BANCA D'ITALIA

EUROSISTEMA

Temi di Discussione

(Working Papers)

The management of interest rate risk during the crisis: evidence from Italian banks

by Lucia Esposito, Andrea Nobili and Tiziano Ropele

September 2013

Number 933

BANCA D'ITALIA
EUROSISTEMA

Temi di discussione

(Working papers)

The management of interest rate risk during the crisis: evidence from Italian banks

by Lucia Esposito, Andrea Nobili and Tiziano Ropele

Number 933 - September 2013

The purpose of the Temi di discussione *series is to promote the circulation of working papers prepared within the Bank of Italy or presented in Bank seminars by outside economists with the aim of stimulating comments and suggestions.*

The views expressed in the articles are those of the authors and do not involve the responsibility of the Bank.

ISSN 1594-7939 (print)
ISSN 2281-3950 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

THE MANAGEMENT OF INTEREST RATE RISK DURING THE CRISIS: EVIDENCE FROM ITALIAN BANKS

by Lucia Esposito*, Andrea Nobili* and Tiziano Ropele*

Abstract

Changes in interest rates constitute a major source of risk for banks' business activity and can adversely affect their financial conditions and performance. We use a unique dataset to analyse Italian banks' exposure to interest rate risk during the crisis, relying on the standardized duration gap approach proposed by the Basel Committee. We provide evidence that banks managed their overall interest rate risk exposure by means of on-balance-sheet restructuring complemented by hedging with financial derivatives. But the complementary relationship between risk-management decisions differs significantly across banks. The different impact of a future increase in interest rates on banks' economic value will be a matter of concern for policymakers when they return to a less accommodative monetary policy stance.

JEL Classification: E43; G21.
Keywords: interest rate risk, derivatives, hedging, financial crisis.

Contents

* Bank of Italy, Economic Research and International Relations.

1. Introduction[1]

The recent financial crisis spurred central banks to react promptly with bold actions. In the euro area, the European Central Bank (ECB) reduced official policy rates to historically low levels and introduced unconventional measures to restore the monetary policy transmission mechanism after the Lehman Brothers collapse in 2008 and then, more recently, the eruption of the sovereign debt crisis.[2] During this period, heightened financial markets volatility, persistent uncertainty about the economic outlook and investors' increased risk aversion had a strong impact on the term structure of interest rates. Figure 1 reports the ECB rate on main refinancing operations and the slope of the yield curve, measured by the difference between the Italian 10-year government bond yield and 3-month Euribor. The slope of the yield curve steepened rapidly from September 2008 to early 2010 and exhibited a slight downward trend afterwards.

Unexpected changes and high volatility in the term structure of interest rates constitute an important source of risk for banks' business activity and can adversely affect their financial conditions and performance. More specifically, interest rate risk is the sensitivity of a bank's cash flows, reported earnings and economic value to changes in interest rates. It arises from the maturity mismatch between fixed-rate assets and liabilities, the different re-pricing dates of floating-rate balance sheet assets and liabilities, the imperfect correlation of interest rates for various assets and liabilities that vary at the same time but not necessarily by the same amount, the various options in banks' assets and liabilities, such as prepayment of loans or early withdrawal of funds. In extreme cases, excess risk leads to the bankruptcy and liquidation of the bank.

Beyond changes in the regulatory framework and financial markets developments, monetary policy can be a crucial factor affecting banks' interest rate risk. The most dramatic example in US history is the financial turmoil of the savings and loan (S&L) industry between 1980 and 1988, which saw more than 1,000 savings and loan associations fail and cost an estimated $150 billion. The crisis was triggered by a shift in monetary policy, when the Federal Reserve began to target monetary aggregates and let the federal funds rate move considerably.[3] The adverse impact on the US banking system originated precisely from the asset-liability mismatch of S&Ls, which had begun to fund their lending by offering very competitive market rates and eventually faced a situation in which the increases in short-term funding costs exceeded the returns on their portfolios

[1] We thank Eugenio Gaiotti, Paolo Del Giovane, Stefano Neri, Martina Bignami, Giovanni Pepe, Giuseppe Della Corte and two anonymous referees for their useful remarks and suggestions. We also benefited from the comments by the participants at the lunch seminar at the Bank of Italy. Ginette Eramo provided invaluable help in constructing the dataset used in the empirical analysis.

[2] See, for example, ECB (2011) and Cecioni et al. (2011) for a discussion of the effectiveness of unconventional monetary policy measures adopted by the ECB and the US Federal Reserve.

[3] Interest rate volatility soared. In September 1979, the federal funds target rate ranged from 11.25 to 11.75 per cent; by December 1980 it ranged between 15 and 20 per cent.

of fixed-rate mortgages. In essence, the S&L industry failed to address the risk of funding long-term loans with short-term deposits.

Banks choose their *optimal exposure* to interest rate risk and combine different strategies to achieve it. They can use on-balance-sheet restructuring in order to modify the maturity mismatch between assets and liabilities. For example, if the aim is to reduce risk exposure to an unexpected increase in interest rates, banks can reduce the share of long-term fixed-rate mortgages in favour of loans with variable rates, or shorten the maturity of new commercial loans. In theory, banks can perfectly isolate themselves from interest rate risk if the date and the amount of each scheduled asset cash inflow are matched with a corresponding liability cash outflow.

Banks can also hedge interest rate risk through interest rate derivatives, especially interest rate swaps. The main advantage of this compared with on-balance-sheet restructuring is that the hedging strategy can be implemented instantaneously. In addition, transaction costs are relatively low by comparison with the potential costs of restructuring the main balance-sheet items. A bank might have to pay a large premium to get its customers to switch from short-term to long-term deposits. Finally, hedging does not increase banks' credit risk; by contrast, switching from fixed-rate to floating-rate mortgages implies an increase in credit risk as borrowers are less likely to be able to meet the higher payments of adjustable-rate mortgages in periods of rising interest rates.

If properly managed, interest rate derivatives can also eliminate all the interest rate risk arising from the maturity mismatch. However, their use is complex and can expose banks to setup costs of a hedging program (the new staff to be hired and data and computer software to be acquired to calculate properly hedging positions) and other risks, such as the risk that the actual changes in the economic value of the hedged and the hedging assets due to a change in interest rates will differ from the expected changes – and the risk of mistakes by management that reduce the value of the bank and increase the probability of its failure.

We examine Italian banks' management of their interest rate risk during the financial crisis using a high quality data-set, to address three main questions: (i) To what extent were Italian banks exposed to interest rate risk? (ii) How did they manage this risk? (iii) What role did interest rate derivatives play in this regard?

When assessing banks' interest rate risk and its determinants, the most challenging task is to obtain a reliable measure of such risk. The vast majority of existing studies have relied on the pioneering approach of Flannery and James (1984), which measures interest rate risk by the estimated sensitivity of the bank's stock price to interest rates changes.[4] A negative and significant coefficient implies that the value of bank equity tends to decrease when interest rates rise. This

[4] See Hirtle (1997), Choi and Elyasiani (1997), Drakos (2001), Fraser et al. (2002), Saporoschenko (2002), Reichert and Shyu (2003), Au Yong et al. (2007), Ballester et al. (2009), Czaja et al. (2010), and English et al. (2012). See also Staikouras (2003) for a survey.

methodology adopts the "earnings or accounting perspective", that is to say it focuses on the risk to banks' current earnings in the near term; it has the advantage of practical feasibility but it would not be applicable for the many Italian banks that are not listed.[5]

In this paper we adopt the "economic or capital perspective" and measure Italian banks' interest rate risk following the guidelines proposed by the Basel Committee on Banking Supervision (2004, 2006). The Basel Committee included the interest rate risk computed in the banking book in the second pillar of the Basel Agreement, albeit without setting a precise capital requirement; however, it provided a number of principles regarding its measurement and management that were acknowledged by the Bank of Italy (2006) in the so-called "simplified methodology" and in more recent updates (Bank of Italy, 2010). Specifically, this methodology relies on a standardized "duration gap approach" whereby banks report their interest rate risk exposure as the potential effect of a parallel upward shift of the entire term structure of interest rates on the present value of their future cash flows. The regulatory provisions recommend that the banks should compute an overall duration gap, namely by considering the effects of interest rate changes on both the on- and off-balance-sheet items, and, since mid-2008, establish a threshold level of alert of 20 per cent for this measure.

The "economic perspective" provides a more comprehensive measurement of interest rate risk than the "earnings perspective", since the banks' future cash flow projections provide a pro forma estimate of the future income generated by their current positions. The standardized approach allows us to compute an interest rate risk measure for all Italian banking groups, including unlisted ones, thus permitting an in-depth and fair assessment of the heterogeneity across all banks.

We faced a significant trade-off between using more refined methodologies and obtaining a comprehensive picture of the exposure of the entire Italian banking system. A growing body of literature tests the robustness of the "simplified methodology". Fiori and Iannotti (2006) developed a value-at-risk model for measuring the interest rate risk on both the banking and the trading book; it is based on new duration parameters that reflect the market conditions prevailing at the time of risk evaluation and take into account a non-linearity in the relation between changes in interest rates and changes in banks' economic value. However, for the 18 largest Italian banks, their results in terms of risk evaluation were consistent with the standardized approach. Entrop et al. (2008)

[5] A different strand of literature focused on the relationship between various measures of interest rates and accounting indicators of banks' profitability, especially the net interest margin (Demirgüç-Kunt and Huizinga, 1999; English, 2002; Casolaro and Gambacorta, 2005; Albertazzi and Gambacorta, 2009; Maudos and de Guevara, 2004; Maudos and Solis, 2009; English et al., 2012). Alessandri and Nelson (2013) have recently developed a theoretical model of a monopolistically competitive bank subject to re-pricing frictions and have tested the model predictions on UK data. They found that, in the long run, both the level and the slope of the yield curve contribute positively to banks' profits. In the short run, however, an interest rate increase compresses the net interest margin consistently with the presence of loan pricing frictions.

proposed a time series accounting-based model combining time series information and different data sources that are available to regulators and external analysts. Their estimates of interest rate risk for a sub-sample of German banks are compared with those of the banks' internal risk evaluation models and have been found to explain the cross-sectional variation better than the standardized approach.

Some Italian banks, typically the large ones, also follow the indications supplied by their own internal models for risk evaluation. In this regard, the Basel Committee has recently provided an overview of the best practices used by the largest banking groups to compute the various risks that characterize their business activity, including the interest rate risk in the banking book (see Basel Committee on Banking Supervision, 2008). As for Italy, an in-depth panel analysis of the consistency between the information deriving from the internal models and that from the standardized approach is impossible because only a few large banks rely on internal models for risk evaluation.[6]

An important issue in the literature on the determinants of interest rate risk is the correct assessment of the relationship between banks' risk-management strategies. Previous studies tackled this question by regressing the "one-year maturity gap", the difference between banks' rate-sensitive assets and liabilities maturing or re-pricing within one year, on the notional value of bank interest rate derivatives, controlling for other bank-specific variables.[7] In general, they found a positive relationship, which they interpreted as evidence that banks used derivatives for speculation purposes rather than for risk hedging. However, this interpretation is open to criticism on the grounds that these authors did not have access to the granular information needed to distinguish between derivatives used for hedging purposes and those for speculation. In a study of US commercial banks, Purnanandam (2007) used a dataset with a much richer identification of hedging activities and showed that the sign of the relation is not robust among different panel specifications, thus leaving unresolved the question of whether banks use financial derivatives as a supplement to or substitute for on-balance-sheet restructuring when they manage their overall interest rate risk.

One drawback of all these studies is that the notional values of financial derivatives might not properly capture all the features of the banks' hedging strategy, as it disregards the maturity of the financial instruments and does not refer to net positions. Using this measure, we would not be able to assess if a bank takes a long or a short position in interest rate derivatives. In order to assess how

[6] As of November 2012 only 13 Italian banking groups were using internal models for interest rate risk evaluation (see the Bank of Italy's *Financial Stability Report*, No. 4, November 2012), and even these indicators cover too short a sample period for us to conduct a reliable econometric analysis.

