DETERMINANTS OF LOAN QUALITY: LESSONS FROM GREEK COOPERATIVE BANKS

Vasiliki MAKRI*, Konstantinos PAPADATOS**

Abstract: The article focuses on the credit risk of cooperative banks in Greece. The main objective is to define which factors are responsible for variations in loan quality during the period 2003-2014. Loan quality is measured by Loan Loss Reserves Ratio (LLR) and dynamic regression techniques are implemented for the econometric estimations. The outlined results suggest that the macroeconomic environment (i.e. public debt, local unemployment, economic activity and inflation) and the accounting ratios (i.e. past loan quality and profitability) seem to be the explanatory variables of problem loans.

Keywords: credit risk, loan quality, loan loss reserves, accounting factors, macroeconomic environment and generalized methods of moments.

JEL Classification: C23, G21

1. INTRODUCTION

Since 2009, Greece has sunk into great economic depression, and thus the structural weaknesses of Greek economy were revealed. The severe sovereign debt crisis caused tremendous economic, financial and political instability, making it the first developed country in modern economic history which failed to repay an IMF loan. Therefore, there seems to be no compelling reason to argue that the Greek banking system was dramatically influenced. Towards this direction, problem loans expanded significantly (i.e. non performing loans ratio exceeded 34 % in 2014⁶), affecting the creditability of financial system. Moreover, the last three years, six

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⁶Source: World Bank Indicators.
cooperative banks collapsed and considerably traumatized their local economies. According to the announcements made by the National Bank of Greece, the main reasons for these credit institutions to be under special liquidation procedure, were the high proportion of problem loans in their portfolios and the incapability of taking initiatives in order to reassure their sustainability.

Generally, cooperative banks are private institutions, whose members are simultaneously their customers. The motive behind the establishment of these banks is regional development and the need to eliminate the obstacles in granting resources and providing loan guaranties for small borrowers and depositors (Karafolas, 2005). Despite local advantages, cooperative banks influence national economy as well since they improve the stability and profitability of financial system (Papadimitriou and Toay, 2014). Fonteyne (2007) highlights that cooperative banks, due to their commitment on traditional financial intermediation activities and undoubtedly on significant credit exposures, are more sensitive in changes of credit quality and interest rates. In Europe, cooperative banks account for 50% of the market of EU bank deposits and loans and play a crucial role in European economic environment, serving more than 250 million customers (around half of the EU’s population) mainly retailers, small and medium size enterprises (SMEs) and local communities (EACB, 2014).

Although the examination of the explanatory variables of loan quality is very popular internationally, in Greece is at a very premature level. To the authors’ best knowledge so far in Greece very few studies have examined credit risk determinants of commercial banks (i.e. Louzis, Vouldis and Metaxas, 2010; Makri and Papadatos, 2014) and none of cooperative banks. In this context, the present study covers the gap in the existing literature, providing for the first time a comprehensive account of macroeconomic and accounting factors, affecting loan quality in Greek cooperative banks, for the period 2003-2014. Our analysis is focused on the aforementioned period in order to capture not only both economic growth and recession of the domestic economy, but also to include the wave of cooperative bank failures, in Greece. Furthermore, Loan Loss Reserves (LLR) is used as a proxy indicator of loan portfolio quality. LLR is a contra asset account, which reduces total loans value to the amount of estimated loan losses by bank managers, considering future prevailing economic conditions (Ahmed Takeda and Thomas, 1999; Balla and Mckenna, 2009).
The aim of our analysis is to create a tool for identifying any existing vulnerabilities of Greek cooperative bank industry. More precisely, the determinant factors can serve as an instrument for reducing loan losses, monitoring loan quality and designing strategies and decision making processes for Greek cooperative banks. Despite their small share to the Greek financial system numbers, its contribution on local economy is crucial, since they offer banking products based on local needs and existing economic conditions. The findings of our study demonstrate that variations in loan quality are driven from macroeconomic environment and accounting indices.

The remainder of the paper is organized into eight sections. Section 2 introduces an analysis on the evolution of Greek cooperative banks. Section 3 presents the literature review. Section 4 demonstrates the methodological framework, as well as the econometric estimations. Section 5 analyzes the sample and data. Sections 6 and 7 provide the empirical findings and an analytical discussion of the results, respectively. Finally, section 8 highlights the main concluding remarks of the paper.

2. The Evolution of the Greek Cooperatives Banks

Greek cooperative banks were established during the 1990s by the law no. 2076/1992 and the act number 2258/1993 issued by National Bank’s Governor. Cooperative banks can offer all types of banking activities and operate on prefectural, regional or national basis. Their minimum capital requirements are depended on their network and the location of each bank’s headquarters. Cooperative banks, similar to any other commercial bank, must follow supervisory and regulatory legislation imposed by the Bank of Greece. Until recently, cooperative financial institutions were limited to serving only their members, the government and other financial institutions. Later on law number 3483/2006 gave the opportunity to the cooperative banks to expand their services to non-members in a proportion up to 50 % of the bank’s loans or deposits (Karafolas and Katarachia, 2009). Another important thing to remember is that they constitute a less developed industry, since their operation has started 20 years ago. Table 1 briefly presents the basic indicators of the Greek cooperative industry.
Table 1 Key figures regarding the Greek cooperative banks

