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# A Simple Stress Test on Indonesian Islamic Banking Industry

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**Abstract**

The purpose of this study is to conduct a stress test on Indonesian Islamic Banking industry in order to assess the capability of the industry to absorb the extreme risks that may happen in the future. Using data from April 2008 to September 2014, the study employs balance sheet approach in performing the stress test on profitability and capital position and the value at risk technique for liquidity stress test. The results of this study show that in term of profitability, Islamic banks in Indonesia are immune from losses if the default rate (Non-Performing Loan) is less than 8.5 %. If the industry can improve the profit margin, the resistance will be higher. In term of capital position, by assuming loss given default (LGD) is constant at 40%, the industry will not go bankrupt if probability of default (PD) is less than 9%. If the PD is more than 9%, total expected loss is more than available capital. Using the value at risk (VaR) at 99% confidence, the study finds that possible deposit flight will not exceed IDR 26 trillion and the liquid asset available is IDR 28 trillion. The study concludes that there is no liquidity threat for Islamic banks in Indonesia. The findings also uncover the risky condition that even though the capital adequacy ratio (CAR) is on average 14%, real capital measured by Equity to total asset (ETA) is only 5.4%.

**Keywords**: Capital; Liquidity; Profitability; Simulation; Stress Test

**JEL Classification**: G17; G21

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**Abstrak**

*Penelitian ini bertujuan untuk melakukan uji kehandalan* (stress test) *pada industri perbankan syariah Indonesia untuk menilai kemampuan industri dalam menyerap risiko ekstrim yang mungkin terjadi di masa depan. Dengan menggunakan data dari bulan April 2008 sampai September 2014, studi ini menggunakan pendekatan neraca dalam melakukan uji kehandalan profitabilitas dan posisi modal. Hasil penelitian ini menunjukkan bahwa dalam hal profitabilitas, bank syariah di Indonesia kebal terhadap kerugian jika kredit bermasalah* (Non-performing Loan) *kurang dari 8,5%. Jika industri bisa memperbaiki margin keuntungan, resistansi atau daya tahan akan semakin tinggi. Dalam hal posisi modal, dengan asumsi loss given default (LGD) konstan sebesar 40%, industri tidak akan bangkrut jika probabilitas default (PD) kurang dari 9%. Jika PD lebih dari 9%, total kerugian yang diharapkan lebih dari modal yang tersedia. Dengan menggunakan nilai risiko (VaR) dengan kepercayaan 99%, penelitian ini menemukan bahwa kemungkinan pelarian dana dari perbankan syariah tidak akan melebihi Rp 26 triliun dan aset likuid yang tersedia adalah Rp 28 triliun. Studi ini menyimpulkan bahwa tidak ada ancaman risiko likuiditas bagi bank syariah di Indonesia. Temuan ini juga mengungkap perbankan syariah berisiko meskipun rasio kecukupan modal (CAR) rata-rata 14% terutama karena modal riil yang diukur oleh Ekuitas terhadap total aset (ETA) hanya 5,4%.*

***Kata Kunci**: Modal; Likuiditas; Profitabilitas; Simulasi; Uji Kehandalan*



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A stress test helps the authority and management to develop the knowledge in risk assessment process, and improve understanding and perception of risks (BCBS, 2009). Therefore, this study attempts to develop a stress test model for Islamic banking in Indonesia. There are obstacles in conducting this study, especially those associated with the relationship between macro-economic variables and bank specific variables. Many unexpected results were found that made this study staggering. That situation inhibits the European Central Bank (ECB) to introduce the stress test standards in 2010. the At the beginning of the study, we assume that there will be an exact relationship between real sector variable and Islamic banking performance since as per our understanding, Islamic banks are attached to the real economic. However, the relationship is totally different. These including the relationship between the index of retail sales or industrial development on Islamic bank financing quality and profitability. It is found that these have no correlation to the performance of Islamic banking in Indonesia.

Of course this result is contradictory to our assumption since we expect the real sector will provide information on the performance of Islamic banking. The statistical test showed a no significant relationship so that they do not qualify to enter the model to estimate the performance of Islamic banking. Time series real sector variable becomes irrelevant. It seems that if we look deeper into Indonesian Islamic banking, it is actually similar to the global phenomenon of Islamic banking. They are more likely to murabahah syndrome. This means that there are many Islamic banks which tend to apply the murabahah principles of Islamic finance than profit loss sharing or shir'kah and mudarabah (Smolo & Mirakhor, 2010).

With this type of business model, it is clear that Islamic banking in Indonesia is more influenced by the movement of interest rate rather than real sector variables. Therefore, in order to test the relationship between economic performance and bank performance such as on credit risk and liquidity and earnings, it appears that the indicator of interest rate of Bank Indonesia or BI-rate was more significant than real sector variables such as industrial production index. Interest rate gives more information in determining the performance of Islamic banking. Of course this could be considered as an irony of Islamic banking. Islamic banking has become more convergence towards conventional banking in general. A study by Chong & Liu (2010) confirmed that Islamic banking was not free of interest but it is still an interest-based banking.