[7] See Hirtle (1997), Schrand (1997), Reichert and Shyu (2003), Au Yong et al. (2007), Zhao and Moser (2009), Purnanandam (2007), and Ballester et al. (2009).

banks manage their overall interest rate risk, we split the total duration gap variable into its two main components. The first is the on-balance-sheet duration gap, measuring the interest rate risk managed by banks using on-balance-sheet restructuring. The second is the off-balance-sheet duration gap, which is the interest rate risk computed on the off-balance-sheet items in the banking book and indicates banks' reliance on interest rate derivatives for hedging purposes. Our measure of the off-balance-sheet duration gap has two main advantages. First, it considers the interest rate derivatives reported in the banking book, which according to the supervisory guidelines should be held for hedging purposes. Second, it is computed on the basis of banks' net positions, weighted by their time to maturity. In this regard, the off-balance-sheet duration gap provides information not only on *how much* banks relied on financial derivatives but also on *how* they used them (i.e. if banks took a long or a short position).

While it is unlikely that banks would "misclassify" their speculative activities as hedging deals, the borderline between the banking and the trading book has not yet been formally defined: some assets may be included in either book and the banks' ultimate choice often may be dictated by the different regulatory treatment rather than risk-management considerations.[8] Let us also remark that banks' exposure in the banking book, by construction, contributes to profits. In particular, "differentials from hedging derivatives" are part of net interest income, while "net hedging gains (losses)" impact on the non-interest income.[9]

We show that the Italian banking system had a limited overall exposure to interest rate risk during the financial crisis, well below the threshold alert level enforced by regulators. There was, however, substantial heterogeneity within the system, with many banks permanently exposed to the decline in interest rates and many others standing to benefit from diminishing rates. Banks relied on on-balance-restructuring and hedging with interest rate derivatives in a complementary way. However, this negative relationship between hedging strategies varied considerably across intermediaries.

We have tested the robustness of our results along a number of dimensions that may be particularly relevant in this context, such as estimation techniques treating the hedging strategies as simultaneous choices (see Purnanandam, 2007), different assumptions on the empirical distribution of overnight deposits according to their time-to-maturity (see Bank of Italy, 2010), as well as by

[8] Hedging interest rate derivatives reported in the banking book are usually classified as financial assets "available-for-sale" and rarely as financial positions "held-to-maturity".

[9] "Net hedging gains (losses)" include capital gains (losses) stemming from the recognition of derivatives designated for "fair-value hedging" together with the offsetting loss or gain on the corresponding hedged item. As for the recognition of derivatives designated for "cash-flow hedging", the effective portion of the derivative's gain or loss is initially reported outside the income statement as part of "other comprehensive income"; subsequently it is reclassified into income when the projected transaction affects earnings. The ineffective portion of the gain or loss is reported in the income statement immediately as "net hedging gains (losses)". Derivatives "held-for-trading" are evaluated at fair value and the gain or loss is recognized immediately in the income statement.

relaxing the standard assumption of a parallel shift in the term structure of interest rates, in order to deal with the anecdotal evidence that longer-term assets and liabilities are less reactive than short-term ones to monetary policy changes.

2. A measure of interest rate risk: the regulatory methodology

In this paper interest rate risk is measured using the "simplified methodology" established by the Bank of Italy (2006), which is consistent with the principles stated by the Basel Committee on Banking Supervision (2004, 2006). The regulatory provisions focus on a "duration gap approach" according to which banks' interest rate risk is measured by the effect on their economic value of a "standardized" interest rate shock, defined as a parallel shift of the entire term structure of interest rates by 200 basis points.

More specifically, the computation of a bank's interest rate risk involved the following steps: *i*) on- and off-balance-sheet items are classified into fourteen time bands according to their remaining time to maturity for fixed-rate items or to their re-pricing schedule for floating-rate items; *ii*) for each time band, assets are offset against liabilities to compute net positions; *iii*) net positions are multiplied by weighting factors reflecting the so-called modified duration, which approximates the sensitivity of the economic value of a net position to an interest rate shift for that time band; *iv*) the total interest rate risk is then calculated as the ratio of the sum of the net weighted positions to regulatory capital.

The overall duration gap (*GAP*) can be represented by the following expression:

$$GAP \equiv \frac{\Delta(NW)}{K} = \sum_{t=1}^{14} \omega_t NP_t \times \Delta shock = \underbrace{\frac{1}{1+r}\sum_{t=1}^{14} t \frac{NP_t}{(1+r(t))^t}}_{MODIFIED\ DURATION} \Delta shock \qquad (1)$$

where $\Delta(NW)$ is the change in the bank's economic value and *K* is regulatory capital. In expression (1) NP_t stands for the net positions computed in each of the 14 time bands, $\Delta shock$ is the interest rate shock and $\omega_t = t/[(1+r(t))^t(1+r)]$ represents the weighting factor (the "modified duration"). For time bands up to one year, the modified durations are those attributable to a zero-coupon bond with a time-to-maturity equal to the median point of the time band and a discount factor of 5 per cent; for the bands with time-to-maturity over one year, the modified durations are those attributable to a fixed-rate bond with a time-to-maturity equal to the median point of the time band with both a coupon rate and a discount factor of 5 per cent. Overall, the regulatory framework assumes a flat term structure of interest rates of 5 per cent for the computation of the modified duration. See Table A1 of the Appendix for more details about the weighting factors.

For our analysis we split the overall duration gap, making it the sum of the on- and off-balance-sheet duration gaps. We call banks with a positive on-balance-sheet duration gap *asset-sensitive* and those with a negative on-balance-sheet duration gap *liability-sensitive*. The duration gap is positive when the value of a bank's assets is more sensitive to a change in interest rate than that of its liabilities; it is negative when the value of liabilities is more sensitive than the value of assets. A bank with a positive (negative) duration gap would incur a loss from an increase (decrease) in interest rates.

To illustrate how the use of financial derivatives is considered in the computation of the off-balance-sheet duration gap, we sketch an example based on interest rate swaps. An interest rate swap is a contract in which one party, the fixed-rate payer, agrees to make a sequence of payments to another party, the floating-rate payer, in exchange for a sequence of payments that vary according to a reference rate (for instance, 3-month Euribor). The fixed-rate payer is said to take a long swap position and will lose when interest rates rise and gains when they fall. The floating-rate payer instead takes a short swap position and will lose when interest rates rise and gain when they fall.

Suppose that bank A proposes to bank B a three-year interest rate swap with a notional principal amount of € 2,000,000. Under the agreement bank B will pay a fixed-rate of 1.5% each year, while bank A will pay a floating-rate indexed to 3-month Euribor. The table below shows the time sequence of payments for each party in the case of a future increase in interest rates. When the contract will expire, bank B will gain € 5,000, so it hedges against the increase in interest rates

Table. An example of an interest rate swap contract

Maturity	3-month Euribor	Fixed rate	Payments to bank A	Payments to bank B	Interest rate differential	Impact on bank A	Impact on bank B
T+1	0.75	1.5	30,000	15,000	-15,000	+15,000	-15,000
T+2	1.75	1.5	30,000	35,000	+5,000	+10,000	-10,000
T+3	2.75	1.5	30,000	55,000	+25,000	-5,000	+5,000

In an economic environment in which interest rates are expected to rise, an asset-sensitive bank needs to hedge against this possibility and will take a long swap position: it will pay a fixed-rate while receiving a floating-rate on the notional amount of the swap contract. This bank will have a negative off-balance-sheet duration gap.

A liability-sensitive bank would gain from an increase in interest rates and may therefore want to insulate itself from a decrease in interest rates by taking a short swap position and becoming the floating-rate payer and the fixed-rate receiver in a swap contract. This bank will have a positive off-balance-sheet duration gap.

3. The empirical analysis

3.1. Descriptive analysis

We use a unique panel dataset of semi-annual observations for 68 Italian banking groups from the second half of 2008 through the first half of 2012. The data come from banks' supervisory reports to the Bank of Italy and are based on consolidated balance sheet items: they include the interest rate risk of foreign banks belonging to Italian banking groups, while excluding individual Italian banks that do not belong to groups. The intermediaries included in the panel account for nearly 70 per cent of the total assets of the banking system.[10]

Let us start the discussion of Italian banks' hedging strategies by presenting some descriptive statistics. In Figure 2 we show the evolution of total interest rate risk and its two components, i.e. the on- and off-balance-sheet duration gaps. Panel A suggests that during the financial crisis the overall exposure of Italian banking groups was limited and well below the 20 per cent threshold: on average, the overall duration gap was -3.3 per cent of regulatory capital. However, banks significantly modified their interest rate exposure over time. In the second half of 2008 and first half of 2009 the average overall duration gap was positive: banks had a positive on-balance-sheet duration gap, partially hedged through the use of interest rate derivatives. From the second half of 2009 onwards, when official interest rates reached unprecedented low levels and the slope of the yield curve remained very steep, banks progressively reduced their total interest rate risk, reaching, on average, a negative duration gap. It appears they managed interest rate risk mostly by reducing their on-balance-sheet positions while keeping their positions in hedging derivatives broadly stable.

However, the picture for the entire banking system disregards heterogeneity among intermediaries. In order to assess the different strategies pursued by banks, we split our panel into three groups: a) banks that exhibited a negative on-balance-sheet duration gap over the entire sample period (hereafter, *liability-sensitive banks*); b) banks that exhibited a positive on-balance-sheet duration gap over the entire sample period (hereafter, *asset-sensitive banks*); and c) banks that varied the sign of their on-balance-sheet exposure over time (hereafter, *other banks*).

Panel B shows the interest rate risk indicators for the liability-sensitive banks. In the second half of 2008 these banks' had an average overall duration gap of about -10 per cent. In the first half of 2009, as the slope of the yield curve increased, they reduced their on-balance-sheet duration gap by potentially gain from a possible future rise in interest rates. After monetary policy rates were sharply reduced, they substantially increased their on-balance-sheet duration gap and barely used interest rate derivatives.

[10] We could not take an earlier starting date because data from supervisory reports display a break between November 2008 and December 2008, owing to a change in data collection methods.

The picture for asset-sensitive banks, presented in Panel C, is very different. Over the entire period these banks also diminished their total exposure (from 20 to 11 per cent). Their risk-management strategy appears to have been to keep the on-balance-sheet duration gap set at large positive values (more than 30 per cent) and to rely largely on hedging derivatives. For these banks there is more evidence of a complementary relationship between strategies.

For other banks (Panel D) the picture is closer to that described for the entire banking system, as 38 of the 68 banks in the panel belong to this group. These banks mostly changed their interest rate risk exposure by reducing their on-balance-sheet positions.

Overall, there is evidence of significant interest rate risk management and of a negative correlation between the on and off-balance-sheet duration gaps.

Further interesting considerations emerge from Table 1, where we take other bank-specific characteristics into account. We draw these from previous empirical studies, selecting variables that may be relevant determinants of banks' interest rate risk. In particular, we consider: size (logarithm of total assets); credit quality (ratio of non-performing loans to total assets); capitalization (core tier 1 ratio, i.e. the ratio of core equity capital to total risk-weighted assets), efficiency (return on equity, operating expenses as a percentage of total assets); and the funding gap (the difference between loans outstanding and retail funds, as a ratio to loans).

Compared with liability-sensitive banks, asset-sensitive ones are generally larger and carry more credit risk in their balance sheets; in addition, they are more specialized in lending and have been more profitable, thanks in part to their lower operating expenses.

3.2. Panel regressions for the on-balance-sheet duration gap

In this section we assess the empirical relation between banks' interest rate risk-management decisions using various panel regressions. We begin with a single-equation regression in which the on-balance-sheet duration gap is the dependent variable and the off-balance-sheet duration gap and other bank-specific characteristics are the explanatory variables:

$$GAP_{it}^{on} = \beta^{on} GAP_{it}^{off} + A' \tau_t + \theta' X_{it} + \alpha_i + \varepsilon_{it}^{on} \qquad (2)$$

In equation (2) GAP_{it}^{on} is the on-balance-sheet duration gap of bank *i* in calendar half *t* and GAP_{it}^{off} is the bank's off-balance-sheet duration gap in the same period. Our preferred specification also includes a vector of time-dummy variables (τ_t), which control for general macroeconomic conditions such as the short-term interest rate, the slope of the yield curve, the volatility of market interest rates, and credit spread (see Purnanandam, 2007). The inclusion of time dummies is particularly useful as it limits a potential endogeneity problem among variables, especially between the interest rate risk indicators that may be driven by common macroeconomic factors (the short-

and long-term interest rates). We include a vector of bank-specific characteristics (X_{it}) as relevant determinants of interest rate risk decisions as well as bank-specific fixed effects (α_i) in order to deal with potential unobserved heterogeneity across banks that is not fully captured by X_{it}. In this regard, we relied on Hausman's test to check whether the bank fixed-effects were uncorrelated with the other explanatory variables, permitting us to rely on bank random effect regressions and thus improving the efficiency of the estimated coefficients.

