Stability Measurement of Dual Banking System in Indonesia: Markov Switching Approach

Siti Fatimah Zahra[1], Ascarya[2], Nurul Huda[3]

Abstract. *Various macro and microeconomic shocks that occur during this time suggest the potential for financial instability. This study attempts to analyze the influence of macro and microeconomic variables of the dual banking stability in Indonesia and compares the stability level of both banking system by using two similar stability measurement models namely the Z-score and Banking Stability Index. The method used in this is a Markov Switching VAR. The results of this study described through two analyze: First, the calculation index of financial stability with Z-score and BSI. Second, results of Markov-Switching prove that the sharia banking system has a higher level of stability compared to the conventional banking system. It means sharia banking is more stable than conventional ones.*

Keywords: *banking stability, dual banking system, Markov switching method*

Abstrak. *Berbagai guncangan makro dan mikroekonomi yang terjadi selama ini menunjukkan adanya potensi instabilitas keuangan. Studi ini mencoba menganalisis pengaruh variabel makro dan mikroekonomi terhadap stabilitas perbankan ganda di Indonesia serta membandingkan tingkat stabilitas kedua sistem perbankan dengan menggunakan komparasi dua model pengukuran stabilitas, yaitu Z-score dan Banking Stability Index. Metode yang digunakan dalam penelitian ini adalah Markov Switching VAR. Hasil penelitian ini dijelaskan melalui dua analisis: Pertama, Perhitungan nilai indeks stabilitas keuangan dengan Zscore dan BSI. Kedua, Hasil Markov Switching, membuktikan bahwa sistem perbankan syariah memiliki tingkat stabilitas yang lebih tinggi dibandingkan dengan sistem perbankan konvensional, yang artinya perbankan syariah terbukti lebih stabil dibandingkan dengan konvensional.*

**Kata kunci**: *stabilitas perbankan, sistem perbankan ganda, model Markov switching*

Introduction

Financial sector stability is an essential prerequisite to keep the sustainable and stable economic growth. According to Swamy (2014), financial stability and macroeconomic stability linked since financial stability will be vulnerable if price stability and macroeconomic stability cannot control. Some studies indicate that higher market power lies on the banking market with the higher level of instability. Even banks are better on the capital side; the risk of failure remains top-- especially the recent market share of banking institutions dominating the financial system. Consequently, banking stability shows greater assumption in ensuring the financial stability.

Along with the rapid pace of economic system, in Indonesia, the financial institution as an intermediary tool is also growing. Since the birth of law no. 19 of 1998 that amends the law no. 7 of 1992 on banking, the term of the dual banking system that is conventional bank system and sharia bank system appears. Based on the total assets of the financial system, the banking industry still dominates the financial system in Indonesia recently—proven by a market share of 80.75% of total asset of the financial institution by the end of 2015.

Figure 1. The Total Assets of the Financial System in Indonesia
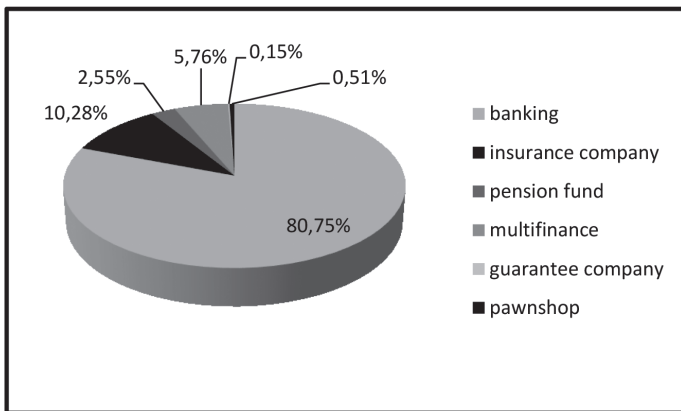
Source: Financial Stability Review Report Bank Indonesia (2015)

The financial system of a country considered stable when it is durable and resistant to various economic disturbances so that it is still able to perform the function of mediation, conduct the payments, and spread the risk well. Also, Ascarya et al. (2009) state that the success of a financial system can be seen either from its performance in allocating optimally economic resources or from the

stability of the financial system in facing the shocks sourced from both financial side and macroeconomic side. From the financial side, its shocks are the non-performing loan (NPL) / non-performing finance (NPF). Meanwhile, from the side of microeconomic, that shock is caused by the sharp changes in exchange rates.

