Macro-Economic Stress Test for Islamic Rural Bank: A Proposed Framework

Uvy Dian Rizky [1]* Abdul Mongid[2], Suhartono Suhartono3, Evi Sistiyarini[2]
[1] Lecturer. IBMT Surabaya
[2]Dept. Of Business Studies, UHW Perbanas Surabaya
3STIE Balikpapan, Balikpapan, Indonesia

Abstract

The stress test is used to manage bank risk to determine how certain a crisis scenario will affect their portfolio value so that it can be used to forecast capital position, income and liquidity. Banking authorities also use stress tests with the aim of maintaining financial system stability. Initially, interest in stress testing was largely confined to practitioners. When the global financial system was hit by turmoil due to the subprime mortgage crisis, awareness of using a stress test increased. Many experts consider stress testing as a methodology to help prepare for crises. Stress tests are essential to evaluate the relationship between macroeconomic conditions and a bank's financial condition. The first step in the assessment is an evaluation of the current health condition of the bank. Stress tests use macroeconomic indicators to develop the model. After that, forecasting is carried out, and the results are used to assess the banking system's resilience, namely its ability to absorb potential exogenous shocks. This activity aims to develop a macroeconomic stress test framework for Islamic rural banks (BPRS). This model is expected to open or start the development of other stress test models in the future. The conceptual model proposes that the components of economic growth, inflation, interest rates, and exchange rates must be the determining variables for credit risk of Islamic Rural Bank (BPRS).

Keywords: Stress Test, Credit Risk, Montecarlo Simulation, Error Correction Model (ECM)

1. Introduction

The stress test is a quantitative method developed by banking supervisors to assess the soundness of the financial system in the event of an extreme shock or crisis. The scenario made is still plausible for testing macroeconomic pressures. They are also important management instruments for banks because they provide useful indicative information on crisis reliability for measuring risk (microeconomic or prudential). Under the new Basel Accord on bank capital adequacy, the presence of a stress-testing methodology is a prerequisite for the adoption of sophisticated methods for minimum quantification of capital requirements.

Financing is a term used in Islamic banks, as in conventional banks, it is called credit (lending). Financing means providing funds or claims based on mudharabah or musyarakah contracts and other financing based on profit-sharing principles (Bank Indonesia Regulation No. 5/7/PBI/2003). Sharia rural banks (BPRS), whose one business function is to channel financing, are at risk of being affected by financing risks. Financing risk or credit risk in conventional terms is defined as the risk arising from the failure of the customer or other party to fulfil their

obligations to the bank. There are five levels of credit risk including current, special mention, substandard, doubtful, and loss (SK.Dirut BI No.30/267/KEP/DIR). The non-current financing consists of substandard, doubtful, and non-performing financing quality. An increase in the number of non-current or non-performing financing impacts the value of the Non-Performing Financing (NPF) ratio.

Non-Performing Financing (NPF) is the ratio between the total non-current category of financing to the total financing. The safe limit for the NPF ratio of BPRS based on Bank Indonesia Circular Number 9/29/PBI/DPbs of 2007 concerning Assessment of the Soundness of Rural Banks Based on Sharia Principles (TKS-BPRS) is 7%. Yulianto and Solikhah (2016) stated that if the NPF ratio of a bank increases, there will be a decrease in the number of deposits that can be collected from customers. People's desire to save or put their funds in Islamic banks will decrease for fear that the stored funds cannot be returned by the bank or only get a small profit share. If it drags on and is not handled properly, then the high NPF ratio can have a negative impact on the bank's collapse (bankruptcy). The factors affecting financing or non-performing loans in banking can generally be sourced from internal and external factors. Internal factors are caused by banking operational activities, including financing growth, and external factors are caused by macroeconomics, such as economic growth, inflation, interest rate, exchange rate, etc. (Kurniadi, Mongid&Hidayat (2018), Auliani, 2016).

