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Threshold Effect of the Number of Bank Relationships on the Tunisian Firm Performance

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Abstract: *The aim of this paper is to define the optimal number of bank relations and to investigate its impact on the performance of some Tunisian firms. To achieve these goals, we used a sample of 36 Tunisian listed companies over the period 2008-2015 and we performed the Panel Smooth Transition Regression (PSTR) as econometric approach. Empirical results show that the optimal number of bank relationship for Tunisian listed companies is 3.222. Findings indicate that within this optimal number, bank-firm relationships exert a positive and significant effect on the performance of the Tunisian listed companies. For macroeconomic factors, results show that the Growth rate of Gross domestic Product (GDPG) increases significantly the firm performance; however, the effect of inflation is negative but not significant.*

Keywords: Tunisian Firms, Bank-Firm Relations, PSTR Model

JEL: G21, G32, L14

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1. Introduction

A bank enterprise relationship could be defined as a bilateral loan agreement between two entities with the aim is to undertake a financial transaction. The first partner is the provider of fund whereas the second is the client. In Literature, there are multiple definitions of bank enterprise relationship. The most widely used one is suggested by Boot (2000: 10) in which the relationship banking consists of provisioning of financial services by a financial intermediary that invests in obtaining customer specific information, often proprietary in nature; and evaluates the profitability of these investments through multiple interactions with the same customer over time and/or across products.

Building a strong and effective relationship is fruitful for both sides. For banks, it reduces the costs associated with information asymmetry either hard or soft and makes the relations with their customers more transparent, longer and less risky. This will lead bank to better manage the behavior and risk profile of its customer. In this case, the bank may benefit from economies of scale, and it could smooth the cost with different types of financial services (Greenbaum and Thakor, 1995). For enterprises, relationship financing makes access to funds easier, avoids the credit rationing and all other extra costs, which in turn will improve the firms' overall performance.

The pioneering paper on bank-firm relationship was conducted by Stiglitz and Weiss (1983), and later on by the works of Hoshi et al (1990), Ongena and Smith (1998), D'Auria et al. (1999), Boot (2000), Berger and Udell (2002), Padilla and Pagano (2000), etc. The authors showed the crucial role of bank in the expansion of enterprises activities and the role of enterprises in creating added value. In fact, by facilitating access to finance, banks will allow enterprises expanding their businesses and the overall economy can fully benefit

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from this association. However, the relationship between both sides could be flawed when one of the required conditions of the contract is missing. Furthermore, information asymmetries and overall macroeconomic condition could affect the nature of the relation. Therefore, it was argued that diversifying partners by increasing the number of relationships could be desired in certain cases. Empirical literature on bank relationship has focused on two main dimensions: the number of bank-firm relationships and the duration. For the first dimension, empirical studies have studied the benefits and costs of single and multiple bank-enterprise relation. Therefore, results are mixed. Several studies highlighted the benefit single bank relationship De Bodt et al. (2005), Peterson and Rajan (1994), and Peterson and Rajan (1995). However, some others defended the benefit of multiple relations Carletti (2004), Dewatripont and Maskin (1995). For the second dimension, long term bank-firm relationship has been strongly discussed more than short term relation (Eber, 2001).

As developed above, several studies investigated the costs and advantages of single and multiple bank-firm relationships (Fowowe, 2017; Vovchak, 2017; Hamdi et al., 2012a; Hamdi et al., 2012b; Hakimi and Hamdi, 2014). However, we noticed the absence of studies that investigate the optimal threshold of the number of bank relations that might affects the firm performance.

This paper tries to fill the gap and contributes to the existing literature as follow: contrary to previous studies that investigated only the effect of single or multiple banking relationships on firm performance, in this work we search the optimal number of relations that may affect the level of performance. Earlier studies on the impact of multiple bank relationships have provided mixed results. However, nothing was said from which number these relations can affect the level of firm performance positively or negatively. In our study, we use Tunisia as a case study for many reasons. First, companies and especially SME play a crucial role in the innovation process, the job creation and in financing economy. Second, most of Tunisian companies consider bank financing as the classic and the most used source of funding[1]. For example, the domestic credit to private sector by banks (% of GDP) was 53.39% in 2000 and it reaches 57.24% in 2008 and 81.15% in 2016. Credit to private sector provided by banks continues to well participate to the Tunisian gross domestic product. It crossed form 53.39% in 2000 to register 75.13% in 2015 and 77% in 2016. Form these statistics, we conclude the strong orientation of the Tunisian firms to bank lending in comparison with the market financing. Hence, bank-firm relationships are considered as an interesting topic that affects the level of performance for both partners.