The phenomenon of global financial instability seen with the various crises occurs in the world including those that hit Indonesia. According to Laeven and Valencia (2012), some recent banking crises are the most expensive crisis regarding fiscal expenditure and output losses. IMF identifies that from 1970 through 2011, in total, there were 147 banking crises, 218 currency crises (10 of which occurred during period 2008 – 2011) and 66 government debt crises (10 of which occurred during 2008-2011). Among those crises, 68 were twin crises, and 8 were triple crises.

One of the most critical crises of Asian economies, including Indonesia, is the crisis that began in the mid-1997 affecting the value of currencies, stock markets, and asset prices of several countries in Southeast Asia. Its crisis commenced in Thailand and Malaysia, later Indonesia and several countries were also impacted. In Indonesian banking sector, the crisis of exchange rate has disrupted the intermediary function characterized by the number of banks becoming insolvent. This crisis happened because the vulnerability to debt position in USD ($) increased so that it burdened the bank liability (Muti'ah, 2010).

As the consequence of that monetary crisis, on August 14, 1997, Bank Indonesia was forced to free the exchange rate of rupiah against foreign exchange, mainly USD and let it fluctuated freely—free floating system replaced the government's managed floating system since the devaluation on October 1978. Therefore, Bank Indonesia no longer intervened in the foreign exchange market to support the rupiah exchange rate, so that market forces merely determined the exchange rate. The rupiah exchange rate then depreciated rapidly and sharply from an average of Rp. 2,450 per $ in June 1997 to Rp 13,513 at the end of January 1998. However, had it strengthened again to around Rp 8,000 in early May 1999 (Tarmidi, 1998).

Also, the crisis that occurred in 2008 also gives the significant impact on the state of the Indonesian economy. That crisis gave negative sentiment to the Indonesian financial market, as shown by the drop in IDX Composite to 1400, which simultaneously forced the rupiah exchange rate above the psychological limit of Rp 9,500.00 per USD. Pressures on national exports and foreign investment and uncertainty over commodity prices would affect the outlook for inflation (Regional Economic Quarter III / 2008: 2).

The financial crisis in Indonesia also re-occurred in the last two years, namely in 2013 by rupiah depreciation against USD. The rupiah exchange rate depreciated by 5.77% month to month (mtm) to Rp 11,963 per USD or on average it experienced the depreciation by 2.42% (mtm) to Rp 11,624 per USD. Moreover, based on the data from the Central Bureau of Statistic Indonesia (BPS), on January 2016, rupiah was depreciated by 0.96% against USD. The lowest average national rate of rupiah exchange rate against the USD occurred in the third week of January 2016 at Rp 13,863.13 per USD. Its depreciation of the exchange rate was mainly triggered by market players' negative sentiments against the tapering-off plan as well as the effect of Indonesia's current account deficit. Bank Indonesia assessed the rupiah depreciation was still in line with the development of regional countries' currencies. Further, Bank Indonesia would continue to maintain the stability of the Rupiah exchange rate in line with its fundamental values to support a controlled economic adjustment (Bank Indonesia 2013).

The depreciation of the rupiah exchange rate has a real impact on the economic activities of entrepreneurs whether it is large, medium, small or micro. For some Indonesian entrepreneurs, the depreciation of the rupiah exchange rate has disrupted the operations of companies with components of imported or paid production costs with USD. The higher the import content, the more the rupiah needs to be exchanged in the same dollar value. The various crises that have occurred affect the condition of state economy through macro and microeconomic variables directly or indirectly. According to the report of Bank Indonesia Financial Stability Review (2015), in 2015, the global financial market condition experienced a devaluation triggered by uncertainty in the direction of monetary policy in the United States (USA). Sentiment in global financial markets coupled with the weakening performance of the Indonesian economy impact the increasing pressure in Indonesian financial markets. In the midst of external and domestic challenges, banks still have good resilience through their performance has slightly declined. Banking resilience can identify with the capital level that is relatively stable.

