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Loan quality determinants: evaluating the contribution of bank-specific variables, macroeconomic factors and firm level information

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Abstract

This paper uses probit and ordered probit methods to examine the impact of banks' policies in terms of cost efficiency, capitalization, activity diversification, credit growth and profitability, on the loan quality in the Tunisian banking sector after controlling for the effects of firm-specific characteristics and macroeconomic conditions. Using a data set with detailed information for more than 9 000 firms comprising the portfolios of the ten largest Tunisian banks, we show that banks which are cost inefficient, low capitalized, diversified and small, are more likely to have a low quality of loans portfolios. However, bank's profitability does not seem to offer an important contribution in explaining the loan quality evolution. Finally, our findings highlight the importance of taking into account firm-specific characteristics and macroeconomic developments when assessing the loan quality of banks from a financial stability perspective.

Loan quality determinants: evaluating the contribution of bank-specific variables, macroeconomic factors and firm level information ☆

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A B S T R A C T

This paper uses probit and ordered probit methods to examine the impact of banks' policies in terms of cost efficiency, capitalization, activity diversification, credit growth and profitability, on the loan quality in the Tunisian banking sector after controlling for the effects of firm-specific characteristics and macroeconomic conditions. Using a data set with detailed information for more than 9 000 firms comprising the portfolios of the ten largest Tunisian banks, we show that banks which are cost inefficient, low capitalized, diversified and small, are more likely to have a low quality of loans portfolios. However, bank's profitability does not seem to offer an important contribution in explaining the loan quality evolution. Finally, our findings highlight the importance of taking into account firm-specific characteristics and macroeconomic developments when assessing the loan quality of banks from a financial stability perspective.

1. Introduction

Exploring the determinants of problem loans is a question of substantial importance for regulatory authorities concerned with financial stability. A growing number of studies have examined the determinants of credit risk especially after the recent crisis by focusing on several categories of determinants such as macroeconomic factors, bank-specific variables or firm-specific characteristics. Many studies in this field have used one of these categories of determinants (Berger and DeYoung, 1997; Bernhardsen, 2001 and Eklund et al., 2001) or two of them, simultaneously, (Bonfim, 2009 and Louzis et al., 2012), in order to explain problem loans determinants.

The main purpose of this study is to empirically examine if loan quality is mostly explained by banks-specific variables (banks' policies in terms of cost efficiency, capitalization, activity diversification, profitability and credit growth), firm-specific factors, macroeconomic conditions or by the combination of these three categories of determinants.

The majority of studies that investigate the determinants of problem loans try to answer the question of what explains the credit default at the firm level (Bonfim, 2009) or attempt to analyze the evolution of non-performing loans (NPLs) taken as an aggregated measure of problem loans at the bank level (Louzis et al., 2012). However, little attention has been paid to the question of what explains that a loan has a given quality or status that lies between the two extreme statuses of safe and defaulted loan. Exploring the latter question is of great importance since it may allow banks as well as regulatory and supervisory authorities to undertake the appropriate actions and policies to mitigate deterioration of the quality of banks' loan portfolios.

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Our study aims to contribute to the literature on loan quality in two ways. Firstly, we consider three distinct types of loan quality determinants: bank-specific variables, macroeconomic developments (systematic risk) and firm-specific factors (idiosyncratic factors). We assume that the impact of bank's policies on their loan portfolios quality varies overall macroeconomic conditions and depends on firms' characteristics. Secondly, our study also contributes to the empirical literature on loan quality by considering disaggregated measure of problem loans rather than using the aggregated level of NPLs[1], by using detailed dataset which contains information on the quality of loans granted by banks to more than 9 000 firms for the period between 2001 and 2010.

Our results show that a high level of bank's cost inefficiency, a low bank's capitalization, a high diversification of the banking activity, and a small size of banks are the main factors that reduce the loan quality of banks. When macroeconomic conditions are taken into account, the findings show that lagged GDP growth has a positive impact on loan quality. However, interest rate on bank loans has a negative effect. When firm-specific variables are added, the results argue that loan quality is impacted by several indicators, such as leverage, external funding cost, liquidity, investment, sales, size and economic sector affiliation.

One implication of our study for policy makers would be to consider a macro prudential regulation and supervision instead of relying only on the micro prudential perspective, when analyzing the quality of banks' loan portfolios (for loan losses provisioning, stress tests, banks capitalization requirements, etc).

The remainder of the paper is organized as follow. Section 2 reviews the theoretical and empirical literature on the determinants of problem loans and formulates the hypotheses relating bank-specific variables to loan quality. Section 3 describes the dataset and presents the econometric methodology used in this study. Section 4 presents the empirical results. Section 5 presents our discussion and interpretation of the main findings of this study. Finally section 6 summarizes our concluding remarks.

2. Literature review and hypotheses

One strand of research in the field of financial institution that has received great amount of attention is the issue of problem loans. Many studies on the causes of bank failures have found that failing institutions have higher proportions of non-performing loans prior to failure and that asset quality displays a statistically significant predictor of insolvency (Berger and DeYoung, 1997). From this perspective, many studies have examined the determinants of credit risk. We can identify four different groups of credit risk models according to their required inputs.

The first group of models contains models which rely mostly on firm-specific accounting variables (Altman, 1968; Bernhardsen, 2001; Eklund et al., 2001; Bunn and redwood, 2003 and Benito et al., 2004). Under these models, variables regarding several dimensions of firms' financial situation, such as, asset growth, profitability, leverage, liquidity, age and size, may account for idiosyncratic risk.

The second group of models contains studies that rely on macroeconomic variables or consider default correlation issues. The main idea behind these models is that credit risk is built up during expansion phases, when banks apply looser credit standards. However, the most of the risk materializes only during the phases of economic recession. Some authors who consider business cycle in credit risk models include Jiménez and Saurina (2006), Pederzoli and Torriceli (2005), Lowe (2002), Carling (2002, 2004), Kent and D'Arcy (2001), Borio et al. (2001), Wilson (1998) and Bangia (2002).

The third group contains credit risk models which use bank-specific information as explanatory variables. These models consider that the policies chosen by each Bank, in particular in terms of improving cost efficiency, capitalization, activity diversification, performance and credit growth have an impact on the evolution of problem loans. Some work in this field includes Berger and DeYoung (1997) and Podpiera and Weill (2008).

1. Non-performing loans may be subject to accounting manipulations for earnings and loss provisioning purposes.

Finally, the fourth group contains models which combine the different types of inputs mentioned above. For example, Bonfim (2009) combined firm-specific variables and macroeconomic conditions to explain the determinants of problem loans (proxied by credit default) in the Portuguese banking sector. Louzis et al. (2012) used bank-specific variables and macroeconomic factors, simultaneously, to examine the determinants of problem loans (proxied by non-performing loans) in the Greek banking sector.

Our study tries to examine the impact of banks' cost efficiency, capitalization, activity diversification, size and performance, on the loan quality in the Tunisian banking sector taking into account information on firms comprising the banks' loan portfolios as well as the evolution of the macroeconomic conditions (as a proxy for the systemic risk). We assume that the relationship between bank-specific variables and loan quality depends on the macroeconomic conditions as well as on firms' characteristics.

In their seminal paper, Berger and DeYoung (1997) explored a sample of US commercial banks during the period 1985-1994 and find that decreases in measured cost efficiency lead to an increase in future problem loans. Also, Podpiera and Weill (2008) provide an empirical evidence of a negative relationship between measured cost efficiency and futures problem loans in the Czech banking industry within the period from 1994 to 2005. More recently, Louzis et al. (2012), exploring the drivers of NPLs of nine largest Greek Banks during the period 2003–2009, find that low cost efficiency is positively associated with increases in future NPLs. One explanation of the negative relation between cost efficiency and problem loans relies on the fact that bad managers do not control and monitor their operating expenses in a sufficient way, which leads to low measured cost efficiency almost immediately. Also, bad managers have poor skills in monitoring borrowers, assessment of pledged collateral and credit scoring (choosing loans with low or negative net present value). These poor practices in terms of borrowers monitoring will be reflected in an increase of the problem loans, but only after some time passes. The present study formulates and tests the following hypothesis regarding the causality between cost efficiency and problem loans:

H.1:''Bad management I'' hypothesis: there is a negative relation between cost efficiency and future problem loans.

