*	*0.0073*	*-0.0286*
	*[-3,77]****	*[-14,80]****	*[-16,91]****	*[13,39]****	*[-6,05]****	*[7,31]****	*[7,55]****	*[-4,98]****	*[0,42]*	*[1,72]**	*[1,12]*	*[-3,06]****
GDP_GROWTH(t-1)	*0.0482*	*-0.3397*	*-0.286*	*0.4196*	*-0.1373*	*0.0131*	*0.003*	*-0.0013*	*-0.3983*	*-0.05*	*-0.4483*	*-0.1646*
	*[5,76]****	*[-15,42]****	*[-16,37]****	*[19,99]****	*[-9,99]****	*[4,26]****	*[3,02]****	*[-2,64]****	*[-17,89]****	*[-5,65]****	*[-17,58]****	*[-4,24]****

Observations:	*158873*	*160723*	*152851*	*165282*	*165282*	*164511*	*159663*	*165282*	*165278*	*165278*	*165278*	*138995*
R-squared:	*0.71*	*0.89*	*0.87*	*0.89*	*0.91*	*0.55*	*0.77*	*0.27*	*0.92*	*0.86*	*0.92*	*0.47*
F-statistic:	*42.79*	*148.05*	*118.07*	*148.92*	*184.34*	*22.44*	*60.4*	*6.89*	*208.69*	*109.98*	*221.01*	*14.5*
C2+C5 undercap	*-0.2385*	*0.5706*	*0.4764*	*-0.2249*	*0.6826*	*-0.1398*	*0.0324*	*-0.0108*	*0.2067*	*0.1779*	*0.3846*	*0.225*
wald test, t stat	*[-3,01]****	*[2,02]***	*[2,33]***	*[-1,09]*	*[2,43]***	*[-1,73]**	*[1,14]*	*[-0,67]*	*[0,88]*	*[1,42]*	*[1,37]*	*[0,40]*
C2+C6 adcap	*-0.075*	*0.3014*	*0.2314*	*-0.3034*	*0.2475*	*-0.0281*	*-0.0037*	*-0.0053*	*0.2292*	*0.0865*	*0.3157*	*-0.1614*
wald test, t stat	*[-7,09]****	*[7,29]****	*[7,90]****	*[-9,95]****	*[8,11]****	*[-6,02]****	*[-1,98]***	*[-4,36]****	*[6,14]****	*[3,97]****	*[6,85]****	*[-2,63]****

I proceed with the second objective to test the impact of an extended period of low policy rates on undercapitalized and adequately capitalized banks during each the period that preceded and that followed the event of the breach of the capital regulation. I run the equations by introducing to the baseline model the two dummy variables *UNDERCAP_BEFORE* [32] and *UNDERCAP_AFTER* [33] (alternatively ADCAP_BEFORE and ADCAP_AFTER) that represent the banks in the period that precede the undercapitalization and the banks in the period that follows the undercapitalization. To measure the impact of the too low for too long interest rates on the risk-taking of the undercapitalized banks (respectively the adequately capitalized banks) during the period that precedes and follows the event of undercapitalization, I introduce two interaction variables by multiplying the variable reflecting the loosening of monetary policy and each one of the dummy variables *UNDERCAP_BEFORE* and *UNDERCAP_AFTER* (alternatively ADCAP_BEFORE and ADCAP_AFTER). Results are presented in table 4A and table 4B respectively.

The results in Table 4A suggest that for undercapitalized banks, a long period of low interest rates is associated with an increase in risk-taking during both periods that precede and that follow the breach of capital regulation. Also this increase in the risk-taking is much more pronounced when compared to other banks (the absolute value of the coefficients is higher): Specifically for banks that face a breach of the capital regulation (total risk based K ratio<8%) in a specific quarter: during the period that preceded the breach of capital constraint, a 1% increase of the QUARTER_NEGATIVE increase by 0.41% the 100%RWA for those banks, also during the period that follow the breach of capital constrain these banks continue to increase their 100%RWA by 0.37% following a 1% increase of the QUARTER_NEGATIVE (same analysis and conclusions for RWA, CRELOANS, LC_ON, LC_ALL) the other banks increase only by 0.27% the 100%RWA following a 1% increase in the QUARTER_NEGATIVE.

In table 4B, I present the results for the adequately capitalized banks. Specifically the results show that a long period of low interest rates is associated with an increase in risk-taking during the period that precedes the breach of capital regulations. During the period that follows the quarter of the regulation breach, a long period of low policy rates is always

[32] *UNDERCAP_BEFORE* takes the value of 1 in all the quarters that precede the quarter during which undercap=1 (total risk based capital ratio<8%)
[33] *UNDERCAP_AFTER* takes the value of 1 in all the quarters that follow the quarter during which undercap=1.

associated with an increase in the risk-taking, however the absolute value of the coefficient clearly decreased (almost divided by 7 over other banks) this is specifically the case concerning the investments choice (0% RWA, RWA 100%, liquidity and CRELOANS) and the expansion of assets (liquidity creation and loans growth).

Accordingly, I conclude that a long period of low interest rates increased risk-taking for both adequately capitalized banks and undercapitalized banks, more intensively than the other banks during the period that preceded their undercapitalization. However, there is difference in behaviour between the undercapitalized banks and the adequately capitalized banks following the event of the breach of the capital constraint: for the undercapitalized banks, once they become undercapitalized, and looking at the period that follows the event of undercapitalization these banks do not retrench from risk taking, quite the opposite they gamble for resurrection and a long period of low rates continue to be associated with an increase in risk taking. For adequately capitalized banks, in the period that follows the breach of the capital constraint these banks continue to take risk but at a much lower level compared to the other well-capitalized banks.

Table 4A The effect of too low for too long real rates for undercapitalized banks: during the whole period that precede and the whole period that follow the event of the breach of the capital regulation *(total risk based capital ratio<8%)*

*This table shows the results of panel fixed effect regressions. ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE and the dummy variables; UNDERCAP_BEFORE takes the value of 1 in all the quarters that precede the quarter during which undercap=1 (total risk based capital ratio<8%); UNDERCAP_AFTER takes the value of 1 in all the quarters that follow the quarter during which undercap=1; 0%RWA is the total assets 0% risk weighted over total assets; 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS=Commercial real estate loans over total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year;; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*17.2005*	*-9.7069*	*26.8505*	*82.7876*	*-12.9786*	*-2.8149*	*2.3969*	*-0.0334*	*29.172*	*4.5684*	*33.7404*	*64.7522*
	*[30,95]****	*[-4,85]****	*[17,74]****	*[48,57]****	*[-9,21]****	*[-13,94]****	*[33,35]****	*[-0,98]*	*[14,13]****	*[5,74]****	*[13,87]****	*[16,32]****
QUARTER_NEGATIVE	*-0.1201*	*0.2695*	*0.2402*	*-0.2271*	*0.2303*	*-0.0305*	*-0.0083*	*-0.0046*	*0.3165*	*0.0727*	*0.3892*	*0.1758*
	*[-57,19]****	*[45,71]****	*[51,81]****	*[-41,32]****	*[63,95]****	*[-36,80]****	*[-30,60]****	*[-33,52]****	*[53,07]****	*[31,52]****	*[57,08]****	*[18,19]****
UNDERCAP_BEFORE	*1.471*	*3.6631*	*1.7149*	*-0.5141*	*-2.5887*	*0.2917*	*-0.1835*	*0.2538*	*3.0484*	*-2.2215*	*0.8269*	*5.9512*
	*[3,19]****	*[2,43]***	*[1,52]*	*[-0,55]*	*[-2,65]****	*[1,27]*	*[-2,35]***	*[5,02]****	*[2,53]***	*[-1,55]*	*[0,47]*	*[2,35]***
UNDERCAP_AFTER	*0.599*	*1.2366*	*-0.3257*	*1.1018*	*1.158*	*0.792*	*0.0394*	*0.2013*	*-0.4406*	*-1.5158*	*-1.9563*	*1.3667*
	[1,29]	*[0,83]*	*[-0,29]*	*[1,27]*	*[1,24]*	*[3,22]****	*[0,52]*	*[3,93]****	*[-0,36]*	*[-1,30]*	*[-1,20]*	*[0,54]*
*QUARTER_NEGATIVE*UNDERCAP_BEFORE*	*0.0548*	*0.1431*	*0.1146*	*-0.1179*	*-0.0445*	*-0.0145*	*-0.0036*	*-0.0003*	*0.021*	*0.0943*	*0.1152*	*0.171*
	*[9,07]****	*[7,83]****	*[8,53]****	*[-7,95]****	*[-3,16]****	*[-6,38]****	*[-4,81]****	*[-0,82]*	*[1,14]*	*[8,16]****	*[5,01]****	*[5,35]****
*QUARTER_NEGATIVE*UNDERCAP_AFTER*	*-0.028*	*0.1076*	*0.1374*	*-0.14*	*0.0872*	*-0.0643*	*0.0073*	*-0.0048*	*0.0032*	*-0.1419*	*-0.1388*	*0.0772*
	[-0,85]	*[1,27]*	*[1,98]***	*[-1,49]*	*[1,32]*	*[-3,75]****	*[1,17]*	*[-1,67]**	*[0,04]*	*[-1,86]**	*[-1,26]*	*[0,46]*
SIZE (t-1)	*-0.6827*	*3.2713*	*2.1605*	*-2.7343*	*1.5247*	*0.204*	*-0.0495*	*0.0089*	*0.399*	*0.0941*	*0.4932*	*-2.7622*
	*[-22,84]****	*[30,51]****	*[26,65]****	*[-29,81]****	*[20,16]****	*[18,89]****	*[-12,85]****	*[4,86]****	*[3,60]****	*[2,21]***	*[3,77]****	*[-12,79]****
EQ_TA (t-1)	*-0.0365*	*-0.0018*	*-0.1084*	*-0.1664*	*-0.064*	*-0.0017*	*0.0061*	*-0.0005*	*-0.5908*	*0.0368*	*-0.554*	*-0.3469*

	*[-8,81]****	*[-0,12]*	*[-9,45]****	*[-12,59]****	*[-7,15]****	*[-1,17]*	*[11,00]****	*[-1,75]**	*[-40,07]****	*[5,65]****	*[-31,38]****	*[-13,39]****
INEFFICIENCY (t-1)	*-0.0118*	*0.0389*	*0.0359*	*-0.0786*	*-0.0212*	*-0.0011*	*-0.0045*	*-0.0008*	*-0.1242*	*-0.0039*	*-0.1281*	*-0.0614*
	*[-11,56]****	*[13,67]****	*[15,90]****	*[-28,97]****	*[-11,62]****	*[-2,91]****	*[-35,62]****	*[-13,67]****	*[-42,35]****	*[-3,26]****	*[-37,67]****	*[-10,81]****
NII (t-1)	*-0.0059*	*-0.0761*	*-0.0687*	*0.0645*	*-0.0215*	*0.0052*	*0.0018*	*-0.0006*	*0.0027*	*0.0064*	*0.0091*	*-0.0258*
	*[-3,36]****	*[-14,29]****	*[-16,36]****	*[12,97]****	*[-6,12]****	*[6,97]****	*[7,41]****	*[-4,99]****	*[0,49]*	*[2,27]***	*[1,40]*	*[-2,76]****
GDP_GROWTH (t-1)	*0.0484*	*-0.3422*	*-0.2882*	*0.4213*	*-0.1373*	*0.0132*	*0.0031*	*-0.0013*	*-0.4005*	*-0.0508*	*-0.4513*	*-0.1627*
	*[5,78]****	*[-15,52]****	*[-16,48]****	*[20,06]****	*[-10,00]****	*[4,31]****	*[3,10]****	*[-2,73]****	*[-17,95]****	*[-5,75]****	*[-17,67]****	*[-4,19]****
Observations:	*158873*	*160723*	*152851*	*165282*	*165282*	*164511*	*159663*	*165282*	*165278*	*165278*	*165278*	*138995*
R-squared:	*0.71*	*0.89*	*0.87*	*0.89*	*0.91*	*0.55*	*0.77*	*0.27*	*0.92*	*0.86*	*0.92*	*0.47*
F-statistic:	*42.82*	*147.69*	*117.81*	*148.77*	*184.61*	*22.45*	*60.43*	*6.83*	*208.01*	*110.19*	*220.39*	*14.42*
C2+C5 before	*-0.0653*	*0.4126*	*0.3548*	*-0.345*	*0.1858*	*-0.045*	*-0.0119*	*-0.0049*	*0.3375*	*0.167*	*0.5044*	*0.3468*
Wald test, t stat	*[-10.53]****	*[22.06]****	*[25.53]****	*[-22.37]****	*[13.08]****	*[-19.03]****	*[-15.56]****	*[-12.09]****	*[17.92]****	*[14.22]****	*[21.44]****	*[10.57]****
C2+C6 after	*-0.1481*	*0.3771*	*0.3776*	*-0.3671*	*0.3175*	*-0.0948*	*-0.001*	*-0.0094*	*0.3197*	*-0.0692*	*0.2504*	*0.253*
Wald test, t stat	*[-4.48]****	*[4.44]****	*[5.43]****	*[-3.93]****	*[4.79]****	*[-5.53]****	*[-0.15]*	*[-3.25]****	*[3.77]****	*[-0.91]*	*[2.28]***	*[1.51]*

Table 4B The effect of too low for too long real rates for adequately capitalized banks: during the whole period that precede and the whole period that follow the event of the breach of the capital regulation *(8%<total risk based capital ratio<10%)*

*This table shows the results of panel fixed effect regressions. ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE and the dummy variables; ADCAP_BEFORE takes the value of 1 in all the quarters that precede the quarter during which adcap=1 (8%<total risk based capital ratio<10%); ADCAP_AFTER takes the value of 1 in all the quarters that follow the quarter during which adcap=1; 0%RWA is the total assets 0% risk weighted over total assets; 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS=Commercial real estate loans over total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year;; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*17.7685*	*-6.9674*	*29.0437*	*78.2661*	*-9.1602*	*-2.4674*	*2.5475*	*-0.0305*	*30.3317*	*4.385*	*34.7167*	*53.8674*
	*[31,02]****	*[-3,39]****	*[18,65]****	*[44,47]****	*[-6,41]****	*[-11,66]****	*[33,85]****	*[-0,85]*	*[14,20]****	*[5,32]****	*[13,81]****	*[13,23]****
QUARTER_NEGATIVE	*-0.1245*	*0.2715*	*0.2428*	*-0.2256*	*0.2279*	*-0.0308*	*-0.0084*	*-0.0045*	*0.3254*	*0.0715*	*0.3969*	*0.1892*
	*[-58,23]****	*[46,10]****	*[52,02]****	*[-40,79]****	*[62,81]****	*[-36,76]****	*[-30,66]****	*[-32,87]****	*[54,53]****	*[29,94]****	*[58,04]****	*[19,50]****
ADCAP_BEFORE	*-0.402*	*0.8456*	*0.7125*	*-0.0553*	*-1.0902*	*-0.1292*	*-0.0714*	*0.0378*	*1.2066*	*0.2562*	*1.4629*	*4.2678*
	*[-7,07]****	*[4,36]****	*[4,93]****	*[-0,36]*	*[-7,86]****	*[-5,36]****	*[-8,09]****	*[7,19]****	*[6,38]****	*[3,39]****	*[6,68]****	*[13,19]****
ADCAP_AFTER	*-0.5068*	*3.0951*	*2.5096*	*-2.6897*	*0.8125*	*0.0252*	*-0.0164*	*0.0393*	*3.3153*	*0.2517*	*3.5671*	*1.637*
	*[-8,58]****	*[15,57]****	*[16,97]****	*[-17,26]****	*[5,42]****	*[1,05]*	*[-1,83]**	*[7,40]****	*[17,50]****	*[3,04]****	*[16,16]****	*[4,87]****
*QUARTER_NEGATIVE*ADCAP_BEFORE*	*0.0352*	*0.1982*	*0.1477*	*-0.1788*	*0.0644*	*-0.0012*	*-0.0027*	*-0.0004*	*0.1253*	*0.0512*	*0.1765*	*0.0772*
	*[8,83]****	*[15,88]****	*[15,66]****	*[-17,07]****	*[7,25]****	*[-0,78]*	*[-5,28]****	*[-1,59]*	*[10,07]****	*[9,82]****	*[12,29]****	*[3,43]****
*QUARTER_NEGATIVE*ADCAP_AFTER*	*0.0447*	*-0.1919*	*-0.1494*	*0.1415*	*-0.0744*	*-0.0072*	*0.0023*	*-0.0008*	*-0.2791*	*0.0081*	*-0.271*	*-0.1535*
	*[8,84]****	*[-11,75]****	*[-12,53]****	*[10,70]****	*[-6,50]****	*[-3,38]****	*[3,18]****	*[-2,03]**	*[-17,85]****	*[0,96]*	*[-14,34]****	*[-5,50]****
SIZE (t-1)	*-0.7009*	*3.103*	*2.0215*	*-2.473*	*1.3147*	*0.1875*	*-0.0571*	*0.009*	*0.3074*	*0.0925*	*0.3999*	*-2.2205*
	*[-22,75]****	*[28,16]****	*[24,26]****	*[-26,15]****	*[17,15]****	*[16,56]****	*[-14,18]****	*[4,70]****	*[2,68]****	*[2,07]**	*[2,96]****	*[-10,02]****
EQ_TA (t-1)	*-0.0409*	*0.0153*	*-0.0945*	*-0.1747*	*-0.0656*	*-0.0024*	*0.0055*	*-0.0003*	*-0.5683*	*0.0388*	*-0.5295*	*-0.3033*
	*[-9,82]****	*[1,07]*	*[-8,19]****	*[-13,16]****	*[-7,27]****	*[-1,66]**	*[9,80]****	*[-1,14]*	*[-38,38]****	*[5,93]****	*[-29,87]****	*[-11,69]****

INEFFICIENCY (t-1)	*-0.0119*	*0.0421*	*0.0385*	*-0.0815*	*-0.0197*	*-0.001*	*-0.0045*	*-0.0008*	*-0.1211*	*-0.0037*	*-0.1248*	*-0.0618*
	*[-11,69]****	*[14,84]****	*[17,08]****	*[-30,05]****	*[-10,79]****	*[-2,74]****	*[-35,76]****	*[-13,51]****	*[-41,36]****	*[-3,09]****	*[-36,78]****	*[-10,89]****
NII (t-1)	*-0.0053*	*-0.076*	*-0.0689*	*0.0636*	*-0.0203*	*0.0054*	*0.0019*	*-0.0006*	*0.0021*	*0.0063*	*0.0084*	*-0.0289*
	*[-3,05]****	*[-14,34]****	*[-16,47]****	*[12,82]****	*[-5,80]****	*[7,19]****	*[7,47]****	*[-4,99]****	*[0,40]*	*[2,18]***	*[1,30]*	*[-3,11]****
GDP_GROWTH (t-1)	*0.047*	*-0.3444*	*-0.2896*	*0.4238*	*-0.1388*	*0.0131*	*0.0031*	*-0.0013*	*-0.4008*	*-0.0515*	*-0.4522*	*-0.1645*
	*[5,61]****	*[-15,66]****	*[-16,61]****	*[20,23]****	*[-10,12]****	*[4,27]****	*[3,11]****	*[-2,66]****	*[-18,01]****	*[-5,81]****	*[-17,75]****	*[-4,24]****
Observations:	*158873*	*160723*	*152851*	*165282*	*165282*	*164511*	*159663*	*165282*	*165278*	*165278*	*165278*	*138995*
R-squared:	*0.71*	*0.89*	*0.87*	*0.89*	*0.91*	*0.55*	*0.77*	*0.27*	*0.92*	*0.86*	*0.92*	*0.47*
F-statistic:	*42.85*	*148.42*	*118.43*	*149.41*	*184.74*	*22.43*	*60.49*	*6.81*	*209.05*	*110.12*	*221.39*	*14.53*
C2+C5	*-0.0893*	*0.4697*	*0.3905*	*-0.4044*	*0.2923*	*-0.032*	*-0.0111*	*-0.0049*	*0.4507*	*0.1227*	*0.5734*	*0.2664*
Wald test, t stat	*[-20,99]****	*[35,15]****	*[38,44]****	*[-35,70]****	*[31,67]****	*[-19,03]****	*[-19,68]****	*[-16,44]****	*[33,73]****	*[22,69]****	*[37,28]****	*[11,21]****
C2+C6	*-0.0798*	*0.0796*	*0.0934*	*-0.0841*	*0.1535*	*-0.038*	*-0.0061*	*-0.0053*	*0.0463*	*0.0796*	*0.1259*	*0.0357*
Wald test, t stat	*[-15,29]****	*[4,73]****	*[7,61]****	*[-6,09]****	*[13,22]****	*[-17,21]****	*[-8,33]****	*[-13,30]****	*[2,86]****	*[9,54]****	*[6,49]****	*[1,25]*

5. Robustness checks

To check the robustness of the results, I conduct several sensitivity analyses:

- *Too low interest rates for too long measures*

First, I determine the variable reflecting the loosening of monetary policy on a basis of 4, 5 and 6 years respectively: I calculate the number of quarters in the previous 16 quarters (respectively 20 and 24 quarters) during which the real federal rate is negative. I obtain similar results to previous assumptions (see appendix 3, table 3A, 3B).

Second, I calculate a similar measure of monetary loosening taking in consideration the rank of the quarters during which the interest rate is negative. Accordingly, on the basis of 12 quarters (respectively 16, 20 and 24 quarters) I calculate the number of quarters during which the real federal rate is negative however I give a weighting of 12 (respectively 16, 20 and 24 quarters) for the quarter (t-1) if the real interest rate is negative, a weighting of 11 for the quarter (t-2) if the real interest rate is negative… and a weighting of 1 for the quarter (t-12) if the real interest rate is negative. I calculate the *WEIGHTED_QUARTER_NEGATIVE12* according to the following formula:

$$WEIGHTED\_QUARTER\_NEGATIVE12_t = \frac{\sum_{n=1}^{12}(13-n) * Dummy\_real_{(t-n)}}{\sum_{n=1}^{12}(13-n)}$$

Where t is a specific quarter, *Dummy_real* is a dummy variable equal 1 if the real interest rate is negative during a specific quarter and 0 otherwise. I estimate the different equations using the *WEIGHTED_QUARTER_NEGATIVE12*, which is calculated alternatively on a basis of 16 quarters, 20 quarters and 24 quarters respectively. Previous conclusions still valid (see appendix 3, table 3C, 3D, 3E).

- *Pre-crisis and post-crisis period*

The results are robust to different pre-crisis subsample periods and for a larger sample period 2001Q1/2010Q4. However estimating the different equations for the post-crisis period 2007Q3/2010Q4, I obtain contradictory results. Specifically, the statistical significant relation between the length of the period of monetary loosening and bank asset riskiness turns to negative for the post crisis period: the variable reflecting monetary loosening is associated with a decrease in

the 100%RWA, and the RWA, an increase in risk free assets (0%RWA and LIQUIDITY) and a decrease in bank assets expansion. Also this variable is associated with an increase in loans non-performance. These results show that the increase in risk-taking (higher risk assets and asset expansion) during the whole pre-crisis period started to materialize from the beginning of the crisis. For the post-crisis period, a longer period of low rates is thus associated with the materialization of risk reflected in higher non performing loans, higher loan loss reserves and provisions ratio.

- *Annual data*

The results are robust when variables at annual frequency are used. Results are reported in appendix5.

- *Splitting the sample by bank size*

I divide the sample into 10 subsamples according to bank size: the first subsample including the 10% smallest banks and the last one including the 10% largest banks. I re-estimate the different regressions for the different categories. All in all the results are robust for such specification.

- *Using an instrumental variable approach*

All the previous panel regressions were estimated using the OLS estimator with individual fixed effects. Still, in the banking literature, some of the explanatory variables used in these regressions are suspected to be endogenous to the measure of risk. Specifically For robustness issues, I re-estimate using the instrumental variable. QUARTER_NEGATIVE, EQ_TA, INEFFICIENCY and NNI are suspected to be endogenous and are instrumented by their lagged value. The size variable and the macro variable (gdp_growth) are treated as exogenous. Results presented in appendix 6 (table 6) are consistent with previous findings.

6. Conclusion

The main objective of this chapter was to study the impact of a long period of low interest rates on U.S commercial bank risk behavior, taking into consideration the different categories of banks capitalization. On a first hand, it has been argued that the low level of rates and the money easing that prevailed the pre-crisis period constitute one of the factor that increased bank risk-taking specifically in the United States. On the other hand, a couple of theoretical papers proposed that

banks behavior following a period of monetary easing could be quite different according to banks capitalization. Using information from the quarterly call reports of U.S. commercial banks and using a variable reflecting the length of period during which interest rates are low, I first investigate whether such association between monetary conditions and banks risk-taking could be detected. Furthermore I differentiate well-capitalized, adequately capitalized and undercapitalized bank and investigate whether bank specific capital characteristics influences banks behaviour following a long period of low rates.

The results show that during the pre-crisis, an extended period of negative real rates encourages bank to increase asset expansion with a move toward riskier assets. For the post-crisis period, longer periods of low rates are no more associated with an increase in risk-taking but with the materialization of risk reflected into higher credit risk ratios.

Concerning bank specific capital characteristics, an extended period of negative real rates impact more intensely the risk-taking for both adequately and undercapitalized banks during the period that preceded the breach of the capital regulation. Following the breach of the capital regulation, undercapitalized banks do not retrench from risk taking, quite the opposite they gamble for resurrection and a longer period of low rates continue to be associated with an increase in risk taking. For the adequately capitalized banks, in the period that follows the breach of the capital constraint these banks also continue to take risk following a longer period of low policy rates but at a much lower trend compared to the other well-capitalized banks.

Correlation matrixes

	Correlation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	*0%RWA*	1.00																	
2	*100%RWA*	-0.20	1.00																
3	*RWA*	-0.31	0.96	1.00															
4	*CRELOANS*	-0.06	0.52	0.51	1.00														
5	*LIQUIDITY*	0.25	-0.72	-0.81	-0.45	1.00													
6	*NPL*	0.09	0.06	0.05	0.04	-0.04	1.00												
7	*LLR*	0.10	0.00	-0.05	-0.03	0.14	0.34	1.00											
8	*LLP*	0.07	0.14	0.13	0.10	-0.11	0.40	0.30	1.00										
9	*LC_ON*	-0.14	0.80	0.79	0.55	-0.76	-0.03	-0.10	0.06	1.00									
10	*LC_OFF*	-0.06	0.38	0.34	0.18	-0.30	-0.13	-0.04	-0.01	0.45	1.00								
11	*LC_ALL*	-0.14	0.78	0.77	0.52	-0.73	-0.06	-0.10	0.05	0.97	0.66	1.00							
12	*LOANG*	-0.12	0.26	0.26	0.20	-0.24	-0.26	-0.25	-0.09	0.28	0.21	0.30	1.00						
13	*QUARTER_NEGATIVE*	-0.02	0.02	0.03	0.04	-0.01	-0.08	-0.01	-0.08	0.05	0.04	0.06	0.04	1.00					
14	*SIZE*	0.05	0.15	0.14	0.27	-0.14	0.01	-0.02	0.12	0.22	0.41	0.30	0.09	0.03	1.00				
15	*EQ_TA*	0.02	-0.16	-0.19	-0.13	0.21	0.04	0.16	-0.02	-0.33	-0.12	-0.31	-0.08	0.01	-0.14	1.00			
16	*INEFFICIENCY*	0.04	-0.01	0.00	0.05	-0.06	0.16	-0.01	0.09	-0.05	-0.08	-0.06	0.03	-0.12	-0.14	-0.10	1.00		
17	*NII*	0.09	-0.05	-0.07	-0.01	0.03	-0.02	0.02	0.02	0.08	0.20	0.12	-0.02	0.06	0.26	-0.08	-0.13	1.00	
18	*GDP_GROWTH*	-0.05	-0.03	-0.03	-0.02	0.02	-0.23	-0.06	-0.24	0.05	0.09	0.07	0.09	0.43	-0.03	-0.02	-0.17	0.05	1.00

0%RWA= total assets 0% risk weighted over total assets; 100%RWA= total assets 100% risk weighted over total assets; RWA= (0% total assets 0% risk weighted+20%* total assets 20% risk weighted+50%* total assets 50% risk weighted+100%* total assets 100% risk weighted) over total assets; CRELOANS=Commercial real estate loans/total assets; LIQUIDITY= (Cash, due from depository institutions and securities)/ total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank' on balance sheet liquidity creation/ total assets; LC_OFF= bank' off balance liquidity creation/ total assets; LC_ALL= bank' liquidity creation/ total ; LOANG=Quarterly growth rate of total loans; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE= log of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year.*

Appendix 1 Composition of risk weighted assets by categories as presented in the bank' quarterly call reports according the FED law.

Total assets 0% risk weighted (rcfd5320)

- Risk weight categories: cash-on-hand, including the amount of domestic and foreign currency owned and held or in transit in all offices of the thrift.
- Securities backed by full faith and credit of U.S. government: includes the amount of securities issued by and other direct claims on: (1) the U.S. Government or its agencies to the extent such securities or claims are unconditionally backed by the full faith and credit of the U.S. Government; or (2) the central government of an Organization of Economic Cooperation and Development (OECD) country
- Notes and obligation of FDIC, including covered assets: Report notes and obligations of the FDIC that have the unconditional backing by the full faith and credit of the U.S. Government. Include the portion of assets fully covered against capital loss and/or yield maintenance agreements by the FDIC. Place that portion of assets without FDIC coverage (for example, those included in a deductible) in a risk-weight category according to the characteristics of the asset
- FSLIC covered assets: Also includes all investments in subsidiaries and/or equity investments that are covered by FSLIC
- Others: Includes all zero-percent risk-weight assets not included above. Also includes deposit reserves at, claims on, and balances due from Federal Reserve Banks, excluding interest rate contracts; the book value of paid-in Federal Reserve Bank stock; and that portion of assets not included elsewhere in the 0% risk-weight category directly and unconditionally guaranteed by the U.S. Government or its agencies, or the central government of an OECD country.

