

Bank-specific factors and credit risk: evidence from Italian banks in different local markets

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316

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Abstract

Purpose – Using bank-level data over the 1994–2015 period, the authors aim to investigate the role of bank-specific factors on credit risk in Italy by considering two different groups of banks, namely, cooperative and non-cooperative (commercial and popular), in different local markets.

Design/methodology/approach – Relying on highly territorially disaggregated data at labour market areas' level, the authors estimate the impact of the role of bank-specific factors on credit risk in Italy from the estimation of a fixed-effect estimator. Non-performing loans to total loans has been used as a proxy of credit risk; the bank-specific factors are as follows: growth of loans, reflecting credit policy; log of total assets, controlling for banks' size; loans to total assets, reflecting the volume of credit market; equity to total assets, capturing the solvency of banks and reflecting their capital strength; return on assets, reflecting the profitability of banks; deposits to loans, reflecting the intermediation cost; cost of total assets, reflecting the banks' efficiency or volume of intermediation cost.

Findings – The empirical findings suggest that regulatory credit policy, capitalisation, volume of credit and volume of intermediation costs are the main bank-specific factors affecting non-performing loans. Nevertheless, the present analysis suggests that the behaviour of cooperative banks' behaviour seems to be in line with that of commercial rather than popular banks, casting doubts about the feasibility of their credit policies. It turns out that recent reforms involving popular and cooperative banks represent the first step toward the enhancement of the stability and efficiency of the Italian banking system. While the present study's benchmark results are not particularly affected by the degree of competition in the banking sector and by banks' size, it shows that both cooperative and non-cooperative banks have undertaken more prudent credit policies after the advent of the financial crisis and the introduction of the Basel regulation.

Originality/value – The relationship between bank-specific factors and credit risk has been analysed using a rich sample of cooperative, commercial and popular banks in Italy over the 1994–2015 period. The authors rely on labour market areas being sub-regional geographical areas where the bulk of the labour force lives and works. The contribution is motivated by the financial distress experienced after the 2008 financial crisis, which has significantly hit the Italian banking system and cooperative banks in particular.

Keywords Bank-specific factors, Credit risk, Cooperative and non-cooperative banks, Market structure

Paper type Research paper

1. Motivation and literature

The link between bank-specific factors and bank risk has been the subject of much attention in the literature, with several contributions, both at national and cross-country levels, been

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JEL classification – G21, G28, C14, D21



devoted to the identification of the relevant bank-specific drivers of credit risk. [Salas and Saurina \(2002\)](#), using data for Spain over the 1985–1997 period, empirically assess the impact of both bank-specific and macroeconomic determinants on credit risk, focusing on two different institutional regimes, namely, commercial and saving banks, and show that factors like branch expansion, inefficiency, portfolio composition, size and market power play a key role in explaining credit quality and that saving banks are largely more affected by bank-specific factors.

[Haq and Heaney \(2012\)](#) relied on a set of 117 banking institutions for 15 European Union (EU) countries over the 1996–2010 period to investigate the impact of various bank-specific factors, like bank capital, charter value, off-balance sheet activities, dividend pay-out ratio, operating leverage and size, on both bank equity risk and credit risk. Their evidence points out to a U-shaped relationship between bank capital and both equity and credit risk. In contrast, while off-balance sheet activities determine an increase in bank risk, evidence of an inverse relationship between dividend pay-out ratio and all the measures of risk that were employed was found. Further, their analysis revealed that both equity and credit risk depend upon banks' size, with large banks contemporaneously exhibiting higher systematic risk but lower credit risk.

[Ghosh \(2015\)](#) relied on a generalised method of moments (GMM) approach to deal with the relationship between bank-industry-specific factors and non-performing loans, considering the whole set of commercial and savings banks in the 50 US States and the District of Columbia over the 1984–2013 period. While higher profitability was found to be inversely correlated with credit risk, capitalisation, liquidity risks, cost inefficiency and the size of the banking industry were found to have a detrimental effect on the variable of interest.

[Chaibi and Ftiti \(2015\)](#), within a dynamic panel data framework, studied the effects of both macroeconomic and bank-specific factors on non-performing loans for a set of commercial banks for France and Germany over the 2005–2011 period, to assess whether the effects of the relevant explanatory variables depended upon the type of banking system, as the two countries are, respectively, classified as market-based and bank-based. The set of bank-specific variables included in the econometric analysis were loan loss provision, inefficiency, leverage, solvency ratio, non-interest income, size and bank profitability, and their evidence revealed that bank-specific factors affect credit quality mostly in the case of the French market-based system.

Other papers, like those of [Agoraki *et al.* \(2011\)](#) and [Tabak *et al.* \(2012\)](#), dealt instead with the relationship between market structure and risk-taking propensity. [Agoraki *et al.* \(2011\)](#) indeed analysed the nexus between capital requirements, market structure and risk-taking propensity, considering a sample of 546 banks for a set of 13 countries from Central and Eastern Europe over the 1998–2005 period, finding evidence of an inverse relationship between market structure and risk-taking and that banks with market power tend to display lower probabilities of default. This contribution further revealed that capital requirements reduce credit risk, although this effect vanishes or can be even reversed once market power is considered. [Tabak *et al.* \(2012\)](#), using data for ten Latin American countries over the 2003–2008 period, focused on the role of competition, size and capital requirements on bank risk. Competition and bank risk exhibited a non-monotonic relationship, with the former further shown to strengthen financial stability. Capital ratios were instead found to play a key role in the case of collusive markets, with beneficial effects on the stability of large banks, if they operate in moderately or highly competitive markets.

Another strand of the literature, see, for instance, [Louzis *et al.* \(2012\)](#) and [Abid *et al.* \(2014\)](#), has focused on the relationship between management quality and risk. [Louzis *et al.* \(2012\)](#), using quarterly data for the nine largest banks in Greece over the 2003–2009 period, proposed the application of dynamic panel methods to identify both the aggregate and bank-specific variables affecting non-performing loans. They showed that most of the variation in the non-performing loans ratio is driven by macroeconomic factors, while management quality plays a preeminent role among the set of bank-specific factors assumed to influence bank risk. Using a similar econometric approach, based on the application of the system GMM, [Abid *et al.* \(2014\)](#) identified the main bank-specific and macroeconomic drivers of households' non-performing loans in a sample of 16 Tunisian banks over the 2003–2012 period. In line with [Louzis *et al.* \(2012\)](#), they showed that although most of the variation in credit risk is explained by variations in the underlying macroeconomic environment, higher quality of management is associated with lower credit risk.

Finally, other contributions have instead focused on of the relationships between ownership structure on both risk-taking behaviour and banks' efficiency.

[Zribi and Boujelbène \(2011\)](#), using data for a set of commercial banks for Tunisia over the 1995–2008 period, showed that beyond customary macro factors, ownership structure, prudential regulation of capital and profitability play a key role in explaining credit risk dynamics.

[Forssbäck \(2011\)](#) investigated the effects of market discipline and ownership on credit risk for a set of 331 banks worldwide over the ten-year period from 1995 to 2005, finding evidence of a negative relationship between market discipline and credit risk, and favourable evidence concerning the existence of a U-shaped relationship between ownership structure and the variable of interest. The paper further showed that the joint effect of market discipline and ownership has a limited impact on credit quality.

[Haque and Brown \(2017\)](#), relying on data for a set of 132 commercial banks of 12 Middle East and North Africa (MENA) region, dealt with the relationship between ownership structure and efficiency, through the application of a data envelopment analysis (DEA) approach, and found that ownership concentration and governmental ownership increase cost efficiency, while there is positive and significant impact on profits only during the pre-crisis period. The impact of ownership structure on bank productivity has instead been studied by [Sanyal and Shankar \(2011\)](#), who relied on data for 107 Indian banks over the 1992–2004 period, showing that private banks are 38% more productive compared to their publicly owned counterparts.

This paper attempts to contribute to the recent literature concerning the effects of bank-specific factors upon the ratio of non-performing loans, trying to assess whether the impact of the relevant bank-specific factors on credit risk varies according to the institutional regime, as our analysis incorporates different types of banks. More specifically, in our analysis, we assess how bank-specific factors influence credit risk by alternatively considering cooperative and non-cooperative banks (popular and commercial), a partition which is relevant given the structure of the Italian banking system. Indeed, as highlighted by various contributions in the literature, see, for instance, [Gutiérrez \(2008\)](#), [Manetti and Bagnoli \(2013\)](#), [Destefanis *et al.* \(2014\)](#), [Bruno *et al.* \(2018\)](#), cooperative banks play a key role in the Italian banking system, as these financial institutions, which are smaller than commercial banks, mostly operate in peripheral, less-developed areas; have consolidated and deep roots with the territory; and represent the main source of funding for small and medium enterprises (SMEs), which would face stricter credit constraints from commercial banks. Further, as emphasised by [Berger and Mester \(1997\)](#) and [Pestana Barros *et al.* \(2010\)](#), the peculiar governance structure of cooperative banks, in which customers are fully involved in the decision-making

process of the intermediary, should, in principle, allow them to better monitor their borrowers, as they are better informed about the quality of debtors. Nevertheless, though, various contributions in the literature, see, for instance, Barra and Zotti (2019a, 2019b), have proven that cooperative banks are more efficient than other types of financial intermediaries, and the performance of cooperative banks has significantly shrunk with the advent of the 2008 financial crisis, a result that, according to Destefanis *et al.* (2014), beyond unfavourable economic conditions, is essentially ascribed to some regulatory features faced by cooperative banks, with a key role played by localisation constraints. It turns out that a genuine analysis aimed at assessing whether the effects of bank-specific factors on credit risk are similar between the different types of banks that compose the Italian banking system would shed light about its functioning and the way the different financial institutions manage credit risk. In particular, the aim of this paper is to assess whether cooperative banks' credit policies are aligned to the ones adopted by commercial or popular banks. Indeed, if the behaviour of cooperative banks mimics that of commercial rather than popular banks, it turns out that the recent reforms of popular and cooperative banks represent a step forward to strengthen financial stability and improve the efficiency of the banking sector. Moreover, we bring additional insights by testing whether the influence of the main bank-specific determinants of non-performing loans varies according to the degree of competition in the banking sector, variations in the degree of economic activity (summarised here by the 2008 financial crisis) and changes in the regulatory environment, such as the introduction of Basel Accords, i.e. Basel II and Basel III.

