BANCA D'ITALIA

EUROSISTEMA

Temi di discussione

(Working Papers)

Credit risk-taking and maturity mismatch: the role of the yield curve

by Giuseppe Ferrero, Andrea Nobili and Gabriele Sene

April 2019

Number 1220

BANCA D'ITALIA
EUROSISTEMA

Temi di discussione

(Working Papers)

Credit risk-taking and maturity mismatch: the role of the yield curve

by Giuseppe Ferrero, Andrea Nobili and Gabriele Sene

Number 1220 - April 2019

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

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

CREDIT RISK-TAKING AND MATURITY MISMATCH: THE ROLE OF THE YIELD CURVE

by Giuseppe Ferrero*, Andrea Nobili* and Gabriele Sene*

Abstract

We study the credit-risk-taking behaviour of Italian banks in response to changes in the term structure of interest rates using a confidential dataset on new loans to non-financial firms. We find that ex-ante risk-taking is negatively related to the short end of the yield curve but positively to the long end. Banks' balance sheet conditions, as captured not only by capitalization but also by the maturity mismatch between assets and liabilities, are key to relating these findings to the theoretical literature.

JEL Classification: E30, E32, E51.
Keywords: yield curve, risk-taking channel, reach-for-yield.

Contents

* Bank of Italy, Economic Research and International Relations.

1. Introduction[1]

The decade preceding the global financial crisis has been characterized by a stable negative relation between the short-term interest rate and the slope of the yield curve in advanced economies. Since the outbreak of the financial crisis this relation has changed substantially. Decreasing natural rates of interest and unconventional monetary policies undertaken by major central banks have led to a reduction of both short- and long-term interest rates and, after the policy rates reached their effective lower bound, the slope of the yield curve progressively flattened. These are the salient features of the so-called low interest rate environment (LIRE). While a LIRE is widely perceived as the appropriate response in a deep and prolonged recession, as it reduces funding costs, eases credit conditions and expands financial wealth by increasing asset prices, many worry about its potential side-effects, especially on financial stability. Most of the concerns stem from pressures that LIRE exerts on banks' profitability and risk-taking incentives.

But are these concerns grounded? The answer is unclear. From a theoretical point of view we may distinguish three different mechanisms through which changes in the term structure of interest rates may affect the attitude of banks towards risk: according to "reach-for-yield" models (see, for example, Adrian and Shin, 2010), to the extent that banks' balance sheets are characterized by short-term liabilities and long-term assets, intermediation margins compress and profitability of bank lending reduces as the yield curve becomes flatter. As a consequence, the present value of future bank cash flows and the forward-looking measures of bank capital decrease, reducing the capacity of financial intermediaries to extend credit: the risky marginal loan made before the reduction in bank capital is not feasible under the reduced risk-bearing capacity of the bank; bank's risk-taking reduces. On the other hand, the literature on asymmetric information and monitoring (see, for example, Allen et al., 2011, and Dell'Ariccia et al., 2014) asserts that a reduction of banks' profitability weakens the incentives to screen and monitor new loans and, as a consequence, risk-taking increases (we will refer to this strand of the literature as "risk-shifting" models). A similar conclusion is reached by the literature on "search-for-yield" which claims that commitment on

[1] We thank Piergiorgio Alessandri, Carlo Altavilla, Peter Bednarek, Elena Carletti, Federico Cingano, Luisa Farinha, Giacomo Rodano, Stefano Siviero, David Zochowski and two anonymous referees for the useful comments and suggestions. We also thank participants to the lunch seminars at Banca d'Italia, the 6th Research Workshop of the MPC Task Force on Banking Analysis for Monetary Policy (Paris, 31 January-1 February 2019), the 2nd Annual Workshop of the ESCB Research Cluster on *Financial Stability, Macroprudential Regulation and Microprudential Supervision* (Frankfurt am Main, 6-7 September 2018), the 2nd Annual Workshop of the ESCB Research Cluster on *Monetary Economics* (Rome, 11-12 October 2018). The usual disclaimers apply.

target returns and managers' compensation schemes are the main reason why financial institutions increase risk-taking when profitability declines (Rajan, 2005).[2]

This paper studies banks' attitude towards credit risk when both the level and the slope of the yield curve are allowed to vary independently, thus better capturing the consequences of movements in the term structure of interest rates for banks' profitability. We achieve this by using a confidential loan-level dataset for Italian banks over a period including both "normal" and "exceptional" times and therefore allowing for very different configurations in the term structure of interest rates. Loan data are matched with detailed information on borrowers' creditworthiness as measured by the Company Accounts Data Service managed by Cerved Group, a leading information provider in Italy.

We contribute to the literature that investigates the empirical relation between banks' attitude towards credit risk and interest rates and, in this regard, we try to assess the relevance of the channels studied in the theoretical literature. Existing empirical works largely focus on the implications of changes in the short end of the term structure of interest rates, under the assumption that shifts in short-term interest rates are negatively correlated with changes in the slope of the yield curve (Borio and Zhu, 2008). Most of the analyses find a negative correlation between banks' risk-taking and short-term interest rates. The few recent works explicitly considering the full term structure do not provide conclusive evidence.[3] Maddaloni and Peydrò (2011) find a positive relationship between banks' lending standards, as captured by survey data, and the short-term rate both in the euro area and the US; the effect of the long-term interest rates, instead is model-dependent and is not robust across different specifications. Jimenez et al. (2014) use credit history information on past doubtful loans from the Spanish credit register between 2002 and 2008 as an ex-ante measure of firms' creditworthiness and find a negative relationship with the overnight risk-free rate; the long-term interest rate, as measured by Spanish government bond yields, has no significant effect on risk-taking when replacing the short-term interest rate in the regressions. Paligorova and Santos (2012) focus on the cost of credit in the US between 1990 and 2008 and conclude that loan spreads applied by banks to riskier firms become relatively smaller in response to a decrease in short-term interest rates and to an increase in long-term rates. Dell'Ariccia et al. (2017) use loan-level data on internal banks' ratings from the Federal Reserve's Survey of Terms of Business Lending over the period 1997 to 2011 and find that the riskiness of banks' loan portfolio is

[2] Despite the terms "reach-for-yield", "risk-shifting" and "search-for-yield" are often used interchangeably in the literature, in the remaining of this paper we will use them to identify the three different mechanisms through which changes in the slope of the yield curve may affect profitability and risk-taking behaviors.

[3] Since we are interested on how risk-taking behaviour changes in response to movements in the term structure, we refer only to the strand of the literature on ex-ante measures of risk-taking.

negatively associated with short-term interest rates. The term-spread between 10-year and one-year Treasury yields is introduced as a control in the model specification and has no significant effect on banks' risk-taking. Finally, Bonfim and Soares (2018) also explore various issues related to the risk-taking channel in Portugal but focus only on the effects of changes in the short-term interest rate.

The "missing evidence" of a clear and robust effect of changes in the yield curve components other than the short-term interest rate on risk-taking, notwithstanding the insights from the theoretical literature and the relevance in the policy debate, may be related to several explanations. First, the choice of the sample period may play an important role. Studies that include contemporaneously both the short-term interest rate and the slope of the yield curve and focus on periods in which the two components are almost perfectly collinear may not be able to identify their effects separately. For example, in the US the correlation between these two components of the term structure increased from -0.65 in the 90s to about -0.95 between the beginning of the 2000s and the outbreak of the global financial crisis (the period in which most of the empirical analyses focus). Afterwards, the correlation declined to -0.5, as a consequence of the reduction of the natural rate of interest, the policy rates reaching their effective lower bound and the implementation of unconventional monetary policy measures. For works focusing on euro-area countries, the issue of multicollinearity could be less relevant as the correlation between the slope – measured by the spread between the 10-year IRS and the EONIA – and the level of the yield curve declined from -0.8 in the period between the beginning of the 2000s and the outbreak of the global financial crisis, to -0.2 thereafter.

A second possible explanation is the granularity of the dataset. Analyses that cannot fully control for borrower- or loan-specific characteristics may provide unreliable results on the statistical significance of some of the estimated coefficients. A similar concern rises from the omission of time-varying bank-specific characteristics which cannot be captured by bank fixed-effects. The maturity mismatch between assets and liabilities, and the related exposure to interest rate risk play an important role in the relationship between the slope of the yield curve and banks' risk-taking. To the extent that banks' maturity mismatch varies across banks and time and the model specification does not take into account the heterogeneity in banks' exposure to interest rate risk, the effect of the long-term interest rates on profitability and on risk-taking may be biased.

In this paper we address the aforementioned issues. The quality and the granularity of our dataset are appealing in a number of aspects, thus improving upon previous literature. First, we consider as the ex-ante measure of credit risk the Z-score assigned by Cerved Group – the leading Information Provider in Italy on firms creditworthiness and one of the major rating agencies in

Europe – to each borrower. The Z-score is a mapping of the probability of firm default over the following two years into risk ratings and it has been previously used to assess heterogeneity in credit supply over the business cycle (Rodano et al., 2018), during the financial crisis (Albertazzi and Marchetti, 2010; Albareto and Finaldi Russo, 2012; Bonaccorsi and Finaldi Russo, 2017) and to test the "zombie lending" hypothesis in the case of Italy (Schivardi, Sette and Tabellini, 2017). Compared to the ex-ante measures of risk-taking used in Jimenez et al. (2014), where "risky" firms are those that in the four previous years had one or more nonperforming loans, the Z-score is based on a larger set of balance sheet characteristics and has a perspective approach. With respect to the measure adopted in Dell'Ariccia et al. (2017), the Z-score is a firm-specific measure of riskiness, not bank- nor loan-specific. On the one side, this allows us to isolate the credit score from bank-specific characteristics and, therefore, it allows an easier comparison of the measure of credit risk across banks; on the other side, by looking only at the Z-score we are not able to directly discriminate between other risk components of the loan. However, recent empirical analyses, such as Dell'Ariccia et al. (2017), show that loan characteristics explain a very small portion of the variation in loan risk ratings, implying that the most relevant component is borrower's riskiness. Moreover, since the credit register data include information about loan-specific characteristics such as maturity, amount granted and frequency of repricing, we can control for loan-level factors that may affect the ex-ante risk assessment at the time the loan is granted.

Second, we rely on supervisory reports to obtain bank-specific variables that are used to investigate heterogeneous effects across banks of a change in the slope of the yield curve. We focus on the duration gap between assets and liabilities as the main source of bank heterogeneity. In Section 2.2 we describe the details on how this measure is computed; to a large extent, banks with a majority of long-term fixed-rate assets and short-term floating-rate liabilities exhibit larger duration gap; those with short-term floating-rate assets and long-term fixed-rate liabilities are characterized by smaller (and in some cases negative) duration gaps. This balance sheet feature has not been explored in previous analyses on banks' risk-taking, although it is commonly used by supervisors in stress test scenarios in order to assess the sensitivity of the market value of the financial institution's net worth to changes in market interest rates. Since the slope of the yield curve is indicative of the marginal gain or loss of an extra amount of lending on intermediaries' balance sheet, a steepening of the curve increases profitability of financial institutions with large duration gaps relatively more than profitability of those with small duration gaps. The "reach-for-yield" channel would imply, therefore, that banks with larger duration gap increase relatively more credit risk-taking when the slope of the yield curve steepens; "risk-shifting" and "search-for-yield" motives, instead, would suggest that those same banks take on relatively more credit risk when the yield curve flattens. All in all, the relationship between banks' risk-taking and the slope of the yield curve could be negative or positive depending on the relevance of the different channels on play but, in any case, the impact would be larger for banks with relatively larger duration gaps.

As an additional source of banks' heterogeneity we look at bank capital. Previous empirical analyses on the role of bank capital on risk-taking provide mixed evidence and have been confined to assess the heterogeneity in the effects of the short-term rate. Jiménez et al. (2014) show that, in the case of Spain, lowly capitalized banks grant relatively more loan applications to ex-ante risky firms than highly capitalized banks in response to a reduction in the overnight rate. Dell'Ariccia et al. (2017) instead find that more capitalized banks are more engaged in risk-taking behaviour when the Federal funds rate is lowered in the United States. Since the relationship between market rates, credit risk-taking and banks' capitalization could also depend on banks' duration gap, we re-assess the role of bank capital for credit risk-taking. According to the "reach-for-yield" channel among banks with large duration gaps, those that would benefit the most from a steepening of the yield curve are the low capitalized ones: banks that were lowly capitalized before the steepening of the yield curve, are also those with tighter capital constraints; for these banks, the increase in profitability due to the steepening of the yield curve not only increases the forward-looking measures of bank capital, but it also relaxes the capital constraint and increases relatively more the marginal benefit from providing the additional risky loan. The opposite holds true for the "risk-shifting" theories that consider bank capital as a measure for bank agency problems (Holmstrom and Tirole, 1997): when profitability reduces the increase in risk-taking is greater the more severe the agency problem is (i.e. the more levered the bank; Allen et al., 2011, and Dell'Ariccia et al., 2014); therefore among banks with larger duration gap those that increase relatively more risk-taking in response to a flattening of the yield curve should be the low capitalized ones. Finally according to the "search-for-yield" mechanism (Rajan, 2005), banks with relatively larger duration gap take on more risk in response to a flattening of the yield curve, which reduces profitability and increases the probability of default on target returns and managers' compensation schemes; among banks with large duration gap those that have more capacity to take more risk, i.e. the more capitalized ones, will increase relatively more the credit risk. Table 1 provides a summary of the expected effects of changes in the slope of the yield curve on risk-taking according to the different channels through which changes in the slope of the yield curve may affect risk-taking behaviour, taking into account heterogeneity in terms of duration gap and capital ratio.

The main results are the following. First, to the best of our knowledge, our paper is the first to present robust evidence of a positive and significant relationship between the slope of the yield curve and banks' risk-taking. The magnitude of the estimated effects corroborates the view that the level of interest rates is an important driver of the ex-ante risk-taking behaviour in providing new loans, but the slope of the yield curve plays a greater role. This evidence suggests that financial stability concerns related to the LIRE are therefore not fully grounded as banks, on average, tend to reduce – not increase – ex-ante risk-taking on new loans to firms in response to a flattening of the yield curve. Second, we find that the effect of the slope of the yield curve on risk-taking is stronger for those with larger duration gap. Third, we provide evidence that among banks with larger duration gap those that are less capitalized increase relatively more risk-taking in response of a steepening of the yield curve.

