Does relationship lending matter in an emerging market?*

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Abstract

This paper analyses the impact of the intensity and duration of bank-firm relationship on Tunisian loan quality over the period 2012-2018. Estimating a panel ordered probit model, our results indicate that the impact of relationship lending (in the form of duration and intensity) on loan quality is different according the firm's profitability level. The intensity of the relationship lending positively (negatively) impacts the loans of high (average or low) quality. When intersecting intensity of a banking relationship with firm balance sheet indicators, the link between the intensity of the bank-firm relationship and loan quality is lower (higher) for good (low) quality firms. In addition, the length of the bank-firm relationship increases the probability of poor quality loans. These results show that perverse and opportunist effects, in the form of strong moral hazard, are persistent for firms at different level of profitability.

1 Introduction and motivation

The topic of relationship lending and bank profitability has motivated ample researchers in order to increase our understanding of its main mechanisms. Loan

The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Central Bank of Tunisia.

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quality is of core importance for both lenders and borrowers, but the context in which banks evolve is important as well.

Relationship lending means that there is an strong, stable and long-term credit between the bank and the firm (Petersen and Rajan (1994)). The prevalent theories of relationship lending (for a review, see Boot (2000) and Ongena and Smith (2001)) suggest that relationship lending play a key role in reducing informational asymmetries, resolving agency problems and mitigating financial market imperfections. The robustness of the relationship lending should have benefits for banks by producing informational rents because the borrowers' risk may be assessed more precisely and fees and commissions revenues tend to increase. However, it is not clear if the relationship lending would increase or reduce the loan quality. On the one hand, it may be argued that a closer relationship lending improves bank monitoring and screening and reduce the monitoring costs, which should decrease the borrower's probability of default (Diamond (1984)). On the other hand, a closer and longer relationship lending can also have a perverse incentive to activate opportunistic behaviours for lenders by using the private information to extracts rents, thus causing the so called hold-up problems and increasing the probability of credit risk (Boot (2000), Rajan (1992)).

According to the existing empirical literature, the connection between relationship lending and the probability of credit risk is not clear. Some papers find that an exclusive bank-firm relationship contributes to create a climate of trust and consolidate the relationship over time, which might reduce the riskiness of the firm (Foglia et al. (1998), Chang et al. (2014)). Some other papers find more contrasted results on the benefits of a longer and closer relationship lending which might boost the willingness to take more risk and may trigger nonperforming loans (Dewatripont and Maskin (1995), Elsas and Krahnen (1998)).

The aim of the paper is to investigate the impact of relationship lending on loan quality granted by the credit registry in Tunisia. The case of Tunisia is interesting for several reasons. First, the financial system is mainly based on banks despite the reforms undertaken to set up a market-based financial sector. Second, the Tunisian banking system is a distorted market that leads to centralised market power dominated by some banks. The Tunisian bank's credit management is inefficient, with a Non Performing Loans (NPL) ratio of 14.5% in 2019[1] which is one of the highest level of NPLs ratio among the Arab Mediterranean Countries . The concentration of this market should promote bank-firm relationship lending, but also opportunistic behaviours and risk-taking from lenders. Specifically, we try to answer the following questions: does the duration and the intensity in the bank-firm relationships increase the loan quality granted by banks? What are the firms' characteristics that improve this relationship?

[1] Source: ceicdata.

The contribution of this paper is fourfold. First, we try to fill the gap in relationship banking literature by focusing on emerging economies' banking structure, using the one from Tunisia. Although there are many studies focused on relationship between banks and firms in deep and competitive economies, there are very few studies on the same topics in emerging economies. These economies can be very different, both in size and in the incentives of their banks and firms. Second, we try to explain the impact of relationship lending on the loan quality and not the probability of credit risk as in many empirical studies (Jiménez and Saurina (2004), Menkhoff and Suwanaporn (2007), Chang et al. (2014), Fiordelisi and Mare (2014a), Belaid et al. (2017)). This variable is more general and precise measure of the loan quality that also includes the probability of loan default. At last, we use an unique credit-file database (data on 2529 bank-firm relationships of 403 firms from 2012 to 2018) provided by the Central Bank of Tunisia. Compared to studies focusing on data collected by the national credit register (Jiménez and Saurina (2004), Dassatti Camors et al. (2019)), credit-file data allows to take into account private information held by banks and include internal ratings that enable a better evaluation of the borrower quality. Moreover, the original data we base this study on is largely unexplored, and has been extended in an unique way here. We estimate an ordered probit panel model with fixed effects in order to take into account the unobserved heterogeneity between firms and banks in our panel data.

The rest of the article is as follows: section 2 develops our hypotheses and a review of the relevant literature. Section 3 explains the macroeconomic setting of the country. Section 4 covers in detail the data and a description of the variables we will use. Section 5 presents our empirical strategy and our results, while section 6 concludes.

2 Theoretical background and hypotheses

2.1 The concept of relationship lending

The theory of relationship lending is based on the idea that close ties between lenders and borrowers may be economically beneficial. Relationship lending is defined as a long-term implicit contract between a lender (generally a bank) and a borrower. The issue of relationships banking and loan quality/credit risk in the banking sector has been extensively studied from the theory of asymmetric information perspective. The decision-making for a bank concerning its credit risk management is subject to valuation problems because the managers/shareholders of the firm knows more than the bank on the quality of its project and on its own intentions of repayment of the credits granted. This asymmetry of information creates an adverse selection and moral hazard problems (Akerlof (1970); Stiglitz and Weiss (1981)). As explained by Cotugno et al. (2013), relationship lending implies repeated interaction between the bank and the borrower over time, which will allow the bank to accumulate private information and establish close ties between the bank and the borrower. Such ties should lead to benefits from the lending institution such as intertemporal smoothing, increased credit availability, reduction of costs of providing further loans, improvement of borrower's project payoffs and more efficient decision in case of financial distress of the borrower.

If relationship lending allows to reduce asymmetric information for banks, it is also associated with costs like exogenous monitoring costs and switching costs. The information privilege of banks could "lock-in" borrowers and permit banks to extract monopoly rents. As a matter of fact, ex post rents extracted by the banks over some periods after the initiation of the loan contract could induce lock-in costs and bargaining power, leading to what is known the hold-up problem (Sharpe (1990); Rajan (1992)). As explained by Rajan (1992), the bargaining power of the relationship lender can decrease entrepreneurial incentives to spend effort in some projects and conduct to opportunistic behaviours for the borrowers, which constitutes opportunity costs of having an informed lender.