The purpose of this paper is to determine the optimal number of bank relations and to test the effect of this number on the performance of Tunisian firms. To achieve these two goals, we used a sample of 36 Tunisian listed companies over the period 2008-2015 and we performed the Panel Smooth Transition Regression (PSTR) as econometric approach.

The remainder of this paper is structured as follows. Section 2 gives a brief literature review. Section 3 presents the data and methodology. Section 4 presents the model estimations and discusses results. Section 5 concludes.

2. Literature Review

The bank enterprise relationship has been a subject of extensive studies since the beginning of the 21st century. To date, the question on the number of bank enterprise relationship is still confusing. In fact, many studies have shown the benefits of having a single and an exclusive bank lending relationship. For example, the findings of Padilla and Pagano (2000), Hoshi et al. (1990), Raghavendra (2000), Harhöff and Körting (1998), Elyasiani and Goldberg (2004), Cole (1998) and Cole et al. (2004) showed that limiting to a one unique bank lending relationship improve the performance of firms since multiplying the partners lead to multiplying costs of maintaining the relationships. Moreover, they opined that having a single and exclusive bank borrower relationship improves the quality of information between the two parties and make the relation more transparent and more effective (Degryse and Ongena, 2001). For these authors, with the absence of information asymmetries, the costs of funding decrease and liquidity becomes more available at affordable costs for enterprises. According to Diamond (1984), maintaining multiple relationships is expensive, primarily due to transactional costs.

Empirically, the study of De Bodt et al. (2005) demonstrated that under a single bank borrower relationship, SMEs can benefits from a competitive lending interest rate and an affordable cost of having credit, which in turn will improve the SMEs financial conditions. Similarly, Peterson and Rajan (1994, 1995) have conducted a study based on U.S. SMEs data, and found that a single and exclusive reduces the cost of financing and lower the probability of credit rationing. Another study by Belaid et al. (2017) covers 383 Tunisian firms during the period 2001-2012. Using 494 types of bank enterprise relationships, their results found that firms with strong bank relationships are less exposed to credit default. However, with regard to the impact of the duration of bank-lending, findings indicate that there is no significant association with credit risk. For many other researchers, keeping a single and exclusive bank relation could be a reason for high risk taken by firms. As Fama (1995) states, an exclusive bank relationship encourages firms to take more risk because they know in advance that they will be financed in the case of financial difficulties. Therefore, an excess of risk taking by these firms may deteriorate their performance and increase their fragility. For Sharpe (1990) and Detragiache et al. (2000), maintaining an exclusive bank relationship in a period of stress and uncertainty, lead to a problem of liquidity since banks will either refuse financing their customers even with good quality or will increase lending rates (credit rationing).

On the other hand, many other researchers investigated the impact of multiple bank enterprise relationships on the performance of firms. For example, Carletti (2004) argued that increasing the number of lender might allow firms to benefit from diseconomies of scale in monitoring and hence obtain lending rates that are more competitive. For Dewatripont and Maskin (1995), increasing the number of relations with lenders is seen as an optimal solution to the soft-budget-constraint problem inherent with single banking relationships. The study of Hamdi et al. (2012) shows that multiplying bank partnership is optimal as it gives firms the choice to select the suitable lenders with the best credit offer. The authors consider multiple bank relationship as the ideal strategy to cope with credit rationing concerns. Thakor (1996) states that increasing the number of banks increases the *ex-ante* probability of credit rationing while working with a large number of banks may increase the *ex post* probability of access to credit. Hakimi et al. (2012) have argued that firms with good quality multiply banking relationships to escape the hold–up problems while firms with bad quality multiply bank relationships to access to other sources of financing often at a higher cost.

Empirically, Ongena and Smith (2000) have conducted a study for 20 European countries using 1079 firms. Their findings suggest that 85% of the surveyed firms have at least more than one bank partner. For countries like France, Italy, Spain and Portugal, firms have on average more than 10 different bank relationships (Peterson and Rajan, 1994; Jeminez and Saurina, 2004). Hakimi and Hamdi (2012) found that firms with multiple bank relations are often facing high interest rates because banks do not have enough information on these entities as the duration of their relationship is short. Therefore, banks and firms did not have strong confidence about each other.