The results for this baseline specification are reported in Table 2. In Panels (A) and (B) we present the estimated coefficients, respectively, for random-effects and fixed-effects regressions. In Panel (C) we show the results excluding the time dummies from the specifications. The estimated coefficient for the off-balance-sheet duration gap is negative and highly significant, indicating an inverse relation between banks' on-balance-sheet restructuring and their hedging decisions using derivatives. The order of magnitude of the estimated effect is very similar across all specifications. Hausman's test tends to reject the null hypothesis of no correlation between the fixed-effects and the other explanatory variables at any confidence level.

In order to examine the heterogeneity in the estimated relationship across banks, we perform the same regressions separately for each of the groups of intermediaries we discussed in the previous section. The results are reported in columns from (b) to (d). The estimated relationship between risk-management strategies differs considerably across banks: it is very weak and not statistically significant for the liability-sensitive banks, stronger for the asset-sensitive ones. Hausman's test suggests that the inclusion of fixed-effects is crucial only in the regressions for the liability-sensitive banks at the 1 per cent confidence level. This outcome, however, does not reflect the difference in the estimated coefficients for the off-balance-sheet duration gap but the change in the sign of the coefficient on the bank size in the two specifications.

As for the other bank-specific variables, two results are noteworthy. First, we find a highly significant relationship with the funding gap, suggesting a significant correlation between liquidity risk and interest rate risk: banks facing higher liquidity risk reduce their on-balance-sheet duration gap more sharply. This picture holds true for all banks of all type, though it is most pronounced for asset-sensitive ones. Second, banks with higher credit risk in their assets also reduce their on-balance-sheet duration gap more sharply. Therefore, our results corroborate the previous finding that US banks with a higher probability of default maintained a lower maturity mismatch between their assets and liabilities (see Purnanandam, 2007). The relationship between credit risk and interest rate risk is stronger and highly significant for the liability-sensitive banks, weaker for the other intermediaries. We notice that if we excluded the time dummies, the estimated coefficient would also be strongly significant and higher. During the crisis, the severe economic recession

caused a dramatic worsening in credit quality while banks' exposure to a rise in interest rate risk declined in response to the cuts in ECB official rates. A higher correlation is likely to reflect the impact of common macro factors related to the difficult economic conditions.

All in all, the strong and significant link between the on-balance-sheet duration gap, liquidity risk and credit risk can be interpreted as the evidence of an integrated risk-management approach by banks. For the liability-sensitive banks, which did not rely extensively on derivatives, the substitution effect among the different risks may be particularly important.

3.3. Panel regressions for the off-balance-sheet duration gap

We now assess the determinants of banks' hedging strategy based on interest rate derivatives. In Table 3 we present the results for alternative regressions in which the off-balance-sheet duration gap is the dependent variable and the on-balance-sheet duration gap and other bank-specific characteristics are the explanatory variables. We carry out this assessment for all categories of banks, comparing random-effects and fixed-effects estimations and regressions with and without time dummies.

It turns out that the estimated relationship between the off- and on-balance sheet duration gaps is still negative and highly significant for the panel of all banks, meaning that risk-management decisions remain complementary. Consistently with the findings in Table 2, the relationship is very weak for the liability-sensitive banks and much stronger for asset-sensitive ones. Interestingly, Hausman's test suggests the use of a fixed-effect estimator for all banks except the liability-sensitive ones. Our view is that the fixed-effects may capture banks' ability to use financial derivatives or the setup costs of a hedging strategy, which are very difficult to be measured.

As for the bank size, the previous literature suggested that larger banks were more likely to engage in hedging derivatives transactions. In our case the significant coefficient suggests that larger banks hedged more against an increase in interest rates. This effect is especially strong for asset-sensitive banks compared with "other banks".

The funding gap enters significantly and with a negative sign in the case of asset-sensitive banks and "other banks": banks facing a higher liquidity risk relied more on interest rate derivatives. Interestingly, Froot et al. (1993) and Purnanandam (2007) found that US banks with a relatively low liquidity ratio (cash and securities over total assets) also made more extensive use of derivatives for hedging consequently arguing that liquid assets and derivatives were substitutes one another. In our regressions the liquidity ratio was not statistically significant. In our view, this indicator did not always reflect banks' liquidity risk; it may simply reflect a shift of portfolios

towards government bonds when their yields are considered attractive compared with return on loans to the private sector. This issue was particularly relevant during the sovereign debt crisis.

Credit risk is strongly correlated with the off-balance-sheet duration gap only in the case of the liability-sensitive banks. The relationship is much weaker for the other categories of bank.

4. Robustness checks

In this section we present the results of a number of checks on the robustness of our previous findings. In particular, we address the following issues: i) the simultaneity problem of interest rate risk hedging strategies; ii) the non-stationarity problem of the data; iii) the treatment of overnight deposits duration; and iv) the non-parallel shift of the interest rate shock.

4.1. Simultaneity among interest rate risk measures

Practical considerations suggest that banks are likely to manage their on- and off-balance-sheet interest rate risk exposures simultaneously. While the estimated single-equation regressions discussed in Section 3 provide mere correlations between the two risk-management strategies, the issue of simultaneity may raise concerns about consistency of the estimated coefficients. In this section we address this issue by modelling a system of two simultaneous equations and relying on a three-stage least squares (3SLS) estimation that also takes into account the correlation between the residuals of the two equations.

In particular, the on-balance-sheet duration gap is instrumented with its own lag, consistently with the view that frequent variations in the on-balance-sheet exposure may be costly for banks. As for the off-balance-sheet duration gap, we explore two instruments. The first is simply the bank fixed-effect, which may capture banks' ability to use derivatives or the setup costs of a hedging strategy. The second instrument is a "derivatives skill" dummy, which takes a value of 1 if a bank uses financial derivatives for both hedging and trading purposes over the entire sample period.[11] For the trading book we consider derivatives related to any possible asset (interest rates, commodities, exchange rates). Notice that, by construction, this bank-specific variable is not time-varying, thus preventing from performing a fixed-effect estimation.

The simultaneous estimation is carried out for the panel of all banks as well as for the set of banks that we classified as asset-sensitive together with "other banks". Unfortunately, we could not estimate a separate system for the asset-sensitive banks because in this case the number of observations is smaller than the number of the coefficients to be estimated. However, the potential differences in the estimated coefficients for these two categories of bank are captured by

[11] Also Purnanandam (2007) uses a similar instrument.

interaction terms between some bank-specific variables[12] and an "asset-sensitive bank" dummy. The regressions for the liability-sensitive banks are not reported because, consistently with the results obtained with single-regression techniques, we found no significant relationship between risk-management strategies.

Columns (a) and (b) of Table 4 report the results obtained using the fixed-effects as instrument for the off-balance-sheet duration gap. The negative correlation between the off- and on-balance-sheet duration gaps is confirmed and the magnitude of the estimated coefficient is similar to that obtained with a standard single-equation procedure for all groups of banks. Indeed, while the contemporaneous correlation is about -0.5, the estimated coefficient for the lagged dependent variable implies a correlation of about -0.8 after one half. These findings suggest that the simultaneity among variables is not a relevant concern for our main results.

The "derivatives-skill" dummy instead turns out to be a poor instrument (see column (a')). The main reason is that most of the banks in the panel held derivatives positions in both books, making hard to discriminate between "skilled" and "not-skilled" banks on the basis of this criterion. The picture is also complicated by the fact that some banks held positions in the trading book but not in the banking book. For example, the liability-sensitive banks did not need to hedge against the interest rate risk with derivatives during the financial crisis because an increase in interest rates was unlikely**,** but we cannot rule out that they had the requisite skill to use these instruments for speculative purposes.

Other banks, especially the asset-sensitive ones, held positions in the banking book but not in the trading book. In principle, these intermediaries could be considered as "skilled". However, in this case the resulting dummy variable would not be an appropriate instrument, since, by construction, it would be perfectly correlated with the off-balance-sheet duration gap. In other words, the information on banks' exposure in the trading book is not a reliable instrument.

4.2. Non-stationarity of the variables

Some of the variables used in the estimation might be non-stationary in the short sample period we considered. As shown in Figure 2, by eyeballing this does not seem to be the case for the interest rate risk indicators. The only variables that exhibit some systematic trend are credit quality, due to the significant increase in non-performing loans during the crisis, and the core tier 1 ratio.

In light of these considerations, we perform a robustness check by repeating all the above analyses with all the variables transformed in first-differences to rule out potential problems of spurious regressions. Interestingly enough, as shown in Table 5, the estimated relationships

[12] Namely, only those bank-specific characteristics that turn out to be individually significant.

between the on- and off-balance-sheet duration gaps are extremely robust regardless of the specific category of bank.

4.3. Changing the duration of overnight deposits

Overnight deposits do not have an explicit maturity. The regulatory framework considers 25 per cent of total overnight deposits as a "non-core" component and includes it in the "overnight" time-band; the remaining "core" component is allocated to the following eight time-bands (from "up to one month" to "over four years up to five years") in proportion to the number of months assigned to each band. For example, the time-band "up to one month" is allotted 1/60 of the core component, the time-band "over one month up to two months" 2/60, and so forth. Different distributions of overnight deposits by time-band may imply significant changes in banks' exposure to the interest rate risk.

We check the robustness of our results to two changes in the "non-core" fraction of total overnight deposits, increasing it to 50 per cent (thus considerably shortening the banks' on-balance-sheet duration gap) and decreasing it to 5 per cent (considerably lengthening the on-balance-sheet duration gap). The first case is in line with the view that overnight deposits represent a core source of funding and should therefore be treated as long-term liabilities. Conversely, the second case is consistent with the view that these deposits are subject to withdrawal at any time and should therefore be regarded as shorter-term liabilities. The recent financial crisis, raising the spectre of bank runs, has made the latter scenario even more compelling.

Table 6 shows that the Italian banking system's overall interest rate risk exposure remains limited.[13] At the same time, however, the composition by category of bank changes; in particular, the shorter the duration of overnight deposits, the larger the number of liability-sensitive banks.

In Table 7 we present the estimated coefficients for panel regressions based on the alternative measures for the on-balance-sheet duration gap under the assumption of a shorter duration of overnight deposits. The results are generally very robust. It is worth noting that the negative correlation among risk-management strategies becomes statistically significant for the liability-sensitive banks as well, albeit less so than for the other banks, and broadly in line with that obtained under the standard assumption recommended by the Basel Committee. Similarly, lengthening the duration of overnight deposits also leaves the results virtually unchanged.

[13] The banking system would incur a loss of less than 5 per cent of regulatory capital after an unexpected increase in interest rate of 200 basis points.

4.4. Non-parallel shifts on the term structure of interest rates

According to the regulatory methodology, the computation of the interest rate risk is based on a parallel shift in the term structure of interest rates. In response, however, to a monetary policy shock, long-term interest rates are typically less reactive than short-term rates.[14] This was one of the reasons for introducing refinements to the standardized methodology, such as measures of interest rate risk based on duration parameters that reflect the actual market conditions prevailing at the time of risk evaluation (Fiori and Iannotti, 2006).

In this section we check the robustness of our results by considering a non-parallel shift of the term structure. In particular, we assume that the rates at longer maturities respond by one half to the interest rate shock. The weighting scheme and the modified durations used for this exercise are reported in Table A2 of the Appendix.

Figure 3 and Table 8 suggest that the assumed interest rate shock (which affects short-term more than long-term rates) does not have any substantial effect on the overall interest rate risk exposure, which remains, on average, at 5 per cent. As for the consequences in terms of categories of bank, we find a shift towards liability-sensitive banks. The estimated regressions in this case are presented in Table 9 and indicate that our main results are also robust to this check.