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<tbody>
<tr>
<td>Banks</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Banking outlets</td>
<td>114</td>
<td>145</td>
<td>177</td>
<td>191</td>
<td>162</td>
<td>127</td>
</tr>
<tr>
<td>Staff</td>
<td>762</td>
<td>974</td>
<td>1.238</td>
<td>1.307</td>
<td>1.133</td>
<td>922</td>
</tr>
<tr>
<td>Total assets (millions €)</td>
<td>1.574</td>
<td>2.570</td>
<td>3.752</td>
<td>4.500</td>
<td>3.610</td>
<td>3.261</td>
</tr>
<tr>
<td>Deposits (millions €)</td>
<td>1.273</td>
<td>2.135</td>
<td>2.927</td>
<td>3.400</td>
<td>2.933</td>
<td>2.630</td>
</tr>
<tr>
<td>Loans (millions €)</td>
<td>1.270</td>
<td>1.935</td>
<td>3.064</td>
<td>3.500</td>
<td>3.259</td>
<td>2.923</td>
</tr>
<tr>
<td>Market share deposits (%)</td>
<td>0.8%</td>
<td>0.8%</td>
<td>0.8%</td>
<td>1.0%</td>
<td>1.8%</td>
<td>1.1%</td>
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<tr>
<td>Market share credits (%)</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.1%</td>
<td>1.0%</td>
<td>1.3%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Members</td>
<td>144.176</td>
<td>175.541</td>
<td>196.179</td>
<td>212.488</td>
<td>189.232</td>
<td>163.135</td>
</tr>
<tr>
<td>Clients</td>
<td>144.176</td>
<td>175.541</td>
<td>N/A</td>
<td>430.686</td>
<td>396.173</td>
<td>407.633</td>
</tr>
</tbody>
</table>


In 2014, only 10 cooperative banks were operating in Greece, since a wave of bank failures started on 2012. The off-balance sheet deposits, the granting resources without underwriting requirements and generally the existence of severe corruption in the industry, led to the collapse of six cooperative banks (Papadimitriou and Toay, 2014) and made the investigation of credit risk determinants on this industry a matter of vital importance. At the end of 2014, the sector had 922 employees and more than 400,000 customers. Additionally, from the remaining cooperative banks, two were active in their geographical region, five exerted activity on prefectural and three on national level. Their ROA and ROE approached 0,01 % and 0,11 %, respectively and capital ratio exceeded 9,5 %. Moreover, despite their 20-year operation, their market share for deposits and credits is still underdeveloped since their contribution on Greek banking system was 1,1% and 0,8%, respectively. Nevertheless, due to the fact that their banking products are based on local needs of SMEs, their market penetration on SMEs reached 15 % (EACB, 2015).

3. LITERATURE REVIEW

In order to assess credit risk determinants, several loan quality indicators have been widely used in the literature. The most popular are Loan Loss Provisions (LLP), Loan Loss Reserves (LLR), loan losses, Non Performing Loans ratio (NPL) and Probability of Default (PD). Among first studies was that of Keeton and Morris (1987), in which loan losses were used as main indicator of problem loans. The
authors explored why the banks’ loan losses vary significantly in 2500 commercial banks in seven US states during the 1979-1985 period. Their research underlined that loan losses variations’ are related to local economic climate and low efficiency of various economic sectors. Furthermore, they noted that the banks which were prone to taking more risks presented more loan losses. Similarly, Sinkey and Greenawlat (1991) analyzed the loan losses of the US commercial banks for the period 1984-1987. They found that both internal and external factors have a decisive impact on loan quality.

The empirical analysis of Cavallo and Manjoni (2001) aimed to define the interdependencies between LLP and various bank, macroeconomic and legal-institutional factors. They collected data from 1.176 banks in 36 countries, between 1988 and 1999, concluding that LLP is positively interacted with loans to total assets ratio and profitability, results that were interpreted as a sign of profits manipulation. Conversely, negative correlations were reported with loans growth rate and public debt. Finally, it was demonstrated that banks from common law countries formulate fewer provisions. Laeven and Manjoni (2003) explored which micro and macro variables exert significant impact on LLP in commercial banks of 45 countries for the period 1988-1999. Despite the significant differences among the examined countries, their results highlighted the negative impact of GDP, confirming the existence of procyclicality. At the same time, it was claimed that LLP is positively associated with profitability and negatively with the rate of change of loans. Bikker and Metzemaartes (2005), based on the two aforementioned studies, examined LLP and LLR in 29 OECD countries from 1991 to 2001. Their findings for both loan quality indicators corroborated the existence of procyclicality and the hypothesis that when capital ratios are being kept low, loan quality is deteriorating.

Moreover, Floro (2010) identified macroeconomic and banking factors influencing LLR in Philippines, by examining 32 commercial banks for the period 2001-2009. His findings supported that LLR shows a positive correlation with NPL, loans to total assets ratio, previous period LLR, earnings before taxes and provisions and short-term interest rates. Negative associations were documented with bank size, capital adequacy ratio, excess capital to risk-weighted capital ratio and GDP growth. Additionally, it was revealed that when banks record losses, they reduce their LLPs. Similarly, Liu and Yang (2010) concentrated on the economic
and financial factors responsible for the deterioration of loan quality in Taiwan from 1986 to 2005. According to their concluding remarks, LLR is negatively related with ROA and land prices, while credit expansion worsens significantly loan quality.

Makri, Tsagkanos and Bellas (2014) detected which bank specific and macroeconomic variables exert significant power on NPL in Eurozone’s banking systems for the pre-crisis period 2000-2008. Their results recorded important relationships between NPL and various macroeconomic factors (public debt, unemployment, economic activity) and micro indicators (capital adequacy ratio, past loan quality and performance).

Makri and Papadatos (2014) studied the influence of accounting information and macroeconomic environment on aggregate LLP of the Greek banking sector, during 2001-2012. They provided evidence that LLP is positively related to unemployment, public debt, previous quarter’s LLP and negatively to capital adequacy ratio. Following the same direction, Makri (2015) explored, both at individual bank and banking system level, whether LLP and LLR are driven from bank specific and macro determinants. Her analysis claims that Greek loan quality is influenced by unemployment, public debt, GDP, inflation, past loan quality, capital adequacy, liquidity and profitability.

