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The Effect of Firm Level Data and Macroeconomic Conditions on Credit Risk of Industrial Tunisian Firms

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Abstract The main purpose of our study is to identify the main factors causing the corporate credit risk. Indeed we evaluate the effect of firm level data as internal factors and or macroeconomic conditions as external factors on credit risk of industrial Tunisian firms. Thus, we use Explanatory Factor Analysis to identify the measures of credit risk. Moreover, we estimate four empirical models which take into account firm specific data and macroeconomic variables. Our results provide a number of important insights. The results obtained suggest that the Tunisian corporate credit risk measured by debt and liquidity level is influenced by firm-specific characteristic. Indeed, we find that the turnovers, total liabilities / total assets and need working capital affect significantly the credit risk of Tunisian industrial firms. In addition, we find an important result that turnovers and Total Liabilities/Total Assets are a key factors comparing with other factors which affect corporate credit risk of Tunisian firms since Tunisian firms are characterized by small and medium firms. Moreover, our results indicate that the corporate credit risk of industrial firms depends on macroeconomic conditions.

Keywords: *corporate credit risk, firm level information, macroeconomic variable, explanatory factor analysis*

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1. Introduction

The corporate credit risk is one of the main risks that seriously affects the country economies. Firms default has serious consequences on financial stability. Indeed, failure due to a corporate credit risk may be accompanied by an increase of bank credit risk since firms default on its debt. Moreover, investors become pessimistic since he loses his money affecting thus the behavior of financial markets.

The understanding of corporate credit risk or the identification of variables which affect corporate bankruptcy is necessary to firms, banks and financial regulatory authorities. First, the identification and the control of determinants that cause corporate bankruptcy allow firms to decrease the risk of default and to maintain their performances especially during crises period. Second, it is necessary for banks because it can maintain their performances and their profitability by lending to firms which are able to meet its financial obligations reducing thus insolvency risk. Finally, financial regulatory authorities can implement numerous reforms regarding the protection of financial system by acting on one of corporate credit risk determinant to mitigate the default of firms. Thus, the identification of key factors that affect corporate credit risk is an important issue to investigate especially in Tunisia as emerging market.

The literature on corporate credit risk has been developed [1,3,7,9,14,20]. Beaver [3] suggests that a large amount of debt held implies a high level of bankruptcy probability. Altman [1] suggests that the discriminant analysis of financial ratios proved to be extremely accurate in predicting bankruptcy. Bonfim [7] who focuses on the analysis of failure risk at the firm level suggests that the macroeconomic conditions present an additional and an independent importance to specific firm information in explaining the credit risk. Bonfim [7] suggests that the study of credit risk determinants my help financial institution to predict the firms default risk. Indeed, this author finds that the default probabilities are influenced by several factors like their financial structure, profitability and liquidity. Qi and Zhao [19] who examine the determinants of creditor recoveries from defaulted debt instruments suggest that firm conditions measured by trailing stock returns present an important determinant of recovery risks. In the same context, Tang and Yan [21] find that firm level determinants affect the default risk.

Despite the development of the literature relating to corporate credit risk but it is still limited. Our study is, to our knowledge, the first to provide such an extensive analysis of the corporate credit risk in the North African emerging countries and especially in Tunisia. Indeed, our objective in this paper is to identify the most important factors that affect corporate credit risk in Tunisia. Thus, we focus on two types of variables which may affect the corporate credit risk which are firm characteristics and macroeconomic variables. Thus, this paper added to the literature by point out the most important factor that can

be needed by banks and financial regulatory authorities to control credit risk and minimize default problem.

Our objective in this paper is to evaluate the contribution of firm level information and macroeconomic variables in explaining the credit risk of 178 Tunisian industrial firms during 9 years from 1997 to 2005. First, we identify the better measures for credit risk by using the Explanatory Factor Analysis (EFA). To identify the right number of credit risk factors we use the scree plot of the eigenvalues. Oblimin rotation is used to ientify the appropriate indicators of each factor measuring credit risk. Second, we estimate four empirical models which take into account firm specific data like turnovers, total liability/ total assets and macroeconomic variables like Index of Industrial production. The first model includes the firm's financial information as explanatory variables of firm's debt level. The second model includes the same variables used in the first one with the addition of macroeconomic variables. The third model includes the firm's financial information as explanatory variables of liquidity level. The fourth model includes the same variables used in the third model with the addition of macroeconomic variables.