5. Conclusions

In this paper we have examined how an unexpected increase in interest rates may affect banks' economic value. We have used a unique panel dataset for Italian banking groups and have assessed the heterogeneity of banks' interest rate risk exposure and their risk-management strategies, following the methodological guidelines of the Basel Committee on Banking Supervision.

We have found that the Italian banking system exhibited a limited exposure to interest rate risk during the period under review, well below the regulatory alert threshold. Italian banking groups managed their overall interest rate risk exposure by means of restructuring of on-balance-sheet assets and liabilities and hedging with financial derivatives. The two risk-management decisions complemented one another, disproving the hypothesis that banks' positions in interest rate derivatives in the banking book were aimed at speculation. In addition, we found that the interest rate risk was significantly correlated to liquidity risk, which suggests that banks followed an integrated risk-management approach during the crisis.

This overall picture conceals substantial heterogeneity across banks. The complementary relationship between interest rate risk-management decisions is especially pronounced for the asset-sensitive banks, while the correlation between liquidity risk and interest rate risk is stronger

[14] However, this does not take into account the substantial disconnect between changes in short-term rates and changes in long-term government bond yields during the sovereign debt crisis.

for the liability-sensitive banks. This different impact of an interest rate change on banks' economic value should be a matter of concern for policymakers.

Our results are likely to represent a lower bound of the negative effects of an interest rate change on banks' net worth. The regulatory duration gap indicators do not consider, by construction, the feedback effects that an increase in interest rates exert on both assets and liabilities: both the adjustment of bank interest rates and, more generally, the weakening of economic activity can lead to a decline in trading volumes, which, in turn, could have an additional negative effect on banks' profitability. Finally, these measures cannot fully take into account the higher cost of funding through the Eurosystem's two 3-year Longer-Term Refinancing Operations, resulting from their indexation to ECB official rates. Those operations supplied the largest portion of liquidity to the banks during the crisis.

References

Albertazzi, U. and L. Gambacorta (2009), Bank profitability and the business cycle, Journal of Financial Stability, 5, 393-409.

Alessandri, P. and B. Nelson (2013), Simple banking: profitability and the yield curve, Journal of Money Credit and Banking, forthcoming.

Au Yong, H., R. Faff, K. Chalmers (2009), Derivative activities and Asia-Pacific banks' interest rate and exchange rate exposures, Journal of International Financial Markets, Institutions and Money, 19, 16-32.

Ballester, L., Ferrer, R., Gonzales, C., Soto, G.M. (2009), Determinants of interest rate exposure of the Spanish banking industry, Working Paper of University of Castilla-La Mancha.

Bank of Italy (2006), New Regulations for the Prudential Supervision of banks, n. 263.

Bank of Italy (2010), New Regulations for the Prudential Supervision of banks, n. 263, an update.

Bank of Italy (2012), Financial Stability Report, No. 4, November, 2012.

Basel Committee on Banking Supervision (2004), Principles for the management and supervision of interest rate risk, Bank for International Settlements.

Basel Committee on Banking Supervision (2006), International convergence of capital measurement and capital standards: a revised framework, Bank for International Settlements.

Basel Committee on Banking Supervision (2008), Range of practices and issues in economic capital modeling, Bank for International Settlements.

Casolaro, L. and L. Gambacorta (2005), Redditività bancaria e ciclo economico, Bancaria n.3.

Cecioni, M., G. Ferrero and A. Secchi (2011), Unconventional monetary policy in theory and in practice?, Bank of Italy, Occasional Paper Series, No. 102.

Choi, J., Elyasiani, E. (1997), Derivative exposure and the interest rate and exchange rate risks of U.S. banks, Journal of Financial Services Research, 12, 267-286.

Czaja, M. G., Scholz, H. and M. Wilkens (2010), Interest rate risk rewards in stock returns of financial corporations: Evidence from Germany, European Financial Management, 16, 124-154.

Demirguç-Kunt, A., and H. Huizinga (1999), Determinants of commercial bank interest margins and profitability: some international evidence, World Bank Economic Review, 13(2), 379-408.

Drakos, K. (2001), Fixed income excess returns and time to maturity, International Review of Financial Analysis, 10(4), 431-442.

ECB (2011), Financial Markets in Early August 2011 and the ECB's Monetary Policy Measures, ECB Monthly Bulletin, September.

English, W. B. (2002), Interest rate risk and bank net interest margins, BIS Quarterly Review, December 2002, 67-82.

English, William B., Skander J. Van den Heuvel, and E. Zakrajsek (2012), Interest rate risk and bank equity valuations, Finance and Economics Discussion Series, pp. 2012-26, Board of Governors of the Federal Reserve System.

Entrop, O., Memmel, C., Wilkens, M., Zeisler, A. (2008), Analyzing the interest rate risk of banks using time series of accounting-based data: Evidence from Germany, Discussion Paper Deutsche Bundesbank, vol. 2, 01/2008.

Fiori, R. and S. Iannotti (2006), Scenario based principal component Value-at-Risk: an application to Italian bank's interest rate risk exposure, *Journal of Risk*, 9,3, 63-99.

Flannery, M. J. and C. M. James (1984), The effect of interest rate changes on the common stock returns of financial institutions, The Journal of Finance, vol. 39, pp. 1141–1153.

Fraser, D.R., Madura, J., Weigand, R.A. (2002), Sources of bank interest rate risk, The Financial Review, 37, 351-368.

Froot, K. A., D. S. Scharfstein and J. C. Stein (1993), Risk Management: Coordinating Corporate Investment and Financing Policies, *Journal of Finance*, 48, 1629-58.

Hirtle, B.J. (1997), Derivatives, portfolio composition, and bank holding company interest rate risk Exposure, *Journal of Financial Services Research* 12, 243-266.

Maudos, J. and J. F. Guevara (2004), Factors explaining the interest margin in the banking sectors of the European union, Journal of Banking and Finance, vol. 28(9), pp. 2259-2281.

Maudos, J. and L. Solis (2009), The determinants of net interest income in the Mexican banking system: an integrated model, Journal of Banking and Finance, vol. 33(10), pp. 1920-1931.

Purnanandam, A. (2007), Interest rate derivatives at commercial banks: An empirical investigation, Journal of Monetary Economics, 54, 1769-1808.

Reichert, A. and Shyu, Y. (2003), Derivative activities and the risk of international banks: a market index and var approach, International Review of Financial Analysis, 12(5), 489-511.

Saporoschenko, A. (2002), The sensitivity of Japanese bank stock returns to economic factors - An examination of asset/liability differences and main bank status, Global Finance Journal, 13, 253-270.

Schrand, C.M. (1997), The association between stock-price interest rate sensitivity and disclosure about derivative instruments. *The Accounting Review* 72, 87-109.

Staikouras S. K. (2003), The interest rate risk exposure of financial intermediaries: a review of the theory and empirical evidence, Financial Markets, Institutions and Instruments, 12(4), 257-289.

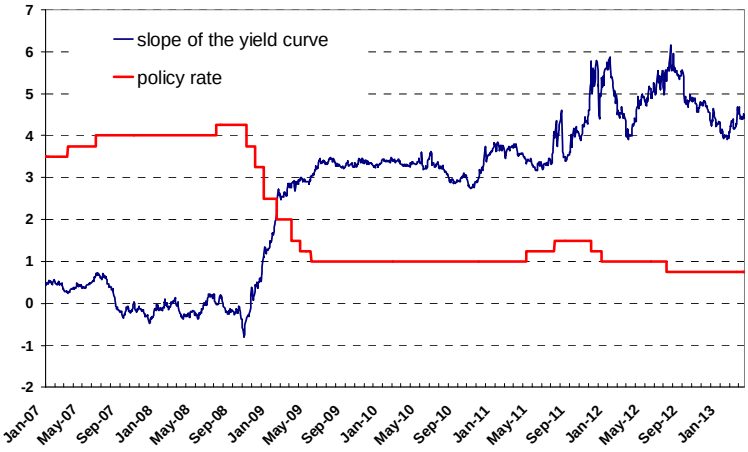
Zhao, F. and J. Moser (2009), Use of derivatives and bank holding companies interest-rate risk, Banking and Finance Review, 1, 51-62.

Figures and tables

Figure 1

Slope of the yield curve and the monetary policy interest rate

(daily data; percentage points)



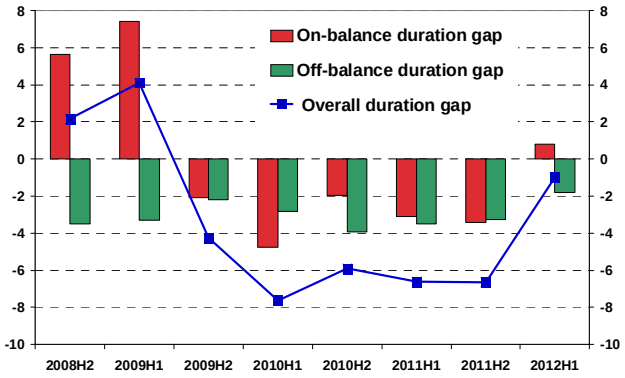
Notes. The slope of the yield curve is the difference between the yield on 10-year Italian government bonds and the 3-month money market rate. The policy rate is the rate on ECB main refinancing operations.

Figure 2

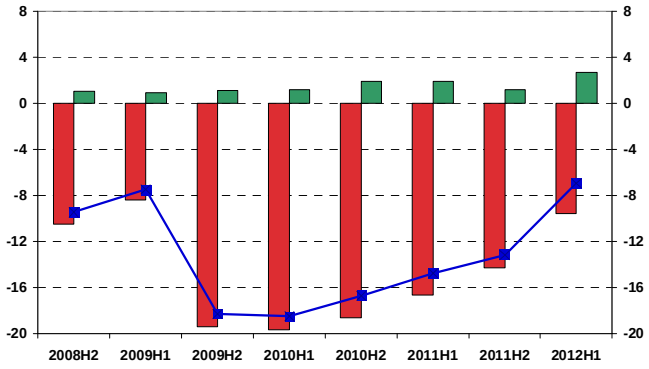
Interest rate risk exposure of Italian banking groups

(percentage points; averages values across banks)

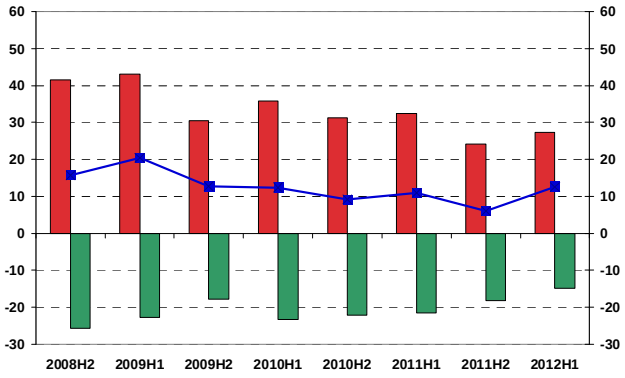
A) All banks



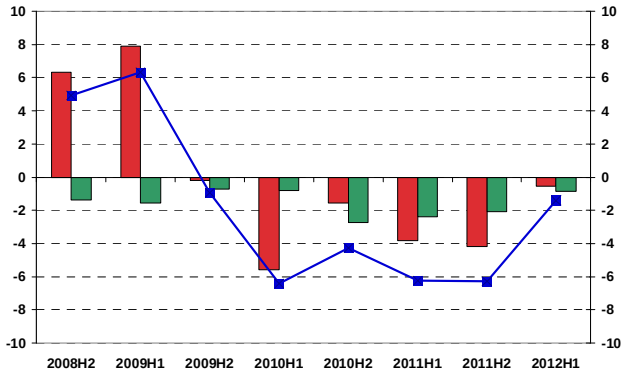
B) Liability-sensitive banks



C) Asset-sensitive banks



D) Other banks



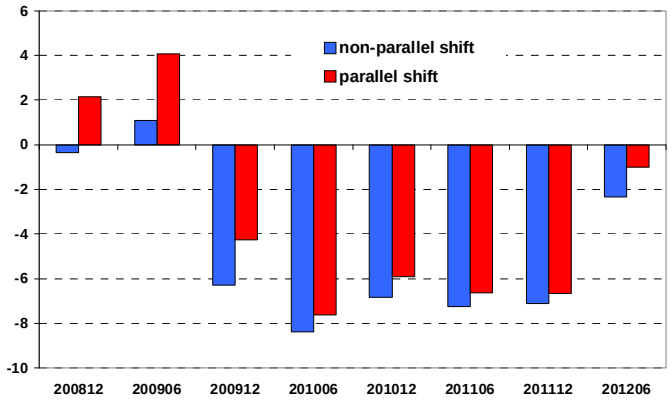
Notes. Asset-sensitive banks are those with a positive on-balance-sheet duration gap over the entire sample period; liability-sensitive banks are those with a negative on-balance-sheet duration gap over the period; other banks are those for which their on-balance-sheet duration gap changed sign at least once over the sample period.