All in all, our results imply that the "reach-for-yield" motive dominates the other two when we relate credit risk-taking to the yield curve. Results are robust to different methods of computing the duration gap, to different measures of risk-taking, to changes in the assumptions about the information set available to banks when providing new loans, to different measures of the interest rates.

Finally our results have important implications both for monetary policy and financial stability: concerning the latter, we provide reassuring answers to concerns for financial stability stemming from a LIRE characterized by low short- and long-term interest rates and a relatively flat yield curve. Our estimates suggest that in this environment banks tend to reduce ex-ante risk-taking on new loans. From a monetary policy perspective, while the literature on the risk-taking channel concludes that banks' attitude towards risk increases in response to an expansionary monetary policy implemented through a reduction of official interest rates, our paper suggests that monetary policies aimed at stimulating the economy by reducing long-term interest rates do not increase ex-ante credit risk.

The remainder of the paper is the following. In Section 2 we describe the sources and the main features of the dataset. In Section 3 we focus on the average effect of changes in the short-term interest rate and the slope of the yield curve on credit risk-taking. Section 4 evaluates the heterogeneity of such effects in terms of banks' capitalization and maturity mismatch between assets and liabilities. Section 5 offers several checks on the robustness of our main results while Section 6 concludes and draws the main policy implications.

2. The data

We exploit a granular dataset at the bank-firm level which collects confidential information over the period 2005 to 2016 from different sources. In particular, we merge (*i*) the ex-ante credit risk measure from Cerved Group at firm-level with (*ii*) loan-level information from the Italian Credit register and (*iii*) a number of bank-specific characteristics from Supervisory Reports.

The ex-ante credit risk is measured at the borrower-level. We use the Z-score indicator provided by Cerved Group, which is the leading information provider in Italy on firms' creditworthiness and one of the major rating agencies in Europe.[4] This indicator is a mapping from the probability of a firm's default over the following two years into risk ratings, which vary from 1 to 9, with the latter representing the riskiest borrowers. The score is computed yearly using the methodology described in Altman (1968) and Altman et al. (1994). In order to control for unobserved characteristics at both sector- and local-level, from the Cerved database we also take firms' sector of economic activity and the zip-code of the registered office. Therefore, since we have the identity of the borrower, we can control for invariant firm-specific characteristics in the estimated regressions using a full set of firm fixed-effects.

Data on lending come from the Italian Credit Register (CR), which covers the universe of banks operating in Italy. We restrict our analysis to the *new* term loans to non-financial firms. Term loans are mainly related to firms' investment decisions in the medium-term and differ considerably from revolving credit lines, which are instead managed day-by-day by firms depending on their liquidity needs. For the construction of the dataset we consider two distinct sections of the CR, which differ for the details provided, the data frequency and the number of reporting intermediaries. Our primary source of information is the Taxia section, which is reported at a quarterly frequency and consists of granular information about the loans granted by a representative sample of Italian intermediaries (about 200 Italian banks and 10 branches and subsidiaries of foreign banks). For each bank-firm relationship we have information about the size, the cost and the maturity of the granted loan (i.e. loans with maturity up to one year versus loans with maturities over one year), the repricing frequency of the loan (i.e. floating- versus fixed-rate) and whether the loan is subsidized or not. The second source of information is reported on a monthly basis for all banks operating in Italy. This dataset provides information about the amount and the maturity of granted credit and the amount and the type of collateral posted on each credit exposure, but has no information about the cost and the repricing schedule of the loan.[5] The two datasets are used separately or combined to test the robustness of our main results. The various terms and conditions are used as control variables in the

---

[4] While larger banks may also have their own internal models for the evaluation of ex-ante credit risk, in 2008 Cerved Group obtained ECAI recognition (external agency for evaluation of creditworthiness) from the Bank of Italy, becoming the first Italian credit rating agency whose credit ratings can be used for the calculation, based on standard methods, of banks' prudential capital ratios based on the Basel II Accord.

[5] The Italian CR has a reporting threshold for the quantity of credit at 75,000 € until 2008 and 30,000 € from 2009 onwards. The threshold refers to the overall exposition of the single borrower towards the whole Italian financial system but, since the CR is a loan-by-loan dataset, a firm having two distinct loans of 40,000 € each with the same bank, or with different banks, appears in our sample with two different records. Therefore the threshold has marginal impact on our analysis. The threshold for Taxia remains 75,000 € also after 2008.

estimated regressions as they may represent important factors of mitigation of the ex-ante credit risk.

The bank-level data come from the Supervisory Reports on banks' balance sheets submitted by each individual bank or banking group to the Bank of Italy. We use both individual and consolidated balance sheet items, depending on the availability of the specific bank characteristic.[6] Since, the dataset provides information about the identity of the holding company of the banking group as well as the identity of the single intermediary, we are also able to control for bank-specific time-invariant unobserved variables by alternatively including fixed-effects at the banking group- or bank-level.

We construct the following bank-specific variables: *capital ratio* is the ratio of reserves and equity to total assets; *size* is the log of bank total assets; *Tier 1 capital ratio* is the ratio of Tier 1 regulatory capital to total risk-weighted assets; *NPL ratio* is the ratio of non-performing loans to total loans; *liquidity ratio* is the ratio of cash and government bonds to total assets; *deposit ratio* is the ratio of retail deposits to total assets; *profitability* is the ratio of gross operating profits to total assets; *loan-to-asset ratio* is the ratio between loans to the private sector to total assets; *duration gap* is a measure of banks' exposure to interest rate risk computed following the standardized methodology described in Bank of Italy (2006) and BCBS (2004, 2006). We discuss in more details the computation of this bank feature in Section 2.2.

As for macroeconomic variables, the nominal short-term interest rate is measured by the Euro Overnight Index Average rate (Eonia rate, afterwards). The long-term interest rate is the 10-year Euro Interest Rate Swap (10-year EURIRS, afterwards), which is a risk-free long-term interest rate. We use a number of macroeconomic controls for business cycle conditions in both Italy and the euro area. In particular, we consider the unemployment rate, the inflation rate and real-time coincident indicators of real economic activity. As for the latter, we use the indicator *Ita-coin* developed by Aprigliano and Bencivelli (2013) for the case of Italy and the indicator *Euro-coin* built by Altissimo et al. (2010).[7] We also consider expectations one-year ahead about both real GDP and inflation for both Italy and the euro area, as provided by Consensus Economics. Finally, as

[6] In order to construct banks' consolidated balance sheets, we carefully manage merges and acquisitions among banks. The two banks involved in each merge operation are considered as separate entities until the effective date of the operation and as a new single one afterwards. At the same time, if a firm has a relationship with a specific bank and this bank disappears from the database because of a merge or an acquisition by another intermediary, we can track whether there is a new relationship with the newly formed bank or with the acquirer. In this case we consider the relationship as a new one since the characteristics of the "new" bank can be different from the previous ones.

[7] *Ita-coin* and *Euro-coin* are coincident indicators of the business cycle. They condense a large number of variables that are available at different frequency in a unified framework by relying on econometric techniques in the field of dynamic factor models.

alternative measures of the short- and the long-term interest rates, we consider the 3-month Euribor rate and the 10-year Italian Government bond yield, respectively.

2.1 Descriptive analysis

In Table 2 we report some summary statistics for the variables used in the empirical analysis. Descriptive statistics are reported for the quarterly Taxia database. The picture is, however, very similar for the monthly database we use in the Section of robustness checks.

As for our variable of main interest, average loan risk rating in the full sample is 5.2 with a standard deviation of 1.7, meaning that loans are, on average, granted to firms with moderate risk (rating of 5). Most of loans are granted at floating-rate and, most importantly, fixed-rate loans have all maturity up to one year. The average loan rate is about 5.1 per cent, with a standard deviation of 2.3. The average loan amount is 11.9, which corresponds to about 150,000 €, with a standard deviation of 1.5 (about 39 million). This reflects the fact that the merge between the CR and the Cerved sample leads to a very granular dataset comprising loans to both small and large firms.

The average capital ratio is 9.8 and the standard deviation is 4.9. Banks also markedly differ in terms of both NPL ratio and deposit ratio, thus indicating high banks' heterogeneity in terms of riskiness, business model and size.

In Figure 1 we compare developments in interest rates with the average value of firm rating, computed on all banks loans granted in a given quarter. Interestingly, the picture does not suggest a systematic and negative correlation with the short-term interest rate. On the contrary, the correlation with the long-term interest rate is much stronger and positive.

2.2 The banks' duration gap: some stylized facts and methodological issues

As far as heterogeneity across banks is considered, a key variable is the duration gap, which captures the sensitivity of the market value of the financial institution's net worth to changes in market interest rates. Regulation assigns an important role to this indicator as a forward-looking measure of banks' exposure to the interest rate risk and provides a standardized methodology for its computation. Accordingly, we rely on the approach described in Bank of Italy (2006), which is consistent with the principles stated by the Basel Committee on Banking Supervision (2004, 2006) and the European Banking Authority Guidelines (EBA, 2015).

Banks' exposure to interest rate risk is calculated by estimating the effect of a shift in the term structure of interest rate on the banking book, taking into account the maturity or the repricing date of all balance sheet items. All banking book assets, liabilities and off-balance-sheet items are allocated in 14 maturity buckets according to their remaining time to maturity or, in the case of floating-rate items, according to their repricing schedule (see Table A1 of Appendix). For each time band, assets are offset against liabilities to produce a net position. This net position is then multiplied by a weighting factor based on a proxy of the so-called "modified duration", specific for each time band. The overall measure of interest rate risk is then calculated as the ratio of the sum of the net weighted positions to Tier1 regulatory capital.

We use this measure of interest rate risk because it provides a direct link between developments in market interest rates, banks' profitability and the maturity mismatch in their balance sheets. Banks with a majority of long-term fixed-rate assets and short-term floating-rate liabilities exhibit a larger duration gap and benefit more from a steepening of the yield curve; banks with more short-term floating-rate assets and long-term fixed-rate liabilities instead benefit to a less extent from a steepening of the yield curve.

The interest rate shock enters additively in the duration gap measure. We consider a 100 basis point upward shift in the interest rates. Stress tests are usually carried out on the interest rate on the banking book at the consolidated level, with the aim of quantifying the effect of a parallel shift of 200 basis points as required by Circular 263. In this regard, the Bank of Italy established a 20% attention threshold for the indicator of interest rate risk under such scenario.

Table 2 shows that Italian banks have, on average, a limited exposure to the interest rate risk. Following an increase by 100 basis points the banks' economic value would decline by 0.2% of regulatory capital. However, the high standard deviation suggests large heterogeneity across banks. However, the value of the interest rate risk depends on the assessment of the financial duration of banking book components that do not have a stated maturity, which are allotted on specific criteria. For example, the reserve requirement is classified in the "up to one month" time band, reflecting the weekly frequency of main refinancing operations with the Eurosystem, the yield of which is used as a benchmark in determining the interest rate on the reserve requirement. Bad debts (net of value adjustments) are classified in the "5 to 7 years" time band, in line with the estimated residual life of the loans based on their turnover rate; cash is classified in the "demand and revocable" time band.

The most relevant issue is the allotment of overnight deposits by time band, which may imply significant changes in both the sign and the magnitude of the interest rate risk. The regulatory framework proposes to treat 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 "4 to 5 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.

The estimated duration of overnight deposits can also reflect banks' internal models, which have to be validated by the supervisory authority. Large banks, for example, rely on such models with the aim of treating current accounts as liabilities with longer maturities, in view of their stable dynamics and the sluggishness of their yields with respect to market rates. This leads, ceteris paribus, to a lengthening of the duration of overnight deposits and to a lower exposure to the interest rate risk with respect to the standardized approach.[8] However, overnight deposits can be subject to withdrawal at any time and should be regarded as short-term liabilities, thus leading to a higher exposure to the interest rate risk. Increase competition in the deposit market and the spectre of a bank run during the financial crisis have made the latter scenario even more compelling.

In Figure 2, we assess the implications of changing the "non-core" component for the interest rate risk measure. We calculate two alternative measures of the duration gap. The first measure is based on the assumption that "non-core" component would decline to 5 per cent, while the second is calculated assuming a "non-core" component of 50%. As far as the banking system is considered, we observe differences only in the level of banks' interest rate risk but not in its dynamics. This picture is very similar even when considering the duration gap at the bank-level. The empirical correlation among the various measures is about 0.8, thus suggesting that the choice of the "non-core" component has little even no significant effect on heterogeneity across banks. In our baseline regressions we consider the fraction of the "non-core" component of overnight deposits to be 50%. As we discuss in the following sections, our main results are virtually unaffected when using measures of the bank duration gap based on different assumptions on the duration of deposits.

For the majority of the banks the sign of the duration gap changes over time. The main reason is that developments in this bank-specific variable reflect not only the maturity mismatch on the on-balance sheet items but also the use of financial derivatives, which allow the intermediaries to hedge against the interest rate risk. In this regard, banks usually take both a long or a short position depending on their expectations about the future path of interest rates.[9] Out of 76 banking groups included in the sample, only 6 intermediaries exhibited a positive duration gap over the entire sample period, against 12 with a persistently negative duration gap. This evidence is rather in contrast with the common view that the sign of the duration gap usually identifies financial firms of

[8] Banking groups are required to discuss the results stemming from internally developed with supervisors. The interes rate risk measures based on internal models are, however, not available and cover very few banking groups for a very short time period.

[9] Off-balance sheet items in the banking book, by construction, contribute to banks' profits. As far as the bank income statement is considered, gains and losses stemming from financial derivatives posted in the banking book are accounted in the item "differentials from hedging derivatives", which is a non-negligible part of net interest income. Derivatives held in the *trading book* are instead evaluated at fair value and the gain or loss is recognized in the item "net hedging gains (losses)", which impacts on the non-interest income.

different nature such as commercial banks, which “lend long and borrow short”, or insurance companies and pension funds, which “lend short and borrow long”. This view is likely to refer to the duration gap on the on-balance sheet items which are difficult to be changed in the short-run.

According to the regulatory methodology, the computation of the interest rate risk is based on a parallel shift in the yield curve. Nonetheless, changes in market interest rates are often associated to changes in the slope of the yield curve. In response to a monetary policy tightening, the long-term rate usually rises less than the short-term rate, resulting in a downward sloping yield curve. Exit strategies from accommodative unconventional monetary policies could instead be associated with a steepening of the yield curve as expectations of low short-term rates reverse and central banks reduce their holdings of long-term securities.

