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Non-Performing Loans, Moral Hazard & Supervisory Authority: The Italian Banking System

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Abstract

This paper aims to identify the existence of an opportunistic form of behaviour – i.e. moral hazard – within the Italian banking sector. Applying a fixed effect threshold panel analysis approach to a dataset of 298 Italian banks from 2006 to 2014, we investigate whether banks' lending behaviour is sensitive to high levels of NPLs (Non-Performing Loans) and whether banks, with higher NPLs, tend to adopt a more aggressive and riskier lending strategy. We also empirically test the hypothesis that the supervisory activity of the Italian banking authority – through credit risk sanctions – is effective in providing incentives for banks to limit their risky lending strategy. Banks, with significant previous losses and significant levels of gross non-performing loans, can reduce the NPLs ratio temporarily by making additional loans due to the dilution effect. However, bank managers may have to accept riskier positions to obtain additional loans potentially generating higher future losses. The empirical results show that banks may be affected by moral hazard problems, but we find no effect of the enforcement action on reducing it. To account for endogeneity, robustness tests are also conducted as part of the study.

Keywords: Non-performing loans; Moral Hazard; Lending behaviour; Bank regulation.
JEL Codes: G21; G30.

1 Introduction

Bailouts within the financial context both in the US, and more recently in Europe, have highlighted a twofold scenario: restoration of confidence, and the social costs of moral hazard. Vigorous growth in the banking sector over recent decades has led to a more forceful and complicated regulatory environment. Indeed, bad governance and excessive risk-taking may undermine the stability of a banking systgobbiem and contribute to an economic downturn. The 2008 US sub-prime crisis – Bear Stearns *versus* Lehman – and the reaction of European governments to sovereign debt problems in Greece, Cyprus, Portugal and Spain are good examples. To prevent widespread economic collapse, governments throughout Europe and the USA felt compelled to intervene

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with public guarantees and recapitalisation programs to bail out financial institutions considered *too big to fail*. To restore confidence and prevent further collapses in the financial system, bailouts are the *extrema ratio* or last resort however they may also act to encourage excessive risk taking.

Conflict of interests and moral hazard in the banking industry are serious threats to the stability of a banking system. In particular, the financial crisis has had a profound impact on banks' activities and business models. Recently, the issue of excessive bank risk-taking has again come to the fore in terms of national public debt in the Southern periphery of the Eurozone. Cyclical profitability challenges in some European countries are amplified by the large stock of NPLs. A rising share of NPLs in the loan portfolio of banks reflects greater risks affecting both the liquidity and the profitability of banks, as a sizeable part of assets are not generating revenue. Moreover, it represents a deterioration of bank balance sheets. Particularly, a deterioration of banks' asset quality is not only financially destabilizing for the banking system, but may also reduce economic efficiency and cause a decline in economic activity. The minimisation of NPLs is necessary to restore confidence in the banking system and foster financial stability. Banks, as a special type of firm, play a pivotal role in the functioning of the real economy. A shock occurring in the banking system may have severe consequences for the real economy, and it may undermine the functioning of bank services on a systemic scale. Moreover, by the very nature of their business, banks are highly exposed to maturity and liquidity risk which may lead to forced asset sales (Diamond and Rajan, 2011).

The level of NPL ratios varies widely across the Euro area, but it remains at rather elevated levels in the majority of countries that were most affected by the financial crisis and this may have constrained credit origination in these countries. The Italian banking system appears to be the one most affected by the phenomenon of NPLs. During 2015, the stock of NPLs stabilized: at the end of the year, gross write-downs amounted to approximately €360 billion (18.1% of total outstanding loans) of which €210 billion were classified as bad debts; net write-downs amounts recorded in the balance sheets reached €197 billion and €87 billion respectively. The share of gross NPLs for the main Italian banking groups was 16.8%, compared with a European average of 5.8% (Bank of Italy, 2015). In particular, more than 80% of bank NPLs were in the corporate sector. High corporate NPLs reflect weak business profitability in a severe recession as well as the heavy indebtedness of many small and medium sized companies SMEs that often have less than 10 employees – corporate NPLs are among the highest in the Euro area (Bank of Italy, 2014).

Considering the role played by NPLs in the Italian banking system, it is interesting to observe the emergence of two distinct phases of the financial crisis over the past decade. During the first one, the Italian banking system proved to be robust in contrast to other European countries since no public recapitalizations were required. In the second phase of the crisis, the banking system began to show some fragility linked to both lower interest rates and a significant increase of NPLs. The crisis had a profound impact on the configuration of NPLs, which was exacerbated by bank-specific factors and the prolonged recession that led to higher default risks in corporate loans.

The aim of this study is twofold. Related to the Italian banking system, the first objective is to investigate whether banks' lending behaviour may be sensitive to a specific level of Gross Non Performing Loans (GNPLs) and, more importantly, whether banks with higher GNPLs ratio tend to adopt more aggressive and riskier lending strategies. The second objective is to investigate the hypothesis that the supervisory activity of the Italian banking authority (i.e. Bank of Italy) – through credit risk sanctions – is effective in providing incentives for banks to limit their risky lending strategy and in ensuring the stability of the Italian banking system. In short, the second objective is to empirically examine the relationship between supervisory effectiveness and bank risk[1].

To detect opportunistic behaviour in the form of moral hazard, following Zhang *et al*. (2016), we adopt a fixed effect threshold panel analysis approach to investigate the role of GNPLs in signalling moral hazard problems. We apply this model to a sample of 298 Italian banks – composed of three different kinds of banks (stock market listed, cooperative, mutual banks) – from 2006 to 2014 in order to test the hypothesis that troubled banks have incentives to take excessive risks. We conduct the analysis on the Italian banking system for two reasons. The first is the fact that bank financing is the main external funding source in Italy; the second concerns the strongly relational banking model on which the Italian financial system is based. We investigate the effectiveness of supervision in containing bank risk through information on credit risk sanctions obtained by examining the Supervisory Bulletin published monthly by the Bank of Italy during the time period 2006-2014[2]. On-site inspections enable the detection of management deficiencies and the verification of both the quality of the internal control systems and the reliability of information produced by banks (Basel Committee on Banking Supervision, 2002).

We hypothesise that banks with higher NPLs ratios take more risks to offset the losses associated with NPLs. Consequently, NPLs increase further as a result of not only higher loan growth but also more importantly due to the relaxation of screening and monitoring standards. Moreover, we also hypothesise that effective supervisory activity by the Italian banking authority both provides incentives for banks to limit their risk-lending strategy and ensures the stability of the Italian banking system as a whole, thus confirming that on-site examinations and sanctions are useful for ensuring the stability of the system (Taylor and Quintyn, 2002; Coffee, 2007; Jackson, 2007; Jackson and Roe, 2009; Delis and Staikouras, 2011).

Our contribution to the existing literature is twofold. Firstly, we apply the threshold model to the Italian banking system; and secondly, we introduce regulatory sanctions as a way to mitigate the moral hazard problem. The results may have important implications both for the design of bank risk management policy, and for the construction of an indicator useful for supervisory authorities in their on-site inspections and in defining the general set of rules and regulations regarding bank risk-taking.

[1] In accordance with Delis and Staikouras (2011), our analysis considers the difference between banking supervision and regulation as stated by the Basel Committee on Banking Supervision (2002). Regulation encompasses formal rules that are adopted by an official public authority. On the other hand, banking supervision comprises the on-going monitoring of law and the imposition of remedial measures in the case of violations.

[2] According to the second pillar of Basel II, credit risk sanctions ensue from on-site inspections. The latter are an essential component of supervisory review, with the application of appropriate sanctions where breaches of law are revealed (Basel Committee on Banking Supervision, 2006).

The paper is organised as follows: Section 2 presents a literature review divided into the relationship between moral hazard problems & non-performing loans and supervisory activity; Section 3 describes the methodology employed; Section 4 details the data used and associated descriptive statistics; Section 5 depicts the empirical results; Section 6 concludes the paper.

2 Literature Review

2.1 Moral hazard problems and non-performing loans

Although the notion of information asymmetry comes from the corporate finance literature (Merton, 1974; Galai and Masulis, 1976; Jensen and Meckling, 1976) and is not focused on the banking sector specifically, the issue is likely to play a pivotal role in the business of financial intermediaries. After the work of Galai and Masulis (1976), Jensen and Meckling (1976) and Merton (1974), who first introduced the risk-shifting problem as one of the major conflicts of interest between shareholders and bondholders, several studies have analysed the relation between the potential costs of risk shifting and a firm's characteristics. Saunders *et al*. (1990) investigate the relationship between bank ownership structure and risk taking[3]. In particular, they argue that the effect of ownership structure on the risk characteristics of banks is much more powerful during periods of deregulation (e.g. activity and interest rate deregulation or closure rule forbearance) than during periods of regulation. After many theoretical papers that have sought to identify factors (e.g. convertible debt, debt maturity, regulation, managerial incentives, growth options) that affect the risk-shifting problems (Smith and Warner, 1979; Barnea *et al*., 1980; Green, 1984; Smith, 1986; Smith and Watts, 1992; Barclay and Smith 1995a, 1995b; Rajan and Zingales, 1995), Eisdorfer (2008) empirically examines risk-shifting behaviour in distressed firms, shedding light on the relation between investment and the volatility of a project. In particular, shareholders' risk-shifting incentives produce a positive relation between volatility and investment.

Jensen and Meckling (1976) – casting new light on the definition of the firm, on the separation of ownership and control and on the social responsibility – argue that managers (i.e. the agent) may have incentives to take riskier activities above the optimal level. In this regard, Jensen and Meckling outline two kinds of moral hazard problem: *a*) managerial rent-seeking, which takes place when agents pursue their private benefits by investing in poor projects; *b*) conflict of interest between shareholders and creditors. Financial institutions, particularly banks, are special because they have more leverage than non-financial firms; shareholders may want to issue risky loans but eventually shift the risk to the depositors. Jensen and Meckling's (1976) theory implicitly suggests that both of these moral hazard problems within the banking sector lead, to a higher loan growth rate and a larger number of NPLs. Both the risk-shifting motive in Jensen and Meckling

[3] For example, Amihud and Lev (1981) and Agrawal and Mandelker (1987) highlighted the conflict of interest between managerially controlled banks and stockholder controlled banks. They showed an inverse relationship between non-bank firms' risk taking and the degree of managerial control.

(1976) and the underinvestment motive in Myers (1977) inspire Diamond and Rajan (2011) to study the reasons why the management of a highly impaired bank, knowing that it may fail, has an incentive to hold, rather than sell, illiquid assets in the future (i.e. «illiquidity seekers»). Indeed, the bank, by selling the asset today will on the one hand raise cash and strengthen the value of its debt; but on the other, the bank will sacrifice the returns that it would obtain if the currently depressed value of the asset recovered. Laeven and Levine (2009) analyse the relationship between risk taking, ownership structure, and national bank regulations using a dataset of 270 banks across 48 countries. They find that banks with more powerful owners tend to take greater risks. Foos *et al*. (2010), on analysing more than 16,000 individual banks from 16 major countries during the 1997-2007 period, find that loan growth is a determinant of loan losses, bank profitability, and bank solvency. In particular, they point out that loan growth leads to an increase in loan loss provisions during the next three subsequent years, to a decrease in relative interest income, and to lower capital ratios. Acharya *et al*. (2015) emphasise a trade-off between two types of moral hazard. If leverage is too low, debt holders lack incentives to monitor managers' behaviour because the debt is safe; otherwise, if leverage is too high, managers will probably substitute safer assets for riskier ones at the expense of debt holders.