Empirical evidence presented in this paper reveals that the ratio of non-performing loans for both cooperative and non-cooperative banks is influenced by the same bank-specific factors, with a significant role found for regulatory credit policy, capitalisation, volume of credit and volume of intermediation costs. As the estimated parameters are quantitatively similar among the three types of banks (i.e. cooperative, commercial and popular), and especially between cooperatives and commercial, it seems reasonable to assert that cooperative banks operate like their commercial counterparts, a result that is further reinforced by the fact that the impact of bank-specific factors on non-performing loans is not particularly affected by the degree of competition in the banking system and by banks' size. It turns out that the 2015 implementation of the reform of popular banks, which introduces size limits by requiring popular banks to be transformed into joint stock companies provided that their amount of assets exceeds €8bn, and the 2016 reform of cooperative banks, aimed at reducing the fragmentation of the sector and its structural weaknesses, allowing these intermediaries to obtain funds outside the cooperative sector in case of financial distress, probably represent a step forward to enhance financial stability and to allow for a more efficient allocation of resources within the financial system. Further, empirical findings presented here further suggest that, after the advent of the 2008 financial crisis and the introduction of the Basel II and III accords, both cooperative and non-cooperative banks adopted more prudent credit policies, implying that the introduction of new capital and deposits requirements was effective in reducing credit risk.

The paper is structured as follows. Section 2 discusses the data and the empirical strategy employed in our econometric analysis, while in Section 3, the main empirical findings are introduced, emphasising the behaviour of the two different types of banks considered and the relevance of market structure, to test whether the benchmark results are affected by the degree of competition in the banking system. Section 4 discusses the robustness checks. Specifically, to test the robustness of our estimates, we initially propose to split the sample of banks according to their size, as large and small banks might behave

differently in terms of risk-taking propensity, and then test whether the advent of the financial crisis and the introduction of the Basel accords have caused structural breaks in the Italian banking system, therefore affecting the parameters of interest. As an additional robustness check, our baseline regressions are extended by employing an alternative dependent variable, represented by the z-score on the return on asset (ROA). We further assess the robustness of our findings by properly considering the size of the local market areas (LMAs), as the latter might affect the degree of competition in the banking market and, in turn, provide bias estimates of the parameters of interest. Section 5 concludes and discusses the main policy implications drawn from the econometric analysis proposed in this paper.

2. Empirical framework

2.1 Data and variables

To empirically identify the main bank-specific drivers of the ratio of non-performing loans and to test whether these effects vary unevenly across the relevant types of banks scrutinised, our analysis is developed using bank-level information. The main source of data is represented by the BilBank 2000 database distributed by ABI (Associazione Bancaria Italiana), which provides a large amount of information concerning both bank balance sheets and bank-specific factors, covering the 1994–2015 period (see [Table 1](#) for more details on the definition of the variables) [1].

The sample of banks consists of cooperative, commercial and popular banks. Branches of banks located abroad, however, are excluded from our sample, as they follow a different regulation, based on both the national and the local rules of the country in which they operate.

Banks in our sample are classified as per the Bank of Italy as follows: major (average funds intermediated more than €65bn), large (average funds intermediated between €27bn and €65bn), medium (average funds intermediated between €9bn and €27bn), small (average funds intermediated between €1.3bn and €9bn) and minor (average funds intermediated less than €1.3bn). Our data set contains, on average, information for 694 banks, categorically and territorially portioned as follows: 437 for cooperative banks (63% of our sample), 206 for commercial banks (30% of our sample) and 51 for popular banks (7% of our sample); 238 for North-West (34% of our sample), 147 for North-East (21% of our sample), 130 for Centre (19% of our sample) and 179 for South (26% of our sample). Due to the territorially highly disaggregated data availability, the financial reforms (privatisation and second banking directive) occurred after 1990 and the integration of markets, Italy is a promising field of analysis ([Table 2](#)).

All monetary aggregates are in thousands and deflated at 2005 Euros. The sample begins in 1994, since some variables are not available before that year.

[Table 3](#) reports descriptive statistics for the main variables employed in the paper, partitioned both at bank and territorial levels. According to [Table 3](#), the proportion of non-performing loans is higher for popular banks, followed by cooperatives and commercial banks. A result that suggests that, at least in the Italian case, popular and cooperative banks are not necessarily less risky than their commercial counterparts. While the ROA is larger for cooperative and popular banks, the degree of capitalisation, volume of credit and volume of cost are similar between the three different types of banks considered. A different picture, however, emerges with respect to both intermediation costs and size, which are higher for commercial banks. Once statistics are partitioned at the territorial level, a clear dualism emerges in the Italian banking system. Descriptive statistics reported in [Table 3](#) indicate that southern regions display a higher proportion

<i>Variables</i>	<i>Symbol</i>	<i>Description</i>
<i>Bank risk</i>		
<i>Credit risk</i>	CR	Non-performing loans to total loans. ^a
<i>Financial stability (1)</i>	ZSCORE _{ROA}	Capitalisation plus return on assets over standard deviation of return on assets. ^a
<i>Financial stability (2)</i>	ZSCORE _{ROE}	One plus return on equity over standard deviation of return on equity. ^a
<i>Bank-specific factors</i>		
<i>Credit policy</i>	GRLO	Loans at time t minus loans at time $t - 1$. ^a
<i>Return on assets</i>	ROA	Profit to total assets. ^a
<i>Capitalisation</i>	ETA	Equity to total assets. ^a
<i>Dimension of bank</i>	TA	Log of total assets. ^a
<i>Volume of credit market</i>	LTA	Loans to total assets. ^a
<i>Intermediation cost</i>	DL	Deposits to loans. ^a
<i>Volume of intermediation cost</i>	CTA	Cost to total assets. ^a
<i>Controls</i>		
<i>Dimension of banks</i>	DYM	Large, medium, small and minor dummies; major used as benchmark group
<i>Timing</i>	TIME	Set of time dummies
<i>Macro regions</i>	MR	Set of region dummies (i.e. 20) included in the model to capture the geographical or spillover effects
<i>Market structure</i>		
<i>Monopolistic dummy</i>	MON	Monopolistic market (assuming 1 if at LMAs' level there is one bank [cooperative or non-cooperative banks], 0 otherwise)
<i>Duopolistic dummy</i>	DUO	Duopolistic market (assuming 2 if at LMAs' level there are two banks [cooperative or non-cooperative banks or both], 0 otherwise)
<i>Oligopolistic dummy</i>	OLIG	Oligopolistic market (assuming 3 if at LMAs' level there are three banks [cooperative or non-cooperative banks or both], 0 otherwise)
<i>Competitive dummy</i>	COMP	Competitive market (assuming 4 if at LMAs' level there are more than three banks [cooperative or non-cooperative banks or both], 0 otherwise)

Note: Deposits and loans are those granted to customers

Source: ^aOwn calculations upon BilBank 2000 database from ABI

Table 1.
Description of the variables

Table 2.
Description of
sample used in the
analysis: the market
structure

Market structure	Cooperative banks					All banks
	North-West	North-East	Centre	South	Cooperative banks	
<i>MON</i>	582	507	669	1,359	2,059	3,117
<i>DUO</i>	747	509	549	961	1,852	2,766
<i>OLIG</i>	939	198	479	579	1,515	2,188
<i>COMP</i>	2,967	2,024	1,170	1,035	3,735	7,196
<i>ITALY</i>	5,235	3,238	2,860	3,934	9,611	15,267
					Commercial banks	Popular banks
					375	233
					604	310
					555	118
					3,003	458
					4,537	1,119

Source: Own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana)

Banks/Variables	CR	GRLO	ROA	ETA	LTA	DL	CTA	TA
<i>Cooperative banks</i> (N = 9,611)	0.0163 0.0194	9938.54 41383.03	0.0053 0.0270	0.1337 0.0415	0.6213 0.1928	1.1752 16.1989	0.0746 0.052	274437.2 465499.4
<i>Commercial banks</i> (N = 4,537)	0.0137 0.0226	239758.6 5193563	-0.0000 0.03288	0.1275 0.0847	0.6005 0.2827	24.8065 349.4974	0.0802 0.0704	1.24e+07 4.22e+07
<i>Popular banks</i> (N = 1,119)	0.0192 0.0286	285044 2513528	0.0049 0.0159	0.1332 0.0629	0.6453 0.1905	0.9080 0.6550	0.0715 0.0498	9993896 2.10e+07
<i>North-West</i> (N = 5,235)	0.0120 0.0179	95452.23 2077605	0.0061 0.0327	0.1376 0.0512	0.6921 0.2068	2.3599 76.9778	0.0743 0.0510	2894735 17400000
<i>North-East</i> (N = 3,238)	0.0134 0.0202	292389.8 4944393	0.0005 0.0326	0.1286 0.0720	0.5940 0.2637	17.6598 218.0379	0.0798 0.0709	8832653 35400000
<i>Centre</i> (N = 2,860)	0.0165 0.0219	16129.28 2199006	0.0039 0.0253	0.1229 0.0535	0.6135 0.2122	8.095 258.9389	0.0758 0.0562	5646839 21200000
<i>South</i> (N = 3,934)	0.0222 0.0241	-8276.78 1575316	0.0029 0.0186	0.1334 0.0610	0.5382 0.1816	8.1774 214.7064	0.0755 0.0563	2581162 22800000
<i>All sample</i> (N = 15,267)	0.0158 0.0213	95258.62 2855534	0.0037 0.0284	0.1318 0.0593	0.6169 0.2236	8.1783 191.2491	0.0760 0.0581	4588873 24400000

Notes: See Table 1 for more details about the description and construction of variables included in the regression. All variables averaged between 1994 and 2015. All monetary aggregates are in thousands of euros (at 2005 prices). Standard deviation in parentheses
Source: Own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana)

Table 3.
Summary of statistics

of non-performing loans and that banks operating in these areas are smaller than those in other macro areas, but better capitalised. Evidence presented in Table 3 further highlights that, over the period considered, less-developed southern regions exhibit a negative growth of loans, a result that can be ascribed to the advent of the crisis, which has been truly severe for these regions, consistently harming their economic performances. Finally, according to Table 3, banks operating in southern regions have lower returns than those in the most developed regions of the country and exhibit lower volumes of credits.

Table 4 reports the pairwise correlations among the main variables used in our econometric analysis. We document a negative and significant correlation between the growth in total loans and the quality of credit. ROA is negatively and significantly correlated with the main variables, but growth of loans. Capitalisation, on the other hand, is found to be inversely and significantly correlated with the ratio of non-performing loans, ROAs and growth in total loans. The log of total assets, which proxies the bank dimension, is shown to be directly correlated with non-performing loans' ratio and growth in total loans and inversely correlated with capitalisation, volume of credit and volume of intermediation cost. The volume of credit is shown to be inversely correlated with non-performing loans' ratio and capitalisation and positively with growth in total loans and ROAs, while intermediation cost correlates negatively with non-performing loans' ratio and ROAs and positively with capitalisation. Finally, the volume of intermediation cost exhibits a positive and statistically significant relationship with all the main variables employed in the paper.