We calculate alternative measures of the duration gap by considering alternative scenarios characterized by non-parallel shifts of yield curve. In particular, we examine two cases: 1) an increase in interest rates that results in a downward sloping yield curve (the short-term rates rise by 200 basis point at maturities up to one year while longer-term rate by 100 basis points); 2) an increase in interest rates that steepens the yield curve at longer maturities (the short-term rates rise by 100 basis point while longer-term rate by 200 basis points). The weighting schemes and modified durations used for these exercises are reported in columns (B) and (C) of Table A1. Again the dynamics of the various measures are very similar over time and the heterogeneity across banks does not change considerably. We, however, test the robustness of our main results by also considering duration gap measures based on different interest rate shocks.

We also assess the cross-section correlation between the duration gap and the other bank-specific characteristics, which have been considered in previous studies of the risk-taking channel of monetary policy to capture heterogeneity across banks (see Jimenez et al., 2014; Dell’Ariccia et al., 2017; Heider et al., 2018). In Figure 3 we report the scatter plot of the duration gap with the various bank features and the fitted values of estimated regressions based on these observations. In all cases the correlation is low, thus suggesting that banks’ duration gap conveys independent information with respect to the other bank-specific variables.

3. Credit risk-taking and the term structure of interest rates

In this section we assess to which extent different components of the yield curve are significant drivers of banks’ risk-taking. We perform our analysis by looking at the intensive margin of lending to non-financial firms.[10] We adapt the empirical approach by Jimenez et al. (2014) to our specific framework and estimate regressions of the following type:

$$q_{ijt} = \beta_1 \textit{short-term rate}_t * risk_{it-4} + \beta_2 \textit{long-term rate}_t * risk_{it-4} + \\ + \omega_i + \mu_j + \tau_t + \gamma X_{jt-1} + \theta Y_{ijt} + \alpha Z_t * risk_{it-4} + \varepsilon_{ijt} \qquad (1)$$

The dependent variable, q_{ijt}, is the logarithm of the new credit flow granted by bank *i* to firm *j* in quarter *t*, and banks' risk-taking is captured by the interaction terms between the firm rating and some macroeconomic variables, namely the short- and the long-term interest rate. Accordingly, $\textit{short-term rate}_t$ is the Eonia rate in quarter *t* while $\textit{long-term rate}_t$ is the 10-year EURIRS rate in quarter *t*. The risk rating, $risk_{it-4}$, of borrower *i* is included with a lag of one year, reflecting the true information available to the loan officers at the time the new loan was granted by bank j. This implies that firm's rating of the previous year is associated to the new loans granted to that firm in all quarters of the current year. However, the release of the new ratings by Cerved Group could be more gradual over time, meaning that banks could have access to updated information about borrowers' creditworthiness in the second part of the year. We explore the robustness of our main results by changing the lag order for firms' rating in Section 5.

The model specification includes various fixed-effects and a number of other control variables to reach the identification of a supply curve. Precisely, ω_i is a set of firm-specific fixed-effects, μ_j is a set of bank-specific fixed-effects, τ_t is a set of time-specific fixed-effects, X_{jt-1} is a vector of time-varying bank-specific variables, Y_{ijt} is a set of loan-specific variables, Z_t is a vector of other macroeconomic variables for the Italian economy, which are also interacted with the firm rating. The macroeconomic variables are the unemployment rate, the coincident indicator *Ita-coin* and the inflation rate, which may affect banks' risk-taking behaviour beyond what is captured by developments in market interest rates.[11] The loan-specific characteristics include the charged interest rate, the maturity, the repricing date of the loan and a dummy variable taking the value of 1 for subsidized loans. All these loan-level features may act as substitutes or complements for the amount of credit when the loan application is considered by the bank. The full set of time fixed-effects allows us to control for unobservable factors at the aggregate level that may affect banks' risk-taking behaviour, such as the impact of changes in the regulatory framework occurred during

[10] Jimenez et al. (2014) analysed both the extensive and the intensive margin of credit, as captured by the rejection/acceptance of loan applications and granted credit volume, respectively. However, when considering within-borrower variation, they found that the extensive margin is not statistically significant and that the change in interest rates affect banks' risk-taking entirely via the intensive margin.

[11] We also check whether our main results are not driven by a systematic response of banks' attitude towards risk to developments in the euro area as a whole. To this end, in the various regressions we also control for current and expected GDP and inflation. Main results remain unchanged, meaning that the specifications including only the Italian macroeconomic controls represent a valid benchmark to be used in the following sections.

the financial crisis and more extensively with the adoption of the Single Supervisory Mechanism. Finally, the set of bank-specific fixed-effects controls for unobserved factors at the bank-level that may affect the amount of granted credit to each borrower. To control for dependence of observations across banks, firms and within quarters, standard errors are two-way clustered at the bank and firm-quarter level. Results are robust to the use of an alternative two-way clustering scheme at the bank-quarter and firm level.

The coefficients of main interest are β_1, which is expected to be negative according to previous analyses, and β_2, whose sign is a-priori unknown. According to this approach, the coefficient β_1 is a direct empirical test of whether the *amount* of lending to risky firms increases when the short-term interest rate declines and β_2 whether the *amount* of lending to risky firms declines or increases when the slope of the yield curve flattens.

Estimates are reported in Table 3. For comparability with previous studies, we begin our analysis by estimating regression (1) including neither the long-term interest rate nor the set of firm-specific fixed-effects. The estimated coefficient suggests a negative and significant effect of the short-term interest rate on bank risk-taking. Lower values of the short-term interest rates are associated, on average, to larger amounts of new lending granted to borrowers with a lower creditworthiness. Based on the estimated coefficients, a one standard deviation (1.5 percentage points) increase in the short-term interest rate is associated to about a 12% increase in the amount of new lending to the riskiest firms (i.e. with a rating class of 9) with respect to the safest ones (i.e. with a rating class of 1). When considering the interquartile range of the firm rating distribution (75^{th} percentile versus 25^{th} percentile), the differential effect is more muted (about 5% in the change of new credit). A reduction in the short-term rate is also associated to an increase in new lending to firms with no rating with respect to safest firms by about 11%. These effects are in general lower than those estimated by Jimenez et al. (2014) for the Spanish economy, where a one standard deviation decrease in the overnight interest rate spurred lending to firms with non-performing loans over the previous four years by 26%.

In column (2) we include the interaction term between the firm rating and the long-term interest rate as an additional explanatory variable. Since in this regression we also control for the interaction term with the short-term interest rate, the estimated coefficient captures the economic effect of a change in the slope of the yield curve.[12] We find that a decrease in the long-term interest rate (for a

[12] Since the model is linear, we may have considered directly the slope of the yield curve instead of the long-term interest rate. Results remain unchanged but the interpretation of the estimated coefficients is different. In particular, the effect of the short-term interest rate on bank risk-taking should be computed as the difference between the coefficient for the Eonia rate and the coefficient for the slope of the yield curve.

given level of the short-term interest rate) significantly reduces risk-taking and the effect is economically relevant as much as the one determined by a similar increase in the Eonia rate. A flattening of the slope of the yield curve due to a reduction of the long term interest rate by one standard deviation (1.4 percentage points) is associated to a decrease in the amount of new lending to riskiest firms with respect to safest firms by about 14% and by 22% in the case of firms with no rating.

The estimation results change dramatically when we progressively include additional control variables in the regression and exploit within borrower variation. In column (3) we include a full set of firm-specific fixed-effects to control for invariant and unobserved characteristics at the borrower-level. The role played by the short-term interest rate reduces by a factor of 6 while the effect of the slope of the yield curve remains highly significant albeit it slightly attenuates in magnitude.

Finally, in column (4) we substitute bank and firm fixed-effects with the more stringent bank-firm fixed-effects so to exploit the variation within the same firm-bank pair over time, thereby controlling for any time-invariant feature in relationship lending. The effect of the short-term interest rate loses statistical significance while that of the long-term rate remains highly statistically significant and broadly unchanged in magnitude. A flattening of the slope of the yield curve due to a reduction of the long term interest rate (for a given level of the short-term rate) by one standard deviation is associated to a decrease in the amount of new lending to riskiest firms with respect to safest firms by about 10%. The reduction in new credit for firms with no rating is about 6%.

Results presented in this section have important implications for policymakers since they suggest that for a comprehensive evaluation of the risk-taking behaviour of financial institutions one should look jointly at the short-term interest rate and the slope of the yield curve. In this regard, we provide reassuring answers to concerns for financial stability related to ex-ante credit risk in a LIRE (ESRB, 2016). In an environment characterized by both low short-term interest rates and a relatively flat yield curve, our estimates suggest that banks, on average, tend to reduce – not increase – ex-ante risk-taking on new loans to firms.

4. Non-linear relationship in firm's rating

Since the firm rating is an ordinal variable, in Table 4 we present alternative regressions aiming at exploring potential non-linear relationships the term-structure of interest rates and banks' risk-taking. We consider specifications including interaction terms between the short- and the long-term rate and a quadratic term in the firm rating. More generally, we carry out alternative regressions capturing potential non-linear effects of changes in interest rates on each different class of rating. To this end, we consider separate dummy variables for each rating class and include their interaction terms with each macroeconomic variable. We compare regressions including firm, bank and time fixed-effects and those including firm-bank and time fixed-effects.

In Figure 4 we compare the change in the amount of new lending for different classes of rating in deviation from the change in new lending to firms with a higher creditworthiness (i.e. belonging to class 1) associated to a steepening of the yield curve obtained with regressions capturing both linear and non-linear effects in the firm rating. In particular, we compare estimates in column (4) of Table 3 (linear relationship with firm rating; solid red line) with those in columns (2) and (4) in Table 4, which shape, respectively a quadratic specification in firm rating (dashed black line) and a more general non-linear relationship (blue histograms), as captured by a single dummy variable for each rating class.

The only non-linearity that emerges in the risk-taking behaviour concerns the class of rating 6, for which the increase in loans is higher than what predicted by the linear specification.[13] Therefore, with this exception, both non-linear specifications provide results similar to those obtained under the linear specification, which can be considered a relevant benchmark to be used in the following sections, provided that we control for unobserved components at the bank-firm level.

5. Heterogeneity across banks

The estimated effects of the market interest rates on risk-taking reported in the previous section are "average effects" across banks. In this Section we focus on heterogeneity across intermediaries and evaluate whether the sensitivity of banks' risk-taking to changes in interest rates depends on bank-specific variables. We focus on the bank-level features suggested by the economic theory, namely the bank duration gap and capitalization. To this end, we consider the following regression:

$$q_{ijt}= \beta_1 Eonia_t*rating_{it-4}*duration\ gap_{jt}+ \beta_2 10\text{-}year\ Eurirs\ rate_t*rating_{it-4}*duration\ gap_{jt}+$$
$$\beta_3 Eonia_t*rating_{it-4}*capital\ ratio_{jt}+ \beta_4 10\text{-}year\ Eurirs\ rate_t*rating_{it-4}*capital\ ratio_{jt} +\cdots+ \varepsilon_{ijt}$$

We augment the baseline specification by adding triple interaction terms between the firm rating, the market interest rates and the bank-specific variables of main interest. To avoid potential endogeneity issues, we follow the standard literature on both the bank lending and the risk-taking

[13] The role of the class of rating 6 has been also pointed out by Rodano et al. (2018). They analyzed lending conditions over the business cycle and showed a strong discontinuity for firms lying between category 6 and 7, which is the threshold for the designation of firms between "performing" or "substandard": in good times, banks would discriminate among firms via the cost of credit while, in bad times, credit rationing would apply via the amount of lending.

channel and consider the lagged values of the various bank-specific variables. Since the duration gap is reported on a half-yearly basis, we use a lag of two quarters for all bank-specific variables.[14]

We present the results obtained with empirical models used in the previous literature, which allows improving upon identification of a credit supply curve. More specifically, we saturate the model with firm-time fixed-effects to better control for demand conditions at the firm-level (see Khwaja and Mian, 2008). This specification has the cost of reducing the number of observations but has the advantage to achieve the identification of the supply by relying on multiple lending, namely by comparing firms getting credit from two or more banks in the same quarter. Moreover, we also include bank-time fixed-effects to control for unobserved time-varying factors at the bank-level, as suggested by Jimenez et al. (2014) and bank-firm fixed effects to control for relationship lending. Finally, all regressions include triple interaction terms between the other macroeconomic variables, the firm rating and the bank-specific variables. The estimates are shown in Table 5.

We start our analysis by considering only interaction terms with the bank duration gap. The estimated coefficients reported in column (1) suggest that, following a steepening of the yield curve, banks with a large duration gap take more risk. The estimated effect is economically relevant. An increase in the slope of the yield curve by its standard deviation (1.4 percentage points) is associated to an increase in lending to the riskiest firms (i.e. with rating 9), which is 4% stronger for banks with a higher values of the duration gap (i.e. at its 75th percentile of 2.9%) with respect to banks with a lower duration gap (i.e. at its 25th percentile of -1.4%). Interestingly, the estimated coefficient for the triple interaction term with the Eonia rate is negative and statistically significant, albeit only at the 10% confidence level. Therefore, banks with a large duration gap take more risk also following a reduction of the short-term interest rate. However, this effect is economically much less relevant as the magnitude of the estimated coefficient is one-fourth of that obtained for the slope of the yield curve.

As far as the economic theory is considered, these empirical results seem to corroborate the view that risk-taking behaviour are mainly driven by "reach-for-yield" motives (Table 1). A positive relationship between risk-taking and the bank duration gap, following a steepening of the yield curve, is indeed consistent with the fact that banks' profitability and risk-bearing capacity increases with a steepening of the yield curve; as a consequence, the risky marginal loan that was not made before the boost in bank capital is now feasible.

[14] Results are robust to the choice of a different lag order for the bank-specific variables. The sign and the magnitude of the estimated coefficients are very similar to specifications considering the contemporaneous value or the first lag of the bank-specific variables.

In column (2) we add triple interaction terms between market interest rates, the firm rating and the bank capital ratio. The estimated coefficients are statistically significant and suggest that *less capitalized banks take more risk*, following a steepening of the yield curve and/or when the short-term interest rate declines. The estimated coefficients imply that an increase in the slope of the yield curve (for a given level of the short-term interest rate) by its standard deviation (1.4%) is associated with an increase in lending to the riskiest firms (i.e. with rating 9), which is 14% stronger for banks with lower capital ratio (i.e. at its 25th percentile of 6.8%) with respect to highly capitalized banks (i.e. at its 75th percentile of 12.0%). Again, developments in the short-term rates are found to play a minor role for banks' risk-taking, as the magnitude of the estimated coefficient remains about one half of that obtained for the slope of the yield curve. However, the effect is economically not negligible. Interestingly, the estimated coefficients with the triple interaction terms with the bank duration gap remain broadly unchanged, thus suggesting that the bank duration gap and capitalization provide independent information for banks' risk-taking.