Total assets 20% risk weighted (rcfd5327)

- Interest-bearing balances due from depository institutions - 20%
- Held to maturity securities - 20%,
- Available for sale securities - 20%
- Federal fund sold and securities purchased under agreements to resell - 20%
- Loans and leases held for sale - 20%
- Loans and leases, net of unearned income - 20%
- Trading assets - 20%
- Other assets – 20%

Total assets 50% risk weighted (rcfd5334)

- Held to maturity securities - 50%
- Available for sale securities - 50%
- Loans and leases held for sale - 50%
- Loans and leases, net of unearned income - 50%
- Trading assets - 50%
- Other assets - 50%

Total assets 100% risk weighted (rcfd5340)

- Interest bearing balances due from depository institutions - 100%
- Held to maturity securities - 100%
- Available for sale securities - 100%
- Federal fund sold and securities purchased under agreements to resell - 100%
- Loans and leases held for sale - 100%
- Loans and leases, net of unearned income - 100%
- Trading assets - 100%
- Other assets - 100%

Appendix 2 Liquidity classification of bank activities according to Berger and Bouwman

	Assets	Liabilities plus equity	Derivatives and off balance sheet items
Liquid	Cash and balances due from depository institutions	Transaction deposit	Net participation acquired
	Securities	Savings deposit	Interest rate derivatives
	Fed funds sold	Overnight federal funds purchased	Foreign exchange derivatives
	Trading Assets	Trading liabilities	Equity and commodity derivatives
	(weight = -1/2)	**(weight = 1/2)**	**(weight = -1/2)**
Semi liquid (weight=0)	Residential real estate loans	Time deposit	Net credit derivatives
	Consumer loans	Other borrowed money	Net securities lent
	Loans to depository institution		
	Loans to state and local government		
	Loans to foreign governments		
	Loans to non-depository financial institutions		
Illiquid	Other real estate owned	Subordinated debt	Unused commitments
	Premises and fixed assets	Other liability	Financial standby letter of credit
	Investment in unconsolidated subsidiaries	Equity	Performance standby letter of credit
	Intangible assets (Goodwill + other intangible assets)	**(weight = -1/2)**	Commercial and similar letter of credit
	Other assets		All other off balance sheet liabilities
	Other loans and lease financing receivables		**(weight = 1/2)**
	Loans to finance agriculture production		
	Loans to finance C&I loans		
	Construction land development and other loans		
	Real estate loans secured by farmland		
	Real estate loans secured by nonfarm non residential properties		
	(weight = 1/2)		

Appendix 3 Robustness checks: regressions using alternative variable reflecting the loosening of monetary policy

Table 3A: The effect of too low for too long real rates calculated on the basis of the previous 16 quarters on banks riskiness, over the period 2001Q1/2007Q2 This table shows the results of panel fixed effect regressions. ****, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE16. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS*=Commercial real estate loans over total assets; *NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year; **QUARTER_NEGATIVE16= number of quarters in the previous 4 years (16 quarters) during which the real federal rate is negative**; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*5.7775*	*16.5803*	*49.9305*	*58.357*	*4.8903*	*-4.1995*	*1.9388*	*-0.3176*	*54.9051*	*7.6556*	*62.5607*	*67.967*
	*[9,49]****	*[7,88]****	*[31,28]****	*[31,99]****	*[3,32]****	*[-18,77]****	*[24,44]****	*[-8,42]****	*[24,84]****	*[8,94]****	*[24,07]****	*[16,57]****
QUARTER_NEGATIVE16	*-0.1224*	*0.2942*	*0.2584*	*-0.2608*	*0.2201*	*-0.0255*	*-0.0071*	*-0.0042*	*0.309*	*0.0641*	*0.3731*	*0.1389*
	*[-74,96]****	*[64,23]****	*[71,79]****	*[-60,19]****	*[79,80]****	*[-38,56]****	*[-32,20]****	*[-38,77]****	*[66,51]****	*[35,37]****	*[70,07]****	*[18,55]****
SIZE(t-1)	*-0.1098*	*1.984*	*1.0259*	*-1.5227*	*0.6395*	*0.269*	*-0.0285*	*0.0234*	*-0.8538*	*-0.0515*	*-0.9053*	*-2.8278*
	*[-3,41]****	*[17,81]****	*[12,14]****	*[-15,72]****	*[8,16]****	*[22,75]****	*[-6,79]****	*[11,73]****	*[-7,28]****	*[-1,12]*	*[-6,56]****	*[-12,82]****
EQ_TA(t-1)	*-0.014*	*-0.0563*	*-0.1559*	*-0.1163*	*-0.1015*	*0.0022*	*0.0074*	*0.0002*	*-0.6481*	*0.0268*	*-0.6213*	*-0.3753*
	*[-3,37]****	*[-3,98]****	*[-13,68]****	*[-8,81]****	*[-11,37]****	*[1,54]*	*[13,22]****	*[0,71]*	*[-43,87]****	*[4,10]****	*[-35,22]****	*[-14,41]****
INEFFICIENCY(t-1)	*0.005*	*-0.0018*	*-0.0001*	*-0.0438*	*-0.0531*	*0.0031*	*-0.0034*	*-0.0002*	*-0.169*	*-0.0146*	*-0.1836*	*-0.0997*
	*[4,98]****	*[-0,65]*	*[-0,05]*	*[-16,47]****	*[-29,98]****	*[8,60]****	*[-26,91]****	*[-3,44]****	*[-59,49]****	*[-12,96]****	*[-56,08]****	*[-17,72]****
NNI(t-1)	*-0.0081*	*-0.0755*	*-0.0678*	*0.0641*	*-0.0186*	*0.0051*	*0.0018*	*-0.0007*	*0.0063*	*0.0059*	*0.0123*	*-0.0222*
	*[-4,70]****	*[-14,32]****	*[-16,33]****	*[13,00]****	*[-5,35]****	*[6,80]****	*[7,10]****	*[-5,32]****	*[1,19]*	*[2,05]***	*[1,90]**	*[-2,38]***
GDP_GROWTH(t-1)	*0.0691*	*-0.4152*	*-0.3434*	*0.5102*	*-0.1398*	*0.0043*	*0.0012*	*-0.0019*	*-0.4189*	*-0.0338*	*-0.4527*	*-0.1236*
	*[8,62]****	*[-19,48]****	*[-20,34]****	*[25,01]****	*[-10,54]****	*[1,46]*	*[1,25]*	*[-4,22]****	*[-19,33]****	*[-3,92]****	*[-18,20]****	*[-3,22]****
Observations:	*158873*	*160723*	*152851*	*165282*	*165282*	*164511*	*159663*	*165282*	*165278*	*165278*	*165278*	*138995*
R-squared:	*0.71*	*0.89*	*0.87*	*0.89*	*0.91*	*0.55*	*0.77*	*0.27*	*0.92*	*0.86*	*0.92*	*0.47*
F-statistic:	*44.12*	*150.68*	*120.85*	*151.64*	*188.38*	*22.54*	*60.56*	*6.89*	*211.69*	*110.31*	*224.34*	*14.41*

Table 3B: The effect of too low for too long real rates calculated on the basis of the previous 20 quarters on banks riskiness, over the period 2001Q1/2007Q2 This table shows the results of panel fixed effect regressions. ****, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE20. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS*=Commercial real estate loans over total assets; *NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year; **QUARTER_NEGATIVE20= number of quarters in the previous 5 years (20 quarters) during which the real federal rate is negative**; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*4.2896*	*20.0349*	*52.7392*	*55.6003*	*7.155*	*-4.2196*	*1.8926*	*-0.3645*	*57.6225*	*7.8993*	*65.5218*	*66.9938*
	*[6,95]****	*[9,46]****	*[32,74]****	*[30,16]****	*[4,83]****	*[-18,62]****	*[23,52]****	*[-9,52]****	*[25,82]****	*[9,15]****	*[24,97]****	*[16,22]****
QUARTER_NEGATIVE20	*-0.1215*	*0.2914*	*0.2548*	*-0.2569*	*0.2165*	*-0.024*	*-0.0069*	*-0.0041*	*0.3018*	*0.0611*	*0.3629*	*0.1262*
	*[-76,40]****	*[65,24]****	*[72,55]****	*[-60,61]****	*[80,48]****	*[-36,97]****	*[-31,69]****	*[-39,64]****	*[66,57]****	*[34,62]****	*[69,81]****	*[17,33]****
SIZE(t-1)	*-0.0326*	*1.8048*	*0.8804*	*-1.3796*	*0.522*	*0.27*	*-0.0261*	*0.0258*	*-0.9946*	*-0.064*	*-1.0586*	*-2.7769*
	[-1,00]	*[16,08]****	*[10,33]****	*[-14,10]****	*[6,63]****	*[22,55]****	*[-6,13]****	*[12,76]****	*[-8,40]****	*[-1,38]*	*[-7,60]****	*[-12,51]****
EQ_TA(t-1)	*-0.0111*	*-0.0632*	*-0.1618*	*-0.1106*	*-0.1062*	*0.0024*	*0.0075*	*0.0003*	*-0.6541*	*0.026*	*-0.6281*	*-0.3759*
	*[-2,67]****	*[-4,47]****	*[-14,21]****	*[-8,38]****	*[-11,92]****	*[1,67]**	*[13,42]****	*[1,06]*	*[-44,30]****	*[3,99]****	*[-35,62]****	*[-14,42]****
INEFFICIENCY(t-1)	*0.0063*	*-0.0048*	*-0.0026*	*-0.0412*	*-0.0552*	*0.0033*	*-0.0033*	*-0.0002*	*-0.1718*	*-0.0151*	*-0.1869*	*-0.1002*
	*[6,21]****	*[-1,71]**	*[-1,20]*	*[-15,49]****	*[-31,15]****	*[9,08]****	*[-26,36]****	*[-2,75]****	*[-60,40]****	*[-13,41]****	*[-57,04]****	*[-17,73]****
NNI(t-1)	*-0.0077*	*-0.0765*	*-0.0686*	*0.0649*	*-0.0193*	*0.0051*	*0.0018*	*-0.0006*	*0.0054*	*0.0058*	*0.0112*	*-0.0226*
	*[-4,48]****	*[-14,51]****	*[-16,53]****	*[13,17]****	*[-5,55]****	*[6,88]****	*[7,18]****	*[-5,22]****	*[1,01]*	*[1,99]***	*[1,73]**	*[-2,42]***
GDP_GROWTH(t-1)	*0.0562*	*-0.3835*	*-0.3129*	*0.4788*	*-0.1127*	*-0.0012*	*0.0001*	*-0.0024*	*-0.3763*	*-0.0218*	*-0.3982*	*-0.0802*
	*[7,13]****	*[-18,19]****	*[-18,74]****	*[23,73]****	*[-8,56]****	*[-0,42]*	*[0,08]*	*[-5,34]****	*[-17,55]****	*[-2,54]***	*[-16,16]****	*[-2,12]***
Observations:	*158873*	*160723*	*152851*	*165282*	*165282*	*164511*	*159663*	*165282*	*165278*	*165278*	*165278*	*138995*
R-squared:	*0.71*	*0.89*	*0.87*	*0.89*	*0.91*	*0.55*	*0.77*	*0.27*	*0.92*	*0.86*	*0.92*	*0.47*
F-statistic:	*44.3*	*151.03*	*121.15*	*151.88*	*188.82*	*22.51*	*60.56*	*6.91*	*211.95*	*110.29*	*224.56*	*14.4*

Table 3C: The effect of too low for too long real rates calculated on the basis of the previous <u>12 weighted quarters</u> on banks riskiness, over the period 2001Q1/2007Q2

*This table shows the results of panel fixed effect regressions. ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and WEIGHTED_QUARTER_NEGATIVE12. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS=Commercial real estate loans over total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year; **WEIGHTED_QUARTER_NEGATIVE12= Weighted number of quarters during which the real federal rate is negative in the previous 3 years (12 quarters)**; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*23.2521*	*-28.1574*	*10.6852*	*99.7987*	*-24.7923*	*-1.24*	*2.804*	*0.1839*	*12.8219*	*0.1599*	*12.9818*	*53.6449*
	*[44,24]****	*[-14,68]****	*[7,41]****	*[61,77]****	*[-18,10]****	*[-6,62]****	*[41,88]****	*[5,88]****	*[6,55]****	*[0,21]*	*[5,62]****	*[14,09]****
WEIGHTED _QUARTER_NEGATIVE12 (t)	*-0.9777*	*2.028*	*1.847*	*-1.5046*	*2.0141*	*-0.3026*	*-0.0798*	*-0.0462*	*2.7716*	*0.7481*	*3.5198*	*1.6557*
	*[-39,35]****	*[29,17]****	*[33,56]****	*[-23,16]****	*[46,71]****	*[-31,27]****	*[-25,23]****	*[-26,99]****	*[39,31]****	*[27,36]****	*[43,71]****	*[14,22]****
SIZE (t-1)	*-0.9933*	*4.263*	*3.0231*	*-3.6437*	*2.1315*	*0.1232*	*-0.0713*	*-0.0015*	*1.264*	*0.3183*	*1.5823*	*-2.1686*
	*[-34,90]****	*[41,34]****	*[39,01]****	*[-41,75]****	*[28,91]****	*[12,23]****	*[-19,81]****	*[-0,87]*	*[11,98]****	*[7,64]****	*[12,70]****	*[-10,38]****
EQ_TA (t-1)	*-0.0465*	*0.0217*	*-0.0871*	*-0.1881*	*-0.043*	*-0.0044*	*0.0055*	*-0.0009*	*-0.5658*	*0.0433*	*-0.5225*	*-0.3313*
	*[-11,19]****	*[1,52]*	*[-7,58]****	*[-14,26]****	*[-4,77]****	*[-3,09]****	*[9,97]****	*[-3,38]****	*[-38,46]****	*[6,62]****	*[-29,63]****	*[-12,81]****
INEFFICIENCY (t-1)	*-0.0137*	*0.0386*	*0.0362*	*-0.0757*	*-0.0163*	*-0.002*	*-0.0048*	*-0.001*	*-0.1181*	*-0.0018*	*-0.1199*	*-0.0528*
	*[-12,79]****	*[12,96]****	*[15,28]****	*[-26,65]****	*[-8,54]****	*[-5,23]****	*[-35,84]****	*[-15,39]****	*[-38,32]****	*[-1,46]*	*[-33,57]****	*[-8,78]****
NNI(t-1)	*-0.0062*	*-0.0784*	*-0.071*	*0.0661*	*-0.0224*	*0.0057*	*0.0019*	*-0.0006*	*0.0012*	*0.0044*	*0.0056*	*-0.0303*
	*[-3,56]****	*[-14,64]****	*[-16,82]****	*[13,24]****	*[-6,32]****	*[7,61]****	*[7,72]****	*[-4,56]****	*[0,23]*	*[1,52]*	*[0,86]*	*[-3,23]****
GDP_GROWTH (t-1)	*-0.0056*	*-0.173*	*-0.1465*	*0.2367*	*-0.0545*	*0.0079*	*0.0015*	*-0.0019*	*-0.2881*	*-0.0405*	*-0.3286*	*-0.1032*
	[-0,64]	*[-7,55]****	*[-8,06]****	*[10,88]****	*[-3,81]****	*[2,50]**	*[1,42]*	*[-3,78]****	*[-12,49]****	*[-4,41]****	*[-12,43]****	*[-2,59]****
Observations:	*158873*	*160723*	*152851*	*165282*	*165282*	*164511*	*159663*	*165282*	*165278*	*165278*	*165278*	*138995*
R-squared:	*0.7*	*0.89*	*0.87*	*0.89*	*0.91*	*0.55*	*0.77*	*0.27*	*0.92*	*0.86*	*0.92*	*0.47*
F-statistic:	*42.07*	*146.07*	*116.15*	*147.35*	*181.9*	*22.29*	*60.17*	*6.72*	*205.94*	*109.72*	*217.93*	*14.38*

Table 3D: The effect of too low for too long real rates calculated on the basis of the previous <u>16 weighted quarters</u> on banks riskiness, over the period 2001Q1/2007Q2

*This table shows the results of panel fixed effect regressions. ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS=Commercial real estate loans over total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year; **WEIGHTED_QUARTER_NEGATIVE16= Weighted number of quarter during which the real federal rate is negative in the previous 4 years (16 quarters)**; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*16.1492*	*-10.1312*	*26.6536*	*83.5973*	*-12.0949*	*-2.7081*	*2.3956*	*-0.05*	*31.0625*	*3.8457*	*34.9082*	*61.6863*
	*[29,08]****	*[-5,06]****	*[17,66]****	*[49,10]****	*[-8,53]****	*[-13,39]****	*[33,33]****	*[-1,47]*	*[15,01]****	*[4,79]****	*[14,33]****	*[15,58]****
WEIGHTED _QUARTER_NEGATIVE16 (t)	*-1.5023*	*3.4474*	*3.0745*	*-2.873*	*2.8852*	*-0.386*	*-0.1035*	*-0.0601*	*4.0523*	*0.9615*	*5.0139*	*2.0913*
	*[-57,73]****	*[47,16]****	*[53,41]****	*[-42,09]****	*[64,53]****	*[-37,43]****	*[-30,57]****	*[-34,05]****	*[54,76]****	*[33,53]****	*[59,28]****	*[17,39]****
SIZE (t-1)	*-0.6242*	*3.3185*	*2.1874*	*-2.79*	*1.4754*	*0.198*	*-0.0505*	*0.0105*	*0.3196*	*0.1304*	*0.4499*	*-2.5652*
	*[-20,91]****	*[30,95]****	*[27,10]****	*[-30,50]****	*[19,40]****	*[18,30]****	*[-13,12]****	*[5,73]****	*[2,88]****	*[2,99]****	*[3,44]****	*[-11,90]****
EQ_TA (t-1)	*-0.036*	*-0.0026*	*-0.1087*	*-0.1668*	*-0.063*	*-0.0018*	*0.0062*	*-0.0005*	*-0.5941*	*0.0369*	*-0.5573*	*-0.3467*
	*[-8,69]****	*[-0,18]*	*[-9,49]****	*[-12,63]****	*[-7,02]****	*[-1,27]*	*[11,21]****	*[-1,85]**	*[-40,34]****	*[5,66]****	*[-31,62]****	*[-13,39]****
INEFFICIENCY (t-1)	*-0.0112*	*0.0358*	*0.0333*	*-0.0758*	*-0.0229*	*-0.0007*	*-0.0044*	*-0.0008*	*-0.1265*	*-0.005*	*-0.1315*	*-0.0665*
	*[-11,05]****	*[12,66]****	*[14,83]****	*[-28,11]****	*[-12,58]****	*[-1,96]**	*[-34,94]****	*[-13,32]****	*[-43,43]****	*[-4,22]****	*[-38,97]****	*[-11,77]****
NNI(t-1)	*-0.0064*	*-0.0789*	*-0.0711*	*0.0669*	*-0.0218*	*0.0055*	*0.0019*	*-0.0006*	*0.0019*	*0.0048*	*0.0067*	*-0.0278*
	*[-3,69]****	*[-14,82]****	*[-16,95]****	*[13,46]****	*[-6,20]****	*[7,39]****	*[7,56]****	*[-4,76]****	*[0,36]*	*[1,66]**	*[1,04]*	*[-2,97]****
GDP_GROWTH (t-1)	*0.0678*	*-0.3832*	*-0.3247*	*0.4491*	*-0.1695*	*0.0168*	*0.0041*	*-0.0004*	*-0.4608*	*-0.0638*	*-0.5246*	*-0.1644*
	*[7,92]****	*[-17,00]****	*[-18,17]****	*[20,90]****	*[-12,09]****	*[5,38]****	*[3,96]****	*[-0,75]*	*[-20,24]****	*[-7,10]****	*[-20,13]****	*[-4,15]****
Observations:	*158873*	*160723*	*152851*	*165282*	*165282*	*164511*	*159663*	*165282*	*165278*	*165278*	*165278*	*138995*
R-squared:	*0.71*	*0.89*	*0.87*	*0.89*	*0.91*	*0.55*	*0.77*	*0.27*	*0.92*	*0.86*	*0.92*	*0.47*
F-statistic:	*42.84*	*147.75*	*117.9*	*148.8*	*184.6*	*22.44*	*60.38*	*6.81*	*208.4*	*110.06*	*220.79*	*14.4*

Table 3E: The effect of too low for too long real rates calculated on the basis of the previous <u>20 weighted quarters</u> on banks riskiness, over the period 2001Q1/2007Q2 *This table shows the results of panel fixed effect regressions. ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and WEIGHTED _QUARTER_NEGATIVE20. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS=Commercial real estate loans over total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year;* ***WEIGHTED_QUARTER_NEGATIVE20= Weighted number of quarter during which the real federal rate is negative in the previous 5 years (20 quarters)****; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*11.4824*	*1.5165*	*36.8197*	*73.0162*	*-4.1829*	*-3.4502*	*2.1671*	*-0.1884*	*42.0307*	*5.7746*	*47.8053*	*64.9442*
	*[19,88]****	*[0,74]*	*[23,74]****	*[41,53]****	*[-2,90]****	*[-16,28]****	*[28,83]****	*[-5,25]****	*[19,67]****	*[6,98]****	*[19,02]****	*[16,05]****
WEIGHTED _QUARTER_NEGATIVE20 (t)	*-1.8541*	*4.3368*	*3.8352*	*-3.7077*	*3.4547*	*-0.4307*	*-0.1181*	*-0.0693*	*4.838*	*1.0813*	*5.9193*	*2.299*
	*[-66,21]****	*[55,17]****	*[62,05]****	*[-50,28]****	*[72,44]****	*[-38,46]****	*[-31,95]****	*[-36,95]****	*[60,76]****	*[35,08]****	*[64,99]****	*[17,90]****
SIZE (t-1)	*-0.3863*	*2.7217*	*1.6671*	*-2.2461*	*1.074*	*0.2348*	*-0.039*	*0.0174*	*-0.2365*	*0.0344*	*-0.2021*	*-2.7149*
	*[-12,51]****	*[24,85]****	*[20,17]****	*[-23,87]****	*[13,90]****	*[20,79]****	*[-9,74]****	*[9,10]****	*[-2,07]***	*[0,77]*	*[-1,50]*	*[-12,38]****
EQ_TA (t-1)	*-0.0277*	*-0.0225*	*-0.1263*	*-0.1486*	*-0.0781*	*-0.0002*	*0.0067*	*-0.0002*	*-0.6151*	*0.0327*	*-0.5824*	*-0.3574*
	*[-6,67]****	*[-1,59]*	*[-11,05]****	*[-11,26]****	*[-8,72]****	*[-0,12]*	*[12,05]****	*[-0,78]*	*[-41,73]****	*[5,02]****	*[-33,05]****	*[-13,78]****
INEFFICIENCY (t-1)	*-0.0071*	*0.0267*	*0.0251*	*-0.0685*	*-0.0311*	*0.0005*	*-0.0041*	*-0.0006*	*-0.1381*	*-0.008*	*-0.1461*	*-0.0774*
	*[-7,08]****	*[9,60]****	*[11,37]****	*[-25,83]****	*[-17,42]****	*[1,32]*	*[-32,91]****	*[-10,61]****	*[-48,36]****	*[-6,88]****	*[-44,20]****	*[-13,94]****
NNI(t-1)	*-0.0066*	*-0.0788*	*-0.0709*	*0.0668*	*-0.0214*	*0.0054*	*0.0019*	*-0.0006*	*0.0025*	*0.005*	*0.0075*	*-0.0262*
	*[-3,80]****	*[-14,85]****	*[-16,95]****	*[13,49]****	*[-6,11]****	*[7,27]****	*[7,49]****	*[-4,86]****	*[0,46]*	*[1,74]**	*[1,16]*	*[-2,80]****
GDP_GROWTH (t-1)	*0.0887*	*-0.4438*	*-0.373*	*0.5143*	*-0.1936*	*0.0152*	*0.004*	*-0.0003*	*-0.4924*	*-0.0611*	*-0.5534*	*-0.1587*
	*[10,56]****	*[-19,98]****	*[-21,20]****	*[24,24]****	*[-14,02]****	*[4,93]****	*[3,95]****	*[-0,56]*	*[-21,90]****	*[-6,87]****	*[-21,50]****	*[-4,04]****
Observations:	*158873*	*160723*	*152851*	*165282*	*165282*	*164511*	*159663*	*165282*	*165278*	*165278*	*165278*	*138995*
R-squared:	*0.71*	*0.89*	*0.87*	*0.89*	*0.91*	*0.55*	*0.77*	*0.27*	*0.92*	*0.86*	*0.92*	*0.47*
F-statistic:	*43.38*	*148.92*	*119.08*	*149.86*	*186.3*	*22.49*	*60.47*	*6.85*	*209.85*	*110.19*	*222.39*	*14.41*

Appendix 4 Robustness checks: regressions over the period 2001Q1/2010Q4

Table 4A: The effect of too low for too long real rates on banks riskiness, over the period 2001Q1/2010Q4 This table shows the results of panel fixed effect regressions. ****, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS=* Commercial real estate loans over total assets; *NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*-4.9814*	*-18.22*	*23.2084*	*79.1834*	*-40.436*	*-16.428*	*-0.6303*	*-1.9068*	*34.8389*	*27.658*	*62.4969*	*143.7904*
	*[-9,70]****	*[-13,88]****	*[22,18]****	*[68,06]****	*[-44,78]****	*[-82,29]****	*[-9,63]****	*[-56,77]****	*[26,47]****	*[57,31]****	*[40,39]****	*[62,00]****
QUARTER_NEGATIVE (t)	*-0.1235*	*0.1793*	*0.1694*	*-0.129*	*0.165*	*-0.0353*	*-0.009*	*-0.0044*	*0.1891*	*0.0831*	*0.2722*	*0.215*
	*[-59,18]****	*[34,47]****	*[40,18]****	*[-26,12]****	*[51,27]****	*[-42,71]****	*[-33,06]****	*[-32,75]****	*[36,77]****	*[38,60]****	*[45,28]****	*[27,31]****
SIZE (t-1)	*0.64*	*3.7213*	*2.3278*	*-2.4989*	*3.0522*	*0.9743*	*0.1215*	*0.1146*	*0.0292*	*-1.2216*	*-1.1924*	*-7.3711*
	*[23,26]****	*[53,27]****	*[41,77]****	*[-40,17]****	*[63,94]****	*[92,45]****	*[35,12]****	*[64,79]****	*[0,42]*	*[-47,39]****	*[-14,51]****	*[-59,56]****
EQ_TA (t-1)	*-0.0981*	*0.0273*	*-0.0726*	*-0.1981*	*-0.063*	*-0.0026*	*0.0029*	*0.0003*	*-0.5892*	*0.0442*	*-0.545*	*-0.1504*
	*[-24,07]****	*[2,63]****	*[-8,46]****	*[-19,88]****	*[-9,35]****	*[-1,71]**	*[5,45]****	*[1,25]*	*[-55,45]****	*[9,64]****	*[-43,10]****	*[-8,02]****
INEFFICIENCY (t-1)	*-0.0608*	*0.0552*	*0.0548*	*-0.0938*	*-0.0326*	*-0.0136*	*-0.0077*	*-0.0023*	*-0.0979*	*0.0168*	*-0.0811*	*0.0866*
	*[-63,08]****	*[25,40]****	*[30,99]****	*[-44,01]****	*[-24,10]****	*[-37,26]****	*[-62,98]****	*[-38,14]****	*[-44,64]****	*[19,21]****	*[-31,69]****	*[24,89]****
NNI (t-1)	*0.0061*	*-0.0649*	*-0.0668*	*0.0583*	*-0.0174*	*0.0089*	*0.0018*	*-0.0004*	*0.0105*	*0.0086*	*0.019*	*-0.0818*
	*[2,93]****	*[-13,94]****	*[-17,73]****	*[12,96]****	*[-5,68]****	*[10,56]****	*[6,52]****	*[-2,87]****	*[2,24]***	*[3,84]****	*[3,40]****	*[-10,69]****
GDP_GROWTH (t-1)	*-0.0298*	*-0.2511*	*-0.2102*	*0.1328*	*-0.244*	*-0.097*	*-0.01*	*-0.0176*	*0.0259*	*0.0989*	*0.1248*	*0.205*
	*[-7,33]****	*[-30,50]****	*[-30,89]****	*[16,15]****	*[-47,92]****	*[-57,43]****	*[-18,44]****	*[-58,65]****	*[3,19]****	*[35,25]****	*[13,39]****	*[16,91]****
Observations:	*238050*	*241021*	*228535*	*248186*	*248186*	*244068*	*238857*	*248186*	*248181*	*248181*	*248181*	*218012*
R-squared:	*0.51*	*0.86*	*0.82*	*0.84*	*0.89*	*0.42*	*0.59*	*0.26*	*0.88*	*0.8*	*0.89*	*0.35*
F-statistic:	*26.36*	*153.68*	*116.49*	*142.76*	*203.59*	*18.64*	*37.13*	*9.1*	*199.95*	*108.11*	*206.81*	*13.07*

Appendix 4 Robustness checks: regressions over the post-crisis period

Table 4B: The effect of too low for too long real rates on banks riskiness, over the period 2007Q3/2010Q4