The rest of the paper is organized as follows: Section 2 presents the literature review. Section 3 describes both the methodological approach and the results of corporate credit risk measures. Methological approch and empirical results of the impact of firm level information and macroeconomic conditions on credit risk are reported in section 4. Section 5 concludes the paper.

2. Literature Review

The analysis of corporate credit risk has become increasingly important subject to be studied. The literature on credit risk modeling is growing [1,3,9,11,14,15,18,20]. One of the pioneers of firm bunkrupcy analyses is Beaver [3] who studies the bankruptcy prediction models. However, Altman [1] use the discriminant-ratio model to predict bankruptcy on a sample of publicly held manufacturing corporations.

This author develop a discriminant function which includes ratios of working capital / total assets, retained earnings/ total assets, earnings before interest and taxes/ total assets, market value equity/ book value of total debt and sales/ total assets. Altman [3] doesn't consider in her study the cash flow to debt ratio which is suggested by Beaver [3] as the single ratio predictor. Altman [3] suggests that the discriminant analysis of financial ratios proved to be extremely accurate in predicting bankruptcy.

Atiya [2] analyses the problem of bankruptcy prediction by using neural-network system. He suggests that the neural-network system can be considered more superior than the other techniques used by searchers. Many others authors study the corporate credit risk like Pesarane et al. [17] who find that the credit risk can be linked to several factors such as the changes of stock exchange indexes, interest rates, inflation, and oil prices. Carling et al. [6] model the risk duration of default by taking into account the macroeconomic conditions. They find that macroeconomic variables have significant explanatory power in the analysis of credit risk. Bonfim [7] evaluates the link between credit risk and changes in macroeconomic conditions. This author concludes that the macroeconomic dynamic has an additional and an independent importance to specific information for firms in explaining the credit risk. Moreover, Bonfim [7] find that default probabilities are influenced by firm-specific characteristics like their financial structure, liquidity and their recent sales performance.

Recently, there are many empirical studies that focus on their study on default prediction models [8,21] to identify the determinants of recovery rates. Qi and Zhao [19] suggest that the seniority index is the most important index in explaining the recovery rates. They also find that firm conditions are the second most important determinant.

3. Credit Risk Measures

3.1. Methodological Approach

The main purpose of this study is to assess the impact of firm level information and macroeconomic conditions on credit risk of industrial tunisian firms. Thus, it seems crucial to identify the better measures for credit risk.

In this context, we use the Explanatory Factor Analysis (EFA). The Explanatory Factor Analysis (EFA) model can be written as:

$$x_i = \Delta\xi_I + \varepsilon_i \tag{1}$$

where X_i is a vector which includes the credit risk indicators (M indicators) for observation i (i= 1…k), Δ represnts the vector of factor loadings of order M x K, and **ξ** is a vector of latent variables. Under the assumption that the random error term ε_i is uncorrelated with latent variables the covariance matrix of x_i is given by:

$$\Xi = \Delta\Phi\Delta' + \Omega \tag{2}$$

where Ξ represents the parameterised covariance matrix. The covariance matrix can be decomposed in the covariance matrix of the factors Φ and the diagonal covariance matrix of error terms Ω. We use the Maximum Likelihood (ML) method to estimate the EFA model (the factors, the disturbance and the indicators are normally distributed). The log-likelihood function is as follow:

$$\text{In L} = \text{In}\,|\,\Xi\,| + \text{tr}[S\,\Xi - 1] \tag{3}$$

where S represents the sample covariance matrix. It is necessary to asses firstly the correlation (Pearson's correlation**)** among credit risk indicators before using Explanatory Factor Analysis (EFA)**.** Second, we choose the number of factors which represents credit risk by using the scree plot which plots the number of factors against the eigenvalues of the covariance matrix of the indicators. According to Kaiser's Rule, only factors with an eigenvalue exceeding one unit should be retained Kaiser and Dickman [13].