2.2 Empirical specification

To empirically assess the role of bank-specific factors on non-performing loans, we follow the approach proposed by Hesse and Cihák (2007) and rely on the application of a fixed-effects estimator [2] with cluster standard errors, to deal with the presence of group-wise heteroscedasticity. As highlighted by Wooldridge (2002), the application of the fixed-effects estimator allows unobserved specific factors to be correlated with the drivers of asset quality, while Beck et al. (2013) emphasised that the presence of these unobserved specific factors allows the fixed-effect estimator to solve the problem of omitted variable bias and to capture the existing heterogeneity within cross-sectional units. It must be further highlighted that, although the main literature surveyed here relies on the application of dynamic panel methods, most notably the GMM, this econometric procedure has little ground in this environment, given the structure of our data set. Indeed, it has been recognised that the GMM is suitable for panels with few time periods and a higher number

Table 4.
Pairwise matrix
correlations between
variables

Variables	CR	GRLO	ROA	ETA	LTA	DL	CTA	TA
CR	1.0000							
ΔLO	-0.0226***	1.0000						
ROA	0.1276***	-0.0046	1.0000					
ETA	-0.1273***	-0.0144	-0.1601***	1.0000				
LTA	-0.1574***	0.0408***	0.1154***	-0.0929***	1.0000			
DL	-0.0275***	-0.0012	-0.1423***	0.1569***	-0.1055***	1.0000		
CTA	-0.3455***	0.0135	-0.4079***	0.1681***	0.2210***	0.0737***	1.0000	
TA	0.0282***	0.1558***	-0.0053	-0.0837***	-0.0191**	-0.0071	-0.0693***	1.0000

Notes: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Source: Own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana)

of individuals (small T, large N) [3]. As our data set is characterised by both a large time span and a large number of cross-sectional units, the application of the GMM is inappropriate in the current framework. As suggested by some preliminary estimates and by Akaike and Schwartz information criteria, we propose a dynamic specification in which all the regressors enter with their first lag in order to control for possible endogeneity problems, while an AR(1) in credit risk captures the degree of persistence. Formally, the model is specified as follows:

$$CR_{i,t} = \alpha_1 CR_{i,t-1} + \beta_j BANK - SPECIFIC_{i,t-1} + REGION_k + TIME_t + \varepsilon_{i,t} \quad (1)$$

where CR is the credit risk (i.e. non-performing loans to total loans) (Espinoza and Prasad, 2010; Louzis *et al.*, 2012; Beck *et al.*, 2013); $BANK - SPECIFIC$ is a vector of bank-specific factors, which includes: GRLO: growth of loans, reflecting credit policy (Salas and Saurina, 2002; Quagliariello, 2007); TA: log of total assets, controlling for banks' size (Salas and Saurina, 2002; Hesse and Cihák, 2007; Quagliariello, 2007; Louzis *et al.*, 2012); LTA: loans to total assets, reflecting the volume of credit market; ETA: equity to total assets, capturing the solvency of banks and reflecting their capital strength (Quagliariello, 2007; Hesse and Cihák, 2007; ROA: return on assets, reflecting the profitability of banks (Quagliariello, 2007; Louzis *et al.*, 2012); DL: deposits to loans, reflecting the intermediation cost; CTA: cost of total assets, reflecting the banks' efficiency or volume of intermediation cost (similar to Hesse and Cihák, 2007; Quagliariello, 2007); $REGION$ is the set of region dummies included in the model in order to capture geographical or spillover effects; $TIME$ is the set of time dummies included in the model to capture changes in macroeconomic dynamics (e.g. the lowering of interest rates) and rules (e.g. the processes of financial deregulation and privatization in Italy). Finally, ε is the error term. Subscripts i and t refer, respectively, to financial intermediaries and time periods (years), while k refers to Italian regions. We include the first lag of CR as an explanatory variable, since the ratio of non-performing loans displays a significant degree of persistence [4]. This further serves to capture capital reserves built in the previous periods. All the relevant variables included in our empirical analysis are deflated (at 2005 prices) to avoid that the relationship might be affected by a price effect. Finally, all standard errors are clustered at the bank level.

3. Empirical evidence

3.1 Regression results: How do cooperative and non-cooperative banks behave?

Table 5 reports the results of our baseline regressions, for the whole sample of banks and for the different types of banking institutions composing the Italian financial system, namely, cooperative, commercial, and popular. Evidence indicates that regulatory credit policy and volume of intermediation costs significantly affect the quality of credit, regardless of the type of banking institutions. Specifically, we show, consistently with the previous findings of Vithessonthi (2016), that regulatory credit policy reduces credit risk. Accordingly, if banks expect a future increase in the amount of non-performing loans, caused by a deterioration in living standards, the growth of credits will reduce credit risk. Higher intermediation costs, on the other hand, have a detrimental effect on the proportion of non-performing loans. This result may suggest, in line with Poghosyan (2013), that as credits become riskier, the higher is the cost of intermediation required by financial institutions to finance the project. Among the other bank-specific factors included in our econometric analysis, we find that volume of credit and intermediation costs reduce the proportion of non-performing loans, although this effect is limited to the whole set of banks and to cooperatives. On the other hand, higher capitalisation is shown to have a negative and

Table 5.
Bank-Specific
Factors and credit
risk

Regressors	All banks	Cooperative banks	Commercial banks	Popular banks
CR_{t-1}	0.7906*** (0.0282)	0.7841*** (0.0252)	0.7902*** (0.0768)	0.6554*** (0.1559)
$\Delta \ln(GRLO)_{t-1}$	-0.0025*** (0.0008)	-0.0049*** (0.0015)	-0.0018** (0.0008)	-0.0093* (0.0052)
ROA_{t-1}	0.0028 (0.0032)	0.0077 (0.0053)	-0.0040 (0.0063)	0.0191 (0.0279)
$\ln(ETA)_{t-1}$	-0.0036*** (0.0008)	-0.0040*** (0.0012)	-0.0036*** (0.0010)	-0.0046 (0.0031)
$\ln(LTA)_{t-1}$	-0.0034*** (0.0010)	-0.0121*** (0.0019)	-0.0017 (0.0014)	-0.0073 (0.0051)
$\ln(DL)_{t-1}$	-0.0016* (0.0010)	-0.0084*** (0.0011)	-0.0001 (0.0013)	-0.0007 (0.0012)
$\ln(CTA)_{t-1}$	0.0033*** (0.0010)	0.0061*** (0.0013)	0.0027** (0.0013)	0.0076* (0.0038)
$\ln(TA)_{t-1}$	0.0004 (0.0004)	0.0010 (0.0007)	-0.0006 (0.0006)	-0.0041 (0.0032)
Constant	0.0080 (0.0062)	-0.0077 (0.0074)	0.0191* (0.0097)	0.0933* (0.0535)
Observations	13,581	8,732	3,870	979
Period	1994-2015	1994-2015	1994-2015	1994-2015
R^2	0.7022	0.7369	0.6426	0.7822
Region fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes

Notes: CR is the measure of bank credit risk calculated through non-performing loans to total loans; BANK-SPECIFIC is a vector of bank-specific factors, such as: GRLO: growth of loans, reflecting credit policy; ROA: return on assets, reflecting the profitability of bank; ETA: equity to total assets, capturing the solvency bank and reflecting capital strength of bank; LTA: loans to total assets, capturing the volume of credit market; DL: deposits to loans, reflecting the intermediation cost; CTA: cost of total assets, reflecting a common indicator of bank's efficiency or volume of intermediation cost; TA: total assets, controlling for size of banks. See Table 1 for more details about the description of the variables; own calculations upon BiBank 2000 database from ABI (Associazione Bancaria Italiana); standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

significant effect on the left-hand-side variable for all the groups considered in our analysis, but popular banks. The empirical findings presented here suggest an important role for regulatory credit policy, with the loan restriction of banks that reduces credit risk. In other words, intermediation cost has a negative influence on bank risk, supporting the idea that a strict credit policy can be beneficial in reducing credit risks. The same applies to the level of bank capitalisation, which is found to reduce credit risk, in line with the predictions of Agoraki *et al.* (2011), Tabak *et al.* (2012) and Ghosh (2015). This result, in line with the predictions of Berger and DeYoung (1997), seems to suggest that managerial incentives to behave opportunistically shrink in the presence of improved capital standards, with beneficial effects on the riskiness of banks' loan portfolios.

Nevertheless, as the main goal of the paper is to assess whether the impact of bank-specific factors on the ratio of non-performing loans is similar between the different types of financial institutions composing the Italian banking system, our results seem to suggest that cooperative banks' behaviour is more aligned to the one of the commercial rather than popular banks. Indeed, the estimated coefficients and their significance indicate that cooperative banks' credit risk policies tend to mimic commercial banks' credit risk policies and diverge from those adopted by popular banks. However, the structural and market differences between cooperative and non-cooperative banks should not be underestimated. As pointed out by Fonteyne (2007) and Ayadi *et al.* (2010) and emphasised by Barra *et al.* (2016), cooperative banks are an important feature of the European banking landscape. These banks are characterised by small size, self-governance and the principle of mutuality (internal: their activity is biased in favour of members; external: there must be activities aimed at supporting the moral, cultural and economic development of the local community). They also face localisation constraints, providing loans only within a restricted area, the so-called area of territorial competence (*area di competenza territoriale*), which includes the municipality in which the bank has its head office and the contiguous areas. These fundamental characteristics could explain some different results between cooperatives and non-cooperatives, especially in terms of monitoring of borrowers and reducing of bad loans.

3.2 Does the market structure affect the estimation?

Recent theoretical and empirical literature has emphasised that the degree of competition is crucial in explaining the dynamics of credit risk, showing mixed evidence. In line with the "competition-fragility" hypothesis, one strand of the literature, summarised here by the contributions of Keeley (1990), Carletti and Hartmann (2002), Berger *et al.* (2009), Agoraki *et al.* (2011) and Jiménez *et al.* (2013), highlights that higher competition in the banking sector decreases the profit margin and reduces the franchise value, therefore increasing credit risk and reducing financial stability. A second strand of the literature, see, for instance, Salas and Saurina (2002), Boyd *et al.* (2006), De Nicolò and Lakouianova (2007), Schaeck *et al.* (2009), Tabak *et al.* (2012), Fiordelisi and Mare (2014) and Kasman and Carvallo (2017), supports instead the "competition-stability" view, according to which increased competition in the financial sector reduces credit risk and the probability of banks' failures. In this section, we test whether the impact of bank-specific factors on the ratio of non-performing loans depends upon the market structure in which banks operate. We therefore construct a set of four dummy variables aimed at identifying the degree of competition at LMA level. According to the official definition provided by the Italian Statistical Office (ISTAT):

Labour market areas are sub-regional geographical areas where the bulk of the labour force lives and works, and where establishments can find the largest amount of the labour force necessary to occupy the offered jobs. They respond to the need for meaningfully comparable sub-regional labour market areas for the reporting and analysis of statistics. LMAs are defined on a functional

basis, the key criterion being the proportion of commuters who cross the LMA boundary on their way to work.