*This table shows the results of panel fixed effect regressions. ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS=Commercial real estate loans over total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*-12.8006*	*123.9745*	*128.3161*	*-12.6946*	*23.1386*	*-9.6654*	*2.4262*	*-1.6942*	*71.1517*	*32.0951*	*103.2468*	*-82.9408*
	*[-5,02]****	*[20,47]****	*[24,17]****	*[-2,73]****	*[6,90]****	*[-10,14]****	*[7,63]****	*[-9,41]****	*[13,19]****	*[19,05]****	*[16,66]****	*[-9,13]****
QUARTER_NEGATIVE (t)	*0.7447*	*-0.809*	*-0.7854*	*1.0766*	*-0.0459*	*0.1878*	*0.0719*	*0.0288*	*-0.7775*	*-0.2865*	*-1.064*	*-1.7311*
	*[56,93]****	*[-37,04]****	*[-41,23]****	*[50,67]****	*[-3,88]****	*[37,42]****	*[44,97]****	*[30,41]****	*[-38,91]****	*[-36,58]****	*[-45,86]****	*[-48,19]****
SIZE (t-1)	*0.7617*	*-3.1522*	*-2.6978*	*1.6617*	*-0.0705*	*0.5718*	*-0.0559*	*0.0909*	*-1.5987*	*-1.3692*	*-2.9678*	*4.8239*
	*[5,81]****	*[-10,04]****	*[-9,81]****	*[6,92]****	*[-0,41]*	*[11,69]****	*[-3,43]****	*[9,83]****	*[-5,74]****	*[-15,72]****	*[-9,27]****	*[10,28]****
EQ_TA (t-1)	*-0.1428*	*-0.1074*	*-0.1133*	*-0.1271*	*-0.2052*	*-0.0307*	*-0.0154*	*0.0017*	*-0.4618*	*0.0893*	*-0.3726*	*0.4767*
	*[-13,69]****	*[-4,84]****	*[-5,83]****	*[-6,42]****	*[-14,77]****	*[-7,77]****	*[-11,97]****	*[2,24]**	*[-21,87]****	*[12,48]****	*[-15,59]****	*[12,05]****
INEFFICIENCY (t-1)	*-0.008*	*-0.0923*	*-0.0753*	*0.0854*	*-0.0687*	*-0.0047*	*-0.004*	*0.0001*	*-0.1591*	*-0.001*	*-0.1601*	*0.0063*
	*[-2,81]****	*[-18,30]****	*[-17,40]****	*[17,11]****	*[-24,51]****	*[-4,12]****	*[-11,01]****	*[0,28]*	*[-33,28]****	*[-0,54]*	*[-28,97]****	*[0,75]*
NII (t-1)	*0.0348*	*-0.0547*	*-0.0563*	*0.0515*	*-0.0047*	*0.0146*	*0.0041*	*0.0008*	*-0.0263*	*-0.0135*	*-0.0398*	*-0.0922*
	*[7,88]****	*[-7,77]****	*[-9,37]****	*[7,62]****	*[-1,16]*	*[8,30]****	*[7,72]****	*[2,38]**	*[-4,04]****	*[-5,15]****	*[-5,24]****	*[-7,54]****
GDP_GROWTH (t-1)	*-0.1245*	*0.0829*	*0.0687*	*-0.2238*	*-0.0441*	*-0.1045*	*-0.0214*	*-0.0206*	*0.2648*	*0.1262*	*0.391*	*0.3998*
	*[-25,19]****	*[10,08]****	*[9,73]****	*[-28,50]****	*[-9,67]****	*[-51,42]****	*[-34,32]****	*[-50,74]****	*[35,33]****	*[45,25]****	*[45,55]****	*[27,76]****
Observations:	*79177*	*80298*	*75684*	*82904*	*82904*	*79557*	*79194*	*82904*	*82903*	*82903*	*82903*	*79017*
R-squared:	*0.61*	*0.93*	*0.9*	*0.92*	*0.96*	*0.61*	*0.69*	*0.41*	*0.94*	*0.86*	*0.94*	*0.53*
F-statistic:	*15.7*	*130.39*	*91.84*	*120.1*	*240.98*	*15.51*	*22.32*	*7.08*	*158.16*	*64.74*	*158.65*	*11.12*

Appendix 5 Robustness checks: regressions using annual data

Table 5: Too low for too long real rates and bank riskiness during the period 2001/2007 (using annual data)

*This table shows the results of panel fixed effect regressions. ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. All variables are in % except SIZE and QUARTER_NEGATIVE. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0*(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS=Commercial real estate loans over total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product compared to the same quarter of previous year;*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*12.8559*	*-15.1305*	*21.5624*	*78.7307*	*-13.7102*	*-3.0169*	*2.3397*	*0.0510*	*12.1047*	*5.4769*	*17.5816*	*72.6615*
	*[12.00]****	*[-3.94]****	*[7.32]****	*[24.13]****	*[-4.96]****	*[-7.36]****	*[16.76]****	*[0.87]*	*[3.11]****	*[3.48]****	*[3.78]****	*[9.61]****
QUARTER_NEGATIVE (t)	*-0.1729*	*0.3139*	*0.2713*	*-0.2564*	*0.2934*	*-0.0305*	*-0.0093*	*-0.0047*	*0.2672*	*0.0751*	*0.3423*	*0.1891*
	*[-36.53]****	*[23.54]****	*[25.72]****	*[-20.28]****	*[35.04]****	*[-16.22]****	*[-14.94]****	*[-17.54]****	*[19.82]****	*[13.19]****	*[21.64]****	*[8.60]****
SIZE (t-1)	*-0.4731*	*3.6077*	*2.4617*	*-2.4944*	*1.5956*	*0.2166*	*-0.0476*	*0.0045*	*1.3061*	*0.0270*	*1.3330*	*-3.1773*
	*[-8.33]****	*[17.68]****	*[15.78]****	*[-14.37]****	*[10.87]****	*[10.01]****	*[-6.44]****	*[1.46]*	*[6.32]****	*[0.32]*	*[5.39]****	*[-7.72]****
EQ_TA (t-1)	*-0.0388*	*0.0168*	*-0.0982*	*-0.1880*	*-0.0496*	*0.0007*	*0.0065*	*-0.0004*	*-0.5886*	*0.0498*	*-0.5388*	*-0.3710*
	*[-4.98]****	*[0.60]*	*[-4.36]****	*[-7.11]****	*[-2.75]****	*[0.25]*	*[6.21]****	*[-0.83]*	*[-20.53]****	*[3.91]****	*[-15.71]****	*[-7.06]****
INEFFICIENCY (t-1)	*-0.0100*	*0.0477*	*0.0472*	*-0.1035*	*-0.0265*	*-0.0017*	*-0.0048*	*-0.0009*	*-0.1135*	*-0.0026*	*-0.1161*	*-0.0556*
	*[-5.30]****	*[8.99]****	*[11.26]****	*[-20.49]****	*[-7.83]****	*[-2.46]***	*[-20.14]****	*[-8.96]****	*[-20.85]****	*[-1.08]*	*[-18.13]****	*[-4.66]****
NNI (t-1)	*-0.0041*	*-0.1069*	*-0.0896*	*0.0777*	*-0.0294*	*0.0055*	*0.0026*	*-0.0005*	*0.0020*	*0.0152*	*0.0172*	*-0.0333*
	[-1.02]	*[-8.54]****	*[-9.06]****	*[6.61]****	*[-3.54]****	*[3.21]****	*[4.51]****	*[-1.96]**	*[0.16]*	*[1.99]***	*[1.10]*	*[-1.50]*
GDP_GROWTH (t-1)	*0.3363*	*-0.5842*	*-0.4247*	*0.5708*	*-0.4843*	*0.0019*	*0.0065*	*0.0019*	*-0.1883*	*-0.0326*	*-0.2210*	*-0.0193*
	*[23.22]****	*[-15.11]****	*[-13.82]****	*[15.25]****	*[-19.91]****	*[0.34]*	*[3.55]****	*[2.38]***	*[-4.82]****	*[-2.05]***	*[-4.89]****	*[-0.26]*
Observations:	*44532*	*45025*	*42791*	*46344*	*46344*	*46116*	*44784*	*46344*	*46343*	*46343*	*46343*	*37952*
R-squared:	*0.71*	*0.89*	*0.87*	*0.88*	*0.90*	*0.56*	*0.76*	*0.37*	*0.92*	*0.86*	*0.92*	*0.48*
F-statistic:	*10.58*	*35.52*	*28.48*	*34.51*	*42.47*	*5.69*	*14.20*	*2.62*	*49.35*	*27.18*	*51.41*	*3.50*

Appendix 6 Robustness checks: regressions using instrumental variables

Table 6: Too low for too long real rates and bank riskiness during the period 2001Q1/2007Q2 (TSLT estimator)

*This table shows the results of panel regressions using the TSLS estimator ***, ** and * indicate levels of significance at 10%, 5% and 1%, respectively. T-statistics are corrected for heteroskedasticity following White's methodology. QUARTER_NEGATIVE, EQ_TA, INEFFICIENCY and NNI are instrumented by their lagged value (t-2).*

All variables are in % except SIZE and QUARTER_NEGATIVE. 0%RWA is the total assets 0% risk weighted over total assets, 100%RWA is the total assets 100% risk weighted over total assets; RWA= [0(total assets 0% risk weighted)+20%*(total assets 20% risk weighted)+50%*(total assets 50% risk weighted)+100%*(total assets 100% risk weighted)]/total assets; LIQUIDITY=The Ratio of liquid assets over total assets, liquid assets include Cash, due from depository institutions and securities; CRELOANS=Commercial real estate loans over total assets; NPL= (loans past due 90 days + non accrual loans) / total loans and leases; LLP= provision for allowance for loan and lease losses / total loans and leases; LLR= allowance for loan and lease losses / total loans and leases; LC_ON= bank on balance sheet liquidity creation/total assets; LC_OFF= bank' off balance liquidity creation/total assets; LC_ALL= Bank liquidity creation over total assets; LOANG= Growth rate of the total loans compared to the same quarter of previous year; QUARTER_NEGATIVE= number of quarters in the previous 3 years during which the real federal rate is negative; SIZE is the natural logarithm of total assets; EQTA= equity over total assets; INEFFICIENCY=Total expenses over total income; NII= non interest income over total income; gdp_growth= Growth rate of the Gross Domestic Product*

Dep, Var:	*0%RWA*	*100%RWA*	*RWA*	*LIQUIDITY*	*CRELOANS*	*NPL*	*LLR*	*LLP*	*LC_ON*	*LC_OFF*	*LC_ALL*	*LOANG*
C	*14.5172*	*0.3892*	*36.0480*	*75.7394*	*-3.3013*	*-2.8826*	*2.4125*	*-0.0470*	*40.4023*	*0.8806*	*41.2829*	*53.1628*
	*[23.26]****	*[0.17]*	*[21.25]****	*[39.53]****	*[-2.12]***	*[-12.15]****	*[28.89]****	*[-1.18]*	*[17.24]****	*[1.04]*	*[15.14]****	*[12.56]****
QUARTER_NEGATIVE (t)	*-0.1264*	*0.3570*	*0.3203*	*-0.3347*	*0.2531*	*-0.0360*	*-0.0094*	*-0.0054*	*0.4122*	*0.0870*	*0.4992*	*0.1974*
	*[-58.66]****	*[57.82]****	*[65.93]****	*[-58.52]****	*[67.79]****	*[-40.07]****	*[-32.53]****	*[-35.94]****	*[66.18]****	*[38.31]****	*[70.76]****	*[19.68]****
SIZE (t-1)	*-0.5046*	*2.7799*	*1.7241*	*-2.4664*	*0.9700*	*0.2092*	*-0.0499*	*0.0114*	*-0.2232*	*0.2623*	*0.0390*	*-2.3276*
	*[-15.26]****	*[23.13]****	*[19.21]****	*[-24.26]****	*[11.69]****	*[16.73]****	*[-11.28]****	*[5.35]****	*[-1.80]**	*[5.81]****	*[0.27]*	*[-10.25]****
EQ_TA (t-1)	*-0.0451*	*-0.0512*	*-0.1651*	*-0.1131*	*-0.0959*	*-0.0044*	*0.0063*	*-0.0014*	*-0.6746*	*0.0636*	*-0.6110*	*-0.0732*
	*[-8.01]****	*[-2.65]****	*[-10.57]****	*[-6.35]****	*[-7.81]****	*[-2.23]***	*[8.47]****	*[-3.96]****	*[-33.24]****	*[7.76]****	*[-25.52]****	*[-2.24]***
INEFFICIENCY (t-1)	*-0.0212*	*0.0413*	*0.0350*	*-0.0567*	*-0.0018*	*-0.0009*	*-0.0049*	*-0.0009*	*-0.1033*	*-0.0043*	*-0.1076*	*-0.0636*
	*[-15.50]****	*[10.35]****	*[10.95]****	*[-14.78]****	*[-0.71]*	*[-1.61]*	*[-26.55]****	*[-9.95]****	*[-25.00]****	*[-2.47]***	*[-22.43]****	*[-8.93]****
NNI (t-1)	*-0.0116*	*-0.0985*	*-0.0915*	*0.1034*	*-0.0240*	*0.0055*	*0.0010*	*-0.0013*	*0.0624*	*0.0214*	*0.0839*	*0.0853*
	*[-2.85]****	*[-7.91]****	*[-9.33]****	*[9.03]****	*[-2.93]****	*[3.12]****	*[1.81]**	*[-4.30]****	*[4.98]****	*[3.69]****	*[5.67]****	*[3.78]****
GDP_GROWTH (t-1)	*0.0214*	*-0.5240*	*-0.4690*	*0.7764*	*-0.0809*	*0.0275*	*0.0051*	*0.0013*	*-0.5892*	*-0.1047*	*-0.6939*	*-0.2955*
	*[2.39]***	*[-21.03]****	*[-23.49]****	*[32.54]****	*[-5.18]****	*[7.54]****	*[4.37]****	*[2.28]***	*[-22.89]****	*[-10.42]****	*[-23.65]****	*[-7.10]****
Observations:	*147679*	*149442*	*142312*	*153531*	*153531*	*152867*	*148503*	*153531*	*153528*	*153528*	*153528*	*135652*
R-squared:	*0.72*	*0.90*	*0.88*	*0.90*	*0.92*	*0.56*	*0.78*	*0.27*	*0.92*	*0.86*	*0.93*	*0.47*
F-statistic:	*43.90*	*152.26*	*121.47*	*153.77*	*190.05*	*22.12*	*61.05*	*6.63*	*212.01*	*107.04*	*225.44*	*14.36*

Concluding Remarks of Part 1

There have been many competing views as to the causes of the financial crisis. Many analyses perceive in the long period of low interest rates that preceded the crisis a fundamental factor that spurred credit boom and housing bubble and initiated a process in which banks expanded their balance sheets and increased their risk-taking. Consequently, widely discussed is the need to review the role of central banks and to include financial stability as an additional objective for monetary policy. The objective of the first part of this thesis was to consider the relation between interest rates and bank behaviour and to specifically understand the theories underlying the risk-taking channel. The main results of this part show that during period when low level of interest rates prevail:

- Banks soften lending practices
- Banks increase investments in risky assets
- Banks decrease investments in risk-free assets
- Banks increase liquidity creation and asset expansion
- Performance and loan quality are enhanced and measures of risk based on profitability and performance do not reflect anomalies at the bank level during the pre-crisis period
- Risk materialize after the emergence of the crisis

It is true that the relationship between loose monetary policy and more generally low levels of interest rates have been found to be associated with an increase in risk-taking at the bank level, however whether this increase in the risk-taking is responsible or more modestly has contributed to recent financial imbalances is less obvious. On a first hand, one could argue that the choice to the bank to invest in risky assets during good economic performance and loose monetary conditions could be quite logical and beneficial and does not necessarily reflect irrational behaviour. On the other hand the crisis has been associated to risk build-up at macro level and micro-prudential supervisions were not able to

detect the anomalies at the bank level. For this reason, it is important to consider and to analyse these results as a whole in order to better understand the implication of the risk-taking channel: softer lending practices associated with environment of low interest rates could lead to increase risk-taking, which build up financial imbalances. Also, looking at the evolution of some asset prices during the last decades, it would be reasonable to say that price stability objective was not totally respected. In the U.S., house price index increased significantly in the late 1990s. Even if there is no agreement among economists that asset price bubbles actually exist, it could be fairly argued that expansionary monetary policies and low policy rates leading to bank asset expansion and to increase in liquidity creation specifically to finance mortgage loans, somewhat fuelled this boom in house prices (Paul (2007), Taylor (2008), Holt (2009), Woods (2009), McDonald and Stokes (2013)). Accordingly, low interest rates associated with increases in asset expansion and asset prices and increase relying on leverage and increase in risk-taking, could make banks and the banking system as a whole more sensitive to shocks. It is essential for monetary authorities to consider the impact of their policies on bank behaviour. For example when expansionary monitory policy leads to increase in loan growth, it would be logical to quest in which field this additional money is being invested, to whom it is being granted, to what purposes... It is also important for prudential authorities to be attentive during periods of available liquidity and benign economic conditions, when even with good performance and high bank capital ratio, other signs of risk-taking such as asset expansion and asset prices increase.

Discussions of the risk-taking channel and the implications of monetary decisions on bank behaviour and financial stability lead to ask more specific questions, widely discussed in current debates, concerning responsibilities and objectives of central banks: Do we need to change central banks mandate? Should central banks not to worry about price stability, economic growth and unemployment? Should central banks be more worried about other things? Specifically, should central banks take into consideration financial and banking

imbalances when setting monetary policies? It is well known that financial instability and crisis constitute important threat for macroeconomic performance specifically in term of employment and price stability issues. For example the latest crisis has caused the lay out of 26 million people in the U.S., also four million families lost their homes to foreclosures following to the crisis and nearly 11 trillion $ in household wealth vanished. So even if not mentioned explicitly in their mandate, a financial stability objective for central banks is quite appropriate and go in line with the objectives of price stability, full employment and good economic performance. By the way we can already realize the importance of financial stability to central banks when they act as lender of last resort and apply quantitative easing during crisis times. However discussions are about whether financial stability must be an explicit economic policy goal for central banks and whether a "macro-prudential" perspective focused on the financial system as a whole, should be assigned to central banks. Results of this first part of the thesis are favourable to such approach. Still, the application of macro-prudential regulation is claimed to be a complicated issue. Macro-prudential supervision would attempt to focus supervision on the financial system as a whole and to take into consideration its stability. Difficulties in this area are to find the adequate elements that permit to judge and to measure financial stability. By definition, it is much more feasible for central banks to control outcomes such as inflation and unemployment that are continuously observable than to seek financial stability policies which main objective is to prevent or mitigate rare events.

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Part 2 Off Balance Sheet Activities and Bank Risk Exposure[34]

[34] This Part in whole is mainly the development of the working paper « Ziadeh-Mikati (2012), Off Balance Sheet Activities, Bank Risk Exposure and Bank Failure: an Empirical Analysis for U.S. Commercial Banks »

Chapter 1 Off Balance Sheet Activities: a Look Inside The Black Box

Abstract

What do banks off balance sheet activities include? How do these activities impact the riskiness of financial institutions? Growth in non-traditional income associated to off balance sheet activities is widely mentioned as an element that increases bank vulnerability. Also the exposure of banks to off balance sheet risk has been cited as an element that played a crucial role in the recent financial crisis. The purpose of this chapter is to clarify the different categories of activities presented off the balance sheet on a bank financial statement focusing on the risks and the benefits related to these activities.

1. Introduction

Off balance sheet activities are an intriguing part of the financial statements. Presented as footnotes to accounts, these contingent items have an important economic impact that affects the future rather than the current shape of an institution: an economic impact that however is not easy to interpret. In fact, if on balance sheet activities are well known and well understood as they appear on the published balance sheets of corporations and financial institutions, by comparison, the comprehension and the determination of the economic purpose of off balance sheet (OBS) items are often less obvious to all but some informed investors or regulators that could assess the underlying information and details of these items.

In the banking industry, the increased bank's reliance on the non-traditional business activities and the increased growth of OBS items relative to traditional on balance sheet items is of concern. On a first hand the volatility of non-interest income partly associated to OBS activities is a widely discussed problem in the banking literature and an element that increases bank risk exposure. On the other hand the recent association between OBS entities and activities and corporate failure and banking crisis makes these activities suspected to be related with higher riskiness.

It is true that several OBS activities include risks that may increase the overall bank risk exposure. Still, OBS activities have both risk-increasing and risk-reducing attributes and many OBS activities enhance the performance and the stability of banks as they generate fee income and as they are used to hedge or reduce specific risk exposure. This chapter, which main objective is to present a deeper view of the OBS items and to shed the light on the nature and the weight of OBS activities undertaken by U.S. commercial banks, is structured as follows: in section 2 an overview and a definition of the main items presented off the balance sheet on a U.S. commercial bank financial statement is presented, Section 3 focus on the advantages and the risks related to each category of the OBS activities as discussed by related theories and empirical studies, this section also provide a brief review of

the main empirical studies that treated the relation between off balance sheet activities and bank health.

2. OBS in the US banking industry

If we take a look on a bank financial statement specifically at the part concerning the off balance sheet activities, we will see a multitude of items: unused commitments, financial standby letters of credit, performance standby letters of credit, commercial and similar letters of credit, securities, credit derivatives, spot foreign exchange contracts, interest rate contracts, foreign exchange contracts, equity derivative contracts and commodity derivative contracts. The following table summarizes the different items presented off the balance sheet in the U.S. commercial banking system financial statements during the period Q1-2001 till Q4-2010:

Table 1: Descriptive statistics of off balance sheet items for the U.S. commercial banks over the period Q1-2001/Q4-2010

	Mean	Median	75th	90th	95th	Max	Min	Std. Dev.	%of banks with non-zero OBS
Unused commitments	11,6744	9,2702	14,7390	21,4726	27,0830	399,30	0,00	13,93	98,86%
Financial standby letters of credit	0,3185	0,0493	0,3133	0,8269	1,3641	28,26	0,00	0,87	58,98%
Performance standby letters of credit	0,1635	0,0000	0,0867	0,5048	0,9141	75,06	0,00	0,52	33,22%
Commercial and similar letters of credit	0,1148	0,0000	0,0000	0,1020	0,3650	420,92	0,00	1,94	16,31%
Securities lent	0,1595	0,0000	0,0000	0,0000	0,0000	598,42	0,00	6,23	0,65%
Other off-balance sheet liabilities	0,2419	0,0000	0,0000	0,0000	0,1685	425,63	0,00	2,38	5,69%
Spot foreign exchange contracts	0,0709	0,0000	0,0000	0,0000	0,0000	257,34	0,00	1,97	1,39%
Credit derivatives (Notional amount)[35]	0,2330	0,0000	0,0000	0,0000	0,0000	1044,39	0,00	9,51	0,81%
Interest Rate Contracts (Notional amount)	6,0016	0,0000	0.0000	0,2147	3,2537	45239	0,00	249,60	11,09%
Foreign Exchange Contracts (Notional amount)	0,8261	0,0000	0,0000	0,0000	0,0000	1961,58	0,00	19,59	1,78%
Equity Derivative Contracts (Notional amount)	0,0475	0,0000	0,0000	0,0000	0,0000	241,53	0,00	1,56	1,67%
Commodity Derivative Contracts (Notional amount)	0,1247	0,0000	0,0000	0,0000	0,0000	2052,35	0,00	9,43	0,43%
Credit derivatives (Gross fair value)[36]	0,0128	0,0000	0,0000	0,0000	0,0000	169,51	0,00	0,76	0,87%
Interest Rate Contracts (Gross fair value) [37]	0,1884	0,0000	0,0000	0,0000	0,0437	1573,48	0,00	8,80	9,87%
Foreign Exchange Contracts (Gross fair value)	0,0368	0,0000	0,0000	0,0000	0,0000	134,26	0,00	0,91	1,89%
Equity Derivative Contracts (Gross fair value)	0,0051	0,0000	0,0000	0,0000	0,0000	23,40	0,00	0,14	1,73%
Commodity Derivative Contracts (Gross fair value)	0,0124	0,0000	0,0000	0,0000	0,0000	131,17	0,00	0,70	0,47%

These different types of OBS items present heterogeneous characteristics and could be grouped in mainly three categories: loans substitutes, derivatives contracts and credit derivatives contracts. In the following, I present the different types of OBS activities, provide a brief definition[38] and usefulness of their use and discuss their weight in the U.S. commercial banking business model.

[35] Calculated as the sum of the notional amount of credit derivatives on which the reporting bank is the beneficiary and the notional amount of credit derivatives on which the reporting bank is the guarantor.
[36] Calculated as the sum of both negative and positive fair values of the credit derivatives on which the reporting bank is the guarantor and the gross positive and negative fair value of the credit derivatives on which the reporting bank is the beneficiary, note that negative fair value of credit derivatives is an absolute positive value.
[37] The total fair values of derivative contracts with gross positive fair values and those with gross negative fair values, note that negative fair values of derivative contracts are absolute positive values.

[38] All definitions in quotation mark are provided by the FED

2.1 Loans substitutes

First, loans substitutes such as loan commitments, credit guarantees and different types of letters of credit have always been part of financial intermediation. Unlike loans, loans substitutes do not appear on the balance sheet, and include substitutes for extending credit to a client where the bank stands ready to make payment to a beneficiary for up to the full principal amount of the instrument if the contingent event occurs.

The main and widely used items presented in this category are unused commitments and credit lines. By definition, unused commitments constitute "the portion of total credit card lines unused or available as of the report date". When a bank makes a credit commitment, it provides a borrower both with immediate cash and the future availability of cash. In the sample, 98% of U.S. commercial banks deal with this category of OBS activities, which constitute on average 11% of a banking institution's total assets (median=9.3%). The average quarterly total amount of unused commitments of all the commercial banks in the sample is between 2.6 and 4.2 trillions of $ which constitute a considerable part compared to banks balance sheets (in the sample the amount of total assets for all U.S. commercial banks is between 7 and 12 trillions $).

Commercial banks also use different types of letters of credit: financial and performance letters of credit and commercial letters of credit. The average quarterly value of the different types of letters of credit in the U.S. commercial banking system is between 300 and 620 billion $. Financial and performance standby letters of credit are the mostly used in the commercial banking industry, almost 60% of commercial banks (58% for the financial standby letter and 33% for the performance standby letter). A standby letter of credit is "a guarantee of payment issued by a bank on behalf of a client that is used as payment of last resort should the client fail to fulfil a contractual commitment with a third party". Standby letters of credit are created as a sign of good faith in business transactions, and are proof of a buyer's credit quality and repayment abilities. The bank issuing the standby letter of credit will perform brief underwriting duties to ensure the

credit quality of the party seeking the letter of credit, then send notification to the bank of the party requesting the letter of credit (typically a seller or creditor).

Commercial letters of credit used by 16% of U.S. commercial banks have been used for centuries to facilitate payment in international trade for transactions between a supplier in one country and a customer in another. "The parties to a letter of credit are the supplier, usually called the beneficiary, the issuing bank, of which the buyer is a client, and an advising bank, of which the beneficiary is a client. When the issuing bank open a commercial letter of credit on behalf of one of its customers, the bank is authorizing another bank, known as the advising or confirming bank, to make payment to the beneficiary (the provider of goods)". The issuing bank makes a commitment to honour drawings made under the credit. In this type of contracts insolvency of the client is one of the main risks the issuing bank is exposed to.

2.2 Credit derivatives

The second category of OBS activities includes the credit derivatives contracts. "Credit derivatives are bilateral financial contracts with payoffs linked to a credit related event such as non-payment of interest, a credit downgrade, or a bankruptcy filing". Similarly to loan sales and securitizations which have had a significant impact on the nature and operation of credit markets, the development of credit derivatives have specifically changed the way firms and financial institutions manage credit risk. By definition "credit derivatives consist of OBS arrangements that allow one party (the beneficiary) to transfer the credit risk of a reference asset to another party (the guarantor)". These instruments permit financial institutions to separate and then transfer the credit risk of the underlying loan. Banks can acquire credit derivatives as protection buyer "credit beneficiary" to hedge credit risk relative to a set of loans, and it can also acquire derivatives as protection seller "credit guarantor" and consequently extended credit protection to other parties. Accordingly banks that originate credit to corporate borrowers need no longer to hold the credit risk associated with these loans, while other

financial firms can hold credit risk without having to originate or fund the underlying credit.

Credit default swaps, total return swaps and credit options are the main types of credit derivatives contracts. A credit default swap is “a contract in which a protection seller or guarantor (risk taker), for a fee, agrees to reimburse a protection purchaser or beneficiary (risk hedger) for any losses that occur due to a credit event on a particular entity, called the reference entity. If there is no credit default event (as defined by the derivative contract), then the protection seller makes no payments to the protection purchaser and receives only the contractually specified fee. Under standard industry definitions, a credit event is normally defined to include bankruptcy, failure to pay, and restructuring”. For example, if a bank granted a loan of $10 million to a company, and if the bank wants to hedge against the default of this company, the bank could enter into a $10 million credit default swap with a third party.

Total return swap is another type of contract that appears off the balance sheet in the credit derivatives part. A total return swap “transfers the total economic performance of a reference asset, which includes all associated cash flows, as well as capital appreciation or depreciation. The protection purchaser (beneficiary) receives a floating rate of interest and any depreciation on the reference asset from the protection seller. The protection seller (guarantor) has the opposite profile. The protection seller receives cash flows on the reference asset, plus any appreciation, and it pays any depreciation to the protection purchaser, plus a floating interest rate. A total return swap may terminate upon a default of the reference asset”.

Finally a credit option “is a structure that allows investors to trade or hedge changes in the credit quality of the reference asset. For example, in a credit spread option, the option writer (protection seller or guarantor) assumes the obligation to purchase or sell the reference asset at a specified "strike" spread level. The option purchaser (protection purchaser or beneficiary) buys the right to sell the reference asset to, or purchase it from, the option writer at the strike spread level”.

Concerning the U.S. commercial banks, less than 1% of these banks engage in credit derivatives contracts. However the notional value of credit derivatives is important: with a quarterly total amount that increased from 500 billions of $ to more than 14 trillions of $. Specifically between 2004 and 2008, credit derivative contracts grew at a 100% compounded annual growth rate and attain a notional value of 14 trillion of $ (see appendix A).

2.3 Derivatives

Another category of OBS items includes derivatives contracts. Derivatives can be based on different types of assets such as commodities, equities (stocks), bonds, interest rates, exchange rates, or indexes (stock market index, consumer price index…). Derivatives were initially developed to meet the demands of corporate and financial institutions' treasurers facing volatile financial markets and helping them hedging specific market risk. They permit to reduce risk for one party while offering the potential of a high return (at increased risk) to another. Banks buy and purchase derivatives mainly to hedge specific risk or to respond to clients' needs. Alternatively, banks could also acquire derivatives to speculate and to take market positions. When banks use derivatives to hedge specific types of risk, derivatives will reduce the bank exposure to the risk in question. For example, when banks use derivatives to control for interest rate risk, banks experience less uncertainty vis-à-vis the volatility of the interest rate. Alternatively, when banks sell derivatives to corporations and other financial institutions to help them hedging financial exposure, they act as dealers taking fees and making the difference between their bid and ask prices on purchases and sales. Finally when banks take market positions and speculate on derivatives they are gambling on the future performance of the underlying assets in an attempt to realize trading profits. Using derivatives in such a manner could have both rewarding and penalizing impact.