However, the opposite sign (positive) of the relation between cost efficiency and problem loans may also be expected as discussed by Berger and DeYoung (1997) and Louzid et al. (2012). From this point of view, banks face a trade-off between increasing short-term operating costs (to allocate resources for monitoring borrowers) and decreasing short-term operating costs to be cost efficient. By skimping on the resources, even on those that should be devoted to preserve the loan quality, bank appears as cost efficient in the short run. But as time passes, the problem loans increase. Thus, we also test the following hypothesis:

H.2: ''Skimping'' hypothesis: there is a positive relation between cost efficiency and future problem loans.

Berger and DeYoung (1997) find that, for banks with low capital ratios, decreases in bank capitalization precede increases in problem loans measured through NPLs. Their result supports the evidence that undercapitalized banks may respond to moral hazard incentives by taking increased portfolio risks. However, Louzis et al. (2012) find no support to the moral hazard hypothesis within the Greek banking sector since the solvency ratio taken as proxy for the banks' risk attitude does not have explanatory power for NPLs. According to this hypothesis, banks with relatively low capital increase their loan portfolio leading to a burgeoning number of problem loans which reflects the classical problem of excessive risk-taking when another party is involved in the risk and cannot easily charge for or prevent such risk-taking. The following hypothesis will be tested:

H.3: ''Moral hazard'' hypothesis: low-capitalization of banks leads to an increase in problem loans.

The banks' choice in term of activity diversification may be related to the evolution of problem loans. Salas and Saurina (2002) using bank size as a proxy for diversification find a negative relation between bank size and problem loans and argue that bigger size allows for more diversification opportunities for Spanish banks. However, Stiroh (2004a) using the ratio of non-interest income (NII) over total income as a proxy for the diversification, does not find evidence for such negative relation between diversification and problem loans for the US banking system, the explanation is that non-interest income growth was highly correlated with net interest income during the 1990s. Louzis et al. (2012) using the two proxies for the Greek banks' diversification, find that when the size is taken into account, neither the size's coefficient has the expected sign, nor it is statistically significant. But when the ratio of NII over total income is used as a proxy for the diversification, they find that the sign of the NII coefficient is negative, as expected, however the coefficient is not statistically significant. We use in our study the ratio of non-interest income (NII) over total income as a proxy for diversification since it reflects banks' reliance on other types of income, except for credit making, and therefore on diversified sources of income. We expect that diversification lowers problem loans. Thus, the following hypothesis will be tested:

H. 4: ''Diversification'' hypothesis: the ratio of non-interest income over total income is negatively related to problem loans.

The ''Too big to fail'' (TBTF) hypothesis has been used as one of the channels relating bank specific factors to problem loans evolution. Stern and Feldman (2004) argue that TBTF banks may have incentives to take excessive risk since the lack of market discipline from the side of the banks' creditors who expect government protection in case of failure. For instance, no clear evidence for a differential risk attitude of TBTF banks has been provided by empirical studies (Louzis et al., 2012). However, the opposite sign (negative) may also be expected since large banks may have more resources to manage the credit risk in an efficient way and therefore improve the quality of their portfolios of loans. According to this hypothesis, we expect that large banks may increase their leverage too much and grant credits to lower quality borrowers at the expenses of increases in problem loans. Therefore, we test the following hypothesis:

H. 5: ''Too Big To Fail'' hypothesis: the banks' size is positively related to problem loans.

The sign of the relation between banks' performance and problem loans is ambiguous. One direction is that bad performance may proxy for lower quality of skills regarding the lending activity (same reasoning as the *"bad management I"* hypothesis, taking past cost efficiency ratio as a proxy for the quality of management) which argues a negative relation between past earnings and problem loans. Louzis et al. (2012) find a negative relation between performance (measured using ROE) and problem loans (measured by NPLs) for the Greek banking system. Thus, we test the following hypothesis:

H. 6: ''Bad management II'' hypothesis: past earnings are negatively associated with increases in problem loans.

The opposite sign (positive) of the relation between past earning and problem loans may also be expected as it is shown by Rajan (1994). Managers may attempt to manipulate current earnings by choosing a policy of negative NPV and extending credits to lower-quality of debtors in order to convince the market for bank's profitability by inflating current earnings at the expenses of future problem loans. We test the following hypothesis:

H. 7: ''Procyclical credit policy'' hypothesis: past earnings are positively related with problem loans.

Tabe 1 : Definition of bank-specific variables and hypotheses

Variables	Definition	Hypotheses tested	Expected signs
Cost Inefficiency	$INEF_{it} = \frac{Operating\ Expenses_{it}}{Operating\ Incomes_{it}}$	''Bad Management'' Hypothesis	(+)
		''Skimping'' Hypothesis	(-)
Capitalization	$CAR_{it} = \frac{Owned\ Capital_{it}}{Risk-Weighted\ Assets_{it}}$	''Moral hazard'' Hypothesis	(-)
Diversification	$DIV_{it} = \frac{Non-Interest\ income_{it}}{Total\ Income_{it}}$	''Diversification'' Hypothesis	(-)
Size	$SIZE_{it} = Ln(Total\ Assets_{it})$	''Too Big To Fail'' Hypothesis	(+)
Profitability	$ROE_{it} = \frac{Net\ profit_{it}}{Total\ Equity_{it}}$	''Bad management II'' Hypothesis	(-)
		''Procyclical credit policy'' Hypothesis	(+)

3. Data and econometric methodology

3.1. Data and variables definition

To explain the loan quality determinants in the Tunisian banking sector, we use in this study three datasets containing bank-specific data, information about firms comprising banks' loan portfolios as well as macroeconomic variables. The dataset containing bank-specific information is drawn from the Financial Market Council (FMC) database as all banks considered in our study are listed in the stock market. Our sample of banks is composed by the ten largest banks of the Tunisian banking sector. At the end of 2010, the ten largest banks accounted for 90.2% of the total assets of the Tunisian banking sector. During our period of analysis (from 2001 to 2010), the average of this share is 84.5%. To examine the impact of bank-specific information on the evolution of the loan quality, we collected data on banks' profitability, cost efficiency, capitalization, activity diversification, credit growth and size.

We use also a set of contemporaneous and lagged macroeconomic variables in our analysis framework. We take into account GDP growth, unemployment rate, inflation rate and lending rates applied on loans to firms. The information on macroeconomic conditions is drawn from the National Institute of Statistic (NIS).

The dataset on loan quality and firms characteristics, used in this study, is drawn from two databases held by the Central Bank of Tunisia (CBT), namely, the Risk Base and the Central Balance Sheet. The Risk Base contains information reported by credit institutions (reporting is mandatory). This reporting aims to share information between credit institutions to facilitate their credit risk assessment and management. This database contains quarterly information on loans[2] granted to firms including their classification (status: current or classified assets). The loans classification methodology is the same for all banks since it relies on the criteria set by the CBT.

The loans classification is used in this study to build indicators for loan quality which vary according to the status of the severity of the problem loans taking more than two values. We build also indicator for loan default status which takes two values (1 if there is a default and 0 if not).

According to the regulation set by the CBT, banks classify their assets into two groups: current assets and classified assets. Are considered as current assets, the loans for which the integral repayment seems to be ensured. These loans are granted to firms characterized, mainly, by: a) balanced

2. Reporting credit institutions aggregate information on loans with similar status for each firm (information is not reported on a loan by loan basis). There is no information on loan maturity, collateral or interest rates.

financial situation, b) management and activity perspectives judged satisfactory and c) adequate form and volume of loans with regard to the needs of principal activity and the real capacity of repayment of firms.

