The impact of macroeconomic variables on credit risk: Evidence from Indonesian business sector level data

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ABSTRACT

This study aims to empirically examine the effect of macroeconomic variables on credit risk in each business sector in Indonesia. Using time-series quarterly data during the period 2011q1-2019q2, this study utilized the Autoregressive Distributed Lag (ARDL) model. The results of this study explain that macroeconomic variables namely GDP growth in the long run have a significant negative effect on credit risk in 6 sectors and in the short term have a significant negative effect on 6 sectors. Inflation has a significant positive effect in the long run on one sector, namely the provision of accommodation and provision of food and drink and a significant negative effect on 6 sectors, in the short term inflation has a significant positive effect on 7 sectors and a significant negative effect on one sector, namely education services. The last variable is the long-term loan interest rate which has a positive effect on 7 sectors and in the short term has a significant positive effect on 6 sectors on the high value of credit risk in each business sector in Indonesia. The result indicating that macroeconomic variables have a real impact on the credit risk.

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Introduction

The financial crisis is a condition happen due to the instability of the economic system. One example is the *sub-prime mortgage crisis* in the United States in 2008 which had an impact on the economy of the US and other countries in the world, including Indonesia. The impact of economic crisis to Indonesia was the declining growth from 6.35% in 2007 to 6.01% in 2008 and to 4.63% in 2009.

Financial crisis not only harming the country with weak economic structure but also one with strong fundamental conditions. In fact, it was not only influence developing countries but also developed countries. Financial Crisis, particularly the banking crises can occur due to economic volatility. The volatility creates uncertainty and risk for banks. Risk is the possibility of facing an unexpected situation, hence successfully managing risk is an important aspect that increases bank profitability (Yurdakul, 2014). The most important risk faced by banks is credit risk which comes from the non-performing loans. Credit risk mainly refers to the possibility of losses to banks due to the inability of the borrower to fulfill their obligations as part of their contract with the bank.

The highest level of credit risk in Indonesia during the 2nd quarter of 2017 is 3.74%, which was the highest point in the last 7 years. The high value of credit risk occurs due to several factors, the first factor is the revocation of restructuring regulations by The Financial Services Authority (FSA) which causes banks to reduce the value of loans provided while non-performing loans continue to increase. The second factor is the increase in non-performing loans (NPLs) due to falling commodity prices and weakening exchange rates.

The contribution of this study is expected to be useful in making decisions to set inflation targets and determine loan interest rates in Indonesia. The data used in this study are still rarely examined, where most of the previous studies used credit risk aggregate data while this study utilized credit risk data at the sectoral level. This study also exploits the most recent data using data from 2010

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quarter 1 to 2019 quarter 2 extracted from the official website of Financial Service Authority, National Statistics Bureau and Bank Indonesia.

The aims of this study is to analyze the effect of macroeconomic variables, namely economic growth, inflation, and interest rates on bank credit risk in each business sector in Indonesia. By using the ARDL method it can be concluded that macroeconomic variables affect credit risk significantly but, in some sectors,, such as the fisheries and government administration, macroeconomic variables do not have a significant effect on the magnitude of credit risk in these sectors. Hence, it is important to understand what sectors influenced by macroeconomic variables. The rest of this paper is as follows: literature review, research method, result and discussion, and conclusion.

Literature Review

Previous research conducted by Castro (2013) using the GMM method with data from Greece, Ireland, Portugal, Spain and Italy (GIPSI) from Quarter 1 in 1997 to quarter 3 in 2011 showed that economic growth variables have significant and negative effects and interest rates, significant positive effect on credit risk.

Then research conducted by Yurdakul (2014) using the ARDL method with data from January 1998 to July 2012 in Turkey showed that economic growth variables have a significant negative effect and inflation and interest rates have a significant positive effect on credit risk.