Previous studies do not appear to show consistency in disclosing the factors that affect the quality of financing, which is proxied by Non-Performing Financing/Loan (NPF/L). Karmila (2017), Fitrotul(2020) and Saputro (2019) reveal that credit growth has a positive effect on NPL, in contrast to Harahap (2017), who reveals that credit growth has a negative effect on NPL. The GDP growth variable, according to Novi (2016), has a positive effect on NPF, in contrast to Indra (2018), which reveal that GDP harms NPF, while Romadhoni (2017) revealed that GDP does not affect NPF. Inflation according to Wanri (2020), and Indra (2018) has a positive effect on NPF while according to Romadhoni (2017), Dewi (2020) and Rindang (2019) inflation has no effect on NPF of BPRS. Interest rates, according to Indra (2018), Rindang (2019) have a positive effect on NPF/NPL, in contrast to Putri (2016), who revealed that interest rates have a negative effect on NPF, while according to Wanri (2020), interest rates have no effect against NPF. The exchange rate, according to Romadhoni (2017), has a positive effect on NPF, while according to Endah (2016) and Sherly (2019), the exchange rate does not affect NPF. Seeing the inconsistent findings, the author is interested in conducting further studies related to the factors that affect Non-Performing Financing (NPF)with the stress test of credit risk at Islamic rural Banks in Indonesia, considering that the authors have not found any research related that the author meant in previous studies.

The conceptual model proposes that the components of economic growth, inflation, interest rates, and exchange rates must be the determining variables for credit risk of Islamic Rural Bank (BPRS) before implementing the stress test.

2. Literatur Reviews

Prior to 2007, interest in Stress Tests was limited to the financial authorities of banks only. As a result, publications related to Stress Testing are very low. According to Scopus data, the total papers related to Stress Tests in banking are as follows. Before 2007 there were 20 papers. Since

the global economic crisis (GFC), the number of papers indexed by Scopus has increased to 168. In 2016 there were 31 papers. However, for Indonesia, studies related to stress testing in banking are not available in Scopus-indexed journals. This part discusses the papers on stress tests and credit risk determinants.

Financing/Credit Growth
Financing Growth or credit growth shows an increase or decrease in the total amount of financing over time (usually in the form of a percentage). The growth of financing could increase the opportunity for banks to obtain income, thereby reducing the NPL ratio. This is in line with Harahap (2017), who revealed that credit growth has a negative effect on Non-Performing Finance (NPF). It is in contrast Saputro, et al (2019) and Ghosh (2015), which reveals that faster credit growth will have implications for increased credit losses due to loose credit standards so that many debtors are incompetent and bring bad credit problems to banks.

H1: Financing or credit growth has a significant effect on credit risk (NPF)

GDP Growth
Gross Domestic Product (GDP) is the most used a macro variable in the economic study. This variable is often used to indicate that economy is growing. It is the total of all goods and services produced by a country at a particular time. Kojuetall (2018) applied GDP growth as the determinant of credit risk in the banking market. The results are inconsistent. Wiryono&Effendi (2020), and Kojuetall (2018) concluded that GDP growth is favourable for credit risk meaning higher economic growth reduced the incidence of credit default.GDP growth can increase in individual and company income. Therefore, the ability to pay debts (credit) increases so that it can potentially reduce NPF (Fatoni, 2019). In contrast, Novi (2016) and Alfaro (2015) reveal that GDP growth which also shows economic growth can provide high expectations for banks in assessing the ability to pay customers so that banks are less careful in distributing loans or financing provided so that it has the potential to increase NPF.

H2: GDP growth has a significant effect on credit risk (NPF)

Inflation
Inflation is the continuous increase in the price of goods, which impacts the decline in people's purchasing power because, in real terms, the income level also decreases with the assumption that the community's income level is constant (Mankiw, 2013). High inflation can have a negative impact on the decline in people's purchasing power and ability to pay debts, so it has the potential to worsen the quality of bank financing (Fitrotul (2020) and Taswan, 2006), as revealed by Indra (2018), Muhamad (2019), Wanri (2020) that inflation has a positive effect on NPF. These conclusions are different from Andreani (2016), which reveal that the actual value of debt payments tends to decrease with higher inflation, thereby reducing NPLs. Chalibi and Ftiti (2015) state that inflation has a negative and significant effect in France and Germany. On the other hand, Madbouly (2020), using the case from Bahrain, found that inflation has a positive and significant effect on credit risk.