However, the performance of banks has slightly declined—banking intermediary function somewhat weakens in line with the slow growth in Bank Loan to Deposit (LDR). The slowing economic growth, on the one hand, has led to slow credit growth, while on the other hand, it has increased the growth of third-party funds of banks. Its combination encourages the decline of the loan to deposit (LDR). The decrease in bank performance is also reflected in the efficiency and return on assets (ROA) that has declined. The decline in

the efficiency of the banking industry can also identify by an increase in the operational efficiency ratio (BOPO). Its decrease in efficiency is the cause of the decline in the profitability of the banking industry. This situation increasingly awakens the government and various economic regulators on the importance of financial system stability. It is because the instability of the financial system will produce horrible impacts that are the loss of public confidence and slow economic growth and income.

The existence of dual banking system implementation becomes an object discussed by the researchers in looking at the level of banking stability with various measurement models. In some studies, the sharia banking system is regarded to be more stable in experiencing macroeconomic shocks than conventional banks. This phenomenon proven by the large number of studies conducted by Darrat (1988, 2002), Kia (2001), Iqbal (2001), Kia and Darrat (2003), Čihák, et al. (2007; 2008), Ascarya, et al. (2009), Beck, et al. (2010), Anisak (2010), Akhter, et al. (2011), Nurfalah (2015). However, in another study conducted by Ichsan (2012), which used Banking Stability Index (BSI) approach as performed by (Segoviano, 2009: Ghosh, 2011). It found that sharia banks are no more stable than conventional banks in which the percentile of conventional banking stability index is higher than sharia banking stability index. Additionally, the volatility of sharia banks is higher than that of conventional banks. However, the level of stability distribution of sharia banks is more evenly distributed compared to conventional banks.

Based on the difference in the results of these measurements, it is interesting to conduct the further study related to banking stability in this dual system. Therefore, this study tries to measure the level of stability of sharia and conventional banking system with two stability measurement model (BSI and Z-Score) to know which banking system that is more stable in facing macro and microeconomic variable shocks.

Literature Review

Financial System Stability

Many economic participants, especially financial market participants, have recognized the term financial stability. In principle, financial stability relates to 2 elements, namely price stability and financial sector stability including financial institutions and financial markets that support the entire financial system. If any of these factors are disrupted or unable to run correctly, other elements will be affected in one hand (Nasution, 2003). According to law no. 9 of 2006, the stability of the financial system is a condition of the financial system that works

effectively and efficiently and able to survive on the internal (within the country) or external (abroad) fluctuation. International Monetary Fund (IMF) states that the financial system considered stable when it can avoid the fall of financial institutions in large numbers and intermediary system interference. Also, Bank Indonesia (BI) also states that a stable financial system is a reliable and resistant financial system in facing various economic disturbances—it can perform the intermediary function, conduct payments and spread the risks well. The risks in a financial system that often experienced are such as credit risk, liquidity risk, operational risk and market risk (Bureau of Financial System Stability of Bank Indonesia, 2012).

In the Islamic financial system, according to Iqbal (1997), the primary framework is a set of rules and laws, collectively referred to sharia, regulating economic, social, political and cultural aspects of Islamic society. Sharia comes from the Qur'an and Sunnah. Ascarya (2009) says that there is no fundamental difference of the scopes or elements that exist in the conventional financial system and Islamic financial system. They are just distinguished by the norms and values that had adopted. The stability of Islamic finance system, in the view of the classical Muslim scholars, occurs when the flow of money from deposits to investment goes smoothly—there is no source of funds that are idle or not utilized.

Four related factors are supporting the creation of financial system stability; (i) a stable macroeconomic environment; (ii) a well-managed financial institution; (iii) effective oversight of financial institutions; and (iv) a secure and reliable payment systems. If there is an interruption in one of the sub-sectors, it will extend to other subsectors (Illing and Liu, 2003; Gadanecz and Jayaram, 2008).