Using the GMM method with data from 147 banks in France and 133 banks in Germany from 2005 to 2011 Chaibi and Ftiti (2015) shows that economic growth variables have a significant negative effect, inflation variables have a significant negative effect, and interest rates have a significant effect positive on credit risk. Moreover, research conducted by Gulati, Goswami & Kumar (2018) using the GMM method with data from commercial banks operating in the 1998/99 to 2013/14 period showed that economic growth variables and inflation variables had a positive relationship with credit risk but were not significant.

Research conducted by Louzis, Vouldis & Metaxas (2012) using the GMM method with data from the 9 largest banks in Greece in the first quarter of 2003 to the third quarter of 2009 showed that economic growth variables had a significant negative effect, and interest rate variables had a significant positive effect on credit risk. Then Research conducted by Ghosh (2015) using FEM and GMM methods with data from 50 banks and other financial institutions in America and Colombia in 1984 to 2013 showed that economic growth variables had a significant negative effect and inflation and interest rates had a significant positive effect on credit risk.

Study by Ali and Daly (2010) utilize the GMM method with data from the United States and Australia in the first quarter of 1995 to the second quarter of 2009. They showed that economic growth and interest rates had negative effect on credit risk. Research conducted by Zribi and Boujelbene (2011) using FEM method with data from 10 banks in Tunisia in 1995 to 2008 showed that economic growth, inflation and interest rates had a significant negative effect on credit risk. Most of the previous study conducted using aggregate data at country level. The aggregation very likely cause a bias during the estimation. That is why we carry out an investigation using the sctoral level data. The estimation will give us more reliable result.

Research and Method

The empirical model used in this study is as follows:

$$CR = a + a_1 t \sum_{i=1}^p \beta_i CR_{t-i} + \sum_{i=0}^{q1} y_i \Delta PDB_{t-i} + \sum_{i=0}^{q2} \delta_i Inflation_{t-i} + \sum_{i=1}^{q3} \theta_i i_{t-i} + et \dots \dots \dots (1)$$

Model explanation,

CR: Banking Credit Risk in the business sector in Indonesia.

ΔPDB : GDP growth rate / economic growth in Indonesia.

Inflation: The inflation rate in Indonesia.

i : Credit interest rates in Indonesia.

ϵ_t : Error term.

Definition of Variables

Credit risk: Credit risk is the ratio of non-performing loans to the volume of credit granted to 16 business sectors in Indonesia.

The calculation of the credit risk in this study is as follows:

$$\text{Credit risk} = \frac{\text{Non-performing loans}}{\text{Credit Amount}} \dots \dots \dots (2)$$

Interest rates: The interest rate used is the *lending interest rate*, which is the loan interest rate for business capital loans and investment loans, then weighted based on the ratio of business capital loans and investment loans. This data is obtained from the website of Bank Indonesia. The period of the data is from quarter 1 2011 to quarter 2 in 2019. Calculations of loan interest rates are as follows:

$$a = \frac{\text{Business Capital Loans}_t}{\text{Business Capital Loans}_t + \text{Investment Credit}_t} \dots\dots\dots (3)$$

Calculation of weight value using the formula as follows:

$$i = \frac{i \text{ Capital}_t (a) - i \text{ Investation } (100-a)_t}{100} \dots\dots\dots (4)$$

Data

Data used in this study is time series data of 16 business sector, spanning from Q1 of 2011 to Q2 of 2019, so that the total observations in this study is 34 for each estimation. Data sources were obtained from several national Government institution, namely:

1. Financial Services Authority (OJK) to obtain data on non-performing loans and total credit from 16 business sector (on Gross Domestic Product) which is then calculated to get credit risk value per business sector in Indonesia
2. Central Statistics Agency (BPS) to obtain data on Indonesia economic growth.
3. Bank Indonesia to obtain inflation and lending interest rates.

This study uses the ARDL (*Auto Regressive Distributed Lag*) model based on (Pesaran, Shin & Smith, 2001). There are several steps in regressing the ARDL model. The first step is the stationarity test. Second step is cointegration test by using the bound test. Based on the cointegration test we can determine the existence of long-run association among variables. The final step is analyzing the short-run and long-run result of ARDL estimation.