To check whether the data used is suitable for an EFA we use thirdly the Kaiser–Meyer–Olkin measure of sampling adequacy. A test statistic above 0.6 indicates that the data is suitable for an EFA [12].

Finally, to ientify the appropriate indicators of each factor measuring credit risk we use the Oblimin rotation. This rotation provides the best saturation factor solution and the best indicators projection of these factors. Ideally, each indicator should be correlated with only one factor.

As a result, a typical indicator will have the high factor loadings on one factor, while it has low loadings on the other factors Harris and Kaiser [10]. These factor scores were used as a dashboard to infer the determinants of credit risk.

3.2. Data

The objective of this paper is to identify the variables which affect the credit risk of industrial Tunisian firms. In search of credit risk measures for 178 Tunisian industrial firms during the period from 2000 to 2009 we use Working Capital/Total Assets; Earnings Before Interest and Taxes (EBIT)/Total Assets; Total Debt / Total Assets; EBITDA/ Interests; Interest/Total Assets ratios as debt ratios. Quick ratio; Current ratio; Cash&Securities/Total Current Assets; Cash/Fixed Charge and Fixed Charge Coverage ratio are used as liquidity ratios.

Table 1. Indicators of credit risk

	Ratios	Sources
Debt ratios	X1:Working Capital/Total Assets	NSI*
	X2:Earnings Before Interest and Taxes (EBIT)/Total Assets	NSI*
	X3: Total Debt / Total Assets	CBT **
	X4:EBITDA / Interests	NSI*
	X5:Interest/Total Assets	CBT**
Liquidity ratios	X6:Quick ratio	NSI*
	X7: Current ratio	NSI*
	X8: Cash and Securities/Total Current Assets	NSI*
	X9:Cash/Fixed Charge	NSI*
	X10:Fixed Charge Coverage ratio	NSI*

Note: NSI* is the National Statistics Institute of Tunisia, CBT** is the Central Bank of Tunisia. EBITDA is the earnings before interest payments, taxes,depreciation and amortizations.

Table 2. Correlation between credit risk indicators

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X_1	1									
X_2	0.415**	1								
X_3	-0.708*	-0.433*	1							
X_4	0.373*	0.986**	0.625*	1						
X_5	-0.378*	0.712*	0.649*	0.500**	1					
X_6	0.395**	0.047**	0.740*	0.623**	0.421*	1				
X_7	0.425*	0.049**	0.271*	0.412**	0.526**	0.658*	1			
X_8	0.253*	0.220*	0.235*	0.326**	0.405**	0.425*	0.927**	1		
X_9	0.327*	0.125*	0.255*	0.458**	0.685*	0.521*	0.544**	0.625*	1	
X_{10}	0.369**	0.325*	0.325*	0.238**	0.208*	0.345**	0.458**	0.598*	0.927**	1

Note: ** represents significance at 5 % level, * represents significance at 10% level. X1:Working Capital/Total Assets, X2:Earnings Before Interest and Taxes (EBIT)/Total Assets, X3: Total Debt / Total Assets, X4:EBITDA / Interests, X5:Interest/Total Assets, X6:Quick ratio, X7: Current ratio, X8: Cash and Securities/Total Current Assets, X9:Cash/Fixed Charge, X10:Fixed Charge Coverage ratio.

3.3. Results

3.3.1. Pearson's Correlation

To better measuring credit risk and to assessing the multidimensional character of credit risk, we employ the Explanatory Factor Analysis (EFA). Thus, we estimate first the Pearson's correlation coefficients between credit risk indicators to study the multicolinearity problem. Second, to identify the factors number for indicators of credit risk we represent the scree plot of the eigenvalues. Table 2 presents Pearson's correlation coefficients between indicators of credit risk. Figure 1 presents the scree plot of the eigenvalues.

The results indicate that most correlations coefficients are generally significant but slightly low which reject the multicolinearity problem. To identify the right number of factors that measures the credit risk from various indicators we use the scree plot of the eigenvalues.

Figure 1. Scree plot of the eigenvalues

Figure 1 clearly indicates that the optimal factor number of our dimensional credit risk is equal 2. Indeed, we should retain only the factors which have an eigenvalue which exceed 1.