A substantial number of academic studies have investigated the relationship between loan growth, NPLs, and bank risk-taking (Demirgüç-Kunt, 1989; Barr *et al*., 1994; Berger and Udell, 1994; Gorton and Rosen, 1995; Shrieves and Dahl, 2003). Bernanke and Gertler (1986) maintain that the impaired loans of banks may induce different bank behaviours according to banks' risk preferences. Prudential banks tend to be more cautious when they face increasing levels of impaired loans. However, it is likely that when the NPLs ratio is too high, both the shareholders and bank managers have clear incentives to shift risks.

When a firm is in financial distress, risk-shifting incentives also play a role in the investment-volatility relationship. Eisdorfer (2008), on analysing the relation between investment and volatility in a sample of 52,112 firms traded on the NYSE, AMEX and Nasdaq over the period 1963 to 2002, provides empirical evidence that expected volatility for distressed firms has a positive effect on investment, and that risk-shifting behaviour is affected by various factors associated with the incentive and ability of shareholders to shift additional firm risk to bondholders. Other authors argue that, after the Lehman Brothers collapse, banks might have saved themselves by holding on to risk assets rather than selling them (Bruche and Llobet, 2011; Diamond and Rajan, 2011). Koudstaal and Wijnbergen (2012), collecting data on US banks between 1993 and 2010, find that higher loan-loss reserves are associated with a more troubled loan portfolio. Zhang *et al*. (2016) examine the impact of NPLs on bank behaviour in the Chinese banking system by estimating a NPLs threshold value. They confirm that an increase in the NPL ratio induces bank management to engage in inappropriate credit expansion and that, potentially, this may result in further deterioration of loan quality and undermine financial stability.

A finding shared by the above studies is that the level of impaired loans can be an important determinant of bank management behaviour. We argue that the level of NPLs could help in detecting the presence of moral hazard in the banking sector.

2.2 Measuring supervisory activity

Another strand of academic literature examines the relationship between banking regulation and supervision. A substantial number of academic studies have analysed the relationship between bank stability and financial regulation, pointing out that banking regulation plays a pivotal role in risk-taking (Barth *et al*., 2002, 2004, 2008a; 2008b; Quintyn *et al*., 2011; Cihàk *et al*., 2012). Some papers report empirical evidence on the relationship among bank risk-taking, supervisory activity, and supervisors' enforcement actions (Delis and Staikouras, 2011).

Performing a type of backward induction, Wu (1969) was the first to note that the accuracy of bank examiners with regard to business loans provides a valid *ex ante* measure of loan quality. Subsequently, other studies have focused on the predictive skills of bank examinations regarding the quality of loans (Berger *et al*., 2000; DeYoung *et al*., 2001; Bhattacharya *et al*., 2002; Delis and Staikouras, 2011). These authors conclude that on-site audits play a disciplinary role. Moreover, other empirical studies argue that on-site audits enhance banking discipline and impose remedial measures on imprudent banks, thus constraining excessive risk-taking (Swindle, 1995; Berger and Davies, 1998; DeYoung *et al*., 2001). Given these assumptions, the number of on-site audits and supervisory sanctions should be positively correlated with banking discipline, and increased transparency in concert with an enhanced market discipline should contribute significantly to banking stability. Other authors confirm this view by arguing that the stability of a banking system is strengthened by: (*i*) limiting information asymmetries; (*ii*) boosting private monitoring; (*iii*) facilitating supervisory oversight; (*iv*) forcing banks to adopt more prudent risk-taking behaviour (Beck *et al*., 2006; Demirgüç-Kunt *et al*., 2008). On the other hand, different views propose a twofold explanation as to why information disclosure may undermine banking system stability. First, increased information disclosure may cause depositors to overreact to adverse information about other banks and start a run on their bank (Chen and Hasan, 2006). Second, information disclosure regulation may lead to pervasive *free riding* of monitoring information and to reduced profit margins (Hyytinen and Takalo, 2002).

An assumption shared by the academic literature and the present study is that supervisors are able to enforce capital regulation. Accordingly, we argue that effective enforcement of capital requirements may be the key incentive mechanism for banks to reduce both their portfolio (by increasing the loans quality) and leverage risk (Flannery, 1989). In the meantime, supervisory forbearance may be interpreted as a government subsidy inducing banks to increase their risky assets (Allen and Rai, 1996; Galloway *et al*., 1997; Cukierman and Izhakian, 2015).

3 Methodology

The problem of moral hazard arises in sampling theory for quality control. Whittle (1954) and Hill (1960) understand that distributions of quality are endogenous, and that they are dependent on the amount of care taken in the production process – they studied how to take this *non-controllable* effort level into account in their analysis of quality from a sample.

Within the banking literature, according to Berger and DeYoung (1997), four modes of management behaviour have been identified. Banks may find that their NPL ratios increase as a result of *bad luck* or *bad management*. In keeping with this picture, bank management may observe an increase in their NPL ratios as a result of bad luck or bad management (Berger and DeYoung, 1997). In the case of *bad luck*, exogenous events increase loan loss provision (reducing asset quality). Bank managements will respond by reducing lending, and the NPLs ratio will fall. On the other hand, if the reason is bad management, bank management, by expecting a rise in the NPL ratio, will respond by taking additional risk in order to reduce losses through higher levels of lending. This additional risk identifies a particular form of bank management behaviour – captured by moral hazard – whereby additional risk-taking in terms of an increase in the loan growth ratio, follows a worsening of the NPL ratio. Moral hazard can induce excessive risk-taking – thus lowering asset quality – and this takes place when managers (agents) endeavour to optimise their own benefits that are not consistent with the interests of the owners (principals). Therefore, a high NPL ratio depresses profitability and constrains new lending. On the revenue side, NPLs generate a *negative carry* because they do not produce cash interest revenues. *Vice versa*, NPLs push up interest rates on performing loans to compensate for the lost revenue. Moreover, NPLs can increase human and operational resources, generate legal and administrative costs, and require valuable bank capital, which if released, may support fresh lending[4].

Furthermore, a high level of NPLs reduces bank valuations and increases the cost of funding. Weak asset quality may be an important factor in explaining Italian banks' higher CDS spreads. Due to the close correlation between the probabilities of default and loss given default, higher NPLs in an economic downturn lead to lower recovery values and larger credit losses. Moreover, banks with worse asset quality are more sensitive to the sovereign distress increasing risk *premia* in the real economy; high levels of NPLs exacerbate this sensitivity by raising the range surrounding possible future losses (CGFS, 2011).

The analysis reported in this paper, uses a threshold regression model to identify moral hazard problems. The threshold model is designed to split up individual observations into regimes. The model is based on Hansen (1999), which proves to be an effective tool with which to investigate possible asymmetric effects:

[4] In large Italian banks, NPLs, even if adequately provisioned, absorb valuable bank capital. The cost of capital for holding NPLs depends on the credit risk approach: *a*) for banks using *standardised methods*, the capital charge for NPLs amounts to 12% of RWA but only applies to NPLs that are inadequately provisioned or not collateralised. Most mid-sized and all small Italian banks follow the standardised method; *b*) under the *internal ratings-based models*, the capital charges on NPLs depend on the risk approach: for banks under the Basel II *IRB Advanced* (*IRBA*) approach, the capital cost for NPLs is twofold: (*i*) a capital deduction for the provision shortfall between Basel II expected losses and IFRS accounting provision. This capital deduction is known as the «IRB shortfall», and (*ii*) a capital charge for gross NPLs based on banks' internal models. All large Italian banks are under the *IRBA approach*. On the other hand, banks under the *IRB foundation* (*IRBF*) approach are only required to deduct the «IRB shortfall». There is no other capital charge on NPLs. In Italy, only two mid-sized banks follow IRBF methods (Basel Committee on Banking Supervision, 2014).

$$y_{i,t} = \alpha_i + \beta_1 x_{i,t} I(q_{i,t} \leq \gamma) + \beta_2 x_{i,t} I(q_{i,t} > \gamma) + \varepsilon_{i,t} \tag{1}$$

where $I(\cdot)$ is the indicator function that takes value one if the statement in brackets is true, zero otherwise; $q_{i,t}$ is the predefined threshold variable; i stands for cross-sectional index; t stands for the time series element. This model allows the threshold value to be chosen endogenously.

Based on (1), the estimation equation can be written:

$$\begin{aligned} NPL_{i,t} = \alpha_i &+ \beta_1 GLGR_{i,t} I(NPL_{i,t-1} \leq \gamma) + \beta_2 GLGR_{i,t} I(\mathrm{NPL}_{i,t-1} > \gamma) + \\ &+ \beta_3 GLGR_{i,t-1} I(NPL_{i,t-1} \leq \gamma) + \beta_4 GLGR_{i,t-1} I(NPL_{i,t-1} > \gamma) + \\ &+ \beta_5 GLGR_{i,t-2} I(NPL_{i,t-1} \leq \gamma) + \beta_6 GLGR_{i,t-2} I(NPL_{i,t-1} > \gamma) + \\ &+ \beta_7 X_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{2}$$

where, $NPL_{i,t}$, the dependent variable, is the ratio between non-performing gross loans and total outstanding gross loans for bank i at time t; $GLGR_{i,t}$ is our first explanatory variable expressed in terms of loan gross growth rate for bank i at time t; $GLGR_{i,t-1}$ is our second explanatory variable expressed in terms of loan gross growth rate lagged one period backwards for bank i at time $t-1$; $GLGR_{i,t-2}$ is our third explanatory variable expressed in terms of loan gross growth rate lagged two periods backwards for bank i at time $t-2$. Based on the assumption outlined above, we expect a negative and significant relationship between banks' loan growth rate and the level of the NPL ratio in the Italian banking system. Normal loan growth associated with standard banking operations may reduce the NPL ratio, but an abnormal growth rate would indicate a moral hazard problem causing subsequent further losses. $X_{i,t}$ is a vector that contains other explanatory variables in greater detail: is our control variable. It is expressed by the deposit growth rate for bank i at time t. Deposits are an important factor in bank balance sheets, influencing the bank's behaviour and loan quality; we presume that the deposit growth ratio can be considered an indicator of the bank's objective function (Lepetit *et al.*, 2008).

Regarding control variables, $C\_I_{i,t}$ is the cost to income ratio measured by operating expenses over the intermediation margin for bank i at time t – it is a proxy for bank efficiency; $CAR_{i,t}$ is the risk-weighted assets ratio between tier 1 capital and tier 2 capital and dividing the total by the total risk-weighted assets for bank i at time t. Since CAR is an important part of both the micro and macro prudential framework[5], it can provide a common measure for a bank's risks, help ensure that capital allocated to assets is commensurate with the risks, and it can potentially highlight where destabilising asset class bubbles arise (Le Leslé and Avramova, 2012). Consequently, we can expect an ambiguous relationship between CAR and NPLs due to the lack of prudence. Excessive management discretion in pushing capital down may also result in aggressive risk-taking and potentially lead to bank failure, with significant related social and economic costs.

[5] The Basel Committee's regulatory solvency measures (Tier 1, Tier 2 and Total Capital, Common Equity Tier 1, Additional Tier 1 and Total Capital under Basel III, as well as other key solvency measures, such as Core Tier 1 or Tier 1 Common) are currently all defined in terms of risk-weighted assets (RWAs). However, Basel III will gradually introduce a new solvency measure, the leverage ratio, initially defined as Tier 1 capital over total unweighted on and off-balance sheet assets. Due to the holding period taken into account, this paper considers RWA ratios (Le Leslé and Avramova, 2012).