ARDL method has several advantages compared to other methods time series. The ARDL method does not require stationary data at level I(1) and is allowed if stationary data at level I(0). The next advantage of ARDL model is that it can be derived from the dynamic error correction model (ECM) model through simple linear transformation. The next advantage is that the ARDL model is suitable for small sample sizes and eliminates omitted variables and autocorrelations (Narayan & Narayan, 2004).

Estimating the short run ARDL can be done by estimating the model with Error Correction Model (ECM), as explained earlier that from the ARDL model we can obtain an ECM model. Estimates with the Error Correction Model based on equation 3.4 are as follows:

$$\Delta Y_t = a_0 + a_1 t + \sum_{i=1}^p \beta_i \Delta y_{t-i} + \sum_{i=0}^{q1} \gamma_i \Delta x_{1t-i} + \sum_{i=0}^{q2} \delta_i \Delta x_{2t-i} + \sum_{i=1}^{qk} \theta_i \Delta x_{3t-i} + \vartheta \text{ECM}_{t-1} + \text{et} \dots\dots\dots (5)$$

ECM_t is an Error Correction Term which can be written as follows:

$$\text{ECM}_t = y - a_0 + a_1 t - \sum_{i=1}^p a_2 \Delta y_{t-i} + \sum_{i=0}^{q1} a_3 \Delta x_{1t-i} + \sum_{i=0}^{q2} a_4 \Delta x_{2t-i} + \sum_{i=1}^{q3} a_5 \Delta x_{3t-i} \dots\dots\dots (6)$$

The important aspect in estimating the ECM model is that the error correction term (ECT) must be negative, the negative value in the ECT indicates that the estimated model is valid. All the coefficients in the short-term equation above are coefficients that connect the dynamic model in the short-term convergent to equilibrium and ϑ represent the speed of adjustment from the short-term to the long-term balance. This shows how the imbalance due to shock in the previous year is adjusted to the long-term balance.

Results and Discussion

Descriptive statistics

Descriptive Statistics for each variable is shown in following table 1:

Table 1: Summary of Descriptive Statistics of Variables

No		Count	Mean	Sd	Min	Max
1	Agriculture, Hunting and Forestry (%)	34	1,732174	,2854533	1,3085	2,2147
2	Fishery (%)	34	3,723721	1,654221	1,8209	10,2105
3	Mining and excavation (%)	34	3,402653	2,380446	,1796	8,1319
4	Manufacture (%)	34	2,818959	,6981149	1,7344	4,1675
5	Electricity, Gas and Water (%)	34	1,079115	,585423	,2808	2,3017
6	Construction (%)	34	4,093797	,5223546	3,138	5,4316
7	Wholesale and retail (%)	34	3,641176	,6590311	2,4685	4,6375
8	Provision of Accommodation and Provision of Drinking Food (%)	34	2,840544	1,515521	,9628	6,1174
9	Warehousing and Communication Transportation (%)	34	3,258174	,9581572	1,9631	5,4517
10	Financial Intermediary (%)	34	,6933353	,4367059	,1513	1,5696
11	Government Administration, Defense, and Mandatory Social Security (%)	34	,1830324	,2527409	,012	,9563
12	Real Estate, Rental Business and Corporate Services (%)	34	2,139941	,4585965	1,5014	2,9474
13	Educational Services (%)	34	1,413524	,3960343	,8116	2,6294
14	Health Services and Social Activities (%)	34	2,716147	1,890019	,7306	7,2829
15	Social Services, Social Culture, Entertainment, and Other Individuals (%)	34	3,000379	,7693111	1,8445	4,6807
16	Personal Services Serving Households (%)	34	3,548559	1,699639	1,9941	8,8586
17	GDP growth (%)	34	5,346674	,4807511	4,7403	6,477
18	Loan Interest Rates (%)	34	11,51279	,7097923	10,300	12,360
19	Inflation (%)	34	4,781471	1,77562	2,482	8,789

Estimation Results

Stationary Tests

The result of stationarity test shows that all sectors except social services are stationary at *first difference* level with a significance level of 10% or 0.1.