3.3.2. Factor Matrix

We have find that the optimal number of credit risk measures in our paper is equal two. In this part of study we search the appropriate indicators of each factor of credit risk using factor matrix (Oblimin rotation). Table 3 presents the factor matrix of the 10 indicators. Table 4 presents the correlation between the two measures of credit risk.

Table 3. Factor matrix credit risk

	Credit risk		
Ratios	**Factor1**	**Factor 2**	**Variance explained**
X1: Working Capital/Total Assets	0.786	-0.374	0.325
X2: Earnings Before Interest and Taxes (EBIT)/Total Assets	0.723	0.255	0.854
X3: Total Debt / Total Assets	-0.708	0.449	0.802
X4:EBITDA / Interests	0.698	0.260	0.607
X5:Interest/Total Assets	0.642	0.367	0.755
X6:Quick ratio	0.255	0.761	0.658
X7: Current ratio	0.449	0.757	0.654
X8: Cash and Securities/Total Current Assets	0.460	-0.676	0.889
X9: Cash/Fixed Charge	0.367	-0.678	0.725
X10: Fixed Charge Coverage ratio	0.280	0.446	0.265
Kaiser–Meyer–Olkin index	0.641 χ2 (12003.683)*		
Variance explained	40%		28%
Total variance explained	68%		

Note: * represents significance at 5 % level.

Table 3 indicates that the Kaiser–Meyer–Olkin index is about 0.641 with a significant χ2 at 5 % level. This result indicates that the 10 indicators used are coherent. Thus, we can conclude that the two-factor model is appropriate.

The debt ratios present a high factor loading for the first factor. Thus, we label factor 1 *debt level factor*. Similarly, the liquidity ratios present a high factor loading for the second factor. Thus, we label factor 2 *liquidity level factor*.

The two factors explain 68 % of the total variance. Debt level factor explains 40% of the variance and liquidity level explains 28% of the variance. In total about 68% of the variance is explained by the two factors, while 32% of the total variance is unexplained, meaning that this part of variance is unique.

Table 4 indicates that the correlation between factor 1 and 2 is equal to 0.12. This correlation is quite low. Thus, we can conclude that the two factors measures present two different types of credit risk and therefore are complements.

Table 4. Correlation matrix between factors

	Factor 1	Factor 2
Factor 1	1	
Factor 2	0.12	1

4. Impact of Firm Level Information and Macroeconomic Conditions on Credit Risk

4.1. Data and Methodological Approach

The objective of this paper is to search the key factors that influence the credit risk. Indeed, we evaluate if the credit risk of industrial Tunisian firms depend to account firm-specific data and or to macroeconomic information. In this analysis, we use a firm specific data like turnovers, EBITDA/TA, total liability/ total assets, Need working capital, Total debt/ Total assets, Circulating debt/ Turnovers of 178 Tunisian industrial companies (all companies are small and medium firms), during 9 years from 1997 to 2005. Moreover, we use macroeconomic conditions like Consumer Price Index (CPI), Index of Industrial Production (IIP) and Broad money (M3) to assess the impact of macroeconomic variables on credit risk.

Empirically to study the impact of firm *level information* and *macroeconomic conditions* on corporate credit risk we estimate the model [7]; Rosch which is as follows:

$$y_{it} = \sqrt{\rho} x_t + \sqrt{(1-\rho)} z_{it} \quad (4)$$

where x_t is a vector of *systematic risk* which includes variables such as Consumer Price Index (CPI) and Broad money (M3). z_{it} v is a vector *of idiosyncratic risk* which includes firm-specific variables.

Bonfim [7] suggests that the assumption of independence between idiosyncratic component and systematic factor is contradicted by empirical evidence. Thus, this author proposed the estimation of the following model to evaluate the contribution of firm level information and macroeconomic condition in explaining defaults probability.

$$y_{it} = \Gamma x_t + \Delta z_{it} \quad (5)$$

where Γ and Δ represent the parameter vectors which can be estimated using a panel model such as:

$$y_{it} = \alpha + \beta X_t + \gamma Z_{it} + \varepsilon_{it} \quad (6)$$

where β and γ represent successively the estimates of Γ and Δ. ε_{it} is the error-term.