3. Data and Methodology

To investigate the impact of the number of bank relationships on the firm performance, an unbalanced sample of 36 Tunisian listed firms over the period 2008-2015 was used. Data are collected from the annual report of each company. In this study, financial institutions are excluded due to their financial structure. It should be mention that in 2015; only 78 firms are listed in the Tunis Stock Exchange. However, we limit our study to the non-financial institutions and it’s for this reason that we retain only 36 firms for all the period of study. The number of listed companies crossed from 50 in 2008 to reach 78 firms in 2015. Most of these companies are financial institutions such as banks, insurance and other financial services institutions. The evolution of the number of Tunisian listed companies is presented in the table 1 below.

Table 1. Number of Tunisian listed firms and Market capitalization

Years	2008	2009	2010	2011	2012	2013	2014	2015
Number	50	52	56	57	59	71	77	78
Market capitalization in % of GDP	17	21	24.1	22.1	19.5	18.8	21.4	20.9

Source: Annual report of the Tunis Stock Exchange

The hypothesis that the number of bank relationships and firm performance are nonlinear motivates us to apply the PSTR model. Based on the previous studies that investigate this relationship and which are ambiguous, we think that an increase or decrease of number of bank relations may not necessarily be associated with an increase or decrease of performance and *vice versa*. The application of this model depends on whether these two variables are nonlinear or not.

3.1. The Model and Variables Definition

To investigate the nonlinear relationship between the number of bank relationships and the performance of Tunisian listed firms, we will specify the following PSTR model. Using this empirical model, we aim to determine the optimal number of bank relations that can affect firm performance. The dependent variable $y_{i,t}$ is the return on assets (ROA) and the transition variable $g(q_{i,t} .\gamma. c)$ is the number of bank-firm relationship *(NREL)*.

The PSTR model, proposed by González et al. (2005), is an extension of the PTR model of Hansen (1999). It is a fixed effects model with exogenous regressors. The PSTR model is considered a nonlinear homogenous panel model. Following González et al. (2005), the theoretical modelling of the PSTR is given by the following equation:

$$y_{i,t} = \mu_i + \beta_0^{'} x_{i,t} + \beta_1^{'} x_{i,t} g\left(nrel_{i,t}, \gamma, c\right) + \varepsilon_{i,t} \qquad (1)$$

For *i= 1. . . N*, and *t= 1. . . T*, where *N* and *T* denote respectively the cross-section and time dimensions of the panel. $y_{i,t}$ is the dependent variable. u_i indicates the vector of the individual fixed effects and $g\left(nrel_{i,t}, \gamma, c\right)$ *g* is the function of transition which depends on the transition variable of transition($nrel_{i,t}$), to the parameter of threshold (C) and to the smooth transition parameter (γ). $x_{i,t} = (x_{i,t}^{1}$,.........,$x_{i,t}^{k})$ is a vector of kk explanatory variables and where $\varepsilon_{i,t}$ is a random disturbance. β_0 and β_1 indicate respectively the parameter vector of the linear model and the non-linear model. The transition function of the PSTR model $g\left(nrel_{i,t}, \gamma, c\right)$ *g* allows the system to transit gradually. To well define this transition function, we use the following logistic form of *m* orders in the equation (2) proposed by González et al. (2005), like Granger and Teräsvirta (1993), Teräsvirta (1994), and Jansen and Teräsvirta (1996):

$$g\left(, nrel_{i,t}, \gamma, c\right) = \left[1 + \exp(-\gamma \prod_{j=1}^{m} \left(nrel_{i,t} - C_j\right)\right]^{-1} \qquad (2)$$