Interest rate derivatives are the most frequently used contract by financial institutions specifically to reduce their interest rate exposure. An interest rate derivative is a derivative in which the underlying asset is the right to pay or receive a notional amount of money at a given interest rate. Another commonly

used contract is the foreign exchange contract. These are contracts to exchange one currency for another as of a specified date and time at a specified rate of exchange (price). Finally, equity and commodity derivatives are contracts committing the reporting bank to purchase or sell equity securities, equity instruments or commodities.

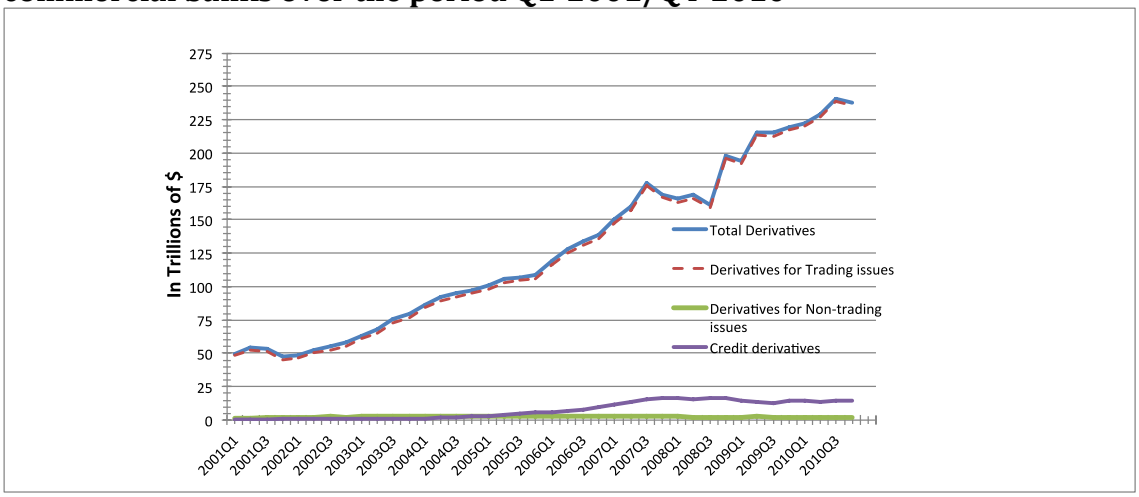
The diverse range of potential underlying assets and payoff alternatives leads to different range of derivatives contracts available to be traded in the market. Specifically, these derivatives contracts with different underlying assets could be of different types: "future/forward" contracts which are agreements to buy or sell an asset on a specified future date for a specified price, "options" which are contracts that give a holder the right (but not the obligation) to buy or sell an asset at a specified future date and "swaps" contract, where the two parties agree to exchange cash flows.

In the case of U.S. commercial banks, only 12% of the entire sample uses the derivative contracts (specifically interest rate, foreign exchange, equity and commodity derivatives) most of which are interest rate derivatives contracts. The average quarterly gross notional amount of derivatives used by the entire commercial banking system is between 47 and 240 trillion of $, the total quarterly fair value (sum of positive and negative exposure) of these contracts which do reflect the bank exposure is between 1 and 11 trillion of $ (see appendix A and B) 60% of which are positive exposure. The quarterly net exposure of derivatives is however much lower (positive exposure minus negative exposure) between 1 and 139 billion $.

Another interesting information that the call reports present is the distinction between derivatives contracts held for trading and those held for other than trading purposes. Derivatives contracts held for trading includes "(a) regularly dealing in interest rate contracts, foreign exchange contracts, equity derivative contracts, and other off-balance sheet commodity contracts, (b) acquiring or taking positions in such items principally for the purpose of selling in the near term or otherwise with the intent to resell (or repurchase) in order to profit from short-

term price movements, or (c) acquiring or taking positions in such items as an accommodation to customers". This information will be used further in the second chapter to specifically distinguish the impact on bank riskiness, of derivatives used for speculation and those used for hedging purposes. In the case of the U.S. commercial banks and according to the dataset, 80% of banks that hold derivatives contracts, do so for non-trading purposes against 20% for trading purposes. However the value of the derivatives held for trading is the most dominant and constitutes 90% of the derivatives value. In Graph 1 we can see how derivatives held for trading did increase during the sample period, in 2010 they are five times their amount in 2001[39]. Derivatives held for other than trading purposes constitute only a trivial part of the total derivatives contracts, they also did increase during the sample period but at a much lower trend.

Graph1: The evolution of the notional amount of derivatives used by U.S. commercial banks over the period Q1-2001/Q4-2010



3. OBS activities and bank risk exposure: Theories and empirical evidence

Under different types of OBS contracts, banks create a contingent asset or liability in exchange of a fee. Accordingly, such items contain both advantages or risk-reducing characteristics and risk-increasing characteristics for banks. OBS

[39] More details in appendix A and B

items are contingent assets and liabilities which affect the future shape of bank' financial statement. However, given the heterogeneity of OBS activities, their impact on bank health will differ according to the type of the item. Also a same product could enhance a specific type of bank risk while exposing bank to a different type of uncertainty. In this section the intention is to shed the light on the different types of risk to which OBS activities expose banks. This section also presents the advantages and the risks associated with the different categories of OBS activities: loans substitutes, derivatives and credit derivatives contracts.

3.1 Loans substitutes

Many questions could be asked about the relation between credit substitutes and bank risk exposure or bank health. Of course such items are a source of fee income, which enhance the profitability and performance of banks, if everything being equal. However a first question is to know whether loans under commitments and under guarantees are riskier than those on the spot market, in other words it is good to know whether the borrower to whom a guarantee or a credit line is granted, is more or less risky, and accordingly whether banks are more or less vigilant while granting such guarantees and credit lines. The relation between bank credit risk and credit substitutes is ambiguous. First, a bank may provide credit substitutes, specifically commitments and credit lines, for some projects or borrowers that have greater credit risk than would occur with spot market financing alone, because the bank has less information when commitment contracts are signed than when spot loan contracts are signed. This lack of information may allow some borrowers to switch to riskier projects (moral hazard) or allow some riskier borrowers to obtain loans that would not be allowed in the spot market (adverse selection) (Avery and Berger, 1991). On the other hand the bank may not offer credit substitute contracts on the same terms to borrowers associated with these informational difficulties as to other borrowers. Consequently, some borrowers may be rationed or sorted out of such contracts and have to wait to finance their projects in the spot market after their informational difficulties have been resolved (Avery and Berger, 1991). Avery and

Berger (1991) investigate this question for loans issued under commitments by U.S banks. Using semi annual observations during the period 1973 till 1986, they find that loans issued under commitment appear to have slightly better performance on average than other loans, suggesting that commitments generate little risk or that this risk is offset by the selection of safer borrowers. Boot and Thakor (1990) present a theoretical model and argue that rather than increasing the exposure of the deposit insurer, loan commitments generate interactive incentives for banks to retard risk-taking. Not only are commitment customers safer than spot borrowers, but also the spot borrowers chosen by the bank are themselves safer than those the bank would choose in the absence of loan commitments.

A second question concern the liquidity constrain of such items: OBS items in the form of unused commitments and loans substitutes is a source of liquidity to bank customer that is potentially a substitute of money (Glick and Plaut 1988). The exposure, or the additional amount drawn arising from the credit substitutes, is of concern: in fact unused positions represent loans that may show up in the banks' loan portfolios in the future, adding to loan growth and funding needs. Also since such items are not constrained by liquidity reserves, banks with larger amount of credit substitutes could be more exposed to drawdown of commitments and credit lines when market conditions tighten. Mora (2010) finds that U.S banks with high exposure to liquidity demand (measured as the ratio of unused commitments to total loans and commitments) had less advantage over other banks in attracting deposits and making loans in the recent crisis. Gatev, Schuermann and Strahan (2004) investigate differences across banks in their ability to manage systematic liquidity risk during the crisis of 1998. They report evidence from the U.S. equity market that unused loan commitments expose banks to systematic liquidity risk (higher stock return volatility and faster deposit growth), whereas transactions deposits insulated them from this risk.

Finally, the third question concerns the diversification impact of OBS items specifically the impact of loans substitutes on bank performance. Hassan (1991)

investigates the impact of OBS activities on total risk of large commercial U.S banks, specifically market risk, diversifiable risk and financial risk. His study shows that none of the OBS categories affect systematic risk except the standby letters of credit, which is found to reduce risk. Also the reducing diversification effects of OBS banking items dominate the risk increasing effect, thus reducing overall riskiness of banks. Papanikolaou and Wolff (2010) investigate the leverage implication of off-balance sheet activities and their impact on bank riskiness for the case of the 12 largest U.S. commercial banks. Using the ratio of the notional amounts of derivative outstanding to tier 1 and tier 2 regulatory capital as proxy of embedded leverage and the ratio of nominal value of OBS liabilities to book equity capital as proxy of OBS leverage, the authors found that leverage has a significant positive impact on total bank risk-taking[40]. They also found that banks that concentrate on traditional banking activities, carry less risk exposure than those that are involved with modern financial instruments.

Many empirical studies do not use disaggregated measures of off balance sheet activities and test the implication of the total amount of OBS activities on bank riskiness. Haq and Heaney (2012) investigate the implication of OBS activities for European countries, they find a positive and statistically significant association between the total amount of OBS activities[41] and different measures of bank risk inter alia credit risk. Duran and Lozano-Vivas (2012) analyze whether the relation between OBS activities and bank risk in the European financial industry can be explained in terms of the adverse selection hypothesis. According to the latter, OBS deals are not means used by banks to get rid of that portion of risk they do not want to hold in their books, therefore risk aversion is a self-regulating mechanism that provides incentives for banks to choose that option for quality in the OBS market. The result of the paper shows that, confirming to the adverse selection

[40] Risk taking is proxied by the standard deviation of the bank stock market returns.

[41] In the study of Haq and Heany (2012), off balance sheet activities are proxied by the ratio of the total value of off-balance sheet activities as reported by Bankscope to total liabilities. No distinction has been made between derivatives and credit substitutes, however according to the authors "*the off-balance sheet activities of most concern for this study are the contingent liabilities of the banks where the bank must honor guarantees when required. Examples include the bank guarantees attached to commercial letters of credit, loan commitments and stand-by letters of credit.*"

hypothesis, EU15 banks that have been more active in the OBS market had a lower probability of failure. However the banking institutions in new European union members used low-quality assets for OBS deals, thus supporting the association of these deals with "junk" assets.

Furthermore, given that off balance sheet activities are associated to fees and non-interest income, some empirical evidence investigates the impact of OBS activities using a proxy derived from non-interest income. Barell et al. (2010) test the impact of OBS exposures on the probability of banking crises in 14 OECD countries since 1980. Using a multinomial Logit method where the dependent variable is the banking crisis variable, they found that the change in a proxy of OBS activities of banks derived from the share of non-interest income has a positive effect on the probability of a crisis. Consequently, expansion of OBS activities relative to on-balance sheet assets by banks increases crisis probability. Lepetit et al. (2007) show that European banks expanding into non-interest income activities presented higher risk and higher insolvency risk than banks which mainly supplied loans. However when distinguishing fee based and trading revenues, they find that it is almost the fee-based revenues that presented the positive link with bank insolvency. They also find that engaging in trading activities might imply a decrease in risk for smaller banks. Deyoung and Torna (2012) investigate a similar issue for U.S. commercial banking system. Specifically, they investigate the implication of fee-based banking activities on the commercial bank failures that occurred during the financial crisis. After differentiating traditional, fee-for-service and stakeholder non interest income, they find that fee-for-service income reduced the probability that healthy banks failed or became financially distressed, while stakeholder income increased the probability that distressed banks failed.

3.2 Derivatives

Derivatives contracts may impact bank performance in diverse ways. Firstly, financial derivatives tools could play great role in stabilizing firms or banks. Used by banks as end users for hedging tools, derivatives could decrease bank risk and

enhance bank performance by reducing the volatility of the underlying asset (the interest rate, the exchange rate, the commodity or the equity asset). Furthermore, banks can also benefit by reducing their risk exposure to their customers when they act as dealer in derivatives contracts, since hedging with derivatives can reduce the probability of financial distress for client firms (Sinkey and Carter (2000)).

Secondly, derivatives are contracts between two parties that specify conditions under which payments are to be made between the parties. Accordingly, "derivative contracts are an obligation against a bank and its customers to make a payment in the future under certain circumstances in which the banks and their customers would prefer not to make the payment". Consequently and according to such scenario, derivative contracts would have negative impact on bank performance. Said (2011) investigate the impact of derivatives on five U.S. banks' performance [42] during the period 2002-2009. The study shows a positive correlation between the bank' performance (ROA, ROE) and alternatively bank efficiency (Noninterest expense as a percentage of total income) and usages of derivatives. Hassan and Khasawneh (2009) test the impact of different kind of derivatives contracts on the riskiness[43] of diverse size of U.S. bank holding companies. They found that among the derivatives contracts, swaps are the major contracts that are incorporated in market risk valuation. Results show that such contracts are viewed as risk reducing tools according to the three risk measures for both big and medium BHCs. Concerning the other types of derivatives the study shows that futures, forwards, and options do not seem to have a major effect in valuation of bank market risk for all the three BHCs groups. However, they find a significant positive relationship between these three types of derivatives and market systematic risk (Beta). Jay choi and Elyasiani (1996) find that the use of derivative contracts by commercial U.S. banks creates a significant additional potential systematic risk beyond the level that reflects a bank's traditional financial statement exposures.

[42] J.P. Morgan Chase, Citibank, Wells Fargo, Bank of America, and The Bank of New York

[43] They measured risk by systematic risk Beta, the equity return risk and the implied asset volatilities

3.3 Credit Derivatives

Credit derivatives are means by which banks can modify their credit risk exposure. Unlike loans' sale or securitization that remove the risk of a loan completely from the bank's balance sheet, with credit derivatives the loan is kept on the balance sheet and only the credit risk of the loan is transferred to the protection seller. A bank can acquire credit derivatives as protection buyer "credit beneficiary" to hedge credit risk relative to a set of loans, and it can also acquire derivatives as protection seller "credit guarantor" and consequently extended credit protection to other parties. While some commentators saw in credit derivatives benefits for the financial system (Alain Greenspan 2003[44]) other saw in these products hidden dangers and systemic risk (Warren Buffett speech 2003[45], Howard Davies). Also the theories and the studies that discuss the impact of credit derivatives on bank soundness present many conflicting views: Credit risk transfer through credit derivatives could bring benefits, reduce credit risk, increase liquidity in the banking industry and implement diversification gains to the financial institution, however it could create moral hazard problem and increase systemic risk.

First, on one hand, the main purpose of credit derivatives is to transfer credit risk to another party that wish to take the risk. This implements a reduction in credit risk exposure for the bank that buys credit protection. During the corporate crisis of 2001 and 2002, many commentators argued that credit derivatives served as a shock absorber. Alan Greenspan has attributed "the resilience of his country's banks in 2001 and 2002—when Enron, WorldCom and the Argentine government defaulted—to credit derivatives, which spread the burden of the defaults across a broad group of banks and other institutions"[46]. On the other hand, credit risk

[44] "What we have found over the years in the marketplace is that derivatives have been an extraordinarily useful vehicle to transfer risk from those who shouldn't be taking it to those who are willing to and are capable of doing so," (Senate Banking Committee in 2003)

[45] "In my view, derivatives are financial weapons of mass destruction, carrying dangers that, while now latent, are potentially lethal" Warren Buffett

[46] See « Risky Business, The Economist, August, 18, 2005 »

transfer may threaten the stability of financial institutions by creating bank incentives to decrease monitoring and to increase risk-taking. Wagner (2005) mentions "banks may simply take on new risks following a reduction in the risks on their balance sheet through credit risk transfer". Partnoy and Skeel (2006) argue that credit derivatives "create the risk of systemic market failure," partly because they reduce borrowers' incentives to monitor and hence "fuel credit expansion". Also Morrison (2005) argues that the availability of credit derivatives could adversely affect banks by reducing their incentives to monitor and to screen borrowers. Instefjord (2005) investigate whether financial innovation of credit derivatives makes banks more exposed to credit risk. The results of his study show that the impact of credit derivatives innovation is double: they enhance risk sharing as suggested by the hedging argument but they also make further acquisition of risk more attractive.

Moreover, the desire to improve portfolio diversification and to improve the management of credit portfolios has also been cited as an advantage of using credit derivatives (see Morrison (2005)). For example, Dong (2005) argues that banks may diversify their loan portfolio "by synthetically accepting credit risk from industries or geographic regions that were underweighted in the portfolio". Accordingly credit derivatives are means by which portfolio managers can adjust the risk and return characteristics of a portfolio to achieve an efficient portfolio. Still, credit derivatives increase the fragility of the risk buyer (the protection seller or the guarantor) by exposing the bank to more credit risk. Similarly "incentives to affirmatively destroy value" have also been cited as a potential problem with credit derivatives. According to Partnoy and Skeel (2006) "a lender that has purchased a credit derivative may have an incentive to use the leverage afforded by its loan to force a default, even if the default imposes serious costs and impairs the value of the firm". Minton et al. (2008) investigate whether credit derivatives make banks sounder. They first examine the reason that pushes U.S. bank holding companies with assets in excess of $1 billion to use credit derivatives. They found that few of these companies use credit derivatives (between 4% and 8% of BHC). They also

found that “among the banks that have positions in credit derivatives, a detailed review of their disclosures reveals that the typical position in credit derivatives is taken on for dealer activities rather than for hedging credit exposures from loans”. They conclude that the use of credit derivatives by banks to hedge loans is limited because of adverse selection and moral hazard problems and because of the inability of banks to use hedge accounting when hedging with credit derivatives.

A last advantage of credit derivatives is related to liquidity in the credit markets. By enabling banks to lend at lower risk, credit derivatives may increase liquidity in the banking industry. Previous financial innovations, specifically in loans sales and securitisation, have been found to be associated with higher lending (Cebenoyan and Strahan 2004 and Franke and Krahnen 2005). Concerning credit derivatives, according to Wagner (2005a) “Credit derivatives foster firm financing by reducing bank’s costs of bearing risk”. Hirtle (2008) find that credit derivatives used by U.S. banks, are associated with an increase in the supply of credit for specific types of loans and borrowers. In contrast, credit derivatives could also be responsible for systemic market failure. The exposure to credit derivative could play an important role in the liquidity shortage for a protection seller. Wagner (2005a) studies the consequences for banking stability of credit derivatives. The author shows that the benefits of increased liquidity from facilitating risk transfer in normal times and from enhancing liquidation in a crisis are counteracted by corresponding increases in banks’ risk-taking. In a further study Wagner (2005b) argues that the diversification benefits implemented by the use of credit risk transfer increase the probability of a liquidity-based crisis. The author explains that increased diversification leads banks to invest more in risky assets and to reduce the provision of liquidity. Finally, Wagner and Marsh (2005) find that the transfer of credit risk from banks to non-banks is more beneficial than credit risk transfer within the banking sector.

Appendix A: Quarterly total amount of off balance sheet items in the U.S. commercial banking system in thousands of $ (Notional amount of derivatives and credit derivatives contract)

	Total assets (th.$)	Credit substitutes (th.$)	Derivatives (th.$) Notional value	Derivatives contracts: Trading (th.$) Notional value	Derivatives contracts: Non trading (th.$): Notional value	Credit derivatives (th.$) Notional value
2001Q1	7,057,741,036	2,699,410,579	49,509,220,900	48,119,753,816	1,389,467,084	421,976,566
2001Q2	7,093,780,449	2,717,286,861	53,933,602,461	52,568,999,887	1,364,602,574	422,012,124
2001Q3	7,210,813,271	2,740,950,515	53,063,799,168	51,485,980,113	1,577,819,055	439,833,795
2001Q4	7,223,921,408	2,749,103,156	47,084,282,373	45,090,382,828	1,993,899,545	498,730,675
2002Q1	7,214,634,849	2,779,187,814	48,511,447,278	46,341,109,482	2,170,337,796	523,150,400
2002Q2	7,460,940,710	2,839,587,573	52,642,815,496	50,408,706,033	2,234,109,463	618,463,836
2002Q3	7,622,531,595	2,849,000,594	55,238,442,520	52,662,668,888	2,575,773,632	665,749,386
2002Q4	7,763,595,611	2,861,895,116	57,996,922,805	55,739,331,523	2,257,591,282	746,219,439
2003Q1	7,916,135,621	2,913,112,162	63,457,923,586	60,907,248,996	2,550,674,590	810,174,151
2003Q2	8,196,648,977	2,962,221,402	67,936,453,782	65,142,983,802	2,793,469,980	914,561,700
2003Q3	8,263,592,172	2,971,578,323	75,550,084,174	72,882,178,813	2,667,905,361	975,344,826
2003Q4	8,326,393,253	2,942,105,290	79,567,874,765	77,067,201,615	2,500,673,150	1,127,038,568
2004Q1	8,538,595,923	3,019,321,756	86,692,066,469	84,070,120,077	2,621,946,392	1,324,206,598
2004Q2	8,772,227,332	3,109,933,810	91,899,137,920	89,221,750,077	2,677,387,843	1,612,201,955
2004Q3	8,977,062,244	3,370,611,404	94,820,597,358	92,135,828,479	2,684,768,879	2,049,468,067
2004Q4	9,030,230,727	3,294,230,345	97,422,806,033	94,667,875,199	2,754,930,834	2,465,465,528
2005Q1	9,189,897,471	3,328,785,017	100,761,625,924	98,189,955,168	2,571,670,756	3,247,059,204
2005Q2	9,344,467,188	3,440,069,662	105,449,743,757	102,875,439,712	2,574,304,045	4,252,009,875
2005Q3	9,601,024,511	3,535,795,899	106,947,628,555	104,316,166,897	2,631,461,658	5,257,791,092
2005Q4	9,744,973,372	3,713,456,569	108,832,333,056	106,148,615,332	2,683,717,724	5,984,249,121
2006Q1	10,069,925,278	3,859,533,752	119,393,213,200	116,706,033,995	2,687,179,205	5,644,827,376
2006Q2	10,352,608,930	4,051,787,807	128,015,286,498	125,354,999,240	2,660,287,258	6,748,731,105

	Total assets (th.$)	Credit substitutes (th.$)	Derivatives (th.$): Notional value	Derivatives contracts: Trading (th.$): Notional value	Derivatives contracts: Non trading (th.$): Notional value	Credit derivatives (th.$): Notional value
2006Q3	10,514,200,520	4,143,897,103	134,153,254,786	131,114,760,499	3,038,494,287	8,090,800,064
2006Q4	10,876,714,602	3,903,399,843	138,809,649,853	135,931,270,673	2,878,379,180	9,216,059,973
2007Q1	11,134,937,025	4,042,960,102	150,475,753,243	147,607,133,989	2,868,619,254	11,333,727,488
2007Q2	11,388,005,751	4,278,551,442	160,267,895,280	157,619,429,315	2,648,465,965	13,153,502,505
2007Q3	11,781,563,170	4,399,266,599	178,037,553,062	175,234,618,073	2,802,934,989	15,654,544,939
2007Q4	12,185,511,880	4,297,751,706	169,236,824,089	166,726,959,581	2,509,864,508	16,137,185,743
2008Q1	12,386,431,668	4,165,664,571	166,100,623,194	163,289,703,636	2,810,919,558	16,608,955,172
2008Q2	12,296,876,402	4,155,813,665	168,603,183,597	166,256,574,036	2,346,609,561	15,633,376,942
2008Q3	12,768,914,389	4,064,452,609	161,472,741,876	159,349,741,565	2,123,000,311	16,143,221,738
2008Q4	13,243,694,756	3,883,709,270	197,719,893,530	195,558,084,376	2,161,809,154	16,029,121,361
2009Q1	12,950,113,173	3,753,692,686	194,203,203,832	191,914,587,613	2,288,616,219	14,595,716,339
2009Q2	12,888,414,611	3,687,422,574	215,653,239,776	213,221,623,818	2,431,615,958	13,412,090,847
2009Q3	12,825,159,812	3,653,206,032	215,053,157,510	212,954,268,515	2,098,888,995	12,973,116,760
2009Q4	12,756,801,952	3,600,215,855	219,410,151,032	217,439,990,349	1,970,160,683	14,104,579,642
2010Q1	12,763,418,723	3,792,952,027	222,081,566,578	220,083,038,774	1,998,527,804	14,451,003,644
2010Q2	12,634,640,724	3,758,956,778	229,445,142,944	227,489,233,948	1,955,908,996	13,961,242,119
2010Q3	12,928,766,814	3,826,275,938	240,917,077,512	238,814,900,403	2,102,177,109	14,549,652,747
2010Q4	12,814,029,372	3,408,039,141	237,956,839,838	236,089,816,433	1,867,023,405	14,150,981,429

Appendix B: Quarterly total amount of off balance sheet items in the U.S. commercial banking system in thousands of $ (Gross fair values for derivatives and credit derivatives contracts)

	Total assets (th.$)	Derivatives contracts (th.$)	Derivatives contracts: held for Trading (th.$)	Derivatives contracts: Non trading (th.$)	Credit derivatives (th.$)
2001Q1	7,057,741,036	1,312,208,658	1,284,750,190	27,458,481	NA
2001Q2	7,093,780,449	1,236,239,505	1,211,745,365	24,494,113	NA
2001Q3	7,210,813,271	1,586,964,054	1,533,723,722	53,240,305	NA
2001Q4	7,223,921,408	1,331,260,405	1,294,221,517	37,038,882	NA
2002Q1	7,214,634,849	1,122,793,136	1,089,698,282	33,094,834	8,801,662
2002Q2	7,460,940,710	1,599,444,634	1,550,436,362	49,008,221	15,647,833
2002Q3	7,622,531,595	2,238,355,750	2,159,518,239	78,838,200	20,958,288
2002Q4	7,763,595,611	2,425,488,864	2,355,203,218	70,285,610	19,212,825
2003Q1	7,916,135,621	2,499,749,826	2,437,105,145	62,644,646	22,898,004
2003Q2	8,196,648,977	2,873,728,954	2,805,484,652	68,244,224	22,442,937
2003Q3	8,263,592,172	2,855,389,667	2,794,888,651	60,501,038	23,409,182
2003Q4	8,326,393,253	2,652,238,554	2,599,895,138	52,343,438	28,168,882
2004Q1	8,538,595,923	2,974,360,535	2,918,725,086	55,635,496	28,246,261
2004Q2	8,772,227,332	2,249,194,825	2,208,163,033	41,031,796	28,005,675
2004Q3	8,977,062,244	2,586,250,275	2,544,685,245	41,565,093	33,056,457
2004Q4	9,030,230,727	2,910,472,966	2,870,559,961	39,913,183	43,522,338
2005Q1	9,189,897,471	2,659,625,635	2,625,011,224	34,614,362	45,627,621
2005Q2	9,344,467,188	3,289,120,238	3,253,619,823	35,500,324	59,018,392
2005Q3	9,601,024,511	2,973,458,685	2,942,632,770	30,825,832	69,763,323
2005Q4	9,744,973,372	2,698,748,370	2,668,427,809	30,320,603	78,979,766
2006Q1	10,069,925,278	2,706,085,216	2,673,458,133	32,627,021	90,467,846
2006Q2	10,352,608,930	2,993,862,086	2,961,645,461	32,216,521	99,690,041

	Total assets (th.$)	Derivatives contracts (th.$)	Derivatives contracts: Trading (th.$)	Derivatives contracts: Non trading (th.$)	Credit derivatives (th.$)
2006Q3	10,514,200,520	2,586,384,881	2,562,700,246	23,684,561	116,708,871
2006Q4	10,876,714,602	2,544,233,368	2,519,977,398	24,255,919	149,504,286
2007Q1	11,134,937,025	2,591,387,965	2,569,769,979	21,618,027	187,924,930
2007Q2	11,388,005,751	3,039,611,624	3,013,248,206	26,363,377	230,317,678
2007Q3	11,781,563,170	3,071,346,904	3,043,658,136	27,688,668	394,521,585
2007Q4	12,185,511,880	3,948,689,396	3,915,565,593	33,123,945	595,909,810
2008Q1	12,386,431,668	5,378,452,686	5,325,248,645	53,203,996	1,101,471,679
2008Q2	12,296,876,402	4,486,850,145	4,452,267,189	34,583,341	975,624,002
2008Q3	12,768,914,389	4,209,706,307	4,171,631,302	38,074,932	1,321,185,364
2008Q4	13,243,694,756	11,990,103,440	11,899,069,958	91,033,820	2,194,693,723
2009Q1	12,950,113,173	10,448,482,689	10,363,088,658	85,393,677	2,143,111,295
2009Q2	12,888,414,611	8,900,292,629	8,835,498,559	64,794,158	1,299,917,871
2009Q3	12,825,159,812	9,369,780,107	9,307,309,802	62,470,023	926,422,847
2009Q4	12,756,801,952	7,975,928,637	7,922,275,657	53,652,828	856,373,638
2010Q1	12,763,418,723	7,980,882,576	7,930,171,279	50,711,435	768,066,458
2010Q2	12,634,640,724	10,121,858,948	10,057,561,362	64,297,284	793,863,779
2010Q3	12,928,766,814	11,821,385,748	11,753,795,581	67,590,298	700,482,572
2010Q4	12,814,029,372	8,698,068,052	8,643,391,743	54,676,043	640,642,521

Chapter 2 The Impact of Off Balance Sheet Activities on Bank Riskiness: Analysis for U.S. Commercial Banks

Abstract

Using data from the quarterly call reports of U.S. commercial banks over the period 2001/2010, this chapter investigates the possible implication of off balance sheet activities on bank risk exposure and bank failure. Given the heterogeneity of banks' off balance sheet activities, I differentiate credit substitute, derivative and credit derivative contracts and study their alternative role on bank riskiness. The results show that different types of off balance sheet activities impact differently bank risk exposure: Credit substitutes are found to enhance bank loans portfolio and bank performance while putting more pressure on bank liquidity. Concerning derivatives contracts, whether used for hedging or for speculating purposes, these contracts are found to implicate higher risk exposure specifically for smaller banks. For larger banks, engaging in derivatives activities has not been found to significantly impact the measures of risk.