In doing so, bank management may «control» the system by under-estimating risks to optimise their capital beyond what prudence requires; $ROA_{i,t}$ is the return on asset ratio between profit before taxes and total assets.

Another control variable is bank size. The size of banks, expressed in terms of the natural logarithm of total assets for bank *i* at time *t*, has often been considered an important factor for NPLs. Large banks have more diversification opportunities, and as such they can reduce the level of troubled loans (Salas and Saurina, 2002; Rajan and Dhal, 2003). In addition, large banks are better able to evaluate loan quality because of their richer resources (Hu *et al.*, 2004). Therefore, bank size is negatively associated with the level of NPLs. However, due to the *too big to fail* argument, we expect a positive relationship between the bank size and level of NPLs (Zhang *et al.*, 2016).

Finally, we introduce macroeconomic conditions or business cycles in order to understand how they can contribute to the level of NPLs. According to Carey (1998), a change in economic conditions may be an important factor affecting bank losses. Quagliariello (2007), on analysing an Italian banking dataset, shows evidence that business cycles affect NPLs. Therefore, in order to control for the 2008 global financial crisis, we introduce dummy variables for the 2010-2014 holding period.

In order to investigate the supervisory activity of the Italian banking Authority, equation (2) can be written as:

$$(3) \qquad \begin{aligned} NPL_{i,t} = \alpha_i + \beta_1 Thr_i + \beta_2 Sa_{i,t-1} + \beta_3 Thr_i^* Sa_{i,t-1} + \beta_4 Thr_i^* Sa_{i,t-2} + \\ + \beta_5 GLGR_{i,t} + \beta_6 GLGR_{i,t-1} + \beta_7 GLGR_{i,t-2} + \beta_8 X_{i,t} + \varepsilon_{i,t} \end{aligned}$$

where, Thr_i is the dummy variable threshold which takes value 1 for banks lying above the threshold endogenously determined with equation 2; $Sa_{i,t}$ is the sanction (in logarithm form) inflicted by the Bank of Italy on bank *i* at time $t-1$, $t-2$, respectively (i.e. anomalies occurring *ex ante* and in the loan screening process not disclosed to the Supervisory Authority); $Thr_i^* Sa_{i,t}$ is an interactive variable between threshold variables and the amount of sanction lagged respectively. The purpose of this interactive variable is to capture supervisory effectiveness in containing bank risk through information on credit risk sanctions; $GLGR_{i,t}$ is the loan gross growth rate for bank *i* at time *t*, $t-1$, $t-2$ respectively. $X_{i,t}$ is a vector that contains other explanatory variables already described in equation 2.

4 Data and Descriptive Statistics

In Italy NPLs have tripled since 2007, growing at around 20% annually since 2008 and reaching €333 billion in June 2014 – 24% of GDP or 16.8% of total loans (Jassaud and Kang, 2015). In the Italian banking system, NPLs cover four categories[6]: *bad debt* (i.e. loans in a state of insolvency), *substandard*, *past due* and *restructured* loans (Figure 1).

More than 80% of bank NPLs are in the corporate sector, reaching nearly 30% on aver-

[6] Since January 2015, the Bank of Italy has aligned the Italian definition of NPLs with the non-performing exposure (NPE) and forbearance notion provided by EU regulation on supervisory reporting.

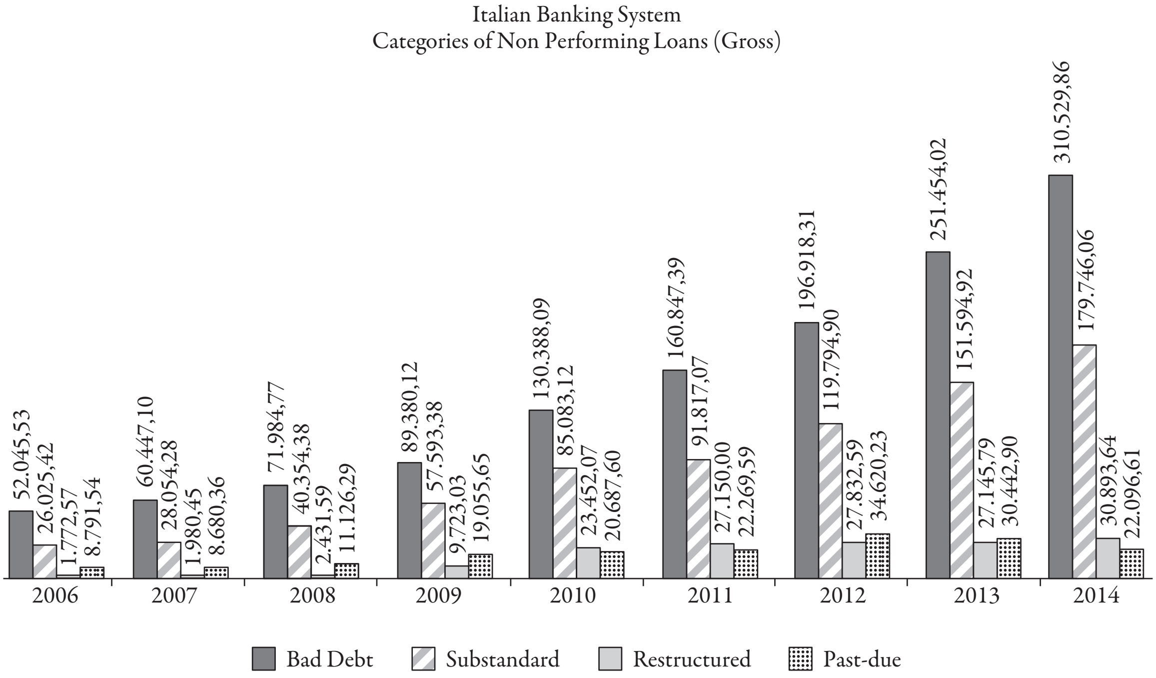

Figure 1: Italian banking system: Non performing loans categories (Gross values – EUR thousands).

age in 2014, with a significant percentage occurring in the South of the country (Bank of Italy, 2014)[7]. The high corporate NPLs ratio reflects the heavy indebtedness of many Italian SMEs. In greater detail, looking at all types of NPLs and all sectors of economic activity, there appears to be a north-south divide, especially in terms of bad loans. The service sector and less technology-intensive sectors are most affected. In early 2009, most regions had bad debt ratios below 10%, by end 2014, most central and southern Italy regions saw their bad debt ratios increase above 20% (Garrido *et al.*, 2016). Moreover, loans are also backed by collateral and guarantees, although court times to access them are very long.

The sample, consisting of Italian Banks surveyed by the ABI Banking database[8], provides all micro data coming from bank balance sheets and income statements of all Italian commercial banks. As the threshold model of Hansen (1999) requires a balanced panel data, we had to drop some banks and observations from the sample. In addition, data availability problems imposed some cancellation of banks with incomplete information, leaving us with a dataset of 298 banks for the period from 2006 to 2014. Specifically, the dataset includes 66 stock banks, 23 cooperative banks and 209 mutual banks, with a total number of 2,682 observations. Although we had to remove some banks, our bank sample represents in terms of assets value 77.2% of the total assets of Italian banking system, as shown in Table 1.

Since outliers might cause inference problems, some of data are winsorized at the 1% level. Descriptive statistics of the key variables in the sample, before and after the winso-

[7] As reported by the Bank of Italy (2014), corporate loans amounted to €1,037 billion (52% of total bank loans in Italy), of which corporate NPLs accounted for almost €300 billion.
[8] The ABI Banking database belongs to the Italian Banking Association (ABI).

Table 1: Breakdown of population and sample

Sample Description	Population		Sample		Percentage (%)	
	Bank number (A)	Total assets (B)	Bank number (C)	Total assets (D)	Bank number (C/A)	Total assets (D/B)
Stock banks	114	1,970,000,000	66	1,458,600,000	57.9	74.0
Cooperative banks	25	249,000,000	23	243,800,000	92.0	97.9
Mutual banks	346	213,000,000	209	174,452,237	60.4	81.9
Total sample	*485*	*2,432,000,000*	*298*	*1,876,852,237*	*61.4*	*77.2*

Table 2: Descriptive statistics of key variables

Sample	Variable	Before Winsorizing				After Winsorizing		
		N.	Mean	Median	Std. Dev	Mean	Median	Std. Dev
Full Sample	GNPLs	2,682	0.1070	0.0914	0.0663	0.1070	0.0914	0.0663
	GLGR	2,384	0.0609	0.0422	0.1399	0.0564	0.0422	0.0944
	DGR	2,384	0.0678	0.0505	0.1369	0.0637	0.0505	0.1056
	C_I	2,682	0.6368	0.6348	0.1263	0.6380	0.6348	0.1148
	CAR	2,682	0.1595	0.1459	0.0626	0.1588	0.1459	0.0578
	ROA	2,682	0.0270	0.0273	0.0098	0.0270	0.0273	0.0098
	Size	2,682	13.6722	13.3119	1.4058	13.6722	13.3119	1.4058
Stock Banks	GNPLs	594	0.1032	0.0853	0.0712	0.1032	0.0853	0.0712
	GLGR	528	0.0590	0.0247	0.2194	0.0481	0.0247	0.1127
	DGR	528	0.0465	0.0244	0.2046	0.0371	0.0244	0.1371
	C_I	594	0.6472	0.6498	0.1730	0.6521	0.6498	0.1324
	CAR	594	0.1424	0.1254	0.0725	0.1411	0.1254	0.0614
	ROA	594	0.0263	0.0274	0.0142	0.0263	0.0274	0.0142
	Size	594	15.2148	14.9787	1.5693	15.2148	14.9787	1.5693
Cooperative Banks	GNPLs	207	0.1098	0.0990	0.0574	0.1098	0.0990	0.0574
	GLGR	184	0.0788	0.0702	0.1047	0.0766	0.0702	0.0893
	DGR	184	0.0711	0.0572	0.0922	0.0703	0.0572	0.0878
	C_I	207	0.6153	0.6238	0.1089	0.6157	0.6238	0.1080
	CAR	207	0.1622	0.1517	0.0511	0.1622	0.1517	0.0511
	ROA	207	0.0277	0.0278	0.0094	0.0277	0.0278	0.0094
	Size	207	14.8777	14.8088	1.4488	14.8777	14.8088	1.4488
Mutual Banks	GNPLs	1,881	0.1079	0.0920	0.0656	0.1079	0.0920	0.0656
	GLGR	1,672	0.0595	0.0431	0.1073	0.0568	0.0431	0.0881
	DGR	1,672	0.0741	0.0555	0.1115	0.0714	0.0555	0.0941
	C_I	1,881	0.6359	0.6321	0.1093	0.6360	0.6321	0.1090
	CAR	1,881	0.1646	0.1502	0.0594	0.1639	0.1502	0.0563
	ROA	1,881	0.0271	0.0271	0.0080	0.0271	0.0271	0.0080
	Size	1,881	13.0523	12.9783	0.7178	13.0523	12.9783	0.7178

Note: The variables are in abbreviations, representatively standing for: GNPLs = NPLs gross ratio (non-performing gross loans divided by total outstanding gross loans); GLGR = Gross loan growth rate; DGR = deposit growth rate; C_I = ratio between operating expenses and intermediation margin; CAR = CAR ratio (i.e. the ratio between Tier 1 & 2 capital divided by the total risk-weighted assets); ROA stands for return on asset and is the ratio between profit before taxes and total assets; Size = end of year total assets (in logarithmic term) respectively.

rizing process, together with the correlation between the variables adopted, are shown, respectively, in Tables 2 and 3.