Where γ >0, c_1<...<c_m and $c = (c_1 \dots \dots c_m)$ is a vector of level parameter. γ represents the supposed positive smooth parameter. Ibarra and Trupkin (2011) reported that if γ is very high the PSTR model is considered as a model with two regimes. Hence, the transition function can be written in the equation (3) as follow:

$$\begin{aligned} ROA_{i,t} = {} & \mu_i + \alpha ROA_{i,t-1} + \beta_0^1 short_{i,t} + \beta_0^2 size_{i,t} + \beta_0^3 age_{i,t} + \beta_0^4 levr_{i,t} + \\ & \beta_0^5 GDPG_{i,t} + \beta_0^6 inf_{i,t} + \left[\beta_1^0 short_{i,t} + \beta_1^1 size_{i,t} + \beta_1^2 age_{i,t} + \beta_1^3 levr_{i,t} + \beta_1^4 GDPG_{i,t} + \right. \\ & \left. \beta_1^5 inf_{i,t} + \beta_1^6 nrel_{i,t} \right] g\left(nrel_{i,t}, \gamma, c\right) + \varepsilon_{i,t} \end{aligned} \qquad (3)$$

In the non-linear model described above, firm performance was explained by the main firm specifics (Size, Age and Leverage), bank credit (short-term credit) and macroeconomic specifics (annual growth of Gross Domestic Product (GDPG) and inflation rate (INF))

(ROA) is the return on Assets measured by the net profit divided by the total Assets. There are several financial and non financial measures of performance. As documented in several previous studies (Chong, 2008; Santos and Brito, 2012; Fowowe 2017), financial measures can includes, returns on investment (ROI), returns on equity (ROE), return on Assets (ROA), earnings per share (EPS), Tobin's Q ratio . Non-financial measures maybe proxied by number of employees, revenue growth, revenue per employee, market share. However, the non-financial measures have the disadvantage of being subjective (Santos and Brito, 2012; Chong, 2008). It's for this reason that we apply for financial measures but we limited our work only for the returns on Assets (ROA). This choice is justified by the fact that only this measure is nonlinear with the performance of firm. However, all other measures are linear with the transition variable (number of bank relations).

(NREL) is the number of bank-firm relationship (Hamdi et al. (2012a), Hamdi et al. (2012b) Hakimi and Hamdi (2014)). *(SHORTC)* is the short-term credit granted to firm and measured by the Napierian logarithm of total short-term credits. As measure of bank credit financing, this variable used in several previous studies (Morgues, 1994; Severin, 2012).

(SIZE) is the firm size measured by the Napierian logarithm of total assets. *(AGE)* is the firm age measured by the difference between the current year and the date of creation. *(LEVRAGE)* is the debt ratio measured by total debt to total Asset. As firm specifics these three variables are considered as key determinants that affect the level of performance (Majumdar, 1997; Papadogonas, 2007; Halil and Hasan, 2012; Akinyomi and Olagunju, 2013; Dogan, 2013).

(GDPG) is the annual growth of Gross Domestic Product. *(INF)* is the inflation rate measured by the index of customer price. Macroeconomic in which operate companies can affect the level of performance. It's for this reason that we introduce in our econometric model two macroeconomic variables (Oliver, 2000; Chee Chee and Herbeman, 2002).

4. Empirical Results and Discussion

In this section, we will present and discuss empirical findings. Before testing the PSTR model and the jointly tests, we will give firstly a descriptive analysis of our data and the correlation matrix. Secondly, the test of stationarity, linearity and the test of the number of transition are performed and discussed. Finally, we estimate the PSTR model.

4.1. Descriptive Statistics and Correlation Matrix

The table 2 below summarise descriptive statistics for all variables used in our study. For each variable, we give average value, median, standard deviation, minimum and maximum values. Descriptive statistics are presented to describe the basic characteristics of data used in this study concerning 36 firms over the period from 2008 to 2015.

Table 2. Descriptive Statistics

					Quantiles			
Variable	N	Mean	S.D.	Min	.25	Mdn	.75	Max
ROA	286	0.03	0.10	-0.28	0.00	0.04	0.08	0.203
NREL	288	2.80	1.97	1.00	1.00	2.00	4.00	10.00
SHORTC	275	15.15	2.14	5.15	14.37	15.65	16.43	18.91
AGE	288	40.08	17.35	8.00	28.00	36.00	50.00	90.00
SIZE	288	7.75	0.41	6.48	7.52	7.73	7.98	9.68
LEVR	231	0.18	0.54	0.00	0.04	0.11	0.19	7.92
GDPG	288	0.02	0.02	-0.02	0.02	0.03	0.04	0.04
INF	288	0.05	0.01	0.04	0.04	0.05	0.05	0.06

The average ROA was 3% with a maximum value of 20.3% and a minimum value of -28%. The number of bank relationships (NREL) recorded a mean value of 2.8 and 10 relations as a maximum value. The average value of short-term credit (SHORTC) is about 15.18 with a minimum of 7.24 and a maximum of 18.50. It's forth recalling that this variable is in Napierian logarithm and to have more precise value we must practice the exponential function in order to get the necessary amount of short-term and long-term credit.