Currently, stress test is becoming a new fashion among bank supervisors. Stress test is aimed to identify a condition that may affect the viability of a bank. As banking failure always means an economic crisis with a huge impact on the economy, regulators around the globe always assume that identifying the problem before it arises is always much better, Stress test is a way to identify the weakness of a particular bank or industry in general. They expect banks to hold sufficient capital to cover losses under such adverse economic conditions. It is also used as a tool for bank supervisors to require bank to hold more capital (Bernanke, 2013).

Literature reveals that stress test is a very good tool as it is forward looking. It means stress test can provide a base for future action necessary after certain conditions are assumed to happen. Certain conditions mean generally highly adverse scenarios that banks may face. It can provide supervisors with information about extreme risk event and its impact on a particular bank (Drehmann, 2008). Regulator can set a scenario that may apply to all banks such as European Banking Authority that regularly issue a scenario for the stress test.

When a common scenario is applied to banks and similar methodology, authority will have information from the stress test. It provides consistent supervisory information on the weakness across

banks. This is very useful information and future regulatory action can be issued to respond. It is totally different from traditional supervisory supervision that focuses on what had happened (ex-post).

Stress test can also be considered as a risk management tool. It can provide management with future probable condition when certain scenarios are imposed. Stress test for individual bank can show the bank's financial performance under downside scenarios which are severe but still plausible. By comparing the results under these scenarios with the baseline (most likely future scenario) management can provide prediction on future performance and this information is important both for management and investors (Borio, Drehmann, & Tsatsaronis, 2013).

Sorge & Virolainen (2006) classify two main approaches to the stress testing. The first is econometric analysis of the balance sheet data or known as a balance sheet model. It is basically using asset and liabilities sides to estimate profitability, capital adequacy and liquidity conditions of the bank. The second approach is the Value at Risk (VaR) model that uses statistical properties to predict the future loss at a certain level of confidence. VaR is regarded as superior because it can provide maximum loss that a bank may incur and if it is compared to the certain attributes such as capital adequacy or liquidity, we can conclude whether the bank will survive or not. Ismac (2013) confirms that liquidity management require a comprehensive approach.

In the balance sheet model, the macro variables are linked with the balance sheet items. The obtained coefficients are then used to simulate the impact of some shocks to the system of equation. It is using a linear relationship and any changes in the predictor will have impact on dependent variable. The dependent variable is basically a variable under stress test. The VaR model follows certain statistical distributions with the estimation of the distribution of loss, providing the quantification of the portfolio sensitivity to several sources of risk. VaR model is useful for market and operational risks stress test.

There are three methods to calculate VaR. The first is variance and covariance method. It is used when historical data is not available. The risk or the volatility follows normal distribution. VaR can be generated when mean value and standard deviation are available. The second is historical simulation. It is under the assumption that future condition is similar to historical data. The third is Monte Carlo simulation. It is regarded as the best method because it can simulate future condition (Sorge & Virolainen, 2006).

There are two approaches on how to set up the macroeconomic stress test namely bottom up and top down approaches (Borio, Drehmann, & Tsatsaronis, 2013). The bottom up approach means the bank is allowed to develop the model and assumption. The role of supervisor is to set the assumptions about the future economic conditions for the stress test. Before that the banking supervisor approves the individual bank's internal models and other assumptions for running the test. It is similar to internal model methodology to calculate capital requirement which is subject to approval before it is being used. The stress test is conducted by the bank and the supervisor collects the result after the test has been performed. Comprehensive study an macroeconomic stress test is done by Boss (2002).

In the top down approach, all the works are under the control of the banking authority. The authority develops the model, assumptions and performs the test. Usually, the authority develops a single model which is used to estimate the impact of certain scenarios on various banks. The supervisor not only sets up the conditions but also conducts the stress test, applying the same assumptions, procedures and models on all banks. The role of the bank is just to provide balance sheet information on the condition of the bank. However in practice, two approaches are implemented at the same time.

This study uses Indonesian Islamic banking data to perform the stress test. We develop a set of data that contains information on asset and its composition, liability and its composition and equity. Please take a note that our preliminary exercise was not satisfactory as these real economic sector variables are not significant to influence the Islamic banking performance.

## METHODS

Data spans from April 2008 to September 2014. For macro-economic data, we put inflation rate, Central Bank rate (BI-rate), industrial production index and retail sale index. There are three stress test areas: profitability stress test, capital stress test and liquidity stress test. The first step is how to estimate the loss given default (LGD) and exposure at default (EAD). For exposure at default (EAD), we use the total financings provided to customers. The definition of the total financings is the entire financings either using mudharabah, musharakah, murabahah as well as other contracts or purchase and sale.

### Profitability Stress test

This test is used to estimate the impact of loan quality on bank profitability. The formulas for the estimation are:

$$Ep = EI - EX \quad (1)$$

$$EI = PA \times PD \times ra \quad (2)$$

$$Ex = TL * rl \quad (3)$$

The formulas postulate that profitability is a result of expected income minus by expected cost. We use reduced form formula for expected income and expenses. Rates for both expenses and incomes are assumed to be fixed.