The second group is the classified assets. Their classification is made with regard to the severity of the problem loan and therefore the risk of loss for banks. There are five classes. Class 1 contains loans for which the repayment seems to be ensured but firms are facing deteriorating financial situation and/or operating in stressed activities. Are classified in class 2, the loans granted to firms facing, mainly, financial difficulties and for which the repayment is becoming uncertain and presenting a reimbursement delay (in principal and/or interest) between 90 and 180 days. Class 3 contains loans granted to firms presenting, mainly, a severe financial distress and for which there is a reimbursement delay (in principal and/or interest) between 180 and 360 days. Are classified in class 4, loans presenting a reimbursement delay (in principal and/or interest) of more than 360 days. Finally, class 5 contains loans presenting a reimbursement delay (in principal and/or interest) of more than 360 days and for which there are a legal proceedings initiated by banks.

For each firm, we have information about to which class its loan belongs. Classes are ranging from class 0 (safe loan) to class 5 (extreme severity of problem loan). This classification will allow us to examine what factors determine the belonging of the loan quality to the different statuses that may exist instead of simply examine the determinants of the credit default. Though, the classical analysis of the determinants of credit default is also possible. In our case, defaulted loans are those classified in classes ranging from 2 to 5. However the non-defaulted loans are those classified in classes 0 and 1. The credit default is measured as credit and interest which have become overdue for more than three months (Bonfim, 2009 and Louzis et al., 2012).

We have also information about the couple debtor-creditor since we know which bank has granted the loan to each firm present in our sample. We have selected firms which have, mainly, one bank as a counterpart[3]. This is to examine the impact of the banks' policies in terms of improving cost efficiency, capitalization, activity diversification, performance and size on the quality of loans comprising their portfolios. This goal cannot be reached if we select firms with many banks as counterparts since we have not information on a loan-by-loan basis.

The Central Balance Sheet contains detailed annual accounting information for a large sample of Tunisian firms. Using the two databases, and considering end-of-year data, as quarterly data is available for a smaller set of companies, for the period between 2001 and 2010, we have a dataset which contains 40 171 observations[4].

The distribution of the observations amongst the six categories of loan classes (as taken from the regulation on banks' assets classification) is as follow:

Table 2: Distribution of loans classes (based on regulation)

class	Freq.	Percent	Cum.
0	24 519	61.04	61.04
1	4 211	10.48	71.52
2	2 636	6.56	78.08
3	2 292	5.71	83.79
4	3 668	9.13	92.92
5	2 845	7.08	100
Total	40 171	100	

3. Note that only big firms are able to negotiate credit conditions with banks and therefore may have more than one bank as creditor. Our sample is composed by SMEs having one bank as counterpart. Note that SMEs represent 80% of total assets held by all firms operating in the Tunisian economy (Source: AFDB's report on the Tunisian Economy, 2012).

4. One observation is defined as a pair firm-year, summing up all credit liabilities for given firm in each year.

While data is available for 2011 and 2012, we have selected information until 2010 for two reasons. The first reason is that loans classification methodology was changed in 2011 by the Central Bank of Tunisia which took in early 2011 temporary measures in order to support firms economically affected by the events that accompanied the revolution of January 2011, asking banks to reschedule loans of the affected companies. Banks were also called to do not classify loans rescheduled in classes 2, 3 or 4 and to do not revise the classification of firms attributed at the end of December 2010. The second reason is that the number of observations in 2012 is very low compared to other years. We constructed several ratios and variables to evaluate each firms' financial situation, namely, their profitability, leverage, external funding cost, liquidity, sales and investment growth. Information is also available regarding the firms' size and age. In variables with significant outliers, we replaced observations which are above the 99th percentile with the value of that percentile (the same procedure was applied to those below the 1st percentile).

One of the main objectives of our study is to examine if loan quality may be explained by firm-specific variables and also to understand what factors determine the belonging of the loans quality to the different statuses at the firm-level. This can be partly reached by analyzing separately summary statistics for firms with a given loan status at *t*, comparing them with loan statuses of the remaining firms.

3.2. Stylized empirical facts and summary statistics

Firstly, we examine what explains the credit default by dividing our sample into two groups, namely, defaulted firms (classes 2-5) and non-defaulted firms (classes 0-1). The credit default is measured as credit and interest which have become overdue for more than three months (Bonfim, 2009 and Louzis et al., 2012). Secondly, we try to explain the determinants of the different loan statuses at the firm-level.

A brief analysis of the summary statistics presented in Table 3 for firms with and without credit default in year t, confirms that these two groups of firms are different. On average, firms with credit default are less profitable, more dependent on external funding sources, have higher external funding cost, have lower liquidity ratios, show weaker sales and investment growth and are slightly younger, which is what should be expected as argued by Bonfim (2009). However, the results suggest that firms with loan defaults are, on average, slightly larger than firms without loan defaults which is not what should be expected as argued in the literature by Jimenez and Saurina (2004), Bunn and Redwood (2003), Bhattacharjee et al. (2002) and Eklund et al. (2001). The literature argues that larger firms are less likely to default due to the systemic effect of firm size on bankruptcy. However, Bernhardsen (2001) finds that this effect is relatively small.

Tabe 3 : Welch test for defaulted and non-defaulted firms and summary statistics

	Mean values for non-defaulted firms at *t*	Mean values for defaulted firms at *t*	Welch test : Ho: Diff = 0	
			Diff = mean (group1.) - mean (group2.)	Ha: Diff not 0 Pr(ITI > ItI)
ROA	6.77	4.75	2.02	0.0000
Leverage	63.83	72.14	-8.32	0.0000
Liquidity ratio	104.26	89.37	14.89	0.0000
Investment growth	21.28	13.38	7.89	0.0000
Sales growth	18.50	9.50	9.00	0.0000
External Funding cost	24.66	30.95	-6.29	0.0000
Firm age	25.71	23.72	1.98	0.0000
Firm size	20.81	20.98	-.17	0.0000
Number of bservations	28 730	11 441		

Notes. ROA, leverage, liquidity ratio, investment growth, sales growth and external funding cost are displayed in percentages. ROA is defined as Net income over total assets. Leverage is defined as total liabilities over total assets. Liquidity ratio is defined as bank deposits, cash, debt receivables and short-term investments divided by current liabilities. Investment growth is the year-on-year growth of net fixed assets. Sales growth is defined as the year-on-year growth rate of sales. External funding cost is defined as financial expenses over debts and can serve as a proxy for interest rate. Firm size is defined as logarithm of total assets.

We also present in Table 3 the results of a mean comparison Welch test to better examine if the variables selected are in fact different for the two subsamples of firms. For all variables taken into account, the mean values for firms with loan default are statistically different from the mean values observed for firms without loan default. This result allows us to use firm-specific characteristics as variables of control, with bank-specific variables, to explain why some firms default and to test our hypotheses, under a regression analysis framework using probit model.

Since our main objective is to understand what explains the loan quality, we divide our sample into six subsamples, using the loan classification made by banks and based on the regulation on assets classification in order to analyze summary statistics for firms with loan status at *t*, comparing them with the remaining firms.

The summary statistics shown in Graph 1 suggest that firms classified in class 0 (having a good loan) are, on average, different from firms that belong to all other classes presenting more severe problem loan (classes from 1 to 5). Firms in class 0 are, on average, more profitable, have higher liquidity ratios, show higher sales and investment growth, less dependent on external funding sources and have lower external funding cost which is what should be expected.

Graph 1 shows also that firms classified in class 0 are, on average, slightly older than other firms except for firms classified in class 1. For the firm's size, graph 1 shows that firms in class 0 are smaller than other firms which is not what should be expected as we assume a positive relation between firm's size and loan's quality.