Bound Test

Table 2 showed the value *bound test* of 16 business sectors in Indonesia, it can be seen that the insignificant variable is the mining and quarrying sector.

Table 2: Bound Test

No	Variables	t-Statistics	
1	Agriculture, Hunting and Forestry	8.953	***
2	Fishery	4.026	*
3	Mining and excavation	2.605	
4	Manufacture	2.823	*
5	Electricity, Gas and Water	9.186	***
6	Construction	4.788	**
7	Wholesale and retail	17.790	***
8	Provision of Accommodation and Provision of Drinking Food	11.810	***
9	Warehousing and Communication Transportation	5.216	**
10	Financial Intermediary	5.157	**
11	Real Estate, Rental Business and Corporate Services	5.940	***
12	Government Administration, Defense, and Mandatory Social Security	7.447	***
13	Educational Services	4.328	*
14	Health Services and Social Activities	6.465	***
15	Social Services, Social Culture, Entertainment, and Other Individuals		
16	Personal Services Serving Households	13.212	***
		I(0)	I(1)
1% Level		4.290	5.610 ***
5% Level		3.230	4.350 **
10% Level		2.720	3.770 *

Note: Estimated Bound Test at a significant level of 1% (***), Estimated Bound Test at a significant level of 5% (**), and Estimated Bound Test at a significant level of 10% (*).

Long-Run Model

The level of significance of variables in the long-term model could be seen in Table 3 where the long-term model in the manufacturing industry sector, the whole sale and retail trade sector, and the real estate sector, rental business, and corporate services there were no significant variables in the long run. Then for the model with the dependent variable mining and quarrying sector, the results of the estimation of this model were not accepted because the results of the bound test indicate there is no cointegration in this model.

Table 3: Level of Significance of Variables in the Long-Term Model

No	Variable	Prob	No	Variable	Prob
1	Agriculture, Hunting and Forestry		4	Manufacture	
	GDP growth	0.0000 ***		GDP growth	0.3770
	Inflation	0.0210 **		Inflation	0.4920
	Loan Interest Rates	0.0000 ***		Loan Interest Rates	0.3720
2	Fishery		5	Electricity, Gas and Water	
	GDP growth	0.0000 **		GDP growth	0.0000 ***
	Inflation	0.0090 ***		Inflation	0.0030 ***
	Loan Interest Rates	0.0050 ***		Loan Interest Rates	0.0000 ***
3	Mining and excavation		6	Construction	
	GDP growth	0.0500 *		GDP growth	0.0130 **
	Inflation	0.1740		Inflation	0.6000
	Loan Interest Rates	0.3060		Loan Interest Rates	0.0110 **
7	Wholesale and retail		12	Government Administration, Defense, and Mandatory Social Security	
	GDP growth	0.3650		GDP growth	0.0000 ***
	Inflation	0.3620		Inflation	0.0050 ***
	Loan Interest Rates	0.3170		Loan Interest Rates	0.0010 ***
8	Provision of Accommodation and Provision of Drinking Food		13	Educational Services	
	GDP growth	0.0020 ***		GDP growth	0.5680
	Inflation	0.0280 **		Inflation	0.1350
	Loan Interest Rates	0.0010 ***		Loan Interest Rates	0.0230 **
9	Warehousing and Communication Transportation		14	Health Services and Social Activities	
	GDP growth	0.0000 ***		GDP growth	0.0010 ***
	Inflation	0.3650		Inflation	0.3510
	Loan Interest Rates	0.5060		Loan Interest Rates	0.4590
10	Financial Intermediary		15	Social Services, Social Culture, Entertainment, and Other Individuals	
	GDP growth	0.0000 ***		GDP growth	-
	Inflation	0.0060 ***		Inflation	-
	Loan Interest Rates	0.6740		Loan Interest Rates	-
11	Real Estate, Rental Business and Corporate Services		16	Personal Services Serving Households	
	GDP growth	0.6370		GDP growth	0.0000 ***
	Inflation	0.7160		Inflation	0.0290 **
	Loan Interest Rates	0.5170		Loan Interest Rates	0.0120 **
	1% Level	0.0100 ***			
	5% Level	0.0500 **			
	10% Level	0.1000 *			

Note: regression results at a significant level of 1% (***), regression results at a significant level of 5% (**), and regression results at a significant level of 10% (*).