In terms of gross loan growth rate (GLGR), the full sample average rate is 5.64% after winsorizing, but cooperative banks report a much higher growth rate at 7.66%. The deposit growth rate is 6.37% for the full sample; in particular, stock banks show on average a 3.71% deposit growth rate compared with cooperative banks 7.03% and mutual banks 7.14% respectively. The level of capital adequacy requirements (CAR) in these commercial banks is reasonably high (15.9% on average) with significant heterogeneity among kinds of banks: for example mutual banks show a remarkable level of CAR at 16.4%. In terms

Table 3: Correlation among key variables

Variables	GNPLs	GLGG	DGR	C_I	CAR	ROA	Size
GNPLs	1						
GLGG	−0.2459*	1					
DGR	−0.1862*	0.7430*	1				
C_I	−0.0417	0.0411	−0.0620*	1			
CAR	0.1385*	−0.0287	−0.0274	−0.0946*	1		
ROA	−0.4478*	0.1910*	0.1185*	−0.0301	0.1739*	1	
Size	−0.0014	−0.008	−0.0359	−0.0774*	−0.0896*	−0.1903*	1

* Denotes statistical significance at 5% level.

Table 4: Descriptive statistics sanctions inflicted by Bank of Italy on the Italian banks under its supervision

Type of Banks	N. of sanctioned banks	Amount of Sanctions	
		Mean	Max
Stock Banks	49	321,393.1	6,352,540.0
Cooperative Banks	5	243,300.0	560,000.0
Mutual Banks	91	94,286.4	450,000.0
Full Sample	145	176,171.0	6,352,540.0

Note: The amount of sanctions is expressed in thousands of Euros.

Source: Bank of Italy Supervisory Bulletin.

of gross NPL ratio, the average rate is 10.7% with no remarkable difference among the different types of banks.

A second dataset section encompasses information on sanctions and on-site bank examinations for the Italian banking system obtained by examining the Supervisory Bulletin[9] published monthly by the Bank of Italy over the period 2006-2014. Starting from the sample of all Italian banks, we matched hard information (coming from the ABI Banking data base) with soft information (coming from the monthly Supervisory Bulletin). Since the Supervisory Bulletin discloses many categories of sanctions but some of them are represented by a small number of observations, with regard to our research question we limited our analysis only to sanctions due to: *a*) general organizational and internal control failures, *b*) deficiencies in the credit process and *c*) omitted credit risk disclosure.

The descriptive statistics reported in Table 4 show a total of 145 sanctions for the sample of banks. In greater detail regarding the amount of sanctions, stock banks have exhibit higher levels on average.

5 Empirical Results

The first step of our empirical analysis is to identify the existence of asymmetric management behaviour based on a high level of credit risk, measured by GNPLs ratio.

[9] The monthly Supervisory Bulletin contains the general measures adopted by credit authorities and other significant measures concerning persons subject to supervision(https://www.bancaditalia.it/pubblicazioni/bollettino-vigilanza/index.html?com.dotmarketing.htmlpage.language=1).

Specifically, adopting a threshold regression model we analyse the asymmetries in the relationship between credit risk and the gross loan growth rate. The aim is to test whether the influence of GLGR is different when credit risk is higher, computing endogenously the threshold above/below where such impact is different. As discussed earlier, banks which have experienced large gross NPL ratios (GNPL) may behave differently from those with low GNPLs by granting credit even to firms with low creditworthiness. In the presence of large losses caused by a high GNPL ratio, there would be therefore an incentive for managers to take more risks. Such a policy could generate in the short run period, a dilution of GNPLs but might increase future losses in the long run, as argued by Clair (1992). Following Zhang *et al.* (2016), by exploring the asymmetric bank behaviour in relation to the value of the GNPL ratio threshold, we can infer the presence of moral hazard.

Table 5 sets out the estimation results. The last rows of the table also show the level and the significance of the endogenous threshold. The first column reports the results for the benchmark linear model with no threshold effect at all. In order to run a fixed or random effects model, we performed the *Hausman* test: the statistic in this instance was 58.45 with p-value = 0.000, which favours the fixed effects model. The second, third, fourth, and fifth columns report different specification models for equation (2). The second specification includes no lags in the gross loan growth ratio (GLGR). Specifications 3 and 4 include a $t - 1$ and $t - 2$ lag in the GLGR respectively. Finally, specification 5 includes the previous models.

Since the deterioration in quality loans occurs with some delay (Clair, 1992), the contemporaneous relationship between the GLGR and the GNPL ratio should be negative. In fact, if banks with significant previous losses or with significant levels of GNPLs make additional loans (i.e. higher loan growth ratio), they may temporarily reduce the GNPL ratio due to the dilution effect. Therefore, in order to achieve higher loan growth, bank managers may have to accept riskier positions potentially generating higher future losses. If the threshold effect is not taken into consideration (model 1) there is no significant impact of the gross loan growth ratio on GNPL, and this is justified by the small increase in lending activity due to the financial crisis that began in 2008. Models 2-4 show the impact of the GLGR depending on the level of credit risk, proxied by a lagged GNPL ratio. In model two, the current level of the gross loan growth ratio significantly reduces the gross NPL only for the banks under the threshold: no effect is shown for banks above the threshold. These results are confirmed in the model 3 for the one year lagged gross loan growth ratio. Model four confirms the negative and significant impact of the GLGR on GNPL for banks under the threshold, but it exhibits a positive and significant impact for those above the threshold. Finally, model 5, which contains all the lags of the variable GLGR, confirms the presence of the asymmetric effect. In the short run, banks with higher GNPL, i.e. the banks above the threshold, show a negative impact of the loan growth rate on NPL due to the dilution effect, but this effect disappears in the long run. These findings confirm the hypothesis that riskier banks, in attempting to reduce their risks, increase their loans by relaxing their screening and monitoring policy (Bofondi and Gobbi, 2006). In doing so, these banks generate a future scenario that is worse. In summation, model 5 supports the hypothesis that bank managers behave badly

Table 5: Regression results with NPLs gross ratio as a threshold

Dependent variable = GNPL	Model 1	Model 2	Model 3	Model 4	Model 5
$GLGR_t$	−0.0147				
	(0.0134)				
$GLGR_{t-1}$	−0.0177				
	(0.0118)				
$GLGR_{t-2}$	−0.0172				
	(0.0139)				
$LGR_{i,t}I(NPL_{i,t-1} \leq \gamma)$		−0.0850***			0.0117
		(0.0150)			(0.0151)
$LGR_{i,t}I(NPL_{i,t-1} > \gamma)$		−0.0055			−0.0795**
		(0.0127)			(0.0363)
$LGR_{i,t-1}I(NPL_{i,t-1} \leq \gamma)$			−0.0793***		−0.0305***
			(0.0142)		(0.0110)
$LGR_{i,t-1}I(NPL_{i,t-1}1 > \gamma)$			0.0145		0.0296
			(0.0121)		(0.0208)
$LGR_{i,t-2}I(NPL_{i,t-1} \leq \gamma)$				−0.0395***	−0.0385***
				(0.0102)	(0.0110)
$LGR_{i,t-2}I(NPL_{i,t-1} > \gamma)$				0.0880***	0.0866***
				(0.0252)	(0.0309)
DGR	0.0057	0.0079	−0.0046	0.0052	0.0071
	(0.0109)	(0.0082)	(0.0088)	(0.0094)	(0.0112)
C_I	−0.0407**	−0.0170	−0.0284	−0.0441**	−0.0447**
	(0.0206)	(0.0187)	(0.0200)	(0.0210)	(0.0208)
CAR	−0.1527***	−0.0598	−0.0983**	−0.1527***	−0.1564***
	(0.0481)	(0.0406)	(0.0439)	(0.0462)	(0.0454)
ROA	−1.3572***	−1.8192***	−1.6292***	−1.3969***	−1.3758***
	(0.2950)	(0.3305)	(0.3440)	(0.3068)	(0.2854)
SIZE	−0.0265**	−0.0249**	-0.0272**	−0.0352***	−0.0315***
	(0.0128)	(0.0104)	(0.0118)	(0.0123)	(0.0116)
Year 2010	0.0071***	0.0114***	0.0074***	0.0079***	0.0062***
	(0.0018)	(0.0024)	(0.0023)	(0.0017)	(0.0018)
Year 2011	0.0184***	0.0230***	0.0203***	0.0189***	0.0176***
	(0.0028)	(0.0026)	(0.0026)	(0.0023)	(0.0027)
Year 2012	0.0446***	0.0481***	0.0454***	0.0463***	0.0435***
	(0.0047)	(0.0042)	(0.0044)	(0.0038)	(0.0045)
Year 2013	0.0710***	0.0726***	0.0710***	0.0727***	0.0693***
	(0.0067)	(0.0058)	(0.0061)	(0.0055)	(0.0064)
Year 2014	0.0910***	0.0941***	0.0916***	0.0923***	0.0889***
	(0.0079)	(0.0068)	(0.0073)	(0.0066)	(0.0075)
Constant	0.5394***	0.4936***	0.5375***	0.6616***	0.6137***
	(0.1825)	(0.1497)	(0.1697)	(0.1762)	(0.1642)
N. obs.	1,788	2,384	2,086	1,788	1,788
R^2	0.7285	0.7310	0.7334	0.7360	0.7411
R^2 Adjusted	0.7265	0.7296	0.7319	0.7342	0.7388
Threshold γ		8.53%	9.62%	16.06%	15.66%
Threshold Conf. Interval (95%)		[8.41%, 8.59%]	[9.29%, 9.64%]	[15.56%, 16.11%]	[15.30%, 15.76%]
P-value		0.00	0.00	0.00	0.00

Note: The table presents estimation results (coefficients and robust standard errors in parentheses) on the relationship between the NPL ratio, GLGR, and other bank specific variables. The estimation method OLS (with bank fixed effects)is used for model 1 only with static and balanced panel data. For models n. 2 – 5 $I(\cdot)$ is the indicator function that takes a value of one if the statement in brackets is true, zero otherwise. The variables are in abbreviations, representatively standing for: GNPL = NPLs gross ratio (gross non-performing loans divided by total gross outstanding loans); GLGR = Gross loan growth rate; $GLGR_{t;t-1;t-2}$ = Gross loan growth rate lagged one and two periods backwards; DGR = deposit growth rate; C_I = cost to income ratio between operating expenses and intermediation margin; CAR = Capital Adequacy Ratio (i.e., the ratio between Tier 1 and 2 capital divided by the total risk-weighted assets); ROA = return on assets that is the ratio between profit before taxes and total assets; Size = end of year total assets (in logarithm term) respectively. The last three rows show, respectively, the thresholds, their confidence level and p-value, which has been constructed using 300 bootstraps, and the confidence interval is calculated using the 5% critical value for the non-rejection zone. ***; **; * denote statistical significance, respectively at 1%, 5% and 10% levels.

when they face pressure due to previous losses, and this is consistent with what we expect: banks may be affected by moral hazard problems.

Table 6: Breakdown between types of banks and the threshold

Threshold level	Stock banks (%)	Cooperative Banks (%)	Mutual banks (%)	Full sample (%)
Under threshold of 15.66%	81.65	82.61	79.90	80.50
Above threshold of 15.66%	18.35	17.39	20.10	19.50
Total	*100*	*100*	*100*	*100*

Threshold is 15.66% of gross NPL's ratio.