1. Introduction

The business of financial intermediation has witnessed a large increase in the use of off balance sheet activities during the last 40 years. This growth that has come as a response to the need of various corporations for different types of guarantees did have a conflicting impact on financial stability and bank soundness. On a first hand, diversification into non-traditional activities has been beneficial to the banking sector specifically by implementing an additional fee income or by constituting new technique for hedging specific risk (Kwast (1989), Santomero and Chung (1992), Templeton and Severiens (1992), Saunders and Walter (1994), and Gallo, Apilado, and Kolari (1996)). On the other hand non-traditional activities did influence banks conditions by increasing banks exposure to different types of risk and by creating banks incentives to more risk taking. (Instefjord (2005), Biais et al. (2010), Rajan (2006))

In this chapter, I am specifically interested in testing the impact of different categories of off balance sheet activities on bank riskiness. Using data from the quarterly call reports of U.S. commercial banks and using information relative to the existence and failure of these banks, the objective of this chapter is to investigate to what extant different types of OBS activities could impact bank riskiness and bank failure in the U.S. commercial banking system during the period 2001-2010. After categorizing OBS items into three main groups, the results show that the influences of OBS activities differ according to the type of OBS item. Also the effect of OBS activities depends on the type of risk taken into consideration. This study contributes to the literature in several ways: first it considers different types of OBS activities and studies their respective implication on bank risk. Second this study tries to investigate the responsibility of OBS in bank failure. Except the study of Deyoung and Torna (2012) that tests the role of noninterest income in the hundreds of U.S. commercial bank failures during the financial crisis, to my knowledge, no study has been conducted to analyse empirically the link between the different categories of OBS activities and bank failure for the case of U.S. commercial banks. Third, in this study specific attention will be given to differentiate the impact of derivatives used for trading and speculating issues and those used for hedging purposes. The remainder of the chapter is as follow: Section

2 presents the dataset and the variables, section 3 presents the different hypothesis, section 4 presents the econometric specifications, results and robustness checks are presented in section 5 and finally section 6 concludes.

2. Data and methodology

This section first describes the dataset used and the specification to construct the sample. The different measure of off balance sheet categories and the different variables used to measure bank riskiness are also presented in this section.

2.1 Data

The source of the financial data is the quarterly consolidated report of condition and income that each insured commercial bank in the U.S. submits to the Federal Reserve[47]. These data are available online via the Federal Reserve website. Therefore, I was able to construct a large unbalanced panel dataset, with quarterly income statement and balance sheet data over the period Q1-2001/Q4-2010 representing a total of 331,714 bank quarter observations for 10,524 U.S. commercial insured banks. In addition to balance sheets and income-statements, the data include information on the identity and closure dates of individual banks over the period of Q1-2004/Q4-2010.

To ensure that the dataset contain true viable commercial banks, I follow the methodology used by Berger and Bouwan (2009)[48] and I keep a bank if it presents all the following specifications: 1) the bank has loans outstanding, 2) the bank has commercial real estate and commercial and industrial loans outstanding, 3) the bank's total deposit is not null, 4) the bank has a positive equity capital, 5) the bank is not a very small bank specifically the bank's total assets exceed $25 million, 6) the unused commitments do not exceed four times total assets, 7) and finally bank's total consumer loans do not exceed 50% of total assets. I also exclude the 2.5% highest and lowest values of most of the bank level variables used in the regressions except the failure variable (dummy variable), the size variable and the

[47] Call Reports are filed by all FDIC insured commercial banks with the Federal Financial Institutions Examination Council ("FFIEC"), which collects this information on behalf of the three primary U.S. banking regulators—the Federal Deposit Insurance Corporation ("FDIC"), the Federal Reserve System ("FRS") and the Office of the Comptroller of the Currency ("OCC").

[48] Berger and Bouwman (2009) use the annual call reports for all commercial banks in the U.S. from 1993 to 2003.

variables representing the different OBS categories. These exclusions let me with a final dataset of 295,294 bank quarter observations for 9,677 banks.

Table 1 Definition of selected variables

This table defines risk measures, bank specific variables as well as macro level variables used in the analysis for the period Q1-2001/Q4-2010.

Variable	Definition	Mean	Std.	Min	Max
NPL	Non-performing loans (loans past due 90 days + non accrual loans) over total loans and leases (in%)	1.14	1.35	0.00	7.29
LLR	Allowance for loan and lease losses over total loans and leases (in%)	1.38	0.52	0.53	3.50
LLP	Provision for allowance for loan and lease losses over total loans and leases (in%)	0.12	0.21	-0.02	1.03
STDROA	Standard deviation of the bank return on assets from an eight-period rolling window	0.15	0.19	0.02	1.01
ZSCORE	Zscore based on ROA from an eight-period rolling window	147.98	102.10	11.52	495.94
LIQUIDITY	The Ratio of liquid assets over total assets (in%), liquid assets include Cash, due from depository institutions and securities.	27.00	15.01	0.00	99.61
FAILURE	A dummy variable that equal 1 if the bank failed during a specific quarter and 0 otherwise. (Available for the period Q1-2004/Q4-2010)	0.00	0.04	0.00	1.00
Credit_substitutes	The ratio of credit substitutes items over total assets (in%). Credit substitutes items are unused commitments, Financial standby letters of credit, Performance standby letters of credit, Commercial and similar letters of credit	12.05	13.33	0.00	499.93
Derivatives_notional	The ratio of the gross notional value of derivatives over total assets (in%). Derivatives consist of interest rate derivatives, foreign exchange derivatives, equity derivatives and commodity derivatives. Gross notional value of derivatives is computed as the sum of contracts held for trading and contracts held for other than trading purposes.	6.9	260.46	0	46985.01
CREDIT_GROSS	The ratio of gross credit derivatives over total assets (in%). gross credit derivatives are computed as the sum of the notional value of the credit derivatives on which the reporting banks is the guarantor and the notioanl value of the credit derivatives on which the reporting banks is the beneficiary.	0.23	9.51	0.00	1044.39
EQ_TA	Total equity over total assets (in%)	10.68	3.43	6.40	32.33
SIZE	Logarithm of total assets	18.90	1.28	17.03	28.20
ROA	Ratio of net income to total assets (in%)	0.22	0.20	-0.68	0.64
LOANG	Growth rate of total loans compared to the same quarter of previous year (in%)	6.88	10.83	-20.16	43.31
CRELOANS	Commercial real estate loans over total assets (in%)	15.34	11.09	0	89.51
Core_deposit	Total Deposits minus time deposits more than $100,000 over total assets (in%)	67.45	11.25	0	97.95
INEFFICIENCY	Total interest expenses over total interest income (in%)	35.70	11.65	-0.18	450
Brokered_deposit	Brokered deposit over total assets (in %)	2.57	6.75	0	93.84
TL_TA	Total loans over total assets (in %)	64.45	14.77	11.05	89.47
GDP_growth	Growth rate of the Gross Domestic Product compared to the same quarter of previous year (in%)	1.71	1.94	-4.11	4.14
Fed_Rate	Quarterly average of the Overnight Federal fund rate (in%)	2.37	1.80	0.12	5.59

2.2 Off balance sheet measures

Off balance sheet activities of U.S. commercial banks as presented in the quarterly call reports could be one of several categories. Following the categorisation presented in chapter 1, I group off balance sheet items into the three main groups:

- Credit substitutes items: contains OBS items that represent characteristics similar to loans. Specifically this category includes unused commitments, financial standby letters of credit, performance standby letters of credit and commercial and similar letters of credit.
- Derivative contracts specifically interest rate contracts, foreign exchange contracts, equity derivative contracts and commodity derivative contracts. This category will be further classified into derivatives held for trading purposes and derivatives held for non-trading purposes[49].
- Credit derivatives include credit default swaps[50], total return swaps, credit options[51] and other credit derivatives. This category will further be classified into credit derivatives on which the reporting bank is the guarantor and credit derivatives on which the reporting bank is the beneficiary.

Concerning derivatives and credit derivatives contracts, in the quarterly call reports both notional amounts and gross fair values (positive and negative exposure in absolute value) of contracts are reported. The latter permit to estimate a measurement of risk exposure. Specifically the total of all contracts with positive value (derivatives receivable) to the bank is the gross positive fair value and represents an initial measurement of risk exposure. The total of all contracts with

[49] This information is available in the call reports.

[50] A credit default swap is a contract in which a protection seller or guarantor (risk taker), for a fee, agrees to reimburse a protection purchaser or beneficiary (risk hedger) for any losses that occur due to a credit event on a particular entity, called the "reference entity." If there is no credit default event (as defined by the derivative contract), then the protection seller makes no payments to the protection purchaser and receives only the contractually specified fee. Under standard industry definitions, a credit event is normally defined to include bankruptcy, failure to pay, and restructuring. Other potential credit events include obligation acceleration, obligation default, and repudiation/moratorium.

[51] A credit option is a structure that allows investors to trade or hedge changes in the credit quality of the reference asset. For example, in a credit spread option, the option writer (protection seller or guarantor) assumes the obligation to purchase or sell the reference asset at a specified "strike" spread level. The option purchaser (protection purchaser or beneficiary) buys the right to sell the reference asset to, or purchase it from, the option writer at the strike spread level.

negative value (derivatives payables) to the bank is the gross negative fair value and represents a measurement of the exposure the bank poses to its counterparties (Comptroller of the Currency Administrator of National Banks (2009)). The nominal or notional value of the derivative contract is the reference amount by which payments are calculated between the parties. The nominal value itself is usually not subject to payment, however, it reflects more precisely the volume of such activities and the implication of banks in derivatives activity. In this study I use the notional amount of derivatives contract to test their implication on bank riskiness.

2.3 Bank risk measures

The objective of this study is to test the impact of OBS activities first on bank risk exposure and second on the probability of bank failure.

a. Bank risk exposure measures

Credit risk

I primarily investigate the possible impact that engaging in OBS activities may have on credit risk. Three proxies are used to assess credit risk, specifically, the ratio of loan loss reserve to total loans that include a future dimension and reflects the expected loan quality, the ratio of non-performing loans to total loans is an ex post measure of credit risk that reflect the actual loan quality, and the ratio of loan loss provision to total loans.

Insolvency risk

The standard deviation of return on assets and the Z-score are used as proxies for measuring bank performance and bank insolvency. Bank's income volatility is calculated on the basis of eight-period rolling windows (8 quarters). An increase in income volatility reflects higher bank' risk-taking strategies. Furthermore, Z-score based on ROA is used to assess bank insolvency risk:

$$ZSCORE_{i,t} = \frac{MEQTA_{i,t} + MROA_{i,t}}{\sigma ROA_{i,t}}$$

Where MEQTA is the ratio of total equity to total assets calculated on the basis of eight period rolling windows, and σROA is the standard deviation of ROA also

calculated on the basis of an eight-period rolling window. The Z-score indicates "the number of standard deviations that the bank's ROA has to drop below its expected value before equity is depleted. Accordingly a higher Z-score corresponds to a lower upper bound of insolvency risk and therefore implies a lower probability of insolvency risk" (Hesse and Čihák (2007)).

Liquidity risk

Liquidity is the ability of bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses (BIS 2008). The ratio of liquid assets to total assets is used to assess bank's liquidity in meeting their debt obligation. Liquid assets include cash, due from depository institutions and securities. This ratio reflects the general liquidity shock absorption capacity of a bank. Banks holding large enough buffers of liquid assets on the asset side of the balance sheet reduce the probability that liquidity demands threaten the viability of the bank (Aspachs et al. (2005)).

b. Bank failure

The U.S. bank call reports, mention the reason of termination of an entity (rssd9061), specifically for each quarter this variable will take a value from 0 to 5 each of which indicate one of the next specific cases:

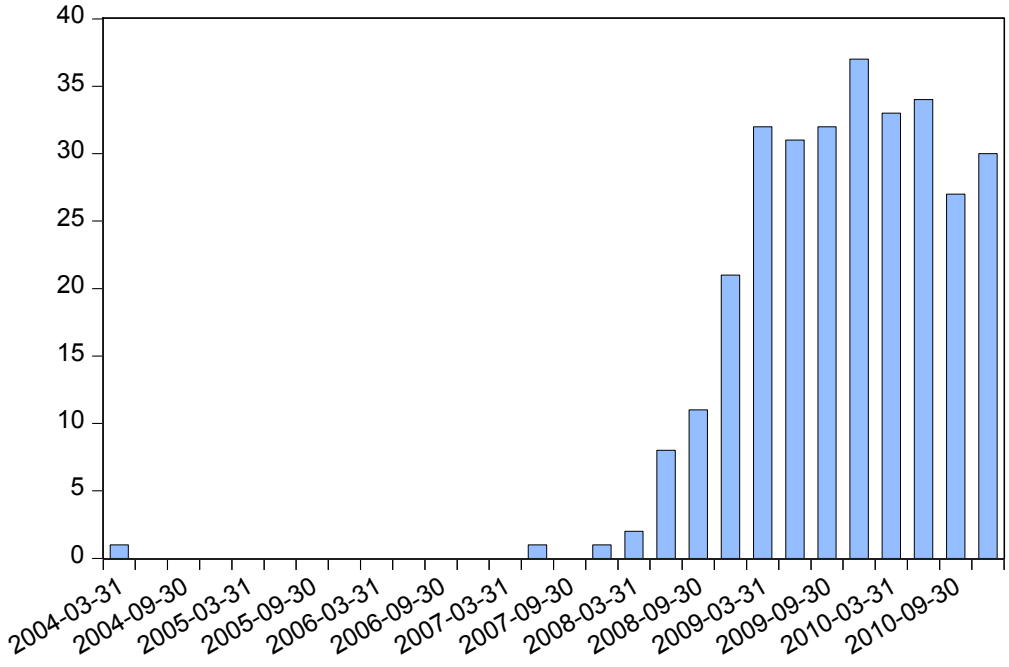
- 0 = Not applicable or entity continues to exist. This includes mergers where the head office becomes a branch and/or branches become branches of the survivor.
- 1 = Voluntary liquidation. No merger or failure has occurred.
- 2 = Closure. Closure, head office closes and does not continue following a merger. If head office closes, its branches, if any, may continue with a new head office.
- 3 = Subsidiary is either inactive or no longer regulated by the Federal Reserve.
- 4 = Failure, entity continues to exist.
- 5 = Failure, entity ceases to exist.

Based on this variable I construct a dummy variable « Failure » which takes the value of

- 1 if the bank failed and remain open or if the bank failed and ceased to exist (case 4 or 5) during a specific quarter
- 0 if the bank continue to exist
- NA (non available) if there is a voluntary liquidation or closure or if the subsidiary is either inactive or no longer regulated by the FED (case 1, 2 or 3). Note that banks with rssd9061 taking the value of 1,2 or 3 are right censored in the model.

In the sample of commercial U.S. banks, this information is available since the first quarter 2004. The figure below shows the number of failures during each quarter[52]:

Figure 1: the number of commercial banks failures during Q1-2004/Q4-2010



In the next table, I perform a mean difference test for the OBS activities between the banks that continued to exist normally during the period Q1-2004/Q4-2010 and banks that failed. For the latter I took the whole period of existence of such banks. (Using a dummy variable "failed bank" equal 1 for each quarter during the

[52] Rssd9061 could take the value of 5 for many consecutive quarters (in other words failure could take the value of 1 for the same bank for many consecutive quarters). I only take in consideration the last quarter during which a bank fails, if in the previous quarters rssd9061=5 "failure" is replaced with NA (only for the previous quarters during which rssd9061=5), this variable corroborate with the information published by the FDIC on banks failure.

sample (Q1-2004/Q4-2010) if the bank failed in a specific quarter and 0 otherwise, makes specifically the distinction between the sub-samples)

Table2: difference in mean test of the OBS activities between failed banks and banks that continue to exist

	Banks continue to exist during 2004Q1:2010Q4		*Failed banks during 2004Q1:2010Q4*			
	Mean	*Nb. Of Observations*	*Mean*	*Nb. Of Observations*	*Mean difference*	*T-stat*
Credit substitutes	*12.12905*	*191 347*	*16.2742*	*6 719*	*-4.145****	*-27.96*
Derivatives (notional)	*7.987425*	*194 692*	*1.311058*	*6 719*	*6.676**	*1.75*
Trading derivatives	*6.954642*	*194 692*	*0.1720357*	*6 719*	*6.783**	*1.78*
Non trading derivatives	*1.032784*	*194 692*	*1.139022*	*6 719*	*-0.106*	*-0.61*
Credit derivatives	*0.2699334*	*193 558*	*0*	*6 719*	*0.270***	*2.21*
Credit derivatives (guarantor)	*0.1265139*	*193 558*	*0*	*6 719*	*0.127***	*2.12*
Credit derivatives (beneficiary)	*0.1434195*	*193 558*	*0*	*6 719*	*0.143***	*2.27*

The difference in means tests show that banks that faced a failure, did invest 4% more on average in credit substitutes, 6% less in derivatives product and 0.2% less in credit derivatives than banks that did not fail. Concerning the distinction between derivatives held for trading and non-trading purposes, the upper table shows that banks that did not fail were engaging more in derivatives for trading purposes compared with those that failed. It is also good to notice that banks that did fail were not engaging in credit derivative activities. Specifically they did not buy or sell any contract as beneficiary or as guarantor of credit derivatives. Furthermore, giving that prior to the financial crisis only few banks failed, and giving that the largest banks which are the most active in dealer activities are too big to fail, I perform a second set of mean difference tests for the period 2007/2010, and another set after dropping the too big to fail banks from the sample (banks with total assets greater than $ 50 billion). All in all, the results of the different specifications show that failed banks were engaging more in credit substitutes and less in derivative contracts (see appendix C).

3. Hypothesis tested

Based on previous theoretical and empirical foundations (see chapter 1 section 3), this study proposes to develop the existing literature by considering the following hypothesis:

H1: *credit substitutes items enhance the quality of bank loans portfolio and bank performance. However, increase reliance on credit substitutes activities, increase the exposure of banks to liquidity risk and increase the probability of bank failure.*

According to Avery and Berger (1990), "all else being equal, a commitment issued to a given borrower for a given project increases a bank's credit risk, however, all else may not be equal on commitment contracts, the borrowers and projects financed under commitment may be very different from those financed in the spot loan market…" The first hypothesis assume that while giving commitments and guarantees, banks are aware of the risk behind such activities, as a result banks will apply sorting processes that tend to link commitment contracts with safer borrowers. On the contrary, credit substitutes are similar to loans. Since such items are not constrained by liquidity reserves, banks with larger amount of credit substitutes could be more exposed to drawdown of commitments and credit lines when market conditions tighten. Hence, I expect banks that increase the portion of credit substitutes relative to total assets, to have greater exposure to liquidity risk and greater probability of failure.

H2: *The impact of derivatives contract on bank riskiness differs according to the purpose behind holding such contracts.*

Initially derivatives were created to reduce, manage and hedge risk. At the bank level when derivatives are used for hedging purposes, they could be considered as tools for protecting banks against specific types of risk. Specifically banks using derivatives for hedging purposes, experience less uncertainty and can increase lending activities which result in greater returns relative to the return on fixed fee for service activities (Deshmukh, Greenbaum, and Kanatas (1983), Brewer, Jackson, Moser and Saunders (1996), Hundman(1999)). Accordingly, I assume that when used as hedging tools, derivatives are expected to enhance bank performance and to decrease the probability of bank failure. However, the fact to be more protected on specific types of risk could create incentives to increase the risk-taking on traditional activities, which would be translated into more exposure to credit risk. Consequently a positive relation is predicted between derivatives held for hedging purposes and credit risk.

On the other hand, banks may also acquire derivatives for trading purposes. When banks take market positions and speculate on derivatives they are gambling on the future performance of the underlying assets in an attempt to realize trading profits. Using derivatives in such context could have both rewarding and penalizing impacts. Still, many views declare that the speculative use of derivatives subjects banks to higher rather than lower risk exposure and can lead to significant financial losses that may threaten the solvency of banks (Jason and Taylor 1994). Kaufman (1999) pointed out several risks inherent in the growing use of derivatives. In particular, the author describes how the marketability of assets exposes trillions of dollars' worth of assets to the changing circumstances of the market, and warns about the "illusion of liquidity" that is, the belief that anything can be bought and sold at any moment in time at a fee. In this study I test the hypothesis that engaging in derivatives product for trading purposes will be associated with an increase in bank riskiness.

H3: *The impact of credit derivatives contract on bank riskiness differs according to whether a bank is a protection buyer or a protection seller*

The main purpose of credit derivatives is to transfer credit risk to another party that wish to take the risk. Accordingly, credit derivatives could implement a reduction in credit risk exposure for the bank that buys credit protection. Still, credit risk transfer may threaten the stability of the protection buyer by creating incentives to decrease monitoring and to increase risk-taking. Therefore, higher credit derivatives for hedging purposes may also implement higher risk exposure. For the protection seller of credit derivatives (guarantor), fee incomes and higher revenues are the main advantages of these contracts. Also banks may diversify their loan portfolio "by synthetically accepting credit risk from industries or geographic regions that were underweighted in the portfolio". On the other hand, when banks act as guarantor to other parties, they are also increasing their exposure to counterparty risk. All in all, I hypothesise that the impact of credit derivatives contracts on bank riskiness differs according to whether a bank is a protection buyer or a protection seller. Also the sign of the relation is an empirical issue and depends on the balance of the two, previously mentioned, opposite effects.

4. Econometric model and estimation methodology

I propose the following two models to explore the risk' implications of banks' off balance sheet items:

4.1 Risk exposure model

This study is first concerned with the impact of engaging in OBS activities on bank risk exposure. Therefore the three types of risk exposure specifically credit risk, insolvency risk and liquidity risk are regressed on the different categories of OBS activities, in addition to a set of factors identified in the previous literature as impacting bank riskiness. The following forms of panel regressions are estimated, where (i, t) indicates bank and time index, respectively:

$$Credit\_risk_{i,t} = \alpha_0 + \alpha_1 OBS_{i,t-1} + \alpha_2 EQTA_{i,t-1} + \alpha_3 ROA_{i,t-1} + \alpha_4 LOANG_{i,t-1} + \alpha_5 SIZE_{i,t-1} + \alpha_6 Inefficiency_{i,t-1} + \alpha_7 Fed\_rate_{t-1} + \alpha_8 GDP_{t-1} + \alpha_9 BHC_{i,t-1} + \varepsilon_{i,t}$$

$$Insolvency\_risk_{i,t} = \alpha_0 + \alpha_1 OBS_{i,t-1} + \alpha_2 SIZE_{i,t-1} + \alpha_3 TLTA_{i,t-1} + \alpha_4 Inefficiency_{i,t-1} + \alpha_5 Fed\_rate_{t-1} + \alpha_6 GDP_{t-1} + \alpha_7 BHC_{i,t-1} + \varepsilon_{i,t}$$

$$Liquidity\_risk_{i,t} = \alpha_0 + \alpha_1 OBS_{i,t-1} + \alpha_2 EQTA_{i,t-1} + \alpha_3 ROA_{i,t-1} + \alpha_4 LOANG_{i,t-1} + \alpha_5 SIZE_{i,t-1} + \alpha_6 Inefficiency_{i,t-1} + \alpha_7 Fed\_rate_{t-1} + \alpha_8 GDP_{t-1} + \alpha_9 BHC_{i,t-1} + \varepsilon_{i,t}$$

The variable of interest is the one representing the off balance sheet items (*OBS*). The latter represents alternatively the three categories of off balance sheet activities: credit substitutes contracts (*Credit_substitutes*), derivatives contracts (*notional_ derivatives*) and credit derivatives contracts (*Credit_DER*). Credit substitutes enter the equation with a retardation of one quarter. Particularly, I argue that such contracts of unused commitments and latent guarantees impact bank risk exposure when they are used by the client, and thus when they are transferred from the off balance sheet to the balance sheet. Accordingly it is more appropriate to study the impact of lagged amount of credit substitutes rather than the actual amount on risk exposure.

In addition to these key variables of interest, for each one of the bank risk equation, I control for specific bank characteristics and macro variables that may have impact on bank risk exposure as suggested by related literature: First, for the insolvency risk model, following Hesse and Čihák (2007) I control for bank-level differences in bank size, loans composition and cost inefficiency using respectively the natural log of total assets, total loans over total assets (*TLTA*) and total interest

expenses to total interest income ratio (*Inefficiency*). Specifically larger banks are better diversified than smaller banks and thus may be more stable, on the other hand, larger banks may profit from being too big to fail to increase their risk taking. The concentration of loans in bank's assets is also a determinant for bank risk exposure. In the insolvency risk model I do not control for bank capitalization or bank profitability since such variables are taken into consideration in the risk measure. Second, in the credit risk model and the liquidity risk model I control for bank capitalization using the ratio of total equity over total assets. Banks are expected to trade-off higher level of equity capital for risky assets. Furthermore bank profitability, bank size, bank cost efficiency and bank loan's growth are also important elements in determining bank riskiness. Finally, for all the equations I include a dummy variable equal 1 if the bank is a member of a bank holding company (*BHC*) and 0 otherwise. Besides, giving that macroeconomic conditions are likely to affect bank's riskiness, I control for the GDP growth and the interest rate for all the three risk equations. All explanatory variables are introduced with lag of one quarter to capture possible past effects of these variables on banks riskiness. I also test for the robustness of the lagged effects by restricting the explanatory variables to contemporaneous effects. Panel equations are performed using the fixed effects panel estimator, which is found to be superior to the random effects estimator based on the Hausman test. T-statistics are corrected for heteroskedasticity following White's methodology.

4.2 Failure model

In order to identify the variables that increase or decrease the probability of bank failure and to specifically consider the impact of off balance sheet items, I estimate a binary Probit model in which the dependent variable "Failure" is a binary indicator variable that equals one if a bank failed during a specific quarter and zero if it continues to exist. The model specifically links the dependent variable to a set of explanatory variables reflecting bank level specific characterizations and macroeconomic condition. The model can be written as:

$$P\left[failure = 1 \middle| x_i \right] = \phi(\beta_0 + \beta_1 OBS_{t-4} + \beta_2 NPL_{t-4} + \beta_3 LOANG_{t-4} + \beta_4 CRELOANS_{t-4} + \beta_5 CORE\_DEPOSIT_{t-4} + \beta_6 BROKERED\_DEPOSIT_{t-4} + \beta_7 COST\_INEFFICIENCY_{t-4} + \beta_8 ROA_{t-4} + \beta_9 EQTA_{t-4} + \beta_{10} BHC_{t-4} + \beta_{11} GDP_{t-4})$$

Where Φ is the standard normal cumulative distribution function, x_i is the vector of explanatory variables and β the vector of parameters to be estimated. The literature presents many factors driving to bank failure among which: deterioration in macroeconomic conditions, poor management, high credit expansion, decrease in assets' quality, high concentration of real estate commercial loans, and high reliance on noncore funding such as brokered deposit (see for example Cole and White (2011), Deyoung and Torna (2012), Wheelock and Wilson (2000)). In this model I assume that the probability of failure depends specifically on the following variables: Off balance sheet activities which is alternatively credit substitutes and derivatives, bank loans' growth, bank non performing loans, the concentration of commercial real estate loans, core deposit, non-core brokered deposit, cost inefficiency, the GDP growth and a dummy variable that equal 1 if the bank is a member of a bank holding company (*BHC*). Giving that most of the failure events did occur during the period 2007/2010, I run the failure model specifically for the period 2007Q1:2010Q4. I also drop the large banks from the estimations. Specifically banks with total assets greater than $ 50 billion are not introduced in the estimations since such banks are not allowed to fail. Also, credit derivative contracts are not introduced in this specification since all the banks that faced failure did not engage in such type of activities. The bank' level and macro variables are introduced with a lag of four quarters. Given that bank failure during a quarter will influence the values of bank specific measures in that quarter, bank failure is more appropriately modelled as a function of the lags than by the contemporaneous values[53].

[53] For robustness check I estimate several models using various lag structures for the independent variables, see section 6.

5. Empirical results and robustness checks

5.1 Bank risk exposure

Given the high correlation between credit derivatives and other derivative contracts (80% see correlation matrix appendix 1) I run the different estimations taking separately each one of the OBS categories. Results from FE panel regressions are reported in tables A, B and C.

a. Bank risk exposure and Credit substitutes

The first three columns in table A present the results of the credit risk model using respectively the loan loss reserve, the loan loss provision and the non performing loans as proxies for assessing credit risk. The results show a negative significant relation between credit substitutes and loans riskiness. In accordance with hypothesis 1 and with previous empirical findings (Avery and Berger (1991)), these results suggest that banks apply rationing or sorting processes that tend to link credit substitutes with safer borrowers.

Concerning the insolvency risk model, I found that credit substitutes enhance bank performance (Table A column 3 and 4). Specifically I found a positive significant relation between Z-score and credit substitutes and a negative significant relation between bank profit volatility and credit substitutes, the two results indicating that banks engaging more in credit substitutes present lower volatility, lower insolvency risk and better performance. Theses results are consistent with the results of Hassan (1991), which shows that the reducing diversification effects of OBS banking items dominate the risk increasing effect, therefore reducing overall the riskiness of banks.

Finally concerning their impact on banks liquidity, also in accordance with hypothesis 1 and in accordance with the results of Gatev, Schuermann and Strahan (2004), the results show that credit substitutes are associated with banks being less liquid. Specifically I found a negative significant relation between engaging in credit substitutes and banks' liquid assets.