Short-Run Model

The level of significance of the variables in the short-term model - in the manufacturing industry sector and the health service sector and social activities- there were no significant variables in the short term. Then in the fisheries sector, the electricity, gas and water sector, the sector of providing accommodation and providing food and drink, and the government administration sector. defense and mandatory social security were all significant variables in the short run. More details could be seen in Table 4.

Table 4: Level of Significance of Variables in the Short-Term Model

N o	Variable	Prob		N o	Variable	Prob
1	Agriculture, Hunting and Forestry			9	Warehousing and Communication Transportation	
	GDP growth	0.000 ***			GDP growth	0.004 ***
	Inflation	0.296			Inflation	0.235
	Loan Interest Rates	0.002 ***			Loan Interest Rates	0.018 **
2	Fishery			10	Financial Intermediary	
	GDP growth	0.032 **			GDP growth	0.067 *
	Inflation	0.041 **			Inflation	0.649
	Loan Interest Rates	0.080 *			Loan Interest Rates	0.073 *
3	Mining and excavation			11	Real Estate, Rental Business and Corporate Services	
	GDP growth	0.111			GDP growth	0.198
	Inflation	0.025 **			Inflation	0.15
	Loan Interest Rates	0.030 **			Loan Interest Rates	0.020 **
4	Manufacture			12	Government Administration, Defense, and Mandatory Social Security	
	GDP growth	0.487			GDP growth	0.000 ***
	Inflation	0.537			Inflation	0.046 **
	Loan Interest Rates	0.358			Loan Interest Rates	0.018 **
5	Electricity, Gas and Water			13	Educational Services	
	GDP growth	0.008 ***			GDP growth	0.092 *
	Inflation	0.009 ***			Inflation	0.098
	Loan Interest Rates	0.001 ***			Loan Interest Rates	0.021 **
6	Construction			14	Health Services and Social Activities	
	GDP growth	0.026 **			GDP growth	0.948
	Inflation	0.609			Inflation	0.314
	Loan Interest Rates	0.026 **			Loan Interest Rates	0.495
7	Wholesale and retail			15	Social Services, Social Culture, Entertainment, and Other Individuals	
	GDP growth	0.000 ***			GDP growth	
	Inflation	0.081 *			Inflation	
	Loan Interest Rates	0.664			Loan Interest Rates	
8	Provision of Accommodation and Provision of Drinking Food			16	Personal Services Serving Households	
	GDP growth	0.018 **			GDP growth	0.025 **
	Inflation	0.091 *			Inflation	0.050 *
	Loan Interest Rates	0.000 ***			Loan Interest Rates	0.203
	1% Level	0.0100				
	5% Level	0.0500				
	10% Level	0.1000				

Note: regression results at a significant level of 1% (***), regression results at a significant level of 5% (**), and regression results at a significant level of 10% (*).

Discussion

Agriculture, Hunting and Forestry

Estimation results in models with agricultural, hunting and forestry dependent variables in the long term influence of GDP growth variables and inflation were namely -0,352 (0,000) and -0,197 (0,021), while the variable loan interest rates had a positive effect with a coefficient of 0.719 and a *p value* of 0,000, in the short term the influence of the GDP growth variable which is -0.746 (0,000) while the variable inflation and loan interest rates had a positive effect on credit risk, respectively 0.021 (0.296) and 6.207 (0.002).