H3: Inflation has a significant effect on credit risk (NPF).

Interest Rate

Interest rates are fees for services banks provide based on conventional principles to customers who use their products (Kasmir, 2011). Islamic banks use market interest rates such as LIBOR, SIBOR or JIBOR to benchmark their financing operations (Veitzhal Rivai, 2013: 248). Chong & Liu (2010) confirmed that Islamic banking was not free of interest, but it is still interest-based banking. When interest rates rise, the competitiveness of Islamic banks increases, with the profit/loss sharing ratioof Islamic banks being able to compete with the increasing interest rates of conventional bank loans. A lower rate causes people to tend to choose to borrow or finance at Islamic banks whose cost of funds is considered lower (Kasmir, 2011), thus causing financing at Islamic banks to be higher and affect the larger NPF ratio. This is in line with Indra (2018), and Rindang (2019), which reveal that interest rates have a positive effect on NPF/NPL. in contrast to Putri (2016), who revealed that interest rates have a negative effect on NPF because the increase in interest rates results in people being reluctant to borrow funds from banks, thereby reducing non-performing financing due to low demand for financing.

H4: Interest rate has a significant effect on credit risk (NPF)

Exchange Rate

The exchange rate is the price of one currency in another country's currency (Sukirno, 2002:358). The Nominal Exchange Rate is the relative price of two countries' currencies. The real exchange rate is the relative price of goods between two countries. The exchange rate of a country is very closely related to exports. If the real exchange rate is low, then domestic goods will be cheaper than foreign goods so will increase exports (Mankiw, 2006: 131).

When the currency weakens, the cost of production increases, especially related to imports. The increase in production costs has an effect on decreasing the income of entrepreneurs and decreasing the ability to pay debts so that it has the potential to increase the NPF. As revealed by Indra (2018) that the depreciation of the exchange rate contributed to the increase in NPL. On the other hand, an increase in the exchange rate has an impact on benefiting export entrepreneurs (exporters) because the price of domestic goods increases, so that entrepreneurs earn more income and the ability to pay debts increases, resulting in a decrease in bank NPF, as Widyaningsih (2021) states that the exchange rate has a negative effect on NPLMpofu, &Nikolaidou (2018) and Valahzaghard, et al (2012) also concluded that foreign exchange all have positive and significant impact on NPL

H5: Exchange rate has a significant effect on credit risk (NPF)

Money Supply

The amount of money supply (M2) measures the aggregate money supply in the economy. The money supply, directly and indirectly, is influenced by central bank policies, so it is a policy tool. In many respects, it has an inverse relationship to interest rates. The role of the money supply in influencing credit is an essential issue in determining NPLs. Previous studies such as Waemustafa&Sukri, 2015 and Lin, Farhani& Koo 2016 have shown that an increase in the

money supply (M2) reduces credit risk, which supports the theoretical view that an increase in M2 can lead to decrease credit risk because borrowers can get lower borrowing costs. The money supply also allows for the availability of liquidity in a loose economy.

H6: Money supply has a significant effect on credit risk (NPF)

3. Stress Test Methodology
The stress test is a method to assess the level of resilience and soundness of banks when faced with crisis conditions that originate from extreme shocks, either externally or internally. A stress test helps the authority and management to develop knowledge in the risk assessment process and improve understanding and perception of risks (BCBS, 2009).

We simplify the test using financing risk only. as measured by the ratio of non-performing financing, which also shows the probability of default. Quagliariello (2009: 237) reveals that external shocks originating from macroeconomics can have an effect on giving stress to the probability of default (PD) and Expected Loss (EL) with hypotheses on Loss Given Default (LGD) and Exposure at Default (EAD), which have an impact on bank's profit and capital.