Some banks exhibit a persistently negative duration gap over the entire sample period. We evaluate the implications for our estimates by excluding observations for these intermediaries, which could manage the interest rate risk differently from the other banks in the sample. If the "reach-for-yield story" continues to holds, such intermediaries are simply less prone to increase risk-taking when the slope steepens; on the other hand", the other theories suggest that they may be engaged in "search-for yield" or "risk-shifting". A steepening of the slope reduces their profitability and risk-taking could increase either because of a lower effort in screening new loans or because of commitment on target returns (or managers' compensation schemes). The estimated coefficients reported in column (3), however, suggest no relevant changes in our main results,

In column (4) we evaluate whether our estimates are essentially related to the inclusion of few banks exhibiting a positive duration gap over the entire sample period. The results remain virtually unaffected when the observations for such banks are excluded from the estimated regression. In columns (5)-(7) we test the robustness of our main results by changing some assumptions in the calculation of the bank duration gap, following the discussion in Section 2.2. We use a measure of the duration gap based on the recommended fraction for the "non-core" component of overnight deposits (25% instead of 50%). Moreover, we consider alternative measures of the duration gap based on interest rate shocks that implies different configurations of the term structure of interest rates, namely a decreasing yield curve (i.e. the short-term rates react less than long-term ones) or, alternatively, an increasing yield curve (i.e. the short-term rates react more than long-term ones). Again, the results are very robust, thus confirming that the technical aspects related to the computation of the duration gap plays no relevant role in our empirical analysis.

Finally, in column (8) we address whether banks' exposure to the interest rate risk and capitalization may interact each other, meaning that the "reach-for-yield" motivation could be stronger for banks with a large duration gap and lower capitalization. To this end, we include a quadruple interaction term between interest rates, firm rating, bank duration gap and bank capital. The estimates suggest that, following a steepening of the yield curve, the effect is magnified if the bank has a large duration gap and a lower capital ratio. When the slope of the yield curve increases by its standard deviation (1.4%), a bank with lower capital ratio (i.e. at its 25th percentile of 6.8) and larger duration gap (i.e. at its 75th percentile of 2.9%) increase lending to the riskiest firms, 15% more than a bank with a higher capital ratio (i.e. at its 75th percentile of 12.0%) and a smaller duration gap (i.e. at its 25th percentile of -1.4%).

All in all, these results confirm the central role of the "reach-for-yield" motives for banks: the impact of changes in interest rates are amplified through the balance sheet management of more levered intermediaries, which benefit relatively more from the increase in their risk-bearing capacity as it relaxes their capital constraints.

6. Robustness checks

In this section we test the robustness of our main results along several dimensions. Most of the various estimates are reported in Table 5. Our main results remain virtually unaffected.

First, we replicate our analysis by using consolidated balance-sheet items for all the considered bank-specific variables, as the duration gap is available at the group-level while the capital ratio – and the other bank-specific controls- are considered at the individual level. The estimates in column (a) confirm that banks with a large duration gap and less capitalized banks take more credit risk-taking in response to a steepening of the yield curve. The magnitude of the estimated effects is magnified for banks with positive duration gap while attenuated for those with a negative duration gap (see column).[15]

Second, the choice of the market interest rates are arbitrary and could be debated. As far as the short-term interest rate is considered, we replicate our main regressions by replacing the overnight rate with a 3-month interest rate, namely the Euribor rate. Practical considerations suggest that banks set their cost of credit as a spread over a reference market rate, which is different from a very-short-term interest rate. As a consequence, the amount of credit granted could be also more responsive to the 3-month Euribor rate. As for the long-term interest rate, we replace the 10-year

[15] Our results are also robust to the exclusion of banks exhibiting persistently negative duration gap over the entire sample period. Results are not reported to save space but are available upon request.

Eurirs rate with the 10-year Italian Government bond yield, given the high exposure of the Italian banking system to the sovereign risk and the implications for their profitability.

Third, we test the robustness of our main results by changing the assumptions about the timing with which firm's rating is available as an information variable for loan officers. In the regression we now consider that firm's rating is observed with a lag of one-year in all quarters of the current year. However, the release of data on firms' creditworthiness by Cerved Group could be more gradual within the same year, meaning that banks could face a lower amount of information in the first part of the year while almost complete information when approaching the end of the year. We, therefore, carry out the same regressions in which we associate the rating of the previous year only to the loans granted in the second half of the year. Loans granted in the first part of the year are associated to firm's rating with a two-year lag.

Fourth, we also estimate the same specification by focusing only on the post-financial crisis period (i.e. from 2008q2 onwards) for two reasons. On the one hand, the breakout of the financial crisis might have induce banks to change their risk aversion. On the other hand, the quality of the data on the bank duration gap is higher since mid-08 due to improvements in the reporting scheme for the interest rate risk for supervisory purposes.

Fifth, we include in our baseline regressions interactions terms with additional macroeconomic control variables. Since the slope of the yield curve may reflect market expectations about economic conditions we control for interactions with one-year expectations about Italian real GDP and inflation, as provided by Consensus Economics. The fact that the main results are virtually unaffected may furtherly corroborate the view that our estimates are mostly capturing the effects of monetary policy on banks' risk-taking, thus reinforcing the related policy implications. We also replace the macroeconomic variables for Italy with those related to the euro area as a whole, to better control for endogenous variations in interest rates related to business cycle developments originated in other euro-area countries but potentially affecting the Italian banks.

Finally, in Table A2 of the Appendix we present results of the regressions which include triple interaction terms between market interest rates, the firm rating and other bank features used in the related empirical literature. In particular, we consider: a) the Tier 1 ratio, since the bank lending channel and capital constraints could be also captured by regulatory ratios (Van den Heuvel, 2007); b) the deposit-to-asset ratio, as banks with a higher fraction of overnight deposits may be induced to take more risk in periods of negative short-term rates as they cannot lower yields on customer deposits to avoid bank runs (Heider et al., 2018); c) the NPL ratio, as a higher fraction of impaired loans may reduce banks' profitability via the increase in loan-loss-provisions; d) the liquidity ratio, since less liquid banks could be more exposed to asymmetric information problems (Stein and

Kashyap, 2000); e) the loan-to-asset ratio, as it helps capturing the business model of more traditional commercial banks with respect to more complex or investment banks; f) the bank size, to control for other features related to the business model. Our main results remain virtually identical and none of the considered bank-specific variables seems to play a role for credit risk-taking

7. Risk-taking as the change in the rating class of the new marginal loan

The granularity of our dataset allows us to evaluate the determinants of the ex-ante credit risk-taking also using the approach proposed by Dell'Ariccia et al (2017), which focuses on the *rating class* to which belongs the borrower of the loan. Accordingly, the dependent variable becomes the risk rating of borrower i for all loans received by banks j (where j=1,,...N) at quarter t and the regression is the following:

$$risk_{it} = \omega_i + \mu_j + \beta_1 short_t + \beta_2 long_t + \gamma X_{jt-1} + \theta Y_{ijt} + \delta Z_t + \varepsilon_{ijt} \qquad (3)$$

In regression (3) the rating, $risk_{it}$, is assigned to all new loans granted to the same borrower in the same year. This implies that we continue to have repeated observations on the left-hand side of our regression. Importantly, this approach aims at evaluating the probability that the marginal loan is provided to riskier firms. Therefore, it is not directly comparable to that proposed by Jimenez et al. (2014), which considers the amount of credit.

Differently from the project by Dell'Ariccia et al. (2017) we have information about the identity of the borrower so, we can assess within-borrower variation and check the robustness of the results to the inclusion of more control variables. The results are reported in Table 7 and, again, they differ considerably across the various fixed-effect models. The estimated coefficients of column (1) would suggest a negative and significant effect of short-term interest rate on bank risk-taking, as lower values of the Eonia rate are associated, on average, to new loans granted to borrowers with a lower creditworthiness. A one standard deviation decrease in the Eonia rate (1.5%) would be associated to an increase in loan risk ratings of 0.13, a result similar to the estimates for the US (where a one standard deviation decrease in the Fed fund rate implies an increase in loan risk ratings of 0.11).

However, the estimates in column (2) show that the results change considerably when we exploit within borrower variation and include a full set of firm-specific fixed-effects to control for invariant and unobserved characteristics of the borrowers. The role played by the short-term interest rate reduces by a factor of 7. On the contrary, the effect of the slope of the yield curve increases and becomes highly significant. A steepening of the yield curve determined by a one standard deviation increase in the 10-year Eurirs rate (1.4%) would be associated to an increase in loan risk ratings of 0.10. Finally, column (3) presents estimates based on a regression comprising firm-bank fixed-effects. The significance of the short-term rate coefficient vanishes away while that of the long-term rate continues to be high and the estimated coefficient remains very similar in magnitude.

We also evaluate the heterogeneity across banks. When assessing the role of bank duration gap and capital, as captured by the corresponding interaction terms with market interest rates, we cannot include more severe controls for loan demand conditions since this approach prevents the use of firm-time fixed-effects. Estimates are reported in column (4). We again find that banks with large duration gap take more risk-taking following a steepening of the yield curve while the role of bank capital seems to be irrelevant. While these results are not fully consistent with those obtained with our baseline econometric approach, we believe that this part of the analysis should be taken with more caution since the identification of a credit supply curve is more challenging, as the approach prevents to fully control for loan demand at the firm-level.

8. Conclusions

In this paper, we have investigated the empirical relation between banks' attitude towards risk and the level and slope of the yield curve, matching a granular information on new loans to non-financial firms from the Italian Credit register with an ex-ante measure of borrower's creditworthiness over a long sample period characterized by very different configurations of the term structure of interest rates.

We corroborate the view that the short end of the yield curve is an important driver of the risk-taking behaviour in providing new loans but, contrary to previous analyses, we find that the long end plays a more important role. According to our estimates, short-term interest rates negatively affect risk-taking and long-term rates do it positively. However, when controlling for firm fixed-effect, the role played by the short-term interest rate dramatically reduces. On the contrary, the effect of long-term interest rates (for a given level of short-term rates) on ex-ante credit risk remains significant and economically relevant.

We also evaluate the empirical relevance of different channels through which changes to the yield curve affects risk-taking behaviour. Our main results support the explanation that a steepening of the yield curve increases the risk-bearing capacity of banks, which react by engaging in "reach-for-yield"; and the larger the duration gap, the larger the increase in credit risk. We also find that banks with lower capitalization are those that increase credit risk relatively more in response to a steepening of the yield curve.

Our main results have immediate and important implications for policymakers. They suggest that for a comprehensive evaluation of the risk-taking behaviour of the banking sector one should look jointly at different components of the yield curve. In this regard, we provide reassuring answers to concerns for financial stability stemming from a low interest rate environment characterized by low short and long-term interest rates and a relatively flat yield curve. Our estimates suggest that banks tend to reduce ex-ante risk-taking on new loans, independently from the sign of the duration gap of their balance sheet.

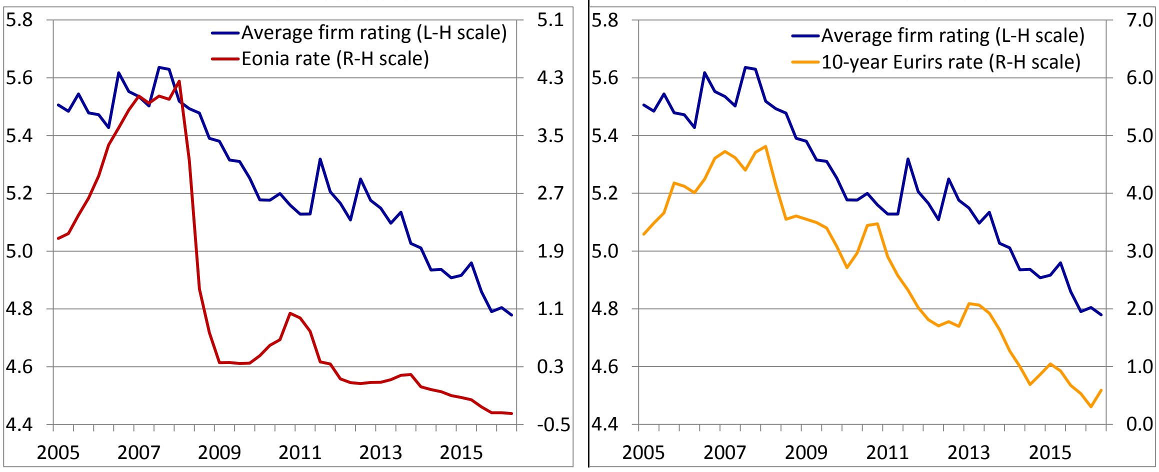
From a monetary policy perspective, instead, the paper suggests that the risk-taking channel of the transmission mechanism is stronger when the changes in the slope of the yield curve are determined by policies that affect the long end. Moreover, while the literature on the risk-taking channel concludes that banks' attitude towards risk increases in response to a decrease of short-term interest rates our paper suggests that monetary policies aimed at stimulating the economy by reducing long-term interest rates do not increase banks' credit-risk; in fact, to the extent that monetary policy decisions induce a flattening or a parallel downward shift of the curve, banks' risk-taking reduces.

Future research will address the transmission of the term structure of interest rates on banks' portfolio of securities using granular information, thus providing complementary information to our findings on banks' credit allocation.

Figures and tables

FIGURE 1 – Average firm rating and interest rates
(quarterly data)

(a) Firm rating and short-term interest rates | **(b) Firm rating and long-term interest rates**



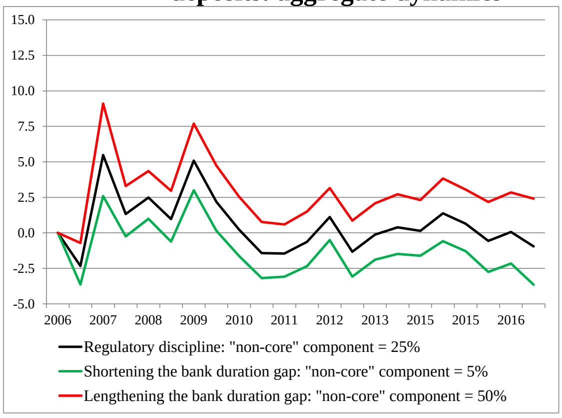
Sources: authors' elaborations on data from Bank of Italy, Cerved Group and Thomson Reuters Datastream.