For the firm age (Age), the average value is 40.08 with a minimum value around 8 years and a maximum of 90 years. The high average age for Tunisian listed companies indicates that these firms are more experienced and this can improve their productive efficiency over the time. The average size (SIZE) is about 7.75 with a maximum value of 9.68 and a minimum value of 6.48. Like short-term and long-term credit, this variable is in Napierian logarithm and to have more precise value, we should practice the exponential function.

As macroeconomic variables, the GDPG records an average of 2% with a maximum value of 4% and a minimum of -2%. The second variable is the inflation rate. The average of this variable is 5% and the maximum and the minimum levels are respectively 6% and 4%.

After giving some statistics about all variables of our study, the following table gives the level and nature of correlation that exists between variables used in the econometric model. Table 3 presents the correlation matrix which gives information on the level and the nature of linkages between variables by determining the coefficients of linear correlations of them taken two by two.

Table 3. Correlation Matrix

	Roa	Nrel	shortc	Age	size	Levr	Gdpg	Inf
Roa	1.0000							
Nrel	0.1555	1.0000						
Shortc	0.0717	0.4011	1.0000					
Age	-0.0682	-0.1463	0.0690	1.0000				
Size	-0.1831	0.1884	0.2858	0.4158	1.0000			
Levr	0.0466	0.1946	0.1591	-0.0763	-0.2131	1.0000		
Gdpg	0.0035	-0.0186	-0.0880	-0.0458	-0.0671	0.0039	1.0000	
Inf	0.0939	0.0001	0.1129	0.0608	0.0443	0.1252	0.4233	1.0000

From table 3, it can be seen that the short-term and the number of bank-firm relations is negatively correlated with firm performance. However, the rest of variables such as firm age, size, leverage and the two macroeconomic variables are positively associated with the dependent variable. The second observation that can be drawn from this table is that there is no high correlation between variables. This leads to confirm the absence of the multicollinearity problem.

4.2. Specific Tests for the PSTR Model

Before testing the PSTR model, there are some *pre*-tests that should be checked. The first one tests for stationarity of all variable used in this study. The second aimed to test the linearity or homogeneity. The third tests the number of regime. Finally, the fourth test is done to identify the optimal threshold. Table 4 presents results of the panel unit root test. Table 5 below summarizes results of the test of linearity based on the statistics of LM Wald, LM Fisher and LR tests.

4.2.1. The Panel Unit Root Test

The procedures of PSTR specification rely on the assumption that all variables in Model (1) are *I(0)* process. To test for stationarity, we used the Levin, Lin, and Chu (2002) test, the Augmented Dickey Fuller tests (ADF) and the Phillips and Perron (1988) test. Results displayed in Table 4 indicate that the LLC, ADF and

PP tests reject the null hypothesis at 1% and 5% significance level for all variables used in this study. From these results, we can conclude that all data are *I(0)* process.

Table 4. Panel unit root test (PURT)

Variables	L.L.C	A.D.F	P.P
ROA	-9.928***	108.407***	130.462***
NREL	-15.294****	96.665***	54.084**
SHORTC	-20.243***	94.637**	72.6633**
AGE	-19.257***	90.477**	124.546***
SIZE	-5.132***	91.737**	154.271***
LEVR	-6.695***	92.379***	87.029***
GDPG	-16.829***	206.701***	260.206***
INF	-5.863***	89.820**	252.448***

Note: (***), (**) denote significance at 1% and 5%, respectively.