4.2. Results

In this paper we evaluate the contribution of account firm-specific data and or to macroeconomic information to explain credit risk of industrial Tunisian firms. Indeed, we estimate four empirical models (Model 6) which take into account firm specific data like turnovers, total liability/ total assets and macroeconomic variables like Index of Industrial production. The first model includes the firm's financial information as explanatory variables of firm's debt level (Panel A). The second model includes the same variables used in the first one, with the addition of macroeconomic variables (Panel B). The third model includes the firm's financial information as explanatory variables of liquidity level (Panel C). The fourth model includes the same variables used in the third model, with the addition of macroeconomic variables (Panel D).

Table 5 presents the estimated coefficients and the probabilities of the estimated for models.

Table 5. The effect of firm level information and macroeconomics variables on debt and liquidity level

		Debt level		Liquidity level	
		Panel A	Panel B	Panel C	Panel D
		Model 1	Model 2	Model 3	Model 4
Firm level information	*Constant*	0.094 (0.479)	11.69* (0.186)	0.068* (0.113)	-3.308 (0.486)
	Turnovers	0.226** (0.000)	0.210** (0.000)	2.267** (0.000)	0.232** (0.001)
	EBITDA/TA	-0.010 (0.325)	0.015** (0.048)	0.227 (0.990)	0.862 (0.644)
	Total Liabilities/Total Assets	-0.214** (0.000)	-0.212** (0.000)	-2.252** (0.000)	-2.235** (0.000)
	Need Working Capital	0.568** (0.000)	0.515** (0.000)	-0.216** (0.040)	-0.158 (0.154)
	Total Debt / Total Assets	0.100 (0.334)	0.114 (0.261)	0.471** (0.000)	0.495** (0.000)
	Circulating debt / Turnover	-0.290 (0.107)	-0.016 (0.188)	0.016 (0.488)	0.850 (0.713)
Macroeconomic variables	*Consumer Price Index*	–	-0.149* (0.022)	–	0.021 (0.601)
	Index of Industrial production	–	0.056* (0.016)	–	0.919 (0.110)
	Broad Money	–	0.414* (0.029)	–	3.474** (0.020)
	Hausman Test	$\chi2$ (5) = 10.45		$\chi2$ (5) = 13.86	
	R^2	0.54	0.82	0.51	0.62

Notes: p values shown in parenthesis,* presents the significance at 10%; ** presents the significance at 5. EBITDA/ TA is the Earnings Before Interest Payments, Taxes, Depreciation and Amortizations/ Total Assets. The dependent variable for models 1 and 2 is the debt level. The dependent variable for models 3 and 4 is the liquidity level.

The probability of the Hausman specification test is low: the probability of fixed effect = 0.000. So, the Hausman specification test implies that the random effects model is preferable to the fixed effects model. To compare models in terms of explanatory power, we have to take the model's goodness of fit (R2) as an indicator of trial. The model's goodness of fit quality allows us to capture the impact of macroeconomic fluctuations on the transition from the first to the second model, or from model 3 to model 4.

Results of Table 5 (Panel A) indicate that the turnovers, total liabilities/ total assets ratio, EBITDA/TA and need working capital have a significant evidence for the first model. The turnovers (total sales) present a positive effect on the debt level. This result is supported by Bonfim [7]. The positive effect of turnovers on credit risk of Tunisian industrial firms can be explained by the fact that when firms anticipate a future gains they will be more optimistic towards its ability to meet their financial obligations. Indeed, firms with high sales performance expect to have lower default probabilities. Consequently, firms with high turnover will take more debt to finance their transactions.

The total liabilities/total assets ratio presents a negative sign of -21.40%. Thus, if the liabilities of Tunisian firms exceed their assets these firms have to stop borrowing in order to equilibrate their balance sheets. Indeed, firms should control the liability proportion in order to decreasing the bankruptcy probability. Beaver [3] suggests that a large amount of debt held implies a high level of bankruptcy probability.