Notes: for the computation of the average firm rating we consider all new bank-firm relationships that appear in a given quarter in the Credit Register and compute the simple average of the Cerved Z-score assigned to the firm involved in the bank-firm relationship. The Cerved Z-score takes values between 1 and 9 where higher values are assigned to riskier firms. The market interest rates are computed as quarterly averages of daily observations.

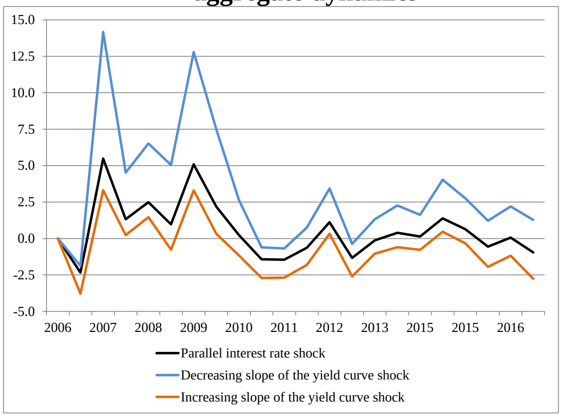
FIGURE 2. Developments in banks' duration gap

(half-yearly observations)

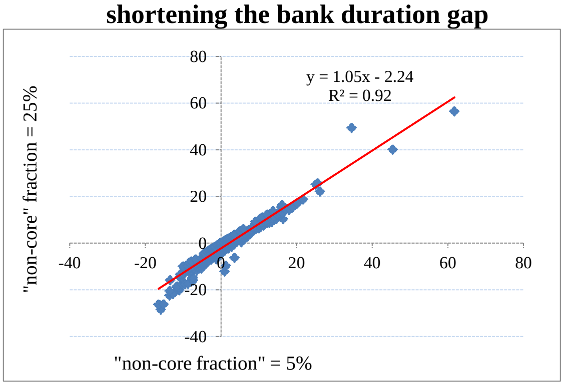
a) Changing the maturity of overnight deposits: aggregate dynamics



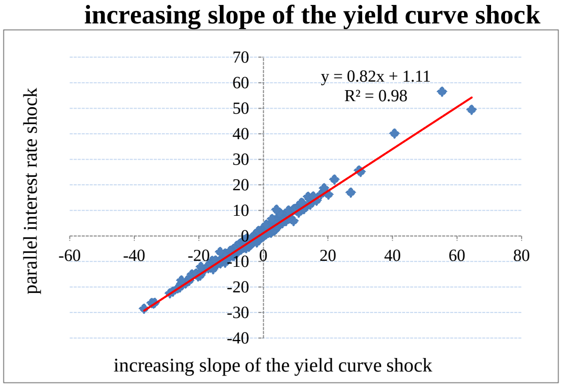
a') Changing the interest shock: aggregate dynamics



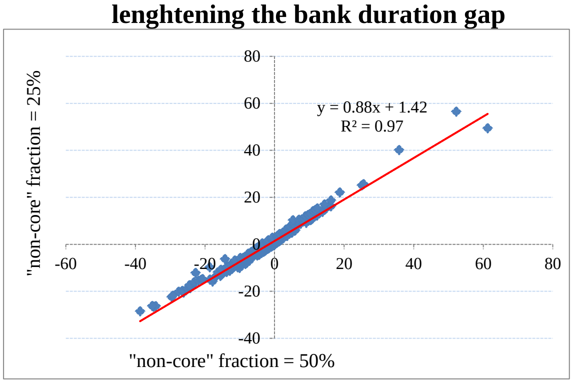
b) Cross-section correlations: shortening the bank duration gap



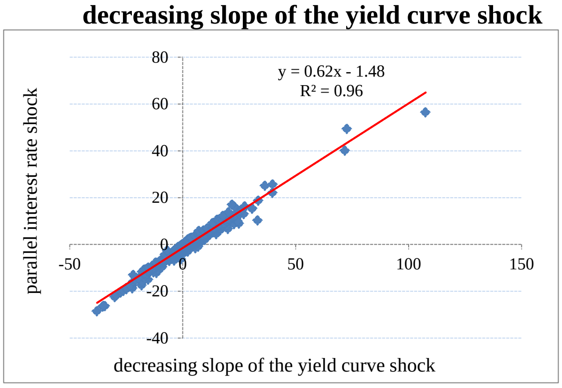
b') Cross-section correlations: parallel vs. increasing slope of the yield curve shock



c) Cross section correlations: lenghtening the bank duration gap



c') Cross-section correlations: parallel vs. decreasing slope of the yield curve shock

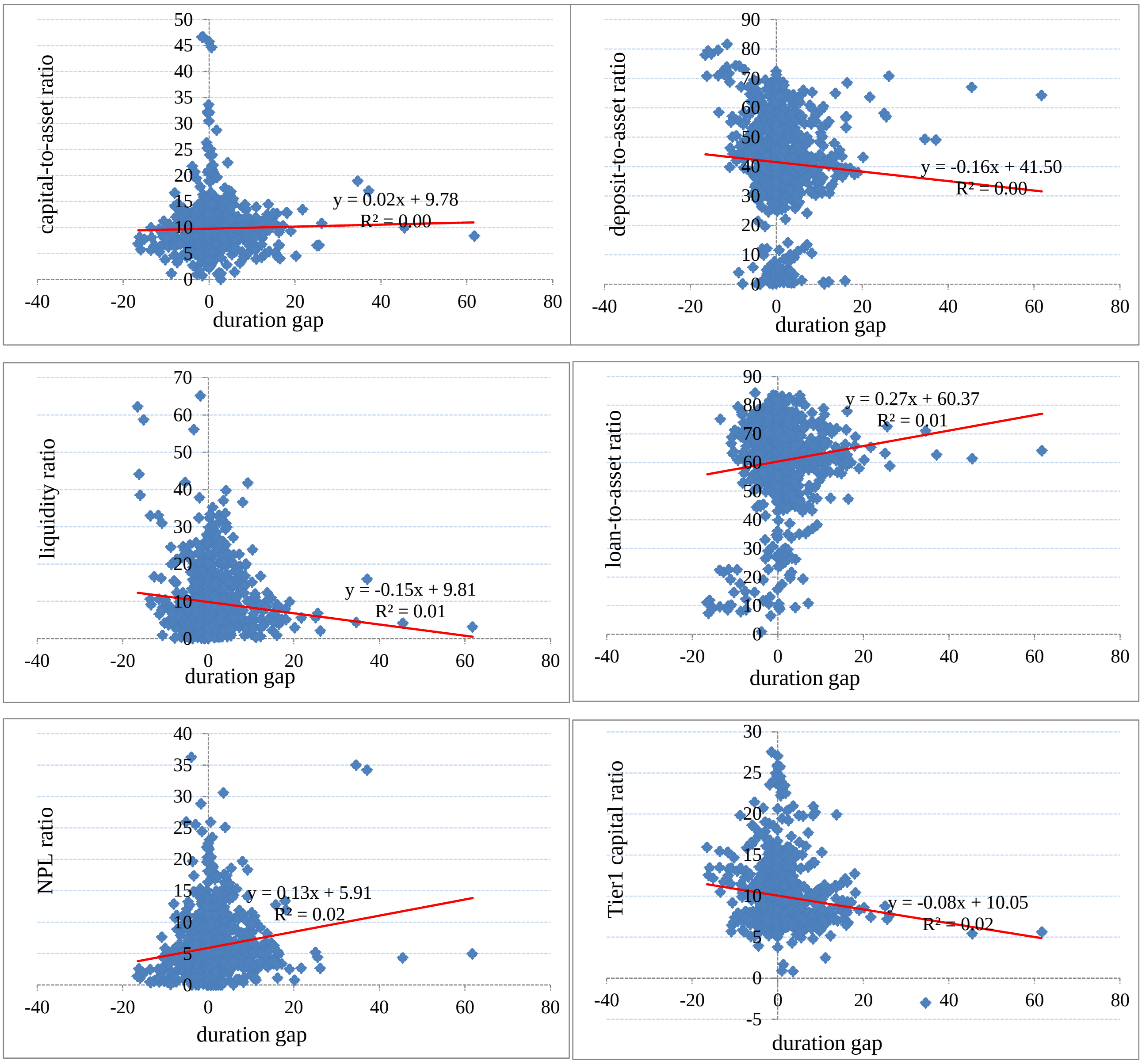


Sources: authors' elaborations on data from Bank of Italy.

Notes: the bank duration gap is calculated by considering a parallel interest rate shock by 100 basis points. The regulatory discipline assumes a "non-core" fraction of overnight deposits equal to 25% in the computation of the duration gap. Lengthening the bank duration gap means increasing the "non-core" fraction of overnight deposits by 50%; shortening the bank duration gap means decreasing the "non-core" fraction of overnight deposits by 5%.

FIGURE 3. Cross-section correlation among bank-specific variables

(half-yearly observations)

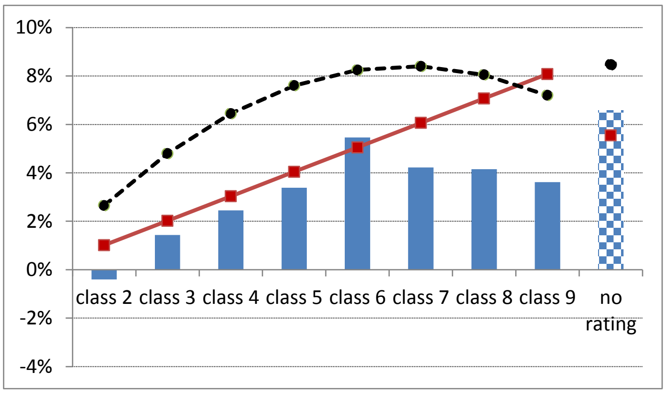


Sources: authors' elaborations on data from Bank of Italy.

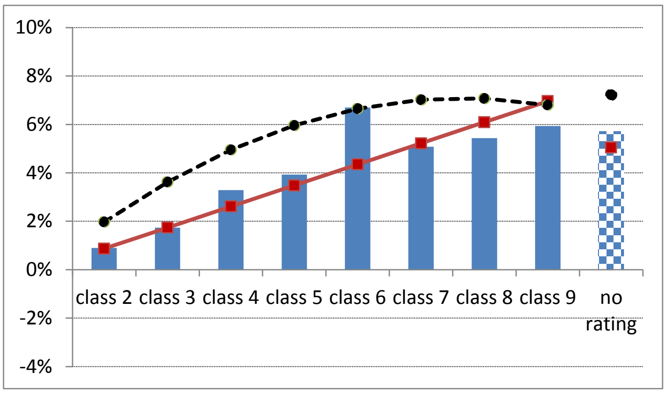
Notes: Each figure plots the bank duration gap against the indicated bank-specific variable in the various semesters. The solid red lines represent the fitted values from linear regressions of the bank duration gap on the same bank-specific variable and a constant. The estimation period is 2005-2016.

FIGURE 4 – Increase in lending for different classes of rating determined by a steepening of the yield curve

a) Including bank, firm & time fixed-effects



b) Including bank*firm & time fixed-effects



Notes: growth rates of loans for different classes of rating, in deviation from the growth rate of loans to firms belonging to rating class 1, determined by a steepening of the yield curve. Solid red line: linear specification in firm rating; dashed black line: quadratic specification in firm rating; blue histograms: specification using a single dummy variable for each rating class.

Table 1 - Expected effect of yield curve on risk-taking

	"reach-for-yield" (Adrian and Shin, 2010)	"risk-shifting" (Allen et al., 2011)	"search-for-yield" (Rajan, 2005)
Slope*Duration_Gap	+	-	-
Slope*Duration_Gap*Capital	-	+	-

Table 2. Descriptive statistics

	Frequency	Observations	Mean	Standard deviation	25th percentile	75th percentile
Firm-level variables						
Risk rating	Annual	1,032,011	5.2	1.7	4.0	7.0
Firm whitout rating (0/1 dummy)	Annual	26,088				
Macroeconomic variables						
Eonia rate (%)	Quarterly	50	1.3	1.5	0.1	2.1
10-year Eurirs rate (%)	Quarterly	50	2.8	1.4	1.7	4.1
10-year Italian BTP yield (%)	Quarterly	50	3.9	1.2	3.6	4.6
Itacoin	Quarterly	50	0.0	0.5	-0.2	0.3
Italian inflation rate (%)	Quarterly	50	1.6	1.2	0.5	2.4
Italian unemployment rate (%)	Quarterly	50	9.2	2.3	7.3	11.6
Eurocoin	Quarterly	50	0.3	0.5	0.0	0.6
Euro-area inflation rate (%)	Quarterly	50	1.6	1.1	0.6	2.3
Euro-area unemployment rate (%)	Quarterly	50	9.9	1.5	9.0	11.0
Expected real GDP - Italy (%)	Quarterly	50	1.1	0.5	0.8	1.4
Expected real GDP - Euro area (%)	Quarterly	50	1.6	0.4	1.3	1.8
Expected inflation rate - Italy (%)	Quarterly	50	1.7	0.4	1.5	2.0
Expected inflation rate - Euro area (%)	Quarterly	50	1.6	0.3	1.4	1.8
Loan-level variables						
Loan size (logarithm)	Quarterly	2,802,302	12.0	1.5	10.9	12.9
Loan cost (%)	Quarterly	2,802,302	5.1	2.3	3.4	6.4
Long-term loans (0/1)	Quarterly	2,802,302	0.4	0.5	0.0	1.0
Fixed-rate loans (0/1)	Quarterly	2,802,302	0.1	0.3	0.0	0.0
Subsidized loan (0/1)	Quarterly	2,802,302	0.0	0.1	0.0	0.0
Bank-level variables						
Consolidated balance sheet items						
Duration gap (%)	Bi-annual	939	-0.2	19.5	-3.9	0.9
Duration gap (%) -"non-core" deposits = 50%	Bi-annual	939	2.3	27.8	-1.4	2.9
Tier 1 capital ratio (%)	Bi-annual	939	10.0	3.9	7.3	11.5
Profitability (%)	Bi-annual	905	0.3	0.9	0.1	0.7
Unconsolidated balance sheet items						
Capital ratio (%)	Quarterly	4,471	9.8	4.9	6.8	12.0
Total assets (logarithm)	Quarterly	4,471	9.0	1.3	8.0	9.8
NPL ratio (%)	Quarterly	4,471	5.9	5.8	2.3	8.1
Deposit ratio (%)	Quarterly	4,471	41.5	19.7	33.6	54.7
Liquidity ratio (%)	Quarterly	4,471	6.2	7.2	1.0	8.9
Loan-to-asset ratio (%)	Quarterly	4,471	63.9	19.5	56.8	76.8

Notes: this table reports descriptive statistics for the variables used in the empirical analysis. The sample includes loan-specific information from the Taxia quarterly database from 2005 to 2016. The firm rating is the risk rating assigned by the Cerved Group to a given firm on an annual basis, where the rating classes are comprised between 1 (lowest credit risk) and 9 (highest credit risk). Bank-level variables are from the Supervisory reports transmitted by the intermediaries to the Bank of Italy. Macroeconomic variables are taken from the Statistical Data Warehouse of the ECB, Bank of Italy and Consensus Economics.