These results are robust to a number of specifications: Particularly I rerun the equations after excluding the biggest banks: I consider the sample of banks with total assets less than $ 50 billion. The results are unchanged. Also, I estimate the equations for the small banks subsample (25% smallest banks), the average banks subsample (banks total assets between the 25 percentile and the 75 percentile)

and the large banks subsample (25% biggest banks), the results are also robust to such specifications. In a further step, I estimate the equations restricting the explanatory variables to contemporaneous effects; the results are also robust to such specifications. Finally, I rerun the equations taking different sub-sample periods. All in all the results are consistent and present high evidence in favour of the first hypothesis which suggest that engaging in credit substitutes are associated with better loan quality, better bank performance but with lower liquidity.

Table A Credit substitutes and bank risk exposure

	Credit risk model			***Inslovency risk model***		***Liquidity model***
Dep. Var:	*LLR*	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*0.2972*	*-2.1321*	*-15.3683*	*516.8722*	*-0.2953*	*74.8285*
	*[4.16]****	*[-55.99]****	*[-69.71]****	*[35.85]****	*[-11.84]****	*[53.64]****
CREDIT_SUBSTITUTES	*-0.0071*	*-0.0022*	*-0.0165*	*0.5767*	*-0.0016*	*-0.1419*
	*[-15.85]****	*[-13.92]****	*[-17.74]****	*[15.00]****	*[-18.19]****	*[-15.20]****
EQ_TA	*0.0106*	*0.0027*	*0.0253*			*-0.2438*
	*[16.41]****	*[7.93]****	*[13.09]****			*[-19.89]****
ROA_QUARTER	*-0.4206*	*-0.1962*	*-1.542*			*1.4101*
	*[-57.59]****	*[-47.21]****	*[-68.90]****			*[14.00]****
LOANG	*-0.011*	*-0.0018*	*-0.024*			*-0.1259*
	*[-113.37]****	*[-34.58]****	*[-81.09]****			*[-71.22]****
SIZE	*0.0771*	*0.124*	*0.8999*	*-19.9283*	*0.0226*	*-2.1708*
	*[20.39]****	*[61.96]****	*[77.25]****	*[-25.54]****	*[16.89]****	*[-29.18]****
INEFFICIENCY	*-0.0041*	*0.0006*	*0.0101*	*-0.7145*	*0.0013*	*0.0205*
	*[-20.28]****	*[7.54]****	*[15.69]****	*[-18.82]****	*[18.42]****	*[7.12]****
BHC	*-0.054*	*-0.0093*	*0.0293*	*-7.364*	*0.0166*	*-1.9856*
	*[-9.33]****	*[-2.99]****	*[1.62]*	*[-5.07]****	*[7.79]****	*[-17.98]****
FED_RATE	*-0.025*	*-0.0172*	*-0.1277*	*10.1404*	*-0.0126*	*-0.6993*
	*[-35.08]****	*[-55.01]****	*[-57.65]****	*[70.21]****	*[-54.45]****	*[-60.24]****
GDP_GROWTH	*0.0042*	*-0.0093*	*-0.0388*	*2.6081*	*-0.0037*	*0.3677*
	*[8.08]****	*[-31.84]****	*[-22.85]****	*[25.24]****	*[-22.69]****	*[43.31]****
TL_TA				*0.0624*	*-0.0001*	
				*[2.15]***	*[-1.57]*	
Observations:	*210142*	*218413*	*214986*	*212273*	*212347*	*218414*
R-squared:	*0.68*	*0.33*	*0.51*	*0.5*	*0.47*	*0.88*
F-statistic:	*49.33*	*11.74*	*24.82*	*23.77*	*21.15*	*168.03*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. CREDIT_SUBSTITUTES is the ratio of credit substitutes items over total assets (in%). Credit substitutes items include unused commitments, Financial standby letters of credit, Performance standby letters of credit, Commercial and similar letters of credit. The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

b. Bank risk exposure and derivative contracts

The relation between derivative contracts and different types of bank riskiness is presented in table B. First, concerning their impact on bank credit risk, the results do not show any significant association between the total notional amount of derivatives contracts and the quality of loans. Besides, differentiating derivatives held for trading purposes from those held for other than trading purposes do not change initial findings (see tables B1 and B2 columns 1, 2 and 3). For more investigation, since large banks are the main users of derivatives for trading purposes (88% of banks engaging in derivatives for trading issues are the 25% biggest banks), I rerun these equations for two subsamples, the 25% biggest banks and the 25% smallest banks. The results are consistent with previous findings (see appendix 3, tables B3, B4, B5 columns 1, 2 and 3), however the results presume a positive association between derivatives and credit risk for small banks (see appendix 3, tables B6, B7 and B8 columns 1, 2 and 3).

Concerning their impact on bank insolvency risk, only a weak negative relation is detected between activities related to derivative products and insolvency risk (positive coefficient for the standard deviation of ROA, and negative relation for the Z-score see table B column 4 and 5). Furthermore, when investigating the impact of derivatives held for other than trading purposes (table B1) from derivatives held for trading (table B2) the results suggest that only derivatives held for non-trading purposes are implicated in bank riskiness. These results present evidence against the hypothesis that derivatives used for hedging could decrease bank riskiness. To investigate further this issue, I rerun these equations for two subsamples, the 25% biggest banks and the 25% smallest banks. While no significant association is found between the use of derivative contracts by large banks and insolvency risk, for smaller banks, engaging in derivatives for either trading or hedging purposes is positively associated with bank insolvency (appendix 3, tables B7 and B8).

Finally, concerning their impact on liquidity holding, the results only show a negative significant impact of derivatives for hedging purposes. Specifically the results suggest that banks engaging more in derivatives for hedging purposes hold less liquid assets. This result is also similar for the 25% smallest and the 25%

largest banks. Concerning the impact of derivatives for trading issues, the results show that for large banks (appendix 3, tables B3, B4 and B5), engaging in derivatives for trading issues have a positive impact on liquidity; specifically, banks increase their holding of liquidity when engaging in derivatives for trading issues. In contrast for small banks (tables B6, B7 and B8), engaging in both type of derivatives activities is found to decrease their holding of liquidity.

All in all, the results propose no significant impact of derivatives contract on bank risk exposures measure for largest banks. For smallest banks, engaging in derivatives either for trading issues or for non-trading issues, implement higher risk exposure.

Table B Derivatives and bank risk exposure during the period 2001Q1/2010Q4

	Credit risk model			*Insolvency risk model*		*Liquidity risk model*
Dep. Var:	*LLR*	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*0.2404*	*-2.1498*	*-15.4765*	*530.6855*	*-0.3331*	*73.5698*
	*[3.34]****	*[-56.28]****	*[-69.94]****	*[36.80]****	*[-13.29]****	*[52.42]****
NOTIONAL_DERIVATIVES	*0.0001*	*0.0000*	*-0.0001*	*-0.0170*	*0.0000*	*-0.0003*
	[0.77]	*[0.97]*	*[-0.80]*	*[-1.73]**	*[1.75]**	*[-0.22]*
EQ_TA	*0.0105*	*0.0027*	*0.0254*			*-0.2433*
	*[16.13]****	*[7.94]****	*[13.10]****			*[-19.95]****
ROA	*-0.4343*	*-0.2007*	*-1.5716*			*1.1145*
	*[-59.43]****	*[-48.25]****	*[-69.94]****			*[11.21]****
LOANG	*-0.0115*	*-0.0019*	*-0.0250*			*-0.1354*
	*[-121.03]****	*[-37.71]****	*[-85.14]****			*[-81.56]****
SIZE1	*0.0758*	*0.1236*	*0.8954*	*-20.5017*	*0.0242*	*-2.1912*
	*[19.94]****	*[61.73]****	*[76.84]****	*[-26.25]****	*[17.95]****	*[-29.20]****
INEFFICIENCY	*-0.0036*	*0.0008*	*0.0109*	*-0.7444*	*0.0013*	*0.0283*
	*[-19.45]****	*[8.81]****	*[16.56]****	*[-19.41]****	*[19.19]****	*[10.12]****
BHC	*-0.0549*	*-0.0095*	*0.0276*	*-7.9167*	*0.0178*	*-1.9998*
	*[-9.40]****	*[-3.05]****	*[1.52]*	*[-5.45]****	*[8.32]****	*[-17.91]****
FED_RATE	*-0.0295*	*-0.0185*	*-0.1377*	*10.5077*	*-0.0137*	*-0.7882*
	*[-46.32]****	*[-61.02]****	*[-62.91]****	*[73.51]****	*[-59.06]****	*[-78.45]****
GDP_GROWTH	*0.0052*	*-0.0090*	*-0.0367*	*2.5668*	*-0.0036*	*0.3861*
	*[10.03]****	*[-30.79]****	*[-21.43]****	*[24.73]****	*[-21.66]****	*[45.74]****
TL_TA				*0.1345*	*-0.0003*	
				*[4.70]****	*[-5.90]****	
Observations:	*210142*	*218413*	*214986*	*212273*	*212347*	*218414*
R-squared:	*0.68*	*0.33*	*0.51*	*0.50*	*0.47*	*0.87*
F-statistic:	*48.53*	*11.62*	*24.54*	*23.69*	*20.82*	*165.34*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. NOTIONAL_DERIVATIVES is the ratio of the gross notional value of derivatives over total assets (in%). Derivatives consist of interest rate derivatives, foreign exchange derivatives, equity derivatives and commodity derivatives. Gross notional value of derivatives is computed as the sum of contracts held for trading and contracts held for other than trading purposes. The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

Table B1 Derivatives held for trading purposes and bank risk exposure during the period 2001Q1/2010Q4

	Credit risk model			*Insolvency risk model*		*Liquidity risk model*
	LLR	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*0.2397*	*-2.1504*	*-15.4745*	*531.0828*	*-0.3338*	*73.6272*
	*[3.34]****	*[-56.32]****	*[-69.93]****	*[36.84]****	*[-13.32]****	*[52.42]****
TRADING_DER	*0.0001*	*0.0000*	*-0.0002*	*-0.0150*	*0.0000*	*0.0019*
	[0.90]	*[1.14]*	*[-0.92]*	*[-1.20]*	*[0.64]*	*[1.62]*
EQ_TA	*0.0105*	*0.0027*	*0.0254*			*-0.2433*
	*[16.12]****	*[7.94]****	*[13.10]****			*[-19.97]****
ROA	*-0.4343*	*-0.2007*	*-1.5717*			*1.1149*
	*[-59.43]****	*[-48.24]****	*[-69.95]****			*[11.21]****
LOANG	*-0.0115*	*-0.0019*	*-0.0250*			*-0.1354*
	*[-121.03]****	*[-37.71]****	*[-85.14]****			*[-81.55]****
SIZE	*0.0759*	*0.1236*	*0.8953*	*-20.5242*	*0.0242*	*-2.1944*
	*[19.97]****	*[61.77]****	*[76.83]****	*[-26.29]****	*[17.98]****	*[-29.22]****
INEFFICIENCY	*-0.0036*	*0.0008*	*0.0109*	*-0.7443*	*0.0013*	*0.0282*
	*[-19.45]****	*[8.81]****	*[16.57]****	*[-19.41]****	*[19.20]****	*[10.09]****
BHC	*-0.0549*	*-0.0095*	*0.0275*	*-7.9151*	*0.0178*	*-1.9985*
	*[-9.40]****	*[-3.05]****	*[1.51]*	*[-5.45]****	*[8.32]****	*[-17.90]****
FED_RATE	*-0.0295*	*-0.0185*	*-0.1377*	*10.5078*	*-0.0137*	*-0.7881*
	*[-46.34]****	*[-61.03]****	*[-62.92]****	*[73.51]****	*[-59.06]****	*[-78.43]****
GDP_GROWTH	*0.0052*	*-0.0090*	*-0.0367*	*2.5668*	*-0.0036*	*0.3859*
	*[10.02]****	*[-30.79]****	*[-21.43]****	*[24.73]****	*[-21.65]****	*[45.71]****
TL_TA				*0.1346*	*-0.0003*	
				*[4.71]****	*[-5.91]****	
Observations:	*210142*	*218413*	*214986*	*212273*	*212347*	*218414*
R-squared:	*0.68*	*0.33*	*0.51*	*0.50*	*0.47*	*0.87*
F-statistic:	*48.53*	*11.62*	*24.54*	*23.69*	*20.82*	*165.34*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. TRADING_DER is the notional amount of derivatives held for trading purposes over total assets (in%). The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

Table B2 Derivatives held for other than trading purposes and bank risk exposure during the period 2001Q1/2010Q4

	Credit risk model			*Insolvency risk model*		*Liquidity risk model*
	LLR	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*0.2367*	*-2.1511*	*-15.4690*	*530.8656*	*-0.3327*	*73.4183*
	*[3.29]****	*[-56.30]****	*[-69.96]****	*[36.81]****	*[-13.27]****	*[52.34]****
NON_TRADING_DER	*-0.0000*	*0.0000*	*0.0000*	*-0.0221*	*0.0001*	*-0.0070*
	[-0.27]	*[0.11]*	*[0.08]*	*[-2.01]***	*[1.82]**	*[-2.98]****
EQ_TA	*0.0105*	*0.0027*	*0.0254*			*-0.2432*
	*[16.13]****	*[7.94]****	*[13.10]****			*[-19.95]****
ROA	*-0.4343*	*-0.2007*	*-1.5717*			*1.1209*
	*[-59.43]****	*[-48.24]****	*[-69.95]****			*[11.27]****
LOANG	*-0.0115*	*-0.0019*	*-0.0250*			*-0.1354*
	*[-121.02]****	*[-37.71]****	*[-85.13]****			*[-81.57]****
SIZE	*0.0760*	*0.1237*	*0.8950*	*-20.5134*	*0.0242*	*-2.1832*
	*[19.99]****	*[61.76]****	*[76.87]****	*[-26.27]****	*[17.93]****	*[-29.11]****
INEFFICIENCY	*-0.0036*	*0.0008*	*0.0109*	*-0.7452*	*0.0013*	*0.0284*
	*[-19.45]****	*[8.83]****	*[16.56]****	*[-19.42]****	*[19.21]****	*[10.15]****
BHC	*-0.0549*	*-0.0095*	*0.0276*	*-7.9108*	*0.0178*	*-1.9997*
	*[-9.41]****	*[-3.05]****	*[1.52]*	*[-5.45]****	*[8.32]****	*[-17.91]****
FED_RATE	*-0.0295*	*-0.0185*	*-0.1377*	*10.5087*	*-0.0137*	*-0.7886*
	*[-46.34]****	*[-61.02]****	*[-62.92]****	*[73.50]****	*[-59.05]****	*[-78.48]****
GDP_GROWTH	*0.0052*	*-0.0090*	*-0.0367*	*2.5653*	*-0.0036*	*0.3861*
	*[10.04]****	*[-30.78]****	*[-21.44]****	*[24.71]****	*[-21.65]****	*[45.73]****
TL_TA				*0.1350*	*-0.0003*	
				*[4.72]****	*[-5.91]****	
Observations:	*210142*	*218413*	*214986*	*212273*	*212347*	*218414*
R-squared:	*0.68*	*0.33*	*0.51*	*0.50*	*0.47*	*0.87*
F-statistic:	*48.53*	*11.62*	*24.54*	*23.69*	*20.82*	*165.36*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. NON_TRADING_DER is the notional amount of derivatives held for other than trading purposes over total assets (in%). The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

c. *Bank risk exposure and credit derivative contracts*

In Table C, I report the results for credit derivatives contracts. An increase in the total notional amount of credit derivatives is found to be associated with higher risk loans ratios (positive coefficient on NPL, LLR, and LLP) and higher insolvency risk ratio (negative coefficient on Z-SCORE and positive coefficient on STDROA). However the results show a positive significant association between credit derivative contracts and liquidity holding. Furthermore I estimate the different equations separating credit derivatives contract on which the reporting bank is the guarantor and credit derivatives contract on which the reporting bank is the beneficiary. The results presented in table C1 and C2 are similar to the previous assumption and reject hypothesis 3. Specifically, no matters the position of the bank in the credit derivative contract: guarantor or beneficiary, both produce an increase in the bank's insolvency risk and a degradation of the quality of the loans' portfolios. On a first hand, consistent with the arguments of Morrison (2005), Wagner (2005) and Partnoy and Skeel (2006) these results suggest that banks engaging more in derivatives as beneficiary against credit risk could have less incentives to monitor and to screen borrowers, which explain the positive relation between the amount of credit derivatives (beneficiary) and bank's riskiness. On the other hand, banks selling credit derivatives and acting as guarantors against credit risk increase their exposure to different types of risk. This result is not consistent with the argument of the diversification benefits of credit derivatives (Morrison (2005), Dong (2005)).

For robustness matter, since credit derivatives are scarcely used by banks (1% of the banks use credit derivatives) and since the usage of such items is specifically concentrated in large banks (the 25% biggest banks hold 95% of the credit derivatives), I estimate the equations focusing on the 25% biggest banks of the sample. The previous assumptions are also robust to such specifications.

Table C Credit derivatives and bank risk exposure during the period 2001Q1/2010Q4

	Credit risk model			*Insolvency risk model*		*Liquidity risk model*
	LLR	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*0.2460*	*-2.1461*	*-15.4695*	*530.6836*	*-0.3330*	*73.6313*
	*[3.42]****	*[-56.22]****	*[-69.91]****	*[36.81]****	*[-13.28]****	*[52.40]****
CREDIT_GROSS	*0.0013*	*0.0008*	*0.0000*	*-0.0699*	*0.0001*	*0.0077*
	*[3.82]****	*[7.85]****	*[0.02]*	*[-1.74]**	*[3.36]****	*[2.56]***
EQ_TA	*0.0105*	*0.0027*	*0.0254*			*-0.2433*
	*[16.13]****	*[7.93]****	*[13.10]****			*[-19.96]****
ROA	*-0.4340*	*-0.2005*	*-1.5717*			*1.1164*
	*[-59.40]****	*[-48.20]****	*[-69.94]****			*[11.22]****
LOANG	*-0.0115*	*-0.0019*	*-0.0250*			*-0.1354*
	*[-121.03]****	*[-37.71]****	*[-85.13]****			*[-81.55]****
SIZE	*0.0755*	*0.1234*	*0.8950*	*-20.5030*	*0.0242*	*-2.1945*
	*[19.89]****	*[61.67]****	*[76.82]****	*[-26.26]****	*[17.94]****	*[-29.21]****
INEFFICIENCY	*-0.0036*	*0.0008*	*0.0109*	*-0.7449*	*0.0013*	*0.0283*
	*[-19.48]****	*[8.78]****	*[16.56]****	*[-19.41]****	*[19.20]****	*[10.09]****
BHC	*-0.0547*	*-0.0094*	*0.0276*	*-7.9279*	*0.0178*	*-1.9980*
	*[-9.37]****	*[-3.00]****	*[1.52]*	*[-5.46]****	*[8.33]****	*[-17.90]****
FED_RATE	*-0.0295*	*-0.0185*	*-0.1377*	*10.5100*	*-0.0137*	*-0.7882*
	*[-46.30]****	*[-61.07]****	*[-62.92]****	*[73.51]****	*[-59.07]****	*[-78.43]****
GDP_GROWTH	*0.0052*	*-0.0090*	*-0.0367*	*2.5651*	*-0.0036*	*0.3860*
	*[9.99]****	*[-30.82]****	*[-21.44]****	*[24.71]****	*[-21.65]****	*[45.72]****
TL_TA				*0.1347*	*-0.0003*	
				*[4.71]****	*[-5.90]****	
Observations:	*210142*	*218413*	*214986*	*212273*	*212347*	*218414*
R-squared:	*0.68*	*0.33*	*0.51*	*0.50*	*0.47*	*0.87*
F-statistic:	*48.54*	*11.63*	*24.54*	*23.69*	*20.82*	*165.34*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. CREDIT_GROSS is the ratio of gross credit derivatives over total assets (in%). gross credit derivatives are computed as the sum of the notional value of the credit derivatives on which the reporting banks is the guarantor and the notional value of the credit derivatives on which the reporting banks is the beneficiary. The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

Table C1 Credit derivatives on which the reporting bank is the guarantor and bank risk exposure during the period 2001Q1/2010Q4

	Credit risk model			*Insolvency risk model*		*Liquidity risk model*
	LLR	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*0.2462*	*-2.1459*	*-15.4696*	*530.7433*	*-0.3332*	*73.6283*
	*[3.43]****	*[-56.21]****	*[-69.91]****	*[36.81]****	*[-13.29]****	*[52.40]****
CREDIT_GUARANTOR	*0.0026*	*0.0016*	*-0.0000*	*-0.1316*	*0.0002*	*0.0140*
	*[3.88]****	*[7.97]****	*[-0.01]*	*[-1.63]*	*[3.09]****	*[2.41]***
EQ_TA)	*0.0105*	*0.0027*	*0.0254*			*-0.2434*
	*[16.12]****	*[7.92]****	*[13.10]****			*[-19.96]****
ROA	*-0.4340*	*-0.2005*	*-1.5717*			*1.1162*
	*[-59.40]****	*[-48.20]****	*[-69.94]****			*[11.22]****
LOANG	*-0.0115*	*-0.0019*	*-0.0250*			*-0.1354*
	*[-121.03]****	*[-37.70]****	*[-85.13]****			*[-81.55]****
SIZE	*0.0755*	*0.1234*	*0.8951*	*-20.5065*	*0.0242*	*-2.1943*
	*[19.89]****	*[61.67]****	*[76.82]****	*[-26.26]****	*[17.95]****	*[-29.21]****
INEFFICIENCY	*-0.0036*	*0.0008*	*0.0109*	*-0.7449*	*0.0013*	*0.0283*
	*[-19.49]****	*[8.77]****	*[16.56]****	*[-19.41]****	*[19.20]****	*[10.09]****
BHC	*-0.0547*	*-0.0094*	*0.0276*	*-7.9239*	*0.0178*	*-1.9984*
	*[-9.37]****	*[-3.01]****	*[1.52]*	*[-5.46]****	*[8.33]****	*[-17.90]****
FED_RATE	*-0.0295*	*-0.0185*	*-0.1377*	*10.5099*	*-0.0137*	*-0.7882*
	*[-46.29]****	*[-61.06]****	*[-62.92]****	*[73.51]****	*[-59.07]****	*[-78.43]****
GDP_GROWTH	*0.0052*	*-0.0090*	*-0.0367*	*2.5651*	*-0.0036*	*0.3860*
	*[9.99]****	*[-30.82]****	*[-21.44]****	*[24.71]****	*[-21.65]****	*[45.72]****
TL_TA				*0.1347*	*-0.0003*	
				*[4.71]****	*[-5.90]****	
Observations:	*210142*	*218413*	*214986*	*212273*	*212347*	*218414*
R-squared:	*0.68*	*0.33*	*0.51*	*0.50*	*0.47*	*0.87*
F-statistic:	*48.54*	*11.63*	*24.54*	*23.69*	*20.82*	*165.34*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. *CREDIT_GUARANTOR* is the ratio of the notional value of the credit derivatives on which the reporting banks is the guarantor over total assets (in%). The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

Table C2 Credit derivatives on which the reporting bank is the beneficiary and bank risk exposure during the period 2001Q1/2010Q4

	Credit risk model			*Insolvency risk model*		*Liquidity risk model*
	LLR	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*0.2457*	*-2.1463*	*-15.4694*	*530.6306*	*-0.3329*	*73.6334*
	*[3.42]****	*[-56.22]****	*[-69.91]****	*[36.80]****	*[-13.27]****	*[52.40]****
CREDIT_BENEFICIARY	*0.0026*	*0.0016*	*0.0001*	*-0.1461*	*0.0002*	*0.0166*
	*[3.72]****	*[7.59]****	*[0.05]*	*[-1.84]**	*[3.40]****	*[2.65]****
EQ_TA	*0.0105*	*0.0027*	*0.0254*			*-0.2433*
	*[16.13]****	*[7.93]****	*[13.10]****			*[-19.96]****
ROA	*-0.4340*	*-0.2005*	*-1.5717*			*1.1166*
	*[-59.40]****	*[-48.19]****	*[-69.94]****			*[11.23]****
LOANG	*-0.0115*	*-0.0019*	*-0.0250*			*-0.1354*
	*[-121.03]****	*[-37.71]****	*[-85.13]****			*[-81.55]****
SIZE	*0.0755*	*0.1234*	*0.8950*	*-20.4999*	*0.0242*	*-2.1947*
	*[19.89]****	*[61.68]****	*[76.82]****	*[-26.25]****	*[17.93]****	*[-29.21]****
INEFFICIENCY	*-0.0036*	*0.0008*	*0.0109*	*-0.7449*	*0.0013*	*0.0283*
	*[-19.48]****	*[8.78]****	*[16.56]****	*[-19.42]****	*[19.20]****	*[10.09]****
BHC	*-0.0546*	*-0.0093*	*0.0277*	*-7.9320*	*0.0178*	*-1.9976*
	*[-9.36]****	*[-2.99]****	*[1.52]*	*[-5.46]****	*[8.33]****	*[-17.89]****
FED_RATE	*-0.0295*	*-0.0185*	*-0.1377*	*10.5101*	*-0.0137*	*-0.7882*
	*[-46.30]****	*[-61.07]****	*[-62.92]****	*[73.51]****	*[-59.07]****	*[-78.43]****
GDP_GROWTH	*0.0052*	*-0.0090*	*-0.0367*	*2.5650*	*-0.0036*	*0.3860*
	*[9.99]****	*[-30.81]****	*[-21.44]****	*[24.71]****	*[-21.65]****	*[45.72]****
TL_TA				*0.1346*	*-0.0003*	
				*[4.71]****	*[-5.90]****	
Observations:	*210142*	*218413*	*214986*	*212273*	*212347*	*218414*
R-squared:	*0.68*	*0.33*	*0.51*	*0.50*	*0.47*	*0.87*
F-statistic:	*48.54*	*11.63*	*24.54*	*23.69*	*20.82*	*165.34*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. CREDIT_ BENEFICIARY is the ratio of the notional value of the credit derivatives on which the reporting banks is the beneficiary over total assets (in %). The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

5.2 Bank failure

The empirical determinants of banks' failure are presented in table D. A first intuitive remark is that the impact of different types of OBS contracts on bank failure is not similar: when credit substitutes are found to have a positive impact on the failure probability (column 1), engaging in derivatives contracts are in contrast reducing the probability of bank failure (column 2). Also, in harmony with hypothesis 2, engaging in derivatives for trading purposes does not have the same impact as engaging in derivatives for non trading purposes. Specifically, results show that derivatives used for trading issues do not have predictive power on bank failure probability (column 3), however using derivatives for non trading issues does have a beneficial impact on bank soundness (column 4).

For robustness issues, I rerun a number of alternative equations. First, since credit substitutes consist mainly of unused commitments, and since interest rate derivatives are the main derivative contracts used by U.S. commercial banks, I rerun the failure model using alternatively the ratio of total unused commitments to total assets instead of total credit substitutes, and the interest rate derivatives instead of total derivatives contracts. Results remain unchanged (appendix 4, table D1). I also rerun the estimations using different number of quarter's retardation for the explanatory variables (from 2 to 8 quarters see appendix 4 tables D2, D3, D4 and D5). On the whole the impact of different categories of OBS on bank riskiness remain approximately unchanged; however the influence of different OBS activities on the probability of bank failure is only significant on the longer run (beyond 3 quarters retardation). Finally I rerun the equations for different sub-sample periods: (Q2-2007/ Q4-2010), (Q3-2007/ Q4-2010), (Q4-2007/ Q4-2010), (Q1-2008/Q4-2010), (Q2-2008/Q4-2010) and (Q3-2008/Q4-2010), the results also remain unchanged.

Concerning the other control variables: in harmony with existing literature, the positive significant coefficient on the non-performing loans confirms the fact that bank' loans portfolio quality is an important determinant of bank health. Also higher loan growth and higher concentration of commercial real estate loans are found to be associated with greater probability of failure. Reliance on core deposit is found to have beneficial impact on banks whereas none core deposit, specifically brokered deposits are found to significantly increase the probability of bank failure. The negative coefficient on the equity ratio indicates that banks with

higher capitalization are less probable to fail in the future. This result shows the importance of capital requirements in order to limit the financial distress of banks. I also found that higher profitability and lower cost inefficiency reduces the probability of failure. This shows that banks with better management are less likely to be subject to a significant risk of occasional failure (Borovikova). Macroeconomic conditions are also found to have predictive power on bank failure, specifically decrease in GDP growth is found to be associated with higher probability of failure. Finally being part of a bank holding company is not found to impact the probability of bank failure.

Table D OBS items and bank failure during the period Q1/2007-Q4/2010

	Failure Model			
	(1)	*(2)*	*(3)*	*(4)*
C	*-3.0080*	*-2.9910*	*-2.9735*	*-2.9914*
	*[-12.52]****	*[-12.02]****	*[-12.11]****	*[-12.13]****
CREDIT_SUBSTITUTES	*0.0021*			
	*[2.32]***			
NOTIONAL_DERIVATIVES		*-0.0086*		
		*[-2.11]***		
TRADING_DER			*-0.0117*	
			[-1.14]	
NONTRADING_DER				*-0.0085*
				*[-1.95]**
NPL	*0.0864*	*0.0847*	*0.0851*	*0.0850*
	*[14.78]****	*[14.70]****	*[14.78]****	*[14.76]****
LOANG	*0.0031*	*0.0031*	*0.0031*	*0.0031*
	*[2.08]***	*[1.99]***	*[2.01]***	*[2.02]***
CRELOANS	*0.0038*	*0.0032*	*0.0034*	*0.0035*
	*[2.14]***	*[1.77]**	*[1.88]**	*[1.96]***
CORE_DEPOSIT	*-0.0036*	*-0.0036*	*-0.0038*	*-0.0036*
	*[-1.99]***	*[-1.87]**	*[-2.00]***	*[-1.92]**
BROKERED_DEPOSIT	*0.0177*	*0.0195*	*0.0185*	*0.0191*
	*[11.71]****	*[11.46]****	*[11.61]****	*[11.95]****
INEFFICIENCY	*0.0165*	*0.0168*	*0.0165*	*0.0167*
	*[7.12]****	*[7.14]****	*[7.06]****	*[7.15]****
ROA	*-0.0677*	*-0.0686*	*-0.0687*	*-0.0686*
	*[-4.13]****	*[-4.14]****	*[-4.16]****	*[-4.15]****
EQ_TA	*-0.0925*	*-0.0911*	*-0.0915*	*-0.0911*
	*[-4.65]****	*[-4.63]****	*[-4.65]****	*[-4.64]****
BHC	*0.1126*	*0.1062*	*0.1130*	*0.1042*
	[1.58]	*[1.51]*	*[1.59]*	*[1.48]*
GDP_GROWTH	*-0.0223*	*-0.0211*	*-0.0211*	*-0.0212*
	*[-2.34]***	*[-2.20]***	*[-2.20]***	*[-2.21]***
Observations:	*103462*	*103462*	*103462*	*103462*
R-squared:	*0.30*	*0.30*	*0.30*	*0.30*
Obs with failure=1	*298*	*298*	*298*	*298*

This table shows Probit estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variable. TRADING_DER is the notional amount of derivatives held for trading purposes over total assets (in%). NON_TRADING_DER is the notional amount of derivatives held for other than trading purposes over total assets (in%). All the explanatory variables are introduced with a lag of four quarters. The definition of the other different variables is available in appendix A. Standard errors are adjusted using the Huber-White method. ***, ** and * indicate statistical significance respectively at 1, 5 and 10% level of significance. Z-Stats are in brackets.