### Capital Stress test

We simplify the test using credit risk only. Probability of default (PD) has been determined as NPL. For LGD, in Indonesia, in general both Islamic and conventional banks' LGD is set at 40%. That means that any occurrence of bad loans worth 100, the bank will always lose as much as 40%. With reference to the formula, the expected losses are the result of the multiplication of PD x LGD x EAD. Stress testing is done by trying to influence the changes that occur in PD, so the impact or expected losses can be calculated. The higher the expected losses (EL), the higher the potential loss or credit risk faced by the banks. Beltratti & Stulz (2011) confirm that capital determines the bank perform.

In order to determine the impact of the increase in PD to expected losses (EL) of the bank, we then performed a simulation. Any potential bank's losses are counted for provision or reserve. Higher provision means higher risk. With reference to the creation of the financing reserves, when a bank estimates probability of losses to be smaller than the reserves made, the capital will be deducted. If a bank appears to have a greater loss than the estimated reserves or provisions that has been made, then immediately reduce Tier 1 capital and Tier 2 capitals. While possibility of loss is smaller than the provision, then the Tier 2 capital will be added by the difference.

The formula to evaluate the capital strength is as follows:

$$EL = PD \times LGD \times EAD \quad (4)$$

Please note this stress test is only considering credit risk. Other risks such as market and operational risks are not included. Bank is assumed to be solvable if EL < Capital.

## Liquidity Stress Test

Liquidity risk is seen as one of the most dangerous risks in the banking industry. Failure in the management of liquidity risk is often regarded as a quick source of bank bankruptcy. Liquidity risk is generally defined as the inability of banks to cope with or fulfill the obligation to provide liquidity, both derived from its obligations or commitments, contingent, as well as from normal transactions. Liquidity management has often been regarded as a risk that does not require very special attention (Ismal, 2013). However, after the banking crisis in 2008 which marked by the destruction of the global banking, showed that the liquidity risk management turns out to have a very important role in maintaining the sustainability of banking business (Beltratti & Stulz, 2011).

Therefore, special committee on the banking supervision through the development of Basel 3, emphasizes on the management of liquidity risk by requiring banks to provide the coverage liquidity and long-term ratios. To ensure that the management of liquidity risk goes well, both in normal and abnormal situations, the global banking authorities such as the BIS and the European Banking Authority (EBA) require banks to conduct stress stretching liquidity risk. The definition of stress stretching on liquidity risk is a systematic process to estimate the liquidity needs and the capability to meet liquidity need in the event of extreme events (BCBS, 2009). These extreme events can occur because of economic or systematic risk, as well as from banks themselves or idiosyncratic risk. Therefore in doing stress testing, we can choose one or combine systemic risk with idiosyncratic risk. Therefore, stress testing generally uses both scenarios (BCBS, 2009).

The essence of stress testing in managing liquidity is to estimate how much a decrease in customer funds when an event occurs. On the other hand, it also tests the bank's ability to generate liquidity from the asset (Bernanke, 2013). As it is known that the bank liquidity is generally divided into two groups known as the natural liquidity and funding liquidity. In the stress testing models used to assess the resilience of the Islamic banking in Indonesia, the approach of using systematic and idiosyncratic risks is applied. The basic framework that needs attention in any conduct of stress testing on liquidity risk is the need to incorporate aspects of time in modeling.

Of course, in this process, we will estimate the worst-case scenario that could be experienced by a bank and its impact on liquidity conditions. The original purpose of the liquidity stretching stress is to identify events simultaneously and quantify the impact of the incident. The first step taken was to identify risk factors and the drivers that can affect the assets and liabilities of the bank. By developing the scenarios that will possibly happen, then we will be able to see how strong the source of funding of the banks. The first step to be taken in stress testing is engagement components derived from the asset side and its effect on liquidity conditions and of the obligations associated with the risk of withdrawal of funds that may be faced by the bank. In relation to the provision of liquidity, the position of banks consisting of cash, wadi'ah certificate of Bank Indonesia and other liquid assets such as government securities as components to provide liquidity.

Other assets such as financing and fixed assets, the liquidation process takes time and expensive. It is not considered a good source of liquidity. In terms of liabilities, this is a source of liquidity. However, on the other hand, items on the liabilities side such as borrowing fund can also be a source of liquidity especially when the banks are able to borrow funds from external sources. By identifying the sources of liquidity and liquidity needs, we will create a relationship between the demand for and supply of liquidity.

Of course there is a trade-off between liquidity and profitability. A concern is that the productive assets of the bank normally consist of assets that have low liquidity as credit. Exception is the

naturally liquid asset such as securities. However, when we talk about credit or financing source, then there is a source of liquidity that cannot be ascertained. It is known as the early redemption or early repayment. In relation to cash flow, then we would predict both deterministic and non-deterministic nature.

The attention of management is on the relationship between liquidity risk, credit risk and operational risk. Failure to manage credit risk will impact the cash flow and disturb liquidity. The same thing also happens when the management failed in managing the market risk and operational risk. The formula used to do stress test is written below:

$$VaR = \mu - SD.\ 2.58 \quad \ldots\ldots (5)$$

In order to estimate the liquidity VaR, this study applies formula in the Microsoft Excel.