Table 3. Term structure of interest rates and credit risk-taking

	(1)	(2)	(3)	(4)
Firm rating	-6.254***	-13.457***	-5.666***	-3.797***
Firm no rating	-21.432	-155.902***	-31.343***	-18.440***
Interactions with macroeconomic variables				
Eonia rate * Firm rating	**-1.023*** **	**-1.323*** **	**-0.217* **	**-0.229**
10-year Eurirs rate * Firm rating		**1.274*** **	**1.007*** **	**0.869*** **
Eonia rate * Firm no rating	**-10.895*** **	**-15.296*** **	**-1.845* **	**-1.579**
10-year Eurirs rate * Firm no rating		**22.214*** **	**6.543*** **	**5.923*** **
Loan-level controls	yes	yes	yes	yes
Bank controls	yes	yes	yes	yes
[(Other macro variables)*(Firm rating, no rating)]	yes	yes	yes	yes
(Year:quarter) fixed effects	yes	yes	yes	yes
Bank fixed effects	yes	yes	yes	no
Firm fixed effects	no	no	yes	no
Firm*Bank fixed effects	no	no	no	yes
Observations	2,780,162	2,780,162	2,639,028	2,365,937
Number of banks	149	148	148	147
Number of firms	405,920	405,920	264,787	230,465
Adjusted R-squared	0.209	0.209	0.724	0.812

Notes: panel regression estimates from 2005Q1 to 2016Q4. The dependent variable is the logarithm of granted loan by the individual bank to a given borrower in a specific quarter, multiplied by 100. The firm rating assumes value from 1 to 9, with higher values associated to riskier firms. Other macroeconomic variables include the Italian inflation rate, the unemployment rate and the business cycle indicator *Ita-coin*. Standard errors are computed using a two-way clustering by bank and firm-quarter. ***,**, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4. Exploring non-linear effects in firm rating

	(1)	(2)	(3)			(4)	
			Rating class	Eonia rate*Rating class	10-year Eurirs rate*Rating class	Eonia rate*Rating class	10-year Eurirs rate*Rating class
Firm rating	-23.314 ***	-17.091 ***	rating=2	-0.106	**0.589**	0.080	**0.899**
Firm with no rating	-69.161 ***	-48.033 ***	rating=3	0.249	**2.797**	0.450	**1.734**
Firm rating^2	1.828 ***	1.339 ***	rating=4	-0.506	**4.149 ****	-0.301	**3.284 ****
			rating=5	-0.594	**5.452 *****	-0.514	**4.933 ****
Eonia rate*Firm rating	**-0.729 ***	**-0.579**	rating=6	-1.347	**7.439 *****	-1.380	**6.700 *****
10-year Eurirs rate*Firm rating	**3.392 *****	**2.450 *****	rating=7	-10.830	**6.165 *****	-0.914	**5.081 *****
Eonia rate*Firm no rating	**-2.961 *****	**-2.410 ****	rating=8	-0.936	**5.833 *****	-1.351	**5.430 *****
10-year Eurirs rate*Firm no rating	**11.602 *****	**9.518 *****	rating=9	-0.196	**4.881 ****	-0.704	**5.921 ****
			no rating	-1.459	**6.575 *****	-1.018	**5.713 *****
Non-linear effects in firm rating							
Eonia rate*(Firm rating)^2	**0.053**	**0.033**					
10-year Eurirs rate*(Firm rating)^2	**-0.249 *****	**-0.157 ****					
(Year:quarter) fixed effects	yes	yes		yes		yes	
Bank fixed effects	yes	no		yes		no	
Firm fixed effects	yes	no		yes		no	
Firm*Bank fixed effects	no	yes		no		no	
[(Other macro variables)*(Firm rating, Firm no rating)]	yes	yes		yes		yes	
[(Other macro variables)*(Firm rating)^2]	yes	yes		yes		yes	
Bank controls	yes	yes		yes		yes	
Loan-level controls	yes	yes		yes		yes	
Observations	2,639,028	2,365,937		2,639,028		2,365,937	
Adjusted R-squared	0.724	0.812		0.724		0.812	

Notes: panel regression estimates from 2005Q1 to 2016Q4. The dependent variable is the logarithm of granted loan by the individual bank to a given borrower in a specific quarter, multiplied by 100. The firm rating assumes value from 1 to 9, with higher values associated to riskier firms. Other macroeconomic variables include the Italian inflation rate, the unemployment rate and the business cycle indicator *Ita-coin*. Standard errors are computed using a two-way clustering by bank and firm-quarter. ***,**, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Heterogeneity across banks

	Excluding interaction with capital ratio	Including interaction with capital ratio	Excluding banks with negative duration gap	Excluding banks with positive duration gap	Different treatment of overnight deposits	Non-parallel shock in interest rates: decreasing slope of the yield curve	Non-parallel shock in interest rates: increasing slope of the yield curve	Interaction terms with duration gap and capital ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Effect on banks with a larger duration gap								
Eonia rate * Firm rating * Duration gap	**-0.028 ***	**-0.028 ***	**-0.028 ***	**-0.032**	**-0.031 ***	**-0.220**	**0.008**	**-0.130 ***
10-year Eurirs rate * Firm rating * Duration gap	**0.085 ****	**0.091 ****	**0.091 ****	**0.096 ****	**0.122 *****	**0.124 *****	**0.154 *****	**0.452 ****
Eonia rate * Firm no rating * Duration gap	-0.220 *	-0.214 *	-0.189	-0.175	-0.221 *	-0.250	-0.030	-0.243
10-year Eurirs rate * Firm no rating * Duration gap	0.574 *	0.576 *	0.492	0.469	0.761 **	0.700 ***	-0.968 ***	1.853
Effect on more capitalized banks								
Eonia rate * Firm rating * Capital ratio		**0.099 ****	**0.114 *****	**0.095 ****	**0.104 *****	**0.102 *****	**0.109 *****	**0.073 ***
10-year Eurirs rate * Firm rating * Capital ratio		**-0.218 *****	**-0.230 *****	**-0.214 *****	**-0.226 *****	**-0.217 *****	**-0.232 *****	**-0.148 ***
Eonia rate * Firm with no rating * Capital ratio		-0.046	0.036	-0.035	-0.026	-0.150	0.012	-0.053
10-year Eurirs rate * Firm with no rating * Capital ratio		0.084	0.022	0.076	0.039	0.050	-0.025	0.366
Eonia rate * Firm rating * Duration gap * Capital ratio								**0.009**
10-year Eurirs rate * Firm rating * Duration gap * Capital ratio								**-0.032 ****
Eonia rate * Firm no rating * Duration gap * Capital ratio								-0.008
10-year Eurirs rate * Firm no rating * Duration gap * Capital ratio								-0.113
Firm*Bank fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Firm*(Year:quarter) fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Bank*(Year:quarter) fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Loan-level controls	yes	yes	yes	yes	yes	yes	yes	yes
[(Firm rating, no rating)*(Duration gap, Capital ratio)]	yes	yes	yes	yes	yes	yes	yes	yes
[(Firm rating, no rating)*Duration gap*Capital ratio]	no	no	no	no	no	no	no	yes
[(Other macro variables)*(Firm rating, no rating)*Duration gap]	yes	yes	yes	yes	yes	yes	yes	yes
[(Other macro variables)*(Firm rating, no rating)*Capital ratio]	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1,079,746	1,079,427	1,058,038	1,049,360	1,079,427	1,079,427	1,079,427	1,079,427

Notes: panel regression estimates from 2005Q1 to 2016Q4. The dependent variable is the logarithm of granted loan by the individual bank to a given borrower in a specific quarter, multiplied by 100. The firm rating assumes value from 1 to 9, with higher values associated to riskier firms. Other macroeconomic variables include the Italian inflation rate, the unemployment rate and the business cycle indicator *Ita-coin*. In column (3) and (4) we exclude observations for banks exhibiting, respectively, negative and positive values of the bank duration gap over the entire sample period. In column (5) we consider a measure of the duration gap where the "non-core" component of overnight deposits is set to 25% instead of 5%. In columns (6) and (7) we consider a measure of the duration gap where the interest rate shock implies non-parallel shifts in the term structure of interest rates. Standard errors are computed using a two-way c tering by bank and firm-quarter. ***,**, and * indicate statistical significance at the

Table 6. Robustness checks

	Using consolidated balance sheet items	Using the 10-year BTP yield as a measure of the long-term rate		Using alternative lagged values of the firm rating		Estimates based only on the financial crisis period (2008q2-2016q4)		Controlling for expectations on Italian growth and inflation		Using all euro-area macroeconomic variables	
	(1)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
Eonia rate * Firm rating		**0.147**		**-0.275 ****		**-0.312**		**-0.229 *****		**0.164**	
10-year Eurirs rate * Firm rating				**0.878 *****		**1.180 *****		**0.869 *****		**0.816 *****	
10-year BTP rate * Firm rating		**0.604 *****									
Effect on banks with a larger duration gap											
Eonia rate * Firm rating * Duration gap	**-0.037 ***		**-0.007**		**-0.029 ***		**-0.018**		**-0.019**		**-0.019**
10-year Eurirs rate * Firm rating * Duration gap	**0.144 *****				**0.085 ****		**0.079 ****		**0.083 ***		**0.093 *****
10-year BTP rate * Firm rating * Duration gap			**0.046 ****								
Effect on more capitalized banks											
Eonia rate * Firm rating * Capital ratio	**0.162 ***		**0.007**		**0.107 *****		**0.111 ****		**0.056**		**0.103 *****
10-year Eurirs rate * Firm rating * Capital ratio	**-0.352 *****				**-0.173 *****		**-0.223 *****		**-0.188 ****		**-0.219 *****
10-year BTP rate * Firm rating * Capital ratio			**-0.123 *****								
Firm*Bank fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
(Year:quarter) fixed effects	-	yes	-	yes	-	-	-	-	-	-	-
Firm*(Year:quarter) fixed effects	yes	-	yes	-	yes	yes	yes	yes	yes	yes	yes
Bank*(Year:quarter) fixed effects	yes	-	yes	-	yes	yes	yes	yes	yes	yes	yes
[(Firm rating) * (Bank variables)]	yes	-	yes	-	yes						
Loan-level controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Bank controls	-	yes	-	yes	-	-	-	-	-	-	-
[(Other macro variables) * (Firm rating)]	-	yes	-	yes	-	-	-	-	-	-	-
[(Other macro variables) * (Firm rating) * Capital ratio]	yes	-	yes	-	yes	yes	yes	yes	yes	yes	yes
[(Other macro variables) * (Firm rating) * Duration gap]	yes	-	yes	-	yes	yes	yes	yes	yes	yes	yes
Observations	804,363	2,365,937	1,079,427	2,365,937	1,079,427	1,803,659	861,620	2,365,937	1,079,427	2,365,937	1,079,427

Notes: panel regression estimates from 2005Q1 to 2016Q4. The dependent variable is the logarithm of granted loan by the individual bank to a given borrower in a specific quarter, multiplied by 100. The firm rating assumes value from 1 to 9, with higher values associated to riskier firms. Other macroeconomic variables include the Italian inflation rate, the unemployment rate and the business cycle indicator *Ita-coin*. In columns (5a)-(5b) we also include interaction terms with expectations 1-year ahead about Italian real GDP and inflation, as provided by Consensus Economics. In columns (6a)-(6b) we replace Italian macroeconomic variables with the corresponding variables for the euro area as a whole. As a business cycle measure we use *Euro-coin*. Standard errors are computed using a two-way clustering by bank and firm-quarter. ***,**, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Using the rating class as dependent variable

	(1)	(2)	(3)	(4)
Eonia rate	**-0.087 *****	**-0.011 ***	**-0.002**	
10-year Eurirs rate	**0.021**	**0.072 *****	**0.064 *****	
Effect on banks with larger duration gap				
Eonia rate * Duration gap				**-0.001 ****
10-year Eurirs rate * Duration gap				**-0.003 *****
Effect on more capitalized banks				
Eonia rate * Capital ratio				**0.000**
10-year Eurirs rate * Capital ratio				**0.001**
Bank fixed effects	yes	yes	-	-
Firm fixed effects	no	yes	-	-
Firm*Bank fixed effects	yes	yes	yes	yes
(Year:quarter) fixed effects	yes	yes	yes	yes
Loan-level controls	yes	yes	yes	yes
Bank controls	yes	yes	yes	yes
Other macro variables	yes	yes	yes	-
[Other macro variables * Capital ratio]	no	yes	no	yes
[Other macro variables * Duration gap]	no	yes	no	yes
Observations	2,499,205	2,375,404	2,130,194	2,130,194

Notes: panel regression estimates from 2005Q1 to 2016Q4. The dependent variable is the rating vale assigned to all loans granted by the same firm in a specific quarter. The firm rating assumes value from 1 to 9, with higher values associated to riskier firms. Observations for firm with no rating are excluded from the estimated regressions. Loan-level controls comprise the granted amount of lending, the charged interest rate, the maturity and the repricing date of the loan. Other macroeconomic variables include the Italian inflation rate, the unemployment rate and the business cycle indicator *Ita-coin*. Standard errors are computed using a two-way clustering by bank and firm-quarter. ***,**, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX A