This theory has been helpful in gaining a general framework of the relationship between lender and borrower, but ample empirical studies have also enabled the research community in testing such theoretical frameworks. A great number of studies find that banks engaging in lending relationships tend to have lower credit risk (Lehmann and Neuberger (2001), Harhoff and Körting (1998)). Some other papers find more contrasted results, showing that borrowers can have a perverse incentive to activate opportunistic behaviours and consequently increasing the probability of non-repayment of loans (Boot (2000); Ferri and Messori (2000); Fiordelisi and Mare (2014b)). For example, Ferri and Messori (2000) show that relationship banking can have both beneficial and detrimental effects for credit allocation depending on the geographical position

of the banks within a country. They point towards socioeconomic structural differences as being responsible for sub-optimal allocation in the south of Italy.

The topic of relationship banking and lender/borrower relationships has been extensively studied, both theoretically and empirically, but less so in the context of matched lender-borrower data in an emerging economy, even less so in a distorted market lead mainly by one bank. A distorted market leads to centralised market power, which affects decision making on loan reimbursements differently than in a competitive market. Economic theory demonstrate that in a monopolist creditor market, the creditor shares in the future surplus is generated by the firm through the future rents the creditor is able to extract. This implies the creditor would be more willing to offer credit than in a competitive market (Petersen and Rajan (1995), Rajan (1992)). In a competitive market, the bank's only way to generate rent is through an information monopoly (Sharpe (1990)). Empirically, Crawford et al. (2018) study credit demand and loan default using the Italian credit-registry. It focuses in particular in a small business lines of credit, and finds that both asymmetric information and market power affect this localised market. They find that market concentration can mitigate (in part) the negative effects of asymmetric information, where banks with higher margins can moderate price increase on their loans in order not to worsen the quality of their pool of lenders. On the other hand, Fiordelisi and Mare (2014b) uses EU cooperative bank data to study bank competition and market stability. Their findings point towards a negative relationship between bank concentration and bank financial stability.

2.2 The identification of relationship lending and related hypotheses

Relationships lending is characterised by two major elements, namely its duration and its intensity (Petersen and Rajan (1994), Degryse et al. (2009), Belaid et al. (2017)).

The duration or length of the bank-borrower relationship has been used as an indicator of the solidness of the relationships lending and the degree of relationship intensity over time. According to the hypothesis of the informational advantage acquired by the bank through the long-term lending relationship (Diamond (1984); Ongena and Smith (2001)), the long-term relationship with the borrower allows the bank to acquire continuously internal and private information necessary for monitoring the creditworthiness of its clients and therefore for decreasing the credit risk. However, if the duration of a bank-borrower relationship is associated with private information accumulation over time, the lock-in costs of a borrower may increase with the length of the lending relationship. Therefore, the duration should increase switching costs as well as the hold-up problem explained above. If the lender-borrower relationship tends to

increase over time, or if borrowers become locked into specific banks with prohibitive switching costs, then the likelihood of terminating a relationship should decline over time, which may increase the credit risk in the long run. But the relation between accumulated information, duration and lock-in costs for the borrower should not be monotonic. There should be first a valuable information advantage that might be decreasing after some time as well as the marginal value of additional information (Diamond (1991)).

Some studies formally model the benefits of long-term lending relationship (see among others Diamond (1984); Berglöf and Thadden (1994); Chemmanur and Fulghieri (1994); Morales Acevedo (2016); Ongena and Smith (2001). Using matched loan-level data from Colombia, Morales Acevedo (2016) find evidence that duration of banking relationship is a good predictor of lowers loan delinquencies. In the same way, Ongena and Smith (2001) conclude that the probability of bank relationship termination increase in duration, which means that the value of the relationship decline over time. In particular, they do not find evidence on the fact that firms become locked into bank relationships.

Based on the aforementioned theoretical developments and empirical studies, we posit and test our first hypothesis:

H1: The duration of bank-firm relationship is positively related to the loan quality.

Another indicator variable used to identify relationship lending is the number of bank relationships. The impact of a closer banking relationship on borrowers' creditworthiness has been subject of debate in the financial intermediation literature. According to the theory of financial intermediation, the intensity of relationship lending allows for unique access to valuable information and therefore should reduce both costly informational frictions and problems associated with renegotiation of loan contracts (Diamond (1984)). In the same way, a closer or an exclusive relationship lending should facilitate the screening and monitoring of borrowers and carry beneficial implications like the sector specialisation of lenders, which may lead to the risk of financial distress. On the other hand, a close banking relationship may have two specific drawbacks that are associated with two primary costs: the soft-budget constraint problem and the liquidity risk (Boot (2000)). The soft-budget constraint problem relates to the potential lack of firmness of the bank to enforce credit contracts when there is a relationship-banking proximity. A borrower close to default may ask the bank for additional credit to avoid default. While any lender would decide not to lend to this borrower, a bank that has already lent money to this borrower may finally decide to grant additional credit in the hope of recovering its previous loan. Borrowers who realise that they can renegotiate their contracts ex post in this way may have perverse incentives ex ante to activate opportunistic behaviours and increase the default probability. This should also lead the bank to refinance unprofitable projects and drop entrepreneurial incentives to avoid

financial distress (Dewatripont and Maskin (1995)). The liquidity risk issue is that the single-banking relationship is not an optimal solution for the borrower. As a matter of fact, this latter will face a serious problem of adverse selection if the bank-relationship is likely to end, due to the fact that other lenders have less information and the removal of the credit is likely interpreted as a problem with the borrowing firm. If the problem of adverse selection is severe, it can be advantageous for firms to establish relationships with several banks. The issue of multiple lending can be serious, especially in economies where bankruptcy costs are high and banks rarely have liquidity problems (Detragiache et al. (2000)).