Referring to the new Capital Accord (Basel II), BCBS (Basel Committee on Banking Supervision) requires banks to conduct stress tests for credit risk, liquidity risk related to collateral value and market risk. In some countries, banking authorities require rigorous and forward-looking stress tests to identify and measure factors that 'may affect the bank'. Banks planning to adopt an internal rating-based approach for calculating credit risk capital requirements are required to conduct a stress test. It is expected that banks will also develop adequate stress-testing methodologies that are appropriate to bank conditions. To assess the adequacy of internal economic capital within the framework of Pillar II, the bank uses a method known as the internal capital adequacy assessment process (ICAAP).
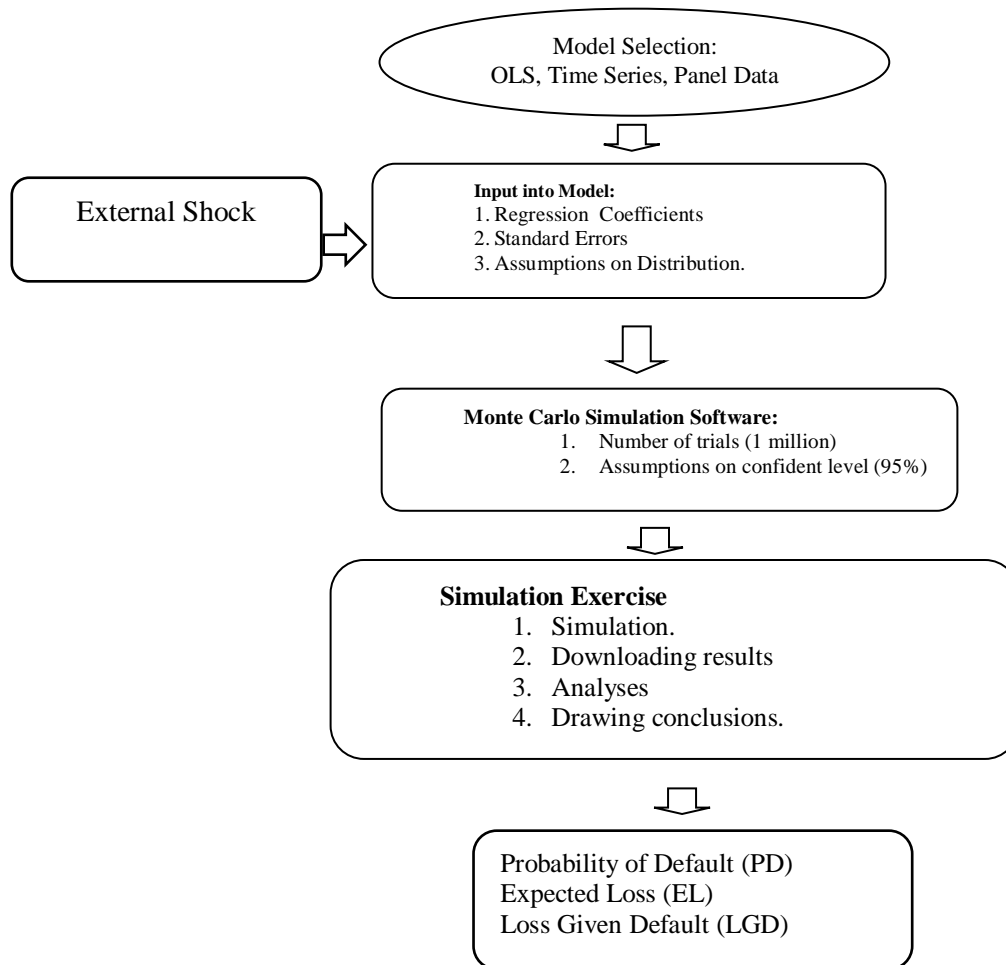
Figure 1. Framework of Bank Stress Test

The probability of default (PD) is the probability that the debtor will default on his obligations to the creditor. The probability of default is measured using the ratio of Non-Performing Loans (NPL) or Non-Performing Financing (NPF), adopting the default risk model from Ong (1999: 63), which assumes that default risk is a company's uncertainty in terms of its ability to fulfil all obligations to debtors and obligators. Generally, the stress-testing literature focuses on forecasting PDs for a one-year horizon. After the estimation results of the NPF equation are obtained, stress tests will be carried out based on variables including Financing or credit growth, GDP growth, interest rates, inflation rates, and currency exchange rates.

