Liquidity risk and interest rate risk on banks: are they related?

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LIQUIDITY RISK AND INTEREST RATE RISK ON BANKS: ARE THEY RELATED?

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ABSTRACT

The present study aims at ascertaining whether a relationship exists between the liquidity risk and the interest rate risk of credit institutions. By analysing the balance sheet of a small Italian bank during the years 2009 and 2010, we outlined its liquidity profile, the variables that influenced its dynamics and their effects on the bank's global management, with particular attention to the interest margin and the interest rate risk in the banking book.
We would like to fill a gap identified in the literature, shedding light on how a set of decisions designed mainly to reduce the liquidity risk and comply with the new parameters established by the Basel III Framework enables a more effective management of the regulatory capital and helps the bank to achieve a solid balance between profitability and solvency.
Our main findings demonstrate that the bank succeeded in modifying its liquidity profile in order to comply with the incoming constraints imposed by the Basel III framework; the actions taken to reduce the liquidity risk also lowered its interest margin, but also enabled the bank to reduce the amount of capital absorbed by the interest rate risk, giving rise to a globally positive effect.

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I. Introduction

Among the reasons for the failure of bank management models, amply highlighted by the effects of the economic crisis and partly facilitated by the regulations imposed by the banking supervisors, there is also the lack of an integrated, overall approach to banking activities capable of simultaneously assessing the fallout of any choices made on different risk domains. An example of this situation comes from the securitisation processes that have often led to looser credit risk assessment methods, due to the assumption of a transfer to the market of loans and the postponement to a subsequent measurement by the rating agencies. In addition, the fact of holding sizable *tranches* of bonds deriving from these processes, i.e. of investing in securities of separate operations, has been discussed much more often in terms of their market risk profile, neglecting the related credit risk although this becomes fundamental in determining the value, for instance, of collateralised debt obligations (CDO) and asset-backed securities (ABS). The inclusion of these instruments in the sole trading book represents an example of such policies.

Much the same can be said about the liquidity risk. While banks are naturally liable to this risk, the availability of an enormous mass of funds, low interest rates, and apparently ever more efficient markets have led to its underestimation and to an exposure that has gradually grown as the crisis has become more severe (BCBS 2010). In a period of an increasing internationalization of the financial systems and a rising pressure of competition, every intermediary had been obliged to seek a delicate equilibrium between a prudent and balanced term structure of the assets and liabilities while pursuing higher and higher levels of profitability. The result has been even very different levels of exposure to the liquidity risk (Tarantola 2008).

The liquidity risk not only stems from the traditional way in which a commercial bank operates, it is also a consequence of other risks (credit risk, market risk, reputational risk,

strategic risk, etc.). In this latter sense, it is a consequential risk (Neu *et al.* 2006; CEBS 2008) that we must necessarily take into consideration along with the other risks, particularly in situations of stress (Strahan 2008; Nikolaou 2009).

There is a particular affinity between the liquidity risk and the interest rate risk in the banking book. The liquidity risk depends on the due dates of the single cash flow associated with the assets and liabilities, while the interest rate risk depends on their repricing period. The link can be seen in one of the main functions of credit institutions, i.e. maturity transformation. Banks finance their investments by issuing liabilities with a shorter mean maturity than that of their investments; the resulting imbalance between the terms for the assets and liabilities means that they take on an interest risk and a liquidity risk (Resti and Sironi 2007). Both of these risks thus come to bear on the same balance sheet items, making it essential for the bank to take a global, integrated approach to managing its assets and liabilities from the point of view both of the maturity periods of the single cash flows and of the interest rates applied.

In particular, decisions designed to improve the bank's liquidity profile in the short and in the medium-to-long term can presumably facilitate a better balance between its assets and liabilities, and consequently a lower impact of the interest rate risk on its capital. Then it is also likely that a lower liquidity risk level may well have potentially negative effects in terms of profitability (Resti 2011), but this may be balanced thanks to a lower absorption of capital.

The literature has thoroughly debated both the liquidity risk and the interest rate risk, but for the time being there seems to be no contribution from the scholars on the integrated management of these types of risk. Conversely, among the actions taken by the supervisors following the financial crisis, special attention has been paid to the role of risk management, one of the responsibilities of which is to ensure that every risk of relevance to the bank is correctly identified and effectively managed according to an integrated logic (Bank of Italy 2012b; EBA 2011).

The present study proposes to fill the gap identified in the literature, using a case study to shed light on how a set of decisions designed mainly to reduce the liquidity risk and comply with the new parameters established by the Basel III Framework, despite entailing an initial opportunity cost for the bank, enables a more effective management, right from the start, of the regulatory capital and helps the bank to achieve a solid balance between profitability and solvency. The hypothesis that we aim to verify is that a direct relationship[1] exists between liquidity risk and interest rate risk in the banking book, such that reducing the exposure to the former also induces a reduction in the bank's exposure to the latter as well. Although this dual improvement in the coverage of these risks means a lower profitability in terms of the interest margin in the short term, it reinforces the bank's capital solidity in the medium to longer term, enabling it to return to more adequate, sustainable profitability levels.

This study is organized as follows: section II outlines the principal contributions in the literature on the topics of liquidity risk and interest rate risk; in section III we focus on an empirical application to a small Italian bank with a view to highlighting the link existing between the liquidity risk and the interest rate risk. In section IV we analyse and discuss our main findings; and section V contains our conclusions, emphasizing the management implications for banks and mentioning potential further research topics.

II. Literature

Literature on the liquidity risk

The topic of the liquidity risk had been attracting the interest of scholars well before the international crisis of 2007 came about and, albeit without establishing specific capital requirements for covering said risk (Resti and Sironi 2010), the banking supervisors have nonetheless emphasized its relevance.

1The relationship investigated does not necessarily implicate a linear function; it refers more in general to a situation of dependence.

The first papers on the liquidity risk date from the 19th century, when Knies (1876, cited in Duttweiler 2009) underscored the need for a cash buffer to compensate for negative gaps between flows of incoming and outgoing payments in cases where their respective maturity periods could not be perfectly controlled. In the 20th century, Saraceno (1942, cited in Mazzei 1992) claimed that "the search (…) for the most fruitful combination of lending and borrowing operations among all the operations that ensure the bank has the necessary balance between income and expenditure, is the core problem of bank management. A bank's liquidity can be defined as its capacity to achieve this balance economically and at all times".

Among the most recent contributions, Gualandri *et al.* (2009) start with the concept that, given the imperfection of the capital markets, the transfer of resources between economic operators necessitates an adequate quantity of financial activities generally accepted as being risk-free by the operators who act as intermediaries in the exchanges. The authors give a definition of a bank's liquidity ("inside liquidity") as its monetary obligations on demand, in the form of deposits in current accounts and credit lines. This definition of liquidity leads to that of a bank's liquidity risk, identified as the difficulty banks may have in promptly and economically meeting their monetary obligations deriving from the management of payments that are made using bank money. According to Ferrari and Ruozi (2009), the liquidity crisis is the result, not the cause of recent bank crises. Their difficulties would originate instead from their having departed from the proper principles of a healthy and prudent management (already established by international banking methods) and having focused excessively on achieving short-term profits, combined with the inefficacy of the banks' internal control systems and, in some countries, also the inadequacy of the banking supervisors' policies.