Existing empirical studies demonstrate that intensity of banking relationship matters, either by focusing on the eventual increasing costs of borrowing in switching banking relationships ((Ioannidou and Ongena (2010), Degryse and Ongena (2001)) or the increase in risky loans for small firms with multiple banking relationships (Ioannidou et al. (2015)). Foglia et al. (1998) show that the relationships of a firm with just one bank creates a climate of trust and consolidate the relationship over time. On the contrary, a relationship with many lenders reduces the monitoring incentive, contributes to the dilution of the information and to the occurrence of asymmetric information (Uchida et al. (2012)).

Based on these studies, we formulate and test our second hypothesis as follows:

H2: The intensity of bank-firm relationship is positively related to the loan quality.

It seems likely that the link between bank-firm relationship (duration and intensity) and the quality of loan will depend on firm's specific characteristics. Concerning intensity, the number of banking relationships can signal the quality of the firm. A firm of good quality in terms of performance and level of debt will have facilities to obtain refinancing from other banks but it will prefer to have a close relationship lending with a single bank so as to have advantageous loan conditions. In the same way, a poor quality firm which expects a deterioration of its performance should develop several banking relationships in order to dilute information and avoid the control of the main bank. Therefore, we expect that link between the intensity of the bank-firm relationship and the loan quality is lower (i.e. higher) for good (i.e. low) quality firms:

H3: The link between the intensity of the bank-firm relationship and the loan quality is lower (i.e. higher) for good (i.e. low) quality firms.

As far as duration in firm-bank relationships concerned, firms facing large information asymmetries with outside investors benefit most from long-term banking relationships, but they are also particularly susceptible to hold-up problems and high switching costs. Ongena and Smith (2001) find evidence that there

are small, profitable and highly leveraged firms that have the shortest relationships. Therefore, we expect that the link between the length of the bank-firm relationship and loan quality is lower (i.e. higher) for good (i.e. low) quality firms:

H4: The link between the length of the bank-firm relationship and loan quality is lower (i.e. higher) for good (i.e. low) quality firms.

3 Macroeconomic environment

The previous NPLs related empirical studies have stated that macroeconomic conditions do impact banks' loan portfolio quality captured by the NPL ratio. Macroeconomic determinants of NPLs include real GDP growth, inflation rate, interest rate and unemployment (Ghosh (2017)). It has been argued that a contraction of real GDP and a higher unemployment rate are associated with deteriorating banks' loan portfolio quality and rising NPLs due to their countercyclical properties. In addition, higher interest rates make loan repayments more expensive which leads to a higher likelihood of credits defaults. However, for a given nominal interest rate, rising inflation rates reduce the real value of debt which makes debt service less expensive. It has also been stated that macroeconomic conditions may not affect NPLs immediately but after some time lag.

Over our analysis period, Tunisian banks' loan portfolio quality worsened during the sub-period 2012-2015 as NPL ratio rose to 16.6 percent of total loans in 2015 before going through a slight improvement within 2016-2018 reflected by a decrease in the NPL ratio reaching 13.3 percent in 2018. The deterioration in the Tunisian banks' loan portfolio quality during 2012-2015 can be explained by the economic contraction by 1.9 percent in 2011 due to the Arab Spring related events that hit Tunisia in 2010-2011. The Tunisian financial sector has shown some vulnerabilities mainly due to the concentration of credit risk in some economic sectors. In 2018, the breakdown of NPLs classified by sector of activity showed a concentration on the industrial and tourism sectors which account for 45.2% of outstanding NPLs (Central Bank of Tunisia (2019)).

Actions undertaken by Tunisian authorities in 2012-2013 include a due-diligence activities that concerned the three largest stated-owned banks (BH, BNA and STB) and helped to identify the main weaknesses including high costs, poor human and operational capacities, weak governance and management, insufficient service quality and poor credit risk management strategies (IMF (2021)). Also, actions have been taken to improve banks' loan-loss provisioning. Specific provisions to NPLs rose from 45.7 percent in 2012 to 55.7 percent in 2018. The authorities have also announced a plan to create a universal asset-management company (AMC) or "bad bank" to handle bad loans

to the tourism sector. However, this plan was rejected by the Parliament in 2014 amid protests, notably by the hotel owners' association (OECD (2015)). Tunisian firms are heavily dependent on loans (low stock market capitalisation of non-financial institutions that reached 12.3

Table 1: Macroeconomic indicators

Year	NPLs	Real GDP	Inflation	Lending interest rate	Unemployment
2010	13	3.5	3.3	4.4	13.1
2011	13.3	-1.9	3.2	4.0	18.3
2012	14.9	4.0	4.6	3.8	17.6
2013	16.5	2.9	5.3	4.6	15.9
2014	15.8	3.0	4.6	4.8	15.0
2015	16.6	1.2	4.4	4.7	15.2
2016	15.6	1.2	3.6	4.2	15.6
2017	13.9	1.9	5.3	4.9	15.3
2018	13.3	2.7	7.3	6.7	15.5
2019	13.4	1.0	6.7	7.7	15.1
2020	13.1	-8.8	5.6	6.9	17.4

Source: Central Bank of Tunisia & IMF

4 Data and variables

4.1 Sample and data collection

We collected credit-file data from the ten largest banks in Tunisia that hold 93% of total banking assets. The data come from the Central Bank of Tunisia and Thomson Reuters Eikon Central database. This database contains different sources of information: information reported by the banks which share information between credit institutions in order to assist their credit risk assessment and management; detailed and annual accounting information on a large sample of Tunisian firms (age of the firm, sector of activity, information on the annual outstanding amount, status of loan and duration of banking relationship); data on loans granted to these firms with information on their status (defaulted or non-defaulted loans) and at last information on the rating given by banks to total loans depending on the credit risk assessments realised by the lenders. Loan quality information and firm-specific variables are collected from the Risk and Central Balance Sheet database held by the Central Bank of Tunisia.