Expected Loss (EL) is the amount of loss that is expected as a result of default (default). Exposure at Default (EAD) is an estimate of the amount of loss that may be faced by a bank when a default occurs. Loss Given Default (LGD) is the portion of bank losses that cannot be returned to the bank due to default after considering the debtor's collateral as a substitute for the debtor's obligations (Hibbeln, 2010).Stress-testing models for credit risk which do not explicitly model write-offs or non-performing loans have to make assumptions about loss given default

(LGD) to assess the full impact of defaults on banks' balance sheets. LGD is often assumed to be constant.

In preparing the framework for conducting stress tests, banks are required to identify the types of risks tested and the various factors that must be considered in the model. Stress tests can be used to analyze the impact of changes in a single risk factor, such as currency depreciation, or the effect of a scenario when there are simultaneous changes in several risk factors, such as an exchange rate crisis and an increase in interest rates. The scenario analysis is a combination of a decrease in gross domestic product (GDP) along with a depreciation of the currency and an increase in interest rates). These simulation typologies are known as sensitivity analysis and scenario analysis. When the top management sets the model, it is top-down. In contrast, when the users develop it, it is bottom up.
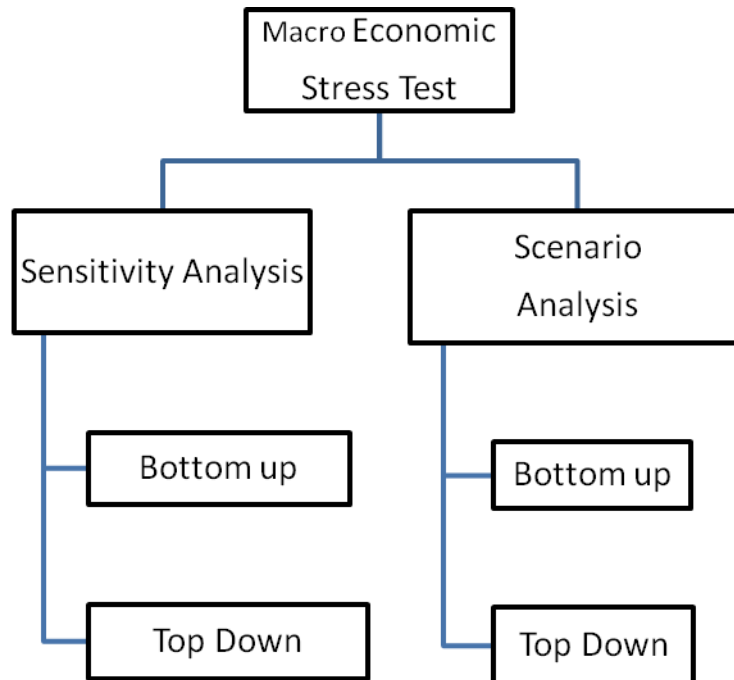

Figure 2 Types of Stress Testing

Montecarlo simulation is a popular tool for stress testing. It is one of the quantitative risk assessment techniques that can be used by various organizations in the risk management process, especially in the stages of risk analysis and/or risk evaluation that has a random variable phenomenon involving a probability distribution of the data variables collected based on past data and theoretical probability distributions.

In the Monte Carlo simulation, values are drawn randomly from the input probability distribution. Each set of samples is called an iteration, and the results resulting from those samples are recorded. A Monte Carlo simulation does this hundreds or thousands of times, resulting in a distribution of possible outcomes. In this way, the Monte Carlo simulation provides a much more comprehensive view of what might happen and even how likely it is

The high probability of default can affect the expected losses that affect the bank's profit and capital. it will result in a larger reserve for bank losses, the impact on bank operating profit will be lower, and the formation of additional bank capital will be low. The higher the expected losses (EL), the higher the potential loss or credit risk faced by the banks. Therefore, Sharia rural banks (BPRS) are necessary to be careful, vigilant and try to anticipate the high probability of default with sufficient capital to cover losses. As bank supervisor requires banks to hold more capital (Bernanke, 2013), and Beltratti & Stulz (2011) confirm that capital determines the bank's performance.