Figure 3

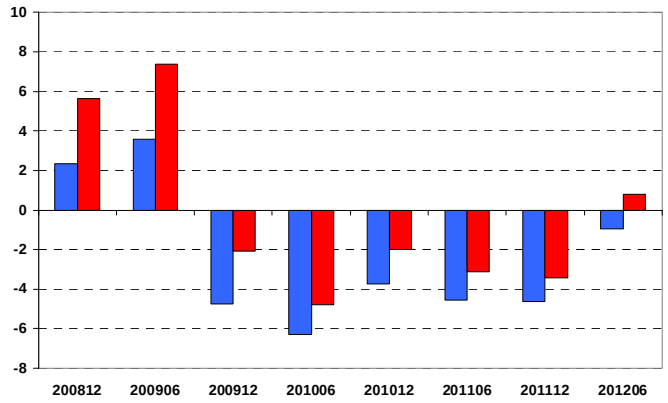
Non-parallel shift of the term structure of interest rates: Effects on Italian banking groups' exposure to interest rate risk

(percentage points; average values across banks)

a) total duration gap



b) on-balance-sheet duration gap



c) off-balance-sheet duration gap

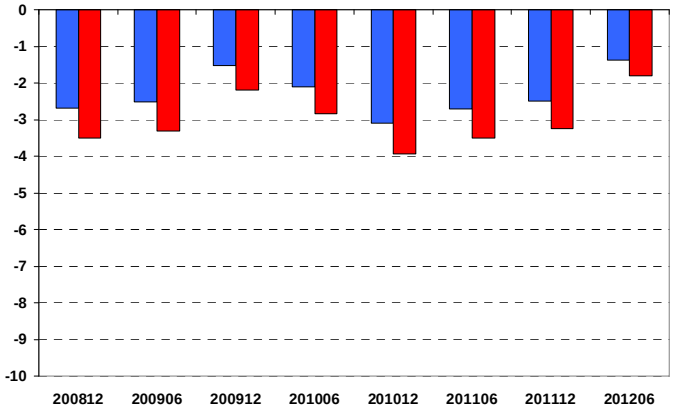


Table 1

Descriptive statistics

(average values)

	All banks	Liability-sensitive banks	Asset-sensitive banks	Other banks
Interest rate risk exposure				
On-balance duration gap	-0.3	-14.7	32.7	-0.3
Off-balance duration gap	-3.0	1.5	-20.5	-1.6
Total duration gap	-3.3	-13.2	12.3	-1.8
Other bank characteristics				
Total assets	42678	11268	59491	54127
Non-performing loans/total loans	3.9	3.0	3.9	4.3
Funding gap	-8.8	-39.3	43.1	-5.7
Tier 1 ratio	13.1	13.6	13.1	12.9
Loan-to-asset ratio	62.6	58.4	63.9	64.4
ROE	0.51	-2.11	3.31	1.18
N. banks	68	20	9	39
of which: derivatives users	56	15	7	34
N. observations	505	142	62	301

*Notes***.** Average values are computed over the period 2008H2-2012H1. *Total duration gap* is banks' exposure to interest rate risk calculated on the on- and off-balance-sheet items. *On-balance-sheet duration gap* is banks' exposure to interest rate risk calculated only on the on-balance-sheet items. *Off-balance-sheet duration gap* is banks' exposure to interest rate risk calculated only on the off-balance-sheet items. *Asset-sensitive banks* are those with a positive on-balance-sheet duration gap over the entire sample period; *liability-sensitive banks* are those with a negative on-balance-sheet duration gap over the period; *other banks* are those for which their on-balance-sheet duration gap changed sign at least once over the sample period.

Table 2

Determinants of the on-balance-sheet duration gap

	All banks	Liability-sensitive banks	Asset-sensitive banks	Other banks
	(a)	(b)	(c)	(d)
Panel A. Dependent variable: on-balance duration gap				
Off-balance duration gap	-0.892 ***	-0.189	-0.929 ***	-0.707 ***
Size	0.009	0.016 **	0.005	-0.002
Non-performing loans/total loans	0.211	1.050 ***	-1.672	0.186
Funding gap	0.043 ***	0.047 ***	-0.174 *	0.033 ***
Tier 1 ratio	0.099	0.919 ***	-0.530	-0.222
ROE	0.037	0.010	-0.175	0.013
Constant	-0.062	-0.338 ***	0.330 *	0.092
N. of observations	496	135	61	300
N. of banks	67	19	9	39
R-squared	0.275	0.530	0.624	0.213
Time dummies	yes	yes	yes	yes
Bank effects	random	random	random	random
Panel B. Dependent variable: on-balance duration gap				
Off-balance duration gap	-0.712 ***	-0.238	-1.148 ***	-0.636 ***
Size	0.044	-0.042	-0.491 **	0.053
Non-performing loans/total loans	-0.569	1.332 **	-5.139 *	-0.925
Funding gap	0.036 ***	0.042 ***	-0.609 ***	0.003
Tier 1 ratio	-0.205	0.436	-1.489	-0.312
ROE	-0.038	0.035	-0.139	-0.066
Constant	-0.305	0.199	5.569 ***	-0.349
N. of observations	496	135	61	300
N. of banks	67	19	9	39
R-squared	0.288	0.541	0.705	0.235
Time dummies	yes	yes	yes	yes
Bank effects	fixed	fixed	fixed	fixed
Hausman test (p-value)	0.17	0.01	1.00	0.88
Panel C. Dependent variable: on-balance duration gap				
Off-balance duration gap	-0.884 ***	-0.223	-0.939 ***	-0.670 ***
Size	0.010	0.018 **	0.009	-0.003
Non-performing loans/total loans	-0.222	0.709 **	-3.136 **	-0.216
Funding gap	0.038 ***	0.039 ***	-0.282 ***	0.033 ***
Tier 1 ratio	-0.026	0.924 ***	-0.838 *	-0.337
ROE	0.060	0.052	-0.189	0.024
Constant	-0.097	-0.420 ***	0.402	0.063
N. of observations	496	135	61	300
N. of banks	67	19	9	39
R-squared	0.187	0.218	0.610	0.134
Time dummies	no	no	no	no
Bank effects	random	random	random	random

Notes. The estimation is based on half-yearly observations spanning the period 2008H2 - 2012H1. The Hausman specification test compares the estimated coefficients obtained with the fixed-effect estimator with those obtained with the random-effects estimator; the null hypothesis is that the difference in the estimated coefficients is not significant. *, **, *** denote the statistical significance of the coefficient at the 1%, 5% and 10% level, respectively.

Table 3

Determinants of the off-balance-sheet duration gap

	All banks	Liability-sensitive banks	Asset-sensitive banks	Other banks
	(a)	(b)	(c)	(d)
Panel A. Dependent variable: off-balance duration gap				
On-balance duration gap	-0.311 ***	-0.039	-0.896 ***	-0.188 ***
Size	-0.010	0.006	-0.014	0.000
Non-performing loans/total loans	0.576 **	0.603 ***	-0.288	0.656 ***
Funding gap	0.007	0.002	-0.248 ***	-0.001
Tier 1 ratio	0.173	-0.035	-1.007 ***	0.264
ROE	0.040	-0.004	-0.244	0.040
Constant	0.037	-0.050	0.507 ***	-0.054
N. of observations	496	135	61	300
N. of banks	67	19	9	39
R-squared	0.218	0.146	0.563	0.185
Time dummies	yes	yes	yes	yes
Bank effects	random	random	random	random
Panel B. Dependent variable: off-balance duration gap				
On-balance duration gap	-0.205 ***	-0.043	-0.531 ***	-0.132 ***
Size	-0.127 ***	-0.024	-0.463 ***	-0.150 ***
Non-performing loans/total loans	0.058	0.764 ***	-3.586 *	0.058
Funding gap	-0.011 *	0.001	-0.463 ***	-0.072 ***
Tier 1 ratio	0.050	-0.141	-0.046	-0.172
ROE	0.059 *	-0.007	0.043	0.074 *
Constant	1.081 ***	0.203	4.860 ***	1.328 ***
N. of observations	496	135	61	300
N. of banks	67	19	9	39
R-squared	0.280	0.156	0.757	0.339
Time dummies	yes	yes	yes	yes
Bank effects	fixed	fixed	fixed	fixed
Hausman test (p-value)	0.00	0.00	1.00	0.00
Panel C. Dependent variable: off-balance duration gap				
On-balance duration gap	-0.287 ***	-0.027	-0.687 ***	-0.168 ***
Size	-0.011 *	0.007	-0.008	-0.001
Non-performing loans/total loans	0.363 *	0.595 ***	-1.802	0.416 *
Funding gap	0.003	0.002	-0.314 ***	-0.003
Tier 1 ratio	0.109	-0.036	-0.560	0.215
ROE	0.049	0.000	-0.100	0.046
Constant	0.041	-0.058	0.370	-0.054
N. of observations	496	135	61	300
N. of banks	67	19	9	39
R-squared	0.193	0.122	0.584	0.155
Time dummies	no	no	no	no
Bank effects	fixed	fixed	fixed	fixed

Notes. The estimation is based on half-yearly observations spanning the period 2008H2 - 2012H1. The Hausman specification test compares the estimated coefficients obtained using the fixed-effect estimator with those obtained using the random-effects estimator; the null hypothesis is that the difference in the estimated coefficients is not significant. *, **, *** denote the statistical significance of the coefficient at the 1%, 5% and 10% level, respectively.

Table 4

Interest rate risk-management strategies as endogenous variables

	All banks	Asset-sensitive and other banks	All banks
	(a)	(b)	(a')
Panel A. Dependent variable: on-balance duration gap			
Lag on-balance duration gap	0.516 ***	0.388 ***	1.241
Off-balance duration gap	-0.474 ***	-0.526 ***	0.971
Off-balance duration gap*Asset dummy		-0.080	0.003
Asset dummy		0.115 ***	-1.752
Size	0.002	-0.004	0.003
Non-performing loans/total loans	0.198	0.088	-1.752
Funding gap	0.032 ***	0.032 ***	0.007
Funding gap*Asset dummy		-0.090 ***	-0.020
Tier 1 ratio	0.052	-0.214	-0.020
ROE	0.026	0.015	0.037
N. of observations	429	313	429
N. of banks	66	48	66
Time dummies	yes	yes	yes
Panel B. Dependent variable: off-balance duration gap			
Bank fixed-effects as instruments	yes	yes	no
"Derivatives skill" dummy			-0.025 *
On-balance duration gap	-0.181 ***	-0.173 **	-0.671 ***
On-balance duration gap*Asset dummy		-0.372 ***	
Asset dummy		-0.141 *	
Size	-0.125 ***	-0.133 ***	0.003
Non-performing loans/total loans	0.110	0.105	1.058 ***
Funding gap	-0.014 **	-0.072 ***	0.035 ***
Funding gap*Asset dummy		-0.162 *	
Tier 1 ratio	-0.020	-0.177	0.063
ROE	0.115 ***	0.102 ***	0.005
N. of observations	429	313	429
N. of banks	66	48	66
Time dummies	yes	yes	yes

Notes. The coefficients are computed using the three-stage least-squares estimator and half-yearly observations spanning the period 2008H2-2012H1. The on-balance-sheet duration gap and the off-balance-sheet duration gap are considered as endogenous variables. As instrument for the on-balance-sheet duration gap we use its own first lag and as instrument for the off-balance-sheet duration gap we use a bank-specific "derivatives skill" dummy variable as discussed in Section 4. *, **, *** denote the statistical significance at the 1%, 5% and 10% level, respectively.