Table A1. Weighting scheme for the calculation of the duration gap

Time band	Approximate modified duration (years)	Parallel shift in the yield curve (basis points)	Weighting factor	Decreasing slope of the yield curve (basis points)	Weighting factor	Increasing slope of the yield curve (basis points)	Weighting factor
	(A)	(B)	(A)x(B)	(C)	(A)x(C)	(D)	(A)x(D)
overnight	0.00	100	0.00	100	0.00	50	0.00
(0, 1 month]	0.04	100	0.04	100	0.04	50	0.02
(1 month, 3 months]	0.16	100	0.16	96	0.15	56	0.09
(3 months, 6 months]	0.36	100	0.36	92	0.33	60	0.22
(6 months, 1 year]	0.71	100	0.71	88	0.62	64	0.45
(1 year, 2 years]	1.38	100	1.38	84	1.16	68	0.94
(2 years, 3 years]	2.25	100	2.25	80	1.80	72	1.62
(3 years, 4 years]	3.07	100	3.07	76	2.33	76	2.33
(4 years, 5 years]	3.85	100	3.85	72	2.77	80	3.08
(5 years, 7 years]	5.08	100	5.08	68	3.45	84	4.27
(7 years, 10 years]	6.63	100	6.63	64	4.24	88	5.83
(10 years, 15 years]	8.92	100	8.92	60	5.35	92	8.21
(15 years, 20 years]	11.21	100	11.21	56	6.28	96	10.76
(20 years, oo]	13.01	100	13.01	50	6.51	100	13.01

Table A2. Interactions with other bank-specific variables

	(1)	(2)	(3)	(4)	(5)	(6)
Eonia rate * Firm rating * Duration gap	**-0.033 ****	**-0.026 ***	**-0.022**	**-0.028 ***	**-0.026 ***	**-0.025**
10-year Eurirs rate * Firm rating * Duration gap	**0.114 *****	**0.095 ****	**0.094 ****	**0.089 ****	**0.093 ****	**0.093 ****
Eonia rate * Firm rating * Capital ratio	**0.092 *****	**0.101 ****	**0.102 *****	**0.108 *****	**0.104 *****	**0.098 ****
10-year Eurirs rate * Firm rating * Capital ratio	**-0.211 *****	**-0.220 *****	**-0.221 *****	**-0.228 *****	**-0.217 *****	**-0.214 *****
Eonia rate * Firm rating * Tier1 ratio	0.010					
10-year Eurirs rate * Firm rating * Tier1 ratio	0.090					
Eonia rate * Firm rating * Deposit ratio		0.009				
10-year Eurirs rate * Firm rating * Deposit ratio		0.007				
Eonia rate * Firm rating * Liquidity ratio			0.045			
10-year Eurirs rate * Firm rating * Liquidity ratio			-0.064			
				-0.025		
Eonia rate * Firm rating * NPL ratio				0.100		
10-year Eurirs rate * Firm rating * NPL ratio						
Eonia rate * Firm rating * Loan-to-asset ratio					0.008	
10-year Eurirs rate * Firm rating * Loan-to-asset ratio					0.013	
Eonia rate * Firm rating * Bank size						-0.079
10-year Eurirs rate * Firm rating * Bank size						-0.101
Firm*Bank fixed effects	yes	yes	yes	yes	yes	yes
Firm*(Year:quarter) fixed effects	yes	yes	yes	yes	yes	yes
Bank*(Year:quarter) fixed effects	yes	yes	yes	yes	yes	yes
Loan-level controls	yes	yes	yes	yes	yes	yes
[(Firm rating)*(Bank variables)]	yes	yes	yes	yes	yes	yes
[(Other macro variables)*(Firm rating)*(Bank variables)]	yes	yes	yes	yes	yes	yes
Observations	1,079,185	1,079,427	1,079,427	1,079,427	1,079,427	1,079,427

Notes: panel regression estimates from 2005Q1 to 2016Q4. The dependent variable is the logarithm of granted loan by the individual bank to a given borrower in a specific quarter, multiplied by 100. The firm rating assumes value from 1 to 9, with higher values associated to riskier firms. Other macroeconomic variables include the Italian inflation rate, the unemployment rate and the business cycle indicator *Ita-coin*. Standard errors are computed using a two-way clustering by bank and firm-quarter. ***,**, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

References

Adrian, Tobias, and Hyun Song Shin (2010), "Financial intermediaries and monetary economics", in Benjamin M. Friedman, and Michael Woodford, eds.: Handbook of Monetary Economics (Elsevier, New York).

Albareto, Giorgio and Paolo Finaldi Russo (2012), "Financial fragility and growth prospects: credit rationing during the crisis", Bank of Italy, Occasional Papers n. 127.

Albertazzi, Ugo, and Domenico J. Marchetti (2010), "Credit supply, flight to quality and evergreening: an analysis of bank-firm relationships after Lehman", Bank of Italy, Economic working papers n. 756.

Allen, F., Elena Carletti and Robert Marquez (2011), "Credit market competition and capital regulation", Review of Financial Studies, 24(4), 983–1018.

Altissimo, Filippo, Riccardo Cristadoro, Mario Forni, Marco Lippi and Giovanni Veronese (2010), "New eurocoin: tracking economic growth in real time", The Review of Economic and Statistics, 92, 1024-1034.

Altman, Edward I. (1968), "Financial ratios, discriminant analysis and the prediction of corporate Bankruptcy", The Journal of Finance, 23, 589-609.

Altman, Edward I., Giancarlo Marco and Franco Varetto (1994), "Corporate distress diagnosis: Comparisons using linear discriminant analysis and neural networks (the Italian experience)", Journal of Banking & Finance, 18, 505-529.

Aprigliano, Valentina and Lorenzo Bencivelli (2013), "Ita-coin: a new coincident indicator for the Italian economy", Bank of Italy, Economic working papers n. 935.

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.

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.

Bonaccorsi di Patti, Emilia and Paolo Finaldi Russo (2017), "Fragilità finanziaria delle imprese e allocazione del credito", Bank of Italy, Occasional Papers n. 371.

Bonfim, Diana and Carla Soares (2018), "The risk-taking channel of monetary policy: exploring all avenues", Journal of Money, Credit and Banking, *forthcoming*.

Borio, Claudio and H. Zhu (2008), "Capital Regulation, Risk-Taking and Monetary Policy: A Missing Link in the Transmission Mechanism?", BIS Working Papers, 268.

Dell'Ariccia, Giovanni, Luc Laeven, and Robert Marquez (2014), "Monetary policy, leverage, and bank risk-taking", Journal of Economic Theory 149, 65–99.

Dell'Ariccia, Giovanni, Luc Leuven, and Gustavo A. Suarez (2017) "Bank leverage and monetary policy's risk-taking channel: evidence from the United States", The Journal of Finance, 72(2), 613-654.

EBA (2015), Guidelines on the management of the interest rate risk arising from non-trading activities, Final report, May 2015.

ESRB (2016), "Macroprudential policy issues arising from low interest rates and structural change in the EU financial system", European Systemic Risk Board, Technical report, November 2016.

Heider, Florian, Farzad Saidi, and Glenn Schepens (2018), "Life below zero: bank lending under negative policy rates", European Central Bank, Working papers, n. 2173.

Jiménez, G., S. Ongena, J.-L. Peydró, and J. Saurina (2014), "Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking?" Econometrica 82 (2), 463–505.

Khwaja, Asim Ijaz, and Atif Mian (2008), "Tracing the impact of bank liquidity shocks: evidence from an emerging market", American Economic Review, 98 (4), 1413-42.

Maddaloni, Angela., and José-Luis Peydrò (2011): "Bank Risk-Taking, Securitization, Supervision, and Low Interest Rates: Evidence From Euro-Area and U.S. Lending Standards", Review of Financial Studies, 24, 2121–2165.

Paligorova, Teodora, and Joao A. C. Santos (2012), "Monetary policy and bank risk-taking: Evidence from the corporate loan market", Working paper, Federal Reserve Bank of New York.

Rajan, Raghuram (2005), "Has financial development made the world riskier?", Proceedings of the Economic Policy Forum of the Federal Reserve Bank of Kansas City, August, 313–369.

Rodano, Giacomo, Nicolas Serrano-Velarde and Emanuele Tarantino (2018), “Lending Standards Over the Credit Cycle”, Review of Financial Studies (forthcoming).

Schivardi, Fabiano, Sette, Enrico and Tabellini, Guido (2017), “Credit Misallocation During the European Financial Crisis”, LUISS School of European Political Economy, SEP Working Papers n. 2017/3.

Stein, Jeremy C. and Anil K. Kashyap (2000), “What Do a Million Observations on Banks Say about the Transmission of Monetary Policy?”, American Economic Review, 90(3), 407-428.

RECENTLY PUBLISHED "TEMI" (*)

N. 1193 – *The effect of grants on university drop-out rates: evidence on the Italian case*, by Francesca Modena, Enrico Rettore and Giulia Martina Tanzi (September 2018).

N. 1194 – *Potential output and microeconomic heterogeneity*, by Davide Fantino (November 2018).

N. 1195 – *Immigrants, labor market dynamics and adjustment to shocks in the Euro Area*, by Gaetano Basso, Francesco D'Amuri and Giovanni Peri (November 2018).

N. 1196 – *Sovereign debt maturity structure and its costs*, by Flavia Corneli (November 2018).

N. 1197 – *Fiscal policy in the US: a new measure of uncertainty and its recent development*, by Alessio Anzuini and Luca Rossi (November 2018).

N. 1198 – *Macroeconomics determinants of the correlation between stocks and bonds*, by Marcello Pericoli (November 2018).

N. 1199 – *Bank capital constraints, lending supply and economic activity*, by Antonio M. Conti, Andrea Nobili and Federico M. Signoretti (November 2018).

N. 1200 – *The effectiveness of capital controls*, by Valerio Nispi Landi and Alessandro Schiavone (November 2018).

N. 1201 – *Contagion in the CoCos market? A case study of two stress events*, by Pierluigi Bologna, Arianna Miglietta and Anatoli Segura (November 2018).

N. 1202 – *Is ECB monetary policy more powerful during expansions?*, by Martina Cecioni (December 2018).

N. 1203 – *Firms' inflation expectations and investment plans*, by Adriana Grasso and Tiziano Ropele (December 2018).

N. 1204 – *Recent trends in economic activity and TFP in Italy with a focus on embodied technical progress*, by Alessandro Mistretta and Francesco Zollino (December 2018).

N. 1205 – *Benefits of Gradualism or Costs of Inaction? Monetary Policy in Times of Uncertainty*, by Giuseppe Ferrero, Mario Pietrunti and Andrea Tiseno (February 2019).

N. 1206 – *Machine learning in the service of policy targeting: the case of public credit guarantees*, by Monica Andini, Michela Boldrini, Emanuele Ciani, Guido de Blasio, Alessio D'Ignazio and Andrea Paladini (February 2019).

N. 1207 – *Do the ECB's monetary policies benefit Emerging Market Economies? A GVAR analysis on the crisis and post-crisis period*, by Andrea Colabella (February 2019).

N. 1208 – *The Economic Effects of Big Events: Evidence from the Great Jubilee 2000 in Rome*, by Raffaello Bronzini, Sauro Mocetti and Matteo Mongardini (February 2019).

N. 1209 – *The added value of more accurate predictions for school rankings*, by Fritz Schiltz, Paolo Sestito, Tommaso Agasisti and Kristof De Witte (February 2019).

N. 1210 – *Identification and estimation of triangular models with a binary treatment*, by Santiago Pereda Fernández (March 2019).

N. 1211 – *U.S. shale producers: a case of dynamic risk management*, by Fabrizio Ferriani and Giovanni Veronese (March 2019).

N. 1212 – *Bank resolution and public backstop in an asymmetric banking union*, by Anatoli Segura Velez (March 2019).

N. 1213 – *A regression discontinuity design for categorical ordered running variables with an application to central bank purchases of corporate bonds*, by Fan Li, Andrea Mercatanti, Taneli Mäkinen and Andrea Silvestrini (March 2019).

(*) 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.

2017

AABERGE, R., F. BOURGUIGNON, A. BRANDOLINI, F. FERREIRA, J. GORNICK, J. HILLS, M. JÄNTTI, S. JENKINS, J. MICKLEWRIGHT, E. MARLIER, B. NOLAN, T. PIKETTY, W. RADERMACHER, T. SMEEDING, N. STERN, J. STIGLITZ, H. SUTHERLAND, *Tony Atkinson and his legacy,* Review of Income and Wealth, v. 63, 3, pp. 411-444, **WP 1138 (September 2017).**

ACCETTURO A., M. BUGAMELLI and A. LAMORGESE, *Law enforcement and political participation: Italy 1861-65,* Journal of Economic Behavior & Organization, v. 140, pp. 224-245, **WP 1124 (July 2017).**

ADAMOPOULOU A. and G.M. TANZI, *Academic dropout and the great recession,* Journal of Human Capital, V. 11, 1, pp. 35–71, **WP 970 (October 2014).**

ALBERTAZZI U., M. BOTTERO and G. SENE, *Information externalities in the credit market and the spell of credit rationing,* Journal of Financial Intermediation, v. 30, pp. 61–70, **WP 980 (November 2014).**

ALESSANDRI P. and H. MUMTAZ, *Financial indicators and density forecasts for US output and inflation,* Review of Economic Dynamics, v. 24, pp. 66-78, **WP 977 (November 2014).**

BARBIERI G., C. ROSSETTI and P. SESTITO, *Teacher motivation and student learning,* Politica economica/Journal of Economic Policy, v. 33, 1, pp.59-72, **WP 761 (June 2010).**

BENTIVOGLI C. and M. LITTERIO, *Foreign ownership and performance: evidence from a panel of Italian firms,* International Journal of the Economics of Business, v. 24, 3, pp. 251-273, **WP 1085 (October 2016).**

BRONZINI R. and A. D'IGNAZIO, *Bank internationalisation and firm exports: evidence from matched firm-bank data,* Review of International Economics, v. 25, 3, pp. 476-499 **WP 1055 (March 2016).**

BRUCHE M. and A. SEGURA, *Debt maturity and the liquidity of secondary debt markets,* Journal of Financial Economics, v. 124, 3, pp. 599-613, **WP 1049 (January 2016).**

BURLON L., *Public expenditure distribution, voting, and growth,* Journal of Public Economic Theory,, v. 19, 4, pp. 789–810, **WP 961 (April 2014).**

BURLON L., A. GERALI, A. NOTARPIETRO and M. PISANI, *Macroeconomic effectiveness of non-standard monetary policy and early exit. a model-based evaluation,* International Finance, v. 20, 2, pp.155-173, **WP 1074 (July 2016).**

BUSETTI F., *Quantile aggregation of density forecasts,* Oxford Bulletin of Economics and Statistics, v. 79, 4, pp. 495-512, **WP 979 (November 2014).**