We have selected only loans with values from 1000 to 10 million dinars in order to avoid any specific effect related to credit scale. Only firms for which we have the information of the date of the loans and for which annual data are available over the considered period are included in our sample. After cleaning the data, our sample consists of 2529 bank-firm lending relationships for 403 firms over the period 2012 to 2018 at the annual frequency.[2]

4.2 Description of variables

4.2.1 Dependent variable

As the aim of this paper is to investigate how the bank-firm relationship (intensity and duration) influences the loan quality, a central point in our study is to define the loan quality as our dependent variable. This variable is built on the information given by banks that classify the loans granted to firms into six classes, in accordance with the regulation on loans' classification set by the Central Bank of Tunisia (the circular n°91-24 of CBT). The first class represent safe loans for which there is integral repayment. The second class includes loans for which the repayment seems to be ensured but they are granted by firms facing deteriorating financial situation. The third class includes loans for which repayment is uncertain with reimbursement delays between 90 and 180 days. The fourth one contains loans for which repayment is uncertain with reimburse-

[2]Throughout the study, bank-firm relationships will be referred to as loans, as they represent the aggregated loan exposures between firm j, bank i at time t.

ment delays between 180 and 360 days. In the fifth class, the reimbursement delay for loan are of more than 360 days. At last, the last class contains loans presenting a reimbursement delay of more than 360 days and for which there is a legal proceedings initiated by banks.

On the basis of this information, we build an ordinal variable *Loanquality* ranging from 1 (very bad loan) to 6 (safe loan). Compared to other studies (Jiménez and Saurina (2004), Menkhoff and Suwanaporn (2007), Chang et al. (2014), Fiordelisi and Mare (2014a), Belaid et al. (2017)) that use a dummy variable for representing the probability of loan default, this variable is more general and precise measure of the loan quality that also includes the probability of loan default.

4.2.2 Independent variables

As we are concerned with relationship lending, our second central point is to define and measure the two indicator variables of the strength of bank-firm relationship, which are duration and intensity.[3] To capture the length of the bank-firm relationship, we build the variable *Duration* as the logarithm value of the duration (measured in years) of the lending relationship between the bank i and the firm j calculated from the beginning of the relationship (which cannot exceed the creation date of the original database, 2010). In the same way, if the relationship lending goes beyond the sample period, it is truncated at a duration starting at 2010.

To capture the intensity of the lending relationship, we build the variable *Intensity* following Belaid et al. (2017) as the ratio between the total amount of loans granted by bank i to firm j and the number of lending banks to firm j. Compared to other studies measuring the intensity as the number of banks lending to each borrower (Ferri and Messori (2000), Chang et al. (2014), Fiordelisi and Mare (2014a)), this indicator ranging from 0 to 1 shows to what extent the relationship lending between the bank i and the firm j is a strong (in terms of amount of loans granted to the firm) and a close (in terms of number of banks lending to the firm) one. A value of one indicates that the firm has exclusively all its credits granted by the same bank and a value near zero means that the amount of credit obtained by the firm j to the bank i is not significant compared to total loans granted by other banks.

One another aim of this paper is to investigate how the bank-firm relationship (intensity and duration) influences the loan quality depending on firm's specific characteristics (see *H3* and *H4*). For that, we include a broad set of firm characteristics as independent variables in the model. We consider the

[3]Some papers (Jiménez and Saurina (2004), Fiordelisi and Mare (2014a)) consider the geographical distance between the bank and the firm as another measure of relationship lending. Here we could not use such a proxy as we do not know the location of the firms.

size of the firm (TA) approximated by the logarithm of the total assets of the firm. As a measure of firm's performance, we use the return on assets of the firm (ROA). As a proxy of the financial risk of the risk, we adopt two alternatives measures: the leverage ratio (*Leverage*) as a simple proxy of the firms' risk of financial distress and the liquidity ratio (*Liquidity*) as a financial health indicator.

As lending behaviour may vary across banks, we control for bank variables that may have an impact on bank lending. We therefore include the logarithm of the total assets of the bank, the return on assets, the leverage ratio and the liquidity ratio of the bank.

Table 2 summarises the main characteristics of variables described above.

Table 2: Summary of the variables.

Name of variables	Description
Dependent variable	
Loan quality	This value is ranging from 1 (very bad loan) to 6 (safe loan).
Independent variables	
Duration	The number of years of the relationship lending between bank i and firm j (cannot go back before 12 years).
Intensity	Ratio between the total amount of loans granted by bank i to firm j and the number of lending banks to firm j. A value of one indicates that the firm has exclusively all its credits granted by the same bank.
Leverage ratio	Total equity / total assets (for both firms and banks)
Liquidity ratio	Liquid assets/ total assets (for both firms and banks)
Return on Assets	Net income/ total assets (for both firms and banks)
Total assets	Log of total assets (for both firms and banks)

4.2.3 Descriptive analysis

Table 3 gives descriptive statistics on the distribution of the observations among the six categories of loan classes. Approximately 22% of the firms in the sample were distressed at the end of the period (category 1-4). However, the average quality of loans is relatively high, with an average of 5.171 (a value of 6 indicating a safe loan and a value of 1 a very bad loan). It means that there is a great dispersion in terms of quality of loans granted by the banks. While the majority of loans are repaid on time (classes 5 to 6 in the loan quality indicator), those who are in the classes 1 to 4 are considered in default.[4] These defaulted loans corresponds to 403 unique firms, which roughly represents 22% of total loans which are in some type of default category. Table 3 illustrates this great dispersion in terms of quality of loans and we can see that a great majority of loans are considered as very good loans in terms of quality ((70% of loans are in class 6).

Table 3 and Table 4 indicates that the mean value of the variable *Intensity* is 0.663, which means that on average Tunisian banks maintain a relatively close

[4] A loan is considered to be in default when there is a delay in the reimbursement of the principal and/or interests of more than three months (Bonfim (2009), Louzis et al. (2012), Belaid et al. (2017)).

relationships with their borrowers. The distribution of the variable *Intensity* between the six classes of loan quality clearly reveal a positive link between the intensity of relationship lending and the loan quality. Added to that, the average of lending relationship duration is 6.786 years and if the result is not as clear as the intensity, there is a a positive link between the duration of relationship lending and the loan quality until the class 3. For loans in class 4 to 6, this effect is less clear-cut.