Apart from commercial banks, international literature also focused on cooperatives banks. Porath (2006) dealt with micro (capital, profitability, loan quality portfolio and market risk etc.) and macro (GDP, interest rates, equity prices, etc.) factors that predict PD of German cooperative and savings banks during the period 1993-2002. His results demonstrated that both macro and micro variables constituted determinant factors of PD, concluding that models including exclusively accounting indicators may not reflect thoroughly bank risk.

Altunbas, Carbo, Gardener and Molyneux (2007) discussed the connection of bank risk, capital and inefficiency in various financial institutions (commercial, savings, cooperative banks etc.) in Europe. The authors analyzed data from 15 European countries, from 1992 to 2000, expressing credit risk via LLR ratio. Their results suggested that LLR is negatively influenced by loans to total assets and solvency ratio of non-financial businesses and positively by the overall banking system’s risk (total provisions). However, their findings regarding capital and profitability indices, liquid assets to deposits ratio and interest rates of government
bonds differentiated among bank categories (commercial, savings, cooperative banks etc.). Furthermore, Deelchand and Padgett (2009) determined the relationship of credit risk, capital and profitability in 263 Japanese cooperative banks for the period 2003-2006. They reported that LLR is influenced positively with inefficiency and bank size, while negatively with capital adequacy ratio and loans to total assets ratio.

Mare (2012) identified factors that are responsible for the bankruptcy of small banks. His research focused on PD of 434 Italian cooperative banks in 20 Italian regions for the period 1993-2011. The investigation presented that macroeconomic factors (such as interbank deposit rate and concentration of local business) are negatively associated with PD, while inverse relationship was noted for local unemployment. Regarding bank specific indicators, positive interdependencies emerged between LLP and liquidity ratio (loans to deposits) and negative with leverage ratio, wage costs (in relation to operating income), ROA and bank size. Similarly, Fiordelisi and Mare (2013) examined which indicators are connected with PD and efficiency in 476 Italian cooperative banks for 1997-2009. Their analysis showed that high efficiency levels improve significantly PD. Moreover, they revealed a positive correlation between PD and loan portfolio quality, loans to deposits ratio and liquidity ratio, while negative with capital adequacy ratio, bank size and economic growth.

Skala (2014) studied which factors influencing the credit policy of 356 polish cooperative banks and their income smoothing behavior, during the period 2006-2012. According to their conclusions, LLP is positively associated with pre-provisioning income, confirming income behaviour. Bank size and non-performing loans were found to be positively and strongly significant, while reverse relationship recorded with loan growth. Macroeconomic indicators unemployment and bankruptcy ratio proved to have positive impact on LLP.

Finally, Alessi, Di Colli, and Lopez (2014) analysed the main determinants of LLP for Italian commercial and cooperative banks during the period 2006-2012. They found that the cooperative banks’ LLP is negatively related to guaranteed loans and positively with bad loans ratio and loan to assets ratio. On the contrary, the hypotheses of income smoothing behaviour and procyclicality were not confirmed.
Based on the merits of the aforementioned studies, it is obvious that there is a large gap in the literature concerning the explanatory factors of loan quality in cooperative banks, in Greece. The necessity of such research is even greater, given the impact of cooperative banks on SMEs and local economies development and the recent failures of six cooperative banks in Greece. In this context, to the authors’ best knowledge, this is the first empirical analysis that focused on accounting and macroeconomic determinants of credit risk at cooperative banking industry both in booming and financial crisis periods of the Greek economy.

4. METHODOLOGY

4.1. Methodological framework

There is ample support that loan quality is characterized by the existence of dynamic relationships (Castro, 2013; Louzis, et al., 2010) identified from the inclusion of lagged dependent variables as independent variable (Baltagi, 2001). Taking this claim into consideration, sophisticated estimators are considered suitable for the exploration of these linkages (Baltagi, 2001 and Quagliariello, 2007). For this reason, GMM First Difference (or GMM Difference) is chosen for our analysis, since GMM estimators are account for problems that might arise from the existence of autocorrelation and heteroscedasticity, providing results with correct standard errors (Cragg, 1983) and being suitable for panel data, which is the case of the present study. GMM estimator was developed by Hansen (1982), while GMM Difference was developed by Holtz-Eakin, Newey and Rosen (1988), and Arellano and Bond (1991) and extended by Arellano and Bover (1995) and Blundell and Bond (1998). The implementation of GMM specification necessitates the use of instrumental variables. Arellano and Bond (1991) argued that GMM presents better results when lagged values of dependent and independent variables are used as instruments. Moving towards this direction, Roodman (2009) suggested that instruments could be originated from the dataset itself and corresponded to lagged variables. For our investigation, the validity of instruments is examined by J statistics for over-identifying restrictions and AR statistical tests in order to control for serial correlation in the residuals.