Table 7: Breakdown of the mean value of GNPL, $GLGR_{t-2}$ and GNPL growth rate for threshold and banks

Type of Banks	Aggregate Value		
Stock Banks	GNPL	$GLGR_{t-2}$	GNPL growth rate
Banks under threshold	0.0761	0.0873	0.1630
Banks above threshold	0.2241	0.0250	0.2247
Total	0.1032	0.0701	0.1757
Cooperative Banks			
Banks under threshold	0.0895	0.1090	0.1204
Banks above threshold	0.2062	0.0677	0.1798
Total	0.1098	0.0983	0.1320
Mutual Banks			
Banks under threshold	0.0811	0.0868	0.1189
Banks above threshold	0.2149	0.0460	0.1810
Total	0.1079	0.0754	0.1326
Full Sample			
Banks under threshold	0.0806	0.0887	0.1289
Banks above threshold	0.2162	0.0429	0.1902
Total	0.1070	0.0760	0.1421

With regard to the control variables, in all of the models a negative and significant relationship between GNPL and CAR, ROA and Size variables is confirmed. These results are consistent with those of previous studies. Specifically, a bank with a higher level of CAR is unlikely to behave in an opportunistic manner in its risk taking choices, and the impaired loans should decrease (Salas and Saurina, 2002). A bank with high ROA has a low propensity to take risky choices: therefore, a negative relationship between ROA and GNPL is expected (Boudriga *et al.*, 2010). The negative relationship between size and GNPL is consistent with the finding of other studies that banks of larger size can better assess the creditworthiness of the customer by using greater resources (Hu *et al.*, 2004).

Given a threshold level of 15.66%, Table 6 show the breakdown of the banks.

It should be noted that, only 19.50% of the banks lie above the threshold in the full sample, and that mutual banks show the highest level.

To confirm the presence of asymmetric behaviour, we present Table 7 that exhibits the mean values of the gross NPL, $t-2$ lagged gross loan growth ratio and growth rate of gross NPL for the banks lying under and above the threshold.

Analysis of Table 7 surprisingly shows that the banks above the threshold, with respect to those below it – be they stock, cooperative or mutual banks – record on average both higher levels of GNPL and growth rates, and a lower two lagged gross

Table 8: Descriptive statistics of amount of sanctions between banks below and above the threshold

				Amount of sanctions				
Description	N. of banks	Of which sanctioned	Of which sanctioned %	Mean	Median	Std	Min	Max
Banks under threshold	2,159	100	4.63	121,371	102,750	106,081	2,580	560,000
Banks above threshold	523	45	8.6	299,155	114,000	955,845	4,000	6,400,000
Total	*2,682*	*145*	*5.41*	*176,545*	*110,500*	*541,956*	*2,580*	*6,400,000*

loan growth ratio. This does not contradict the presence of moral hazard; rather, it supports the idea that the management of riskier banks have lowered the lending activity standards process by granting credit to firms with a low credit standing, in an attempt to reduce past NPLs. In other words, the higher the level of GNPL, the lesser the lending activity and the greater the incentives to relax lending criteria to attract all customers tends to be. These findings show that the worse scenario that banks above threshold have to face, due to a past policy that largely trusted on increases in lending without serious screening.

From this perspective, it could be useful to analyse the consequences on credit risk of enforcement actions (sanctions) imposed by supervisory authority for banks. Table 8 exhibits the breakdown of the descriptive statistics of these sanctions on banks under and above the threshold.

We note that the rate of the sanctioned banks lying above the threshold is double that of the below-threshold ones. Moreover, the amount of the sanctions is greater for the banks in which there may have been moral hazard. To test whether the enforcement action is effective in changing the sanctioned banks' behaviours, we report Table 8. In this Table, the result of the regressions follow a panel data regression model with fixed effect, according to the results of the econometric tests. The first two models of Table 8 test the impact of the sanction on GNPL, with one and two lags respectively. Models 3 and 4 add: 1) the dummy variable «threshold» which takes a value of 1 for banks lying above the threshold of 15.66% and zero for banks under this threshold, and 2) the interaction between threshold variables and the amount of sanction lagged respectively by one and two years. Models 3 and 4 have been therefore, intended to validate the research hypothesis that the sanction could mitigate moral hazard incentives.

Consistently with other studies (Caiazza *et al.*, 2015), the results show that a sanction at time $t-1$ in model 1 displays a positive, but not significant relationship with GNPL. Surprisingly, the relationship between sanction and GNPL is still positive and significant even two years after the sanction (model 2), testifying to the ineffectiveness of the sanctions over 2 years. The same results are obtained in models 3 and 4, where there is an interaction between the threshold variable and the sanction. In this case, only the coefficient of the threshold variable is positive and significant. This result suggests that the enforcement action has no effect on the moral hazard behaviour. This is not in line with expectations, but it is explained by a very small number of sanctioned banks with respect to all the banks lying above threshold.

Table 9: Regression results with NPLs gross ratio as a threshold and sanction

Dependent variable = GNPL	Model 1	Model 2	Model 3	Model 4
Threshold			0.0470***	0.0458***
			(0.0031)	(0.0031)
$Sanction_{t-1}$	0.0001		0.0002	
	(0.0002)		(0.0002)	
$Threshold*Sanction_{t-1}$			−0.0008	
			(0.0005)	
$Sanction_{t-2}$		0.0008***		0.0003
		(0.0003)		(0.0002)
$Threshold*Sanction_{t-2}$				0.0003
				(0.0005)
$GLGR_t$	−0.0145	−0.0153	−0.0154	−0.0153
	(0.0135)	(0.0135)	(0.0117)	(0.0119)
$GLGR_{t-1}$	−0.0175	−0.0194*	−0.0127	−0.0132
	(0.0118)	(0.0117)	(0.0093)	(0.0093)
$GLGR_{t-2}$	−0.0170	−0.0173	−0.0150	−0.0146
	(0.0139)	(0.0139)	(0.0106)	(0.0106)
DGR	0.0056	0.0062	0.0012	0.0019
	(0.0109)	(0.0109)	(0.0083)	(0.0083)
C_I	−0.0406**	−0.0400*	−0.0226	−0.0223
	(0.0206)	(0.0205)	(0.0171)	(0.0170)
CAR	−0.1528***	−0.1564***	−0.1112***	−0.1141***
	(0.0483)	(0.0468)	(0.0394)	(0.0389)
ROA	−1.3547***	−1.3498***	−0.9938***	−0.9782***
	(0.2948)	(0.2919)	(0.1660)	(0.1637)
Size	−0.0265**	−0.0253**	−0.0184*	−0.0179*
	(0.0128)	(0.0127)	(0.0098)	(0.0097)
Year 2010	0.0071***	0.0066***	0.0058***	0.0058***
	(0.0018)	(0.0019)	(0.0015)	(0.0016)
Year 2011	0.0183***	0.0181***	0.0153***	0.0155***
	(0.0029)	(0.0028)	(0.0023)	(0.0023)
Year 2012	0.0446***	0.0441***	0.0338***	0.0338***
	(0.0047)	(0.0047)	(0.0040)	(0.0041)
Year 2013	0.0710***	0.0695***	0.0517***	0.0514***
	(0.0067)	(0.0067)	(0.0056)	(0.0056)
Year 2014	0.0911***	0.0903***	0.0677***	0.0680***
	(0.0079)	(0.0079)	(0.0068)	(0.0069)
Constant	0.5401***	0.5230***	0.3970***	0.3901***
	(0.1827)	(0.1804)	(0.1370)	(0.1355)
N. Obs.	1,788	1,788	1,788	1,788
R^2	0.7285	0.7302	0.8058	0.8059
R^2 Adjusted	0.7264	0.7281	0.8041	0.8042

Note: The table presents estimation results (coefficients and robust standard errors in parentheses) on the relationship among the gross NPLs ratio, bank risk and sanctions inflicted by Bank of Italy. The variables are in abbreviations, representatively standing for: Threshold: is the dummy variable which takes a value of 1 for banks lying above the threshold of 15.66% and zero for banks under this threshold; $Sanction_{i,t}$: is the sanction (in logarithm form) inflicted by the Bank of Italy on bank i at time $t-1, t-2$, respectively (i.e. anomalies occurring *ex ante* and in the loan screening process not disclosed to the Supervisory Authority); $Threshold_i * Sanction_{i,t}$ is an interactive variable between threshold variables and the amount of sanction lagged respectively. GNPL = NPLs gross ratio (gross non-performing loans divided by total gross outstanding loans); GLGR= Gross loan growth rate; $GLGR_{t;t-1;t-2}$ = Gross loan growth rate lagged one and two periods backwards; DGR = deposit growth rate; C_I = cost to income ratio between operating expenses and intermediation margin; CAR= Capital Adequacy Ratio (i.e. the ratio between Tier 1 and 2 capital divided by the total risk-weighted assets); ROA = return on assets that is the ratio between profit before taxes and total assets; Size = end of year total assets (in log term) respectively. Sanction is the sanction (in logarithm form) inflicted by the Bank of Italy on bank i at time t, $t-1$ *and* $t-2$. ***; **; * denote statistical significance, respectively at 1%, 5% and 10% levels.

6 Robustness Analysis

To alleviate endogeneity issues, we perform an additional robustness analysis. In particular, we shed light on the role played by loan growth rate, as a key explanatory variable that is potentially endogenous because it might be affected by the current NPL ratios. The robustness analysis is conducted both for the three different kinds of banks (i.e. stock, cooperative, mutual) and for different dependent variables. To overcome the potential endogeneity bias, lagged explanatory variables and instrumental variables are used.

6.1 Estimations with different types of banks

To examine the sensitivity of the findings, we test whether they are robust to the different kinds of banks (i.e. stock, cooperative and mutual banks). According to the results set out in Table 1, there is a higher proportion of mutual banks relative to the whole sample, and it is worth noting that only a small proportion of cooperative banks are included in our sample. To check the robustness of our results, we therefore divide the overall sample into two groups as follows: group 1: 66 stock banks plus 23 cooperative banks (excluding mutual banks): and group 2: 209 mutual banks (excluding stock and cooperative banks). As a first step, we are interested in the existence of the threshold effect in both groups. Model 1 and model 2 favour the existence of the threshold effect. The estimated threshold value for group 1 is higher than that of the second group. Both groups support the hypothesis that bank managers behave badly when they face pressure due to previous losses. Models 3 and 4, together with models 5 and 6, report the impact of the sanction for those banks above a certain threshold: that is, 19% for stock and cooperative banks and 14.45% for mutual banks respectively. To check the sensitivity of the results, we re-estimate our models creating a dummy variable, namely Threshold (1 for banks with NPLs ratio above the threshold previously estimated; 0 otherwise). Columns 2, 3, 5 and 6 show that, above the estimated threshold and after controlling for the sub-bank group, riskier banks increase the NPL ratio level and also that the relationship is positive and statistically significant at the 1% level. Moreover, it would be interesting to see the interaction effect of threshold and sanction (at both time $t-1$ and $t-2$). In this case, we run our equations by augmenting them with an interaction term between threshold and sanction$_{t-1;t-2}$. Although threshold enters positively and significantly, the interaction term enters insignificantly both at time $t-1$ and $t-2$, emphasising what was found in the all sample analysis. After controlling for the threshold effects with sub-bank groups, our base results remain unchanged, suggesting that our results are insensitive to sub-bank groups.