Table 5

Interest rate risk management during the financial crisis: variables expressed in first-differences

	All banks	Liability-sensitive banks	Asset-sensitive banks	Other banks
	(b)	(c)	(d)	(e)
Panel A. Dependent variable: on-balance duration gap				
Off-balance duration gap	-0.751 ***	0.129	-0.953 ***	-0.668 ***
Size	0.001	0.005	-0.002	0.002
Non-performing loans/total loans	-0.605	2.483 **	-4.351	-1.048
Funding gap	0.057 ***	0.063 ***	-0.212	0.046 *
Tier 1 ratio	-0.289	0.518 **	-0.554	-0.449
ROE	-0.058	0.112 *	0.097	-0.113
Constant	0.054	-0.006	0.068	0.039
N. of observations	427	116	52	259
N. of banks	66	18	9	39
R-squared	0.255	0.741	0.500	0.183
Time dummies	yes	yes	yes	yes
Bank effects	random	random	random	random
Panel B. Dependent variable: off-balance duration gap				
On-balance duration gap	-0.159 ***	0.020	-0.280 ***	-0.125 ***
Size	0.016	-0.024	0.373 **	0.018
Non-performing loans/total loans	0.093	0.042	-2.338	0.371
Funding gap	0.009 *	-0.002	0.465 *	-0.011
Tier 1 ratio	-0.045	-0.021	-0.150	-0.107
ROE	0.045	0.008	0.114	0.052
Constant	-0.160	0.204	-3.743 **	-0.172
N. of observations	427	116	52	259
N. of banks	66	18	9	39
R-squared	0.151	0.111	0.566	0.183
Time dummies	yes	yes	yes	yes
Bank effects	fixed	fixed	fixed	fixed

Notes. The estimation of the coefficients is based on half-yearly observations spanning the period 2008H2 - 2012H1.All variables are expressed in first-differences with the exception of bank *size*. *, **, *** denote the statistical significance at the 1%, 5% and 10% level, respectively.

Table 6

Changing the duration of deposits with unstated maturity

	Shortening the duration	Regulatory duration	Lenghtening the duration
Effects on interest rate risk:		*Average values*	
On-balance duration gap	-4.6	0.1	4.8
Off-balance duration gap	-3.1	-3.1	-3.1
Total duration gap	-7.7	-3.0	1.7
Effects on panel composition:		*Number of banks*	
Liability-sensitive banks	28	19	11
Asset-sensitive banks	6	9	18
Other banks	33	39	38

*Notes***.** Descriptive statistics are computed over the period 2008H2-2012H1. *Total duration gap* is banks' exposure to interest rate risk calculated on the on- and off-balance-sheet items. *On-balance-sheet duration gap* is banks' exposure to interest rate risk calculated only on the on-balance-sheet items. *Off-balance-sheet duration gap* is banks' exposure to interest rate risk calculated only on the off-balance-sheet items. *Asset-sensitive banks* are those with a positive on-balance-sheet duration gap over the entire sample period; *liability-sensitive banks* are those with a negative on-balance-sheet duration gap over the period; *other banks* are those for which their on-balance-sheet duration gap changed sign at least once over the sample period.

Table 7

Interest rate risk management during the financial crisis: shortening the duration of overnight deposits

	All banks	Liability-sensitive banks	Asset-sensitive banks	Other banks
	(a)	(b)	(c)	(d)
Panel A. Dependent variable: on-balance duration gap				
Off-balance duration gap	-0.866 ***	-0.208 *	-0.811 ***	-0.696 ***
Size	0.008	0.012 **	0.028	-0.001
Non-performing loans/total loans	0.347	1.075 ***	-1.859	0.116
Funding gap	0.057 ***	0.064 ***	-0.006	0.047 ***
Tier 1 ratio	0.278	1.135 ***	1.364	-0.114
ROE	0.049	0.019	0.156	0.004
N. of observations	494	199	41	254
N. of banks	67	28	6	33
R-squared	0.279	0.479	0.718	0.242
Time dummies	yes	yes	yes	yes
Bank-effects	random	random	random	random
Panel B. Dependent variable: off-balance duration gap				
On-balance duration gap	-0.185 ***	-0.062	-0.795 ***	-0.128 ***
Size	-0.132 ***	-0.042	-0.541 ***	-0.157 ***
Non-performing loans/total loans	0.078	0.684 *	-6.421 ***	0.025
Liquid assets/total assets	-0.010 *	0.001	-0.429 ***	-0.073 ***
Tier 1 ratio	0.072	0.138	-1.179	-0.202
ROE	0.061 *	0.029	-0.132	0.063
N. of observations	494	199	41	254
N. of banks	67	28	6	33
R-squared	0.262	0.085	0.914	0.371
Time dummies	yes	yes	yes	yes
Bank-effects	fixed	fixed	fixed	fixed

Notes. The estimation is based on half-yearly observations spanning the period 2008H2 - 2012H1. *, **, *** denote the statistical significance of the coefficient at the 1%, 5% and 10% level, respectively.

Table 8

Non-parallel shift of the term structure of interest rates:

	Parallel shift	Non-parallel shift
Effects on interest rate risk:	*Average values*	
On-balance duration gap	0.1	-2.4
Off-balance duration gap	-3.1	-2.3
Total duration gap	-3.0	-4.7
Effects on panel composition:	*Number of banks*	
Liability-sensitive banks	19	27
Asset-sensitive banks	9	7
Other banks	39	33

*Notes***.** Descriptive statistics are computed over the period 2008H2-2012H1. *Total duration gap* is banks' exposure to interest rate risk calculated on the on- and off-balance-sheet items. *On-balance-sheet duration gap* is banks' exposure to interest rate risk calculated only on the on-balance-sheet items. *Off-balance-sheet duration gap* is banks' exposure to interest rate risk calculated only on the off-balance-sheet items. *Asset-sensitive banks* are those with a positive on-balance-sheet duration gap over the entire sample period; *liability-sensitive banks* are those with a negative on-balance-sheet duration gap over the period; *other banks* are those for which their on-balance-sheet duration gap changed sign at least once over the sample period.

Table 9

Interest rate risk management during the financial crisis: non-parallel shifts of the term structure of interest rates

	All banks	All banks	Liability-sensitive banks	Asset-sensitive banks	Other banks
	(a)	(b)	(c)	(d)	(e)
Panel A. Dependent variable: on-balance duration gap					
Off-balance duration gap	-0.878 ***	-0.791 ***	-0.319 **	-0.882 ***	-0.821 ***
Size	0.006	-0.013	-0.176 ***	-0.559 ***	-0.004
Non-performing loans/total loans	-0.025	-0.724 *	0.605	-4.562 *	-0.823
Liquid assets/total assets	0.096	0.073	-0.048	0.416	0.049
Deposit-to-asset ratio	-0.177 ***	-0.037	-0.410 ***	1.363 ***	0.024
Tier 1 ratio	0.137	-0.189	0.563 *	-2.787 **	-0.347
Loan-to-asset ratio	0.127 ***	-0.022	0.071	0.127	-0.285 *
ROE	0.061	-0.020	0.066	-0.196	-0.070
Constant	-0.074	0.179	1.474 ***	5.655 ***	0.301
N. of observations	503	503	198	50	255
N. of banks	68	68	28	7	33
R-squared	0.269	0.285	0.392	0.853	0.282
Time dummies	yes	yes	yes	yes	yes
Bank-fixed effects	no	yes	yes	yes	yes
Panel B. Dependent variable: on-balance duration gap					
On-balance duration gap	-0.876 ***	-0.783 ***	-0.295 *	-1.054 **	-0.822 ***
Size	0.003	0.002	-0.143 ***	-0.642	0.014
Non-performing loans/total loans	-0.020	-0.467	0.294	-10.204	-0.543
Liquid assets/total assets	0.093	0.068	0.009	-0.288	0.007
Deposit-to-asset ratio	-0.170 ***	-0.046	-0.324 ***	2.170	0.062
Tier 1 ratio	0.191	-0.009	0.483 **	-2.354	-0.199
Loan-to-asset ratio	0.121 ***	0.030	0.067	-0.254	-0.170
ROE	0.055	-0.012	0.070	0.756	-0.035
Constant	-0.081	-0.033	1.186 ***	6.575	0.029
N. of observations	503	503	246	26	231
N. of banks	68	68	34	4	30
R-squared	0.287	0.301	0.315	0.935	0.332
Time dummies	yes	yes	yes	yes	yes
Bank-fixed effects	no	yes	yes	yes	yes

Notes. The estimation is based on half-yearly observations spanning the period 2008H2 - 2012H1. *, **, *** denote the statistical significance of the coefficient at the 1%, 5% and 10% level, respectively.

Appendix

Table A1

Weighting scheme for the interest rate risk measure

Time band	Median maturity expressed in months	Approximate modified duration expressed in years (A)	Interest rate shock in basis points (B)	Weighting factor (C)=(A)x(B)
overnight	0.00	0.00	200	0.00
up to 1 month	0.50	0.04	200	0.08
over 1 month and up to 3 months	2.00	0.16	200	0.32
over 3 months and up to 6 months	4.50	0.36	200	0.72
over 6 months and up to 1 year	9.00	0.71	200	1.42
over 1 year and up to 2 years	1.50	1.38	200	2.76
over 2 years and up to 3 years	2.50	2.25	200	4.50
over 3 years and up to 4 years	3.50	3.07	200	6.14
over 4 years and up to 5 years	4.50	3.85	200	7.70
over 5 years and up to 7 years	6.00	5.08	200	10.16
over 7 years and up to 10 years	8.50	6.63	200	13.26
over 10 years and up to 15 years	12.50	8.92	200	17.84
over 15 years and up to 20 years	17.50	11.21	200	22.42
over 20 years	22.50	13.01	200	26.02

Table A2

Weighting scheme for the interest rate risk measure based on non-parallel interest rate shock

Time band	Median maturity expressed in months	Approximate modified duration expressed in years (A)	Interest rate shock in basis points (non-parallel shift: Hp (a))	Interest rate shock in basis points (non-parallel shift: Hp (b))	Weighting factor (C)=(A)x(B)	Weighting factor (C)=(A)x(B)
overnight	0.00	0.00	200	200	0.00	0.00
up to 1 month	0.50	0.04	200	200	0.08	0.08
over 1 month and up to 3 months	2.00	0.16	200	200	0.32	0.32
over 3 months and up to 6 months	4.50	0.36	200	200	0.72	0.72
over 6 months and up to 1 year	9.00	0.71	200	200	1.42	1.42
over 1 year and up to 2 years	1.50	1.38	200	200	2.76	2.76
over 2 years and up to 3 years	2.50	2.25	194	188	4.36	4.22
over 3 years and up to 4 years	3.50	3.07	188	175	5.76	5.37
over 4 years and up to 5 years	4.50	3.85	181	163	6.98	6.26
over 5 years and up to 7 years	6.00	5.08	175	150	8.89	7.62
over 7 years and up to 10 years	8.50	6.63	169	138	11.19	9.12
over 10 years and up to 15 years	12.50	8.92	163	125	14.50	11.15
over 15 years and up to 20 years	17.50	11.21	156	113	17.52	12.61
over 20 years	22.50	13.01	150	100	19.52	13.01

RECENTLY PUBLISHED "TEMI" (*)

N. 905 – *Family firms and the Great Recession: out of sight, out of mind?*, by Leandro D'Aurizio and Livio Romano (April 2013).

N. 906 – *Price discovery in the Italian sovereign bonds market: the role of order flow*, by Alessandro Girardi and Claudio Impenna (April 2013).

N. 907 – *Public-private wage differentials in euro area countries: evidence from quantile decomposition analysis*, by Domenico Depalo and Raffaela Giordano (April 2013).

N. 908 – *Asking income and consumption questions in the same survey: what are the risks?*, by Giulia Cifaldi and Andrea Neri (April 2013).