Credit risk and loan portfolio quality are two concepts that are extremely interrelated. As noted by Saunders and Cornet (2008), credit risk is identified as
the risk that promised cash flows from loans and securities might not be paid in full. Generally, credit risk is inextricably associated with extensive bank failures and instability in banking system (Berger and Humprey, 1997; Mullings, 2003). The main goal of this study is to define which factors influence loan portfolio quality of cooperative banks. Based on the consideration that loan quality is characterized from the existence of dynamic relationships, our basic equation is formulated as following:

\[ LQ_{i,t} = LQ_{i,t-j} + ACC_{i,t-j} + MACRO_{t-j} \]  

where LQ denotes loan quality indicator, ACC accounting (bank specific) factors, MACRO macroeconomic indicators, i the examined cooperative bank and t-j the examined period. In the current analysis, the depended variable, hence loan quality is measured via LLR ratio. Loan loss reserves are banks’ estimations arising from varying economic circumstances, credit risk and loan quality (Walter, 1991; Ahmed et al., 1999, Balla and Mckenna, 2009). The level of LLR reflects the exposure risk and loan portfolio quality (Walter, 1991), due to its dependency on provisions and loan losses (Gebhardt and Novotny-Farkas, 2013). Along similar lines, Bikker and Metzemarkes (2005) argued that LLR are the year-on-year accumulated net provisioning that have to be associated with real expected loan losses. Additionally, Fillat and Montoriol-Garriga (2010) underlined that loan loss reserves should cover expected losses since an inadequate reserves level can have a direct impact on the capital of financial institutions. To this end, if a bank has insufficient reserves it is considered that the regulatory capital ratios have been overestimated and the bank is in great danger (Balla and Mckenna, 2009). Bearing in mind this, the detection of determinant factors of loan loss reserves is crucial not only for the stability of the financial system itself but also for a healthy and well-functioning society.

Table 2 summarizes the examined independent variables and their expected sign according to economic theory and literature. It must be underlined that these variables are investigated at current time (t) and previous periods (t-j). More
precisely, it is assumed that the current level of loan quality is influenced not only by current accounting and macroeconomic variables, but also by accounting and macroeconomic variables of previous time periods, as their impact can be either direct or with time lag. In this case, the basic econometric equation (1) is calculated thrice. Once, by exploring micro and macro variables of current period (t) and afterwards those of previous years (t-1) and (t-2). Ultimately, by calculating equation (1) separately at time (t), (t-1) and (t-2), econometric problems from the inclusion of same explanatory variables several times in the same equation are considerably reduced. Furthermore, it is recorded a clearer picture of the accounting and macroeconomic determinants. Moreover, our basic model was presented in three different versions. In the first one, both accounting and macroeconomic variables incorporated in the same equation. Additionally, bank specific and macroeconomic indices independently investigated so as to provide more extensive information, concerning the relation among explanatory variables and loan quality.

**Table 2. Presentation of Variables**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Explanation</th>
<th>Expected Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLR&lt;sub&gt;t&lt;/sub&gt;&lt;sub&gt;-j&lt;/sub&gt;</td>
<td>Loans Loss Reserves as % of Total Loans</td>
<td>(+)</td>
</tr>
<tr>
<td>CAP</td>
<td>Bank Capital and Reserves to Total Assets</td>
<td>(+) / (-)</td>
</tr>
<tr>
<td>LtA</td>
<td>Bank Liquidity: Total Loans to Total Assets</td>
<td>(+)</td>
</tr>
<tr>
<td>ROA</td>
<td>Performance indicator: Return on Assets</td>
<td>(-)</td>
</tr>
<tr>
<td>LUNMP</td>
<td>Local unemployment rate</td>
<td>(+)</td>
</tr>
<tr>
<td>GDP</td>
<td>GDP growth rate</td>
<td>(-)</td>
</tr>
<tr>
<td>INFL</td>
<td>Average inflation rate</td>
<td>(+) / (-)</td>
</tr>
<tr>
<td>DEBT</td>
<td>Public debt as % of GDP</td>
<td>(+)</td>
</tr>
</tbody>
</table>

The first examined explanatory variable is the dynamic performance of credit risk in time. The inclusion of past loan quality on the right hand of the equation is required in order to evaluate whether past loan decisions (LLR<sub>t</sub><sub>-j</sub>) define changes on the current level of LLR (Laeven and Manjoni, 2003; Fonseca and Gonzalez, 2008; Frait and Komárková, 2013).
Apart from the dynamic persistence of credit risk, accounting variables are also investigated as possible determinants. To begin with, capital ratio (CAP) reflects the bank’s risk attitude and is widely used as a proxy indicator of capital adequacy. Its impact on loan quality can be either positive or negative (e.g. Shrieves and Dahl, 1992, Fiordelisi and Mare, 2013). Based on moral hazard hypothesis, regarding its negative impact, it is supported that banks with low capital ratios might correspond more easily to moral hazard incentives and their loan quality is considerably deteriorated (Berger and De Young, 1997). Similarly, Orgler and Taggart (1983) suggested that banks, due to collapse risk, might decrease (increase) their capital ratios, when problem loans reduced (increased). However, as underlined by Berger and De Young (1997), a positive influence between capital and loan quality is also feasible due to the fact that banks might react cautiously, when loan quality is deteriorated, by increasing their capital base in advance.

The effect of bank liquidity, expressed through loans to totals assets ratio (LtA), is comprised in the analysis too. Bank liquidity, to some extent, is associated to bank’s attitude towards risk and severe bank failures (Sinkey and Greenwalt, 1991; Festić and Repina, 2009; Cotugno, Stefanelli and Torluzzo, 2010; Guy and Lowe, 2011). Towards this direction, low bank liquidity equals high value of LtA indicators and high amount of problems loans. Consequently, a positive relationship is expected between LtA and loan quality. Further empirical evidence supporting its positive impact may lie in the findings of Cavallo and Manjoni (2001), Floro (2010), etc.