A work by Cornett *et al.* (2011) concerns how banks managed the liquidity shock that occurred during the financial crisis of 2007-2009 by adjusting their holdings of cash and other liquid assets, as well as how these efforts to weather the storm affected credit availability. In

particular, by examining a sample of North American commercial banks, they showed that liquidity risk exposure is not only negatively correlated with loan growth in the crisis, but it is also positively correlated with the growth in liquid assets, supporting the interpretation that efforts to build up balance sheet liquidity displaced funding to support new lending. They also show that the market liquidity of bank assets negatively affected their accumulation of liquid assets and positively affected their loan growth. By quantifying how much credit would have contracted if banks had entered the fall of 2008 less exposed to liquidity risk, these authors highlighted that new credit production, as the sum of both on balance-sheet loans and undrawn commitments, fell by about $500 billion in the fourth quarter of 2008; had liquidity exposure been in the lower quartile across the whole banking system, their estimates suggest that new credit would have fallen by just $87 billion, or almost 90% less than the unadjusted figure.

As for the impact of the new rules on liquidity risk management deriving from the Basel III agreement (BCBS 2010 and 2011), Resti (2011) makes the point that the introduction of the compulsory "liquidity coverage ratio" (LCR) and "net stable funding ratio" (NSFR)[2] will have a significant impact on the banks' activity. In particular, the author indicates that the reduction in the maturity transformation activities that will derive from applying these ratios is destined (given a positively sloping curve of "normal" interest rates) to produce a decline in the revenue, and of the interest margin in particular. Similarly, the "compulsory" holding of a consistent quantity of liquid assets is seen as being liable to dilute the ROA. A study conducted by McKinsey & Company (2010) for the European banking sector comes to the same conclusions as Resti, estimating the impact of the new ratios, in terms of the growth of the liquid assets, at approximately Euro 2 billion relating to the LCR indicator, while it estimates a growth in the long-term funding (with a maturity beyond one year) of between 3.5 and 5.0 billion Euro for the NSFR. Referring to the banks' profitability, the McKinsey study

2The criteria for calculating these ratios and the positions associated with them will be discussed in section III.

gives an estimate of the ROE that takes the effects of the introduction of the two liquidity indicators into account: this means a reduction to 4.3% as opposed to a pre-crisis average of 15%.

Finally, the study by La Ganga and Trevisan (2010) emphasizes how the enforcement of the new regulation will strengthen the process of changing company strategies, already partially started, returning to businesses more focused on traditional activities (so-called back to basic) with a probable downsizing of trading activities. The necessity to extend funding maturities and to strengthen its more stable components will give rise to a considerable reduction in the banks' interest margin and an increasing pressure of the competition on the retail funding. Including highly liquid assets in the buffer will also give rise to an increase in the opportunity costs, and investments designed to strengthen the bank's coverage of its liquidity risk, as required by the supervisory authorities, have already been and will continue to be numerous. The authors make the point that all these costs will unavoidably lead to lower profits, so it is hard to imagine a return to the extraordinary levels of profitability for the banking sector seen in the past, facilitated by a market that was rewarding extreme financial innovation.

Literature on the interest rate risk in the banking book

The interest rate risk for financial intermediaries, defined as the possibility of fluctuations in the market rate producing significant variations in one direction or the other on the balance of assets (Zen 2008), has been the object of the supervisory authorities' attention since 1997, when the Basel Committee (BCBS 1997 and 2004) published guidelines on the management of this type of risk. These principles, revised in 2004 following the introduction of the Basel II agreement (BCBS 2006), do not involve any specific capital requirement concerning the risk coming to bear on the banking book. Instead, they emphasize the importance of transparency in providing information and they recommend that the supervisory authorities in the single

states adhering to the BIS impose a capital supplement for banks carrying a considerable interest rate risk on their banking books[3].

The literature has amply debated the various types of interest rate risk to which banks are exposed (BCBS 2004)[4]. The main contributions published over the years focus on analysing the various approaches used to assess exposure to this risk, generally distinguishable as being based on the "current earnings perspective" or the "economic value perspective". The scholars and the operators in the sector alike consider these approaches complementary, not alternative. They can each be distinguished by specific target variables and analytical methods. In particular, the "current earnings perspective" focuses on controlling the variability of a bank's interest margin, and therefore implicitly also of its profitability on a short-term time horizon. The models that take this approach are based on the finding of mismatching between the maturity periods or first repricing events for the lending and borrowing positions within a given period of analysis. The most commonly used analytical methods comprise the so-called "gap management" models, in which the principal target variable is represented by the operating interest margin (Resti and Sironi 2007). The object of the "market value perspective" is to control the effects of variations in the interest rate on the global market value of a bank's financial assets and liabilities. By comparison with the previous approach, the time horizon considered is long because all the dynamics of the cash flow generated by each instrument contributing to the bank's portfolio are taken into account. The main target variable is the market value of the bank's capital, defined as the difference between the market value of the interest-generating financial assets and of the positions with a positive market value relating to derivatives on interest rates, and the market value of the liabilities and of the positions with a negative market value relating to derivatives on interest rates. The analytical models most often used in the context of this approach are the so-called

3 For Italy, see the Bank of Italy (2006).

4 For detailed surveys on sources of interest rate risk, see also (Gualandri 1991); (English 2002); (Fraser *et al.* 2002); (Lusignani 2004).

"financial models", which rely on techniques originally developed to measure the interest rate risk in bond portfolios (Brigo and Mercurio 2007; Staikouras 2006; Grundke 2004).

Among the most recent contributions, it is also worth mentioning the publication by Drago (2006) on the impact of the assessment criteria introduced by the IAS/IFRS - and IAS 39 and IFRS 7 in particular - on how banks cover their interest rate risk. The analysis shows that standard setters scarcely take into account the managerial context of bank operability, by supposing, for instance, a ratio of one to one between hedged element and hedging instrument, which implies a hedging activity for each hedged position. On the contrary, the actual banking operability assesses the risk management on homogeneous portfolios of assets and liabilities. The subsequent introduction, within the IAS 39, of macro-hedging does not seem to have solved the problems highlighted, since banks' hedging target is often the interest margin, while the macro-hedging proposal allows only the fair value hedge, not feasible with the specified objective.

Memmel (2011) investigated a sample of 1562 German banks during the period between September 2005 and December 2009 with a view to seeking a relation between the systematic factor of the exposure to interest rate risk and the shape of the term structure, to clarify what factors determine banks' interest rate risk exposure and how profitable is their term transformation, ultimately aiming to establish whether banks with a large exposure to interest rate risk also achieve a high interest margin. The results showed that the systematic factor of the exposure to interest rate risk (assumed as corresponding to the shape of the past and current term structure of interest rates) moves in accordance with the possible earnings from term transformation, but at bank level bank specific and regulatory effects are far more important. For savings and cooperative banks, in particular, earnings from term transformation are an important source of interest income, and timely changes in earning from term transformation strongly affect their interest income. However, in the cross-section, the

interest margin is not much determined by the exposure to interest rate risk. Finally, the study showed that results apply especially to the small and medium-sized banks in the German savings and cooperative bank sector; in contrast, the large German banks seem to have much less exposure to interest rate risk than the savings and cooperative banks.