6.2 Different dependent variables

As an additional robustness test, we also consider other dependent variables. We use NPL/TA (gross non-performing loans stock over total assets), BADLOANS/LOANS (gross bad loans over total gross outstanding loans) and NPLs net ratio (NPLs net of allowances and loan loss provisions). Table 11 reports the empirical results. Comparison of the results shows that the main variables of interest keep the same relationship with respect to the baseline model with a high statistical significance: banks facing previous significant losses have an incentive to take higher risks, which will then result in further

Table 10: Estimation of the threshold effects with sub-bank groups

Dependent variable = GNPL	Stock and Cooperative banks			Mutual banks		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$GLGR_t$		0.0138	0.0135		−0.0229	−0.0232
		(0.0182)	(0.0181)		(0.0160)	(0.0163)
$GLGR_{t-1}$		0.0048	0.0047		−0.0241*	−0.0245*
		(0.0149)	(0.0151)		(0.0134)	(0.0134)
$GLGR_{t-2}$		0.0028	0.0024		−0.0149	−0.0147
		(0.0123)	(0.0121)		(0.0154)	(0.0154)
$GLGR_{i,t}I(NPL_{i,t-1} \leq \gamma)$	0.0154			0.0063		
	(0.0203)			(0.0212)		
$GLGR_{i,t}I(NPL_{i,t-1} > \gamma)$	−0.2743			−0.0796***		
	(0.2067)			(0.0305)		
$GLGR_{i,t-1}I(NPL_{i,t-1} \leq \gamma)$	−0.0010			−0.0492***		
	(0.0178)			(0.0135)		
$GLGR_{i,t-1}I(NPL_{i,t-1} > \gamma)$	−0.0671			0.0177		
	(0.0963)			(0.0231)		
$GLGR_{i,t-2}I(NPL_{i,t-1} \leq \gamma)$	−0.0094			−0.0575***		
	(0.0154)			(0.0143)		
$GLGR_{i,t-2}I(NPL_{i,t-1} > \gamma)$	0.0981***			0.0721**		
	(0.0321)			(0.0313)		
Threshold		0.0510***	0.0527***		0.0531***	0.0523***
		(0.0054)	(0.0058)		(0.0044)	(0.0045)
$Sanction_{t-1}$		0.0001			0.0001	
		(0.0002)			(0.0003)	
$Threshold*Sanction_{t-1}$		0.0001			−0.0004	
		(0.0017)			(0.0006)	
$Sanction_{t-2}$			0.0004			0.0005
			(0.0003)			(0.0004)
$Threshold*Sanction_{t-2}$			−0.0009			0.0000
			(0.0006)			(0.0007)
DGR	−0.0147	-0.0179	−0.0176	0.0129	0.0091	0.0099
	(0.0172)	(0.0140)	(0.0141)	(0.0154)	(0.0127)	(0.0127)
C_I	0.0444*	0.0428**	0.0448**	−0.1118***	−0.0755***	−0.0755***
	(0.0233)	(0.0197)	(0.0198)	(0.0238)	(0.0190)	(0.0190)
CAR	−0.0481	0.0141	0.0188	−0.2979***	−0.2206***	−0.2151***
	(0.0496)	(0.0390)	(0.0393)	(0.0783)	(0.0634)	(0.0633)
ROA	−0.7303***	−0.5690***	−0.5774***	−1.9524***	−1.1004***	−1.0986***
	(0.1808)	(0.1214)	(0.1253)	(0.2918)	(0.2560)	(0.2664)
Size	−0.0285	-0.0154	−0.0151	−0.0183	−0.0078	−0.0068
	(0.0192)	(0.0159)	(0.0160)	(0.0122)	(0.0107)	(0.0108)
Year 2010	0.0057**	0.0046*	0.0044	0.0053**	0.0061***	0.0059***
	(0.0028)	(0.0027)	(0.0027)	(0.0025)	(0.0022)	(0.0022)
Year 2011	0.0183***	0.0173***	0.0176***	0.0117***	0.0133***	0.0133***
	(0.0037)	(0.0033)	(0.0034)	(0.0034)	(0.0033)	(0.0033)
Year 2012	0.0499***	0.0430***	0.0425***	0.0290***	0.0300***	0.0298***
	(0.0058)	(0.0054)	(0.0055)	(0.0055)	(0.0050)	(0.0050)
Year 2013	0.0816***	0.0663***	0.0652***	0.0505***	0.0468***	0.0465***
	(0.0084)	(0.0076)	(0.0079)	(0.0078)	(0.0070)	(0.0071)
Year 2014	0.1036***	0.0857***	0.0850***	0.0682***	0.0579***	0.0574***
	(0.0095)	(0.0088)	(0.0088)	(0.0100)	(0.0087)	(0.0088)
Constant	0.5140*	0.3013	0.2954	0.5127***	0.3086**	0.2950**
	(0.2973)	(0.2447)	(0.2479)	(0.1644)	(0.1433)	(0.1440)
N. Obs.	534	534	534	1,254	1,254	1,254
R^2	0.8000	0.8523	0.8528	0.7457	0.8082	0.8087
R^2 Adjusted	0.7938	0.8477	0.8483	0.7424	0.8058	0.8062
Threshold γ (%)	19			14.45		
Threshold γ Conf. Interval (95%)	[18.81%; 19.15%]			[14.00; 14.50%]		
P-value	0.01			0.00		

Note: The first two models are focused on stock and cooperative banks whereas model 3 and 4 refer to mutual banks. The table presents estimation results (coefficients and robust standard errors in parentheses) on the relationship between the gross NPL ratios, bank risk and sanctions inflicted by Bank of Italy, for different banks types. $I(\cdot)$ is the indicator function that takes a value of one if the statement in brackets is true and a value of zero otherwise. The variables are in abbreviations, representatively standing for: GNPL = NPLs gross ratio (gross non-performing loans divided by total gross outstanding loans); GLGR = Gross loan growth rate; $GLGR_{t;t-1;t-2}$ = Gross loan growth rate lagged one and two periods backwards; DGR = deposit growth rate; C_I = cost to income ratio between operating expenses and intermediation margin; CAR = Capital Adequacy Ratio (i.e. the ratio between Tier 1 and 2 capital divided by the total risk-weighted assets); ROA = return on assets that is the ratio between profit before taxes and total assets; Size = end of year total assets (in logarithm term) respectively. Sanction is the sanction (in logarithm form) inflicted by the Bank of Italy on bank i at time t, $t-1$ *and* $t-2$. ***; **; * denote statistical significance, respectively at 1%, 5% and 10% levels.

Table 11: Estimation of the threshold effects with different dependent variables

Dependent Variables	NPLs gross ratio	NPLs/TA	BAD LOANS/ LOANS	NPLs net ratio
$GLGR_{i,t}I(NPL_{i,t-1} \leq \gamma)$	0.0117	0.0328***	−0.0021	0.0035
	(0.0151)	(0.0105)	(0.0102)	(0.0098)
$GLGR_{i,t}I(NPL_{i,t-1} > \gamma)$	−0.0795**	−0.1312	−0.0710	−0.0528**
	(0.0363)	(0.1959)	(0.0456)	(0.0262)
$GLGR_{i,t-1}I(NPL_{i,t-1} \leq \gamma)$	−0.0305***	0.0188*	−0.0021	−0.0230***
	(0.0110)	(0.0112)	(0.0066)	(0.0077)
$GLGR_{i,t}I(NPL_{i,t-1} > \gamma)$	0.0296	−0.2984	0.0157	−0.0019
	(0.0208)	(0.2360)	(0.0259)	(0.0136)
$GLGR_{i,t-2}I(NPL_{i,t-1} \leq \gamma)$	−0.0385***	−0.0011	−0.0187***	−0.0268***
	(0.0110)	(0.0095)	(0.0067)	(0.0075)
$GLGR_{i,t-2}I(NPL_{i,t-1} > \gamma)$	0.0866***	0.2045***	0.0909***	0.0327**
	(0.0309)	(0.0587)	(0.0289)	(0.0130)
DGR	0.0071	−0.0057	0.0116	0.0014
	(0.0112)	(0.0088)	(0.0073)	(0.0091)
C_I	−0.0447**	−0.0075	−0.0239**	−0.0221
	(0.0208)	(0.0162)	(0.0121)	(0.0170)
CAR	−0.1564***	−0.0836**	−0.0855**	−0.1510***
	(0.0454)	(0.0411)	(0.0348)	(0.0390)
ROA	−1.3758***	−1.0488***	−0.9765***	−0.5456**
	(0.2854)	(0.1611)	(0.1654)	(0.2532)
Size	−0.0315***	−0.0615***	−0.0278***	−0.0134
	(0.0116)	(0.0139)	(0.0077)	(0.0091)
year_2010	0.0062***	0.0088***	0.0062***	0.0046***
	(0.0018)	(0.0016)	(0.0012)	(0.0015)
Year 2011	0.0176***	0.0214***	0.0128***	0.0123***
	(0.0027)	(0.0025)	(0.0018)	(0.0021)
Year 2012	0.0435***	0.0419***	0.0240***	0.0335***
	(0.0045)	(0.0043)	(0.0029)	(0.0034)
Year 2013	0.0693***	0.0586***	0.0411***	0.0495***
	(0.0064)	(0.0060)	(0.0041)	(0.0049)
Year 2014	0.0889***	0.0699***	0.0590***	0.0558***
	(0.0075)	(0.0075)	(0.0050)	(0.0056)
Constant	0.6137***	0.9443***	0.4758***	0.3043**
	(0.1642)	(0.1940)	(0.1087)	(0.1306)
N. Obs.	1,788	1,788	1,788	1,788
R^2	0.7411	0.6274	0.6872	0.6409
R^2 Adjusted	0.7388	0.6240	0.6844	0.6376
Threshold γ	15.66%	17.55%	10.26%	10.47%
Threshold γ Conf. Interval (95%)	[15.30%, 15.76%]	[16.98%, 17.71%]	[10.04%, 10.39%]	[10.11%, 10.58%]
P-value	0.00	0.00	0.00	0.00

Note: Model 1, reported only to help comparison, is the same as model 5 in Table 6 and its dependent variable is the gross NPL ratio; in model 2, the dependent variable is represented by the ratio between gross NPLs to total assets; in model 3, the dependent variable is the ratio between gross bad loans to gross outstanding loans, and in model 4 the net NPLs ratio, i.e. NPLs net of allowances and loan loss provisions. The table presents estimation results (coefficients and robust standard errors in parentheses) on the relationship between the gross NPLs ratio, bank risk and sanctions inflicted by Bank of Italy, for different banks types. $I(\cdot)$ is the indicator function that takes a value of one if the statement in brackets is true, zero otherwise. The variables are in abbreviations, representatively standing for: GNPL = NPLs gross ratio (gross non-performing loans divided by total gross outstanding loans); GLGR = Gross loan growth rate; $GLGR_{t;t-1;t-2}$ = Gross loan growth rate lagged one and two periods backwards; DGR= deposit growth rate; C_I = cost to income ratio between operating expenses and intermediation margin; CAR = Capital Adequacy Ratio (i.e. the ratio between Tier 1 and 2 capital divided by the total risk-weighted assets); ROA = return on assets that is the ratio between profit before taxes and total assets; Size = end of year total assets (in logarithm term) respectively. Sanction is the sanction (in logarithm form) inflicted by the Bank of Italy on bank *i* at time *t*, *t* − 1 *and t* − 2. ***; **; * denote statistical significance, respectively at 1%, 5% and 10% levels.