LMA is therefore represented by a set of two or more contiguous municipalities, which constitute a single labour market and that are comparable in terms of bilateral flows of population. The ISTAT has identified 686 LMAs, which are partitioned into twenty macro regions [5], respectively, represented by North-West, North-East, Centre and South. Over the 686 LMAs, 114 are in North-West, 119 in North-East, 128 in Centre and the remaining 325 in Southern. Our data set contains information for 321 LMAs, territorially partitioned as follows: 89 for North-Western, 55 for North-Eastern, 65 for Centre and 112 for South. As we rely on highly disaggregated data and given the special stratification embedded in our information, our analysis allows us to not only obtain a rich and detailed picture of the characteristics of the Italian banking system but also capture the existing heterogeneity across geographical areas, the contribution of local credit institutions and of different market structures on credit risk. It turns out that, differently from the existing literature, we measure the degree of competition in the banking sector by building indices of the market structure at the LMA level. Specifically, following Destefanis *et al.* (2014), (see Table 6 for more information on statistics of variables based on different market structure). Formally, we construct a variable taking the value of 1 when the LMA level, there is one bank (MON: MONOPOLY); 2 when at the LMA level there are two banks (DUOP: DUOPOLY); 3 when at LMA level there are three banks (OLIG: OLIGOPOLY) and finally 4 when at LMA level there are more than three banks (COMP: COMPETITION) the model described in equation (1) becomes:

$$\begin{aligned}
 CR_{i,t} &= \alpha_0 + \alpha_1 CR_{i,t-1} + \beta_j BANK - SPECIFIC_{i,t-1} + TIME_t \\
 &+ \varepsilon_{i,t} \text{ if market structure} \\
 &= [MON, DUOP, OLIG, COMP]
 \end{aligned}
 \tag{2}$$

As the empirical assessment of the role of the market structure would cause a consistent loss of observations which might bias our estimates, we proceed by excluding, one-by-one, all the relevant market structures. Table 6 reports descriptive statistics of the main variables based on the four market structures identified. According to the descriptive statistics presented in

Market structures/Variables	CR	GRLO	ROA	ETA	LTA	DL	CTA	TA
<i>MON (N = 3,117)</i>	0.0193 0.0212	10676.52 286223.90	0.0053 0.0203	0.1340 0.0506	0.5938 0.1951	1.0924 0.7855	0.0712 0.0507	499086 1604318
<i>DUOP (N = 2,766)</i>	0.0185 0.0207	34272.60 288778.10	0.0059 0.0143	0.1299 0.0502	0.6302 0.2007	3.5151 80.4731	0.0709 0.0501	1273917 3823786
<i>OLIG (N = 2,188)</i>	0.0157 0.0197	12441.17 397681.60	0.0052 0.0138	0.1258 0.0451	0.6458 0.1991	1.1759 8.5640	0.0757 0.0530	1350776 4314434
<i>COMP (N = 7,196)</i>	0.0132 0.0217	183224.40 4178454.00	0.0017 0.0373	0.1335 0.0690	0.6130 0.2479	15.1692 273.8622	0.0802 0.0647	8619165 34900000

Table 6.
Descriptive statistics
of variables based on
different market
structure

Source: Own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana)

Table 6, the ratio of non-performing loans is higher in the case of the monopolistic market and lower in the case of the fully competitive environment, while the opposite holds for growth of loans, which is found to be higher in the case of perfect competition and lower in the presence of market power. ROAs are instead shown to be quantitatively similar in the case of imperfect competition and largely higher compared to the fully competitive market. While capitalisation is similar among the different market structures, oligopolistic markets display higher levels of volume of credit compared to monopoly and perfect competition. The volume of intermediation cost and bank dimension are instead found to be consistently higher for competitive markets compared to their market power counterparts.

Table 7 assesses the impact of bank-specific factors on the ratio of non-performing loans for the whole sample and for the three main different types of banks, considering the degree of competition in which banks operate. Empirical evidence, in line with the estimates obtained so far, indicates that regulatory credit policy, capitalisation and volume of credit market significantly reduce credit risk and are not significantly influenced by either the market structure or the type of banks scrutinised. Finally, while volume of intermediation cost has a detrimental effect upon the variable of interest, regardless of the degree of competition and the type of bank, the effects of intermediation cost are significant and depend on both the market structure and the financial institution considered. Specifically, we show that intermediation cost is not significant in the case of cooperative banks, but negatively and significantly affects the proportion of bad loans held by commercial banks, once we exclude monopolistic and competitive markets. Finally, we find evidence of a weak and significant effect in the case of popular banks in all the market structures considered but the case in which we exclude the competitive market. These results reinforce our main findings according to which cooperative banks substantially behave like their commercial counterparts. Differently from the main literature considered in this paper, but in line with the findings of [Martín-Oliver *et al.* \(2020\)](#), the empirical evidence presented in **Table 7** indicates that, at least in the Italian case, the ratio of non-performing loans is not particularly affected by both the market structure in which banks operate and by the type of financial institution considered.

4. Robustness checks

4.1 Does the bank size affect the estimation?

To assess the robustness of our estimates, we initially partition banks according to their size, as the latter, as shown by various contributions in the literature, see for instance [Salas and Saurina \(2002\)](#), [Ghosh \(2015\)](#) and [Chaibi and Ftiti \(2015\)](#), is a relevant bank-specific factor of credit risk. To test whether banks' size affects the main results, we follow the classification proposed by the Bank of Italy, already discussed in Section 2.1. Since the empirical assessment of the role of the bank's size would cause a consistent loss of observations, which might bias our estimates, we will alternatively exclude major, large, medium, small and minor banks. Evidence presented in **Table 8** suggests that, once banks are partitioned according to their size, the main findings are almost unaffected, as regulatory policies, capitalisation, volume of credit, intermediation costs and volume of intermediation costs are shown to statistically affect the proportion of non-performing loans. Once again, our estimates indicate that more stringent credit policies, capitalisation, volume of credit and intermediation costs reduce credit risk, while the volume of costs has a positive impact upon the variable of interest. Differently from the main literature surveyed here, our evidence indicates that, at least in the Italian case, banks' size has no sizable impact on the share of non-performing loans.

Table 7.
Bank-specific factors
and credit risk: the
role of market
structure

Regressors	All banks			Cooperative banks	
	NO MON	NO DUOP	NO OLIG	NO COMP	NO MON
CR _{t-1}	0.7992*** (0.0375)	0.7706*** (0.0359)	0.7905*** (0.0297)	0.7494*** (0.0297)	0.8016*** (0.0348)
Δln(GRLO) _{t-1}	-0.0023*** (0.0008)	-0.0025*** (0.0008)	-0.0027*** (0.0008)	-0.0026*** (0.0012)	-0.0022*** (0.0008)
ROA _{t-1}	0.0011 (0.0024)	0.0020 (0.0027)	0.0014 (0.0023)	0.0463*** (0.0142)	0.0016 (0.0025)
ln(ETA) _{t-1}	-0.0038*** (0.0009)	-0.0042*** (0.0009)	-0.0043*** (0.0008)	-0.0014 (0.0011)	-0.0038*** (0.0008)
ln(LTA) _{t-1}	-0.0032*** (0.0011)	-0.0031*** (0.0011)	-0.0029*** (0.0011)	-0.0071*** (0.0019)	-0.0031*** (0.0011)
ln(DL) _{t-1}	-0.0015 (0.0011)	-0.0012 (0.0010)	-0.0012 (0.0010)	-0.0043*** (0.0013)	-0.0015 (0.0010)
ln(CTA) _{t-1}	0.0034*** (0.0011)	0.0032*** (0.0011)	0.0031*** (0.0011)	0.0042*** (0.0013)	0.0033*** (0.0011)
ln(FA) _{t-1}	0.0002 (0.0005)	-0.0000 (0.0005)	0.0003 (0.0005)	0.0012 (0.0008)	0.0002 (0.0005)
Constant	0.0166** (0.0069)	0.0164** (0.0070)	0.0061 (0.0067)	0.0047 (0.0102)	0.0077 (0.0068)
Observations	10,771	11,079	11,607	7,286	11,311
Period	1994–2015	1994–2015	1994–2015	1994–2015	1994–2015
R ²	0.6865	0.6811	0.6965	0.7277	0.6977
Region fixed effect	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes

Notes: CR is the measure of bank credit risk calculated through non-performing loans to total loans; BANK-SPECIFIC is a vector of bank-specific factors, such as: GRLO; growth of loans, reflecting credit policy; ROA: return on assets, reflecting the profitability of bank; ETA: equity to total assets, capturing the solvency bank and reflecting capital strength of bank; LTA: loans to total assets, capturing the volume of credit market; DL: deposits to loans, reflecting the intermediation cost; CTA: cost of total assets, reflecting a common indicator of bank's efficiency or volume of intermediation cost; TA: total assets, controlling for size of banks. See [Table 1](#) for more details about the description of the variables; own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana); standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(continued)

Regressors	Cooperative banks			Commercial banks			
	NO DUOP	NO OLIG	NO OLIG	NO COMP	NO MON	NO DUOP	NO OLIG
CR _{<i>t-1</i>}	0.7735*** (0.0335)	0.7788*** (0.0305)	0.7765*** (0.0334)	0.7889*** (0.0291)	0.7947*** (0.0292)	0.7919*** (0.0291)	0.7919*** (0.0291)
Δln(GRLO) _{<i>t-1</i>}	-0.0025*** (0.0008)	-0.0024*** (0.0008)	-0.0023*** (0.0008)	-0.0026*** (0.0008)	-0.0026*** (0.0008)	-0.0029*** (0.0008)	-0.0029*** (0.0008)
ROA _{<i>t-1</i>}	0.0022 (0.0028)	0.0026 (0.0028)	0.0069 (0.0080)	0.0028 (0.0029)	0.0027 (0.0028)	0.0019 (0.0026)	0.0019 (0.0026)
ln(ETA) _{<i>t-1</i>}	-0.0037*** (0.0008)	-0.0039*** (0.0008)	-0.0031*** (0.0008)	-0.0037*** (0.0008)	-0.0038*** (0.0008)	-0.0040*** (0.0008)	-0.0040*** (0.0008)
ln(LTA) _{<i>t-1</i>}	-0.0031*** (0.0010)	-0.0030*** (0.0010)	-0.0027** (0.0011)	-0.0035*** (0.0010)	-0.0033*** (0.0010)	-0.0033*** (0.0010)	-0.0033*** (0.0010)
ln(DL) _{<i>t-1</i>}	-0.0012 (0.0010)	-0.0014 (0.0010)	-0.0009 (0.0010)	-0.0017* (0.0010)	-0.0016 (0.0010)	-0.0014 (0.0010)	-0.0014 (0.0010)
ln(CTA) _{<i>t-1</i>}	0.0030*** (0.0010)	0.0032*** (0.0010)	0.0031*** (0.0011)	0.0034*** (0.0010)	0.0035*** (0.0010)	0.0033*** (0.0010)	0.0033*** (0.0010)
ln(TA) _{<i>t-1</i>}	-0.0000 (0.0005)	0.0002 (0.0005)	0.0003 (0.0005)	0.0003 (0.0005)	0.0004 (0.0005)	0.0004 (0.0005)	0.0004 (0.0005)
Constant	0.0127* (0.0067)	0.0092 (0.0066)	-0.0037 (0.0057)	0.0109* (0.0062)	0.0078 (0.0064)	0.0075 (0.0067)	0.0075 (0.0067)
Observations	11,893	12,2	10,197	13,249	13,044	13,09	13,09
Period	1994–2015	1994–2015	1994–2015	1994–2015	1994–2015	1994–2015	1994–2015
R ²	0.6928	0.6897	0.6923	0.6979	0.6990	0.7035	0.7035
Region fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7.