N. 909 – *Credit supply during a sovereign debt crisis*, by Marcello Bofondi, Luisa Carpinelli and Enrico Sette (April 2013).

N. 910 – *Geography, productivity and trade: does selection explain why some locations are more productive than others?*, by Antonio Accetturo, Valter Di Giacinto, Giacinto Micucci and Marcello Pagnini (April 2013).

N. 911 – *Trust and preferences: evidence from survey data*, by Giuseppe Albanese, Guido de Blasio and Paolo Sestito (April 2013).

N. 912 – *Tempered stable Ornstein-Uhlenbeck processes: a practical view*, by Michele Leonardo Bianchi, Svetlozar T. Rachev and Frank J. Fabozzi (June 2013).

N. 913 – *Forward-looking robust portfolio selection*, by Sara Cecchetti and Laura Sigalotti (June 2013).

N. 914 – *When the baby cries at night. Inelastic buyers in non-competitive markets*, by Giacomo Calzolari, Andrea Ichino, Francesco Manaresi and Viki Nellas (June 2013).

N. 915 – *Local development that money can't buy: Italy's Contratti di Programma*, by Monica Andini and Guido de Blasio (June 2013).

N. 916 – *The effect of organized crime on public funds*, by Guglielmo Barone and Gaia Narciso (June 2013).

N. 917 – *Relationship and transaction lending in a crisis*, by Patrick Bolton, Xavier Freixas, Leonardo Gambacorta and Paolo Emilio Mistrulli (July 2013).

N. 918 – *Macroeconomic effects of precautionary demand for oil*, by Alessio Anzuini, Patrizio Pagano and Massimiliano Pisani (July 2013).

N. 919 – *Skill upgrading and exports*, by Antonio Accetturo, Matteo Bugamelli and Andrea Lamorgese (July 2013).

N. 920 – *Tracking world trade and GDP in real time*, by Roberto Golinelli and Giuseppe Parigi (July 2013).

N. 921 – *Should monetary policy lean against the wind? An analysis based on a DSGE model with banking*, by Leonardo Gambacorta and Federico M. Signoretti (July 2013).

N. 922 – *Marshallian labor market pooling: evidence from Italy*, by Monica Andini, Guido de Blasio, Gilles Duranton and William C. Strange (July 2013).

N. 923 – *Do euro area countries respond asymmetrically to the common monetary policy?*, by Matteo Barigozzi, Antonio M. Conti and Matteo Luciani (July 2013).

N. 924 – *Trade elasticity and vertical specialisation*, by Ines Buono and Filippo Vergara Caffarelli (July 2013).

N. 925 – *Down and out in Italian towns: measuring the impact of economic downturns on crime*, by Guido de Blasio and Carlo Menon (July 2013).

N. 926 – *The procyclicality of foreign bank lending: evidence from the global financial crisis*, by Ugo Albertazzi and Margherita Bottero (July 2013).

(*) Requests for copies should be sent to:
Banca d'Italia – Servizio Studi di struttura economica e finanziaria – Divisione Biblioteca e Archivio storico – Via Nazionale, 91 – 00184 Rome – (fax 0039 06 47922059). They are available on the Internet www.bancaditalia.it.

2010

A. PRATI and M. SBRACIA, *Uncertainty and currency crises: evidence from survey data*, Journal of Monetary Economics, v, 57, 6, pp. 668-681, **TD No. 446 (July 2002).**

L. MONTEFORTE and S. SIVIERO, *The Economic Consequences of Euro Area Modelling Shortcuts*, Applied Economics, v. 42, 19-21, pp. 2399-2415, **TD No. 458 (December 2002).**

S. MAGRI, *Debt maturity choice of nonpublic Italian firms* , Journal of Money, Credit, and Banking, v.42, 2-3, pp. 443-463, **TD No. 574 (January 2006).**

G. DE BLASIO and G. NUZZO, *Historical traditions of civicness and local economic development*, Journal of Regional Science, v. 50, 4, pp. 833-857, **TD No. 591 (May 2006).**

E. IOSSA and G. PALUMBO, *Over-optimism and lender liability in the consumer credit market*, Oxford Economic Papers, v. 62, 2, pp. 374-394, **TD No. 598 (September 2006).**

S. NERI and A. NOBILI, *The transmission of US monetary policy to the euro area*, International Finance, v. 13, 1, pp. 55-78, **TD No. 606 (December 2006).**

F. ALTISSIMO, R. CRISTADORO, M. FORNI, M. LIPPI and G. VERONESE, *New Eurocoin: Tracking Economic Growth in Real Time*, Review of Economics and Statistics, v. 92, 4, pp. 1024-1034, **TD No. 631 (June 2007).**

U. ALBERTAZZI and L. GAMBACORTA, *Bank profitability and taxation*, Journal of Banking and Finance, v. 34, 11, pp. 2801-2810, **TD No. 649 (November 2007).**

L. GAMBACORTA and C. ROSSI, *Modelling bank lending in the euro area: a nonlinear approach*, Applied Financial Economics, v. 20, 14, pp. 1099-1112 ,**TD No. 650 (November 2007).**

M. IACOVIELLO and S. NERI, *Housing market spillovers: evidence from an estimated DSGE model*, American Economic Journal: Macroeconomics, v. 2, 2, pp. 125-164, **TD No. 659 (January 2008).**

F. BALASSONE, F. MAURA and S. ZOTTERI, *Cyclical asymmetry in fiscal variables in the EU*, Empirica, **TD No. 671**, v. 37, 4, pp. 381-402 **(June 2008).**

F. D'AMURI, GIANMARCO I.P. OTTAVIANO and G. PERI, *The labor market impact of immigration on the western german labor market in the 1990s*, European Economic Review, v. 54, 4, pp. 550-570, **TD No. 687 (August 2008).**

A. ACCETTURO, *Agglomeration and growth: the effects of commuting costs*, Papers in Regional Science, v. 89, 1, pp. 173-190, **TD No. 688 (September 2008).**

S. NOBILI and G. PALAZZO, *Explaining and forecasting bond risk premiums*, Financial Analysts Journal, v. 66, 4, pp. 67-82, **TD No. 689 (September 2008).**

A. B. ATKINSON and A. BRANDOLINI, *On analysing the world distribution of income*, World Bank Economic Review , v. 24, 1 , pp. 1-37, **TD No. 701 (January 2009).**

R. CAPPARIELLO and R. ZIZZA, *Dropping the Books and Working Off the Books*, Labour, v. 24, 2, pp. 139-162 ,**TD No. 702 (January 2009).**

C. NICOLETTI and C. RONDINELLI, *The (mis)specification of discrete duration models with unobserved heterogeneity: a Monte Carlo study*, Journal of Econometrics, v. 159, 1, pp. 1-13, **TD No. 705 (March 2009).**

L. FORNI, A. GERALI and M. PISANI, *Macroeconomic effects of greater competition in the service sector: the case of Italy*, Macroeconomic Dynamics, v. 14, 5, pp. 677-708, **TD No. 706 (March 2009).**

V. DI GIACINTO, G. MICUCCI and P. MONTANARO, *Dynamic macroeconomic effects of public capital: evidence from regional Italian data*, Giornale degli economisti e annali di economia, v. 69, 1, pp. 29-66, **TD No. 733 (November 2009).**

F. COLUMBA, L. GAMBACORTA and P. E. MISTRULLI, *Mutual Guarantee institutions and small business finance*, Journal of Financial Stability, v. 6, 1, pp. 45-54, **TD No. 735 (November 2009).**

A. GERALI, S. NERI, L. SESSA and F. M. SIGNORETTI, *Credit and banking in a DSGE model of the Euro Area*, Journal of Money, Credit and Banking, v. 42, 6, pp. 107-141, **TD No. 740 (January 2010).**

M. AFFINITO and E. TAGLIAFERRI, *Why do (or did?) banks securitize their loans? Evidence from Italy*, Journal of Financial Stability, v. 6, 4, pp. 189-202, **TD No. 741 (January 2010).**

S. FEDERICO, *Outsourcing versus integration at home or abroad and firm heterogeneity*, Empirica, v. 37, 1, pp. 47-63, **TD No. 742 (February 2010).**

V. DI GIACINTO, *On vector autoregressive modeling in space and time*, Journal of Geographical Systems, v. 12, 2, pp. 125-154, **TD No. 746 (February 2010).**

L. FORNI, A. GERALI and M. PISANI, *The macroeconomics of fiscal consolidations in euro area countries,* Journal of Economic Dynamics and Control, v. 34, 9, pp. 1791-1812, **TD No. 747 (March 2010).**

S. MOCETTI and C. PORELLO, *How does immigration affect native internal mobility? new evidence from Italy,* Regional Science and Urban Economics, v. 40, 6, pp. 427-439, **TD No. 748 (March 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap spread changes before and during the subprime financial turmoil,* Journal of Current Issues in Finance, Business and Economics, v. 3, 4, pp., **TD No. 749 (March 2010).**

P. CIPOLLONE, P. MONTANARO and P. SESTITO, *Value-added measures in Italian high schools: problems and findings*, Giornale degli economisti e annali di economia, v. 69, 2, pp. 81-114, **TD No. 754 (March 2010).**

A. BRANDOLINI, S. MAGRI and T. M SMEEDING, *Asset-based measurement of poverty,* Journal of Policy Analysis and Management, v. 29, 2 , pp. 267-284, **TD No. 755 (March 2010).**

G. CAPPELLETTI, *A Note on rationalizability and restrictions on beliefs,* The B.E. Journal of Theoretical Economics, v. 10, 1, pp. 1-11,**TD No. 757 (April 2010).**

S. DI ADDARIO and D. VURI, *Entrepreneurship and market size. the case of young college graduates in Italy,* Labour Economics, v. 17, 5, pp. 848-858, **TD No. 775 (September 2010).**

A. CALZA and A. ZAGHINI, *Sectoral money demand and the great disinflation in the US,* Journal of Money, Credit, and Banking, v. 42, 8, pp. 1663-1678, **TD No. 785 (January 2011).**

2011

S. DI ADDARIO, *Job search in thick markets,* Journal of Urban Economics, v. 69, 3, pp. 303-318, **TD No. 605 (December 2006).**

F. SCHIVARDI and E. VIVIANO, *Entry barriers in retail trade*, Economic Journal, v. 121, 551, pp. 145-170, **TD No. 616 (February 2007).**

G. FERRERO, A. NOBILI and P. PASSIGLIA, *Assessing excess liquidity in the Euro Area: the role of sectoral distribution of money,* Applied Economics, v. 43, 23, pp. 3213-3230, **TD No. 627 (April 2007).**

P. E. MISTRULLI, *Assessing financial contagion in the interbank market: maximun entropy versus observed interbank lending patterns,* Journal of Banking & Finance, v. 35, 5, pp. 1114-1127, **TD No. 641 (September 2007).**

E. CIAPANNA, *Directed matching with endogenous markov probability: clients or competitors?*, The RAND Journal of Economics, v. 42, 1, pp. 92-120, **TD No. 665 (April 2008).**

M. BUGAMELLI and F. PATERNÒ, *Output growth volatility and remittances*, Economica, v. 78, 311, pp. 480-500, **TD No. 673 (June 2008).**

V. DI GIACINTO e M. PAGNINI, *Local and global agglomeration patterns: two econometrics-based indicators,* Regional Science and Urban Economics, v. 41, 3, pp. 266-280, **TD No. 674 (June 2008).**

G. BARONE and F. CINGANO, *Service regulation and growth: evidence from OECD countries*, Economic Journal, v. 121, 555, pp. 931-957, **TD No. 675 (June 2008).**

R. GIORDANO and P. TOMMASINO, *What determines debt intolerance? The role of political and monetary institutions*, European Journal of Political Economy, v. 27, 3, pp. 471-484, **TD No. 700 (January 2009).**

P. ANGELINI, A. NOBILI e C. PICILLO, *The interbank market after August 2007: What has changed, and why?*, Journal of Money, Credit and Banking, v. 43, 5, pp. 923-958, **TD No. 731 (October 2009).**

G. BARONE and S. MOCETTI, *Tax morale and public spending inefficiency*, International Tax and Public Finance, v. 18, 6, pp. 724-49, **TD No. 732 (November 2009).**