Bank performance, measured by ROA, is also linked to loan quality in the present econometric specification. Financial institutions with significant amount of bad loans must formulate higher provisions, hence expenses, which are responsible for decreasing profits (Sinkey, 1998). This suggests that the sign of the relationship is expected to be negative and is usually ascribed to the risk behaviour of the bank managers. Indeed, banks with low profitability indices are forced to generate more income, so they are getting involved into riskier lending activities. In contrast, profitable banks are not strained to augment their income and have fewer stimulus to provide credit to less trustworthy loan applicants. Moreover, Boudriga, Taktak and Jellouli (2009b) underlined that banks with low profitability ratios might not be able to control their operating expenses and their borrowers’ quality.
Macroeconomic indicators were also explored as possible explanatory factors of credit risk. First of all, the unemployment rate was examined. However, taking into account that cooperative banks finance local economy, local unemployment rate was included in \( \text{LUNMP} \) instead of the national unemployment rate, in order to control for the existing local economic conditions. In fact, when economic conditions ameliorated, the number of unemployed is decreased, their disposal income is increased and consequently they are consistent with their loan obligations. Hence, it is anticipated a positive relationship between unemployment and loan quality (Brookes, Dicks and Pradhan, 1994; Bikker and Metzemarkes, 2005; Glogowski, 2008 etc.).

Additionally, the impact of business cycle and economic activity investigated through national GDP growth index\(^8\). During economic development, households and businesses repay normally their loan instalments and generally bad loans are kept low. At the same time, due to extreme competition, banks relax their lending criteria, providing credit even to less trustworthy borrowers and, as a result, loan demand is considerably expanded. Conversely, when unfavourable economic conditions take place, the borrowers’ financial condition is deteriorating, the levels of problem loans are being risen, banks’ profitability is decreased and the financing of new investments is extremely limited. Based on the above argument, GDP growth and loan quality considered to be negatively associated, confirming the existence of procyclicality (Salas and Saurina, 2002; Pederzoli, Torricelli and Castellani, 2010; Jakubik and Reininger, 2013).

Contrary to local unemployment and GDP, inflation’s impact is equivocal (e.g. Babihuga, 2007; Kavkler and Festić, 2010; Guy and Lowe, 2011). On one hand, loan repayment can be difficult, when high inflation exists, as borrowers’ real income is decreasing (when wages and salaries remain stable). On the contrary, high inflation may ease the payment of loan instalments, since the real value of loan is reducing (Jakubík and Schmieder, 2008; Nkusu, 2011; Castro, 2013). Taking into consideration all of the above, the effect of the inflation rate can be either negative or positive.

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\(^8\) Similar to unemployment rate, since cooperative banks finance local economies, our main objective was to examine all macroeconomic variables with their local values. Nevertheless, due to data unavailability, we ended up using GDP and the remaining macro factors with their national values.
Recent developments in the field of loan quality determinants have led to a renewed interest in the connection of public debt with credit risk (e.g. Makri et al., 2014; Makri, 2015). Until now, the evidence demonstrate that debt and banking crises are interdependent (Furceri and Zdzienicka, 2012; Tagkalakis, 2014). Therefore, the investigation of public debt as a possible determinant factor of loan quality is indispensable. The basic motive behind its examination was to explore whether a country’s financial position could define the level of problem loans. It is valuable to note that a country’s banking system is significantly induced, when its financial condition is reduced, since its creditability is on stake. In other words, significant liquidity problems might arise on the banking system due to the deterioration of the country’s credit liability (Reinhart and Rogoff, 2010). Furthermore, during periods of public debt expansion, governments are forced to take strict fiscal measures in order to limit considerably their expenses (abolition or reduction social benefits). This implies that the repayment of loan obligations is getting more and more difficult, as the disposable income is being reduced (Perotti, 1996). Given the above discussion, a positive relationship between public debt and loan quality is expected.

4.2. Econometric specifications

Based on the methodological framework, our first empirical model, in which the LLR explanatory factors of the Greek cooperative banking industry are determined, is the following:

\[
LLR_{it} = a_0 + a_1 LLR_{it-1} + a_2 CAP_{it} + a_3 LtA_{it} + a_4 ROA_{it} + a_5 GDP_{it} + a_7 
\]

\[
LUNMP_{it} + a_8 INFL_{it} + a_9 DEBT_{it} + \varepsilon_{it}, \tag{2}
\]

where LLR is the loans loss reserves to total loans ratio and stands for credit risk, i and t the examined bank and year respectively. The independent variables along with their expected signs are briefly presented in Table 1. Moreover, in order to explore the significance power of micro and macro variables separately, econometric equations are shaped as follows:

\[
LLR_{it} = a_0 + a_1 LLR_{it-1} + a_2 CAP_{it} + a_3 LtA_{it} + a_4 ROA_{it} + \varepsilon_{it}, \tag{2a}
\]

\[
LLR_{it} = a_0 + a_1 GDP_{it} + a_2 LUNMP_{it} + a_3 INFL_{it} + a_4 DEBT_{it} + \varepsilon_{it}. \tag{2b}
\]
As mentioned before, so as to investigate whether the previous years’ (t-1 and t-2) micro and macro variables exert significant impact on current level of LLR, the following models are also tested:

\[
LLR_{i,t} = a_0 + a_1 LLR_{i,t-1} + a_2 \text{CAP}_{i,t-1} + a_3 \text{LtA}_{i,t-1} + a_4 \text{ROA}_{i,t-1} + a_5 \text{GDP}_{i,t-1} + a_7 \text{LUNMP}_{i,t-1} + a_8 \text{INFL}_{i,t-1} + a_9 \text{DEBT}_{i,t-1} + \varepsilon_{i,t-1}
\]

(3)

\[
LLR_{i,t} = a_0 + a_1 LLR_{i,t-1} + a_2 \text{CAP}_{i,t-1} + a_3 \text{LtA}_{i,t-1} + a_4 \text{ROA}_{i,t-1} + \varepsilon_{i,t-1}
\]