4. Conclusions

The conceptual model of this stress test research activity provides new insights for academics about the complex but challenging way to conduct stress tests in banking. What is interesting about this framework is the level of comprehensiveness it pays attention to macroeconomic variables. The most crucial economic performance indicator is economic growth, both as measured by Gross Domestic Product (GDP) and Gross National Product (GNP). Economic growth is seen as a necessary condition for healthy economic development. The macroeconomic environment's impact model on credit risk always includes GDP or GNP growth as an important determinant. The general finding from previous research is that economic growth is the primary driver of credit quality. Economic growth is a driving force for improving credit quality or vice versa. Studies from previous research show that credit risk is influenced by macroeconomic developments, which include exchange rates, inflation and lending rates and the money supply. Further, t banks must pay more attention to the factors that affect NPF, especially the exchange rate, which has a strong effect, and try to anticipate the high probability of default with sufficient capital to cover losses.

Studies on stress testing for the banking sector and the business sector, in general, have yet to be discovered in academic circles. Stress testing is a relatively new methodology and requires advanced computer equipment and software. However, considering that stress testing is very beneficial, both individually, companies or banks, implementing stress testing that is carried out seriously and carefully will positively impact a country's ability to anticipate the crisis. Academics, especially financial economists, need to learn and try to practice stress testing so that they are left behind in the application of this methodology.

References

Alfaro, R and M Drehmann (2009): "Macro stress tests and crises: What can we learn?", *BIS Quarterly Review*, December, pp 29-41.

Auliani, Mia Maraya., & Muhamad Syaichu. (2016). "Analisis Pengaruh Faktor Internal dan Faktor Eksternal terhadap Tingkat Pembiayaan Bermasalah pada Bank Umum Syariah di Indonesia Periode Tahun 2010-2014". *Diponegoro Journal of Management*. Volume 5, Nomor 3, pp. 1-13. ISSN: 2337-3792.

Andreani,Caroline (2016). "AnalisisFaktor-faktor yang Mempengaruhi Non Performing Loan pada Bank Umum di Indonesia". *Jurnal Wira Ekonomi Mikroskil*. Volume 6, Nomor 02.

BCBS. (2009). Principles for sound stress testing practices and supervision. Basel Committee on Banking Supervision.

Beltratti, A., & Stulz, R. M. (2011). The credit crisis around the globe: Why did some banks perform better? (February 11, 2011). Fisher College of Business Working Paper No. 2010-03-005

Bernanke, B. S. (2013). Stress testing banks: What have we learned? Financial Markets Conference Speech, Federal Reserve Bank of Atlanta.

Chaibi, H., &Ftiti, Z. (2015). Credit risk determinants: Evidence from a cross-country study. *Research in international business and finance*, *33*, 1-16.

Chong, B. S. and Liu, M. H. (2010) Islamic banking: Interest-free or interest-based? *Pacific Basin Finance Journal*, 17 (1), pp. 125-144.

Fatoni, Ahmad.. (2019). "The Influence of Financial Performance and Macroeconomic Conditions on Non-Performing Financing of Sharia BPR in Indonesia". EQUILIBRIUM: *Journal of Islamic Econ*omics, Volume 7, Number 2

Fitrotul, F. (2020). "Macroeconomic Stress Testing on the Risk of Banking Failure in Indonesia". JBPE Journal of Business and Political Economy, Vol 2 (1).

Ghosh, Amith (2015). "Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states". *Journal of Financial Stability* Vol.20. p 93–104.

Harahap, A. Y. (2017). *Pengaruh CAR, NPF dan FDR terhadap Return Bagi Hasil Deposito Mudharabahpada Perbankan Syariah di Indonesia Periode 2012–2016 dengan Profitabilitassebagai Variabel Moderating* (Doctoral dissertation).

Indra. (2018). "A Macro Stress Test Model of Credit Risk: An Empirical Studies of Conventional and Islamic Banking in Indonesia". Journal of Economics & Public Policy (E-ISSN: 2528-4673 P-ISSN: 2086-6313), Vol. 9, No. 2.