Table 3: Loan distribution

Loan Quality	Relationships Nbr.	Unique Firms	Frequency (%)	Av. Intensity	Av. Duration
1	121	18	4.78	0.14	6.29
2	195	30	7.7	0.47	6.98
3	126	21	5	0.69	7.67
4	118	20	4.67	0.68	6.14
5	166	30	6.56	0.75	6.86
6	1803	284	71.29	0.7	6.87
Total	2529	403	100	-	-

Table 4: Summary statistics

Statistic	Mean	St. Dev.	Min	Max
Loan quality	5.171	1.528	1	6
TA_bank	8.683	0.574	7.392	9.389
TA_firm	21.681	1.478	18.486	24.987
Leverage_bank	7.991	2.400	2.971	15.070
Leverage_firm	22.884	19.982	−56.011	84.748
Liquidity_bank	77.133	6.337	57.658	95.428
Liquidity_firm	67.442	24.712	4.264	100.000
ROA_bank	0.966	0.996	−2.564	4.330
ROA_firm	0.043	0.134	−1.154	0.631
Intensity	0.663	0.382	0.002	1.000
Duration	6.786	3.652	1	12

5 Econometric methodology

A known approach to modelling NPls is to use logit or probit models (Bonfim (2009); Avdjiev and Serena (2020)). To answer our hypotheses we run our model following an ordered probit approach, with as dependant variable LQ_{ijt} which represents quality of loan granted by bank i to firm j at time t (1 to 6, 6 being good quality loan), and our variable of interest is return on assets of banks. Define the index $\kappa = (ij)$ to represent an observation related to any pair

(ij) of (bank,firm). We consider the following latent model:

$$Y^*_{\kappa t} = \beta_1\ Duration_{\kappa t} + \beta_2\ Intensity_{\kappa t} + X^{'}_{mt}\ \beta_3 + \sigma_\epsilon\ \epsilon_{\kappa t},\ \ \epsilon_{\kappa t} \approx N(0,1),\ (1)$$

or

$$Y^*_{\kappa t} = Z^{'}_{\kappa t}\ \Omega + \epsilon_{\kappa t},\ \kappa = (1,1),...,(I,J),\ t = 1,...,T. \quad (2)$$

The total sample consists of I banks, J firms and T years. Z is the vector of variables Duration, Intensity and X and $\mathbf{X}_{mt}$ is a vector composed of the following variables:

$$(ROA_{m\tau}, TA_{m\tau}, liquidity_{m\tau}, leverage_{m\tau}, \lambda_i, \lambda_j)\ ,\ m = b, f,\ \tau = t-1, t. \quad (3)$$

The indices b, f refer respectively to banks and firms. λ_i and λ_j are respectively bank and firm specific effects. The regressors in the vector $Z_{\kappa t}$ are assumed to be strictly exogenous and the panel is balanced. The latent model 2 allows to define a partition of the variable dependent variable (quality of a loan granted from bank i to firm j) as follows

$$Y_{\kappa t} = \begin{cases} 1, & \text{if } Y^*_{\kappa t} \in (-\infty, \gamma_1], \\ 2, & \text{if } Y^*_{\kappa t} \in (\gamma_1, \gamma_2], \\ . & \\ . & \\ 6, & \text{if } Y^*_{\kappa t} \in (\gamma_6, \infty]. \end{cases} \quad (4)$$

The coefficients $\gamma_1 < \gamma_2 < ... < \gamma_6$ are unknown parameters. The probability of an outcome conditional on the exogenous regressors and fixed effects is :

$$Pr\left(Y_{\kappa t} = \nu \mid Z_{\kappa t},\ \Omega\right) = \zeta\left(\gamma_{\nu+1} - Z^{'}_{\kappa t}\ \Omega\right) - \zeta\left(\gamma_\nu - Z^{'}_{\kappa t}\ \Omega\right), \quad (5)$$

where $\nu = 1, ..., 6$. $\zeta(.)$ is the standard Normal CDF $N(0,1)$.

Our motivation for considering a fixed effect model, rather than random effect, is the following. The sample of banks and firms considered represent the bulk of the banking sector and private companies in Tunisia. So, our sample "coincides" with the population.

A challenging issue when dealing with unobserved heterogeneity in fixed effects panel data models is a bias caused by the so-called incidental parameter problem. The maximum likelihood estimate of the residual variance is likely to be biased. Bias with the slope estimates on the explanatory variables in the latent model can also occur. To reduce the bias, we choose the following sufficient statistics for the fixed effect. Consider a given explanatory variable x_{ijt} for a pair (i,j) representing a bank and a firm. We add the following variables to x_{ijt} in the latent regression:

$$w^1_{ijt} = \bar{x}_i = \sum_j \sum_t x_{ijt} \text{ and } w^2_{ijt} = \bar{x}_j = \sum_i \sum_t x_{ijt}.$$

This reduces substantially the number of parameters to estimate, since instead of $I \times J$ fixed effects, we now have only as many parameters as explanatory variables in the regression. The variable w^1_{ijt} has the same values for a given bank i for all firms and years. But the values differs across banks. Similarly, in the vector w^2_{ijt}, the values are similar for a given firm j for all firms and years. The values change across firms.We can also proceed in a similar way for time fixed effects. Rather than including in the model as many dummies as years, we calculate the mean over banks and firms:

$$w^3_{ijt} = \bar{x}_t = \sum_i \sum_j x_{ijt}.$$

To avoid considering too many variables in the model, we select $w^\eta_{ijt}, \eta = 2, 3$ for our two variables of interest, i.e. duration and intensity of a loan.
In order to identify the scale of the parameter vector, we make the standard assumption of no constant in the latent mean equation and the variance of the error-term is set to 1. The model is estimated using maximum likelihood estimator.

Define an element of the vector $Z_{\kappa t}$ as $(z^l_{\kappa t}), l = 1, ...L$. We compute the marginal effects which measures the effect of a unit change in a variable $(z^l_{\kappa t})$ on the probability of a given outcome $\nu, \nu = 1, 2, ...6$. We denote $\hat{\omega}^l$ the estimated coefficients of $(z^l_{\kappa t})$ in the latent regression.

We calculate the marginal effect of each observed set of $(z^l_{\kappa t})$ and average the marginal effects across the sample:

$$AME(\nu) = \frac{1}{I \times J \times T} \sum_i \sum_j \sum_t ME(\nu, Z'_{\kappa t}\hat{\Omega}), \ \kappa = (i, j) \tag{6}$$

where

$$ME(\nu, Z'_{\kappa t}\hat{\Omega}) = \frac{\partial P(Y_{\kappa t} = \nu)}{\partial z^l_{kt}} = -\frac{\hat{\omega}^l}{\sigma} \ \phi\left(\frac{\gamma_{\nu+1} - Z'_{\kappa t}\hat{\Omega}}{\sigma}\right) - \phi\left(\frac{\gamma_\nu - Z'_{\kappa t}\hat{\Omega}}{\sigma}\right)$$

where ϕ is the pdf of the error term $\epsilon_{\kappa t}$.