4.2.2. The Test of Linearity

The objective of this empirical study is to confirm that there is a non-linear relationship between bank credit and firm performance. To this end, we conduct a test of linearity against the PSTR model. The null hypothesis is H_0: $\beta_1 = 0$ and the alternative is H_1: $\beta_1 \neq 0H$. However, the test will be nonstandard since, under H_0 the PSTR model contains unidentified nuisance parameters[2]. The transition function $g(q_{i,t}, \gamma, c)$ will be replaced by its first order Taylor expansion round γ= 0. The null hypothesis of this test becomes, H_0: $\gamma = 0$. The new function of transition can be written as following in the following equation:

$$y_{i,t} = \mu_i + \beta_0'^* X_{i,t} + \beta_1'^* X_{i,t} q_{i,t} + \cdots + \beta_m'^* X_{i,t}\, q_{i,t}^m + \varepsilon_{i,t}^* \tag{4}$$

Where the parameter vectors $\beta_1'^*, \ldots\ldots, \beta_m'^*$ are multiples of γ and $\varepsilon_{i,t}^*$ = $\varepsilon_{i,t} + R_m \beta^* X_{i,t}$ where R_m is the residual of Taylor development. This null hypothesis may be conveniently tested by a Wald and Likelihood ratio tests. If we denote *SSR₀* the panel sum of squared residuals under H_0 (linear panel model with individual effects) and SSR1the panel sum of squared residuals under H_1 (PSTR model with two regimes), the Wald LM test can be written in the equation (5) as:

$$LM_w = \frac{TN(\,SCR_0 - SCR_1)}{SCR_0} \tag{5}$$

Where; SCR_0 and SCR_1denote the residual squared sum of the panel under the null hypothesis (lineair panel model with individual effects) and the residual squared sum of the panel under the alternative hypothesis (PSTR model with m transition). If the sample size is small, Gonzàlez et al. (2005) suggest the use of the Fisher statistics (LMF) which is defined in the equation (6) as:

$$LM_w = \frac{TN(\,SCR_0 - SCR_1)/mk}{SCR_0/TN - N - mk} \tag{6}$$

Where; *k* is the number of explanatory variables. LM_F is assumed to follow Fisher distribution with *mk* and *TN - N- mk* degrees of freedom (*F* (*mk*, *TN- N - mk*)). Under the null hypothesis, all linearity tests follow a chi-2 distribution with *k* degrees of freedom ($\chi^2(k)$).

Table 5 shows that the null hypothesis is rejected at the 1% and 5% levels for the three tests. Results imply that there exists non-linear relationship between number of bank lending relationships and Tunisian firm performance. We thus employ the estimation of non-linear model using the PSTR estimation.

Table 5. Linearity Test

Tests	Number of bank-firm relations (NREL)
Lagrange Multiplier (W)	16.102
	(0.0065)
Lagrange Multiplier (F)	2.836
	(0.0170)
Likelihood-ratio test (LR)	16.707
	(0.0050)

After checking the stationarity and the non-linearity hypothesis between bank credit and firm performance, the third step consists to test for remaining of linearity.

4.2.3. Test of Number of Transition

This test identifies the number of the function of transition. This test aims to check the null hypothesis when the PSTR model has one function of transition (m=1) against the alternative hypothesis when the model has at least two functions of transition (m=2). Decisions of this test are based on the LM_w and LM_F statistics. If the coefficients are statistically significant at level of 5%, we reject the null hypothesis and we admit that it exist at least two functions of transition. Otherwise, we cannot reject the null hypothesis and we conclude that the model has one threshold.

Table 6. Test for the Number of Regimes

Hyposteses	Tests	Statistics	P-value
(1)H0 : r = 0;H1 : r = 0	LM test	8,151	0,067
	LR test	3,504	0,098
(2)H0 : r = 1;H1 : r = 2	LM test	4.332	0.143
	LR test	1.134	0.284

Results from Table 6 indicate that both hypothesis without threshold *(r = 0)* and with at least two thresholds *(r = 2)* are rejected at the 1% and 5% significance for the two tests. Based on these results, the sample has only one threshold of number of bank relationships.

The last step determines the threshold of number of bank relations that affects firm performance. In other words, we will determine the optimal number of lending relations from which firm performance will be positively or negatively affected.

4.2.3. The Optimal Threshold

Table 7 below indicates that the threshold of the number of bank relationship is 3.222. Consequently, the optimal number of bank relationship for Tunisian listed companies is between three and four relations. In comparison with the mean value of this variable, descriptive statistics records a value of 2.80. This value indicates that on average, our sample has a number of banking relation between two and three relations. This level is not far for the optimal number.