The studies conducted by Drehmann *et al.* (2010), and Alessandri and Drehmann (2010) are among the first to provide an overall picture of the impact of the interest rate risk and the credit risk on banks' activity. The work by Drehmann *et al.* proposes a general framework for measuring the riskiness of banks, which are subject to correlated interest rate and credit shocks. The analysis concentrates on the positions belonging to the banking book of a realistic hypothetical bank created *ad hoc* for the case study; these positions are submitted to a stress test and the results are judged by two criteria: the first, designed to verify compliance with the so-called "economic value condition", measures the adequacy of the value of the assets resulting from the model in relation to the value of the liabilities. Using the hypothesis of "perfect foresight", it attempts to capture how current and future changes due to the stress scenario affect the value of all the banks positions instantaneously; it thus gives a long-term view of the impact of a credit shock. The second criterion, the so-called "capital adequacy condition", reflects current general regulatory approaches. The authors assume that the banking book is valued using book-value accounting, so the profits and losses are accounted for only when they materialise, highlighting the real net cash flows and not the changes in the economic value of the balance sheet items affected. As a result, a particular trend of the profits may lead a bank to become undercapitalised in the short run because of severe losses which are expected to be outweighed by future profits. According to the economic value perspective, the bank would still be solvent, but - given the market or supervisory constraints - it could have serious difficulty in continuing to operate. Drehmann *et al.* also attempt to measure whether the bank in question is sufficiently well capitalised through time by

projecting the banks' write-offs, the net interest income, and the capital requirements in a consistent fashion. The results show a strong interaction between credit risk and interest rate risk, sufficient to influence the net-profitability and the capital adequacy: in particular, the magnitude of each risk component and the speed with which the profits return back to equilibrium after the hypothesized shocks depend, among other things, on the repricing characteristics of the positions in the banking book and on the cost of financing them.

Starting from the above-described model, Alessandri and Drehmann (2010) develop a model of economic capital in which the credit risk and the interest rate risk on the banking book interact in a non-linear, dynamic fashion. They show how changes in net interest income can be decomposed into two components: the first one captures the impact of changes in the yield curve, while the second accounts for the crystallisation of credit risk, which implies a loss of interest payments on defaulted loans. Conditionally on the state of the macroeconomy, these two sources of income risk seem to be independent. Assuming a one-year horizon, the authors apply a model to quantify the economic capital following the supervisors' recommendations, which define it as the amount of capital a bank needs to absorb unexpected losses (BCBS 2009). The model is implemented on a hypothetical stylized UK bank, comparing the so-called "integrated" economic capital (i.e. the capital level implied by a consistent, joint analysis of credit and interest rate risk) with the so-called "simple" economic capital (the sum of capital calculated considering the credit risk and the interest rate risk separately). For all the portfolios considered, the authors find that the so-called "simple" economic capital consistently exceeds the "integrated" economic capital, although the differences depend on the structure and on the repricing features of the bank's portfolio, thus representing an upper bound relative to the banks' overall risk and an adequate measure of the risk underlying a bank's banking book.

III. Empirical analysis: methodology and framework

The hypothesis of a relationship existing between the liquidity risk and the interest rate risk on the banking book is tested by analysing a small Italian bank over a period of two years, 2009 and 2010. The institution is examined according to its liquidity profile, the variables influencing its dynamics, and its impact on the interest rate risk, on the banking book and on the global management of the intermediary.

The legal framework for liquidity risk

The new international framework for liquidity risk measurement, standards and monitoring (BCBS 2010) has established two minimum standards for funding liquidity: the liquidity coverage ratio (LCR), and the net stable funding ratio (NSFR). Both the LCR and the NSFR will be subject to an observation period and will include a review clause to address any unintended consequences. After an observation period started in 2011, the LCR, including any revisions, will be introduced on 1 January 2015. The NSFR, including any revisions, will move to a minimum standard by 1 January 2018[5].

The LCR standard aims to ensure that a bank maintains an adequate level of unencumbered, high-quality liquid assets that can be converted into cash to meet its liquidity needs for a 30 calendar day time horizon, in a significantly severe liquidity stress scenario specified by the supervisors. The stock of liquid assets should at least enable the bank to survive until day 30 of the stress scenario, by which time it is assumed that appropriate corrective action can be taken by management and/or supervisors, and/or the bank can be resolved in an orderly way. The standard requires that the value of the stock of high-quality liquid assets should at least equate to the total net cash outflows (BCBS 2010):

5 The Italian Central Bank has already set some rules for liquidity risk assessment and management. See Bank of Italy (2006), 4th update of 13 December 2010.

$$LCR = \frac{HQLA}{\text{Total Net Cash Outflows over the next 30 Calendar Days}} \geqslant 1 \quad [6] \qquad (1).$$

The numerator of the LCR is the "stock of high-quality liquid assets" (HQLA). In order to qualify as HQLA, assets should be liquid in markets during a time of stress and should ideally be central bank eligible. Two categories of assets can be included in the stock. The assets to be included in each category are those that the bank is holding on the first day of the stress period. "Level 1" assets can be included without limit, while "Level 2" assets can only comprise up to 40% of the stock.

The term "total net cash outflows" is defined as the total expected cash outflows minus total expected cash inflows in the specified stress scenario for the subsequent 30 calendar days. Total expected cash outflows are calculated by multiplying the outstanding balances of various categories or types of liabilities and off-balance-sheet commitments by the rates at which they are expected to run off or be drawn down. Total expected cash inflows are calculated by multiplying the outstanding balances of various categories of contractual receivables by the rates at which they are expected to flow in under the conditions of the scenario up to an aggregate cap of 75% of total expected cash outflows:

$$\begin{aligned}&\text{Total Net Cash Outflows over the next 30 Calendar Days} = \\ &= \text{Outflows} - \text{Min}\{\text{Inflows}; 75\% \text{ of Outflows}\}\end{aligned} \qquad (2)$$

The NSFR aims to promote more medium- and long-term funding of the assets and activities of banking organizations. This standard is designed to act as a minimum enforcement mechanism to complement the LCR and reinforce other supervisory efforts by promoting structural changes in the liquidity risk profiles of institutions, moving away from short-term

6 The total net cash outflows for the scenario are to be calculated for 30 calendar days into the future. Banks and supervisors are also expected to be aware of any potential mismatches within the 30-day period and ensure that sufficient liquid assets are available to meet any cash-flow gaps throughout the period.

funding mismatches toward more stable, longer-term funding of assets and business activities. The NSFR is defined as the amount of stable funding available to the amount of stable funding required: it must be greater than 1[7].

$$NSFR = \frac{\text{Available Amount of Stable Funding}}{\text{Required Amount of Stable Funding}} = \frac{ASF}{RSF} > 1 \qquad (3).$$

"Stable funding" is defined as the portion of those types and amounts of equity and liability financing expected to be reliable sources of funds over a one-year time horizon under conditions of extended stress. The amount of such funding required of a specific institution is a function of the liquidity characteristics of the various types of assets held, off-balance-sheet contingent exposures incurred, and/or activities pursued by the institution.

Both the above requirements influence a bank's capacity for maturity transformation and necessarily implicate a considerable impact on their business model and their profitability.

The legal framework for the interest rate risk on the banking book

Banks have to implement effective rules, processes and instruments for managing the interest rate risk from assets other than those allocated to the supervisory trading book. The regulatory authorities (BCBS 2004; Bank of Italy 2006) provide methodological guidelines for the construction of a simplified system for measuring internal capital to support the interest rate risk in the banking book[8], consisting of five consecutive steps.

1) Determining "significant currencies"

"Significant currencies" are those that account for more than 5% of the total assets or liabilities in the banking book. For the purposes of the methodology for the calculation of interest rate risk exposure, positions denominated in "significant currencies" shall be

7Supervisors may also use alternative levels of this NSFR as thresholds for potential supervisory action.
8It includes the assets other than those allocated to the supervisory trading book.

considered currency by currency, while positions not in "non-significant currencies" shall be aggregated.