6 Results

The results of the baseline model assessing the impact of relationship lending on the probability of loan quality are presented in Table 5. Table 6 gives the results of the model integrating the interaction variables between firm's characteristics and the variable *Intensity* whereas Table 7 gives the result of the model integrating the interaction variables between firm's characteristics and the variable *Duration*. In order to interpret our results, we need to compute marginal effects of these three models that are reported in Tables 8, 9 and 10.

6.1 Testing H1 and H4 : direct and indirect effects of duration

Let us start by examining hypothesis H1: does the duration of the bank-firm relationship increase the likelihood that loans are of good quality? In Table 5, we present results obtained from the ordered probit model with core variables and marginal effects of this model are given in Table 8. We see that the coefficient of the variable *Duration* is positive for outcomes $\nu = 1, ..., 5$ and negative for outcome $\nu = 6$. This result suggests that the duration of the relationship between banks and firms increases the probability of poor quality loans, and decreases the probability of good quality loans. This result is consistent with agency theories (soft-budget constraint discussed above), where long relationships are opportunistically maintained by firms to delay or mitigate default risks (customer relationships matter more than the risks inherent in loans). In order to test whether this explanation holds for our sample, we add to the original model cross-effects of the variable *Duration* with variables describing firms' health, i.e. ROA, leverage, liquidity ratio and total assets (see Table 7). The underlying idea is the following : if the length of the customer relationships dominates, then firms with degraded liquidity/credit ratios, or firms taking on high leverage risks, should increase the risk of ex-ante adverse selection and increase the likelihood that the loans granted will be, ex post, non-performing.[5] When we compare the results found in the original model 5 and results including interaction variables in Table 7, we find that in the former no threshold is significant, while at least one is in the latter. This shows that the first regression does *not* adequately discriminate behaviours across outcomes and that the mean effect captured by the negative sign of the duration variable certainly captures behaviours in one of the outcomes ν. It means that the variables in the regression in Table 5 do not help to differentiate their effects on the different loan quality levels.[6]

In Table 7, marginal effects of the model including interaction variables between firm characteristics and the variable *Duration* reveal some interesting features. First, the coefficient of the variable *ROA* is the highest compared to the coefficients of the other variables describing firm characteristics. The marginal effect is negative for the outcomes $1, .., 5$ and positive (and high) for the outcome 6. This corresponds to what is expected, i.e. that an increase in the return-of-assets improves loan quality only for firms whose loans are already of good quality. Second, the variable *Duration*, taken alone, has no significant effect, regardless of the outcome. When we look at the marginal effects of the variables crossed with *Duration* in Table 10, although they are significant and positive for all outcomes, the coefficients obtained are small. This means that

[5] In this case, we expect the marginal effects crossed with firm characteristics to be positive for the lowest values of ν (which correspond to outcomes with the lowest quality of loans) and negative for the highest values of ν (which corresponds to the highest quality of loans.)

[6] The correct interpretations are therefore those of marginal effects corresponding to estimates where at least one threshold is statistically significant.

duration does not significantly alter the direct effects of firm's characteristics on loan quality. It is therefore difficult to validate hypothesis H4 for our sample.[7]

The conclusion is that, for our sample, none of the hypotheses H1 and H4 seem to be validated. Duration is not a discriminant variable that directly influences loan quality. The indirect effects, via firm characteristics, are small. One explanation is that the variable *Duration* captures a learning effect. Firms take out loans with banks and the banks continue to do so as long as the firms have strong economic and financial performance. Duration thus appears to be a process of selecting the right firms over time. In this situation, duration has a positive effect on the probability of selecting firms with good loans. According to the agency theory, we would say that duration increases the incentive constraint on agents (in this case firms) who must continue to improve firm performance to continue to receive loans from banks. This behaviour is opposed to that of "customer relationships". In this case, there are no effects related to the incentive constraint. There may even be moral hazard or adverse selection effects, if loan offers are uncorrelated (or weakly correlated) with firms' performance. Other studies (Sohn and Choi (2011) find that banks can have a conflict of interest that comes with pre-existing lending relationships, and that bank quality does not necessarily convey the risk classes of its client firms.

6.2 Testing H2 and H3 : direct and indirect effects of intensity

For the same reasons of identification and omission bias as in the previous section, we interpret the marginal effects calculated from the regression with the cross-effects of the firms' characteristic variables with the intensity variable, i.e. Table 6.

If we look at the marginal effects of the variable *Intensity*, they are negatively significant for outcomes 1 to 5 and positively significant with a high coefficient for outcome 6. This result suggests that the intensity of the relationship lending positively impacts the loans of high quality and negatively impacts the loans of average or low quality. This result suggests a dilution effect and an adverse selection problem in the sense that firms that already have poor quality loans would have an incentive to multiply their loans with different banks. This result validates our hypothesis *H2* when we consider firms with high quality loans but not for firms with average or low quality loans. This result also shows that it is

[7] The introduction of these cross effects is however useful. Indeed, comparing Tables 5 and 7, we see how drastically the coefficients common to both regressions change. In the cross-effects regression, the coefficient on firms' ROA is 3 times higher than in the regression where these effects are omitted. The coefficient on firms' total assets is 2 times higher. The coefficient on duration itself changes sign and becomes positive and at least 5 times higher in absolute value. All this indicates the existence of omission biases in the original regression (Table 5) with a systematic underestimation of the effects.

important to consider the different types of loans in terms of quality to estimate the impact of the relationship lending on the loan quality.