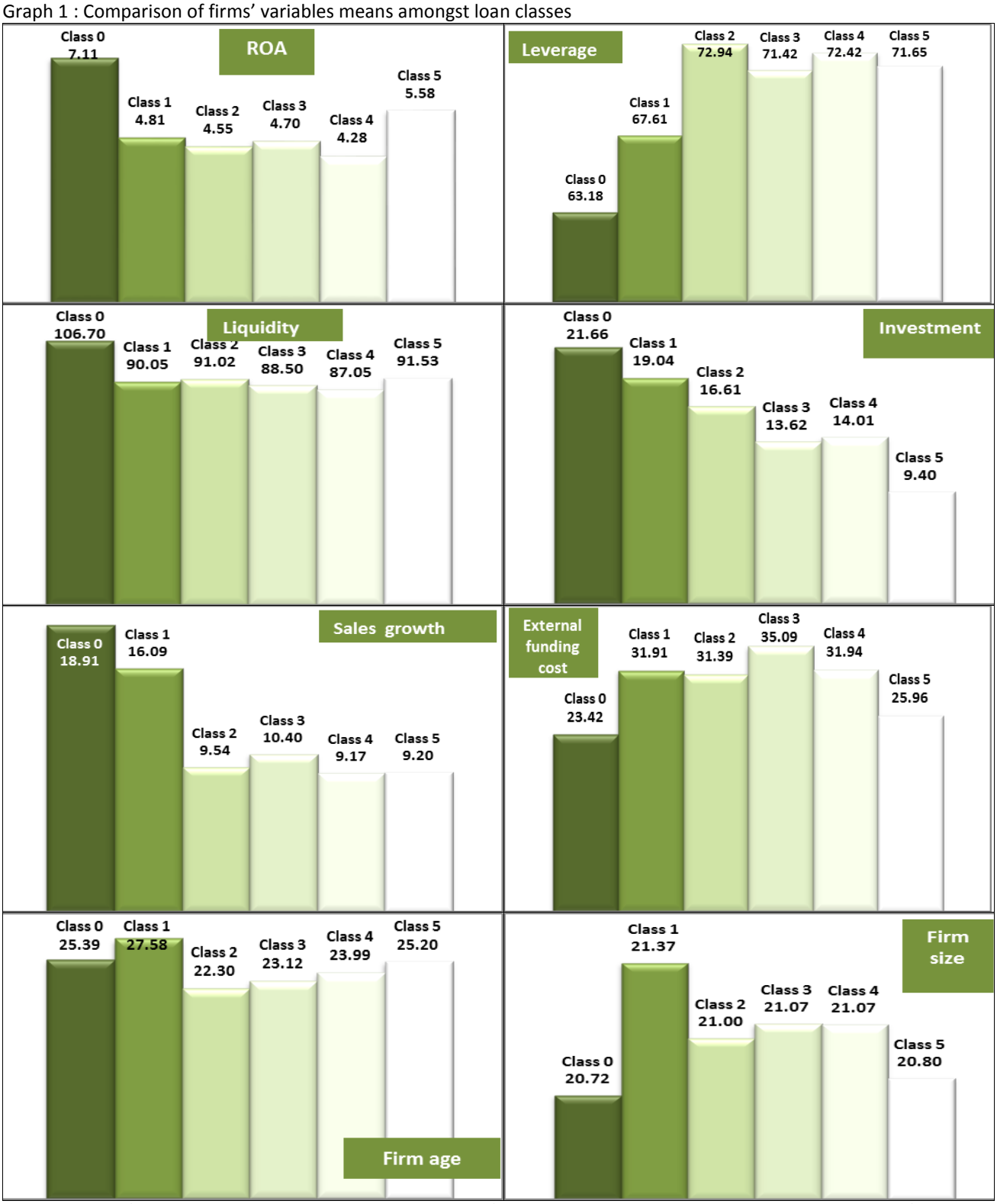
We also present in Table 4 the results of a mean comparison Welch test. For all variables considered, the mean values for firms in class 0 are statistically different from the mean values observed for firms in all other classes. One unique exception is for the firm age of class 5. The signs of the mean values differences are as expected except for the firm age (for class 1) and size (for all classes). Firms in class 0 are younger than firms in class 1 but older than firms in classes 2-5. In fact, it has been argued by the literature that younger firms should be more sensitive to external shocks and should be expected to show higher bankruptcy probabilities than older firms. On the other hand, firms in class 0 are slightly smaller than firms in the remaining classes, in contrast to what is often seen in the literature.

The results reported in Table 4 also suggest that firms in class 1 are, on average, different from firms presenting more severe problem loan (classes from 2 to 5). Welch test shows that the mean values for firms in class 1 are statistically different from the mean values observed for firms in the other classes 2-5 in terms of leverage, sales growth, age and size. However, Welch test argues that classes 2, 3 and 4 are not statistically different in the mean values for the variables considered. In fact, firms classified in these three classes seem to be similar in term of profitability, leverage, liquidity, sales growth, investment rate and external funding cost. Thus, these three classes will be considered as one category under a regression analysis framework using ordered probit method.

For firms in class 5 which have the most severe problem loan, the results are not as expected when compared to firms in classes 2-4 presenting less severe problem loan. In fact, firms in class 5 are, on average, more profitable than firms in classes 2-4, have higher liquidity ratios and have lower cost of external funding. One explanation of this result may rely on the fact that, since banks have initiated legal proceedings against firms classified in class 5, it may be that these firms are bought by new investors and that a recovery plans are initiated leading to an improvement of firms' financial situation. For the other variables the results are as expected. Firms presenting the most severe problem loan (class 5) have lower ratios of sales and investment growth than firms in classes 2-4.

The Welch test presented in Table 4, allows us to conclude that there are four distinct statuses of problem loan for which there are statistically significant differences in the mean values for the variables taken into account in our study instead of six classes according to the classification made by banks in Tunisia as shown in Table 2. Thus we can classify our 40 171 observations into the four categories of loan quality. The classification shown in Table 5 will be considered under a regression analysis framework using ordered probit model.

Graph 1 : Comparison of firms' variables means amongst loan classes



Notes. ROA is defined as Net income over total assets. Leverage is defined as total liabilities over total assets. Liquidity ratio is defined as bank deposits, cash, debt receivables and short-term investments divided by current liabilities. Investment growth is the year-on-year growth of net fixed assets. Sales growth is defined as the year-on-year growth rate of sales. External funding cost is defined as financial expenses over debts and can serve as a proxy for interest rate. Firm size is defined as logarithm of total assets.

Tabe 4 : Welch test for firms in class *j* at *t* compared to firms in the other classes at *t*

	Class 0	Welch test : Ho: Diff = 0 Class 0 versus Class 1		Welch test : Ho: Diff = 0 Class 0 versus Class 2		Welch test : Ho: Diff = 0 Class 0 versus Class 3		Welch test : Ho: Diff = 0 Class 0 versus Class 4		Welch test : Ho: Diff = 0 Class 0 versus Class 5	
	Mean values for firms in class 0 at *t*	Mean values for firms in class 1 at *t*	Difference	Mean values for firms in class 2 at *t*	Difference	Mean values for firms in class 3 at *t*	Difference	Mean values for firms in class 4 at *t*	Difference	Mean values for firms in class 5 at *t*	Difference
ROA	**7.11**	**4.81**	2.30***	**4.55**	2.56***	**4.70**	2.41***	**4.28**	2.82***	**5.58**	1.52***
Leverage	**63.18**	**67.61**	-4.43***	**72.94**	-9.77***	**71.42**	-8.42***	**72.42**	-9.24***	**71.65**	-8.47***
Liquidity ratio	**106.70**	**90.05**	16.65***	**91.02**	15.68***	**88.50**	18.20***	**87.05**	19.65***	**91.53**	15.17***
Investment growth	**21.66**	**19.04**	2.62*	**16.61**	5.05***	**13.62**	8.05***	**14.01**	7.65***	**9.40**	12.26***
Sales growth	**18.91**	**16.09**	2.83***	**9.54**	9.37***	**10.40**	8.50***	**9.17**	9.74***	**9.20**	9.72***
External funding cost	**23.42**	**31.91**	-8.49***	**31.39**	-7.97***	**35.09**	-11.67***	**31.94**	-8.52***	**25.96**	-2.54*
Firm age	**25.39**	**27.58**	-2.19***	**22.30**	3.09***	**23.12**	2.27***	**23.99**	1.40***	**25.20**	0.19
Firm size	**20.72**	**21.37**	-0.65***	**21.00**	-0.28***	**21.07**	-0.35***	**21.07**	-0.35***	**20.80**	-0.09*
Number of Observations	**24 519**	**4 211**		**2 636**		**2 292**		**3 668**		**2 845**	