2) Classification of assets and liabilities into time bands

Fixed-rate assets and liabilities shall be slotted into 14 time bands on the basis of their residual maturity. Floating-rate assets and liabilities shall be slotted into different time bands on the basis of the time remaining to the next repricing date. Current account assets are classified in the "demand" time band[9], while the sum of current account liabilities and demand deposits are allocated as follows:

- in the "demand" time band a fixed amount equal to 25% ("non-core" component);
- for the remaining amount ("core component"), in the next eight time bands (from "up to one month" to "4 to 5 years") in proportion to the number of months contained in them[10].

Derivatives are allocated to the time bands in accordance with the criteria for capital requirements in respect of market risks.

3) Weighting of net exposures within each time band

Within each time band, assets are offset against liabilities to produce a net position. The net position of every time band is multiplied by the specified weighting factors. The factors are based on a hypothetical interest rate shift[11] – 200 basis points throughout the time spectrum - and a proxy of the modified duration for each time band[12].

9This does not include transactions formally settled as current accounts but regarding other forms of lending with specific time profiles (such as advances subject to final payment).

10For example, the band "up to one month" includes 1/60 of the residual amount, and the band "6 months-1 year" includes 6/60.

11On determining the internal capital under normal conditions, the banks could consider annual interest rate changes registered during an observation period of 6 years, and considering alternatively the first percentile (downgrade) or the 99th (upgrade). On estimating the internal capital under stress conditions, the hypothetical interest rate shifts are determined on the basis of scenarios selected by banks, in addition to the hypothetical interest rate shift of ± 200 basis points throughout the time spectrum. In case of downgrade scenarios, banks must guarantee the non-negativity of the interest rates. See Bank of Italy, Circ. n. 263/2006, 6th update, 27 December 2010.

12The modified duration approximates the sensitivity of the economic value of a position in a time band with respect to interest rate shifts for that time band. The Basel Committee specifies that it was calculated assuming that all positions in each time band have a yield of 5%.

4) Sum of weighted exposures of the different time bands

The weighted exposures of the different bands can be summed[13]. The net weighted exposure thus approximates the change in the present value of positions held in a given currency in the event of the interest rate shock assumed.

5) Aggregation of exposures in different currencies.

The absolute values of exposures for the individual "significant currencies" and the aggregate of "non-significant currencies" are summed[14]. This method gives a value representing the change in economic value of the bank for the given interest rate scenario[15].

The liquidity framework of the bank analysed

The balance sheet for the year 2009-2010 of the bank involved in our case study was rearranged to highlight the relevant positions for the calculation of liquidity indicators Basel III compliant and sensitive to changes in the interest rates. As company policy, there are not included the securities belonging to the trading book, so that the prospect could be considered equivalent to the banking book (Table 1). By applying the Basel III rules we then calculate the LCR and NSFR indicators.

[Please, insert Table 1 here]

The Basel III compliant calculation of the liquidity indicators generated the following values (Table 2):

[Please, insert Table 2 here]

13 Accordingly, the long and short exposures of different bands can be fully offset against one another.

14 Considering the sum of the absolute values is tantamount to assuming, for regulatory capital purposes, the worst combination of positive and negative interest rate shocks for the intermediary.

15 The economic value is defined as the present value of the cash flows.

Between 2009 and 2010, the LCR indicator rose from 0.557 to 1.273 (+71.6 basis points, bp) and the NSFR from 0.998 to 1.072 (+7.4 bp); both the indicators improved from one operating year to the other, settling at a higher level than the minimum threshold established by the Basel Committee. By comparison with 2009, the bank therefore succeeded in modifying its liquidity profile to comply with the liquidity constraints imposed by the supervisors. The differences recorded in the indicators between the two business years show that the bank put more effort into improving its liquidity at one month, and less into improving it at one year. It is worth noting here that banks (like the Italian banks) that have maintained a more traditional activity should meet with fewer difficulties in managing their structural liquidity, requiring more extensive measures on their short-term liquidity instead. For Italian banks, in particular, having had to comply up until a few years ago with rigid rules on maturity transformation, and having continued to follow them (as a control instrument) even after they were repealed, could have further reinforced this situation. On the other hand, the Anglo-Saxon style banks are more oriented towards an "originate to distribute" (OtD) model, and could meet with greater difficulty, under market stressed conditions, in adapting to the structural liquidity indicators because of their different business model.

IV. Effects of liquidity risk management on the interest margin and the interest rate risk on the banking book

Effects on interest margin

The improvements identified in the bank's liquidity have a fallout on its profitability and consequently on its capacity to generate positive results. For credit intermediaries, the main economic result is given by the interest margin (IM), especially for the smaller banks where, according to the Bank of Italy (2012a), it accounts for approximately 72% of the intermediation margin, against the 60% of larger banks.

We consequently investigated how much of the reduction in the IM for the period recorded in 2010 can be attributed to the action taken on the bank's liquidity, i.e. we wanted to quantify the opportunity cost that it had to sustain to improve its liquidity risk management. Table 3 shows the interest margin achieved in 2009 and 2010.

[Please, insert Table 3 here]

Although the interest margin was positive in both years, it was lower in 2010 than in 2009 (by 4.10%). To see how much the decrease in the interest margin derived from the action taken to improve the bank's liquidity, we calculated the amounts of received and paid interest by multiplying the single mean rates on interest received and interest paid, established for each of the bank's interest-bearing items, by the mass of each of these. This enabled us to see how much the interest connected to each item improved or worsened (Table 4).

[Please, insert Table 4 here]

Table 4 shows how, in opposition to the decrease in the interest margin, there was an increase of the interest rate spread (given by the difference between the rate for funding and the rate for investments), which rose from 2.03% to 2.09%. Considering the amount of the interest, there was a drop in the interest paid for each funding item and particularly in the interest on the passive current accounts and deposits (-1,482,000 Euro) and the issue of bonds (-2,300,000 Euro); the interest received also dropped for almost all the investments, with the active current accounts and payments under reserve declining by -3,066,000 Euro and the interest deriving from mortgages dropping by -1,046,000 Euro, not compensated by the improvements generated by the rise in the interest on loans to banks (+81,000 Euro) and on

the securities portfolio (+7000 Euro). In general, the variation in the amount of interest generated from one year to the next was due to the movements of two variables, i.e. the mass of each item and the related mean interest rate. Of these two variables, the entity of the masses involved is endogenous to the bank[16], while the rates are exogenous, because they vary with the market. The slight rise in the interest rates consequently cannot be attributed to the bank's policies, it is more a matter of the market conditions in 2010. The shrinkage of the interest margin is therefore attributable more to dynamics beyond the bank's control than to its liquidity management. To isolate the variation in the interest margin due to the bank's liquidity management, we can go back to Table 4 and modify the figures, applying the same interest rates for 2009 to the volume of the positions for 2010 (Table 5).