(3a)

\[
LLR_{i,t} = a_0 + a_1 \text{GDP}_{i,t-1} + a_2 \text{LUNMP}_{i,t-1} + a_3 \text{INFL}_{i,t-1} + a_4 \text{DEBT}_{i,t-1} + \varepsilon_{i,t-1}
\]

(3b)

\[
LLR_{it} = a_0 + a_1 LLR_{i,t-2} + a_2 \text{CAP}_{i,t-2} + a_3 \text{LtA}_{i,t-2} + a_4 \text{ROA}_{i,t-2} + a_5 \text{GDP}_{i,t-2} + a_7 \text{LUNMP}_{i,t-2} + a_8 \text{INFL}_{i,t-2} + a_9 \text{DEBT}_{i,t-2} + \varepsilon_{i,t-2}
\]

(4)

\[
LLR_{it} = a_0 + a_1 LLR_{i,t-2} + a_2 \text{CAP}_{i,t-2} + a_3 \text{LtA}_{i,t-2} + a_4 \text{ROA}_{i,t-2} + \varepsilon_{i,t-2}
\]

(4a)

\[
LLR_{it} = a_0 + a_1 \text{GDP}_{i,t-2} + a_2 \text{LUNMP}_{i,t-2} + a_3 \text{INFL}_{i,t-2} + a_4 \text{DEBT}_{i,t-2} + \varepsilon_{i,t-2}
\]

(4b)

Econometric analysis is implemented through GMM difference estimator, where previous years’ variables (time lags) are used as instruments. The instruments’ validity was controlled through J statistics, while statistical tests AR1 and AR2 are implemented for exploring serial correlation among the residuals of first differences. With regard to control whether the series are autoregressive, Kao panel cointegration test is implemented.

5. SAMPLE AND DATA

In the present study, individual bank level data are used. Specifically, the final sample consisted of an unbalanced panel data of 11 cooperative banks with 149 annual observations. The examined period extended from 2003 to 2014, including both economic growth and recession of the Greek economy. The accounting information is collected through the financial statements of cooperative banks and macroeconomic indices from the Hellenic Statistical Authority (EL.STAT.).

6. EMPIRICAL RESULTS

The estimation results are presented in Table 3, which also presents the coefficients of the independent variables with their corresponding p-values and
statistical tests AR1, AR2 and J for all the examined time periods. We underline that in most of the equations, the aforementioned tests demonstrate acceptable values and the null hypothesis (H0: no cointegration) of Kao panel cointegration test is not rejected (p-value = 0.275).

The analysis for period t showed that profitability, public debt and local unemployment define changes in loan quality. In particular, it was ascertained a negative relationship between loan loss reserves and ROA (Model 2, 2a), while an inverse one with public debt (Model 2 and 2b) and local unemployment (Model 2b). The results for period t-1 confirmed that current loan loss reserves are linked to previous year’s loan quality and various macroeconomic indicators. More precisely, previous year’s LLR (Model 3 and 3a), public debt (Model 3 and 3b), inflation (Model 3b) and local unemployment (Model 3b) demonstrate positive association with current level of loan quality. Finally, the econometric estimations for period t-2 detected the dynamic persistence of credit risk and the significant effect of economic activity and public debt. Specifically, two years ago LLR (Model 4a) and public debt (Model 4 and 4b) exert positive significant impact on current level of credit risk, while GDP (Model 4 and 4b) negative.
<table>
<thead>
<tr>
<th>Variables</th>
<th>$t$</th>
<th>$t-1$</th>
<th>$t-2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model (2)</td>
<td>Model (2a)</td>
<td>Model (2b)</td>
</tr>
<tr>
<td>LLR$_{it-1}$</td>
<td>0.259 (0.474)</td>
<td>0.633 (0.265)</td>
<td><strong>5.041</strong> (0.047)</td>
</tr>
<tr>
<td>LLR$_{it-2}$</td>
<td>0.109 (0.646)</td>
<td>0.199 (0.662)</td>
<td>0.858 (0.194)</td>
</tr>
<tr>
<td>CAP$_{it}$</td>
<td>0.046 (0.379)</td>
<td>0.070 (0.367)</td>
<td>0.049 (0.848)</td>
</tr>
<tr>
<td>CAP$_{it-1}$</td>
<td>-0.490 (0.008)</td>
<td>-0.899 (0.019)</td>
<td>4.162 (0.121)</td>
</tr>
<tr>
<td>CAP$_{it-2}$</td>
<td>-0.293 (0.398)</td>
<td>-0.055 (0.586)</td>
<td>GDP$_{it}$</td>
</tr>
<tr>
<td>GDP$_{it-1}$</td>
<td>-0.293 (0.398)</td>
<td>-0.055 (0.586)</td>
<td>GDP$_{it-2}$</td>
</tr>
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</table>