When we estimate the cross effects between the variable *Intensity* and firm's characteristic variables, we find an interesting result. Indeed, among all the firms' characteristic variables, the one that plays the most important role is the variable *ROA* as in previous section. For outcomes $\nu = 1, ..., 5$, the individual marginal effect of ROA is negative, while its cross effect with the intensity variable is positive (the total effect is positive). This result reveals that, for firms with initially poor or medium quality loans, improving their ROA decreases the probability of continuing to have low quality loans. But, when these firms increase their banking relationships, they are likely to continue to have degraded loans, despite the improvement in their financial indicator. This phenomenon can be interpreted as the fact that firms that increase their banking relationships have less incentive to improve their ROA as a signal to banks. For outcome $\nu = 6$, we see a positive sign for the marginal ROA effect (taken alone) and a negative sign with the cross-intensity effect. Therefore, for firms with good quality loans, increasing bank relationships also has a disincentive effect since it reduces the probability of continuing to have good quality loans. This result verifies our hypothesis (H4) according to which the link between the intensity of the bank-firm relationship and loan quality is lower (higher) for good (low) quality firms. Our results are contrary to those found by Belaid et al. (2017) who conclude that Tunisian firms which have an intense relation with banks are more likely to have loans of higher quality. However, this paper does not take into account the significance level of thresholds in the order logit model as well as marginal effects in the different outcomes of the loan quality level.

Table 5: Regression results of the core variables

	Estimate	Std. Error	t value	P-value	
ROA(banks)	-0.12	0.03	-3.93	0.00	***
ROA(firms)	0.59	0.21	2.78	0.01	**
Total assets (banks)	0.39	0.06	6.23	0.00	***
Total assets (firms)	0.04	0.02	2.03	0.04	*
Leverage (banks)	0.08	0.01	5.84	0.00	***
Leverage (firms)	-0.01	0.00	-4.21	0.00	***
Liquidity(banks)	-0.02	0.00	-5.00	0.00	***
Liquidity(firms)	0.00	0.00	3.63	0.00	***
Intensity	3.67	0.49	7.45	0.00	***
Duration	-0.17	0.06	-2.98	0.00	**
	Threshold parameters				
	Estimate	Coeff.	Std. Error	t value	P-value
Threshold	(1$\Longrightarrow$2)	1.63	7.88	0.21	0.84
Threshold	(2$\Longrightarrow$3)	2.25	7.88	0.29	0.78
Threshold	(3$\Longrightarrow$4)	2.50	7.88	0.32	0.75
Threshold	(4$\Longrightarrow$5)	2.69	7.88	0.34	0.73
Threshold	(5$\Longrightarrow$6)	2.92	7.88	0.37	0.71

Note: *,**,*** : statistical significance at resp. 10%, 5%, 1%.

Table 6: Regression results with interaction variables between Intensity and firm's characteristics

	Estimate	Std. Error	t value	P-value	
ROA	2.43	0.48	5.05	0.00	***
Total assets	0.01	0.04	0.38	0.71	
Leverage	-0.02	0.00	-5.17	0.00	***
Liquidity	0.01	0.00	5.69	0.00	***
Intensity	2.72	1.20	2.26	0.02	*
Duration	-0.06	0.04	-1.56	0.12	
CPI	-0.75	0.49	-1.52	0.13	
GDP	0.14	0.08	1.78	0.07	.
ROA $\times intensity$	-2.59	0.60	-4.31	0.00	***
Leverage $\times intensity$	0.01	0.00	3.62	0.00	***
Liquidity $\times intensity$	-0.01	0.00	-4.76	0.00	***
Total assets $\times intensity$	0.07	0.05	1.36	0.17	
Threshold Estimate		Parameters	Std. error	t value	P-value	
Threshold	(1$\Longrightarrow$2)	3.45	1.67	2.06	0.04	
Threshold	(2$\Longrightarrow$3)	4.08	1.67	2.44	0.01	
Threshold	(3$\Longrightarrow$4)	4.33	1.67	2.59	0.01	*
Threshold	(4$\Longrightarrow$5)	4.52	1.68	2.70	0.01	*
Threshold	(5$\Longrightarrow$6)	4.74	1.68	2.83	0.00	**

Note: *,**,*** : statistical significance at resp. 10%, 5%, 1%.

Table 7: Regression results with interaction variables between Duration and firm's characteristics

	Estimate	Std. Error	t-value	P-value	
ROA	1.70	0.62	2.75	0.01	**
Total assets	0.10	0.05	2.02	0.04	*
Leverage	0.00	0.00	0.18	0.86	
Liquidity	0.01	0.00	3.91	0.00	***
Intensity	0.85	0.07	12.47	2.20E-16	***
Duration	0.93	0.61	1.52	0.13	
CPI	-1.16	0.47	-2.49	0.01	*
GDP	0.17	0.08	2.26	0.02	*
ROA$\times Duration$	-0.50	0.30	-1.63	0.10	
Leverage $\times Duration$	0.00	0.00	-1.90	0.06	.
Liquidity $\times Duration$	0.00	0.00	-2.65	0.01	**
Total assets $\times Duration$	-0.03	0.03	-1.16	0.25	
Threshold estimate					
		Parameters	Std error	t value	P- value	
Threshold	(1$\Longrightarrow$2)	14.81	4.43	3.34	0.00	***
Threshold	(2$\Longrightarrow$3)	15.41	4.43	3.48	0.00	***
Threshold	(3$\Longrightarrow$4)	15.65	4.43	3.53	0.00	***
Threshold	(4$\Longrightarrow$5)	15.83	4.43	3.57	0.00	***
Threshold	(5$\Longrightarrow$6)	16.05	4.43	3.62	0.00	***

Note: *,**,*** : statistical significance at resp. 10%, 5%, 1%.

7 Conclusion

In this paper, we analyses the impact of the intensity and duration of bank-firm relationship on loan quality in an emerging market characterised by market concentration like Tunisia. For that we use data collected from the credit registry of the Central Bank of Tunisia consisting of 2529 bank-firms lending relationships for 403 Tunisian firms over the period 2012-2018. Using a panel ordered probit model, we estimate non-performing loans on proxies of relationship lending interacting with firm balance sheets.

Our findings reveal that it is important to take into account different levels of loan quality (and not just a binary variable for the credit risk as in the prevailing literature) because our results differ according to the quality of the firms' loans. First, we find that the intensity of the relationship lending positively impacts the loans of high quality and negatively impacts the loans of average or low quality. When intersecting intensity of a banking relationship with firm balance sheet indicators, we find that the link between the intensity of the bank-firm relationship and loan quality is lower (higher) for good (low) quality firms. Second, our results reveal that the length of the relationship between banks and firms increases the probability of poor quality loans, and decreases the probability of good quality loans. These results suggest that the consideration of cross-effects between relationship lending and firm's characteristics is also important.