[Please, insert Table 5 here]

Table 5 shows that keeping the interest rate unchanged gives us a slightly higher loss on the interest margin, amounting to Euro -1,016,000. On the funding side, where there were no marked differences in the masses involved, the variations in the borrowing rate are not very large, but - by comparison with the previous situation (Table 4) - the interest related to the current liabilities and deposits increased (335.000 Euro), and so did the rate relating to the issue of bonds (351.000 Euro), and these changes were only partially balanced by the reduction in the interest generated by the certificates of deposit (-178.000 Euro), achieving a global Euro 457,000 increase in the interest paid. On the side of the investments, there is an evident reduction in the interest generated by active current accounts and payments under reserve (-2,340,000 Euro) and by loans to customers in general, compensated by the increase in the interest relating to the securities portfolio (Euro 2,618,000); the reduction in the interest

16For the bank examined, we assume that all changes on the amount of each item are largely due to the policy regime applied for the improvement of liquidity risk profile.

relating to the "other" items (-508.000 Euro) contributes to the negative overall variation in the lending rate, down by Euro 559,000. We could say that the cost of improving the bank's liquidity, in case of unchanged interest rates, corresponds to a reduction in its interest margin of Euro 1,016,000, but if we look at the variation in the interest rate between 2009 and 2010, we see that all the rates dropped by much the same amount (54 bp for the borrowing rate and 47 bp for interest received), except for the rate applied to the securities portfolio, which fell by 191 bp (Table 4). This variation cannot be attributed, like the other rates, to market dynamics outside the bank; the lower return is associated with the safer, more liquid securities purchased by the bank to improve its liquidity (given the liquidity-profitability trade-off), so in this specific case the bank's liquidity management also affected its lending rate, because the increase in the HQLA "Level 1" securities and the corresponding reduction in the loans to customers produced not only a variation in the masses involved, but also a reduction in the mean lending rate due to the lower returns on the securities purchased. To understand the real effects of the action taken to manage the liquidity risk, we applied the interest rate of the securities portfolio "2010" after discounting the mean effect relating to the market dynamics (approximately 20 bp), maintaining the same rate as in 2009 for all the other positions (Table 6).

[Please, insert Table 6 here]

Table 6 shows the real impact of the bank's liquidity management decisions on the interest margin. On the side of the lending rate, the worsening rates due to reducing the loans to customers was so considerable that it could not be compensated by the increase in the interest generated by the securities portfolio, leading to a total negative balance of Euro -2,915,000 that, combined with the interest paid, meant a Euro -3,371,000 shrinkage of the bank's interest

margin. This reduction can be interpreted as the price that the bank was obliged to pay to improve its liquidity. Thus, with respect to the Euro -985,000 reduction in the margin initially identified in the balance sheet, the impact of its liquidity management action would have been three times greater if it had not been mitigated by the general reduction in the interest rate due to the particular market conditions.

Effects on the interest rate risk of the banking book

The procedure established by the supervisory authorities to ascertain the exposure of the banking book to the interest rate risk was applied to the bank examined here, obtaining the results shown in Table 7 for the year 2009, and in Table 8 for 2010. In particular, the 2009 value of the aggregate positions (Euro 7,662,000) set against the regulatory capital (Euro 102,739,000) gives us an indicator of 7.46%, i.e. lower than the critical threshold (20%). This indicator substantially expresses the proportion of the capital absorbed by the interest rate risk. In 2010 the amount of regulatory capital absorbed was Euro 6,179,000, which means 6.11% of the regulatory capital (Euro 101,072,000).

[Please, insert Table 7 here]

[Please, insert Table 8 here]

[Please, insert Table 9 here]

Further analysing the indicator of exposure to the interest rate risk, we see that the reduction of the regulatory capital between 2009 and 2010 (-1.6%) would have had a negative effect because it reduced the denominator. This effect was amply balanced, however, by the improvement in the numerator, which dropped by -19.4%, enabling the global value of the

indicator to be reduced from 7.46% to 6.11%. Consequently, the improvement in the bank's liquidity position is accompanied by a reduction of its exposure to the interest rate risk. We can therefore say that, although the action on its liquidity generated a contraction of its interest margin, these actions enabled the bank to reduce the amount of capital absorbed by the interest rate risk. As shown in Drehmann *et al.* (2010), we confirm that a correlation exists between the two risks analysed that does not necessarily implicate a linear relationship, but rather a general dependence.

To further clarify how the bank's liquidity management influenced the interest rate risk, we considered the assets and liabilities, aggregated according to the supervisors' requirements to establish the bank's interest rate risk exposure in the banking book; for each time band we highlighted the changes of corresponding items and the total exposure variation. Furthermore, we determined the contribution of each time band position to the total change of the bank's interest rate risk exposure (Table 10).

[Please, insert Table 10 here]

We can see from Table 10 that the changes incurred in the bank's assets and liabilities following its adoption of a policy to improve its liquidity also favoured a reduction of the exposure to the interest rate risk.

Among the actions taken by the bank that prompted the improvement of liquidity profile, the activities that favoured the increased of the LCR were mostly characterized by the diminution of "demand and revocable" liabilities, that produces no effects on the exposure to interest rate risk, due to a null weighting factor for the related time band. The augment of HQLA, in particular within the time bands "3 to 6 months" and "6 to 12 months" and as replacement of "floating rate loans", determined an increase of the exposure to the interest rate risk that

compensated the decrease associated to the time band “up to 1 month”. Consequently, we can highlight that the improvement in the LCR had an almost null effect on the variation of bank’s interest rate exposure, as we expected taking into account the weighting factors associated with the positions with maturity up to 12 months.

We identified the most meaningful contributions to the reduction of bank’s exposure to interest rate risk by analysing the NSFR assessment. In particular, the increase of liabilities belonging to the time bands “1 to 5 years” determined the increase of the indicator, by augmenting the numerator (available amount of stable funding – ASF); on the other hand, considering the asset side of the balance sheet, we identified that the strategy of reducing the assets duration, implemented by enlarging the position with the shortest maturity and diminishing those with longest maturity, caused on that time bands the growth of the exposure to the interest rate risk. Nonetheless, the diminution of assets belonging to time bands “5 to over 20 years”, not only produced a decrease of the required amount of stable funding (RSF, the denominator of the NSFR indicator), further improving the long-term liquidity indicator, but also affected the most relevant reduction of the net exposure to the interest rate risk, counterbalancing the previous augments and determining a comprehensive negative variation (-1,483,000 Euro, Table 9).

The analysis thus shows that the actions to improve the liquidity led to a more limited exposure to the interest rate risk, and the relationship identified is presumably generally verifiable for the majority of financial intermediaries. It therefore seems feasible to claim that, among the consequences of all the actions taken by the bank to improve its liquidity profile, there is also a positive effect on the interest rate risk.

V. Conclusion

The present study aimed to ascertain whether a relationship exists between the liquidity risk and the interest rate risk of credit institutions. In particular, by means of analysis of a small Italian bank during the years 2009 and 2010, we outlined its liquidity profile, the variables that influenced its dynamics and their effect on the bank's global management, paying particular attention to the interest margin and the interest rate risk exposure of the banking book. The main findings enabled us to demonstrate that, between 2009 and 2010, the bank succeeded in modifying its liquidity profile in order to comply with the incoming constraints imposed by the Basel III Framework, and the differences recorded in the indicators between the two periods give the impression that the bank put more effort into improving its liquidity at one month than at one year. Given the trade-off between liquidity and profitability, improvements in the former are translated into a cost that penalizes the bank's operating profit (Neu *et al.* 2006). Although the interest margin remained positive in both years, it was lower in 2010 than in 2009 (-4.10%, equal to -985,000 Euro). To see how much this reduction was attributable to the actions taken to improve the bank's liquidity profile, we calculated the amounts of interest incomes and expenses for each item, monitoring how they changed. Our findings showed that the cost of the policies implemented to improve the liquidity profile, without the general reduction in the market rates occurring in 2010, would have been -3,371,000 Euro, almost 3 times higher than the reduction in the interest margin actually recorded in the balance sheet.