Table 3. Empirical results
<table>
<thead>
<tr>
<th>GDP_{it-2}</th>
<th>LUNMP_{it}</th>
<th>LUNMP_{it-1}</th>
<th>LUNMP_{it-2}</th>
<th>-0.273*** (0.007)</th>
<th>-0.267** (0.024)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUNMP_{it}</td>
<td>0.046 (0.678)</td>
<td>0.337 *** (0.001)</td>
<td>-0.805 (0.214)</td>
<td>0.289*** (0.000)</td>
<td>0.290 (0.243)</td>
</tr>
<tr>
<td>LUNMP_{it-1}</td>
<td>0.100 (0.554)</td>
<td>0.100 (0.669)</td>
<td>0.676 (0.363)</td>
<td>0.390** (0.022)</td>
<td>-0.164 (0.506)</td>
</tr>
<tr>
<td>LUNMP_{it-2}</td>
<td>0.042** (0.023)</td>
<td>0.064** (0.030)</td>
<td>0.242* (0.092)</td>
<td>0.075** (0.011)</td>
<td>0.068** (0.047)</td>
</tr>
<tr>
<td>INFL_{it}</td>
<td>-0.101 (0.554)</td>
<td>0.100 (0.669)</td>
<td>0.676 (0.363)</td>
<td>0.390** (0.022)</td>
<td>-0.164 (0.506)</td>
</tr>
<tr>
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</tr>
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<td>INFL_{it-2}</td>
<td>0.042** (0.023)</td>
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<td>0.242* (0.092)</td>
<td>0.075** (0.011)</td>
<td>0.068** (0.047)</td>
</tr>
<tr>
<td>DEBT_{it}</td>
<td>0.032</td>
<td>0.076</td>
<td>0.043</td>
<td>0.000</td>
<td>0.062</td>
</tr>
<tr>
<td>DEBT_{it-1}</td>
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<td>0.211</td>
<td>0.168</td>
<td>0.883</td>
<td>0.676</td>
</tr>
<tr>
<td>DEBT_{it-2}</td>
<td>0.431</td>
<td>0.935</td>
<td>0.290</td>
<td>0.962</td>
<td>0.413</td>
</tr>
</tbody>
</table>

**AR1 (p-value)**
0.032 0.076 0.043 0.000 0.062 0.039 0.057 0.070 0.000

**AR2 (p-value)**
0.197 0.211 0.168 0.883 0.676 0.114 0.797 0.159 0.895

**J statistic (p-value)**
0.431 0.935 0.290 0.962 0.413 0.320 0.784 0.613 0.624
Note: Table shows the coefficients estimates (coefficients in bold are significant), and p-values of the difference GMM regression model,

* Significance at the 10% level,
** Significance at the 5% level,
*** Significance at the 1% level,

LLR is the loan loss reserves to total loans, CAP is the capital ratio (defined as capital and reserves to total assets), LtA is the loans to Assets ratio, ROA is the profitability ratio: return on assets, GDP is the annual percentage growth rate of GDP, LUNMP is the local annual unemployment rate, INFL is the annual rate of inflation and DEBT is the public debt as percentage of GDP, where i corresponds to the examined bank and t to the year,
7. DISCUSSION

The evaluation of estimation results implies that macroeconomic and accounting factors contribute decisively on defining loan quality, hence credit risk for the Greek cooperative banking industry. Regarding macroeconomic conditions, several interesting results were obtained. Firstly, the public debt is undoubtedly a significant determinant factor, since its positive impact is presented in all the examined models. Indeed, it was revealed that not only the current values of public debt but also those of two previous periods are correlated with the current level of LLR. This relationship argues that fiscal problems in Greece are linked to loan quality and can be attributed to the imposed strict measures by the governments (Perotti, 1996) and the banks’ liquidity problems due to the country’s bad credit ratings (Reinhart and Rogoff, 2010). Despite the fact that debt and banking crises are interdependent, until recently the relationship between public debt and credit risk had been underestimated in empirical studies. However, similar to Makri and Papadatos (2014) and Makri (2015), the impact of the public debt is strongly confirmed for the Greek cooperative banks. It must be noted that this result might lead to further investigation in other countries too, particularly those with high public debt and generally important fiscal problems.

Similarly, local unemployment, which examines the local economic activity in the operating area of cooperative banks, is another explanatory factor. More precisely, it was recorded that local unemployment determines the current and next year values of LLR. Therefore, it seems that when banks operate in areas with high unemployment level, are forced to formulate higher loan loss reserves. In particular, when the number of unemployed is increased, their disposable income is drastically reduced and the payment of loan instalments is becoming more difficult. This finding is consistent with many studies in different countries, such as Brookes et al. (1994), Mare (2012), Skala (2014), Makri and Papadatos (2014).

GDP growth rate also defines credit risk. Nevertheless, contrary to public debt and local unemployment, GDP does not have current impact on LLR, since its negative significant effect take place after two years. This negative relationship supports the view that in periods of economic expansion, households and firms have sufficient income to repay their loans and the levels of loan quality indicators are being kept low. In contrast, during economic distress, the borrowers’ economic
situation is deteriorated and, consequently, loan quality is considerably worsened. Thus, similar to previous research (Porath, 2006; Louzis et al., 2010; Fiordelisi and Mare, 2013; Curcio and Hasan, 2015; Makri, 2016 etc.), the existence of procyclicality is confirmed.

Inflation is another macro index that explains changes on loan portfolio quality, since it was recorded that an increase (decrease) in inflation rate worsens (improves) LLR of the following year. Although, economic theory suggests that the impact of inflation on credit risk is ambiguous, it seems that in Greece when high inflation exists, the borrowers’ real income is decreasing (when wages and salaries remain stable) and loan repayment is difficult.

Along with macroeconomic environment, the dynamic persistence of credit risk is an additional determinant, since past performance of loan quality exerts significant positive effect on the current level of loan loss reserves. This result is consistent with the findings of Jimenez and Saurina (2006), Fonseca and Gonzalez (2008), Frait and Komárková (2013), Castro (2013), Makri (2016) etc.

Finally, profitability, expressed through ROA, influences negatively loan quality. However, its significant impact is exclusively direct without presenting time lag. This negative correlation is linked to the bank behaviour towards risk. Financial institutions with high (low) profitability indices have less (more) pressure to increase their revenues and apparently less (more) incentive to provide higher-risk loans. Furthermore, banks with low profitability might encounter more difficulties in monitoring loan quality and their operating expenses (Boudriga et al., 2009b). Similar conclusions concerning profitability and credit risk, were obtained by Louzis et al. (2010), Zoubi and Al-Khazali (2007), Boudriga et al. (2009a), Liu and Yang (2010), Stefanelli and Cotugno (2012), Mare (2012), etc.