Analyzing Table 5 we find that the need working capital affects positively the debt level of Industrial Tunisian firms. This result can be explained by the fact that when firms present a need working capital they search access to bank loans since Tunisian firms are characterized by a lower cash flow.

Results of panel A indicate that the credit risk measured by debt level depends largely to firm-specific information. However, the adjustment degree of the first model isn't very high. Indeed, the determinant coefficient R^2 is equal to 0.54. Thus, we suggest the addition of other variables to model 1 to explain the debt level. In the second model we consider the effect of macroeconomic conditions and the firm-specific variables on the debt level.

Panel B of Table 5 indicates that despite the addition of macroeconomic variables the significant variables (firm level information) in the first model keep their weighting value and their signs in the second model. These results are consistent with those of Bonfim [7]. This author indicates that the estimators of firm level information do not change despite the addition of macroeconomic variables by the fact that the relevant information of macroeconomic variables is totally independent to those of firm-specific variables.

Model 2 (panel B) estimations indicate that all macroeconomic variables used in this paper affect significantly the credit risk of industrial firms. This result is very important for banks and regulatory authorities to

keep the financial stability in Tunisia. Indeed, regulatory authorities can act on these variables in order to reducing the firms' probability default.

The consumer price index presents a negative sign. This result is explained by the fact that the increases of inflation rate incite monetary authority to increase the interest rate which implies a decrease of debt level of Tunisian firms.

The index of industrial production is significant and positive (0.056). Despite, the improvement of the industrial production of Tunisian firms' level implies we find an increase of debt level. This result can be explained by the fact that industrial firms choose banking debt to finance their activities despite the increase of industrial production level since the cash flow of Tunisian firms is still limited.

The explanatory power of the second model (panel B) is better than that of the first one because it presents a determinant coefficient R^2 of 0.82 largely higher than 0.54 of the first model. Consequently, these results allow us to conclude that the macroeconomic dynamic has an important additional contribution to the firm-specific variables on our debt model.

Concerning the third model (Panel C) it estimates the impact of firm-specific variables on the liquidity level. The results present four significant variables which are: turnovers, total liabilities/total assets ratio, total debts / total assets ratio and capital requirements. The turnover is significant and positive, when it varies positively about 1%, the liquidity level as the second measure of credit risk increases by 2.26%, which is expected.

The total liabilities/ total assets ratio has a significant negative effect (-2.25) on liquidity. The increase of liability ratio contributes to decrease the liquidity level (increase of default risk [6]). Thus, liquidity constraints imply some difficulties to pay obligations. Our results are going with those of Bunn and Redwood [5] and Benito [4].

The results of model 4 indicate that the estimated coefficients for firm-specific variables do not change despite the addition of others macroeconomic variables Bonfim [7]. Moreover, the inclusion of these three macroeconomic variables (model 4) has generated an improvement in the adjustment quality of the model, which is observed by the increases of the determinant coefficient R2 from 0.51 in model 3 to 0.62 in model 4. Indeed, the broad money is significantly positive which is explained by the fact the the increases of broad money implies the increases of liquidity level.

The comparison analysis of Table 5 indicates that turnovers, total liabilities / total assets ratio, total debts/total assets ratio and need working capital (firm level information) are the important variables that affect the corporate credit risk. Moreover, the macroeconomic variables like M3 affect directly the measures of corporate credit risk. Moreover, we find that turnovers and Total Liabilities/Total Assets as internal factors are always significant in all tested models comparing with other significant variables. This can be explained by the fact that all tested firms are small and medium firms which are very sensitive to their turnovers and their level of liabilities. This result can explain the banks manager behaviors that focus initially on turnovers to assess the financial health of Tunisian firms since most of Tunisian firms are characterized as small and medium firms.

5. Conclusion

The objective of this paper is to assess if the credit risk of industrial Tunisian firms depend to firm level information and or to macroeconomic information. In this study we measure the corporate credit risk from two factors which are debt and liquidity level. We identify these measures by using the Explanatory Factor Analysis (EFA).

To identify the key variables which affect the industrial firms credit risk, we estimate four empirical models which take into account firm specific data like turnovers, total liability/ total assets and macroeconomic variables like Index of Industrial production and broad money.