Fisheries

The estimation results of the model with the dependent variable of fisheries in the long run were the effects of GDP growth variables and loan interest rates which were positive with coefficients of 2,582 (0,000) and 1,799 (0.005) while the Inflation variable had a negative effect with a coefficient value of -1.181 and *p value* of 0.009, in the short term the influence of GDP growth variables, inflation, and loan interest rates have a positive effect on credit risk, namely 5.329 (0.032), 0.722 (0.041) and 6.207 (0.080).

Mining and Quarrying

Long-term estimation results in this study could not be accepted, this was because the *Bound Test value* of this model (ho: 2.605) was not accepted because the statistical t value is less than the critical value of the *bound test* (2,720). The conclusion of the test was that this model was not significant or did not have cointegration between variables. Furthermore, for the short term the effect of GDP growth variable was negative with a coefficient of -0.8003 and a *p value* of 0.111, while inflation and loan interest rates have a positive effect with a coefficient and *p value* of 0.2651 (0.025) and 0,7618 (0.030).

Processing Industry

Estimation results in the model with the dependent variable of the manufacturing industry in the long run were the effects of GDP growth variables and inflation which were negative with coefficient values and *p-values* respectively respectively -1.290 (0.377) and -0.181 (0.492) while the variable loan interest rates had a positive effect with a coefficient of 0.593 and a *p value* of 0.372, in the short term the influence of the GDP growth variable, inflation, and loan interest rates, which were negative with coefficients and *p values* of -0.211 (0.487), -0.296 (0.537) and -0,373 (0,358).

Electricity, Gas, and Water

Estimation results on the model with the dependent variable electricity, gas, and water in the long term influence of GDP growth variables and inflation were negative with the coefficient value and *p value* about 1,208 (0,000) and -0,241 (0,003) while the loan interest rate variable had a positive effect with a coefficient value of 0.644 and *p value* 0,000, in the short term effect of GDP growth variables which was negative with a coefficient of -0.829 and *p value* 0.008 while inflation and loan interest rates have a positive effect with coefficient and *p-value* respectively respectively 0.107 (0.009) and 0.691 (0.001).

Construction

Estimation results in the model with the construction dependent variable in the long run were influences from GDP growth variables and inflation which were negative with coefficient and *p value values* of -0.613 (respectively 0.013) and -0.039 (0.600) while the variable loan interest rates had a positive effect with a coefficient of 0.498 and *p value* 0.011, in the short term the influence of GDP growth variables and inflation which was negative with coefficient and *p value values* of -0.430 (0.026) and -0.027 (0.609) while variable lending rates have a positive effect on the value coefficient of 0.350 and *p value* of 0.026.

Wholesale and Retail Trade

The estimation results on the model with the dependent variable wholesale and retail trade in the long term influence of GDP growth variables were 12.759 (0.365) while the Inflation and interest rates loans had a negative effect on credit risk with coefficients and *p values* of -0,481 (0,362) and -3,855 (0,317), in the short term the influence of GDP growth variables namely -1,077 (0,000) while Inflation and lending rates had a positive effect on credit risk with coefficients and *p values* respectively 0.041 (0.081) and 0.117 (0.664).

Provision of Accommodation and Provision of Food and Beverage

Estimating on the model with the dependent variable provision of accommodation and provision of food and beverages in the long term influence of GDP growth variables and loan interest rates namely negative with coefficient and *p value* respectively -4,104 (0,002) and -4,808 (0,001) while the influence of Inflation variables were positive to credit risk with a coefficient of 1.142 and *p value* of 0.028, in Short-term influence of GDP growth variables and Inflation were positive with coefficient and *p value* respectively 1.059 (0.018) and 0.092 (0.091) while the influence of variable lending rates, namely negative to credit risk with a coefficient of -1.671 and a *p value* of 0.000.

Financial Intermediary

Estimation results in the model with the dependent variable financial intermediaries in the long term influence of GDP growth variables, inflation and loan interest rates showed a negative trends with coefficient value and *p value* each of -0,654 (0,000) -0,164 (0,006) and -0,045 (0,674), in the short term the effect of GDP growth variable is positive with a coefficient of 0.503 and *p value* 0.067 while Inflation and loan interest rates negatively affect credit risk with coefficients and *p values* respectively -0.017 (0.649) and -0.713 (0.073).