Kasmir. (2011). *Manajemen perbankan*. Jakarta: PT Raja GrafindoPersada

Koju, L., Koju, R., & Wang, S. (2018). Does banking management affect credit risk? Evidence from the Indian banking system. *International Journal of Financial Studies*, *6*(3), 67.

Kurniadi, D., Mongid, A., & Hidayat, S. E. (2018). "A Simple Stress Test on Indonesian Islamic Banking Industry". *Journal of Finance and Banking*, 22(1): 148-161

Lin,H.Y.,Farhani,N.H.,&Koo,M.(2016). The Impact of Macro economic Factors on Credit Risk in Conventional Banks and Islamic Banks: Evidence from Indonesia.*InternationalJournalofFinancial*Research,7(4),105-116

Madbouly, A. (2020). Macroeconomic Determinants of Banks' Credit Risk: The Case of Bahrain. *Journal of Asian Business Strategy*, *10*(2), 172.

Mankiw, N Gregory. 2007. Macroeconomics. Jakarta: Erlangga

Mpofu,T.R.,&Nikolaidou,E.(2018). Determinants of credit risk in the banking system in Sub-Saharan Africa. *Review of development finance*,8(2),141-153.

Muhamad. (2019). "Determinants of Non-Performing Financing (NPF) on Sharia Rural Banks (BPRS) in Indonesia". *EFFICIENT Indonesian Journal of Development Economics*, Vol 2 (1). Pages: 341-353.

Quagliariello, Mario. (2009). Stress Testing the Banking System: Methodologies and Applications. Cambridge University Press.

Rindang. (2019). "Analysis of the influence of bank internal and external factors on Non-Performing Financing (NPF) in Islamic Rural Banks in Indonesia". *Journal of Islamic Economics & Finance*, Vol. 5 No. 1. Page: 42-49

Romadhoni, N. (2017) analisis is kinerjakeuangan pt. brisyariahden ganmeng gunakanpendekatanrasio risk profile, good corporate governance, earnings, and capital tahun 2015-2017, Thesis, Unpublished.

Saputro, Arfan et al. (2019). "Analysis of the Effect of Credit Growth, Bank Loan Interest Rates and Inflation on Non-performing Loans". Expansion: Journal of Economics, Finance, Banking and Accounting. Vol. 11, No.5

Sukirno, S. (2004). *Makroekonomi teori pengantar*. Jakarta: PT Raja Grafindo Perkasa

Taswan. (2006). *Manajemen Perbankan*. Yogyakarta: UP

Valahzaghard,Mohammad&Kashefi,Maryam&Alikhani,Amin&Hosseini,Seyed. (2012). The effect of macroeconomic factors on credit risk in the banking system of Iran.*ManagementScienceLetters*.2.1747-1754

Veitzhal Rivai, Rifki Ismail, Islamic Risk Management For Islamic Bank, (Jakarta: PT Gramedia Pustaka Utama, 2013), p. 248.

Wanri, M, et al. (2020). "The Effect of Economic Condition and Banking Policy on Non-Performing Financing and Profitability: Evidence from Islamic Rural Banks in Indonesia". ISSAT: International Seminar of Science and Applied Technology. *Advances in Engineering Research*., Volume 198/1

www.bi.go.id. Diakses tanggal 15 Februari 2021

www.ojk.go.id. Diakses tanggal 20 Februari 2021.

Yulianto A, Solikhah B. (2016). "The Internal Factors of Indonesian Sharian Banking to Predict The Mudharabah Deposits". *Review of Integrative Business & Economic Research* 5(1): 210–218.

Waemustafa, W., &Sukri, S. (2015). Bank specific and macroeconomics dynamic determinants of credit risk in Islamic banks and conventional banks. *International Journal of Economics and Financial Issues*, *5*(2), 476-481.

Wiryono,S.K.,&Effendi,K.A.(2018). Islamic bank credit risk: macroeconomic and bank specific factors. Othman, K., Laidin, J.,&Ismail, N. (2020).Determinants of Islamic Bank Credit Riskin ASEAN Countries. *Journal Of Emerging Economies And Islamic Research*,8(3),1-16.