The results obtained suggest that the credit risk of Tunisian industrial firms depends to firm-specific characteristics, such as their turnover, total liabilities/ total assets ratio as well as their need working capital. Indeed, industrial Tunisian firms with highly turnover take more debt to finance their transactions. Moreover, because industrial Tunisian firms are small and medium firms thus their credit risk are very sensitive to their turnovers. Furthermore, the increase of liability ratio contributes to decrease the liquidity level increasing thus default risk. Indeed, liquidity constraints imply some difficulties to pay obligations.

Estimations panel model results indicate that the macroeconomic juncture directly affects the credit risk and independently of the firm-specific data. All macroeconomic variables used in this paper affect significantly the credit risk measured by debt level. Indeed, the consumer price index, index of industrial production and Broad Money affect significantly the debt level. This result is very important for regulatory authorities to keep the financial stability in Tunisia. Indeed, regulatory authorities can act on these variables in order to reducing the firms of probability default.

References

[1] Altman E.I. 1968. Financial ratios discriminant analysis and the prediction of corporate bankruptcy. J of Financ 23: 589-611.

[2] Atiya A F. 2001. Bankruptcy prediction for credit risk using neural networks: A survey and new results. IEEE Transactions on neural networks, 12:929-935.

[3] Beaver W. 1966. Financial Ratios as Predictors of Failure. J Account Res: 77-111.

[4] Benito A, J avier Delgado F, Martınez Pages J (2004) Asynthetic indicator of financial pressure for Spanish firms. Banco de Espana Working Paper 411.

[5] Bunn P, Redwood V. 2003. Company accounts based modelling of business failures and the implications for financial stability. Bank of England Working Paper 210.

[6] Carling K, Tor J, Jesper L, Kasper R. 2007. Corporate credit risk modeling and the macroeconomy. J Bank Financ 31: 845-868.

[7] Bonfim. 2009. Credit risk drivers: Evaluating the contribution of firm level information and of macroeconomic dynamics. J Bank Financ 33: 281-299.

[8] Duffie, Darrell A, Guillaume H, Leandro S (2009) Frailty Correlated Default. J of Financ 64:2089-123.

[9] Frydman H, Altman E, Kao D. 1985. Introducing recursive partitioning for financial classification: The case of financial distress. J of Financ 40:269-291.

[10] Harris C, Kaiser H. 1964. Oblique factor analytic solutions by orthogonal transformation. Psychometrika 29: 347-362.

[11] Jakunbik P. 2007. Macroeconomic environment and credit risk. Czech J Econ Financ 57:60-78.

[12] Kaiser H. 1970. A second generation little. Psychometrika 35: 401-415.

[13] Kaiser H, Dickman K. 1959. Analytic determination of common factors. Am. Psychol. 14, 425.

[14] Li K. 1999. Bayesian analysis of duration models: An application to Chapter 11 bankruptcy. Economic Let 63: 305-312.

[15] Hsieh, Hung N. C P. 2010. A data driven ensemble classifier for credit scoring analysis. Expert Syst Appl, 37: 534-545.

[16] Stock J H, Watson M W. 2002. Forecasting using principal components from a large number of predictors. J Am Stat Assoc 97: 1167 1179.

[17] Pesaran M, Hashem, Schuermann TT, Bjorn-Jak Weiner, Scott M. 2006. Macroeconomic dynamics and credit risk: A global perspective. J Money Credit Bank 38: 1211-1262.

[18] Ravi Kumar P, Ravi V. 2007. Bankruptcy prediction in banks and firms via statistical and intelligent techniques. Eur J Oper Res 180: 1-28.

[19] Qi M, Zhao X. 2013. Debt structure, market value of firm and recovery rate. J credit risk 9:3-37.

[20] Shumway T. 2001. Forecasting bankruptcy more accurately: A simple hazard model. J Bus 74: 101-124.

[21] Tang D, Yan H. 2010. Market conditions, default risk and credit spreads. J Bank Financ 34: 743-753.

[22] Wansbeek T, Meijer E. 2000. Measurement error and latent variables in econometrics. North Holland, Amsterdam.