Table 7. Threshold Values

Threshold level	Number of bank-firm relations (NREL)
γ	5.000
$\boldsymbol{C}$	**3.222**
AIC	-6.0932
BIC	-5.880

There are no previous studies that investigated the threshold of number of bank relationships. However, we can refer to earlier studies taking into the mean values of number of bank relations. For the same Tunisian context, Hamdi et al. (2012a) found that the average number of banking relationships is between 2 and 3 more precisely 2.613. In another study, Hamdi et al. (2012b) reported that the mean number was 1.755. More recently, Hakimi and Hamdi (2014) indicate that the average number of bank relations was 1.74.

4.3 Results of the PSTR Model

Table 8 presents the estimation of PSTR model for the whole sample of 36 Tunisian listed firms during the period 2008-2015. The estimation is done by applying nonlinear least squares to data eliminated the individual effects.

Table 8. Coefficient Estimation of the PSTR Model

Number of bank-firm relations (NREL)			
Variables	Coeff	T-value	P-value
NREL	**0.005**	**1.072**	**0.284**
SIZE	0.038	1.388	0.166
LEVR	-0.018	-0.696	0.486
SHORTC	0.010	2.706	0.007***
AGE	-0.001	-0.758	0.448
GDPG	0.420	1.788	0.075*
INF	-0.170	-0.250	0.802
NREL* $\boldsymbol{g(nrel_{i,t}, \gamma, c)}$	**0.221**	**3.775**	**0.000*** **
SIZE* $g(nrel_{i,t}, \gamma, c)$	-0.337	-2.322	0.000***
LEVR* $g(nrel_{i,t}, \gamma, c)$	-0.191	-4.684	0.000***
SHORTC* $g(nrel_{i,t}, \gamma, c)$	0.321	4.990	0.000***
AGE* $g(nrel_{i,t}, \gamma, c)$	0.036	3.479	0.000***
C		5.000	
γ		3.222	
Obs		259	

****, ** and * indicate level of significance respectively at 1%, 5% and 10%*

Results displayed in table 8 indicate that only short-term credits increase significantly at 1% the Tunisian firm performance. However, the rest of variables do not exert any significant effect. For companies, bank credit is a means of funding that support their activities, improve their productivity and stimulate economic growth. The short-term bank credits have for object to insure the balance companies' account. The short-term credit contracted by SME is often granted with lower interest rate compared to those of long-term. These low interest rates lead to a reduction in financing costs and consequently increase firm performance. However, in the short term, company can be exposed to an insufficiency in working capital.

Taking into the size of Tunisian companies which are medium and small sized, short term credit is most appropriate for these firms. It's worth recalling that our sample is made by non-financial listed companies. Hence, these firms can be financed in the financial marked and yet, it seems that bank credit acts significantly on firm performance. This result confirms a complementary relationship of bank financing and under financial market.

With regards to the macroeconomic variables, results show that GDPG exerts a positive and significant impact on the firm performance. This result implies that an increase in the level of economic activity is accompanied by increases in ROA. However the effect of inflation is negative and insignificant. Under a stable macroeconomic environment, firms invest more and improve their activities which lead to an increase in their performance. Also, an increase in economic activity flows through to sales activity and thus positively affects ROA. This result supports findings of McNamara and Duncan (1995).

Let's turn to the effect of our explicative variables taking into account the transition function. In other words, an interpretation of the impact of these variables combined with the optimal threshold of the number of bank relationships is needed. Results presented in Table 8 show that the effect of all explicative variables become significant taking into account the optimal number of bank relationships which ranges between three and four relations. Results indicate that short-term credit (*SHORTC*NREL*), and firm size *(SIZE* NREL)* act positively on the Tunisian firm performance. However, the effect of leverage *(LEVR* NREL),* firm age *(AGE* NREL)* and inflation *(INF* NREL)* is negative.

Findings indicate that with the optimal number of bank lending relations 3.222, (NREL) exerts a positive and significant effect on the performance of the Tunisian listed companies. Companies search to have multiple bank relationships in order to access to other sources of funding and banks try to diversify their credit risk. Two theoretical explanations are presented to justify the orientation to multiple bank relationship. For companies with good quality, multiple bank relationships are considered as a solution to escape from the market power and from the *hold-up* problems. For distress companies, the multi-banking is an effective way for the access to other sources of funding often in higher costs. Our results are in line with Ogawa et al. (2007), Refait-Alexandre and Serve (2016).