Table 7.

Regressors	Commercial banks			Popular banks		
	NO COMP	NO MON	NO DUOP	NO OLIG	NO COMP	
CR_{t-1}	0.7778*** (0.0252)	0.7900*** (0.0290)	0.7845*** (0.0289)	0.8005*** (0.0266)	0.7884*** (0.0286)	
$\Delta \ln(\text{GRO})_{t-1}$	-0.0029** (0.0012)	-0.0024*** (0.0007)	-0.0024*** (0.0007)	-0.0024*** (0.0007)	-0.0025*** (0.0008)	
ROA_{t-1}	0.0067 (0.0056)	0.0028 (0.0029)	0.0031 (0.0030)	0.0030 (0.0029)	0.0028 (0.0029)	
$\ln(\text{ETA})_{t-1}$	-0.0031*** (0.0010)	-0.0036*** (0.0008)	-0.0039*** (0.0008)	-0.0035*** (0.0008)	-0.0035*** (0.0008)	
$\ln(\text{LTA})_{t-1}$	-0.0073*** (0.0016)	-0.0034*** (0.0010)	-0.0034*** (0.0010)	-0.0033*** (0.0010)	-0.0034*** (0.0011)	
$\ln(\text{DL})_{t-1}$	-0.0051*** (0.0011)	-0.0017* (0.0010)	-0.0017* (0.0010)	-0.0017* (0.0010)	-0.0017 (0.0010)	
$\ln(\text{CTA})_{t-1}$	0.0043*** (0.0010)	0.0032*** (0.0010)	0.0033*** (0.0010)	0.0032*** (0.0010)	0.0033*** (0.0010)	
$\ln(\text{TA})_{t-1}$	0.0010 (0.0006)	0.0004 (0.0004)	0.0004 (0.0004)	0.0005 (0.0004)	0.0004 (0.0005)	
Constant	0.0024 (0.0086)	0.0120* (0.0064)	0.0110* (0.0063)	0.0058 (0.0059)	0.0120* (0.0065)	
Observations	11,071	13,373	13,306	13,485	13,181	
Period	1994–2015	1994–2015	1994–2015	1994–2015	1994–2015	
R^2	0.7361	0.6980	0.6969	0.7078	0.6971	
Region fixed effect	Yes	Yes	Yes	Yes	Yes	
Time fixed effects	Yes	Yes	Yes	Yes	Yes	

Regressors	Excluding minor banks	Excluding small banks	Excluding medium banks	Excluding large banks	Excluding major banks	Minor banks	Small banks
CR _{t-1}	0.7700*** (0.1050)	0.7958*** (0.0295)	0.7880*** (0.0279)	0.7788*** (0.0253)	0.7913*** (0.0284)	0.7820*** (0.0256)	0.6535*** (0.0834)
Δln(GRLO) _{t-1}	-0.0034 (0.0025)	-0.0021*** (0.0007)	-0.0023*** (0.0006)	-0.0024*** (0.0007)	-0.0025*** (0.0008)	-0.0021*** (0.0007)	-0.0026 (0.0021)
ROA _{t-1}	0.0033 (0.0174)	0.0031 (0.0031)	0.0046 (0.0034)	0.0019 (0.0031)	0.0026 (0.0032)	0.0057* (0.0034)	0.0103 (0.0162)
ln(ETA) _{t-1}	-0.0041*** (0.0014)	-0.0036*** (0.0008)	-0.0040*** (0.0008)	-0.0036*** (0.0008)	-0.0035*** (0.0008)	-0.0041*** (0.0010)	-0.0065*** (0.0022)
ln(LTA) _{t-1}	-0.0026 (0.0017)	-0.0026* (0.0015)	-0.0036*** (0.0011)	-0.0043*** (0.0008)	-0.0034*** (0.0010)	-0.0069*** (0.0011)	-0.0063*** (0.0014)
ln(DLA) _{t-1}	0.0003 (0.0015)	-0.0014 (0.0015)	-0.0018 (0.0011)	-0.0027*** (0.0006)	-0.0017* (0.0010)	-0.0053*** (0.0009)	-0.0008 (0.0007)
ln(CTA) _{t-1}	0.0035** (0.0017)	0.0023* (0.0014)	0.0039*** (0.0008)	0.0034*** (0.0010)	0.0034*** (0.0011)	0.0051*** (0.0010)	0.0038** (0.0018)
ln(TA) _{t-1}	-0.0005 (0.0010)	0.0009* (0.0005)	0.0004 (0.0004)	0.0004 (0.0005)	0.0005 (0.0005)	0.0011* (0.0006)	-0.0012 (0.0013)
Constant	0.0162 (0.0166)	0.0027 (0.0080)	0.0093 (0.0061)	0.0122* (0.0069)	0.0072 (0.0064)	0.0045 (0.0090)	0.0134 (0.0164)
Observations	3,437	11,379	12,892	13,256	13,360	10,144	2,202
Period	1994-2015	1994-2015	1994-2015	1994-2015	1994-2015	1994-2015	1994-2015
R ²	0.6649	0.6937	0.6983	0.7239	0.7004	0.7210	0.7230
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: CR is the measure of bank credit risk calculated through non-performing loans to total loans; BANK-SPECIFIC is a vector of bank-specific factors, such as: GRLO: growth of loans, reflecting credit policy; ROA: return on assets, reflecting the profitability of bank; ETA: equity to total assets, capturing the solvency bank and reflecting capital strength of bank; LTA: loans to total assets, capturing the volume of credit market; DLA: deposits to loans, reflecting the intermediation cost; CTA: cost of total assets, reflecting a common indicator of bank's efficiency or volume of intermediation cost; TA: total assets, controlling for size of banks. See Table 1 for more details about the description of the variables; own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana); standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8. Bank-specific factors and credit risk: the role of bank size

4.2 Does financial crisis affect the estimation?

The advent of 2008 financial crisis has stimulated a large amount of literature aimed at addressing the impact of the recession on several dimensions of the financial system.

Altunbas *et al.* (2011) and Claessens and van Horen (2015) focus their attention on how banks' business models were affected by the crisis, with great emphasis on their location decisions. While Altunbas *et al.* (2011) show that financial institutions with a high level of risk were less capitalised, large in terms of size and with an aggressive credit policy, Claessens and van Horen (2015) show that, following the financial crisis, several financial institutions decided to reduce their presence abroad.

A second strand of the literature (Beltratti and Stultz, 2012; Demircuc-Kunt *et al.*, 2013 and Berger and Bouwman, 2013) has instead emphasised the role of capital requirements during the various recessionary episodes. While Beltratti and Stultz (2012) show that banks with less leverage and lower stock returns displayed better performances during the recessionary periods, the opposite is found by Demircuc-Kunt *et al.* (2013) whose evidence suggests that better-capitalised banks exhibited better performance in terms of stock returns, a result that is further strengthened by the application of other measures of capital, like TIER 1 capital.

On the other hand, the contribution of Berger and Bouwman (2013) focuses on the relationship between capital and size during the crisis, finding that small banks take advantage of their capital levels during both expansions and recessions.

As the advent of the financial crisis might have caused a structural break in the functioning of the Italian banking system which, in turn, might affect the parameters of interest, we exploit the nature of our data and propose a set of econometric estimates, limitedly to the 1994–2007 period. Formally, the model described in equation (1) becomes:

$$CR_{i,t} = \alpha_0 + \alpha_1 CR_{i,t-1} + \beta_j BANK - SPECIFIC_{i,t-1} + TIME_t + \varepsilon_{i,t} \text{ if pre - crisis} \quad (3)$$

Evidence reported in Table 9 indicates that once we allow for the effects of the financial crisis, the benchmark results are only partially affected. Specifically, compared with our benchmark specifications, our results confirm a negative and significant impact of regulatory credit policy. While capitalisation loses its significance, both the volume of credit market and intermediation cost are now significant only in the case of cooperative banks. Volume of intermediation cost is instead significant only once we consider the whole set of banks and cooperatives.

4.3 Do Basel agreements affect the estimation?

The effects of Basel regulation on credit risk have been widely debated in the economic literature, both theoretically and empirically. Hakenes and Schnabel (2011) analyse the impact of Basel II accord on the nexus between bank size and risk-taking within a theoretical framework. They show that one of the effects of the Basel II accord was to provide large banks with a competitive advantage in the market and that increased competition led small banks to undertake risky projects, with a detrimental effect on aggregate risk-taking. Gavalas (2015) investigated the effects of the Basel III accord on bank performance using data for some EU countries, showing that capital requirements increased banks' marginal costs which, in turn, determined an increase in lending rates. Moreover, the paper finds evidence of an inverse relationship between the Basel agreements and the total volume of loans. Buch *et al.* (2015) investigated the effects of uncertainty on bank lending, showing that better-capitalised banks, where capitalisation is measured using TIER1