CESARONI T. and S. IEZZI, *The predictive content of business survey indicators: evidence from SIGE,* Journal of Business Cycle Research, v.13, 1, pp 75–104, **WP 1031 (October 2015).**

CONTI P., D. MARELLA and A. NERI, *Statistical matching and uncertainty analysis in combining household income and expenditure data,* Statistical Methods & Applications, v. 26, 3, pp 485–505, **WP 1018 (July 2015).**

D'AMURI F., *Monitoring and disincentives in containing paid sick leave,* Labour Economics, v. 49, pp. 74-83, **WP 787 (January 2011).**

D'AMURI F. and J. MARCUCCI, *The predictive power of google searches in forecasting unemployment,* International Journal of Forecasting, v. 33, 4, pp. 801-816, **WP 891 (November 2012).**

DE BLASIO G. and S. POY, *The impact of local minimum wages on employment: evidence from Italy in the 1950s,* Journal of Regional Science, v. 57, 1, pp. 48-74, **WP 953 (March 2014).**

DEL GIOVANE P., A. NOBILI and F. M. SIGNORETTI, *Assessing the sources of credit supply tightening: was the sovereign debt crisis different from Lehman?,* International Journal of Central Banking, v. 13, 2, pp. 197-234, **WP 942 (November 2013).**

DEL PRETE S., M. PAGNINI, P. ROSSI and V. VACCA, *Lending organization and credit supply during the 2008–2009 crisis,* Economic Notes, v. 46, 2, pp. 207–236, **WP 1108 (April 2017).**

DELLE MONACHE D. and I. PETRELLA, *Adaptive models and heavy tails with an application to inflation forecasting,* International Journal of Forecasting, v. 33, 2, pp. 482-501, **WP 1052 (March 2016).**

FEDERICO S. and E. TOSTI, *Exporters and importers of services: firm-level evidence on Italy,* The World Economy, v. 40, 10, pp. 2078-2096, **WP 877 (September 2012).**

GIACOMELLI S. and C. MENON, *Does weak contract enforcement affect firm size? Evidence from the neighbour's court,* Journal of Economic Geography, v. 17, 6, pp. 1251-1282, **WP 898 (January 2013).**

LOBERTO M. and C. PERRICONE, *Does trend inflation make a difference?,* Economic Modelling, v. 61, pp. 351–375, **WP 1033 (October 2015).**

MANCINI A.L., C. MONFARDINI and S. PASQUA, *Is a good example the best sermon? Children's imitation of parental reading,* Review of Economics of the Household, v. 15, 3, pp 965–993, **D No. 958 (April 2014).**

MEEKS R., B. NELSON and P. ALESSANDRI, *Shadow banks and macroeconomic instability,* Journal of Money, Credit and Banking, v. 49, 7, pp. 1483–1516, **WP 939 (November 2013).**

MICUCCI G. and P. ROSSI, *Debt restructuring and the role of banks' organizational structure and lending technologies,* Journal of Financial Services Research, v. 51, 3, pp 339–361, **WP 763 (June 2010).**

MOCETTI S., M. PAGNINI and E. SETTE, *Information technology and banking organization,* Journal of Journal of Financial Services Research, v. 51, pp. 313-338, **WP 752 (March 2010).**

MOCETTI S. and E. VIVIANO, *Looking behind mortgage delinquencies,* Journal of Banking & Finance, v. 75, pp. 53-63, **WP 999 (January 2015).**

NOBILI A. and F. ZOLLINO, *A structural model for the housing and credit market in Italy,* Journal of Housing Economics, v. 36, pp. 73-87, **WP 887 (October 2012).**

PALAZZO F., *Search costs and the severity of adverse selection,* Research in Economics, v. 71, 1, pp. 171-197, **WP 1073 (July 2016).**

PATACCHINI E. and E. RAINONE, *Social ties and the demand for financial services,* Journal of Financial Services Research, v. 52, 1–2, pp 35–88, **WP 1115 (June 2017).**

PATACCHINI E., E. RAINONE and Y. ZENOU, *Heterogeneous peer effects in education,* Journal of Economic Behavior & Organization, v. 134, pp. 190–227, **WP 1048 (January 2016).**

SBRANA G., A. SILVESTRINI and F. VENDITTI, *Short-term inflation forecasting: the M.E.T.A. approach,* International Journal of Forecasting, v. 33, 4, pp. 1065-1081, **WP 1016 (June 2015).**

SEGURA A. and J. SUAREZ, *How excessive is banks' maturity transformation?,* Review of Financial Studies, v. 30, 10, pp. 3538–3580, **WP 1065 (April 2016).**

VACCA V., *An unexpected crisis? Looking at pricing effectiveness of heterogeneous banks,* Economic Notes, v. 46, 2, pp. 171–206, **WP 814 (July 2011).**

VERGARA CAFFARELI F., *One-way flow networks with decreasing returns to linking,* Dynamic Games and Applications, v. 7, 2, pp. 323-345, **WP 734 (November 2009).**

ZAGHINI A., *A Tale of fragmentation: corporate funding in the euro-area bond market,* International Review of Financial Analysis, v. 49, pp. 59-68, **WP 1104 (February 2017).**

2018

ADAMOPOULOU A. and E. KAYA, *Young adults living with their parents and the influence of peers,* Oxford Bulletin of Economics and Statistics,v. 80, pp. 689-713, **WP 1038 (November 2015).**

ANDINI M., E. CIANI, G. DE BLASIO, A. D'IGNAZIO and V. SILVESTRINI, *Targeting with machine learning: an application to a tax rebate program in Italy,* Journal of Economic Behavior & Organization, v. 156, pp. 86-102, **WP 1158 (December 2017).**

BARONE G., G. DE BLASIO and S. MOCETTI, *The real effects of credit crunch in the great recession: evidence from Italian provinces,* Regional Science and Urban Economics, v. 70, pp. 352-59, **WP 1057 (March 2016).**

BELOTTI F. and G. ILARDI *Consistent inference in fixed-effects stochastic frontier models,* Journal of Econometrics, v. 202, 2, pp. 161-177, **WP 1147 (October 2017).**

BERTON F., S. MOCETTI, A. PRESBITERO and M. RICHIARDI, *Banks, firms, and jobs,* Review of Financial Studies, v.31, 6, pp. 2113-2156, **WP 1097 (February 2017).**

BOFONDI M., L. CARPINELLI and E. SETTE, *Credit supply during a sovereign debt crisis,* Journal of the European Economic Association, v.16, 3, pp. 696-729, **WP 909 (April 2013).**

BOKAN N., A. GERALI, S. GOMES, P. JACQUINOT and M. PISANI, *EAGLE-FLI: a macroeconomic model of banking and financial interdependence in the euro area,* Economic Modelling, v. 69, C, pp. 249-280, **WP 1064 (April 2016).**

BRILLI Y. and M. TONELLO, *Does increasing compulsory education reduce or displace adolescent crime? New evidence from administrative and victimization data,* CESifo Economic Studies, v. 64, 1, pp. 15–4, **WP 1008 (April 2015).**

BUONO I. and S. FORMAI *The heterogeneous response of domestic sales and exports to bank credit shocks,* Journal of International Economics, v. 113, pp. 55-73, **WP 1066 (March 2018).**

BURLON L., A. GERALI, A. NOTARPIETRO and M. PISANI, *Non-standard monetary policy, asset prices and macroprudential policy in a monetary union,* Journal of International Money and Finance, v. 88, pp. 25-53, **WP 1089 (October 2016).**

CARTA F. and M. DE PHLIPPIS, *You've Come a long way, baby. Husbands' commuting time and family labour supply,* Regional Science and Urban Economics, v. 69, pp. 25-37, **WP 1003 (March 2015).**

CARTA F. and L. RIZZICA, *Early kindergarten, maternal labor supply and children's outcomes: evidence from Italy,* Journal of Public Economics, v. 158, pp. 79-102, **WP 1030 (October 2015).**

CASIRAGHI M., E. GAIOTTI, L. RODANO and A. SECCHI, *A "Reverse Robin Hood"? The distributional implications of non-standard monetary policy for Italian households,* Journal of International Money and Finance, v. 85, pp. 215-235, **WP 1077 (July 2016).**

CECCHETTI S., F. NATOLI and L. SIGALOTTI, *Tail co-movement in inflation expectations as an indicator of anchoring,* International Journal of Central Banking, v. 14, 1, pp. 35-71, **WP 1025 (July 2015).**

CIANI E. and C. DEIANA, *No Free lunch, buddy: housing transfers and informal care later in life,* Review of Economics of the Household, v.16, 4, pp. 971-1001, **WP 1117 (June 2017).**

CIPRIANI M., A. GUARINO, G. GUAZZAROTTI, F. TAGLIATI and S. FISHER, *Informational contagion in the laboratory,* Review of Finance, v. 22, 3, pp. 877-904, **WP 1063 (April 2016).**

DE BLASIO G, S. DE MITRI, S. D'IGNAZIO, P. FINALDI RUSSO and L. STOPPANI, *Public guarantees to SME borrowing. A RDD evaluation,* Journal of Banking & Finance, v. 96, pp. 73-86, **WP 1111 (April 2017).**

GERALI A., A. LOCARNO, A. NOTARPIETRO and M. PISANI, *The sovereign crisis and Italy's potential output,* Journal of Policy Modeling, v. 40, 2, pp. 418-433, **WP 1010 (June 2015).**

LIBERATI D., *An estimated DSGE model with search and matching frictions in the credit market,* International Journal of Monetary Economics and Finance (IJMEF), v. 11, 6, pp. 567-617, **WP 986 (November 2014).**

LINARELLO A., *Direct and indirect effects of trade liberalization: evidence from Chile,* Journal of Development Economics, v. 134, pp. 160-175, **WP 994 (December 2014).**

NUCCI F. and M. RIGGI, *Labor force participation, wage rigidities, and inflation,* Journal of Macroeconomics, v. 55, 3 pp. 274-292, **WP 1054 (March 2016).**

RIGON M. and F. ZANETTI, *Optimal monetary policy and fiscal policy interaction in a non_ricardian economy,* International Journal of Central Banking, v. 14 3, pp. 389-436, **WP 1155 (December 2017).**

SEGURA A., *Why did sponsor banks rescue their SIVs?,* Review of Finance, v. 22, 2, pp. 661-697, **WP 1100 (February 2017).**

2019

CIANI E. and P. FISHER, *Dif-in-dif estimators of multiplicative treatment effects*, Journal of Econometric Methods, v. 8. 1, pp. 1-10, **WP 985 (November 2014).**

FORTHCOMING

ACCETTURO A., W. DI GIACINTO, G. MICUCCI and M. PAGNINI, *Geography, productivity and trade: does selection explain why some locations are more productive than others?,* Journal of Regional Science, **WP 910 (April 2013).**

ALBANESE G., G. DE BLASIO and P. SESTITO, *Trust, risk and time preferences: evidence from survey data,* International Review of Economics, **WP 911 (April 2013).**

APRIGLIANO V., G. ARDIZZI and L. MONTEFORTE, *Using the payment system data to forecast the economic activity,* International Journal of Central Banking, **WP 1098 (February 2017).**

ARNAUDO D., G. MICUCCI, M. RIGON and P. ROSSI, *Should I stay or should I go? Firms' mobility across banks in the aftermath of the financial crisis*, Italian Economic Journal / Rivista italiana degli economisti, **WP 1086 (October 2016).**

"TEMI" LATER PUBLISHED ELSEWHERE

BELOTTI F. and G. ILARDI, *Consistent inference in fixed-effects stochastic frontier models*, Journal of Econometrics, **WP 1147 (October 2017).**

BUSETTI F. and M. CAIVANO, *Low frequency drivers of the real interest rate: empirical evidence for advanced economies,* International Finance, **WP 1132 (September 2017).**

CHIADES P., L. GRECO, V. MENGOTTO, L. MORETTI and P. VALBONESI, *Fiscal consolidation by intergovernmental transfers cuts? Economic Modelling,* **WP 1076 (July 2016).**

CIANI E., F. DAVID and G. DE BLASIO, *Local responses to labor demand shocks: a re-assessment of the case of Italy,* IMF Economic Review, **WP 1112 (April 2017).**

COLETTA M., R. DE BONIS and S. PIERMATTEI, *Household debt in OECD countries: the role of supply-side and demand-side factors,* Social Indicators Research, **WP 989 (November 2014).**

CORSELLO F. and V. NISPI LANDI, *Labor market and financial shocks: a time-varying analysis,* Journal of Money, Credit and Banking, **WP 1179 (June 2018).**

COVA P., P. PAGANO and M. PISANI, *Domestic and international macroeconomic effects of the Eurosystem Expanded Asset Purchase Programme,* IMF Economic Review, **WP 1036 (October 2015).**

D'AMURI F., *Monitoring and disincentives in containing paid sick leave,* Labour Economics, **WP 787 (January 2011).**

D'IGNAZIO A. and C. MENON, *The causal effect of credit Guarantees for SMEs: evidence from Italy,* Scandinavian Journal of Economics, **WP 900 (February 2013).**

ERCOLANI V. and J. VALLE E AZEVEDO, *How can the government spending multiplier be small at the zero lower bound?,* Macroeconomic Dynamics, **WP 1174 (April 2018).**

FEDERICO S. and E. TOSTI, *Exporters and importers of services: firm-level evidence on Italy,* The World Economy, **WP 877 (September 2012).**

GERALI A. and S. NERI, *Natural rates across the Atlantic,* Journal of Macroeconomics, **WP 1140 (September 2017).**

GIACOMELLI S. and C. MENON, *Does weak contract enforcement affect firm size? Evidence from the neighbour's court,* Journal of Economic Geography, **WP 898 (January 2013).**

GIORDANO C., M. MARINUCCI and A. SILVESTRINI, *The macro determinants of firms' and households' investment: evidence from Italy,* Economic Modelling, **WP 1167 (March 2018).**

NATOLI F. and L. SIGALOTTI, *Tail co-movement in inflation expectations as an indicator of anchoring,* International Journal of Central Banking, **WP 1025 (July 2015).**

RIGGI M., *Capital destruction, jobless recoveries, and the discipline device role of unemployment,* Macroeconomic Dynamics, **WP 871 (July 2012).**

RIZZICA L., *Raising aspirations and higher education. evidence from the UK's widening participation policy,* Journal of Labor Economics, **WP 1188 (September 2018).**

SEGURA A., *Why did sponsor banks rescue their SIVs?,* Review of Finance, **WP 1100 (February 2017).**