## RESULTS

### Stress Testing on Profitability

The first step of this study is to perform stress test on profitability. In order to do it, we first, calculate price of asset and price of liabilities. These prices are very critical in estimating expected income and expected expenses that will build profitability. Our model shows that price of fund is 7.2% and price of asset is 7.9%. In general, we can conclude that the margin is very low. When it is compared to commercial bank, it is only a quarter in term of profitability. Similar to their conventional counterpart, Islamic banks in Indonesia are also mainly commercial banks. A commercial bank focuses its business on taking deposit and lending the money to individual and firms (Madura, 2008). Table 1 summarizes the price of fund and the price of asset of Islamic banks in Indonesia.

Based on Table 1, the average cost of fund (price of fund) stood at 7.22% and price of productive Asset stood at 7.94%. This two data are very important to calculate the expected return and expenses in the stress testing for profitability. Please note that there is undisclosed assumption that the price of fund is not risk adjusted because the market value of the liability is always 100% except during the crisis where the haircut applies. In asset side, the price is risk-adjusted as we consider the default rate. Our calculation base on PD 3.5%, risk-adjusted price is 7.2%.

After we find the price of asset and liabilities, we then calculate the expected income and expenses based on historical data. We apply the following formulas:

Ep = EI-EX. This formula is used to calculate profitability.

EI = PA x PD x ra. This is a formula to calculate expected income.

Ex = TL * rl. It is formula to calculate expected expenses.

Definition:

Ep : expected profit

Ex : expected expenses

PA : Productive asset

PD : Probability of default

ra : return of productive assets

rl : price of liabilities

Based on historical data, our model shows that on average the expected income is IDR6,988 billion

**Table 1.** Price of Funds and Productive Assets

| Variable | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Price of fund | 78 | 0.07224 | 0.039023 | 0.0088 | 0.1558 |
| Price of asset | 78 | 0.07937 | 0.044696 | 0.0111 | 0.2121 |

and expected expenses is IDR6,674 billion with expected profit of IDR 314 billion. Table 2 reveals that there is still a possibility that Islamic banks in Indonesia experience losses as the minimum value is IDR1,365 billion. It means although the industry is still profitable, the movement in the cost of funding, return on productive asset and probability of default (PD) can drag the industry into losses. In order to assess the possibility of losses, we set a model that relates return on productive asset to PD. For simplicity, the yield (price of productive asset) and rate of expenses (price of fund) are assumed constant. This assumption is valid as most of financings in Indonesian Islamic banks are based on murabahah financing which is based on interest. It means there is a room for bank to adjust rate for both asset and liabilities sides.

We also assume that the income is variably determined by PD. As we are aware that higher PD means that the quality of productive asset is getting lower. It means the portion of asset that produces income is also getting lower. We do not penalize the non-performing loan (PD) with higher capital requirement. In practice, banks that experience higher NPL must put aside capital to cover the losses.

This specific capital provision will increase cost and reduce capital adequacy ratio (CAR). We can develop a simultaneous equation to see the impact of economic condition that may increase PD. However, our preliminary exercise shows it is not possible as economic data are not that much related to bank variables. We may need better data management package to deal with time series banking data.

**Table 2**. Simulated Income and Expenses

| Variable | Obs. | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|
| Expected Income | 78 | 6988.229 | 5046.299 | 405.5972 | 23657.79 |
| Expected Expenses | 78 | 6674.204 | 4712.99 | 493.542 | 22842.95 |
| Simulated Profit | 78 | 314.0253 | 967.0025 | -1365.708 | 3486.846 |
| Real Profit | 78 | 2402.32 | 1389.092 | 186.6351 | 5042.765 |

**Table 3**. Simulated Profitability (Income and Expenses)

| Financing | PD (%) | Yield (%) | Funding | Rate (%) | Profit |
|---|---|---|---|---|---|
| 99394.87 | 0.5 | 7.94 | 100331 | 7.22 | 601.9199 |
| 99394.87 | 1.0 | 7.94 | 100331 | 7.22 | 562.4746 |
| 99394.87 | 1.5 | 7.94 | 100331 | 7.22 | 523.0293 |
| 99394.87 | 2.0 | 7.94 | 100331 | 7.22 | 483.584 |
| 99394.87 | 2.5 | 7.94 | 100331 | 7.22 | 444.1387 |
| 99394.87 | 3.0 | 7.94 | 100331 | 7.22 | 404.6934 |
| 99394.87 | 3.6 | 7.94 | 100331 | 7.22 | 358.4461 |
| 99394.87 | 4.0 | 7.94 | 100331 | 7.22 | 325.8027 |
| 99394.87 | 4.5 | 7.94 | 100331 | 7.22 | 286.3574 |
| 99394.87 | 5.0 | 7.94 | 100331 | 7.22 | 246.9121 |
| 99394.87 | 5.5 | 7.94 | 100331 | 7.22 | 207.4668 |
| 99394.87 | 6.0 | 7.94 | 100331 | 7.22 | 168.0215 |
| 99394.87 | 7.0 | 7.94 | 100331 | 7.22 | 89.13094 |
| 99394.87 | 8.0 | 7.94 | 100331 | 7.22 | 10.24034 |
| 99394.87 | 9.0 | 7.94 | 100331 | 7.22 | -68.6503 |
| 99394.87 | 10.0 | 7.94 | 100331 | 7.22 | -147.541 |
| 99394.87 | 11.0 | 7.94 | 100331 | 7.22 | -226.431 |
| 99394.87 | 12.0 | 7.94 | 100331 | 7.22 | -305.322 |
| 99394.87 | 13.0 | 7.94 | 100331 | 7.22 | -384.213 |

From our simulation in the Table 3, we find that profitability of Islamic banks in Indonesia is not as strong as it is expected. When PD increases to 8%, bank is still capable to earn profit. However, when the PD increases to more than 8%, the bank experienced losses. Referring to the narrow margin of cost of financing and return on productive asset, there is more works to do to improve the situation. Comparing the result to Indonesian banking as a whole, PD of Islamic banks is relatively higher than their conventional counterparts. Conventional bank's PD is only 2.23% but Islamic bank is 3.5%. It means 50% higher than conventional bank.