	Class 1	Welch test : Ho: Diff = 0 Class 1 versus Class 2		Welch test : Ho: Diff = 0 Class 1 versus Class 3		Welch test : Ho: Diff = 0 Class 1 versus Class 4		Welch test : Ho: Diff = 0 Class 1 versus Class 5	
	Mean values for firms in class 1 at *t*	Mean values for firms in class 2 at *t*	Difference	Mean values for firms in class 3 at *t*	Difference	Mean values for firms in class 4 at *t*	Difference	Mean values for firms in class 5 at *t*	Difference
ROA	**4.81**	**4.55**	0.26	**4.70**	0.11	**4.28**	0.52*	**5.58**	-0.77**
Leverage	**67.61**	**72.94**	-5.33***	**71.42**	-3.81***	**72.42**	-4.81***	**71.65**	-4.04***
Liquidity ratio	**90.05**	**91.02**	-0.97	**88.50**	1.55	**87.05**	3.00*	**91.53**	-1.48
Investment growth	**19.04**	**16.61**	2.43	**13.62**	5.43***	**14.01**	5.03***	**9.40**	9.64***
Sales growth	**16.09**	**9.54**	6.54***	**10.40**	5.68***	**9.17**	6.91***	**9.20**	6.89***
External funding cost	**31.91**	**31.39**	0.52	**35.09**	-3.18*	**31.94**	-0.03	**25.96**	5.95***
Firm age	**27.58**	**22.30**	5.29***	**23.12**	4.46***	**23.99**	3.6***	**25.20**	2.38***
Firm size	**21.37**	**21.00**	0.37***	**21.07**	0.30***	**21.07**	0.30***	**20.80**	0.57***
Number of Observations	**4 211**	**2 636**		**2 292**		**3 668**		**2 845**	

	Class 2	Welch test : Ho: Diff = 0 Class 2 versus Class 3		Welch test : Ho: Diff = 0 Class 2 versus Class 4		Welch test : Ho: Diff = 0 Class 2 versus Class 5	
	Mean values for firms in class 2 at *t*	Mean values for firms in class 3 at *t*	Difference	Mean values for firms in class 4 at *t*	Difference	Mean values for firms in class 5 at *t*	Difference
ROA	**4.55**	**4.70**	-0.15	**4.28**	0.26	**5.58**	-1.03***
Leverage	**72.94**	**71.42**	1.52	**72.42**	0.53	**71.65**	1.29
Liquidity ratio	**91.02**	**88.50**	2.51	**87.05**	3.97**	**91.53**	-0.51
Investment growth	**16.61**	**13.62**	2.99	**14.01**	2.60	**9.40**	7.21***
Sales growth	**9.54**	**10.40**	-0.87	**9.17**	0.37	**9.20**	0.34
External funding cost	**31.39**	**35.09**	-3.70*	**31.94**	-0.55	**25.96**	5.43***
Firm age	**22.30**	**23.12**	0.82	**23.99**	-1.69***	**25.20**	-2.91***
Firm size	**21.00**	**21.07**	-0.07	**21.07**	-0.07	**20.80**	0.20***
Number of Observations	**2 636**	**2 292**		**3 668**		**2 845**	

	Class 3	Welch test : Ho: Diff = 0 Class 3 versus Class 4		Welch test : Ho: Diff = 0 Class 3 versus Class 5	
	Mean values for firms in class 3 at *t*	Mean values for firms in class 4 at *t*	Difference	Mean values for firms in class 5 at *t*	Difference
ROA	**4.70**	**4.28**	0.41	**5.58**	-0.88**
Leverage	**71.42**	**72.42**	-0.99	**71.65**	-0.23
Liquidity ratio	**88.50**	**87.05**	1.45	**91.53**	-3.02**
Investment growth	**13.62**	**14.01**	-0.39	**9.40**	4.21**
Sales growth	**10.40**	**9.17**	1.23	**9.20**	1.21
External funding cost	**35.09**	**31.94**	3.15	**25.96**	9.13***
Firm age	**23.12**	**23.99**	-0.87*	**25.20**	-2.08***
Firm size	**21.07**	**21.07**	0.00	**20.80**	0.27***
Number of Observations	**2 292**	**3 668**		**2 845**	

	Class 4	Welch test : Ho: Diff = 0 Class 4 versus Class 5	
	Mean values for firms in class 4 at *t*	Mean values for firms in class 5 at *t*	Difference
ROA	**4.28**	**5.58**	-1.30***
Leverage	**72.42**	**71.65**	0.77
Liquidity ratio	**87.05**	**91.53**	-4.47**
Investment growth	**14.01**	**9.40**	4.61***
Sales growth	**9.17**	**9.20**	-0.03
External funding cost	**31.94**	**25.96**	5.98***
Firm age	**23.99**	**25.20**	-1.21***
Firm size	**21.07**	**20.80**	0.26***
Number of Observations	**3 668**	**2 845**	

***.** and * denote significant at 1%, 5% and 10% respectively.

Table 5: Distribution of loan quality indicator

Initial loans classification (based on regulation)			New loans classification (based on Welch test)			
Loan class	Freq.	Percent	Loan status/quality	Freq.	Percent	Cum.
0	24 519	61.04	**1 : good loan**	24 519	61.04	61.04
1	4 211	10.48	**2 : fair loan**	4 211	10.48	71.52
2	2 636	6.56				
3	2 292	5.71	**3 : bad loan**	8 596	21.40	92.92
4	3 668	9.13				
5	2 845	7.08	**4 : very bad loan**	2 845	7.08	100.00
Total	40 171	100.00	Total	40 171	100.00	

3.3. Modelling loan quality

3.3.1. Probit regression

Probit model is a binary outcome model among the most used in applied economics (consumption decision: whether a consumer makes a purchase or not; labor: whether an individual participates in the labor market or not; agriculture: whether a farmer uses organic practices or not; etc). In the probit model, the dependent variable is a binary response which takes the value 1 if an event happens and 0 otherwise. In this study, the event to be examined is the credit default.

In our study the dependent variable *y* (loan default status) takes two values, such that:

$$y_{it} = \begin{cases} 1 \ \textit{if there is a loan default} \quad (\textit{loan classes from } 2 \textit{ to } 5) \\ 0 \ \textit{if not } (\textit{loan classes } 0\text{–}1) \end{cases}$$

Binary outcome models such as probit and logit models estimate the probability that *y=1* as a function of the independent variables:

$$\mathrm{p} = pr\left[y = 1 / X\right] = \mathrm{F}(\mathrm{X}'\beta)$$

The values of the predicted probabilities have to be limited between 0 and 1. Thus, restrictions have to be applied to $X'\beta$ to satisfy this condition. The model to be estimated in this study will depend on the assumption made on the error distribution *F(.)*, assuming a standard normal distribution function $\phi(.)$ yields a probit model. For the probit model, $F(X'\beta)$ is the cumulative distribution function (CDF) of the standard normal distribution, such that :

$$\mathrm{F}(\mathrm{X}'\beta) = \phi(\mathrm{X}'\beta) = \int_{-\infty}^{+\infty} \phi(\mathrm{Z})\,\mathrm{dZ}$$

The marginal effects reported when estimating probit model, reflect the change in the probability of having a credit default (*y=1*) given 1 unit change in an independent variable X. For the probit model, the marginal effects are calculated as:

$$\partial \mathrm{p} / \partial \mathrm{X}_{\mathrm{j}} = \mathrm{F}'(\mathrm{X}'\beta)\,\beta_j = \phi(\mathrm{X}'\beta)\,\beta_j$$

Within probit model, coefficients and marginal effects have the same signs because $F'(X'\beta)$ is positive. The marginal effects depend on X, so we estimate the marginal effects at a specific value of X (typically the means, also using the average marginal effects).