Regressors	All banks			Cooperative banks			Commercial banks			Popular banks		
CR _{<i>t-1</i>}	0.5727***	(0.0442)		0.5903***	(0.0253)		0.6098***	(0.1455)		0.2100	(0.1365)	
$\Delta \ln(\text{GRLO})_{t-1}$	-0.0029***	(0.0009)		-0.0059***	(0.0013)		-0.0017*	(0.0010)		-0.0094**	(0.0047)	
ROA _{<i>t-1</i>}	0.0082	(0.0061)		0.0107	(0.0083)		0.0127	(0.0079)		0.0140	(0.0324)	
$\ln(\text{ETA})_{t-1}$	-0.0005	(0.0007)		-0.0010	(0.0012)		-0.0001	(0.0009)		-0.0041	(0.0031)	
$\ln(\text{LTA})_{t-1}$	-0.0019	(0.0015)		-0.0087***	(0.0021)		-0.0003	(0.0020)		-0.0039	(0.0035)	
$\ln(\text{DL})_{t-1}$	0.0003	(0.0014)		-0.0029**	(0.0013)		0.0010	(0.0020)		0.0024	(0.0015)	
$\ln(\text{CTA})_{t-1}$	0.0024*	(0.0013)		0.0055***	(0.0014)		0.0016	(0.0019)		0.0068	(0.0041)	
$\ln(\text{TA})_{t-1}$	0.0006	(0.0005)		0.0000	(0.0008)		0.0001	(0.0006)		-0.0027	(0.0022)	
Constant	0.0047	(0.0069)		0.0048	(0.0079)		0.0019	(0.0086)		0.0412	(0.0291)	
Observations	9,755			6,442			2,643			670		
Period	1994–2008			1994–2008			1994–2008			1994–2008		
R ²	0.4759			0.5792			0.3565			0.4210		
Region fixed effects	Yes			Yes			Yes			Yes		
Time fixed effects	Yes			Yes			Yes			Yes		

Notes: CR is the measure of bank credit risk calculated through non-performing loans to total loans; BANK-SPECIFIC is a vector of bank-specific factors, such as: GRLO: growth of loans, reflecting credit policy; ROA: return on assets, reflecting the profitability of bank; ETA: equity to total assets, capturing the solvency bank and reflecting capital strength of bank; LTA: loans to total assets, capturing the volume of credit market; DL: deposits to loans, reflecting the intermediation cost; CTA: cost of total assets, reflecting a common indicator of bank's efficiency or volume of intermediation cost; TA: total assets, controlling for size of banks. See Table 1 for more details about the description of the variables; own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana); standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9. Bank-specific factors and credit risk: the effects of the financial crisis

regulatory quality, are less affected by higher uncertainty. [Kim and Sohn \(2017\)](#), using data from US-insured commercial banks, analyse the effects of liquidity on the relationship between bank capital requirements and bank lending. They show that the relationship between capital requirements and credit growth crucially depends on the level of liquidity, with these requirements representing a beneficial policy only for large banks, if they have enough liquid assets. [Roulet \(2018\)](#), using data from a set of commercial banks of 22 countries over the 2008–2015 period, studied the effects of capital requirements introduced by the Basel III accord after the 2008 recession. Their paper shows that capital requirements had a negative effect on lending growth, especially for large banks, while liquidity indicators are found to have a positive but perverse effect on the variable of interest. [Naceur and Routlet \(2018\)](#) address the effects of capital ratios and liquidity requirements for the United States and Europe after the financial crisis, showing that the regulation determined an increase in the ability of US banks to absorb risks when they expand their credit capacities, while the effects of capital requirements and liquidity are like the ones found by [Roulet \(2018\)](#).

In the context of the current contribution, it seems therefore reasonable to address whether the introduction of the capital requirements embedded in the Basel regulations changed banks' incentives which, in turn, might affect the estimated bank-specific parameters. To empirically assess whether our benchmark results are altered by the introduction of the Basel regulation, the model is re-estimated considering both Basel II (1995–2005 period) and Basel III (1995–2013). Formally, the model described in [equation \(1\)](#) becomes:

$$CR_{i,t} = \alpha_0 + \alpha_1 CR_{i,t-1} + \beta_j BANK - SPECIFIC_{i,t-1} + TIME_t + \varepsilon_{i,t} \quad \text{if } pre \\ - \text{Basel agreements} \quad (4)$$

Results reported in [Table 10](#) indicate that the introduction of both Basel II and Basel III accords did not significantly change the benchmark results. Specifically, we still find evidence of a significant effect of growth of loans, volume of the credit market and volume of intermediation cost. While capitalisation is found to have a weak impact for the whole set of banks and for commercial, once Basel III is considered, the intermediation cost is significant in the case of cooperative banks and in the case of popular banks, although this effect is limited to the Basel III accord.

4.4 Does a different dependent variable affect the estimation?

To further test the robustness of our estimates, in this section, we propose a set of econometric specifications in which an alternative measure of bank insolvency risk is employed, summarised here by the z-score on the ROAs. Although the ratio of non-performing loans represents the most widely and commonly used measure of credit risk, the z-score of the returns of asset, often associated with the concept of volatility, is used to capture both bank soundness and financial instability [6] (see, among others, [De Nicolò and Lakouianova, 2007](#); [Laeven and Levine, 2009](#); [Hesse and Cihák, 2007](#); [Uhde and Heimeshoff, 2009](#); [Fiordelisi and Mare, 2014](#); [Chiaramonte et al., 2015](#); [Barra and Zotti, 2019a, 2019b](#)). Specifically, for each bank i and time t , the z-score indicator is defined as follows:

$$Z - SCORE_{ROA,i,t} = \frac{ETA_{i,t} + ROA_{i,t}}{\sigma_{ROA,i,t}}$$

where ETA is the level of capitalisation of the bank (i.e. equity to total assets), ROA denotes the ratio between profit and total assets (i.e. return on assets) and σ_{ROA} is the standard

Regressors	All banks		Cooperative banks		Cooperative banks	
	Basel II		Basel III		Basel III	
CR _{<i>t-1</i>}	0.4693*** (0.0335)	0.6357*** (0.0360)	0.5151*** (0.0257)	0.6731*** (0.0235)		
$\Delta \ln(\text{GRLO})_{t-1}$	-0.0028** (0.0011)	-0.0028*** (0.0008)	-0.0064*** (0.0017)	-0.0059*** (0.0013)		
ROA _{<i>t-1</i>}	-0.0055 (0.0045)	0.0063 (0.0052)	-0.0003 (0.0085)	0.0137 (0.0084)		
$\ln(\text{ETA})_{t-1}$	-0.0005 (0.0008)	-0.0014** (0.0007)	-0.0020 (0.0013)	-0.0013 (0.0011)		
$\ln(\text{LTA})_{t-1}$	-0.0027** (0.0012)	-0.0027** (0.0012)	-0.0098*** (0.0028)	-0.0091*** (0.0019)		
$\ln(\text{DL})_{t-1}$	-0.0006 (0.0006)	-0.0005 (0.0011)	-0.0034** (0.0016)	-0.0044*** (0.0011)		
$\ln(\text{CTA})_{t-1}$	0.0014* (0.0008)	0.0025** (0.0010)	0.0033*** (0.0013)	0.0052*** (0.0013)		
$\ln(\text{TA})_{t-1}$	0.0003 (0.0006)	0.0006 (0.0004)	-0.0018* (0.0010)	0.0005 (0.0007)		
Constant	0.0045 (0.0070)	-0.0068 (0.0047)	0.0180* (0.0100)	0.0159* (0.0086)		
Observations	7,835	11,692	5,189	7,642		
Period	1994–2005	1995–2011	1994–2005	1995–2011		
R ²	0.5416	0.5377	0.6070	0.6253		
Region fixed effects	Yes	Yes	Yes	Yes		
Time fixed effects	Yes	Yes	Yes	Yes		

Notes: CR is the measure of bank credit risk calculated through non-performing loans to total loans; BANK-SPECIFIC is a the vector of bank-specific factors, solvency bank and reflecting capital strength of bank; ROA: return on assets, reflecting the profitability of bank; ETA: equity to total assets, capturing the intermediation cost; CTA: cost of total assets, reflecting a common indicator of bank's efficiency or volume of intermediation cost; TA: total assets, controlling for size of banks. See Table 1 for more details about the description of the variables; own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana); standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(continued)

Table 10. Bank-specific factors and credit risk: the effects of Basel agreements

Table 10.

Regressors	Commercial banks		Popular banks	
	Basel II	Basel III	Basel II	Basel III
CR_{t-1}	0.3791*** (0.0518)	0.6080*** (0.1103)	0.1469 (0.1221)	0.2990** (0.1456)
$\Delta \ln(\text{GRO})_{t-1}$	-0.0010 (0.0012)	-0.0018** (0.0009)	-0.0088* (0.0050)	-0.0101** (0.0047)
ROA_{t-1}	0.0022 (0.0043)	0.0062 (0.0063)	0.0001 (0.0316)	0.0273 (0.0351)
$\ln(\text{ETA})_{t-1}$	0.0010 (0.0009)	-0.0018* (0.0010)	-0.0051 (0.0040)	-0.0018 (0.0027)
$\ln(\text{LTA})_{t-1}$	0.0005 (0.0012)	-0.0013 (0.0017)	-0.0014 (0.0042)	-0.0097*** (0.0036)
$\ln(\text{DL})_{t-1}$	0.0007 (0.0007)	0.0004 (0.0016)	0.0034 (0.0029)	-0.0018** (0.0009)
$\ln(\text{CTA})_{t-1}$	0.0001 (0.0009)	0.0024* (0.0013)	0.0055 (0.0044)	0.0102*** (0.0038)
$\ln(\text{TA})_{t-1}$	0.0005 (0.0007)	-0.0001 (0.0006)	-0.0031 (0.0024)	-0.0024 (0.0023)
Constant	-0.0048 (0.0089)	0.0187** (0.0087)	0.0600 (0.0372)	0.0431 (0.0320)
Observations	2,091	3,251	555	799
Period	1994-2005	1995-2011	1994-2005	1995-2011
R^2	0.4678	0.4224	0.4082	0.5089
Region fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes

deviation of the *ROA*. Following [Agoraki et al. \(2011\)](#) and [Soedarmono et al. \(2013\)](#), σ_{ROA} at time t is calculated based on observations of *ROA* from time t to $t - 2$ (a three-period rolling window). The *z-score* therefore represents a good proxy of a bank's distance to default and does not require strong assumptions about the distribution of the *ROAs* ([Strobel, 2011](#)). It combines banks' buffers (capital and profits) with the risks they face (measured by the standard deviation of returns), reflecting the number of standard deviations by which returns would have to fall from the mean to wipe out equity. A higher value of *z-score* implies a lower probability of insolvency risk ([Uhde and Heimeshoff, 2009](#)) and greater stability (e.g. inverse of the probability of defaults), providing a direct measure of the banking system stability. Further, as emphasised by [Kasman and Kasman \(2015\)](#), the application of the *z-score* allows to obtain a more direct measure of bank soundness compared to other measures of risk. The *z-score* is a positive function of both banks' profitability and capital ratio and a negative function of the conditional volatility.