To determine the interest rate risk, we applied the method indicated by the Basel Committee to calculate the summary indicator of the interest rate risk on the banking book. The calculated value of the indicator was below the critical threshold of 20% in both years, and dropped from 7.46% in 2009 to 6.11% in 2010. We can therefore say that the action taken by the bank to improve its liquidity profile generated a simultaneous reduction in its exposure to

the interest rate risk. In short, although the action taken to reduce its liquidity risk also lowered its interest margin, it enabled the bank to reduce the amount of capital absorbed by the interest rate risk, giving rise to a globally positive effect.

The analyses conducted so far enable us to say that the costs of implementing a policy of liquidity risk reduction could be compensated by lower capital absorption in terms of interest rate risk. Moreover, the "flight to liquidity" strategy could be particularly suitable in presence of particular trends of the market rates, and may appreciably contribute to improve bank's stability and activity.

Although these assessments relate to specific features of the bank investigated, they are applicable to the majority of financial intermediaries, given that their liquidity risk and interest rate risk always originate from maturity transformation activities, so any action to improve the synchronization of the expiries has a positive effect on both the liquidity risk and the interest rate risk. The future developments of our research will aim to amplify the sample of banks analysed, and to identify the quantitative relationship between these two types of risk, in order to recognize an integrated model for the assessment and management of banking risk.

On the whole, our analysis confirms the hypothesis of a link not only between the liquidity risk and the other banking risks, and the interest rate risk on the banking book in particular, but also with the other main dimensions of a bank's activities, revealing the need to arrive at an integrated risk management in which the control of each of these risks is placed in relation to the bank's different functions and influences its strategic decisions.

Appendix A

Table 1: Balance Sheet "liquidity indicators compliant" of the bank analysed (2009-2010)

ITEMS	12.31.09 (a)	%09 (b)	12.31.10 (c)	%10 (d)	Δ (%)
ASSETS	**1,061,257**	**100.0**	**1,069,658**	**100.0**	**0.8**
LOANS AND RECEIVABLES WITH BANKS	**10,917**	**1.1**	**22,653**	**2.1**	**107.5**
LOANS AND RECEIVABLES WITH CUSTOMERS	**909,992**	**87.7**	**852,816**	**79.7**	**-6.3**
- DEMAND AND REVOCABLE	254,551	24.5	209,181	19.6	-17.8
- MORTGAGES (FLOATING RATE)	507,035	48.9	498,667	46.6	-1.7
- MORTGAGES (FIXED RATE)	127,184	12.3	109,253	10.2	-13.8
- BAD LOANS	20,053	1.9	33,995	3.2	69.5
SECURITIES	**77,257**	**7.4**	**136,764**	**13.1**	**77.0**
- FLOATING RATE	50,137	4.8	124,727	11.9	148.8
- FIXED RATE	26,070	2.5	10,427	1.0	-60.0
PROPERTIES	**23,915**	**2.3**	**25,302**	**2.4**	**5.8**
INSENSITIVE ASSETS	**39,176**	**3.8**	**32,123**	**3.0**	**-0.1**
LIABILITIES	**955,475**	**100.0**	**996,148**	**100.0**	**4.3**
LIABILITIES TO BANKS	**4367**	0.5	**2573**	0.3	**-41.1**
LIABILITIES TO CUSTOMERS	**422,180**	**44.2**	**447,480**	**44.9**	**6.0**
- REPO TO CUSTOMERS	3021	0.3	1993	0.2	-34.0
DEBT-LIKE INSTRUMENTS	**495,724**	**51.9**	**501,734**	**50.4**	**1.2**
- INSTRUMENTS (FLOATING RATE)	344,308	36.0	280,956	28.2	-18.4
- INSTRUMENTS (FIXED RATE)	151,416	15.8	220,778	22.2	45.8
INSENSITIVE LIABILITIES	**33,204**	**3.5**	**44,361**	**4.5**	**33.6**
DERIVATIVES	**13,170**	**100.0**	**12,464**	**100.0**	**-5.4**

Note: (a) and (c) are expressed in thousands of Euro.
Source: own elaboration with balance sheet data.

Table 2: LCR and NSFR (2009-2010)

2009			2010			Δ (bp)
LCR =	**0.557 =**	77,208 / 138,726	**LCR =**	**1.273 =**	131,095 / 102,943	71.6
NSFR=	**0.998 =**	917,622 / 919,718	**NSFR =**	**1.072 =**	943,590 / 880,316	7.4

Note: numerators and denominators are expressed in thousands of Euro.
Source: own elaboration with balance sheet data.

Table 3: Interest Margin (IM) 2009-2010

	2009	2010	Δ(%)
a) Interest and similar income	41,334	36,227	-12.36
b) Interest and similar expenditure	17,314	13,192	-23.81
IM (a-b)	24,020	23,035	-4.10

Note: in thousands of Euro unless otherwise indicated.
Source: own elaboration with balance sheet data.

Table 4: Interest Margin (IM) by item (2009-2010)

ITEMS	2009			2010			Δ	
	r (%)	IT	I	r (%)	IT	I	Δr	ΔIT
a) ASSETS	**3.72**	**977,949**	**41,334**	**3.25**	**978,238**	**36,227**	**-0.47**	**289**
LOANS AND RECEIVABLES WITH BANKS	1.08	10,917	118	0.88	22,653	199	-0.20	11,736
DEMAND AND REVOCABLE	5.16	254,551	13,127	4.81	209,181	10,062	-0.35	-45,370
MORTGAGES	3.78	481,885	18,225	3.57	481,189	17,178	-0.21	-696
UNSECURED LOANS	4.65	105,975	4926	4.51	96,709	4360	-0.14	-9266
SECURITIES	4.40	77,257	3399	2.49	136,764	3405	-1.91	59,507
OTHER (SUBSIDIES AND BILLS DISCOUNTING)	3.25	47,364	1539	3.22	31,742	1022	-0.03	-15,622
b) LIABILITIES	**1.69**	**922,271**	**17,314**	**1.15**	**951,788**	**13,192**	**-0.54**	**29,517**
LIABILITIES TO BANKS	1.46	4367	64	1.09	2573	28	-0.37	-1,794
LIABILITIES TO CUSTOMERS	1.25	417,912	5214	0.84	444,736	3732	-0.41	26,824
REPO TO CUSTOMERS	1.95	3020	59	0.99	1993	20	-0.95	-1027
DEBT LIKE INSTRUMENTS	2.43	471,942	11,463	1.88	486,378	9163	-0.55	14,436
CERTIFICATES OF DEPOSIT	2.11	23,782	502	1.59	15,356	245	-0.52	-8426
OTHER (UNPAID EXPIRED LIABILITIES)	0.94	1248	12	0.50	752	4	-0.44	-496
Interest Rate Spread and IM (a-b)	**2.03**		**24,020**	**2.09**		**23,035**	**0.06**	

Notes: thousands of Euro unless otherwise indicated; r (%) = interest rate; IT = amount of the n^{th} position; I = interest income (expense). Δr = variation in the interest rate 2010-2009. ΔIT = variation in the amount of the n^{th} position 2010-2009. ΔI = variation in the interest 2010-2009. Figures may not add up due to rounding.
Source: own elaboration with balance sheet data.