significant losses. Table 12 shows the impact of the dummy variable «threshold» (1 for banks lying above the threshold of 15.66% and zero otherwise) and the interaction between threshold variables and the sanction amount lagged respectively by one and two years. The Sanction term shows a statistical significance regarding bad loans over total outstanding loans at time $t-1$ and to NPLs/TA and to NPLs net ratio at time $t-2$

Table 12: Estimation of the sanction impact with different dependent variables

Dependent Variables	NPLs gross ratio	NPLs gross ratio	NPLs/TA	NPLs/TA	BADLOANS/ LOANS	BADLOANS/ LOANS	NPLs net ratio	NPLs net ratio
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Threshold	0.0470***	0.0458***	0.0305***	0.0302***	0.0401***	0.0398***	0.0366***	0.0363***
	(0.0031)	(0.0031)	(0.0026)	(0.0026)	(0.0025)	(0.0026)	(0.0021)	(0.0021)
$Sanction_{t-1}$	0.0002		−0.0002		0.0003**		0.0001	
	(0.0002)		(0.0002)		(0.0001)		(0.0001)	
Threshold* $Sanction_{t-1}$	−0.0008		−0.0001		−0.0006		−0.0003	
	(0.0005)		(0.0003)		(0.0005)		(0.0004)	
$Sanction_{t-2}$		0.0003		0.0004*		0.0002		0.0003*
		(0.0002)		(0.0002)		(0.0001)		(0.0002)
Threshold* $Sanction_{t-2}$		0.0003		0.0003		−0.0003		0.0000
		(0.0005)		(0.0004)		(0.0003)		(0.0004)
$GLGR_t$	−0.0154	−0.0153	0.0315***	0.0315***	−0.0116*	−0.0117*	−0.0125	−0.0126
	(0.0117)	(0.0119)	(0.0109)	(0.0110)	(0.0068)	(0.0068)	(0.0086)	(0.0087)
$GLGR_{t-1}$	−0.0127	−0.0132	0.0181*	0.0174*	0.0000	−0.0005	−0.0141**	−0.0147**
	(0.0093)	(0.0093)	(0.0094)	(0.0093)	(0.0057)	(0.0058)	(0.0070)	(0.0070)
$GLGR_{t-2}$	−0.0150	−0.0146	0.0108	0.0113	−0.0043	−0.0047	−0.0138*	−0.0137*
	(0.0106)	(0.0106)	(0.0112)	(0.0113)	(0.0069)	(0.0069)	(0.0072)	(0.0071)
DGR	0.0012	0.0019	−0.0045	−0.0042	0.0047	0.0049	−0.0004	−0.0001
	(0.0083)	(0.0083)	(0.0080)	(0.0080)	(0.0057)	(0.0057)	(0.0074)	(0.0074)
C_I	−0.0226	−0.0223	0.0022	0.0028	−0.0180*	−0.0176*	−0.0094	−0.0091
	(0.0171)	(0.0170)	(0.0155)	(0.0155)	(0.0091)	(0.0091)	(0.0139)	(0.0139)
CAR	−0.1112***	−0.1141***	−0.0615	−0.0648*	−0.0463	−0.0460	−0.1190***	−0.1208***
	(0.0394)	(0.0389)	(0.0375)	(0.0366)	(0.0288)	(0.0287)	(0.0326)	(0.0324)
ROA	−0.9938***	−0.9782***	−0.8717***	−0.8569***	−0.6450***	−0.6403***	−0.3452**	−0.3379**
	(0.1660)	(0.1637)	(0.1552)	(0.1605)	(0.1021)	(0.1018)	(0.1458)	(0.1432)
SIZE	−0.0184*	−0.0179*	−0.0620***	−0.0614***	−0.0134**	−0.0133**	−0.0095	−0.0090
	(0.0098)	(0.0097)	(0.0139)	(0.0139)	(0.0060)	(0.0060)	(0.0071)	(0.0071)
Year 2010	0.0058***	0.0058***	0.0085***	0.0083***	0.0055***	0.0054***	0.0044***	0.0043***
	(0.0015)	(0.0016)	(0.0015)	(0.0016)	(0.0011)	(0.0011)	(0.0013)	(0.0013)
Year 2011	0.0153***	0.0155***	0.0198***	0.0194***	0.0110***	0.0114***	0.0096***	0.0096***
	(0.0023)	(0.0023)	(0.0022)	(0.0022)	(0.0016)	(0.0016)	(0.0017)	(0.0017)
Year 2012	0.0338***	0.0338***	0.0349***	0.0348***	0.0199***	0.0199***	0.0251***	0.0250***
	(0.0040)	(0.0041)	(0.0041)	(0.0041)	(0.0026)	(0.0026)	(0.0028)	(0.0029)
Year 2013	0.0517***	0.0514***	0.0484***	0.0477***	0.0311***	0.0309***	0.0365***	0.0360***
	(0.0056)	(0.0056)	(0.0055)	(0.0056)	(0.0035)	(0.0035)	(0.0040)	(0.0040)
Year 2014	0.0677***	0.0680***	0.0606***	0.0604***	0.0436***	0.0436***	0.0416***	0.0415***
	(0.0068)	(0.0069)	(0.0068)	(0.0069)	(0.0044)	(0.0045)	(0.0046)	(0.0046)
Constant	0.3970***	0.3901***	0.9314***	0.9225***	0.2577***	0.2557***	0.2269**	0.2202**
	(0.1370)	(0.1355)	(0.1964)	(0.1964)	(0.0827)	(0.0825)	(0.1013)	(0.1005)
N. Obs.	1,788	1,788	1,788	1,788	1,788	1,788	1,788	1,788
R^2	0.8058	0.8059	0.6804	0.6820	0.7816	0.7812	0.7366	0.7372
R^2 Adjusted	0.8041	0.8042	0.6775	0.6791	0.7796	0.7792	0.7342	0.7349

Note: The table presents estimation results (coefficients and robust standard errors in parentheses) on the relationship among the gross NPL ratio, bank risk and sanctions inflicted by Bank of Italy. As an additional robustness test, we also consider other dependent variables: NPL/TA (gross non-performing loans stock over total assets), BADLOANS/LOANS (gross bad loans over total gross outstanding loans) and NPL net ratio (NPLs net of allowances and loan loss provisions). The variables are in abbreviations, representatively standing for: Threshold: a dummy variable which takes a value of 1 for banks lying above the threshold of 15.66% and zero for banks under this threshold; $Sanction_{i,t}$; is the sanction (in logarithm form) inflicted by the Bank of Italy on bank i at time $t-1$, $t-2$, respectively (i.e. anomalies occurring *ex ante* and in the loan screening process not disclosed to the Supervisory Authority); $Threshold_i{}^*Sanction_{i,t}$ is an interactive variable between threshold variables and the amount of sanction lagged respectively. GNPL = NPLs gross ratio (gross non-performing loans divided by total gross outstanding loans); GLGR = Gross loan growth rate; $GLGR_{t;t-1;t-2}$ = Gross loan growth rate lagged one and two periods backwards; DGR = deposit growth rate; C_I = cost to income ratio between operating expenses and intermediation margin; CAR = Capital Adequacy Ratio (i.e., the ratio between Tier 1 and 2 capital divided by the total risk-weighted assets); ROA = return on assets that is the ratio between profit before taxes and total assets; Size = end of year total assets (in log term) respectively. Sanction is the sanction (in logarithm form) inflicted by the Bank of Italy on bank i at time t, $t-1$ *and* $t-2$. ***; **; * denote statistical significance, respectively at 1%, 5% and 10% levels.

respectively. Moreover, the interaction term between threshold and sanction remains insignificant at time $t - 1$ and $t - 2$, and regarding each dependent variable that is added.

6.3 Endogeneity issue

In this section, we explore whether loan growth rate, as a key explanatory variable, is potentially endogenous as it might be affected by the current NPL ratio. We use one-year lagged values of all bank-specific controls as a first step to check the sensitivity of the results, because endogeneity stemming from other bank-specific characteristics might also influence our baseline results. The results are presented in Table 13. Column 2 shows that even after using lagged variables, our baseline results remain unchanged, suggesting that the estimations are insensitive to any endogeneity issues. Furthermore, we perform an additional robustness analysis by introducing instrumental variables and through the use of the 2SLS method to estimate slope coefficients. As an instrumental variable, we use the number of cars in the village or city where the bank has its headquarters[10]. Column 3 reports the results using the 2SLS method. The results confirm our hypothesis: banks facing previous significant losses have the incentive to take higher risks, which will then result in further significant losses. Table 14 reports the empirical results related to the impact of the sanction. Overall, when endogeneity is accounted for our core conclusion remains valid.

7 Implications and Conclusions

Conflicts of interest and moral hazard in the banking industry are serious threats to the stability of a banking system. Recently, the issue of excessive bank risk-taking has again come to the fore in terms of national public debt in the Southern periphery of the Eurozone.

In Italy since 2007, NPLs have tripled, growing at around 20% annually since 2008. They reached €333 billion in June 2014 – 24% of GDP or 16.8% of total loans (Jassaud and Kang, 2015). In the Italian banking system, NPLs are put into four categories: *bad debt* (i.e. loans in a state of insolvency), *substandard*, *past due* and *restructured* loans. More than 80% of bank NPLs are in the corporate sector, reaching nearly 30% on average in 2014, with a significant percentage occurring in the South of the country (Bank of Italy, 2014). The high corporate NPL ratio reflects the heavy indebtedness of many Italian SMEs. The NPL growth ratio exhibits a substantial increase in comparison with loans and deposits growth ratios.

In this study, we try to take a step forward in explaining the microeconomic determinants of NPLs. Differently from the majority of most existing papers, with the exception of Zhang *et al.* (2016), we consider the asymmetric effects by analysing the impact of the

[10] The data relating to the number of cars for villages and cities have been downloaded from the web site of Italian National Statistical Institute.