Islamic banks in Indonesia hold most of their portfolio in financings. This means any problem related to financings can have a devastated impact on the income and profitability of Islamic banks. Islamic banks are more prone to the problem as the margin is relatively lower than conventional banks. It means it is critical to maintain the NPL at a tolerable rate. According to the banking authority, NPL is not allowed to exceed 5%.

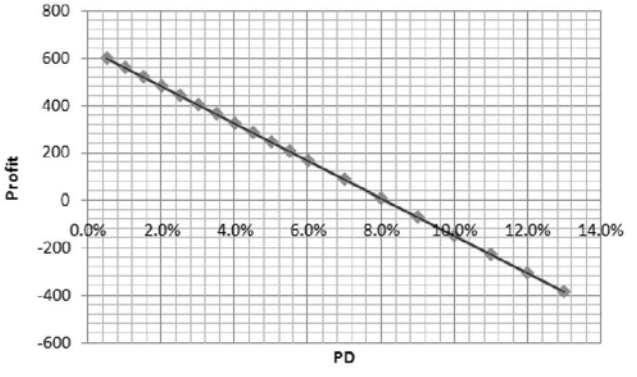


**Figure 1**. Relationship between Profitability and PD

Based on the stress test on probability default (PD), when PD increases up to 8%, a bank will experience losses. This condition means that bank should make all effort to prevent the PD exceeding 5%. Indonesian banking authority currently sets up the maximum NPL at 5%. If a bank's PD exceeded the maximum, regulatory action will be imposed which is known as special surveillance condition (DPK). All efforts are made to reduce the default rate including no expansion on new loan policy, putting more capital and management changes.

## Capital Stress Test

Referring to formula that EL = PD x LGD x EAD, we perform the calculations on how potential losses Islamic bank might face. A bank experiences losses when there is an increase in default. In the simulation model, we see the resilience of banks with regards to credit risk. We use baseline for PD at 3.5% which is the average number of experienced PD for Islamic banks. As it has been mentioned earlier, there is a regulation in Indonesia where the NPL of any banks should not be more than 5%. When a bank has NPL above 5% or more then the bank will go under special supervision, which means having to make additional capital or obey the plan to stop more lending and focusing more on managing the problem financings.

Regulatory capital is set up by the regulator to cover unexpected loss. In the banking business according to Basel Committee on Banking Supervision (Basel Committee) there are three types of risks that must be covered by capital under Pillar I of Basel II. These are credit risk, market risk and operational risk (BSBS, 2009). As it has been mentioned earlier, in this stress test, we only cover credit risk due to data availability and simplicity.

As we estimate the capital requirement using simple Internal Rating Base (foundation IRB), we only calculate probability of default. Other risk measures are provided by the authority. In Indonesia, there is a general agreement that loss given default (LGD) is 40%. The definition of these credit risk's components are: (1) Probability of default (PD) is the average percentage of obligors that default. As the data on this figure is not publicly available, we then use credit / financing quality that falls un-

der category of default or close to default which includes substandard and doubtful. This classification is in the course of one year. (2) Exposure at default (EAD), which gives an estimate of the amount outstanding. (3) Loss given default (LGD), which gives the percentage of exposure the bank might lose in case the borrower defaults. These losses are usually shown as a percentage.

Using the above information, we then can calculate the expected losses both in amount and in percentage. For the expected losses in amount is EL = PD x LGD x EAD. And for expected losses in percentage is EL = PD x LGD. In this stress testing we apply LGD 40% meaning that every 100 default, bank will loss 40. EAD is total financings. Financing in this definition is total productive asset that include financings and Sukuk. In general financings are around 95% of total productive assets of Indonesian Islamic banks. In defining capital, we use a loose definition which includes paid in capital, reserves and current profit. The description of the data used in this stress test is presented in Table 4.

From Table 4, we can see historically the PD on average is 3.6% and minimum achieved was 2.25% and maximum was 5.7%. During the period of observation, the average financing is IDR 99 trillion and in September 2014, it was IDR 187 trillion. We assume that LGD is constant at 40%. Using the expected losses formula we can compute the total expected losses.

We investigated the relationship between probability of default (PD) and central bank rate (BI Rate) using data from the Islamic banking industry bulletin issued by Bank Indonesia. Using linear regression, we find that the coefficient is 0.378 with a constant coefficient of 0.01 as presented in Table 5. This means that every 1% increase in BI rate (SBI) will always be followed by an increase of 0.38% in probability of default (PD). While the model implicitly says that the lowest probability of default (PD) on Islamic banking was around 1%. This figure illustrates the probability of default (PD) below 1%. By taking into account the relatively high margins in financing businesses with the probability of default (PD) 1% was already very profitable. Table 5 summarizes the relationship between SBI and PD.