Marginal effects can be estimated using either the method of the marginal effects at the mean or the method of the average marginal effects. Using the first method, the marginal effects are estimated for the average person in the sample $\overline{X}$, such that:

$$\partial \mathrm{p} / \partial \mathrm{X}_{\mathrm{j}} = \mathrm{F}'(\overline{\mathrm{X}}'\beta)\,\beta_j = \phi(\overline{\mathrm{X}}'\beta)\,\beta_j$$

A problem with this method is that there may not be such a person in the sample (one example is the case of a binary independent variable that takes 1 or 0). Using the second method, the marginal effects are estimated as the average of the individual marginal effects, such that:

$$\partial \mathrm{p}/\partial \mathrm{X}_{\mathrm{j}} = \frac{\sum \mathrm{F}'(\mathrm{X}'\beta)\,\beta_{\mathrm{j}}}{n}$$

The two methods of estimating the marginal effects produce almost identical results.

After estimating the model, we can predict the probability that *y=1* for each observation, such that:

$$\hat{\mathrm{p}} = pr[y = 1/X] = \mathrm{F}(\mathrm{X}'\hat{\beta})$$

If the predicted probability is greater than 0.5 we can predict that *y=1*, otherwise *y=0*. The percent correctly predicted values are the proportion of the true predictions to total predictions.

3.3.2. Ordered probit regression

In a second stage, we use another modeling technique, namely ordered pobit, where we define different levels of problem loans severity by constructing loan quality statuses taking an ordered outcomes raging from 1 to 4 instead of considering a binary dependent variable taking the values of 1 (in the case of default) or 0 (in the case of non-default). Under the ordered probit model, the dependent variable is taking four values (based on the Welch test) instead of six values (based on the regulation), as shown in Table 5.

$$y_{it} = \begin{cases} 1 \ \textit{if loan of firm i in year t is a good loan} \ (\textit{loan class } 0) \\ 2 \ \textit{if loan of firm i in year t is a fair loan} \ (\textit{loan class } 1) \\ 3 \ \textit{if loan of firm i in year t is a bad loan} \ (\textit{loan classes from } 2 \textit{ to } 4) \\ 4 \ \textit{if loan of firm i in year t is a very bad loan} \ (\textit{loan class } 5) \end{cases}$$

The ordered outcomes are modeled using ordered logit and ordered probit models. These models are often used, for example, to model health status that is assessed as poor (*y = 1*), good (*y = 2*), or excellent (*y = 3*). Using this econometric approach, we try to model the quality of the loan of firm *i*, we specify:

$$y_i^* = \mathrm{X}_{\mathrm{i}}'\beta + \varepsilon_i$$

For very low y^*, loan status is good; for $y^* > \alpha_1$, loan status worsens; for $y^* > \alpha_2$, it worsens further; and so on. For an m-alternative ordered model, we define:

$y_i = j \quad if \quad \alpha_{j-1} < y^*_i \leq \alpha_j. \quad j=1.\ldots..m$

where $\alpha_0 = -\infty$ and $\alpha_m = \infty$, then :

$$\begin{aligned} \Pr(y_i=j) &= \Pr(\alpha_{j-1} < y^*_i \leq \alpha_j) \\ &= \Pr(\alpha_{j-1} < \mathrm{X}_{\mathrm{i}}'\beta + \varepsilon_i \leq \alpha_j) \\ &= \Pr(\alpha_{j-1} - \mathrm{X}_{\mathrm{i}}'\beta < \varepsilon_i \leq \alpha_j - \mathrm{X}_{\mathrm{i}}'\beta) \\ &= F(\alpha_j - \mathrm{X}_{\mathrm{i}}'\beta) - \mathrm{F}(\alpha_{j-1} - \mathrm{X}_{\mathrm{i}}'\beta) \end{aligned}$$

Where *F* is the cumulative distribution function (c.d.f) of ε_i. The regression parameters β, and the *m-1* threshold parameters, $\alpha_{1\ldots}\ \alpha_{m-1}$, are obtained by maximizing the log likelihood with $p_{ij} = \Pr(y_i = j)$.

For the ordered probit model, ε is standard normally distributed with $F(.) = \Phi(.)$, with:

$$\Phi(X'\beta) = \int_{-\infty}^{X'\beta} \phi(\mathrm{z})\,\mathrm{dz}$$

The sign of regression parameters, β, can be immediately interpreted as determining whether the latent variable, y^*, increases with the regressor. A positive sign of β_j indicates that an increase in X_{ij}

necessarily increases the probability of being in the highest category ($y_i = m$) and decreases the probability of being in the lowest category ($y_i = 1$).

Using ordered probit model we try to examine what explains the loan quality in the Tunisian banking sector taking into account firm-specific information, bank-specific variables as well as macroeconomic conditions. In our study, loan quality indicator takes four possible outcomes ranging from 1 (good loan) to 4 (very bad loan).

4. Results

4.1. Results obtained using probit models

In Table 6 we present the results obtained using probit models. We start in the first two models by using a set of contemporaneous and lagged bank-specific explanatory variables to examine the impact of banks' policies in terms of cost efficiency, capitalization, activity diversification, size and performance, on problem loans.

The coefficient of bank's cost inefficiency ratio, in model 1, is positive and significant which implies that increases in bank's measured cost inefficiency at *t* (in other words decreases in bank's measured cost efficiency at *t*) lead to future higher default probabilities in bank's loan portfolios (at *t+1*) which is consistent with the results found by Berger and DeYoung (1997) and Podpiera and Weill (2008). This result supports the ''Bad management I'' and does not support the "skimping" hypothesis. In model 2, when we used two lags, the coefficient of bank's cost inefficiency is negative but not significant.

The coefficient of bank's capitalization ratio (in model 1 and 2) is negative and significant as should be expected. This result supports the "moral hazard" hypothesis which suggests that low capitalized banks have incentives to take excessive risks**.**

Moreover, bank's activity diversification ratio, measured using non-interest income (NNI) over total income, has a negative coefficient, in model 1, and this is what should be expected according to the "diversification" hypothesis. In model 2 when we used two lags (for the other explanatory variables), the sign of the diversification coefficient becomes positive. However, in models 1 and 2, the diversification's coefficients are not significant which means that activity diversification does not contribute to explain loan default probability for the Tunisian banks.

Bank's size has a negative and significant coefficient (in model 1 and 2) which is not what should be expected according to the "TBTF" hypothesis. The coefficient of credit growth is also negative and significant which supports the result found using bank's size as both variables may be used when testing the "TBTF" hypothesis.

Profitability ratio has a positive coefficient which means that banks with higher profitability at *t* are more likely to have higher problem loans at *t+1* and *t+2* (in model 1 and 2, respectively). These results support the "procyclical credit policy" hypothesis but do not support the "Bad Management II" hypothesis.

In model 3, we try to simultaneously examine the role played by macroeconomic developments, together with bank-specific variables, by adding a set of contemporaneous and lagged macroeconomic variables to our panel data regression. We took into account GDP growth, unemployment rate, inflation rate and lending rates applied on loans to firms. As unemployment rate is negatively correlated with GDP, we use it in model 4. The results show that lagged GDP growth has a negative impact on loan default probability and this is what should be expected as an expansionary phase of the economy presents relatively low loan defaults rates since firms face a sufficient amount of income to service their debts. Moreover, interest rate on bank loans has, as expected, a positive contemporaneous impact on default probabilities which implies that higher cost of debts is associated with higher probabilities of firms' default. This result supports our findings in the summary statistics showing a positive relation between external funding cost (as a proxy for interest rate) and default probability. The coefficient of inflation is negative and significant. One explanation of this result is that an increase in inflation rate may lead to a decrease in the weight of the nominal debt within the firms' balance sheet.