6. Robustness checks: search for causal relation between credit substitutes and bank riskiness

Concerning the impact of credit substitutes OBS category on bank riskiness the previous results have shown:

- A negative impact of credit substitutes (unused commitments, credit lines, letter of credit) on bank liquidity
- And a positive impact of credit substitutes on bank performance (Z-score and ROA volatility) and loans quality (NPL, LLR and LLP)

A main concern about these results is that they may only show correlations and not causality. Specifically, a guarantee or an unused commitment do impact bank liquidity and credit risk if such items are used. Accordingly, the issue is to find a relation between the drawdown of credit substitutes and bank liquidity, credit risk and bank performance. The problem is that the data do not allow us to know how much of the credit substitutes presented off the balance sheet have been used and have been transferred to the balance sheet as loans. In a try to assess the excessive drawdown of off balance sheet credit substitutes category of items and based on a suggestion made by Robert Deyoung, I use the following methodology:

To construct the excessive drawdown measure I use a two-step procedure. In a first step I calculate for each bank the quarterly total amount growth of loans and the quarterly total amount growth of credit substitutes

$$\Delta loans = Loans_t - Loans_{t-1}$$
$$\Delta credit\_substitutes = credit\_substitutes_t - credit\_substitutes_{t-1}$$

In a second step I create a dummy variable "*Drawdown*" that takes the value:

- -1 if $\Delta loans<0$ and $\Delta credit\_substitutes>0$
- 0 if $\Delta loans<0$ and $\Delta credit\_substitutes<0$
- 0 if $\Delta loans>0$ and $\Delta credit\_substitutes>0$
- 1 if $\Delta loans>0$ and $\Delta credit\_substitutes<0$

According to this procedure, it is assumed that a positive $\Delta loans$ which reflects an increase in the total amount of loans from one quarter to another, could be due to an increase in the spot market loans or it could also be due to an increase in the

drawdown of credit substitutes which are transferred from the off balance sheet side to the balance sheet side as loans. When both $\Delta loans$ and $\Delta credit\_substitutes$ increases, this translate an information that the bank is increasing loans on the spot market and at the same time the bank is increasing promises of loans via the credit substitutes items. The only case in which we could be sure of drawdown of credit substitutes is when the total amount of loans increase and at the same time the total amount of credit substitutes decreases, this could be partly interpreted as the fact that when drawdowns of credit substitutes increase, the amount of credit substitutes off the balance sheet decreases and loans show up on the balance sheet (increase in $\Delta loans$).

It is expected that a positive drawdown of credit substitutes to decrease bank liquid assets, and to have a positive impact on bank credit risk and bank performance. To test these possibilities I use the *drawdown* variable and estimate the following equations:

$$Liquidity_{i,t} = \alpha_1 + \alpha_2 (drawdown)_{t-1} + \alpha_3 Control_{t-1}$$
$$Credit\_risk_{i,t} = \alpha_1 + \alpha_2 (drawdown)_{t-1} + \alpha_3 Control_{t-1}$$
$$Insolvency_{i,t} = \alpha_1 + \alpha_2 (drawdown)_{t-1} + \alpha_3 Control_{t-1}$$

In a first step I include neither the credit substitutes variable nor the loan growth variable to the estimations. These results (see appendix 5, table E1) confirm the previous results and provide evidence that the use and the drawdown of credit substitutes have a beneficial impact on credit risk and bank performance (positive coefficient between drawdown and the credit risk measure) also these results show that a positive drawdown of credit substitutes decrease banks' liquid assets. In a second step, I re-estimate these equations by adding the credit substitutes and the loan growth to the explanatory variables, the previous conclusion still valid (see appendix 5, table E2).

7. Conclusion

This chapter uses data from the quarterly bank call reports during the period 2001-2010 to investigate the nature of off balance sheet activities undertaken by the U.S. commercial banking system and the impact of such activities on bank failure and bank health. On the whole, the main OBS activities undertaken by the U.S. commercial banks are credit substitutes. The latter are used by 98% of U.S. commercial banks and constitute a non-trivial part compared to their balance

sheet activities. The results show that the use of credit substitutes is advantageous: higher credit substitutes are associated with better bank performance and lower credit risk. However, banks that engage more in credit substitutes are also less liquid. When I investigate the role of credit substitutes in the failure of U.S. banks during the sample period, results first show that compared to healthy banks, banks that failed did have higher percentage of credit substitutes to total assets. Furthermore results from Probit estimations did confirm that banks engaging in high level of commitments and guarantees faced an increase in failure risk.

U.S. commercial banks also engage in derivatives contracts (including interest rate, exchange rate, equity and commodity contracts) and credit derivatives contracts. Even if the number of banks engaging in derivatives contracts is relatively low, much lower than those engaging in credit substitutes, conversely in term of transaction amount, derivatives constitute a large portion of the banking activities. The results of this study first show that credit derivatives are found to increase the exposure of banks to different types of risk. Still, no bank that faces failure was engaging in credit derivatives contract. Concerning the other type of derivatives, results suggest that these contracts increase bank riskiness for small banks. For the largest banks no significant impact of derivatives was detected. Finally, concerning their implication on bank failure during the period 2007:2010, this study shows that using derivatives for hedging purposes decrease the probability of bank failure.

Appendix 1 Correlation matrix

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	STDROA	1.00																					
2	ZSCORE	-0.62	1.00																				
3	NPL	0.27	-0.23	1.00																			
4	LLR	0.24	-0.15	0.32	1.00																		
5	LLP	0.26	-0.25	0.39	0.27	1.00																	
6	LIQUIDITY	-0.05	0.09	-0.03	0.16	-0.09	1.00																
7	FAILURE	0.01	-0.01	0.00	0.00	0.00	0.00	1.00															
8	Credit_substitutes	-0.03	0.01	-0.11	-0.04	0.01	-0.31	0.00	1.00														
9	Derivatives_notional	0.00	0.00	0.00	0.00	0.03	-0.01	0.00	0.11	1.00													
10	Credit_Gross	0.00	0.00	0.00	0.00	0.03	-0.01	0.00	0.06	**0.81**	1.00												
11	EQTA	0.14	0.15	0.04	0.16	-0.03	0.19	0.00	-0.09	-0.02	-0.01	1.00											
12	SIZE	-0.08	0.10	0.02	-0.03	0.14	-0.16	0.00	0.39	0.19	0.13	-0.14	1.00										
13	ROA	-0.26	0.17	-0.28	-0.09	-0.50	0.08	-0.01	0.02	0.00	-0.01	0.05	-0.01	1.00									
14	LOANG	-0.05	0.03	-0.26	-0.24	-0.09	-0.23	0.00	0.20	0.00	0.00	-0.07	0.10	0.01	1.00								
15	TLTA	0.01	-0.06	0.03	-0.17	0.09	-0.94	0.00	0.28	-0.02	-0.02	-0.23	0.16	-0.04	0.24	1.00							
16	CRELOANS	0.05	-0.05	0.06	-0.02	0.11	-0.46	0.00	0.18	-0.02	-0.02	-0.12	0.29	-0.11	0.19	0.47	1.00						
17	core_deposit	-0.07	0.01	-0.05	0.00	-0.10	0.15	-0.01	-0.13	-0.09	-0.06	-0.09	-0.27	0.11	-0.15	-0.14	-0.15	1.00					
18	INEFFICIENCY	-0.05	0.05	0.00	-0.17	-0.02	-0.14	0.00	0.02	0.03	0.02	-0.15	0.11	-0.21	0.09	0.14	0.01	-0.37	1.00				
19	Brokered deposit	0.10	-0.10	0.08	0.01	0.13	-0.25	0.01	0.13	0.00	0.00	-0.09	0.15	-0.13	0.16	0.27	0.23	-0.33	0.23	1.00			
20	GDP_Growth	-0.12	0.11	-0.19	-0.01	-0.21	0.04	-0.01	0.04	0.00	0.00	-0.02	-0.03	0.20	0.05	-0.04	-0.03	0.10	-0.15	-0.07	1.00		
21	Fed_Rate	-0.19	0.18	-0.27	-0.15	-0.26	-0.08	-0.01	0.11	0.01	0.01	-0.01	-0.01	0.17	0.14	0.05	-0.01	-0.01	0.42	0.01	0.35	1.00	
22	BHC	-0.05	-0.03	-0.01	0.00	0.02	-0.06	0.00	0.09	0.01	0.00	-0.17	0.11	0.12	-0.06	0.06	0.00	0.03	-0.01	0.03	-0.01	0.01	1.00

Appendix 2 Mean difference test using different subsamples and dropping large banks

Mean difference test of OBS activities between failed banks and banks that continue to exist for the period 2004Q1/2010Q4 after excluding the biggest banks (Total assets>$50 billion)

	Banks continue to exist during 2004Q1:2010Q4		*Failed banks during 2004Q1:2010Q4*			
	Mean	*Nb. Of Observations*	*Mean*	*Nb. Of Observations*	*Mean difference*	*T-stat*
Credit substitutes	*12.02079*	*190 663*	*16.2742*	*6 719*	*-4.253****	*-29.10*
Derivatives (notional)	*2.467812*	*193 839*	*1.311058*	*6 719*	*1.157***	*2.46*
Trading derivatives	*1.526737*	*193 839*	*.1720357*	*6 719*	*1.355****	*3.17*
Non trading derivatives	*.9410758*	*193 839*	*1.139022*	*6 719*	*-0.198*	*-1.16*
Credit derivatives	*.0625363*	*192 770*	*0*	*6 719*	*0.0625*	*1.40*
Credit derivatives (guarantor)	*.0279768*	*192 770*	*0*	*6 719*	*0.0280*	*1.15*
Credit derivatives (beneficiary)	*.0345595*	*192 770*	*0*	*6 719*	*0.0346*	*1.61*

Mean difference test of OBS activities between failed banks and banks that continue to exist for the period 2007Q1 2010Q4 after excluding the biggest banks (Total assets >$50 billion)

	Banks continue to exist during 2007Q1:2010Q4		*Failed banks during 2007Q1:2010Q4*			
	Mean	*Nb. Of Observations*	*Mean*	*Nb. Of Observations*	*Mean difference*	*T-stat*
Credit substitutes	*11.42694*	*107 083*	*13.18476*	*3 484*	*-1.758****	*-9.38*
Derivatives (notional)	*2.047808*	*108 808*	*1.040768*	*3 484*	*1.007***	*1.97*
Trading derivatives	*1.105107*	*108 808*	*0.1118484*	*3 484*	*0.993***	*2.26*
Non trading derivatives	*0.9427005*	*108 808*	*0.92892*	*3 484*	*0.0138*	*0.06*
Credit derivatives	*0.0325151*	*107 739*	*0*	*3 484*	*0.0325*	*1.28*
Credit derivatives (guarantor)	*0.0146188*	*107 739*	*0*	*3 484*	*0.0146*	*1.03*
Credit derivatives (beneficiary)	*0.0178963*	*107 739*	*0*	*3 484*	*0.0179*	*1.26*

Mean difference test during the period 2007Q1 2010Q4

	Banks continue to exist during 2007Q1:2010Q4		*Failed banks during 2007Q1:2010Q4*			
	Mean	*Nb. Of Observations*	*Mean*	*Nb. Of Observations*	*Mean difference*	*T-stat*
Credit substitutes	*11.53716*	*107 513*	*13.18476*	*3 484*	*-1.648****	*-8.67*
Derivatives (notional)	*9.053292*	*109 360*	*1.040768*	*3 484*	*8.013*	*1.20*
Trading derivatives	*8.030927*	*109 360*	*0.1118484*	*3 484*	*7.919*	*1.18*
Non trading derivatives	*1.022365*	*109 360*	*0.92892*	*3 484*	*0.0934*	*0.37*
Credit derivatives	*0.31996*	*108 226*	*0*	*3 484*	*0.320*	*1.60*
Credit derivatives (guarantor)	*0.1503019*	*108 226*	*0*	*3 484*	*0.150*	*1.57*
Credit derivatives (beneficiary)	*0.1696581*	*108 226*	*0*	*3 484*	*0.170*	*1.61*

APPENDIX 3

Table B3 Derivatives and bank risk exposure, large banks (25% biggest banks)

Eq Name:	*Credit risk model*			*Insolvency risk model*		*Liquidity risk model*
Dep. Var:	*LLR*	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*-1.1595*	*-2.7655*	*-23.0576*	*1070.7651*	*-1.2051*	*72.6193*
	*[-7.86]****	*[-34.65]****	*[-49.35]****	*[29.88]****	*[-23.18]****	*[28.79]****
NOTIONAL_DERIVATIVES	*0.0000*	*0.0000*	*-0.0003*	*-0.0034*	*-0.0000*	*0.0007*
	[0.40]	*[0.40]*	*[-1.43]*	*[-0.34]*	*[-0.06]*	*[0.66]*
EQ_TA	*0.0082*	*0.0023*	*0.0308*			*-0.4621*
	*[6.64]****	*[3.33]****	*[8.26]****			*[-19.11]****
ROA	*-0.6785*	*-0.3338*	*-2.1299*			*1.4122*
	*[-42.90]****	*[-34.78]****	*[-44.57]****			*[7.01]****
LOANG	*-0.0110*	*-0.0026*	*-0.0268*			*-0.1041*
	*[-58.52]****	*[-25.56]****	*[-47.73]****			*[-33.17]****
SIZE	*0.1475*	*0.1492*	*1.2063*	*-43.7228*	*0.0624*	*-1.9973*
	*[20.23]****	*[38.15]****	*[52.31]****	*[-24.91]****	*[24.28]****	*[-15.77]****
INEFFICIENCY	*-0.0052*	*0.0009*	*0.0126*	*-1.4321*	*0.0023*	*-0.0085*
	*[-16.21]****	*[5.27]****	*[13.56]****	*[-21.10]****	*[20.94]****	*[-1.47]*
BHC	*-0.0260*	*-0.0213*	*0.1158*	*-8.7514*	*0.0158*	*-1.1541*
	*[-2.29]***	*[-3.45]****	*[3.19]****	*[-2.29]***	*[3.38]****	*[-4.82]****
FED_RATE	*-0.0495*	*-0.0248*	*-0.2046*	*18.0718*	*-0.0226*	*-0.7313*
	*[-38.61]****	*[-35.47]****	*[-53.39]****	*[57.54]****	*[-48.79]****	*[-33.52]****
GDP_GROWTH	*0.0022*	*-0.0133*	*-0.0387*	*3.1395*	*-0.0032*	*0.4120*
	*[2.19]***	*[-22.17]****	*[-12.87]****	*[14.57]****	*[-9.76]****	*[26.20]****
TL_TA				*-0.0013*	*0.0001*	
				[-0.02]	*[0.81]*	
Observations:	*53535*	*55642*	*54507*	*53830*	*53318*	*55643*
R-squared:	*0.69*	*0.47*	*0.62*	*0.50*	*0.49*	*0.86*
F-statistic:	*39.62*	*16.74*	*29.33*	*17.97*	*17.12*	*119.25*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. NOTIONAL_DERIVATIVES is the ratio of the gross notional value of derivatives over total assets (in%). Derivatives consist of interest rate derivatives, foreign exchange derivatives, equity derivatives and commodity derivatives. Gross notional value of derivatives is computed as the sum of contracts held for trading and contracts held for other than trading purposes. The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

Table B4 Derivatives held for trading and bank risk exposure, large banks (25% biggest banks)

	Credit risk model			*Insolvency risk model*		*Liquidity risk model*
	LLR	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*-1.1562*	*-2.7653*	*-23.061*	*1070.5378*	*-1.2054*	*72.7498*
	*[-7.84]****	*[-34.66]****	*[-49.34]****	*[29.88]****	*[-23.19]****	*[28.84]****
TRADING_DER	*0.0001*	*0*	*-0.0004*	*-0.0084*	*0*	*0.0024*
	[0.79]	*[0.52]*	*[-1.68]**	*[-0.69]*	*[-0.40]*	*[2.02]***
EQ_TA	*0.0082*	*0.0023*	*0.0308*			*-0.462*
	*[6.64]****	*[3.33]****	*[8.26]****			*[-19.13]****
ROA	*-0.6783*	*-0.3338*	*-2.1306*			*1.4147*
	*[-42.90]****	*[-34.78]****	*[-44.58]****			*[7.02]****
LOANG	*-0.011*	*-0.0026*	*-0.0268*			*-0.1041*
	*[-58.52]****	*[-25.57]****	*[-47.74]****			*[-33.16]****
SIZE	*0.1474*	*0.1492*	*1.2065*	*-43.7096*	*0.0624*	*-2.0041*
	*[20.22]****	*[38.16]****	*[52.31]****	*[-24.91]****	*[24.29]****	*[-15.82]****
INEFFICIENCY	*-0.0052*	*0.0009*	*0.0127*	*-1.431*	*0.0023*	*-0.0087*
	*[-16.22]****	*[5.27]****	*[13.57]****	*[-21.08]****	*[20.95]****	*[-1.51]*
BHC	*-0.0259*	*-0.0213*	*0.1155*	*-8.757*	*0.0158*	*-1.1513*
	*[-2.29]***	*[-3.44]****	*[3.19]****	*[-2.29]***	*[3.38]****	*[-4.81]****
FED_RATE	*-0.0495*	*-0.0248*	*-0.2045*	*18.0702*	*-0.0226*	*-0.731*
	*[-38.63]****	*[-35.48]****	*[-53.39]****	*[57.54]****	*[-48.79]****	*[-33.50]****
GDP_GROWTH	*0.0022*	*-0.0133*	*-0.0386*	*3.1414*	*-0.0032*	*0.4115*
	*[2.18]***	*[-22.17]****	*[-12.86]****	*[14.58]****	*[-9.76]****	*[26.17]****
TL_TA				*-0.0019*	*0.0001*	
				[-0.03]	*[0.81]*	
Observations:	*53535*	*55642*	*54507*	*53830*	*53318*	*55643*
R-squared:	*0.69*	*0.47*	*0.62*	*0.5*	*0.49*	*0.86*
F-statistic:	*39.63*	*16.74*	*29.33*	*17.97*	*17.12*	*119.27*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. TRADING_DER is the notional amount of derivatives held for trading purposes over total assets (in%). The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

Table B5 Derivatives held for other than trading purposes and bank risk exposure, large banks (25% biggest banks)

	Credit risk model			*Insolvency risk model*		*Liquidity risk model*
	LLR	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*-1.1671*	*-2.7671*	*-23.0257*	*1071.4000*	*-1.2048*	*72.3790*
	*[-7.91]****	*[-34.70]****	*[-49.34]****	*[29.92]****	*[-23.18]****	*[28.67]****
NON_TRADING_DER	*-0.0002*	*-0.0000*	*0.0002*	*0.0157*	*0.0000*	*-0.0064*
	[-1.20]	*[-0.10]*	*[0.56]*	*[1.38]*	*[0.41]*	*[-2.69]****
EQ_TA	*0.0082*	*0.0023*	*0.0309*			*-0.4621*
	*[6.64]****	*[3.33]****	*[8.27]****			*[-19.08]****
ROA_QUARTER	*-0.6780*	*-0.3337*	*-2.1309*			*1.4311*
	*[-42.88]****	*[-34.77]****	*[-44.57]****			*[7.10]****
LOANG	*-0.0111*	*-0.0026*	*-0.0268*			*-0.1042*
	*[-58.52]****	*[-25.57]****	*[-47.69]****			*[-33.20]****
SIZE	*0.1479*	*0.1493*	*1.2046*	*-43.7606*	*0.0623*	*-1.9849*
	*[20.28]****	*[38.21]****	*[52.32]****	*[-24.96]****	*[24.28]****	*[-15.65]****
INEFFICIENCY	*-0.0052*	*0.0009*	*0.0126*	*-1.4317*	*0.0023*	*-0.0082*
	*[-16.21]****	*[5.29]****	*[13.51]****	*[-21.07]****	*[20.94]****	*[-1.43]*
BHC	*-0.0259*	*-0.0213*	*0.1160*	*-8.7530*	*0.0158*	*-1.1518*
	*[-2.29]***	*[-3.45]****	*[3.20]****	*[-2.29]***	*[3.38]****	*[-4.81]****
FED_RATE	*-0.0495*	*-0.0248*	*-0.2045*	*18.0715*	*-0.0226*	*-0.7324*
	*[-38.64]****	*[-35.49]****	*[-53.34]****	*[57.52]****	*[-48.79]****	*[-33.55]****
GDP_GROWTH	*0.0022*	*-0.0133*	*-0.0387*	*3.1403*	*-0.0032*	*0.4120*
	*[2.19]***	*[-22.17]****	*[-12.89]****	*[14.57]****	*[-9.76]****	*[26.17]****
TL_TA				*-0.0007*	*0.0001*	
				[-0.01]	*[0.82]*	
Observations:	*53535*	*55642*	*54507*	*53830*	*53318*	*55643*
R-squared:	*0.69*	*0.47*	*0.62*	*0.50*	*0.49*	*0.86*
F-statistic:	*39.63*	*16.74*	*29.32*	*17.97*	*17.12*	*119.28*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. NON_TRADING_DER is the notional amount of derivatives held for other than trading purposes over total assets (in%). The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

Table B6 Derivatives and bank risk exposure, small banks (25% smallest banks)

	credit risk model			*Insolvency risk model*		*Liquidity risk model*
	LLR_WIN	*LLP_WIN*	*NPL_WIN*	*ZSCORE8_WIN*	*STDROA8_WIN*	*LIQUIDITY*
C	*-1.1595*	*-2.7655*	*-23.0576*	*1070.7651*	*-1.2051*	*72.6193*
	*[-7.86]****	*[-34.65]****	*[-49.35]****	*[29.88]****	*[-23.18]****	*[28.79]****
NOTIONAL_DERIVATIVES	*0.0000*	*0.0000*	*-0.0003*	*-0.0034*	*-0.0000*	*0.0007*
	[0.40]	*[0.40]*	*[-1.43]*	*[-0.34]*	*[-0.06]*	*[0.66]*
EQ_TA	*0.0082*	*0.0023*	*0.0308*			*-0.4621*
	*[6.64]****	*[3.33]****	*[8.26]****			*[-19.11]****
ROA	*-0.6785*	*-0.3338*	*-2.1299*			*1.4122*
	*[-42.90]****	*[-34.78]****	*[-44.57]****			*[7.01]****
LOANG	*-0.0110*	*-0.0026*	*-0.0268*			*-0.1041*
	*[-58.52]****	*[-25.56]****	*[-47.73]****			*[-33.17]****
SIZE	*0.1475*	*0.1492*	*1.2063*	*-43.7228*	*0.0624*	*-1.9973*
	*[20.23]****	*[38.15]****	*[52.31]****	*[-24.91]****	*[24.28]****	*[-15.77]****
INEFFICIENCY	*-0.0052*	*0.0009*	*0.0126*	*-1.4321*	*0.0023*	*-0.0085*
	*[-16.21]****	*[5.27]****	*[13.56]****	*[-21.10]****	*[20.94]****	*[-1.47]*
BHC	*-0.0260*	*-0.0213*	*0.1158*	*-8.7514*	*0.0158*	*-1.1541*
	*[-2.29]***	*[-3.45]****	*[3.19]****	*[-2.29]***	*[3.38]****	*[-4.82]****
FED_RATE	*-0.0495*	*-0.0248*	*-0.2046*	*18.0718*	*-0.0226*	*-0.7313*
	*[-38.61]****	*[-35.47]****	*[-53.39]****	*[57.54]****	*[-48.79]****	*[-33.52]****
GDP_GROWTH	*0.0022*	*-0.0133*	*-0.0387*	*3.1395*	*-0.0032*	*0.4120*
	*[2.19]***	*[-22.17]****	*[-12.87]****	*[14.57]****	*[-9.76]****	*[26.20]****
TL_TA				*-0.0013*	*0.0001*	
				[-0.02]	*[0.81]*	
Observations:	*53535*	*55642*	*54507*	*53830*	*53318*	*55643*
R-squared:	*0.69*	*0.47*	*0.62*	*0.50*	*0.49*	*0.86*
F-statistic:	*39.62*	*16.74*	*29.33*	*17.97*	*17.12*	*119.25*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. NOTIONAL_DERIVATIVES is the ratio of the gross notional value of derivatives over total assets (in%). Derivatives consist of interest rate derivatives, foreign exchange derivatives, equity derivatives and commodity derivatives. Gross notional value of derivatives is computed as the sum of contracts held for trading and contracts held for other than trading purposes. The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

Table B7 Derivatives held for trading and bank risk exposure, small banks (25% smallest banks)

	Credit risk model			*Insolvency risk model*		*Liquidity risk model*
	LLR	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*6.8963*	*-1.8745*	*-7.6413*	*254.2213*	*0.6830*	*56.8933*
	*[23.82]****	*[-12.68]****	*[-8.16]****	*[5.61]****	*[8.06]****	*[10.47]****
TRADING_DER	*-0.0546*	*0.0232*	*-0.0150*	*-5.8262*	*0.0115*	*-0.3907*
	[-1.64]	*[0.59]*	*[-0.15]*	*[-5.90]****	*[5.66]****	*[-0.64]*
EQ_TA	*0.0013*	*0.0023*	*-0.0028*			*-0.2163*
	[0.77]	*[2.88]****	*[-0.55]*			*[-7.23]****
ROA	*-0.2130*	*-0.0483*	*-0.7840*			*-0.0903*
	*[-15.30]****	*[-6.61]****	*[-18.44]****			*[-0.46]*
LOANG	*-0.0102*	*-0.0008*	*-0.0177*			*-0.1630*
	*[-48.52]****	*[-7.77]****	*[-26.90]****			*[-44.58]****
SIZE	*-0.2946*	*0.1124*	*0.5227*	*-7.3408*	*-0.0300*	*-1.1818*
	*[-18.33]****	*[13.69]****	*[10.09]****	*[-2.85]****	*[-6.26]****	*[-3.89]****
INEFFICIENCY	*-0.0022*	*0.0004*	*0.0062*	*-0.3310*	*0.0002*	*0.0220*
	*[-5.52]****	*[2.64]****	*[3.92]****	*[-4.65]****	*[1.57]*	*[4.32]****
BHC	*-0.1241*	*-0.0120*	*-0.0308*	*-17.4848*	*0.0425*	*-1.2284*
	*[-7.33]****	*[-1.49]*	*[-0.60]*	*[-4.88]****	*[8.94]****	*[-4.24]****
FED_RATE	*-0.0130*	*-0.0112*	*-0.0826*	*5.2552*	*-0.0067*	*-0.7949*
	*[-10.37]****	*[-19.52]****	*[-17.80]****	*[21.28]****	*[-19.48]****	*[-41.27]****
GDP_GROWTH	*0.0096*	*-0.0044*	*-0.0201*	*1.3845*	*-0.0039*	*0.3072*
	*[8.67]****	*[-7.39]****	*[-5.13]****	*[7.28]****	*[-12.85]****	*[16.77]****
TL_TA				*0.2462*	*-0.0004*	
				*[4.52]****	*[-4.04]****	
Observations:	*46475*	*49109*	*48468*	*49286*	*49596*	*49109*
R-squared:	*0.75*	*0.25*	*0.50*	*0.58*	*0.56*	*0.89*
F-statistic:	*44.96*	*5.36*	*15.62*	*21.99*	*20.28*	*134.74*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. TRADING_DER is the notional amount of derivatives held for trading purposes over total assets (in%). The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

Table B8 Derivatives held for other than trading purposes and bank risk exposure, small banks (25% smallest banks)

		Credit risk model		*Insolvency risk model*		*Liquidity risk model*
	LLR	*LLP*	*NPL*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	6.9224	-1.8776	-7.5658	254.1307	0.6826	56.6771
	[23.92]***	[-12.72]***	[-8.08]***	[5.60]***	[8.06]***	[10.43]***
NON_TRADING_DER	0.0102	0.0000	0.0373	-1.2015	0.0021	-0.1410
	[3.09]***	[0.00]	[2.86]***	[-2.60]***	[1.82]*	[-2.41]**
EQ_TA	0.0012	0.0024	-0.0031			-0.2155
	[0.71]	[2.90]***	[-0.61]			[-7.21]***
ROA	-0.2128	-0.0483	-0.7834			-0.0924
	[-15.28]***	[-6.61]***	[-18.43]***			[-0.47]
LOANG	-0.0102	-0.0008	-0.0176			-0.1630
	[-48.53]***	[-7.77]***	[-26.90]***			[-44.60]***
SIZE	-0.2961	0.1125	0.5185	-7.3276	-0.0300	-1.1699
	[-18.43]***	[13.72]***	[10.01]***	[-2.84]***	[-6.26]***	[-3.85]***
INEFFICIENCY	-0.0022	0.0004	0.0063	-0.3342	0.0002	0.0219
	[-5.47]***	[2.63]***	[3.94]***	[-4.67]***	[1.62]	[4.29]***
BHC	-0.1246	-0.0121	-0.0329	-17.3929	0.0423	-1.2200
	[-7.35]***	[-1.49]	[-0.64]	[-4.86]***	[8.91]***	[-4.21]***
FED_RATE	-0.0130	-0.0112	-0.0825	5.2478	-0.0067	-0.7952
	[-10.32]***	[-19.51]***	[-17.79]***	[21.21]***	[-19.41]***	[-41.28]***
GDP_GROWTH	0.0096	-0.0044	-0.0200	1.3893	-0.0039	0.3068
	[8.70]***	[-7.40]***	[-5.10]***	[7.30]***	[-12.87]***	[16.75]***
TL_TA				0.2453	-0.0004	
				[4.50]***	[-4.01]***	
Observations:	46475	49109	48468	49286	49596	49109
R-squared:	0.75	0.25	0.50	0.58	0.56	0.89
F-statistic:	44.97	5.36	15.63	22.00	20.29	134.75

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. NON_TRADING_DER is the notional amount of derivatives held for other than trading purposes over total assets (in%). The definition of the different variables is available in appendix A. ***, **, * indicate statistical significance respectively at the 1%, 5% and 10% level; t-statistics (in brackets) are corrected for heteroskedasticity following White's methodology.