From the estimation result, we can see that the impact of any increase in PD against potential losses that will be faced by Islamic banks is around IDR 1.5 trillion to the value that ranges between 3% or 4%. With reference to ETA ratio which stood at 5.4% then we can predict how Islamic banking in Indonesia can survive to face NPL problem. By using a simple simulation, pessimistic and optimistic positions then we can see that the Indonesian banking will only be able to survive when the PD reaches up to about 20%. Assuming that the loss given default (LGD) remains 40%. This condition can be a signal to us that the increase in PD, which is solely driven by the increase in the BI rate, is absorbable when it ranged up to 10%. For more details, please see Table 6.

**Table 4.** Descriptive Statistics of Credit Risk Component

| Variable | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Probability of Default | 78 | 0.0358622 | 0.0087574 | 0.0221624 | 0.057217 |
| Loss Given Default | 78 | 0.4 | 0.0 | 0.4 | 0.4 |
| Financing | 78 | 99551.88 | 56016.55 | 15231.94 | 187884.8 |
| Equity Capital | 78 | 9100.408 | 4924.265 | 1467.6 | 18580.17 |

**Table 5**. Probability of Default and SBI

| PD | Coef. | Std. Err.t | T | P>t | [95% Conf Interval] | |
|---|---|---|---|---|---|---|
| SBI | 0.3783338 | 0.0913053 | 4.14 | 0.000 | 0.1964836 | 0.560184 |
| _cons | 0.0097426 | 0.0063677 | 1.53 | 0.130 | -0.0029398 | 0.022425 |

**Table 6**. Simulated Expected losses and Capital Position

| PD (%) | LGD | EAD | EL | EL Optimistic | EL Pessimistic | Capital | Excess Capital |
|---|---|---|---|---|---|---|---|
| 1.9 | 0.4 | 187884 | 1400.546 | 1050.41 | 1750.683 | 6907 | 5506.454 |
| 2.1 | 0.4 | 187884 | 1585.362 | 1189.021 | 1981.702 | 6907 | 5321.638 |
| 2.4 | 0.4 | 187884 | 1770.177 | 1327.633 | 2212.721 | 6907 | 5136.823 |
| 2.6 | 0.4 | 187884 | 1954.992 | 1466.244 | 2443.741 | 6907 | 4952.008 |
| 2.8 | 0.4 | 187884 | 2139.808 | 1604.856 | 2674.76 | 6907 | 4767.192 |
| 3.1 | 0.4 | 187884 | 2324.623 | 1743.468 | 2905.779 | 6907 | 4582.377 |
| 3.3 | 0.4 | 187884 | 2509.439 | 1882.079 | 3136.799 | 6907 | 4397.561 |
| 3.6 | 0.4 | 187884 | 2694.254 | 2020.691 | 3367.818 | 6907 | 4212.746 |
| 3.8 | 0.4 | 187884 | 2879.07 | 2159.302 | 3598.837 | 6907 | 4027.93 |
| 4.1 | 0.4 | 187884 | 3063.885 | 2297.914 | 3829.857 | 6907 | 3843.115 |
| 4.3 | 0.4 | 187884 | 3248.701 | 2436.526 | 4060.876 | 6907 | 3658.299 |
| 4.6 | 0.4 | 187884 | 3433.516 | 2575.137 | 4291.895 | 6907 | 3473.484 |
| 4.8 | 0.4 | 187884 | 3618.332 | 2713.749 | 4522.914 | 6907 | 3288.668 |
| 5.1 | 0.4 | 187884 | 3803.147 | 2852.36 | 4753.934 | 6907 | 3103.853 |
| 5.3 | 0.4 | 187884 | 3987.963 | 2990.972 | 4984.953 | 6907 | 2919.037 |
| 5.6 | 0.4 | 187884 | 4172.778 | 3129.583 | 5215.972 | 6907 | 2734.222 |
| 5.8 | 0.4 | 187884 | 4357.593 | 3268.195 | 5446.992 | 6907 | 2549.407 |
| 6.0 | 0.4 | 187884 | 4542.409 | 3406.807 | 5678.011 | 6907 | 2364.591 |
| 6.3 | 0.4 | 187884 | 4727.224 | 3545.418 | 5909.03 | 6907 | 2179.776 |
| 6.5 | 0.4 | 187884 | 4912.04 | 3684.03 | 6140.05 | 6907 | 1994.96 |
| 6.8 | 0.4 | 187884 | 5096.855 | 3822.641 | 6371.069 | 6907 | 1810.145 |
| 7.0 | 0.4 | 187884 | 5281.671 | 3961.253 | 6602.088 | 6907 | 1625.329 |
| 7.3 | 0.4 | 187884 | 5466.486 | 4099.865 | 6833.108 | 6907 | 1440.514 |
| 7.5 | 0.4 | 187884 | 5651.302 | 4238.476 | 7064.127 | 6907 | 1255.698 |
| 7.8 | 0.4 | 187884 | 5836.117 | 4377.088 | 7295.146 | 6907 | 1070.883 |
| 8.0 | 0.4 | 187884 | 6020.933 | 4515.699 | 7526.166 | 6907 | 886.0675 |
| 8.3 | 0.4 | 187884 | 6205.748 | 4654.311 | 7757.185 | 6907 | 701.252 |
| 8.5 | 0.4 | 187884 | 6390.563 | 4792.923 | 7988.204 | 6907 | 516.4366 |
| 8.7 | 0.4 | 187884 | 6575.379 | 4931.534 | 8219.224 | 6907 | 331.6211 |
| 9.0 | 0.4 | 187884 | 6760.194 | 5070.146 | 8450.243 | 6907 | 146.8057 |
| 9.2 | 0.4 | 187884 | 6945.01 | 5208.757 | 8681.262 | 6907 | -38.0098 |
| 9.5 | 0.4 | 187884 | 7129.825 | 5347.369 | 8912.282 | 6907 | -222.825 |