The determination of loan quality factors in cooperative banking industry revealed significant economic insights for taxpayers, regulatory and supervisory authorities, bank’s management and local communities not only for Greece, but also for countries with similar characteristics i.e. comparable cooperative banking industries (short time of operation, market share, small size etc.) and fiscal problems (severe public debt burden). The revealed accounting and macro indices of cooperative banks can serve as a signalling and predictive tool for the maintaining of financial health in the region, the deterioration of loan losses, the formulation policy and decision-making strategies. The existence of a healthy
financial environment can play a crucial role on the development of local market by supporting and encouraging local entrepreneurship.

8. Conclusion

The present study contributes to our understanding of determinants in loan quality in Greece, by exploring for the first time the cooperative banking sector, for the period 2003-2014. This prolonged period gave us the opportunity to include in our research both the economic growth and the recession period of the domestic economy. The empirical investigation clearly showed that macroeconomic and accounting indicators define loan loss reserves, hence credit risk. Particularly, public debt, local unemployment, GDP, inflation, dynamic persistence of credit risk in time and profitability seem to interpret significantly changes on loan quality levels.

Acknowledgements

Fruitful discussions in early stages of this empirical study with Emeritus Professor Athanasios Bellas are gratefully acknowledged.

Appendix

Table A. Statistical measures of examined variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Median</th>
<th>Max</th>
<th>Min</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLR_{it}</td>
<td>0.072</td>
<td>0.056</td>
<td>0.297</td>
<td>0.003</td>
<td>0.058</td>
</tr>
<tr>
<td>LLR_{it-1}</td>
<td>0.064</td>
<td>0.047</td>
<td>0.290</td>
<td>0.003</td>
<td>0.056</td>
</tr>
<tr>
<td>LLR_{it-2}</td>
<td>0.058</td>
<td>0.040</td>
<td>0.290</td>
<td>0.003</td>
<td>0.055</td>
</tr>
<tr>
<td>CAP_{it}</td>
<td>0.986</td>
<td>0.138</td>
<td>8.544</td>
<td>0.054</td>
<td>2.437</td>
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<tr>
<td>CAP_{it-1}</td>
<td>0.147</td>
<td>0.135</td>
<td>0.421</td>
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<td>0.070</td>
</tr>
<tr>
<td>CAP_{it-2}</td>
<td>0.162</td>
<td>0.148</td>
<td>0.451</td>
<td>0.054</td>
<td>0.082</td>
</tr>
<tr>
<td>LtA_{it}</td>
<td>0.780</td>
<td>0.786</td>
<td>1.064</td>
<td>0.487</td>
<td>0.101</td>
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<tr>
<td>LtA_{it-1}</td>
<td>0.776</td>
<td>0.782</td>
<td>1.378</td>
<td>0.487</td>
<td>0.112</td>
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<tr>
<td>LtA_{it-2}</td>
<td>0.772</td>
<td>0.779</td>
<td>1.729</td>
<td>0.487</td>
<td>0.141</td>
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<tr>
<td>ROA_{it}</td>
<td>0.005</td>
<td>0.009</td>
<td>0.046</td>
<td>-0.260</td>
<td>0.031</td>
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<td>ROA_{it-1}</td>
<td>0.010</td>
<td>0.011</td>
<td>0.046</td>
<td>-0.136</td>
<td>0.017</td>
</tr>
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### Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Median</th>
<th>Max</th>
<th>Min</th>
<th>SD</th>
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<tr>
<td>ROA(_{it-2})</td>
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<td>0,012</td>
<td>0,057</td>
<td>-0,032</td>
<td>0,013</td>
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<tr>
<td>GDP(_it)</td>
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<td>-0,002</td>
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<td>0,045</td>
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<tr>
<td>GDP(_{it-1})</td>
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<td>-0,002</td>
<td>0,059</td>
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<td>GDP(_{it-2})</td>
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<td>0,022</td>
<td>0,059</td>
<td>-0,071</td>
<td>0,043</td>
</tr>
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<td>LUNMP(_it)</td>
<td>0,009</td>
<td>0,022</td>
<td>0,059</td>
<td>-0,071</td>
<td>0,043</td>
</tr>
<tr>
<td>LUNMP(_{it-1})</td>
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<td>0,117</td>
<td>0,371</td>
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<td>0,112</td>
<td>0,291</td>
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<td>0,059</td>
</tr>
<tr>
<td>INFL(_it)</td>
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<td>0,047</td>
<td>-0,014</td>
<td>0,017</td>
</tr>
<tr>
<td>INFL(_{it-1})</td>
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<td>0,033</td>
<td>0,047</td>
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<tr>
<td>INFL(_{it-2})</td>
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<td>0,033</td>
<td>0,047</td>
<td>0,010</td>
<td>0,010</td>
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<tr>
<td>DEBT(_{it})</td>
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<td>DEBT(_{it-1})</td>
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<tr>
<td>DEBT(_{it-2})</td>
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<td>1,074</td>
<td>1,703</td>
<td>0,974</td>
<td>0,226</td>
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Note: LLR is the loan loss reserves to total loans, CAP is the capital ratio (defined as capital and reserves to total assets), LTA is the loans to assets ratio, ROA is the profitability ratio: return on assets, GDP is the annual percentage growth rate of GDP, LUNMP is the local annual unemployment rate, INFL is the annual rate of inflation and DEBT is the public debt as percentage of GDP, where \(i\) corresponds to the examined bank and \(t\) to the year.

### Bibliography

44. Karafolas, S., and Katarachia N. (2009), Legislative framework on agriculture and credit and Credit Cooperatives in Greece, Droit Comparé des Coopératives Européennes, 95-114