Figure 2. Factors in supporting Stable and Healthy Financial Stability
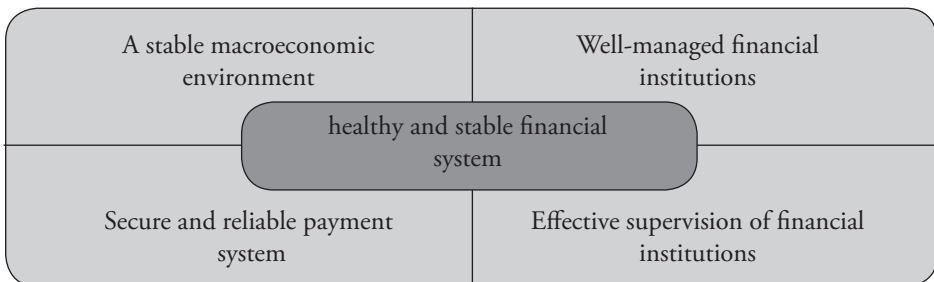
Source: Booklet of SSK DPNP, Bank Indonesia (2007)

The increasing trend of global financial sector supported by technological developments causes the financial system to become more integrated without time lag and borders. Moreover, financial product innovation is increasingly dynamic and diverse with the increasing complexity. These developments not only cause the sources of financial system instability to increase and be more varied, but these also lead to the more difficult situation to overcome the uncertainty. As a G-20 member, Indonesia commits to implement the Financial Sector Assessment Program (FSAP) in 2016. The FSAP aims to assess the stability and development of the national financial sector comprehensively to maintain the stability of the financial system implemented every 5 (five) years. Indonesia has firstly followed FSAP in 2009/2010 (LPS, 2016).

To know the sensitivity of a financial system in experiencing macroeconomic variable shocks, one can do with macro stress testing proposed by the IMF and World Bank. Stress in the financial sector can measure through risk proxies in each financial sub-sector. There are several studies in measuring and analyzing the financial stability based on the caused stress. Financial stability seen from the proxy of stress by performing Financial Stress Index (FSI) in the financial sector can be taken advantage as a measure of financial sector stability such as done by Illing and Liu (2003), Morales and Estrada (2010), and Korohama (2013).

There are also assessments by using aggregate financial stability index like a study by Gersl and Hermanek (2006). They construct aggregate financial stability with indicators based on the FSI value of the IMF for the Czech Republic. A study by Verlis (2010) which aims to see stability in Jamaica from 1997 to March 2010 using microeconomic, macroeconomic indicators, and the performance factors of the banking sector. Albulescu (2010) that examines the financial system of Rome, with an index built on the financial system, vulnerability, strength, and indicators of international economic conditions.

Other measurements can also make by formulating a Financial Stability Condition Index (FSCI) based on variables sourced from market information and balance sheet from financial institutions and other economic actors. This index performed by Van Den End and Tabbae (2005) in examining the financial stability of the Netherlands and Van Den End (2006) in reviewing the financial stability of the six OECD member countries. The study of financial system stability measurement in Indonesia by using Financial Stability Index (FSI) has been conducted by Irawan (2006), Haddad et al. (2007), and Ascarya et al. (2009) by using banking, capital market and money market, variables.

Measurement of Banking Stability

The measure of banking stability in this study uses two calculation models namely Banking Stability Index (BSI) and Z-Score. The Banking Stability Index has widely used in previous studies (Segoviano, 2009; Ghosh 2011; Ichsan 2012; Mucheva and Magdalena 2013; Kočišová 2014). Similarly, Z-Score also has been used in the studies of (Čihák et al. (2007; 2008), Beck et al. (2010, 2012), Zakaria (2013), Ghassan and Taher (2013), Altaee, et al (2013), Tomak (2013), Elbadri (2015).

A study conducted by Ghosh (2011) tries to measure banking stability in India by constructing an index of Banking Stability Index (BSI). Three banking indicators used are: First, Loan-Loss Provision (LLP) ratio to total assets. Second, The ratio of total capital to the risk of total weighted assets; or; capital adequacy ratio (CAR). Third, Probability of Return on Asset (ROA) measured from the ratio of profit after tax to total assets.