Table 5: Interest Margin (IM) by item (for the same interest rates), 2009-2010

ITEMS	2009			2010			Δ
	r (%)	IT	I	r (%)	IT	I	ΔIT
a) ASSETS	**3.72**	**977,949**	**41,334**	**3.72**	**978,238**	**40,775**	**290**
LOANS AND RECEIVABLES WITH BANKS	1.08	10,917	118	1.08	22,653	246	11,736
DEMAND AND REVOCABLE	5.16	254,551	13,127	5.16	209,181	10,787	-45,370
MORTGAGES	3.78	481,885	18,225	3.78	481,189	18,199	-696
UNSECURED LOANS	4.65	105,975	4926	4.65	96,709	4495	-9266
SECURITIES	4.40	77,257	3399	4.40	136,764	6016	59,507
OTHER (SUBSIDIES AND BILLS DISCOUNTING)	3.25	47,364	1539	3.25	31,742	1032	-15,622
b) LIABILITIES	**1.69**	**922,271**	**17,314**	**1.69**	**951,788**	**17,771**	**29,517**
LIABILITIES TO BANKS	1.46	4367	64	1.46	2573	38	-1794
LIABILITIES TO CUSTOMERS	1.25	417,912	5214	1.25	444,736	5549	26,824
REPO TO CUSTOMERS	1.95	3020	59	1.95	1993	39	-1027
DEBT LIKE INSTRUMENTS	2.43	471,942	11,463	2.43	486,378	11,814	14,436
CERTIFICATES OF DEPOSIT	2.11	23,782	502	2.11	15,356	324	-8426
OTHER (UNPAID EXPIRED LIABILITIES)	0.94	1248	12	0.94	752	7	-496
Interest Rate Spread and IM (a-b)	**2.03**		**24,020**	**2.03**		**23,004**	

Notes: in thousands of Euro unless otherwise indicated; r (%) = interest rate; IT = amount of the n^{th} position; I = interest income (expense). ΔIT = variation in the amount of the n^{th} position 2010-2009. ΔI = variation in the interest 2010-2009.
Source: own elaboration with balance sheet data.

Table 6: Interest Margin (IM) by item (with the same interest rates, except for "securities") 2009-2010

ITEMS	2009			2010			Δ
	r (%)	IT	I	r (%)	IT	I	ΔIT
a) ASSETS	**3.72**	**977,949**	**41,334**	**3.43**	**978,238**	**38,419**	**291**
LOANS AND RECEIVABLES WITH BANKS	1.08	10,917	118	1.08	22,653	246	11'736
DEMAND AND REVOCABLE	5.16	254,551	13'127	5.16	209,181	10,787	-45,370
MORTGAGES	3.78	481,885	18,225	3.78	481,189	18,199	-696
UNSECURED LOANS	4.65	105,975	4926	4.65	96,709	4495	-9266
SECURITIES	**4.40**	**77,257**	**3399**	**2.68**	**136,764**	**3661**	**59,507**
OTHER (SUBSIDIES AND BILLS DISCOUNTING)	3.25	47,364	1539	3.25	31,742	1032	-15,622
b) LIABILITIES	**1.69**	**922,271**	**17,314**	**1.69**	**951,788**	**17,771**	**29,518**
LIABILITIES TO BANKS	1.46	4367	64	1.46	2573	38	-1794
LIABILITIES TO CUSTOMERS	1.25	417,912	5214	1.25	444,736	5549	26,824
REPO TO CUSTOMERS	1.95	3020	59	1.95	1993	39	-1027
DEBT LIKE INSTRUMENTS	2.43	471,942	11,463	2.43	486,378	11,814	14,436
CERTIFICATES OF DEPOSIT	2.11	23,782	502	2.11	15,356	324	-8426
OTHER (UNPAID EXPIRED LIABILITIES)	0.94	1248	12	0.94	752	7	-496
Interest Rate Spread and IM (a-b)	**2.03**		**24,020**	**1.74**		**20,648**	

Notes: in thousands of Euro unless otherwise indicated; r (%) = interest rate; IT = amount of the n^{th} position; I = interest income (expense). ΔIT = variation in the amount of the n^{th} position 2010-2009. ΔI = variation in the interest 2010-2009.
Source: own elaboration with balance sheet data.

Table 7: Interest rate risk of the banking book (2009)

Exposures (Euro and different currencies)				Assumed positive shock (+200 bp)				Assumed negative shock (-200 bp)		
Time bands	Assets (A)	Liabilities (B)	Net exposures (A) - (B)	Proxy of modified duration (years) (a)	Assumed interest rate shock (b)	Weighting factor (a) • (b)	Weighted exposures	Proxy of modified duration (years) (a)	Assumed interest rate shock (b)	Weighting factor (a) • (b)
Demand and revocable	283,875	464,500	-180,625	0.00	200 bp	0.00%	-	0.00	-200 bp	0.00%
Up to 1 month	471,129	19,251	451,878	0.04	200 bp	0.08%	362	0.04	-200 bp	-0.08%
From 1 to 3 months	72,837	162,533	-89,696	0.16	200 bp	0.32%	-287	0.16	-200 bp	-0.32%
From 3 to 6 months	74,435	199,495	-125,060	0.36	200 bp	0.72%	-900	0.36	-200 bp	-0.72%
From 6 to 12 months	10,769	11,471	-702	0.71	200 bp	1.42%	-10	0.71	-200 bp	-1.42%
From 1 to 2 years	13,907	19,319	-5412	1.38	200 bp	2.76%	-149	1.38	-200 bp	-2.76%
From 2 to 3 years	10,617	64,417	-53,800	2.25	200 bp	4.50%	-2421	2.25	-200 bp	-4.50%
From 3 to 4 years	10,395	859	9536	3.07	200 bp	6.14%	586	3.07	-200 bp	-6.14%
From 4 to 5 years	9943	12,166	-2,223	3.85	200 bp	7.70%	-171	3.85	-200 bp	-7.70%
From 5 to 7 years	30,334	1707	28,627	5.08	200 bp	10.16%	2909	5.08	-200 bp	-10.16%
From 7 to 10 years	12,942	2664	10,278	6.63	200 bp	13.26%	1363	6.63	-200 bp	-13.26%
From 10 to 15 years	19,043	3429	15,614	8.92	200 bp	17.84%	2786	8.92	-200 bp	-17.84%
From 15 to 20 years	12,030	1440	10,590	11.21	200 bp	22.42%	2374	11.21	-200 bp	-22.42%
Over 20 years	4981	281	4700	13.01	200 bp	26.02%	1223	13.01	-200 bp	-26.02%
TOTAL	**1,037,237**	**963,532**	**73,705**				**7662**			
Total Interest Rate Risk Exposure (IRRE) =				**7662**						
Regulatory Capital (RC) =				**102,739**						
Interest Rate Risk Indicator (IRRI) = IRRE/RC =				**7.46%**						

Note: in thousands of Euro unless otherwise indicated.
Source: own elaboration with balance sheet data.