L. FORNI, A. GERALI and M. PISANI, *The Macroeconomics of Fiscal Consolidation in a Monetary Union: the Case of Italy,* in Luigi Paganetto (ed.), Recovery after the crisis. Perspectives and policies, VDM Verlag Dr. Muller, **TD No. 747 (March 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap changes before and during the subprime financial turmoil*, in Barbara L. Campos and Janet P. Wilkins (eds.), The Financial Crisis: Issues in Business, Finance and Global Economics, New York, Nova Science Publishers, Inc., **TD No. 749 (March 2010).**

A. LEVY and A. ZAGHINI, *The pricing of government guaranteed bank bonds*, Banks and Bank Systems, v. 6, 3, pp. 16-24, **TD No. 753 (March 2010).**

G. BARONE, R. FELICI and M. PAGNINI, *Switching costs in local credit markets*, International Journal of Industrial Organization, v. 29, 6, pp. 694-704, **TD No. 760 (June 2010).**

G. BARBIERI, C. ROSSETTI e P. SESTITO, *The determinants of teacher mobility: evidence using Italian teachers' transfer applications*, Economics of Education Review, v. 30, 6, pp. 1430-1444, **TD No. 761 (marzo 2010).**

G. GRANDE and I. VISCO, *A public guarantee of a minimum return to defined contribution pension scheme members,* The Journal of Risk, v. 13, 3, pp. 3-43, **TD No. 762 (June 2010).**

P. DEL GIOVANE, G. ERAMO and A. NOBILI, *Disentangling demand and supply in credit developments: a survey-based analysis for Italy,* Journal of Banking and Finance, v. 35, 10, pp. 2719-2732, **TD No. 764 (June 2010).**

G. BARONE and S. MOCETTI, *With a little help from abroad: the effect of low-skilled immigration on the female labour supply*, Labour Economics, v. 18, 5, pp. 664-675, **TD No. 766 (July 2010).**

S. FEDERICO and A. FELETTIGH, *Measuring the price elasticity of import demand in the destination markets of italian exports*, Economia e Politica Industriale, v. 38, 1, pp. 127-162, **TD No. 776 (October 2010).**

S. MAGRI and R. PICO, *The rise of risk-based pricing of mortgage interest rates in Italy*, Journal of Banking and Finance, v. 35, 5, pp. 1277-1290, **TD No. 778 (October 2010).**

M. TABOGA, *Under/over-valuation of the stock market and cyclically adjusted earnings*, International Finance, v. 14, 1, pp. 135-164, **TD No. 780 (December 2010).**

S. NERI, *Housing, consumption and monetary policy: how different are the U.S. and the Euro area?*, Journal of Banking and Finance, v.35, 11, pp. 3019-3041, **TD No. 807 (April 2011).**

V. CUCINIELLO, *The welfare effect of foreign monetary conservatism with non-atomistic wage setters*, Journal of Money, Credit and Banking, v. 43, 8, pp. 1719-1734, **TD No. 810 (June 2011).**

A. CALZA and A. ZAGHINI, *welfare costs of inflation and the circulation of US currency abroad,* The B.E. Journal of Macroeconomics, v. 11, 1, Art. 12, **TD No. 812 (June 2011).**

I. FAIELLA, *La spesa energetica delle famiglie italiane*, Energia, v. 32, 4, pp. 40-46, **TD No. 822 (September 2011).**

R. DE BONIS and A. SILVESTRINI, *The effects of financial and real wealth on consumption: new evidence from OECD countries,* Applied Financial Economics, v. 21, 5, pp. 409–425, **TD No. 837 (November 2011).**

F. CAPRIOLI, P. RIZZA and P. TOMMASINO, *Optimal fiscal policy when agents fear government default*, Revue Economique, v. 62, 6, pp. 1031-1043, **TD No. 859 (March 2012).**

2012

F. CINGANO and A. ROSOLIA, *People I know: job search and social networks*, Journal of Labor Economics, v. 30, 2, pp. 291-332, **TD No. 600 (September 2006).**

G. GOBBI and R. ZIZZA, *Does the underground economy hold back financial deepening? Evidence from the italian credit market*, Economia Marche, Review of Regional Studies, v. 31, 1, pp. 1-29, **TD No. 646 (November 2006).**

S. MOCETTI, *Educational choices and the selection process before and after compulsory school*, Education Economics, v. 20, 2, pp. 189-209, **TD No. 691 (September 2008).**

M. PERICOLI and M. TABOGA, *Bond risk premia, macroeconomic fundamentals and the exchange rate*, International Review of Economics and Finance, v. 22, 1, pp. 42-65, **TD No. 699 (January 2009).**

F. LIPPI and A. NOBILI, *Oil and the macroeconomy: a quantitative structural analysis*, Journal of European Economic Association, v. 10, 5, pp. 1059-1083, **TD No. 704 (March 2009).**

G. ASCARI and T. ROPELE, *Disinflation in a DSGE perspective: sacrifice ratio or welfare gain ratio?*, Journal of Economic Dynamics and Control, v. 36, 2, pp. 169-182, **TD No. 736 (January 2010).**

S. FEDERICO, *Headquarter intensity and the choice between outsourcing versus integration at home or abroad*, Industrial and Corporate Chang, v. 21, 6, pp. 1337-1358, **TD No. 742 (February 2010).**

I. BUONO and G. LALANNE, *The effect of the Uruguay Round on the intensive and extensive margins of trade*, Journal of International Economics, v. 86, 2, pp. 269-283, **TD No. 743 (February 2010).**

S. GOMES, P. JACQUINOT and M. PISANI, *The EAGLE. A model for policy analysis of macroeconomic interdependence in the euro area,* Economic Modelling, v. 29, 5, pp. 1686-1714, **TD No. 770 (July 2010).**

A. ACCETTURO and G. DE BLASIO, *Policies for local development: an evaluation of Italy's "Patti Territoriali"*, Regional Science and Urban Economics, v. 42, 1-2, pp. 15-26, **TD No. 789 (January 2006).**

F. BUSETTI and S. DI SANZO, *Bootstrap LR tests of stationarity, common trends and cointegration*, Journal of Statistical Computation and Simulation, v. 82, 9, pp. 1343-1355, **TD No. 799 (March 2006).**

S. NERI and T. ROPELE, *Imperfect information, real-time data and monetary policy in the Euro area*, The Economic Journal, v. 122, 561, pp. 651-674, **TD No. 802 (March 2011).**

G. CAPPELLETTI, G. GUAZZAROTTI and P. TOMMASINO, *What determines annuity demand at retirement?*, The Geneva Papers on Risk and Insurance – Issues and Practice, pp. 1-26, **TD No. 805 (April 2011).**

A. ANZUINI and F. FORNARI, *Macroeconomic determinants of carry trade activity*, Review of International Economics, v. 20, 3, pp. 468-488, **TD No. 817 (September 2011).**

M. AFFINITO, *Do interbank customer relationships exist? And how did they function in the crisis? Learning from Italy*, Journal of Banking and Finance, v. 36, 12, pp. 3163-3184, **TD No. 826 (October 2011).**

R. CRISTADORO and D. MARCONI, *Household savings in China*, Journal of Chinese Economic and Business Studies, v. 10, 3, pp. 275-299, **TD No. 838 (November 2011).**

P. GUERRIERI and F. VERGARA CAFFARELLI, *Trade Openness and International Fragmentation of Production in the European Union: The New Divide?*, Review of International Economics, v. 20, 3, pp. 535-551, **TD No. 855 (February 2012).**

V. DI GIACINTO, G. MICUCCI and P. MONTANARO, *Network effects of public transposrt infrastructure: evidence on Italian regions*, Papers in Regional Science, v. 91, 3, pp. 515-541, **TD No. 869 (July 2012).**

A. FILIPPIN and M. PACCAGNELLA, *Family background, self-confidence and economic outcomes*, Economics of Education Review, v. 31, 5, pp. 824-834, **TD No. 875 (July 2012).**

2013

F. CINGANO and P. PINOTTI, *Politicians at work. The private returns and social costs of political connections*, Journal of the European Economic Association, v. 11, 2, pp. 433-465, **TD No. 709 (May 2009).**

F. BUSETTI and J. MARCUCCI, *Comparing forecast accuracy: a Monte Carlo investigation*, International Journal of Forecasting, v. 29, 1, pp. 13-27, **TD No. 723 (September 2009).**

A. FINICELLI, P. PAGANO and M. SBRACIA, *Ricardian Selection*, Journal of International Economics, v. 89, 1, pp. 96-109, **TD No. 728 (October 2009).**

L. MONTEFORTE and G. MORETTI, *Real-time forecasts of inflation: the role of financial variables*, Journal of Forecasting, v. 32, 1, pp. 51-61, **TD No. 767 (July 2010).**

E. GAIOTTI, *Credit availablility and investment: lessons from the "Great Recession"*, European Economic Review, v. 59, pp. 212-227, **TD No. 793 (February 2011).**

A. ACCETTURO e L. INFANTE, *Skills or Culture? An analysis of the decision to work by immigrant women in Italy*, IZA Journal of Migration, v. 2, 2, pp. 1-21, **TD No. 815 (July 2011).**

G. BARONE and G. DE BLASIO, *Electoral rules and voter turnout*, International Review of Law and Economics, v. 36, 1, pp. 25-35, **TD No. 833 (November 2011).**

FORTHCOMING

M. BUGAMELLI and A. ROSOLIA, *Produttività e concorrenza estera*, Rivista di politica economica, **TD No. 578 (February 2006).**

M. BRATTI, D. CHECCHI and G. DE BLASIO, *Does the expansion of higher education increase the equality of educational opportunities? Evidence from Italy*, in R. Matoušek; D. Stavárek (eds.), Labour, **TD No. 679 (June 2008).**

A. MERCATANTI, *A likelihood-based analysis for relaxing the exclusion restriction in randomized experiments with imperfect compliance*, Australian and New Zealand Journal of Statistics, **TD No. 683 (August 2008).**

P. SESTITO and E. VIVIANO, *Reservation wages: explaining some puzzling regional patterns*, Labour, **TD No. 696 (December 2008).**

P. PINOTTI, M. BIANCHI and P. BUONANNO, *Do immigrants cause crime?*, Journal of the European Economic Association, **TD No. 698 (December 2008).**

Y. ALTUNBAS, L. GAMBACORTA and D. MARQUÉS-IBÁÑEZ, *Bank risk and monetary policy*, Journal of Financial Stability, **TD No. 712 (May 2009).**

M. TABOGA, *The riskiness of corporate bonds*, Journal of Money, Credit and Banking, **TD No. 730 (October 2009).**

F. D'AMURI, *Gli effetti della legge 133/2008 sulle assenze per malattia nel settore pubblico*, Rivista di Politica Economica, **TD No. 787 (January 2011).**

E. COCOZZA and P. PISELLI, *Testing for east-west contagion in the European banking sector during the financial crisis*, in R. Matoušek; D. Stavárek (eds.), Financial Integration in the European Union, Taylor & Francis, **TD No. 790 (February 2011).**

F. NUCCI and M. RIGGI, *Performance pay and changes in U.S. labor market dynamics*, Journal of Economic Dynamics and Control, **TD No. 800 (March 2011).**

A. DE SOCIO, *Squeezing liquidity in a "lemons market" or asking liquidity "on tap"*, Journal of Banking and Finance, **TD No. 819 (September 2011).**

O. BLANCHARD and M. RIGGI, *Why are the 2000s so different from the 1970s? A structural interpretation of changes in the macroeconomic effects of oil prices*, Journal of the European Economic Association, **TD No. 835 (November 2011).**

E. GENNARI and G. MESSINA, *How sticky are local expenditures in Italy? Assessing the relevance of the flypaper effect through municipal data*, International Tax and Public Finance, **TD No. 844 (January 2012).**

S. FEDERICO, *Industry dynamics and competition from low-wage countries: evidence on Italy*, Oxford Bulletin of Economics and Statistics, **TD No. 879 (September 2012).**

F. D'AMURI and G. PERI, *Immigration, jobs and employment protection: evidence from Europe before and during the Great Recession*, Journal of the European Economic Association, **TD No. 886 (October 2012).**