Formally, the model described in [equation \(1\)](#) becomes:

$$Z - SCORE_{ROA,i,t} = \alpha_0 + \alpha_1 Z - SCORE_{ROA,i,t-1} + \beta_j BANK - SPECIFIC_{i,t-1} + TIME_t + \varepsilon_{i,t} \quad (5)$$

Evidence reported in [Table 11](#) suggests that growth of loans is significant among the different types of banks examined, but the whole sample. Capitalisation has a positive, as expected, and significant impact on the variable of interest, though it is not significant in the case of commercial banks. The volume of the credit market exhibits a positive and statistically significant relationship with the endogenous variable limitedly to the whole set of banks and cooperatives, while intermediation cost is significant only in the case of cooperative banks. Finally, while the volume of intermediation cost is significant only in the

Regressors	All banks	Cooperative banks	Commercial banks	Popular banks
$\ln(Z.SCORE-ROA)_{t-1}$	0.1291*** (0.0107)	0.3639*** (0.0887)	0.5010*** (0.0686)	0.5246*** (0.0723)
$\Delta \ln(GRLO)_{t-1}$	-0.0443 (0.0330)	-0.1321*** (0.0335)	-0.0728** (0.0321)	-0.2339*** (0.0644)
ROA_{t-1}	0.6131 (0.4467)	-0.3136 (0.5202)	0.0365 (0.7505)	-1.3444 (0.8905)
$\ln(ETA)_{t-1}$	0.6413*** (0.0331)	0.3488*** (0.0929)	0.1133 (0.0779)	0.1153* (0.0632)
$\ln(LTA)_{t-1}$	0.0954** (0.0381)	0.0694** (0.0282)	0.0141 (0.0388)	0.1361 (0.0876)
$\ln(DL)_{t-1}$	0.0230 (0.0232)	0.0775*** (0.0161)	0.0076 (0.0252)	-0.0140 (0.0325)
$\ln(CTA)_{t-1}$	-0.0748** (0.0355)	-0.0189 (0.0278)	0.0036 (0.0375)	-0.1128 (0.0895)
$\ln(TA)_{t-1}$	0.0239 (0.0228)	-0.0076 (0.0149)	-0.0524** (0.0223)	-0.0648 (0.0430)
Constant	3.4162*** (0.3149)	2.9679*** (0.5428)	1.7716*** (0.4605)	2.5444*** (0.9035)
Observations	13,528	8,726	3,824	978
Period	1994–2015	1994–2015	1994–2015	1994–2015
R^2	0.7022	0.9755	0.7864	0.9188
Region fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes

Notes: Z-SCORE is the measure of bank stability (see equation in Section 4.2); BANK-SPECIFIC is a vector of bank-specific factors, such as: GRLO: growth of loans, reflecting credit policy; ROA: return on assets, reflecting the profitability of bank; ETA: equity to total assets, capturing the solvency bank and reflecting capital strength of bank; LTA: loans to total assets, capturing the volume of credit market; DL: deposits to loans, reflecting the intermediation cost; CTA: cost of total assets, reflecting a common indicator of bank's efficiency or volume of intermediation cost; TA: total assets, controlling for size of banks. See [Table 1](#) for more details about the description of the variables; own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana); standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11. Bank-specific factors and credit risk: changing dependent variable (Z-SCORE)

case of the whole set of banks, higher bank size is found to reduce the z-score on ROA limitedly to commercial banks. All in all, evidence suggests that the benchmark results are only weakly affected by the application of an alternative dependent variable.

4.5 Do potential differences inside LMAs affect the estimates?

As the proxies of the market structure employed might be biased by the size of the LMAs, as larger cities might be more attractive for financial institutions and, hence, more competitive, we propose a set of econometric estimates where we exclude LMAs belonging to the first and tenth decile. This econometric exercise rules out the possibility that the size of the LMAs might bias our measures of the market structure and, in turn, to bias our evidence.

The evidence reported in [Table 12](#) indicates that the growth of loans significantly reduces credit risk, although we do find evidence of a statistically insignificant effect for both commercial and popular banks once we remove the tenth decile.

In line with the evidence reported so far, the ROA play no significant role in affecting the ratio of non-performing loans, while both capitalisation and volume of the credit market are found to reduce credit risk. A relatively limited impact is instead found for intermediation costs, while the volume of intermediation cost is found to have an adverse impact on credit risk.

The log of total assets, in line with the estimates reported so far, is instead found to have no significant impact on the variable of interest.

All in all, the evidence reported in [Table 12](#) seem to confirm the robustness of our findings and the results reported in our benchmark analysis, hence implying that our evidence is confirmed even after we exclude smaller and larger LMAs, which might affect the degree of competition and, in turn, our findings.

[Table 13](#) reports a set of econometric estimates in which we employ the z-score instead of the ratio of non-performing loans as our proxy of credit risk and remove the smallest and the largest LMAs. Accordingly, there is some evidence of an inverse and significant relationship between the growth of loans and the variable under scrutiny. While the effects of the ROA on the variable of interest are weak, both ETA and LTA are found to have a positive and significant effect on the z-score. Moreover, while there is some evidence of a positive effect of intermediation costs on the variable of interest, both the volume of intermediation costs and total assets play no role in affecting the z-score. The results reported in

3 provide additional evidence concerning the robustness of our findings and confirm that our benchmark findings are not significantly affected by the size of the LMAs.

5. Conclusions and policy implication

Using bank-level data over the 1994–2015 period, this paper investigates the impact of bank-specific factors upon the ratio of non-performing loans in Italy, by addressing whether the effects of bank-specific factors upon credit risk depend on the institutional system in which banks operate. Specifically, the goal of the paper is to test whether the impact of the relevant bank-specific factors included in the econometric analysis depends upon the type of financial intermediary considered, by partitioning the population of banks according to cooperative and non-cooperative banks, i.e. popular and commercial, dichotomy. The advent of the financial crisis has indeed caused various and prolonged situations of financial distress that have involved cooperative banks as well, casting doubts about the ability of these financial institutions to efficiently monitor their borrowers and about the feasibility of their credit strategies. It turns out that a genuine analysis aimed at assessing whether the effects of bank-specific factors on credit risk are similar between cooperative and non-cooperative banks would shed light about the functioning of the Italian banking system.

Regressors	All banks- Excluding 1st decile		All banks- Excluding 10th decile		Cooperative banks- Excluding 1st decile		Cooperative banks- Excluding 10th decile	
	CR_{t-1}	0.7711*** (0.0265)	0.8110*** (0.0291)	0.7771*** (0.0269)	0.7802*** (0.0259)	0.7771*** (0.0269)	0.7802*** (0.0259)	0.7771*** (0.0269)
$\Delta \ln(\text{GRLO})_{t-1}$	-0.0025*** (0.0008)	-0.0019** (0.0007)	-0.0061*** (0.0017)	-0.0039*** (0.0012)	-0.0061*** (0.0017)	-0.0039*** (0.0012)	-0.0061*** (0.0017)	-0.0039*** (0.0012)
ROA_{t-1}	0.0009 (0.0024)	0.0054 (0.0044)	0.0040 (0.0032)	0.0047 (0.0034)	0.0040 (0.0032)	0.0047 (0.0034)	0.0040 (0.0032)	0.0047 (0.0034)
$\ln(\text{ETA})_{t-1}$	-0.0033*** (0.0008)	-0.0030*** (0.0007)	-0.0041*** (0.0013)	-0.0039*** (0.0011)	-0.0041*** (0.0013)	-0.0039*** (0.0011)	-0.0041*** (0.0013)	-0.0039*** (0.0011)
$\ln(\text{LTA})_{t-1}$	-0.0037*** (0.0008)	-0.0031*** (0.0012)	-0.0131*** (0.0022)	-0.0117*** (0.0019)	-0.0131*** (0.0022)	-0.0117*** (0.0019)	-0.0131*** (0.0022)	-0.0117*** (0.0019)
$\ln(\text{DL})_{t-1}$	-0.0023*** (0.0006)	-0.0013 (0.0012)	-0.0087*** (0.0013)	-0.0082*** (0.0011)	-0.0087*** (0.0013)	-0.0082*** (0.0011)	-0.0087*** (0.0013)	-0.0082*** (0.0011)
$\ln(\text{CTA})_{t-1}$	0.0028** (0.0011)	0.0035*** (0.0009)	0.0055*** (0.0014)	0.0062*** (0.0013)	0.0055*** (0.0014)	0.0062*** (0.0013)	0.0055*** (0.0014)	0.0062*** (0.0013)
$\ln(\text{TA})_{t-1}$	0.0002 (0.0005)	0.0009* (0.0005)	0.0004 (0.0009)	0.0014* (0.0007)	0.0004 (0.0009)	0.0014* (0.0007)	0.0004 (0.0009)	0.0014* (0.0007)
Constant	0.0162** (0.0072)	0.0061 (0.0071)	0.0151 (0.0104)	0.0045 (0.0091)	0.0151 (0.0104)	0.0045 (0.0091)	0.0151 (0.0104)	0.0045 (0.0091)
Observations	12,163	12,440	7,625	8,442	7,625	8,442	7,625	8,442
Period	1994–2015	1994–2015	1994–2015	1994–2015	1994–2015	1994–2015	1994–2015	1994–2015
R^2	0.7339	0.7163	0.7454	0.7331	0.7454	0.7331	0.7454	0.7331
Region fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES

Notes: CR is the measure of bank credit risk calculated through non-performing loans to total loans; BANK-SPECIFIC is a the vector of bank-specific factors, such as: GRLO; growth of loans, reflecting credit policy; ROA: return on assets, reflecting the profitability of bank; ETA: equity to total assets, capturing the solvency bank and reflecting capital strength of bank; LTA: loans to total assets, capturing the volume of credit market; DL: deposits to loans, reflecting the intermediation cost; CTA: cost of total assets, reflecting a common indicator of bank's efficiency or volume of intermediation cost; TA: total assets, controlling for size of banks. See Table 1 for more details about the description of the variables; own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana); standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(continued)

Table 12. Bank-specific factors and credit risk: the potential differences inside LMAs

Table 12.