Table 13: Estimation of the threshold effects with lagged independent variables and using an instrumental variable

Dependent variable = GNPL	Baseline model (1)	One-year lag (2)	IV (3)
$GLGR_{i,t}I(NPL_{i,t-1} \leq \gamma)$	0.0117		−0.0760
	(0.0151)		(0.1457)
$GLGR_{i,t}I(NPL_{i,t-1} > \gamma)$	−0.0795**		−0.1558
	(0.0363)		(0.1629)
$GLGR_{i,t-1}I(NPL_{i,t-1} \leq \gamma)$	−0.0305***	−0.0226*	−0.5899**
	(0.0110)	(0.0122)	(0.2277)
$GLGR_{i,t-1}I(NPL_{i,t-1} > \gamma)$	0.0296	0.0550**	−1.2625***
	(0.0208)	(0.0261)	(0.2400)
$GLGR_{i,t-2}I(NPL_{i,t-1} \leq \gamma)$	−0.0385***	−0.0342***	−0.1463
	(0.0110)	(0.0100)	(0.1885)
$GLGR_{i,t-2}I(NPL_{i,t-1} > \gamma)$	0.0866***	0.0927***	0.7431***
	(0.0309)	(0.0337)	(0.2143)
DGR	0.0071		−0.0009
	(0.0112)		(0.0560)
DGR_{t-1}		−0.0020	
		(0.0097)	
C_I	−0.0447**		−0.0098
	(0.0208)		(0.0239)
C_I_{t-1}		−0.0443**	
		(0.0187)	
CAR	−0.1564***		−0.0855*
	(0.0454)		(0.0504)
CAR_{t-1}		−0.0157	
		(0.0434)	
ROA	−1.3758***		−1.4173***
	(0.2854)		(0.2958)
ROA_{t-1}		−2.2460***	
		(0.3236)	
Size	−0.0315***		0.0660*
	(0.0116)		(0.0392)
$SIZE_{t-1}$		−0.0332***	
		(0.0105)	
Year 2010	0.0062***	0.0018	−0.0296***
	(0.0018)	(0.0023)	(0.0104)
Year 2011	0.0176***	0.0106***	−0.0231
	(0.0027)	(0.0036)	(0.0166)
Year 2012	0.0435***	0.0400***	−0.0323
	(0.0045)	(0.0043)	(0.0285)
Year 2013	0.0693***	0.0626***	−0.0202
	(0.0064)	(0.0065)	(0.0389)
Year 2014	0.0889***	0.0758***	−0.0356
	(0.0075)	(0.0083)	(0.0445)
Constant	0.6137***	0.6439***	−0.6620
	(0.1642)	(0.1455)	(0.5119)
N. Obs.	1,788	1,788	1,788
R^2	0.7411	0.7362	0.7646
R^2 Adjusted	0.7388	0.7341	0.7624
Threshold γ	15.66%	17.74%	17.68%
Threshold γ Conf. Interval (95%)	[15.30%, 15.76%]	[17.29%, 17.79%]	[17.74%, 17.75%]
P-value	0.00	0.00	0.00

Note: Models 1 and 3, reported only to help the comparison, are the same as model 5 shown respectively in Tables 6 and 7. The table presents estimation results (coefficients and robust standard errors in parentheses) on the relationship among the gross NPL ratio, bank risk and sanctions inflicted by Bank of Italy, for different banks types. $I(\cdot)$ is the indicator function that takes a value of one if the statement in brackets is true, zero otherwise. The variables are in abbreviations, representatively standing for: GLGR = Gross loan growth rate; $GLGR_{i;t-1;t-2}$ = Gross loan growth rate lagged one and two periods backwards; DGR = deposit growth rate; C_I = cost to income ratio between operating expenses and intermediation margin; CAR = Capital Adequacy Ratio (i.e., the ratio between Tier 1 and 2 capital divided by the total risk-weighted assets); ROA = return on assets that is the ratio between profit before taxes and total assets; Size= end of year total assets (in logarithm term) respectively. Sanction is the sanction (in logarithm form) inflicted by the Bank of Italy on bank *i* at time *t*, $t-1$ *and* $t-2$. ***; **; * denote statistical significance, respectively at 1%, 5% and 10% levels.

Table 14: Estimation of the sanction's influence with a robust model

Dependent variable = GNPL	Baseline model (1)	Baseline model (2)	One-year lag (3)	One-year lag (4)	IV (5)	IV (6)
Threshold	0.0470***	0.0458***	0.0526***	0.0526***	0.0469***	0.0458***
	(0.0031)	(0.0031)	(0.0029)	(0.0029)	(0.0031)	(0.0031)
$Sanction_{t-1}$	0.0002		0.0000		0.0002	
	(0.0002)		(0.0002)		(0.0002)	
$Threshold{*}Sanction_{t-1}$	−0.0008		0.0002		−0.0008	
	(0.0005)		(0.0006)		(0.0005)	
$Sanction_{t-2}$		0.0003		0.0003		0.0004
		(0.0002)		(0.0002)		(0.0002)
$Threshold{*}Sanction_{t-2}$		0.0003		0.0001		0.0002
		(0.0005)		(0.0005)		(0.0005)
$GLGR_t$	−0.0154	−0.0153			−0.0543	−0.0477
	(0.0117)	(0.0119)			(0.1602)	(0.1591)
$GLGR_{t-1}$	−0.0127	−0.0132	−0.0007	−0.0016	−0.2520	−0.2875
	(0.0093)	(0.0093)	(0.0099)	(0.0100)	(0.1949)	(0.1932)
$GLGR_{t-2}$	−0.0150	−0.0146	-0.0098	−0.0101	−0.3640***	−0.3507**
	(0.0106)	(0.0106)	(0.0093)	(0.0093)	(0.1316)	(0.1368)
DGR	0.0012	0.0019			−0.0305	−0.0338
	(0,0083)	(0,0083)			(0,0752)	(0,0739)
DGR_{t-1}			−0.0118*	−0.0119*		
			(0.0069)	(0.0069)		
C_I	−0.0226	−0.0223			−0.0156	−0.0143
	(0.0171)	(0.0170)			(0.0219)	(0.0219)
C_I_{t-1}			−0.0185	−0.0181		
			(0.0152)	(0.0152)		
CAR	−0.1112***	−0.1141***			−0.1534***	−0.1531***
	(0.0394)	(0.0389)			(0.0425)	(0.0425)
CAR_{t-1}			−0.0241	−0.0230		
			(0.0326)	(0.0324)		
ROA	−0.9938***	−0.9782***			−0.5015**	−0.4880**
	(0.1660)	(0.1637)			(0.2214)	(0.2203)
ROA_{t-1}			−1.3720***	−1.3611***		
			(0.2420)	(0.2414)		
Size	−0.0184*	−0.0179*			0.0489	0.0521*
	(0.0098)	(0.0097)			(0.0301)	(0.0299)
$Size_{t-1}$			−0.0136	−0.0132		
			(0.0090)	(0.0089)		
Year 2010	0.0058***	0.0058***	0.0035*	0.0034*	−0.0130	−0.0152**
	(0.0015)	(0.0016)	(0.0018)	(0.0019)	(0.0081)	(0.0075)
Year 2011	0.0153***	0.0155***	0.0113***	0.0112***	−0.0243**	−0.0251**
	(0.0023)	(0.0023)	(0.0028)	(0.0028)	(0.0113)	(0.0111)
Year 2012	0.0338***	0.0338***	0.0339***	0.0337***	−0.0159	−0.0186
	(0.0040)	(0.0041)	(0.0034)	(0.0035)	(0.0223)	(0.0221)
Year 2013	0.0517***	0.0514***	0.0518***	0.0513***	−0.0171	−0.0197
	(0.0056)	(0.0056)	(0.0052)	(0.0053)	(0.0291)	(0.0291)
Year 2014	0.0677***	0.0680***	0.0603***	0.0599***	−0.0147	−0.0182
	(0.0068)	(0.0069)	(0.0066)	(0.0067)	(0.0335)	(0.0332)
Constant	0.3970***	0.3901***	0.3293***	0.3226***	−0.4531	−0.4957
	(0.1370)	(0.1355)	(0.1240)	(0.1238)	(0.3985)	(0.3957)
N. Obs.	1,788	1,788	1,788	1,788	1,788	1,788
R^2	0.8058	0.8059	0.8165	0.8167	0.8071	0.8073
R^2 Adjusted	0.8041	0.8042	0.8150	0.8151	0.8053	0.8055

Note: The table presents estimation results (coefficients and robust standard errors in parentheses) on the relationship among the gross NPL ratio, bank risk and sanctions inflicted by Bank of Italy. The variables are in abbreviations, representatively standing for: Threshold: is the dummy variable which takes a value of 1 for banks lying above the threshold of 15.66% and zero for banks under this threshold; $Sanction_{i,t}$: is the sanction (in logarithm form) inflicted by the Bank of Italy on bank *i* at time *t* − 1, *t* − 2, respectively (i.e. anomalies occurring *ex ante* and in the loan screening process not disclosed to the Supervisory Authority); $Threshold_i{*}Sanction_{i,t}$ is an interactive variable between threshold variables and the amount of sanction lagged respectively. GNPL = NPL gross ratio (gross non-performing loans divided by total gross outstanding loans); GLGR = Gross loan growth rate; $GLGR_{t;t-1;t-v2}$ = Gross loan growth rate lagged one and two periods backwards; DGR = deposit growth rate; C_I = cost to income ratio between operating expenses and intermediation margin; CAR = Capital Adequacy Ratio (i.e., the ratio between Tier 1 and 2 capital divided by the total risk-weighted assets); ROA = return on assets that is the ratio between profit before taxes and total assets; Size = end of year total assets (in logarithm term) respectively. Sanction is the sanction (in logarithm form) inflicted by the Bank of Italy on bank *i* at time *t, t* − 1 *and t* − 2. ***; **; * denote statistical significance, respectively at 1%, 5% and 10% levels.

gross loan growth rate on gross NPL ratio. Specifically, by utilizing balanced panel data on 298 banks in Italy from 2006 to 2014, this paper takes into account one-period lagged gross NPL ratios as the threshold variable to test the hypothesis that troubled banks have incentives to take excessive risks. To this end, we investigate whether banks' lending behaviour may be sensitive to a specific level of gross NPLs and, more importantly, whether banks with higher NPL ratios tend to adopt a more aggressive and riskier lending strategy.

Having determined the threshold, we then empirically test the hypothesis that the supervisory activity of the Italian banking authority (i.e. the Bank of Italy) – through credit risk sanctions – is effective in providing incentives for banks to limit their risky lending strategy and in ensuring the stability of the Italian banking system.

If banks with significant previous losses or with a significant level of gross NPLs make additional loans, they can reduce the NPL ratio temporarily due to the dilution effect. Therefore, in order to obtain additional loans, banks managers may have to accept riskier positions potentially generating higher future losses.

The empirical results support our hypothesis that bank managers behave badly when they face pressure due to previous losses. In fact, bank managers increase their lending activity even in a worse scenario. Moreover with the one-year lagged effect, the contemporaneous effect of GLGR for those troubled banks is negative, while the two-year lagged effect becomes positive and statistically significant. This is consistent with what we expected: banks may be affected by moral hazard problems. Unfortunately, we find no effect of the enforcement action on reducing risk. Our results are robust through different models where different proxies for the GNPL ratio and the instrumental variable for GLGR are adopted.

The findings may have important implications both for banks and supervisory authorities. With regard to banks, the empirical results suggest that risk management audit and governance control should be reinforced in those banks where the GNPL is dramatically high because they are exposed to a dangerous smoothing of credit standards. The resolution of the large *post* crisis NPL problem in Europe requires a comprehensive strategy involving coordination among all relevant stakeholders. Micro-prudential supervision plays a pivotal role in addressing NPL issues. Particularly, the Single Supervisory Mechanism (SSM) has established a separate task force to focus on the NPLs issue, and to outline the best response and long-term strategy for banks to reduce their NPL levels. In addition, structural polices need to complement the supervisory response and address major institutional and structural impediments to NPL resolution. These should include measures to improve the legal environment relevant for NPL workouts, by introducing efficient personal and corporate insolvency frameworks as well as speeding up debt recovery. Other areas for improvement include distressed debt markets as well as impediments related to taxation.

Regarding supervisory authorities, the findings provide some guidance: either they should increase the number and intensity of on-site inspections, or they should introduce a NPL threshold as an indicator linked to a request of more transparent bank policy goals. On one hand, bank management should further strengthen internal calculation capabilities and, if needed, use external expertise of distressed asset managers. On the other hand, authorities should support the development of a NPL servicing industry and of an efficient NPL market. Moreover, the size and the prevalence of NPLs require a comprehensive strategy that takes into account economic, supervisory and legal measures. The Italian authorities have implemented a number of reforms in recent years aimed at speeding up bankruptcy and foreclosure proceedings, fostering bank provisioning, easing NPLs' disposal and strengthening bank corporate governance.

There are other related issues that are worthy of future research; for example the investigation of NPLs in the Italian banking industry across loan-types. To our knowledge such data are presently not available. We plan to investigate this topic in future studies.

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