These indicators derived from three main dimensions of banking operations: stability, health, and profitability, in which the higher values of these indicators indicate an increase in bank operations on that aspect. While the ROA, as a considerable measure of bank profitability in the literature, is also widely used as a measurement of stability and health banking (Ghosh, 2011).

In the calculation, BSI consists of two stages, namely:

$$d = \frac{A_i - m_i}{M_i - m_i} \ \cdots\cdots\cdots\cdots \ (1)$$

Information:

I   = indicator i is the index for each dimension I (d_1)

A   = the actual value of each variable

M and m = the maximum and minimum values of dimension i

Furthermore, values that are higher than d_1 suggest a higher achievement level of the bank in that dimension. In the n-dimensional space, the index used in the following equation:

$$BSI_j = \frac{\sqrt{\sum_{i=1}^{n}(1-d_i)^2}}{\sqrt{n}} \ \cdots\cdots\cdots \ (2)$$

Given that this BSI index has minimum and maximum values that naturally may vary according to time, it indicates that this BSI index has the right flexibility in the calculation. It is quite possible to compare the level of banking stability over time, and it is also relative to other banks. Thus, this index is considered highly dynamic and flexible (Ghosh, 2011).

The Z-Score variable has widely used in previous studies as an indicator in determining the level of banking stability. IMF also uses z-score to evaluate bank stability. The Z-score calculation based on the historical accounting data of the bank's financial statements that is a combination of three indicators, such as: capital adequacy, profitability and volatility measures. (Altae, 2013). The banking sector will go bankrupt or even crisis if the percentage of assets is lower than the percentage of the loan value (Čihak et al., 2008). The Z-Score equation formulated as follows:

$$Z \equiv (k + \mu) / \sigma ROA \ldots\ldots (3)$$

Z-score is a function of total equity and reserves/total assets added with the average return on assets (ROA) and divided by the standard deviation of ROA. The greater the result of z-score the more the conditions stable (Čihak et al., 2008).

In the study of Altaee et al. (2013: 96) explains that the calculation of Z-score value can calculate as $z = (k + \mu) / \sigma$. Where k is the percentage of capital and reserves of total assets, μ is the average percentage of ROA (net income of total assets), and σ is the standard deviation of ROA as a proxy of return volatility. The higher the z-score values, the lower the risk of default, and vice versa. The higher σ indicates the instability of bank earnings that decrease the amount of z-score.

In this study, the measurement of banking stability made by using z-score because it is considered to be fair and more relevant to measure the stability of banking regarding that banking is a financial institution that is high risk-high return. From the results of this z-score, it known which banking system is more stable because when the z-score is higher, the occurrence of bankruptcy is lower. The measurement of bankruptcy in various financial institutions has a category of stability assessment through a z-score range, i.e., the score above 2.90 categorized as "solvent," the score between 2.90 - 1.20 categorized as "a gray area," and the score is below 1.20 is categorized as "insolvent." (Altman in Anisak, 2010).

Previous Studies

Rahim and Zakaria (2013) compare financial stability between sharia banks and conventional banks operating in Malaysia during the period 2005-2010. The research sample consists of 17 sharia banks and 21 conventional banks using panel data analysis. This study uses Z-Score and NPL to total credit as a proxy indicator for financial stability. The results show that sharia banks are more stable than conventional banks. Also, this study also finds that all factors affecting the stability of sharia and conventional banks remain the same, except the income

diversity index. Stability in sharia banks is not determined by income diversity as conventional banks did. This fact explains the reason of why sharia banks remain stable compared to convention banks during the recent crises when various sources of bank income have been affected by negative impacts.