Transportation, Warehousing, and Communication

Estimation results on the model with the dependent variable transportation, warehousing, and communication in the long term influence of GDP growth variables were negative with a coefficient of -2,126 and a *p value* 0,000 while Inflation and loan interest rates had a positive effect (Castro, 2013; Yurdakul, 2014) on credit risk with coefficients and *p values* respectively 0.359 (0.365) and 0.407 (0.506), in the short term the influence of GDP growth variables, Inflation, and loan interest rates are negative with coefficients and *p values* of -0.985 (0.004), -0.838 (0.235) and -1,469 (0.018)

Real Estate, Rental Business and Company Services

Estimation results in the model with the dependent variable real estate, rental business, and company services and in the long run the influence of GDP growth variables and inflation was positive at 1.793 (0.637) and 0.442 (0.716) then the effect of variable interest rates on loans on credit risk is -4,279 (0,517), in the short term the influence of GDP growth variables and Inflation were negative, namely -0.161 (0.198) and -0.039 (0.276) and then the influence of loan interest rate variables, which were positive for credit risk about 0.385 (0.020).

Government Administration, Defense and Mandatory Social Security

The estimation results on the model with the dependent variables of government administration, defense, and mandatory social security in the long term influence of GDP growth variables and loan interest rates had a positive effect on credit risk with coefficient and *p value* respectively 0.423 (0.000) and 0.277 (0.001) while the Inflation variable was negative with a coefficient of -0.141 and a *p value* of 0.005, in the short term the effect of GDP growth variables, inflation, and loan interest rates were positive with coefficients and *p values* of 0.504 (0,000), 0.049 (0.046) and 0.417 (0.018)).

Education Services

Estimation results in the model with the dependent variable of education services in the long run were the effects of GDP growth variables and inflation which were negative with coefficient values and *p-values* respectively respectively of -0.152 (0.568) and -0.137 (0.135) while the loan interest rate variable has a positive effect with a coefficient of 0.562 and a *p value* of 0.023, in the short term the influence of GDP growth variables was positive with a coefficient of 0.501 and a *p value* of 0.092 while Inflation and loan interest rates have a negative effect on credit risk with the coefficient and *p value* respectively -0.071 (0.098) and -0.931 (0.021).

Health Services and Social Activities

The estimation results on the model with the dependent variable health services and social activities in the long term influence of GDP growth variables and loan interest rates had a positive effect on risk credit with coefficient and *p value* are 2.396 (0.001) and 0.240 (0.459), while Inflation were negative with a coefficient of -0.131 and *p value* of 0.351, in the short term the effect of growth variables GDP and Inflation had a negative effect on credit risk with coefficients and *p values* of -0.045 (0.948) and -0.069 (0.314), while lending rates were positive with a coefficient value of 0.126 and a *p value* of 0.495.

Social Services, Social Culture, Entertainment, and Other Individuals

This sector was not feasible to be estimated using the ARDL method because credit risk data in this sector is not stationary.

Individual Services Serving Households

The estimation results on the model with dependent variables of individual services serving households in the long term influence of GDP growth variables and loan interest rates (Castro, 2013; Yurdakul, 2014) had a positive effect on credit risk with coefficient and *p value* respectively 3.202 (0.000) and 1.358 (0.012), while the Inflation variable (Chaibi & Ftiti, 2014) had a negative effect with a coefficient value of -0.650 and *p value* of 0.029, in the short term influence of GDP growth variables and loan interest rates negatively affect credit risk with coefficients and *p values* respectively -2,697 (0.025) and -1,617 (0,203) while the variables Inflation is positive with a coefficient of 0.542 and a *p value* of 0.050.