Table 6 : Probit regressions (dependent variable: dummy loan default)

		Model 1		Model 2		Model 3		Model 4	
Cost Inefficiency	(t-1)	0.016***	(3.9)			0.011**	(2.8)	0.017**	(3.1)
	(t-2)			-0.002	(-0.34)				
CAR	(t-1)	-0.126***	(-12.2)						
	(t-2)			-0.112***	(-9.01)	-0.135***	(-9.1)	-0.151***	(-9.3)
Diversification		-0.006	(-1.5)	0.002	(0.53)	0.032***	(5.9)	0.037***	(6.8)
Bank size		-0.022***	(-2.9)	-0.053***	(-5.69)	-0.051***	(-5.1)	-0.053***	(-4.9)
Credit growth		-0.025***	(-15.9)	-0.015***	(-8.26	-0.007***	(-3.3)	-0.007***	(-3.4)
ROE	(t-1)	0.019***	(3.9)						
	(t-2)			0.035***	(6.55)	0.020***	(2.8)	0.018**	(2.4)
GDP	(t-1)					-0.142***	(-7.1)		
Unemployment								0.151***	(-5.5)
Inflation						-0.229***	(-6.7)	-0.255***	(-6.7)
Lending rates						1.669***	(18.9)	1.83***	(19.1)
ROA								-0.004	(1.1)
Leverage	(t-2)							0.008***	(5.3)
Liquidity ratio								-0.003***	(-5.4)
Investment growth								-0.001***	(-2.6)
Sales growth								-0.003***	(-6.3)
Ext. funding cost	(t-2)							0.002***	(3.2)
Firm age								-0.014***	(-3.9)
Firm size								0.227***	(9.4)
Agriculture								0.639***	(2.7)
Real estate								0.699***	(3.5)
Commerce								0.956***	(5.7)
Tourism								4.287***	(10)
Constant		-4.49***	(-16.7)	-3.87***	(-11.4)	-14.8***	(-16.5)	-20.81***	(-18.2)
Number of obs.		27 733		20 256		18 864		18 864	
Number of firms		7 576		5 609		5 231		5 231	
Pseudo-R^2		0.07		0.09		0.11		0.11	
AIC		17 186.4		12 030.4		10 510.3		10 189.7	
Obs. per group									
Min		1		1		1		1	
Average		3.7		3.6		3.6		3.6	
Max		9		8		8		8	

Notes: z-scores in parentheses. All models estimated using a random-effects probit estimator, where the dependent variable is the dummy loan default. Firms' variables are defined in Table 3. Macroeconomic variables: GDP, unemployment and inflation are calculated as annual growth. Lending rates is the annual average of lending rates to firms. Banks' variables: ROE is defined as Net income divided by total equity. CAR is the capital adequacy ratio. Cost inefficiency is defined as operating expenses divided by operating incomes. Diversification is defined as non interest income (NII) divided by total income. Bank size is defined as logarithm of total assets. Credit growth is defined as the year-on-year growth rate of credit.

When macroeconomic variables are added in model 3, the results for bank-specific variables remain robust except for firm's diversification coefficient which becomes significant. Bank's activity diversification ratio has a positive and significant coefficient and this is not what should be expected according to the "diversification" hypothesis which supposes a negative relation between activity diversification and loan default probability.

In model 4, we added a set of firm-specific explanatory variables. The results for bank-specific variables and macroeconomic conditions remain robust. For instance, in Table 2 (descriptive statistics), we had argued that firms with loan default were, on average, less profitable than the remaining firms in the sample. However, under the regression analysis framework (model 4 in Table 6), firm profitability does not seem to offer an important contribution in explaining why do some firms default as the coefficient of profitability is not significant. This coefficient is negative and this is what should be expected as argued by Bonfim (2009) as more profitable firms should have a more solid financial situation and, consequently, show lower default probabilities. Firms which are more dependent on external funding sources (with higher leverage ratio) are more likely to default on their loan commitments. We take two lags of leverage as we expect that indebtedness conditions have an impact on firm's financial condition only after a certain period. Also, the external funding cost ratio has a positive impact on default probability, implying that firms funded by costly external funding sources are more likely to default on their credit commitments after two years. Moreover, liquidity ratio has a negative impact on default probability which implies that firms facing stronger liquidity

constraints are more likely to have higher difficulties in paying back their debts commitments, which is consistent with the results found by Bonfim (2009), Benito et al. (2004) and Bunn and Redwood (2003). The investment ratio displays a negative coefficient which means that firms with weaker investment rate are more likely to default. It seems reasonable to admit that stressed firms are not expected to invest in large projects. Sales growth ratio exhibits also a negative coefficient which suggests that firms with higher sales growth rates are less likely to default. The results also show that older firms are less likely to default. The firm size has a positive coefficient which implies that larger firms are more likely to default and this is not what should be expected as argued in the literature by Jimenez and Saurina (2004), Bunn and Redwood (2003), Bhattacharjee et al. (2002) and Eklund et al. (2001), as larger firms are less likely to default due to the systemic effect of firm size on bankruptcy. However, Bernhardsen (2001) finds that this effect is relatively small. We added also in model 4, sector dummies to our specification (omitting the dummy variable for industrial firms). The results show that industrial firms are less likely to default on their loan commitments. The results argue also that firms operating in the tourism sector have the highest probability of default as this sector is the most vulnerable sector.

4.2. Robustness checks using ordered probit models

In order to check the robustness of our results in section 4.1 regarding the impact of banks' policies in terms of cost efficiency, capitalization, activity diversification, size and profitability, on loans default probabilities, we estimate ordered probit models where the dependent variable is the loan status which proxies for the loan quality and takes four values ranging from 1 (good loan) to 4 (very bad loan). We use as explanatory variables bank-specific factors, firms-specific variables as well as macroeconomic information.

Table 7 : Ordered probit regressions (dependent variable: loan status)

		Model 5		Model 6		Model 7		Model 8	
Cost Inefficiency	(t-1)	0.003*	(1.8)						
	(t-2)			0.006***	(3.1)	0.007***	(3.5)	0.009***	(6.3)
CAR	(t-1)	-0.044***	(-14.9)						
	(t-2)			-0.042***	(-12)	-0.035***	(-9.5)	-0.035***	(-9.3)
Diversification		0.005***	(4.4)	0.003**	(2.1)	0.007***	(4.9)	0.007***	(4.7)
Bank size		-0.003*	(-1.7)	-0.007***	(-2.8)	-0.008***	(-3.2)	-0.008***	(-3.2)
Credit growth		-0.014***	(-26)	-0.011***	(-18)	-0.006***	(-9.4)	-0.006***	(-9.1)
ROE	(t-1)	-0.007***	(-4.5)						
	(t-2)			-0.004**	(-2.3)	-0.014***	(-6.7)	-0.011***	(-5.1)
GDP	(t-1)					-0.105***	(-15.6)	-0.104***	(-15)
Unemployment									
Inflation						-0.140***	(-11.7)	-0.147***	(-12)
Lending rates						0.487***	(24.9)	0.552***	(27)
ROA								0.000	(-0.1)
Leverage	(t-2)							0.003***	(9.3)
Liquidity ratio								-0.001***	(-4.3)
Investment growth								-0.001***	(-4)
Sales growth								-0.001***	(-9)
Ext. funding cost	(t-2)							0.001***	(7.6)
Firm age								-0.002***	(-3.1)
Firm size								0.072***	(14)
Agriculture								0.178***	(5.5)
Real estate								0.019	(0.6)
Commerce								0.289***	(12.6)
Tourism								0.721***	(23.9)
Number of obs.		27 733		20 256		18 864		18 864	
Pseudo-R^2		0.02		0.01		0.06		0.09	
AIC		57 879.9		41 806.3		37 884.5		36 468.8	

The results reported in table 7 (models 5 and 6 with one and two lags, respectively) show that the coefficient of bank's cost inefficiency ratio is positive which implies that increases in bank's measured cost inefficiency lead to higher severity of problem loans (poor loan quality) in banks' loan portfolios. This result supports the "Bad Management" hypothesis which has been confirmed using probit methods in section 4.1.