Table 8: Interest rate risk of the banking book (2010)

Exposures (Euro and different currencies)				Assumed positive shock (+200 bp)				Assumed negative shock (-200 bp)		
Time bands	Assets (A)	Liabilities (B)	Net exposures (A) - (B)	Proxy of modified duration (years) (a)	Assumed interest rate shock (b)	Weighting factor (a) • (b)	Weighted exposures	Proxy of modified duration (years) (a)	Assumed interest rate shock (b)	Weighting factor (a) • (b)
Demand and revocable	254,239	267,025	-12,786	0.00	200 bp	0.00%	0	0.00	-200 bp	0.00%
Up to 1 month	451,112	37,194	413,918	0.04	200 bp	0.08%	331	0.04	-200 bp	-0.08%
From 1 to 3 months	88,377	166,742	-78,365	0.16	200 bp	0.32%	-251	0.16	-200 bp	-0.32%
From 3 to 6 months	139,365	123,712	15,653	0.36	200 bp	0.72%	113	0.36	-200 bp	-0.72%
From 6 to 12 months	24,208	68,741	-44,533	0.71	200 bp	1.42%	-632	0.71	-200 bp	-1.42%
From 1 to 2 years	33,758	139,145	-105,387	1.38	200 bp	2.76%	-2909	1.38	-200 bp	-2.76%
From 2 to 3 years	26,428	90,259	-63,831	2.25	200 bp	4.50%	-2872	2.25	-200 bp	-4.50%
From 3 to 4 years	12,106	73,140	-61,034	3.07	200 bp	6.14%	-3747	3.07	-200 bp	-6.14%
From 4 to 5 years	5326	54,320	-48,994	3.85	200 bp	7.70%	-3773	3.85	-200 bp	-7.70%
From 5 to 7 years	7830	1764	6066	5.08	200 bp	10.16%	616	5.08	-200 bp	-10.16%
From 7 to 10 years	16,824	2664	14,160	6.63	200 bp	13.26%	1878	6.63	-200 bp	-13.26%
From 10 to 15 years	14,946	3115	11,831	8.92	200 bp	17.84%	2111	8.92	-200 bp	-17.84%
From 15 to 20 years	8227	955	7272	11.21	200 bp	22.42%	1630	11.21	-200 bp	-22.42%
Over 20 years	5257	159	5098	13.01	200 bp	26.02%	1326	13.01	-200 bp	-26.02%
TOTAL	**1,088,003**	**1,028,935**	**59,068**				**-6179**			
Total Interest Rate Risk Exposure (IRRE) =							**6179**			
Regulatory Capital (RC) =							**101,072**			
Interest Rate Risk Indicator (IRRI) = IRRE/RC =							**6.11%**			

Note: in thousands of Euro unless otherwise indicated.
Source: own elaboration with balance sheet data.

Table 9: Changes on the interest rate risk in the banking book (2009-2010)

	2009	2010	Δ(%)
Total Interest Rate Risk Exposure (IRRE)	7662	6179	-19.4
Regulatory Capital (RC)	102,739	101,072	-1.6
Interest Rate Risk Indicator (IRRI) = IRRE/RC (%)	7.46	6.11	

Note: in thousands of Euro unless otherwise indicated.
Source: own elaboration with balance sheet data.

Table 10: Comprehensive Effects of Liquidity Risk Management on Interest Rate Risk Exposure (2009-2010)

Δ2010-2009 / Time bands		Demand and revocable	Up to 1 month	1 to 3 months	3 to 6 months	6 to 12 months	1 to 2 years	2 to 3 years	3 to 4 years	4 to 5 years	5 to 7 years	7 to 10 years	10 to 15 years	15 to 20 years	Over 20 years	Total
Assets		**-27,582**	**-19,422**	**-8002**	**65,044**	**13,599**	**18,313**	**15,501**	**1684**	**-4634**	**-22,534**	**3826**	**-4164**	**-3828**	**275**	**28,076**
Assets like instruments	Fixed rate bonds (with prepayment option)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fixed rate bonds (other)	0	-14	-14,860	-10,033	54	0	10	-11	0	15	6303	0	-2	2456	-16,082
	Floating rate bonds	4457	0	6447	59,510	-2	0	0	0	0	0	0	0	0	0	70,412
Loans to customers	Current accounts (fixed rate)	-2627	0	0	18	941	1579	2848	238	0	-1579	0	0	0	0	1418
	Fixed rate loans (with prepayment option)	571	-1904	-664	-554	-785	-1076	-1050	-699	-470	-1111	-763	-1766	-2369	-1683	-14,323
	Other loans (fixed rate)	1346	-291	251	-211	6735	8294	11,304	-452	-663	-7371	-1714	-2390	-1457	-498	12,883
	Current accounts (floating rate)	-27,558	0	0	253	3142	3849	0	0	0	0	0	0	0	0	-20,314
	Other loans (floating rate)	-18,437	-17,060	2911	16,045	3514	5667	2389	2608	-3501	-12,488	0	-8	0	0	-18,360
Loans to banks	Fixed rate loans	14,741	-625	-1458	16	0	0	0	0	0	0	0	0	0	0	12,674
	Floating rate loans	-75	-581	-629	0	0	0	0	0	0	0	0	0	0	0	-1285
	Reserve base	0	1053	0	0	0	0	0	0	0	0	0	0	0	0	1053
Liabilities		**-197,535**	**14,786**	**-18,972**	**-75,309**	**58,760**	**120,549**	**25,943**	**72,330**	**42,160**	**0**	**0**	**0**	**0**	**0**	**42,712**
Liabilities like instruments	Fixed rate bonds (with prepayment option)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fixed rate bonds (other)	-10	-2236	-5998	-4689	17,817	70,191	-23,906	22,481	-7689	0	0	0	0	0	65,961

	Floating rate bonds	-89,462	12,637	-25,322	-83,968	16,019	498	0	0	0	0	0	0	0	0	-169,598
Deposits to customer accounts	Current accounts and deposits (fixed rate)	-1207	0	0	0	0	0	0	0	0	0	0	0	0	0	-1207
	Fixed rate deposits (other, with prepayment option)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fixed rate deposits (other)	751	0	1115	877	0	0	0	0	0	0	0	0	0	0	2743
	Current accounts and deposits (floating rate)	-226,647	4154	8308	12,462	24,924	49,849	49,849	49,849	49,849	0	0	0	0	0	22,597
	Floating rate deposits (other)	141,022	0	2653	9	0	11	0	0	0	0	0	0	0	0	143,695
Deposits by banks	Fixed rate deposits	-25	231	272	0	0	0	0	0	0	0	0	0	0	0	478
	Floating rate deposits	-22,046	0	0	0	0	0	0	0	0	0	0	0	0	0	-22,046
Other liabilities	Fixed and floating rate liabilities	89	0	0	0	0	0	0	0	0	0	0	0	0	0	89
Off-balance sheet items		**-2114**	**-3752**	**361**	**360**	**1330**	**2,261**	**411**	**76**	**23**	**-27**	**56**	**381**	**510**	**123**	**-1**
Net exposures 2009		**-180,625**	**451,878**	**-89,696**	**-125,060**	**-702**	**-5412**	**-53,800**	**9536**	**2223**	**28,627**	**10,278**	**15,614**	**10,590**	**4700**	**73,705**
Net exposures 2010		**-12,786**	**413,918**	**-78,365**	**15,653**	**-44,533**	**-105,387**	**-63,831**	**-61,034**	**-48,994**	**6066**	**14,160**	**11,831**	**7272**	**5098**	**59,068**
Δ Net exposures 2010-2009		**167,839**	**-37,960**	**11,331**	**140,713**	**-43,831**	**-99,975**	**-10,031**	**-70,570**	**-46,771**	**-22,561**	**3882**	**-3783**	**-3318**	**398**	**-14,637**
Weighting factors (±%)		*0.00*	*0.08*	*0.32*	*0.72*	*1.42*	*2.76*	*4.50*	*6.14*	*7.70*	*10.16*	*13.26*	*17.84*	*22.42*	*26.02*	
Δ Net weighted exposure for each time band		**0**	**-693**	**538**	**788**	**642**	**3058**	**5293**	**3162**	**3944**	**-3525**	**-3240**	**-4896**	**-4005**	**-2549**	**-1483**

Note: in thousands of Euro unless otherwise indicated.
Source: own elaboration with balance sheet data.

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