APPENDIX 4 Robustness checks: Failure model

Table D1 Unused commitments, interest rate derivatives and bank failure during the period Q1/2007-Q4/2010

	Failure model			
	(1)	*(2)*	*(3)*	*(4)*
C	*-3.0200*	*-2.9956*	*-2.9754*	*-2.9943*
	*[-12.59]****	*[-12.04]****	*[-12.12]****	*[-12.14]****
UNUSED_COMMITMENTS	*0.0029*			
	*[2.86]****			
NOTIONAL_INTEREST_DER		*-0.0086*		
		*[-2.06]***		
INTEREST_DER_TRADING			*-0.0117*	
			[-1.13]	
INTEREST_DER_NON_TRADING				*-0.0085*
				*[-1.90]**
NPL	*0.0866*	*0.0848*	*0.0851*	*0.0849*
	*[14.82]****	*[14.71]****	*[14.79]****	*[14.76]****
LOANG	*0.0030*	*0.0031*	*0.0031*	*0.0031*
	*[2.04]***	*[2.00]***	*[2.01]***	*[2.03]***
CRELOANS	*0.0038*	*0.0033*	*0.0034*	*0.0035*
	*[2.14]***	*[1.79]**	*[1.88]**	*[1.97]***
CORE_DEPOSIT	*-0.0036*	*-0.0035*	*-0.0037*	*-0.0036*
	*[-1.98]***	*[-1.84]**	*[-1.99]***	*[-1.90]**
BROKERED_DEPOSIT	*0.0176*	*0.0195*	*0.0185*	*0.0191*
	*[11.58]****	*[11.44]****	*[11.61]****	*[11.93]****
INEFFICIENCY	*0.0166*	*0.0167*	*0.0165*	*0.0167*
	*[7.15]****	*[7.13]****	*[7.06]****	*[7.15]****
ROA	*-0.0674*	*-0.0686*	*-0.0687*	*-0.0686*
	*[-4.12]****	*[-4.14]****	*[-4.16]****	*[-4.15]****
EQ_TA	*-0.0927*	*-0.0910*	*-0.0915*	*-0.0911*
	*[-4.64]****	*[-4.62]****	*[-4.65]****	*[-4.64]****
BHC	*0.1138*	*0.1055*	*0.1128*	*0.1037*
	[1.59]	*[1.50]*	*[1.59]*	*[1.48]*
GDP_GROWTH	*-0.0227*	*-0.0211*	*-0.0211*	*-0.0212*
	*[-2.38]***	*[-2.20]***	*[-2.20]***	*[-2.21]***
Observations:	*103462*	*103462*	*103462*	*103462*
R-squared:	*0.30*	*0.30*	*0.30*	*0.30*
Obs with failure=1	*298*	*298*	*298*	*298*

This table shows Probit estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variable. All explanatory variables are introduced with a lag of four quarters. UNUSED_COMMITMENTS is the % of unused commitments value over total assets, NOTIONAL_INTEREST_DER is the % of the notional amount of interest derivative contracts over total assets. INTEREST_DER_TRADING is the % of the notional amount of interest derivative contracts held for trading over total assets, INTEREST_DER_NON_TRADING is the % of the notional amount of interest derivative contracts held for other than trading issues over total assets.The definition of the other different variables is available in appendix A. Standard errors are adjusted using the Huber-White method. ***, ** and * indicate statistical significance respectively at 1, 5 and 10% level of significance. Z-Stats are in brackets.

Table D2: Credit substitutes and bank failure during the period Q1/2007-Q4/2010, robustness check using different number of quarter lags

	Failure Model					
Dep. Var:	*2 quarters*	*3 quarters*	*5 quarters*	*6 quarters*	*7 quarters*	*8 quarters*
C	*-1.7743*	*-2.5123*	*-3.2795*	*-3.7526*	*-4.0470*	*-3.8995*
	*[-4.90]****	*[-8.56]****	*[-14.38]****	*[-14.33]****	*[-16.58]****	*[-18.14]****
CREDIT_SUBSTITUTES	*0.0013*	*0.0019*	*0.0021*	*0.0024*	*0.0033*	*0.0035*
	[0.75]	*[1.72]**	*[2.74]****	*[3.50]****	*[4.27]****	*[4.82]****
NPL	*0.0819*	*0.0904*	*0.0770*	*0.0577*	*0.0429*	*0.0334*
	*[15.40]****	*[19.01]****	*[10.48]****	*[5.91]****	*[5.27]****	*[4.99]****
LOANG	*-0.0001*	*0.0020*	*0.0020*	*0.0021*	*0.0019*	*0.0022*
	[-0.14]	*[1.04]*	*[1.46]*	*[1.41]*	*[1.36]*	*[1.41]*
CRELOAN	*0.0013*	*0.0028*	*0.0059*	*0.0075*	*0.0088*	*0.0097*
	[0.57]	*[1.40]*	*[3.62]****	*[5.07]****	*[6.07]****	*[6.80]****
CORE_DEPOSIT	*-0.0033*	*-0.0049*	*-0.0035*	*-0.0032*	*-0.0024*	*-0.0037*
	[-1.38]	*[-2.52]***	*[-2.02]***	*[-1.95]**	*[-1.49]*	*[-2.38]***
BROKERED_DEPOSIT	*0.0167*	*0.0173*	*0.0185*	*0.0176*	*0.0176*	*0.0164*
	*[8.65]****	*[10.87]****	*[12.88]****	*[12.33]****	*[12.22]****	*[11.11]****
INEFFICIENCY	*0.0095*	*0.0132*	*0.0181*	*0.0215*	*0.0236*	*0.0224*
	*[3.57]****	*[5.43]****	*[7.83]****	*[9.02]****	*[10.09]****	*[9.86]****
ROA	*-0.0705*	*-0.0652*	*-0.0682*	*-0.0680*	*-0.0676*	*-0.0691*
	*[-4.65]****	*[-4.02]****	*[-3.97]****	*[-3.17]****	*[-3.08]****	*[-3.99]****
EQ_TA	*-0.2069*	*-0.1276*	*-0.0648*	*-0.0286*	*-0.0099*	*-0.0045*
	*[-4.64]****	*[-3.96]****	*[-4.87]****	*[-1.60]*	*[-0.71]*	*[-0.45]*
BHC	*0.0111*	*0.0879*	*0.1295*	*0.1700*	*0.1825*	*0.1759*
	[0.14]	*[1.18]*	*[1.94]**	*[2.65]****	*[2.84]****	*[2.76]****
GDP_GROWTH	*-0.0497*	*-0.0333*	*-0.0114*	*-0.0187*	*-0.0271*	*-0.0351*
	*[-4.35]****	*[-3.43]****	*[-1.30]*	*[-1.94]**	*[-2.87]****	*[-3.42]****
Observations:	*104998*	*104236*	*102664*	*101886*	*101093*	*100319*
R-squared:	*0.47*	*0.37*	*0.23*	*0.19*	*0.16*	*0.14*
F-statistic:	*300*	*298*	*297*	*294*	*291*	*289*

This table shows Probit estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variable. All explanatory variables are introduced with a lag of respectively 2, 3, 5, 6, 7 and 8 quarters. The definition of the different variables is available in appendix A. Standard errors are adjusted using the Huber-White method. ***, ** and * indicate statistical significance respectively at 1, 5 and 10% level of significance. Z-Stats are in brackets.

Table D3: Derivatives and bank failure during the period Q1/2007-Q4/2010: robustness check using different number of quarter lags

	Failure model					
	2 quarters	*3 quarters*	*5 quarters*	*6 quarters*	*7 quarters*	*8 quarters*
C	*-1.7617*	*-2.4880*	*-3.2761*	*-3.7364*	*-4.0159*	*-3.8620*
	*[-4.74]****	*[-8.22]****	*[-14.05]****	*[-13.85]****	*[-16.15]****	*[-17.65]****
NOTIONAL_DERIVATIVES	*-0.0046*	*-0.0074*	*-0.0124*	*-0.0096*	*-0.0104*	*-0.0112*
	[-1.02]	*[-1.67]**	*[-3.02]****	*[-2.77]****	*[-2.87]****	*[-3.38]****
NPL	*0.0809*	*0.0890*	*0.0750*	*0.0558*	*0.0406*	*0.0312*
	*[14.79]****	*[18.74]****	*[10.33]****	*[5.86]****	*[5.16]****	*[4.79]****
LOANG	*-0.0002*	*0.0019*	*0.0019*	*0.0019*	*0.0018*	*0.0022*
	[-0.27]	*[1.00]*	*[1.29]*	*[1.30]*	*[1.29]*	*[1.42]*
CRELOANS	*0.0009*	*0.0022*	*0.0054*	*0.0070*	*0.0083*	*0.0092*
	[0.38]	*[1.09]*	*[3.19]****	*[4.67]****	*[5.66]****	*[6.43]****
CORE_DEPOSIT	*-0.0031*	*-0.0049*	*-0.0034*	*-0.0032*	*-0.0026*	*-0.0041*
	[-1.32]	*[-2.43]***	*[-1.89]**	*[-1.90]**	*[-1.57]*	*[-2.56]***
BROKERED_DEPOSIT	*0.0178*	*0.0187*	*0.0208*	*0.0197*	*0.0200*	*0.0189*
	*[8.14]****	*[10.50]****	*[12.80]****	*[12.12]****	*[12.29]****	*[11.56]****
INEFFICIENCY	*0.0095*	*0.0133*	*0.0185*	*0.0220*	*0.0241*	*0.0231*
	*[3.58]****	*[5.44]****	*[7.89]****	*[9.04]****	*[10.16]****	*[9.97]****
ROA	*-0.0714*	*-0.0661*	*-0.0694*	*-0.0700*	*-0.0700*	*-0.0710*
	*[-4.68]****	*[-4.03]****	*[-3.98]****	*[-3.21]****	*[-3.14]****	*[-3.97]****
EQ_TA	*-0.2059*	*-0.1264*	*-0.0629*	*-0.0272*	*-0.0084*	*-0.0031*
	*[-4.66]****	*[-3.95]****	*[-4.78]****	*[-1.54]*	*[-0.62]*	*[-0.31]*
BHC	*0.0061*	*0.0824*	*0.1216*	*0.1645*	*0.1786*	*0.1750*
	[0.08]	*[1.12]*	*[1.86]**	*[2.62]****	*[2.86]****	*[2.82]****
GDP_GROWTH	*-0.0494*	*-0.0326*	*-0.0097*	*-0.0164*	*-0.0237*	*-0.0315*
	*[-4.34]****	*[-3.36]****	*[-1.09]*	*[-1.68]**	*[-2.49]***	*[-3.04]****
Observations:	*104998*	*104236*	*102664*	*101886*	*101093*	*100319*
R-squared:	*0.47*	*0.37*	*0.24*	*0.19*	*0.16*	*0.14*
F-statistic:	*300*	*298*	*297*	*294*	*291*	*289*

This table shows Probit estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variable. All explanatory variables are introduced with a lag of respectively 2, 3, 5, 6, 7 and 8 quarters. The definition of the different variables is available in appendix A. Standard errors are adjusted using the Huber-White method. ***, ** and * indicate statistical significance respectively at 1, 5 and 10% level of significance. Z-Stats are in brackets.

Table D4: Derivatives held for trading and bank failure during the period Q1/2007-Q4/2010 robustness check using different number of quarter lags

	Failure model					
Dep. Var:	*2 quarters*	*3 quarters*	*5 quarters*	*6 quarters*	*7 quarters*	*8 quarters*
C	*-1.7523*	*-2.4781*	*-3.2464*	*-3.7158*	*-3.9893*	*-3.8374*
	*[-4.74]****	*[-8.26]****	*[-13.96]****	*[-13.89]****	*[-16.18]****	*[-17.70]****
TRADING_DER	*-0.0119*	*-0.0109*	*-0.0996*	*-0.0126*	*-0.0116*	*-0.0113*
	[-1.06]	*[-1.07]*	*[-2.21]***	*[-1.57]*	*[-1.63]*	*[-1.62]*
NPL	*0.0811*	*0.0893*	*0.0755*	*0.0562*	*0.0409*	*0.0315*
	*[14.77]****	*[18.82]****	*[10.30]****	*[5.88]****	*[5.18]****	*[4.83]****
LOANG	*-0.0001*	*0.0019*	*0.0018*	*0.0020*	*0.0019*	*0.0023*
	[-0.19]	*[1.00]*	*[1.29]*	*[1.35]*	*[1.36]*	*[1.49]*
CRELOANS	*0.0009*	*0.0024*	*0.0052*	*0.0070*	*0.0082*	*0.0091*
	[0.41]	*[1.20]*	*[3.13]****	*[4.65]****	*[5.57]****	*[6.32]****
CORE_DEPOSIT	*-0.0032*	*-0.0050*	*-0.0037*	*-0.0034*	*-0.0027*	*-0.0042*
	[-1.36]	*[-2.53]***	*[-2.04]***	*[-1.99]***	*[-1.67]**	*[-2.66]****
BROKERED_DEPOSIT	*0.0174*	*0.0180*	*0.0197*	*0.0187*	*0.0189*	*0.0176*
	*[8.70]****	*[10.88]****	*[12.98]****	*[12.30]****	*[12.37]****	*[11.26]****
INEFFICIENCY	*0.0094*	*0.0131*	*0.0183*	*0.0216*	*0.0237*	*0.0227*
	*[3.54]****	*[5.39]****	*[7.84]****	*[8.97]****	*[10.07]****	*[9.87]****
ROA	*-0.0714*	*-0.0661*	*-0.0697*	*-0.0700*	*-0.0701*	*-0.0707*
	*[-4.68]****	*[-4.05]****	*[-3.98]****	*[-3.25]****	*[-3.20]****	*[-4.04]****
EQ_TA	*-0.2066*	*-0.1269*	*-0.0637*	*-0.0276*	*-0.0088*	*-0.0034*
	*[-4.67]****	*[-3.96]****	*[-4.79]****	*[-1.56]*	*[-0.65]*	*[-0.34]*
BHC	*0.0111*	*0.0887*	*0.1304*	*0.1702*	*0.1840*	*0.1798*
	[0.14]	*[1.19]*	*[1.96]***	*[2.68]****	*[2.91]****	*[2.86]****
GDP_GROWTH	*-0.0494*	*-0.0326*	*-0.0102*	*-0.0168*	*-0.0244*	*-0.0328*
	*[-4.35]****	*[-3.37]****	*[-1.15]*	*[-1.73]**	*[-2.58]****	*[-3.19]****
Observations:	*104998*	*104236*	*102664*	*101886*	*101093*	*100319*
R-squared:	*0.47*	*0.37*	*0.24*	*0.19*	*0.16*	*0.14*
F-statistic:	*300*	*298*	*297*	*294*	*291*	*289*

This table shows Probit estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variable. TRADING_DER is the notional amount of derivatives held for trading purposes over total assets (in%). All explanatory variables are introduced with a lag of respectively 2, 3, 5, 6, 7 and 8 quarters. The definition of the other different variables is available in appendix A. Standard errors are adjusted using the Huber-White method. ***, ** and * indicate statistical significance respectively at 1, 5 and 10% level of significance. Z-Stats are in brackets.

Table D5: Derivatives held for non-trading purposes and bank failure during the period Q1/2007-Q4/2010, robustness check using different number of quarter lags

	Failure model					
Dep. Var:	*2 quarters*	*3 quarters*	*5 quarters*	*6 quarters*	*7 quarters*	*8 quarters*
C	*-1.7645*	*-2.4921*	*-3.2653*	*-3.7287*	*-4.0051*	*-3.8513*
	*[-4.76]****	*[-8.28]****	*[-14.11]****	*[-13.91]****	*[-16.22]****	*[-17.73]****
NON_TRADING_DER	*-0.0040*	*-0.0073*	*-0.0105*	*-0.0096*	*-0.0106*	*-0.0119*
	[-0.75]	*[-1.47]*	*[-2.56]***	*[-2.48]***	*[-2.64]****	*[-3.27]****
NPL	*0.0811*	*0.0892*	*0.0753*	*0.0561*	*0.0409*	*0.0314*
	*[14.91]****	*[18.86]****	*[10.37]****	*[5.89]****	*[5.19]****	*[4.82]****
LOANG	*-0.0002*	*0.0020*	*0.0019*	*0.0020*	*0.0019*	*0.0023*
	[-0.24]	*[1.01]*	*[1.34]*	*[1.34]*	*[1.34]*	*[1.46]*
CRELOANS	*0.0011*	*0.0024*	*0.0057*	*0.0074*	*0.0087*	*0.0095*
	[0.47]	*[1.22]*	*[3.49]****	*[4.99]****	*[6.02]****	*[6.75]****
CORE_DEPOSIT	*-0.0032*	*-0.0049*	*-0.0036*	*-0.0033*	*-0.0027*	*-0.0042*
	[-1.34]	*[-2.46]***	*[-2.00]***	*[-1.98]***	*[-1.67]**	*[-2.66]****
BROKERED_DEPOSIT	*0.0174*	*0.0184*	*0.0201*	*0.0192*	*0.0195*	*0.0184*
	*[8.33]****	*[10.79]****	*[13.16]****	*[12.61]****	*[12.81]****	*[12.05]****
INEFFICIENCY	*0.0095*	*0.0133*	*0.0184*	*0.0219*	*0.0240*	*0.0229*
	*[3.60]****	*[5.46]****	*[7.86]****	*[9.02]****	*[10.12]****	*[9.90]****
ROA	*-0.0713*	*-0.0661*	*-0.0696*	*-0.0700*	*-0.0700*	*-0.0709*
	*[-4.68]****	*[-4.04]****	*[-3.99]****	*[-3.21]****	*[-3.14]****	*[-3.98]****
EQ_TA	*-0.2058*	*-0.1263*	*-0.0632*	*-0.0274*	*-0.0087*	*-0.0034*
	*[-4.66]****	*[-3.96]****	*[-4.81]****	*[-1.56]*	*[-0.64]*	*[-0.34]*
BHC	*0.0060*	*0.0809*	*0.1195*	*0.1621*	*0.1759*	*0.1723*
	[0.08]	*[1.10]*	*[1.83]**	*[2.58]****	*[2.82]****	*[2.79]****
GDP_GROWTH	*-0.0494*	*-0.0326*	*-0.0098*	*-0.0166*	*-0.0239*	*-0.0316*
	*[-4.35]****	*[-3.37]****	*[-1.11]*	*[-1.70]**	*[-2.52]***	*[-3.06]****
Observations:	*104998*	*104236*	*102664*	*101886*	*101093*	*100319*
R-squared:	*0.47*	*0.37*	*0.24*	*0.19*	*0.16*	*0.14*
F-statistic:	*300*	*298*	*297*	*294*	*291*	*289*

This table shows Probit estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variable. NON_TRADING_DER is the notional amount of derivatives held for other than trading purposes over total assets (in%) All explanatory variables are introduced with a lag of respectively 2, 3, 5, 6, 7 and 8 quarters. The definition of the other different variables is available in appendix A. Standard errors are adjusted using the Huber-White method. ***, ** and * indicate statistical significance respectively at 1, 5 and 10% level of significance. Z-Stats are in brackets.

APPENDIX 5 Robustness checks: Drawdown of credit substitutes

Table E1 Drawdown of credit substitutes and bank risk exposure during the period Q1/2001-Q4/2010

	NPL	*LLR*	*LLP*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*-14.63****	*-0.196****	*-1.141****	*371.8****	*-0.0714****	*73.47****
	[-100.99]	*[-4.19]*	*[-60.12]*	*[25.59]*	*[-4.21]*	*[87.70]*
DRAWDOWN	*-0.0755****	*-0.0416****	*-0.00130****	*3.100****	*-0.00446****	*-0.722****
	[-25.40]	*[-43.17]*	*[-3.33]*	*[12.85]*	*[-15.96]*	*[-41.57]*
EQ_TA	*0.0137****	*0.00605****	*0.00337****	*1.446****	*0.00437****	*-0.106****
	[11.09]	*[15.08]*	*[20.57]*	*[12.12]*	*[31.33]*	*[-14.90]*
ROA	*-1.501****	*-0.421****	*-0.130****	*87.81****	*-0.166****	*0.102*
	[-102.00]	*[-89.11]*	*[-66.79]*	*[72.79]*	*[-118.12]*	*[1.22]*
SIZE	*0.839****	*0.0906****	*0.0666****	*-13.99****	*0.0102****	*-2.398****
	[111.75]	*[37.42]*	*[67.70]*	*[-18.15]*	*[11.36]*	*[-55.23]*
INEFFICIENCY	*0.0145****	*-0.000147*	*0.00100****	*-0.204****	*0.0000446*	*0.0781****
	[40.79]	*[-1.27]*	*[21.46]*	*[-6.18]*	*[1.16]*	*[37.87]*
BHC	*0.0899****	*-0.0170****	*-0.00878****	*-7.618****	*0.0120****	*-1.514****
	[6.16]	*[-3.58]*	*[-4.58]*	*[-5.65]*	*[7.61]*	*[-17.80]*
FED_RATE	*-0.144****	*-0.0393****	*-0.0142****	*8.255****	*-0.00762****	*-0.956****
	[-88.87]	*[-74.45]*	*[-66.88]*	*[62.14]*	*[-49.41]*	*[-101.34]*
GDP_GROWTH	*-0.0415****	*0.00503****	*-0.00752****	*2.154****	*-0.00237****	*0.422****
	[-32.12]	*[12.06]*	*[-44.40]*	*[21.52]*	*[-20.46]*	*[56.46]*
Observations:	*254,186*	*248,025*	*247,272*	*204,496*	*204,214*	*258,264*
R-sq	*0.188*	*0.104*	*0.115*	*0.099*	*0.131*	*0.074*
adj. R-sq	*0.158*	*0.07*	*0.081*	*0.059*	*0.093*	*0.04*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. *Drawdown* is a dummy variable reflecting the drawdown of credit substitutes, description of this variable is provided in section 6. The definition of the other different variables is available in appendix A. Standard errors are adjusted using the Huber-White method. ***, ** and * indicate statistical significance respectively at 1, 5 and 10% level of significance. Z-Stats are in brackets.

Table E2 Drawdown of credit substitutes and bank risk exposure during the period Q1/2001-Q4/2010 (including credit substitutes and loan growth as explanatory variables)

	NPL	*LLR*	*LLP*	*ZSCORE*	*STDROA*	*LIQUIDITY*
C	*-15.40****	*0.257****	*-1.654****	*407.1****	*-0.163****	*74.06****
	[-82.86]	*[4.52]*	*[-65.80]*	*[25.59]*	*[-9.33]*	*[72.91]*
DRAWDOWN	*-0.0170****	*-0.0148****	*0.000675*	*1.963****	*-0.00146****	*-0.430****
	[-5.41]	*[-15.25]*	*[1.59]*	*[7.74]*	*[-5.30]*	*[-24.79]*
CREDIT_SUBSTITUTES	*-0.0169****	*-0.00748****	*-0.00131****	*0.483****	*-0.000910****	*-0.151****
	[-35.31]	*[-49.42]*	*[-19.62]*	*[12.62]*	*[-21.79]*	*[-57.56]*
EQ_TA	*0.0252****	*0.0106****	*0.00277****	*2.599****	*0.00232****	*-0.245****
	[15.79]	*[21.52]*	*[12.66]*	*[19.87]*	*[16.25]*	*[-28.09]*
ROA	*-1.541****	*-0.420****	*-0.125****	*83.98****	*-0.149****	*1.469****
	[-94.68]	*[-84.97]*	*[-56.40]*	*[65.94]*	*[-107.48]*	*[16.92]*
SIZE	*0.901****	*0.0794****	*0.0963****	*-16.81****	*0.0169****	*-2.134****
	[91.81]	*[26.46]*	*[72.52]*	*[-19.95]*	*[18.34]*	*[-39.79]*
INEFFICIENCY	*0.0104****	*-0.00406****	*0.000280****	*-0.132****	*-0.000148****	*0.0223****
	[24.90]	*[-31.56]*	*[4.98]*	*[-3.86]*	*[-3.96]*	*[9.80]*
BHC	*0.0318*	*-0.0523****	*-0.00919****	*-9.044****	*0.0127****	*-1.900****
	[1.87]	*[-9.98]*	*[-3.99]*	*[-6.39]*	*[8.18]*	*[-20.33]*
FED_RATE	*-0.128****	*-0.0248****	*-0.0141****	*7.708****	*-0.00598****	*-0.698****
	[-74.09]	*[-46.50]*	*[-60.34]*	*[55.23]*	*[-39.35]*	*[-73.39]*
GDP_GROWTH	*-0.0387****	*0.00405****	*-0.00671****	*2.352****	*-0.00275****	*0.364****
	[-29.43]	*[10.05]*	*[-37.76]*	*[22.83]*	*[-24.50]*	*[50.80]*
LOANG	*-0.0237****	*-0.0107****	*-0.00103****	*0.465****	*-0.00115****	*-0.118****
	[-92.35]	*[-135.83]*	*[-29.76]*	*[22.43]*	*[-51.02]*	*[-84.24]*
Observations:	*213551*	*208913*	*207867*	*196174*	*196106*	*216939*
R-sq	*0.25*	*0.221*	*0.144*	*0.106*	*0.153*	*0.133*
adj. R-sq	*0.218*	*0.187*	*0.106*	*0.065*	*0.115*	*0.097*

This table shows Panel fixed effect estimation results where the dependent variable is regressed on a constant, the bank level variables and macro level variables. All explanatory variables are introduced with a lag of one quarter. *Drawdown* is a dummy variable reflecting the drawdown of credit substitutes, description of this variable is provided in section 6. The definition of the other different variables is available in appendix A. Standard errors are adjusted using the Huber-White method. ***, ** and * indicate statistical significance respectively at 1, 5 and 10% level of significance. Z-Stats are in brackets.

Concluding Remarks of Part 2

Off balance sheet activities, widely associated to financial innovations and untraditional activities, are an intriguing part of the bank financial statement. The volatility of non-traditional activities is commonly discussed in banking literature. Also after the financial crisis, analysis highlighting the exposure of banks to off balance sheet risk specifically to derivatives' risk and the argument of "insufficient recognition of the role of financial innovation in magnifying both the boom and the unwinding of financial imbalances and their consequences on the real economy" were specifically reported by the Financial Crisis Inquiry Commission (2011). The objective of this second part of the thesis was to provide a better understanding of the different types of items that could be presented off the balance sheet on banks' financial statements, to understand the implication of the U.S. commercial banking system in these different types of activities and to determine the different types of risk to which these activities expose banks.

A main finding of this part is that most of the U.S. commercial banks (98%) engage in the traditional part of the OBS activities, specifically in activities related to provision of commitments and of different types of guarantees and letters of credit. This category "credit substitutes" which accounted for about 25% of the U.S. commercial banking system' total assets, is found to enhance bank loans portfolio and bank performance while putting more pressure on bank liquidity.

The comment that OBS activities are stratospherically huge is mainly associated with derivatives, which notional amount constitutes 99% of the total amount of OBS activities (in the 4th quarter 2010, OBS activities of the U.S. commercial banking system were 20 times its total assets (see appendix A Chapter1)). Derivatives are mainly used by U.S. commercial banks for hedging issues (10% of commercial banks). Also few banks (2%) use derivatives for trading purposes. Keep in mind that dealer banks are very large in volume: in the U.S. commercial banking system, derivatives for trading constitute 94% of total OBS activities. This part shows that, at the bank level, derivatives are implicated in higher risk exposure for small banks. For larger banks, engaging in derivatives activities has not been found to significantly impact the measures of risk. Finally between 45 and 70 commercial banks in the U.S. engage in credit derivatives (less

than 1% of the U.S. commercial banking system). Credit derivatives notional amount constitute 6% of OBS activities.

All in all, when the majority of the U.S. commercial banks engage in the traditional part of off balance sheet activities, only few of them are responsible of hundreds of trillions of $ in derivatives activities mostly used for trading issues. The notional amounts of derivatives activities are so enormous compared to the global economy, accordingly the huge amount of money to be paid could have serious implication for the financial system. The Financial Crisis Inquiry Commission (2011) reported that *"While the vulnerabilities that created the potential for crisis were years in the making, it was the collapse of the housing bubble fuelled by low interest rates, easy and available credit, scant regulation, and toxic mortgages that was the spark that ignited a string of events, which led to a full-blown crisis in the fall of 2008*" they also conclude that "*over-the-counter derivatives contributed significantly to this crisis. The enactment of legislation in 2000 to ban the regulation by both the federal and state governments of over-the-counter (OTC) derivatives was a key turning point in the march toward the financial crisis*". After the financial crisis, many called for limiting and regulating the market of derivatives in the banking sector. Still, since 2008 derivatives bubble hasn't stop rising and become even mainly concentrated among a select few banks.

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