Regressors	Commercial banks-	Commercial banks-	Popular banks-	Popular banks-
	Excluding 1st decile	Excluding 10th decile	Excluding 1st decile	Excluding 10th decile
CR_{t-1}	0.7338*** (0.0596)	0.9029*** (0.0930)	0.6535*** (0.1593)	0.6338*** (0.1578)
$\Delta \ln(\text{GRO})_{t-1}$	-0.0015* (0.0009)	-0.0007 (0.0009)	-0.0099* (0.0057)	-0.0080 (0.0052)
ROA_{t-1}	-0.0118 (0.0089)	0.0175 (0.0149)	0.0330 (0.0476)	0.0229 (0.0474)
$\ln(\text{ETA})_{t-1}$	-0.0030*** (0.0011)	-0.0022** (0.0008)	-0.0049 (0.0033)	-0.0035 (0.0030)
$\ln(\text{LTA})_{t-1}$	-0.0019** (0.0009)	-0.0007 (0.0018)	-0.0075 (0.0057)	-0.0059 (0.0050)
$\ln(\text{DL})_{t-1}$	-0.0009 (0.0006)	0.0010 (0.0019)	-0.0007 (0.0013)	-0.0003 (0.0012)
$\ln(\text{CTA})_{t-1}$	0.0021 (0.0014)	0.0025** (0.0013)	0.0081** (0.0040)	0.0070* (0.0040)
$\ln(\text{TA})_{t-1}$	-0.0005 (0.0007)	-0.0000 (0.0007)	-0.0049 (0.0036)	-0.0042 (0.0032)
Constant	0.0212* (0.0110)	0.0109 (0.0107)	0.1187* (0.0623)	0.1106* (0.0593)
Observations	3,612	3,085	926	913
Period	1994–2015	1994–2015	1994–2015	1994–2015
R^2	0.7231	0.7008	0.7796	0.7753
Region fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES

Regressors	All banks-Excluding 1st decile	All banks-Excluding 10th decile	Cooperative banks-Excluding 1st decile	Cooperative banks-Excluding 10th decile
$\ln(Z_SCORE_ROA)_{t-1}$	0.1226*** (0.0114)	0.1379*** (0.0118)	0.3658*** (0.0732)	0.3914*** (0.0707)
$\Delta \ln(GRLO)_{t-1}$	-0.0314 (0.0342)	-0.0497 (0.0379)	-0.1212*** (0.0350)	-0.11627*** (0.0262)
ROA_{t-1}	0.3423 (0.3982)	0.4055 (0.4748)	-0.4405* (0.2665)	-0.4764* (0.2696)
$\ln(ETA)_{t-1}$	0.6447*** (0.0359)	0.6535*** (0.0354)	0.3513*** (0.0793)	0.3227*** (0.0751)
$\ln(LTA)_{t-1}$	0.1349*** (0.0440)	0.0719 (0.0464)	0.0930*** (0.0294)	0.0514*** (0.0256)
$\ln(DL)_{t-1}$	0.0440* (0.0247)	0.0177 (0.0255)	0.0922*** (0.0181)	0.0755*** (0.0158)
$\ln(CTA)_{t-1}$	-0.0788** (0.0378)	-0.0143 (0.0411)	-0.0160 (0.0297)	-0.0169 (0.0270)
$\ln(TA)_{t-1}$	0.0304 (0.0250)	0.0386* (0.0231)	-0.0053 (0.0176)	-0.0162 (0.0148)
Constant	3.3918*** (0.3395)	3.4439*** (0.3338)	3.4052*** (0.4325)	3.2814*** (0.4090)
Observations	12,121	12,415	7,619	8,436
Period	1994-2015	1994-2015	1994-2015	1994-2015
R^2	0.6905	0.7394	0.9752	0.9755
Region fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES

Notes: Z-SCORE is the measure of bank stability (see equation in Section 4.2); BANK-SPECIFIC is a vector of bank-specific factors, such as: GRLO; growth of loans, reflecting credit policy; ROA: return on assets, reflecting the profitability of bank; ETA: equity to total assets, capturing the solvency bank and reflecting capital strength of bank; LTA: loans to total assets, capturing the volume of credit market; DL: deposits to loans, reflecting the intermediation cost; CTA: cost of total assets, reflecting a common indicator of bank's efficiency or volume of intermediation cost; TA: total assets, controlling for size of banks. See Table 1 for more details about the description of the variables; own calculations upon BilBank 2000 database from ABI (Associazione Bancaria Italiana); standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(continued)

Bank-specific factors and credit risk

Table 13. Bank-specific factors and credit risk: the potential differences inside LMAs

Table 13.

Regressors	Commercial banks-Excluding 1st decile	Commercial banks-Excluding 10th decile	Popular banks-Excluding 1st decile	Popular banks-Excluding 10th decile
$\ln(Z_SCORE-ROA)_{t-1}$	0.4727*** (0.0727)	0.5322*** (0.0819)	0.5326*** (0.0716)	0.5252*** (0.0669)
$\Delta \ln(GRLO)_{t-1}$	-0.0661** (0.0326)	-0.0485 (0.0395)	-0.2433*** (0.0678)	-0.2005*** (0.0599)
ROA_{t-1}	0.0908 (0.9750)	1.3351 (0.8898)	-1.1280 (1.2063)	-2.0820 (1.3222)
$\ln(ETA)_{t-1}$	0.1217 (0.0819)	0.1250 (0.0883)	0.1087* (0.0622)	0.1356** (0.0626)
$\ln(LTA)_{t-1}$	0.0077 (0.0380)	0.0342 (0.0468)	0.1090 (0.0949)	0.1540 (0.0946)
$\ln(DL)_{t-1}$	0.0060 (0.0247)	0.0334 (0.0265)	-0.0035 (0.0255)	-0.0073 (0.0301)
$\ln(CTA)_{t-1}$	0.0056 (0.0344)	-0.0094 (0.0474)	-0.0743 (0.0773)	-0.1086 (0.0935)
$\ln(TA)_{t-1}$	-0.0552** (0.0235)	-0.0427* (0.0231)	-0.0569 (0.0483)	-0.0694 (0.0443)
Constant	1.8867*** (0.4801)	1.4792*** (0.5427)	1.9740** (0.9466)	2.1520** (0.9183)
Observations	3,577	3,067	925	912
Period	1994-2015	1994-2015	1994-2015	1994-2015
R^2	0.7947	0.8307	0.9264	0.9259
Region fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES

Empirical evidence presented in the paper reveals that the ratio of non-performing loans for both cooperative and non-cooperative banks is influenced by the same bank-specific factors, with a significant role found for regulatory credit policy, capitalisation, volume of credit and volume of intermediation costs. Specifically, while regulatory credit policy, capitalisation and volume of credit are found to reduce the ratio of non-performing loans, higher volume of intermediation costs has a positive effect on the latter. The empirical findings presented here suggest an important role of regulatory credit policy, with the loan restriction of banks that reduces the risk. In other words, intermediation cost has a negative influence on bank risk, supporting the idea that a strict credit policy can be beneficial in reducing the risks related to an increase in the proportion of non-performing loans. The same applies to the level of bank capitalisation, which is found to reduce credit risk, as higher levels of capitalisation allow banks to cover any risks that could harm their balance sheets, with beneficial effects for the stability of the financial system and, in turn, for the real economy. As the estimated parameters are quantitatively similar, especially once we compare cooperative and commercial banks, it seems reasonable to assert that the cooperative banks' behaviour is closest to commercial rather than popular banks. To provide additional insights, our analysis further considers the role of the market structure and of banks' size. Results presented here highlight that the ratio of non-performing loans is not particularly affected, either by the degree of competition or by banks' size, a result that reinforces the idea that, although different in nature and size, cooperative banks tend to behave like their commercial counterparts. To assess the robustness of our estimates, various alternative strategies have been proposed. Specifically, we initially assess whether the estimated parameters remain stable following the financial crisis and the introduction of Basel II and III, as both variations in the macroeconomic and regulatory environment might have changed banks' behaviour. We then rely on the application of an alternative measure of credit risk, summarised here by the z-score on the ROA. Further, as the size of the LMAs might affect the degree of competition in the banking market and, through that, bias our estimates, as an additional robustness check, we propose a set of econometric estimates where we alternatively remove the smallest and the largest LMAs. This battery of robustness checks mostly confirms the main findings, although the advent of the financial crisis and the introduction of the capital requirements embedded in the Basel regulation have forced both cooperative and non-cooperative banks to undertake more prudent credit policies, based on credit restrictions. Evidence presented here has various policy implications, especially with respect to the stability of the Italian banking sector. Our results indicate that policy measures aimed at improving banks' monitoring abilities would be beneficial, as the higher the ability of banks in monitoring their borrowers, the lower is the amount of non-performing loans, thus determining an efficient allocation of resources. A similar picture concerns the role of capitalisation, where regulators should impose capital standards, rendering banks more and better capitalised, reducing credit risk.

At the same time, policy measures which reduce the costs of intermediation would be highly beneficial in reducing credit risk. These policies should mostly be tailored towards commercial banks, as the latter face significantly larger costs of intermediation compared to other types of financial intermediaries. Measures based on the expansion of the cooperative banking sector, on the other hand, should be taken with caution. Indeed, although our evidence points to an inverse relationship between the volume of credits provided by these banking institutions and their ratios of non-performing loans, at the same time, it has been proven that the expiation of their branches caused a worsening in the levels of credit risk (Bernini and Brighi, 2018).

From this perspective, however, the recent reforms of cooperative banks, aimed at reducing its fragmentation and to increase the availability of external sources in case of financial distress, represent a significant step forward to enhance the stability and the resilience of the Italian financial system. The same applies to the recent reforms of *banche popolari*, which requires these banks to be converted into joint stock companies provided that their assets exceed €8bn.

Notes

1. Unfortunately, we do not have information on some of the variables used in the analysis for years before 1994 and after 2015. For this reason, our analysis only covers the 1994–2015 period. Furthermore, the ABI-data set is compared with Bankscope-data set. The debate is in favour of the first because it has some valuable information.
2. For the purposes of the paper and given the structure of our data, we have opted for the application of a pooled regression, i.e., fixed or random effect. The first step is to determine whether individual effects are relevant or not. If the individual effects are not relevant, the pooled regression model is the best option. The Breusch–Pagan test (Breusch and Pagan, 1980) was performed. Contrast results suggest that the constant coefficient model was not suitable for the data. The second step is to choose between the fixed-effects and the random-effects models. The Hausman test provides an answer for the best choice (Hausman 1978; Hausman and McFadden 1984). The null hypothesis assumes that the most appropriate model is the random-effects, with the fixed-effect model being an alternative hypothesis. Test results rejected the null hypothesis, thus concluding that the best estimation technique for the data was provided by the model of fixed coefficients.
3. For a more detailed discussion concerning the properties of the GMM estimator, please refer to Roodman (2009).
4. The choice of the lag structure is suggested by some preliminary estimates.
5. More specifically, the Italian regions are divided as follows: South (Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia and Sardegna), North-West (Valle d'Aosta, Lombardia, Piemonte and Liguria), North-East (Trentino Alto Adige, Friuli Venezia Giulia, Veneto and Emilia-Romagna) and finally Centre (c—Toscana, Marche, Umbria and Lazio).
6. As suggested by Roy (1952), the indicator of financial stability corresponds to the inverse of the probability of default, and it's considered in literature as one of the main indicators to quantify the financial stability in the banking sector (see, among others, Boyd and Graham, 1986, 1988; Boyd and Runkle, 1993; Maechler *et al.*, 2005; Laeven and Levine, 2009; Uhde and Heimeshoff, 2009; Fink *et al.*, 2009; Demirguc-Kunt and Huizinga, 2010; Houston *et al.*, 2010; Beck *et al.*, 2012; Fiordelisi and Mare, 2014).

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