From Table 6, we notice that the expected losses depend on three variables. LGD is assumed to be constant and total EAD is the last total financing available from Indonesia Sharia banking Statistics bulletin issued by Bank Indonesia. We can notice that amount of capital deteriorates when PD increases. Expected losses (EL) will consume capital that in practical condition any increase in PD will also increase income and liquidity. When PD is above 9%, practically Islamic banking system is collapse because its equity is less than zero. When equity is less than zero, economically it is on bankruptcy condition. From this stress test we can conclude that Islamic bank will collapse if the NPL exceeded 9%. In the US, Bernake (2013) points out that capital is in general stronger than expected.

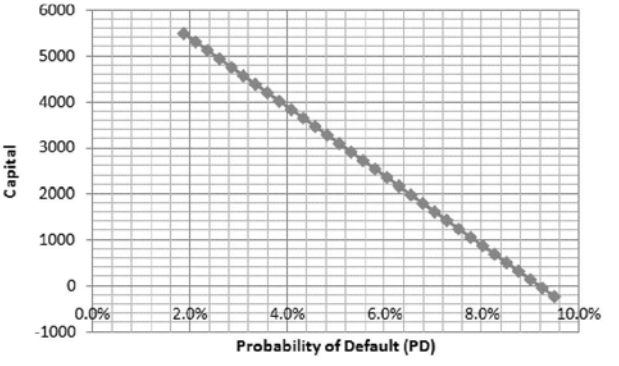


**Figure 2**. Impact of Probability of Default on Bank Capital

Stress testing results were based on the liquidity ratio set for the supervisory purposes, recalculated after a shock, and then the results were compared with the regulatory requirement (30%). In case the recalculated post-shock liquidity ratio exceeded the liquidity ratio requirement, the banks would hardly face any liquidity problems. Another method is using Value at Risk (Var) technique. In this stage, we estimate VaR for liquidity risk by using deposit. We simply assume that deposit flight from Islamic bank will create a liquidity crisis in Islamic banking industry. We follow the simplest method known as variance covariance method that assumes the distribution follows a normal curve. It may not be realistic for Islamic banking industry in Indonesia as the growth of the industry follows exponential distribution. However, the tool to perform such calculation is still not yet available. In performing the test, we follow a standard level of confidence of 99% meaning that only 1% possibility the variable exceed the VaR value. For more details, please look at Table 7.

We calculate the VaR value for total deposits. We input the mean value of IDR 100 trillion and the Standard deviation (SD) of IDR 54.1 trillion. Using the standard VaR modeling using Microsoft Excel, we find the VaR is IDR -25.72 trillion. From this result, we can conclude that total deposit flight with confident level of 99% is not more than IDR 25.7 trillion. In other words, the possibility that deposit flights beyond IDR 25.7 trillion is only 1%. It means we confidently declare that the Islamic banks in Indonesia are immune from the liquidity crisis because the liquid asset available is around IDR 27.951 trillion on average.

For the current account, the VaR is very low, only IDR 44 billion because this sources of funds is relatively stable. For the saving and investment accounts, the VaR are IDR 7 trillion and IDR 19 trillion respectively. If we combine current account, saving account and time deposits, the VaR is slightly higher. It is normal because our assumption is that there is no correlation or diversification impact.

We manipulate the data using the current situation. The standard deviation to mean or known as coefficient variation (CV) is 54%. The latest total deposit position is IDR 185.51 trillion and IDR 102 trillion for standard deviation. We assume confident level of 99% and normal distribution is applicable. We find the VaR is IDR 46 trillion. Referring to the latest condition of liquid asset as IDR 51 trillion, we can conclude that in term of liquidity stress test, Islamic banks in Indonesia pass the test.