Between 3 and 4 bank relations as optimal threshold of number of bank relationship, an increase of the firm size decreases significantly the performance of the Tunisian listed companies. The negative relationship has been explained by the structural inertia theory. More than the firm becomes larger, the volume of bureaucracy increases and this may cause stiff resistance to change which will ultimately decrease the level of profit. This result is in line with Hannan and Freeman (1984), Amato and Burson (2007). In contrary, findings indicate that an increase in the firm age (AGE) under the optimal number of bank relations is associated with an increase of performance. This result means that if firms become older, their performance will be improved. The theory of learning by doing, explains the positive relationship. Our results support the finding of Halil and Hasan (2012), Papadogonas (2007) and different from Pervan et al. (2017) and Lwango et al. (2017).

Results indicate that the leverage ratio (LEVR) taking into the optima number of banking relationship acts negatively and significantly at 1% of significance on the firm performance. This means that an increase of total debt compared to total equity decreases significantly the performance of Tunisian companies. Debt affects negatively the firm performance especially under a high cost of debt. Also, a weak level of equity compared to debt decreases the firm performance in period of financial distress or financial crisis. Whatever the creditor, banker or supplier it results a reduction in line of credit toward firms in period of instability and crisis. It's for this reason that firms are invited to strengthen the level of own equity. Various theories are based on the determinants of capital structure and how this capital structure can affects firm value or performance (Modigliani and Miller, 1958; Modigliani and Miller, 1963; Miller, 1977). Our results indicate that higher leverage is associated with lower performance. The higher leverage or the high debt (debt overhang) leads to higher agency costs stemming from the conflict between shareholders, managers and bondholders, resulting either in underinvestment or investment in overly risky projects. Our results are in line with Rajan and Zingales (1995), Majumdar and Chhibber (1999), Pandey (2002), and Ghosh (2008).

5. Conclusions and Policy Implications

Using a sample of 36 Tunisian listed companies over the period 2008-2015 and performing the PSTR model as econometric approach, the aim of this paper was to determine to optimal bank relations and to test the effect the number of banking relationships on the performance of non-financial Tunisian listed firms. Results of PSTR model indicate that the optimal number of relations is between 3 and 4 relations precisely 3.222 relations. This result suggests that multiple bank relations precisely between three and four relations are more suitable for Tunisian companies. Considering some firm specifics of Tunisian companies like size, age and financial structure, single bank relation cannot supply the necessary funds able to develop their activities and support them especially in the periods of crises.

Findings indicate the effect of the number of relation (NREL) does not exert any significant effect on the level of performance. However, from the optimal number of relationships (3.222), the effect becomes positive and significant. Companies search to have multiple bank relationships in order to access to other sources of funding and banks try to diversify their credit risk. Two theoretical explanations are presented to justify the orientation to multiple bank relationship. For companies with good quality, multiple bank relationships are considered as a solution to escape from the market power and from the *hold-up* problems. For distress companies, the multi-banking is an effective way for the access to other sources of funding often in higher costs. Results indicate also that short-term credits increase significantly the Tunisian firm performance. For companies, bank credit is a means of funding that support their activities, improve their productivity and stimulate economic growth.

For macroeconomic factors, results show that GDPG increases significantly the firm performance. Under a stable macroeconomic environment, firms invest more and improve their activities which lead to an increase in their performance. Also, an increase in economic activity flows through to sales activity and thus positively affects ROA. However inflation does not exert any significant effect.

Results of this paper can be considered very valuable for both Tunisian banks and companies. First, this determines the optimal number of bank relations that affects the firm performance. Policy makers, financial analysts and investors are able to specify the optimal number of relations. Consequently, within an optimal number of bank lending, they can ensure the necessary funds and avoid the debt overhang situation that affects negatively the firm performance and the real economy. Also, results in this paper could be of great interest since it will able for investors in a specific economy to make decision between single and multiple bank relationships.

End Notes

1. *In December 2016 the total bank credit granted to Tunisian companies was 256280 MD for short-term credit and 21430645 MD for long-term credit.*
2. *For more details, see Hansen, (1999) González et al. (2005), following Luukkonen et al. (1998)*

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