The coefficient of bank's capitalization ratio is negative and significant as should be expected supporting the "moral hazard" hypothesis (using one lag in model 5 and two lags in model 6). This result confirms the result found using probit methods in section 4.1. In models 5 and 6, bank's activity diversification has a positive and significant coefficient and this is not what should be expected according to the "diversification" hypothesis. Bank's size has a negative and significant coefficient and this is not what should be expected according to the "TBTF" hypothesis. Bank profitability ratio has a negative and significant coefficient, in model 5 and 6 (with one and two lags respectively) which means that a decrease in firm's profitability leads to a higher severity of problem loans and this result supports the "bad management II" hypothesis.

We added in model 7, macroeconomic information with the bank-specific variables. The results regarding the impact of bank-specific variables remain robust. For the macroeconomic variables, the results are the same as those found under the probit regression in Table 6. In model 8, we added firm-specific variables to the previous specification. The results regarding the impact of bank-specific factors and macroeconomic information remain robust. For the firm-specific variables, the results found under the ordered probit regression are similar to those found under probit regression reported in Table 6. One exception is for the real estate coefficient which ceases to be significant when using the ordered probit regression.

The Akaike information criteria (AIC) suggests that the model 4 using probit method and taking into account, simultaneously, bank-specific variables, firm-specific characteristics and macroeconomic factors, is the one which provides the more accurate results regarding the explanation of the impact of banks' policies in terms of cost efficiency, capitalization, activity diversification, credit growth and performance, on the loan problems. Table 8 summarizes the results found and their implication on the hypotheses tested in this study.

Tabe 8 : Summary results of tested hypotheses

Variables	Hypotheses tested	Expected signs	Results found		Hypotheses
			Probit	Ordered probit	
Cost Inefficiency	''Bad Management'' Hypothesis	(+)	(+)	(+)	C
	''Skimping'' Hypothesis	(-)	(+)	(+)	NC
Capitalization	''Moral hazard'' Hypothesis	(-)	(-)	(-)	C
Diversification	''Diversification'' Hypothesis	(-)	(+)	(+)	NC
Size	''Too Big To Fail'' Hypothesis	(+)	(-)	(-)	NC
Profitability	''Bad management II'' Hypothesis	(-)	(+)	(-)	NC
	''Procyclical credit policy'' Hypothesis	(+)	(+)	(-)	NC

Note: C. and NC denote hypothesis confirmed and non-confirmed, respectively.

5. Discussion and interpretation

The results obtained with probit and ordered probit methods provide clear evidence that loan quality in the Tunisian banking sector is positively impacted by bank's cost efficiency which support the "Bad Management" hypothesis but do not support the "Skimping" hypothesis. In other words, the negative relation between cost efficiency and problem loans relies on the fact that cost inefficient banks are managed by bad managers who do not control and monitor their operating expenses in a sufficient way, which leads to low measured cost efficiency almost immediately. Also, bad managers have poor skills in monitoring borrowers, credit scoring and assessment of pledged collateral. These poor practices in terms of credit risk management will be reflected in an increase of the problem loans (in other words a decrease in the loan quality), but only after some time passes (after one year).

The results provide also clear evidence that loan quality in the Tunisian banking sector is positively impacted by banks' capitalization which supports the "Moral hazard" hypothesis suggesting that low capitalized banks have incentives to increase their credits by extending loans to lower quality of borrowers at the expenses of increases in future problem loans.

The results found for the relation between bank's activity diversification and problem loans suggest that there is no evidence in the Tunisian banking sector for the "diversification" hypothesis

which supposes a negative relation between NII ratio and loan default probability as banks that rely on other types of income, except for credit making, may be more risk averse regarding credit risk by applying more rigorous credit standards than concentrated banks relying, mainly, on the financial intermediation function. The positive relation between activity diversification and problem loan, found using probit and ordered probit methods, may be explained by the fact that banks that rely on other types of banking activities may have poor skills in terms of credit risk management as they have other core business (investments, financial engineering, etc). These banks may also do not devote enough resources to improve such skills at the expenses of decreases of loan portfolios quality.

Our findings using the two econometric methods, argue that loan quality is positively affected by bank's size which is not what should be expected according to the "TBTF" hypothesis supposing that, given the lack of market discipline from the side of banks' creditors who expect government protection in case of failure, large banks may increase their risk taking by granting credits to borrowers with lower quality which leads to a decrease in their loan portfolios quality. We can explain our result by the fact that large banks may have sufficient resources allowing them to improve their credit risk management unlike small banks which leads to a positive relation between bank's size and loan quality.

The positive relation between Bank's profitability and problem loans, found when we used probit method, supports the "procyclical credit policy" hypothesis which suggests that banks' managers may manipulate current earnings by taking excessive risk at the expenses of the increase in future problem loans. Such managers' behavior may be motivated by incentives to convince the market of bank's profitability in the short run. However, when we used ordered probit, the results suggest a negative relation between bank's performance and problem loans. This result may be explained by the fact that bad performance may proxy for lower quality of management including poor skills in terms of credit risk management which leads to increases in future problem loans and therefore to decreases in the loan portfolios' quality. These results found using probit and ordered probit, do not seem to offer an important contribution in explaining the relation between bank's performance and loan quality.

When macroeconomic factors and firm-specific characteristics are taken into account the results regarding the impact of bank-specific variables on loan quality improve considerably. Both results found using probit and ordered probit regressions argue that loan quality is positively affected by bank's cost efficiency, capitalization and size and negatively impacted by bank's activity diversification. However, the impact of bank's performance is still ambiguous. The results suggest also that lagged GDP growth has a positive impact on loan quality which is what should be expected as an expansionary phase of the economy presents relatively low loan defaults rates since firms face a sufficient amount of income to service their debts. Interest rate on bank loans has a negative contemporaneous impact on loan quality which implies that higher cost of debts is associated with higher probabilities of firms' default. When firm-specific variables are taken into account, the results obtained suggest also that loan quality is impacted by several firm-specific factors, such as leverage, external funding cost, liquidity, investment, sales, size and economic sector affiliation. These findings allow us to argue that macroeconomic and microeconomic conditions have an additional contribution in explaining the determinants of loan quality which should be examined from a financial stability perspective.

Our results have several policy implications. First, there is an evidence that bank's cost efficiency may serve as leading indicator for future problem loans suggesting that regulatory authorities should focus on bank's managerial performance in order to detect banks with potential problem loans increases. Second, regulators should place emphasis on under-capitalized banks having severe credit exposures in order to prevent future financial instability. Finally, policy makers should consider macro prudential regulation and supervision instead of relying only on the micro prudential perspective, when analyzing the loan quality of banks (for loan losses provisioning, stress tests, banks capitalization requirements, etc). One possible consideration, from the macro prudential regulation perspective, is to make banks' capital requirements countercyclical since credit risk may vary with overall macroeconomic conditions. One objective of such regulation would be to act as countervailing force to the natural decline in measured credit risk in a boom and the subsequent rise in measured credit risk during the collapse.

6. Conclusion

In this study we examine the determinants of the loan quality in the Tunisian banking sector. We find an evidence for the "Bad Management" and "Moral Hazard" hypotheses suggesting positive relations between loan quality and bank's cost efficiency and capitalization, respectively. However, no evidence is found for the "TBTF", "activity diversification" and "Procyclical Credit Policy" effects. Moreover, our findings highlight the importance of taking into account firm-specific characteristics and macroeconomic developments when analyzing the loan quality of banks from a financial stability perspective.

The study can be extended in different ways. Firstly, future studies of the loan quality determinants may focus on different types of loans (business, mortgage, consumer) rather than considering an aggregate level. Secondly, other statistical techniques may be used, such as duration models, to examine the intertemporal relations between loan quality and bank-specific variables, firms' characteristics and macroeconomic developments since we have found that some relations materialize only after some time passes. Thirdly, future lines of research may examine firms' access to credit after default rather than only analyzing the determinants of the credit default event.

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