**Table 7**. Value at Risk (VaR) for Total Funds, Current Account, Saving, and Time Deposits

| Feature | Total Funds | Current Account | Saving | Time Deposit |
|---|---|---|---|---|
| Latest | 185,508 | 18,522 | 57,199 | 115,728 |
| Mean | 100,331 | 10,215 | 30,480 | 59,776 |
| SD | 54,185 | 4,410 | 16,113 | 33,881 |
| Confidence Level | 0.99 | 0.99 | 0.99 | 0.99 |
| Extreme | 0.01 | 0.01 | 0.01 | 0.01 |
| VaR Liquidity | (25,722) | (44.366) | (7,005) | (19,043) |

**Table 8**. Impact of BI-Rate on Sources of Funding

| Deposit | Coefficient | Std. Err. | T-value | P>t (probability) |
|---|---|---|---|---|
| SBI | -1839623 | 588834 | -3.12 | 0.003 |
| Constant | 227336 | 41066 | 5.54 | 0 |

## DISCUSSION

The bottom line in this study is that each of this prediction is classified into two groups: optimistic and pessimistic predictions. Optimistic prediction is when we assume that the conditions are better, so that the results of the calculation will be reduced by 25%. For pessimistic prediction, the estimation results are added with 25%. With reference to the relationship between PD, LGD and EAD, we can calculate the expected losses (EL). Expected losses (EL) are the results or the impact of the development of the SBI and PD against the bank's capital position.

Assuming that the relationship between PD, LGD, and EAD is linear relationship, and EL functions serve as a reduction for capital. The capital is measured using Equity to Total Assets ratio not capital adequacy ratio (CAR). In this study, we do not use CAR since CAR calculation is more complicated than Equity to Total Assets ratio. Assumptions about asset quality were very decisive in the Capital Adequacy Ratio or CAR. For simplicity, this model tries to calculate impact on Equity to Total Assets ratio. Actually, with reference to the relationship between ETA and CAR, which generally has a fixed constant relationship, we can predict how the impact of any increase in SBI and PD to a decrease in CAR.

Liquidity risk stress testing is performed in order to identify and quantify the resistance of Islamic banks to negative liquidity shocks, i.e., unexpected and sizeable reduction of financial resources of banks. In this case, we focus on deposit flight from Islamic banks to conventional or flight to non-banking instruments. The aim of the liquidity risk stress testing is to assess the balance sheet capacity to fulfill the deposit flight in term of size and timing. The liquidity risk stress testing is based on the sensitivity test principle. It is used as the evaluation tool of the domestic financial system's resilience to unfavorable short-term one-off liquidity shocks. When performing a liquidity stress testing, no regard is given to the potential actions of the central bank and other governmental institutions that might improve the liquidity situation of commercial banks. Stress test is aimed to provide management of the bank with the risk they will face when certain situations happened.

The effect of a shock is neutralized by having liquid assets on the basis of individual scenarios. Individually, banks can respond by various actions such as possibility of attracting other financial resources to offset a decrease in financial resources triggered by a liquidity shock. Bank can also respond in lacking financial resources by selling productive assets. It is assumed that some asset classes would be sold at a price lower than their market value (fire sale).

Estimation of the linear relationship between the third party funding of Islamic banking and central bank rate (SBI) found a significant relationship in which any increase in SBI always has a marginal effect of -1839623 and constant of 227.336 with which all showed significant figures and the SBI signs a negative impact. This means that any increase in SBI will always be followed by a decrease in third-party funds in the Islamic banking as a result of the deposit flight. By using this relationship, then we will arrange the impact of the relationship between the BI-rate and deposit rate. With constant of IDR 227 trillion, meaning that the actual condition of the current potential of Islamic banking is about IDR 227 trillion in deposits. Currently, total deposits of Islamic banking are IDR 185 trillion.

Assuming a linear relationship, then the sensitivity of the BI rate can be assessed. Each 1% increase in the BI rate, there will be a decrease in funding of IDR 18 trillion. This means this linear relationship can give us information about how big the impact of the decline in deposits due to the increase in BI rate. From the estimation result, we can see a linear relationship between the customer deposit and existing liquid assets in the banking today. We can estimate that the liquidity problem will occur until SBI reached a certain rate. Currently a total of

liquid assets owned by banks amounted to 47 trillion, with a ratio of 25% against the third party funds.

## CONCLUSION AND SUGGESTIONS

### Conclusion

Stress test on Islamic banking industry in Indonesia provides some interesting insights. Our struggle to consolidate the data finally has paid off. Our simulations on profitability come to a conclusion that profitability of Islamic banks in Indonesia is not as strong as our expectation. Relying on financings too much make the Islamic banks prone to credit crisis. When the PD increases to more than 8%, the bank will experience losses. This is because the profit margin of Islamic bank is relatively low. Islamic banks in Indonesia hold most of their portfolio in financings. This means any problem related to financings can have a devastated impact on the income and profitability of Islamic banks in Indonesia. Therefore, Islamic banks in Indonesia need to reduce their assets concentration on financings and diversify their earning assets into other forms of earning assets. From the stress test on capital position, we find that expected losses depend on three variables: namely PD, LGD and EAD. We find that amount of capital deteriorates when the PD increases. When the PD is above 9%, practically Islamic banking system is collapse because its equity is negative. When the capital is negative, economically the bank is in bankruptcy. Therefore, Islamic banks have to be continuously be prudent in extending their financings to ensure the PD rate is always below 9%.

For liquidity, stress test uses the VaR value for total deposits. Using the mean value of IDR 100 trillion and the standard deviation (SD) of IDR 54.1 trillion, we find the VaRof IDR 25.72 trillion. It means 99% certainty that total deposit flight is not more than IDR 25.7 trillion. Considering the liquid asset available is around IDR 27.951 trillion on average, the Islamic bank system is immune from liquidity crisis.

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