Our results show that relationship lending is not always relevant in the Tunisian banking sector which has difficulties to mitigate agency problems and knows soft-budget constraint and lock-in problems. Perverse and opportunist effects, in the form of strong moral hazard, are persistent for firms at different level of profitability.

Our findings have important policy implications. This moral hazard situation, where banks continue to lend to low-performing firms while earning important income on the interest, will be detrimental to the real economic situation in the country. The Tunisian banking sector is far too concentrated around few big banks, leading to distorted lending behaviours. Important efforts to introduce competition in this market would be highly beneficial for the stability of the domestic banking sector.

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8 Appendix: marginal effects

Table 8: Marginal effects of core variables

	Pr(Out=1)		**Pr(Out=2)**		**Pr(Out=3)**	
ROA (banks)	0,007	***	0,013	***	0,007	***
ROA (firms)	-0,038	**	-0,064	**	-0,035	**
Total assets (banks)	-0,025	***	-0,043	***	-0,023	***
Total assets (firms)	-0,002	*	-0,004	*	-0,002	*
Leverage (banks)	-0,005	***	-0,009	***	-0,005	***
Leverage (firms)	0,000	***	0,001	***	0,000	***
Liquid. ratio (banks)	0,001	***	0,002	***	0,001	***
Liquid. ratio (firms)	0,000	***	0,000	***	0,000	***
Intensity	-0,235	***	-0,400	***	-0,218	***
Duration	0,011	**	0,019	**	0,010	**
	Pr(Out=4)		**Pr(Out=5)**		**Pr(Out=6)**	
ROA (banks)	0,005	***	0,006	***	-0,039	***
ROA (firms)	-0,027	**	-0,030	**	0,194	**
Total assets (banks)	-0,018	***	-0,020	***	0,130	***
Total assets (firms)	-0,002	*	-0,002	*	0,013	*
Leverage (banks)	-0,004	***	-0,004	***	0,027	***
Leverage (firms)	0,000	***	0,000	***	-0,002	***
Liquid. ratio (banks)	0,001	***	0,001	***	-0,007	***
Liquid. ratio (firms)	0,000	***	0,000	***	0,001	***
Intensity	-0,170	***	-0,188	***	1,211	***
Duration	0,008	**	0,009	**	-0,057	**

Note : *,**,*** : statistical significance at resp. 10%, 5% and 1%.
Pr(out=i): probability of outcome i.

Table 9: Marginal effects: firms' characteristics interacted with intensity

	Pr(Out=1)		**Pr(Out=2)**		**Pr(Out=3)**	
ROA	-0,163	***	-0,279	***	-0,145	***
Total assets	-0,001		-0,002		-0,001	
Leverage	0,001	***	0,002	***	0,001	***
Liquid. ratio	-0,001	***	-0,001	***	-0,001	***
Intensity	-0,182	*	-0,312	*	-0,162	*
Duration	0,004		0,006		0,003	
CPI	0,050		0,086		0,045	
GDP	-0,009	*	-0,016	*	-0,008	*
ROA × Intensity	0,173	***	0,297	***	0,155	***
Leverage × Intensity	-0,001	***	-0,002	***	-0,001	***
Liquidity ratio × Intensity	0,001	***	0,002	***	0,001	***
Total assets × Intensity	-0,004		-0,008		-0,004	
	Pr(Out=4)		**Pr(Out=5)**		**Pr(Out=6)**	
ROA	-0,110	***	-0,118	***	0,816	***
Total assets	-0,001		-0,001		0,004	
Leverage	0,001	***	0,001	***	-0,005	***
Liquid. ratio	-0,001	***	-0,001	***	0,004	***
Intensity	-0,123	*	-0,132	*	0,911	*
Duration	0,003		0,003		-0,019	
CPI	0,034		0,036		-0,250	
GDP	-0,006	,	-0,007	*	0,047	*
ROA× Intensity	0,117	***	0,125	***	-0,867	***
Leverage × Intensity	-0,001	***	-0,001	***	0,005	***
Liquid. ratio × Intensity	0,001	***	0,001	***	-0,005	***
Total assets × Intensity	-0,003		-0,003		0,022	

Note : *,**,*** : statistical significance at resp. 10%, 5% and 1%.
Pr(out=i): probability of outcome i.

Table 10: Marginal effects: firms' characteristics interacted with duration

	Pr(Out=1)		**Pr(Out=2)**		**Pr(Out=3)**	
ROA	-0,127	**	-0,190	**	-0,098	**
Total Assets	-0,008	*	-0,011	*	-0,006	*
Leverage	0,000		0,000		0,000	
Liquid. Ratio	-0,001	***	-0,001	***	-0,001	***
Intensity	-0,063	***	-0,095	***	-0,049	***
Duration	-0,069		-0,103		-0,053	
Inflation	0,087	*	0,130	*	0,067	*
GDP	-0,013	*	-0,019	*	-0,010	*
ROA × Duration	0,037		0,055		0,029	
Leverage × Duration	0,000	*	0,000	*	0,000	*
Liquid. Ratio × Duration	0,000	**	0,000	**	0,000	**
Total Asset ×Duration	0,002		0,003		0,002	
	Pr(Out=4)		**Pr(Out=5)**		**Pr(Out=6)**	
ROA	-0,075	**	-0,081	**	0,571	**
Tot. Assets	-0,004	*	-0,005	*	0,034	*
Leverage	0,000		0,000		0,000	
Liquid. Ratio	-0,001	***	-0,001	***	0,004	***
Intensity	-0,037	***	-0,040	***	0,284	***
Duration	-0,041		-0,044		0,310	
Inflation	0,051	*	0,055	*	-0,390	*
GDP	-0,008	*	-0,008	*	0,058	*
ROA × Duration	0,022		0,024		-0,166	
Leverage × Duration	0,000	*	0,000	,	-0,001	*
Liquid. Ratio × Duration	0,000	*	0,000	**	-0,001	**
Tot. Asset × Duration	0,001		0,001		-0,010	

Note : *,**,*** : statistical significance at resp. 10%, 5% and 1%.
Pr(out=i): probability of outcome i.