Conclusions

The influence of GDP growth in the long-term is negative significant to credit risk in 6 sectors (agriculture, hunting and forestry, electricity, gas and water, the construction sector, the provision of accommodation and the provision of food and drink, the transportation sector, warehousing and communication, and the financial intermediary sector), while in the short term is significantly

negative in 6 sectors (agriculture, hunting and forestry sector, the electricity, gas and water sector, the construction sector, the wholesale and retail trade sector, and the individual service sector that serves households)

The impact of inflation on credit risk in the long run that was significantly positive in the sector of providing accommodation and provision of food and drink and significantly negative in 6 sectors (agriculture sector, hunting, and forestry, fisheries sector, electricity, gas and water sector, sector financial intermediaries, government administration, defense and mandatory social security sectors, and individual service sectors serving households) then in the short term were significantly positive in 7 sectors (fisheries, mining and quarrying sectors, electricity, gas and water sectors, sectors wholesale and retail trade, the accommodation and food and beverage supply sector, the government administration sector, defense and mandatory social security, and the individual service sector that serves households) were significantly negative in the education service sector.

The influence of loan interest rates on credit risk in the long run is significantly positive in 7 sectors (agriculture, hunting and forestry, fisheries, electricity, gas and water, instruction sector, government administration, defense and guarantee sectors compulsory social services, the education service sector, and the individual service sector that serves households. While in the short term is significantly positive in 6 sectors (agriculture, hunting and forestry, the fisheries sector, the electricity, gas and water sector, the instruction sector, the real estate sector, rental business, and corporate services, and the government administration sector, defense, and mandatory social security.

The limitation of this study is the short data period. It only includes data from 2011 to 2019. This is due to the difference of sectoral classification before 2010 (9 sectors) and after 2010 (16 sectors). Moreover, credit risk data classification does not include the information of the type of credit, namely working capital loan, investment loan, and consumption loan in each sector. This information will give us better understanding of the effect of macroeconomic variables on each sector.

References

- Ali, A., & Daly, K. (2010). Macroeconomic determinants of credit risk : Recent evidence from a cross country study. *International Review of Financial Analysis*, 19(3), 165–171. <https://doi.org/10.1016/j.irfa.2010.03.001>
- Castro, V. (2013). Macroeconomic determinants of the credit risk in the banking system: The case of the GIPSI. *Economic Modelling*, 31, 672-683. <https://doi.org/10.1016/j.econmod.2013.01.027>
- Chaibi, H. & Fiti Z. (2014). Credit risk determinants: Evidence from a cross-country study. *Unpublished Thesis. Tunisia: University of Tunis*.
- Ghosh, A. (2015). Banking-Industry Specific and Regional Economic Determinants of Non-Performing Loan: Evidence from US State. *Journal of Financial Stability*. 20, 93-104. <https://doi.org/10.1016/j.jfs.2015.08.004>
- Gulati, R., Goswami, A., & Kumar, S. (2018). What drives credit risk in the Indian banking industry? An empirical investigation. *Economic Systems*. 43(1), 42-62. <https://doi.org/10.1016/j.ecosys.2018.08.004>
- Louzis, D.P., Vouldis, A.T., & Metaxas, V.L. (2013). Macroeconomic and Bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking and Finance*. 36(4), 1012-1027. <https://doi.org/10.1016/j.jbankfin.2011.10.012>
- Narayan S. & Narayan P.K. (2004). An empirical analysis of Fiji's import demand function. *Journal of Economic Studies*. 32(2):158-168. <https://doi.org/10.1108/01443580510600931>
- Pesaran, M. H., Shin, Y., & Smith, R.J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics*. 2(16): 289-326.
- DOI: <https://doi.org/10.1002/jae.616>
- Yurdakul, F. (2014). Macroeconomic Modelling Of Credit Risk For Banks. *Procedia-Social and Behavioral Sciences*. 109(1). 784-793. <https://doi.org/10.1016/j.sbspro.2013.12.544>
- Zribi, N. & Boujelbene Y. (2011). The factors influencing bank credit risk: The case of Tunisia. *Journal of Accounting and Taxation*. 3(4). 70-78. <https://doi.org/10.5897/JAT11.006>