Ichsan (2012) tries to see dual banking stability in Indonesia in the 2005-2011 period using independent variables: IPI, BI Rate, Exchange Rate, Inflation, Money Supply (M2), and a dependent variable: Banking Stability Index (BSI). The method used is VAR VECM. The result of BSI shows that sharia bank is not more stable than the conventional bank where the percentile value BSI conventional banks is more significant than BSI sharia banks, and volatility level of sharia bank is higher than the conventional bank. However, the distribution level of sharia banking stability is more evenly distributed compared to conventional banks. Variables that are prone to shake the stability of conventional banks are Inflation (8.56%), BI rate (4.09%), and Money Supply (2.07%). That is in contrast with the stability of sharia banks that are only vulnerable to inflation (18.56%) and income (8.46%).

Simorangkir (2012) examines several types of banking to serve as a detection sample of early warning occurrence of the crisis. This examination includes Government Bank (BP), Private Bank (BS), Foreign Exchange Bank (BSD), Non-Foreign Exchange Private Bank (BSND), Foreign Bank (BA), Mixed Bank (BC), Frozen Bank Business Activity (BBKU) and Frozen Operational Bank (BBO). The results of this study indicate that the Markov Switching (MS) model produces robust results as an early warning indicator of bank runs. This condition reflected in the test results of the actual results in 102 banks showing the MS result only gives the wrong signal in the range of 0.69% to 2.08%.

Ghosh (2011) examines the stability of 28 banks in India in the period 1997-2007. The dependent variable used is Banking Stability Index (BSI) because this index is considered to have a degree of flexibility in comparing the level of stability over time. While the independent variables are Total Assets, Cost Income Ratio (CIR), Real Loan Growth, Branch Growth, Merger, Herfindahl Index, Real GDP Growth, Real Interest Rate, and Divestment. Regression analysis method used in this study. The results indicate that the expansion of branches allows for better diversification of risks that result from a positive impact on BSI. Growth in GDP growth and a decrease in real interest rates may lower the possibility of bank failures. The existence of government investment, the presence of foreign banks, and competition (as measured by Herfindahl Index) give a positive effect on banking stability improvement (BSI).

Čihák et al. (2008) measured banking stability using data from 1993 to 2004. The measurement of banking stability did by using regression analysis (OLS) on

banking z-score value. Independent variables used include macroeconomic variables (GDP, inflation, exchange rate depreciation), Herfindahl index (seeing the financial stability of total banking assets of a country), and governance indicators (GCG). While the dependent variable used is the value of Z-score, which are a function of capital, reserve bank, an average return of assets divided by standard deviation from ROA. The results of this study, in cross-country, prove that sharia bank is more stable than the conventional bank. The most significant average z-score scores are the smaller sharia banks, large conventional banks, small conventional banks, and large sharia Banks. The macroeconomic variables that have the most significant effect on stability are exchange rate depreciation, while GDP and inflation are not very substantial.

Kusuma and Duasa (2017) trying to build an early warning system for preserving financial system stability. This research suggests that there are several indicators that able to figure out the resilience of Islamic banking. They also suggest that the resilience of Islamic banking needs to supported by the resilience in the real sector.

Method

The data used in this study are secondary data in the monthly form obtained from Bank Indonesia namely Economic and Financial Statistic Bank Indonesia (Indonesia: SEKI-BI), Financial Services Authority (Indonesia: OJK) that are Indonesian Banking Statistics (SPI-OJK) and Sharia Banking Statistics (SPS-OJK), and Bureau Central of Statistics. It also uses period data between January 2006 and December 2015.

Generally, in this study, there are four equation models—the two use dependent variable z-score, and the rests use a dependent variable of banking stability index (BSI).

Z-score equation model

Model 1: $Z\text{-}score\_K_t = A_0 + A_1 IPI_{t-i} + A_2 INF_{t-j} + A_3 EXC_{t-k} + A_4 BR_{t-l} + A_5 DBK_{t-m} + A_6 CAR_{t-n} + A_7 LDR_{t-o} + A_8 PUAB_{t-p} + \varepsilon t$ ..……(4)

Model 2: $Z\text{-}score\_S_t = A_0 + A_1 IPI_{t-i} + A_2 INF_{t-j} + A_3 EXC_{t-k} + A_4 BR_{t-l} + A_5 DBS_{t-m} + A_6 CAR_{t-n} + A_7 FDR_{t-o} + A_8 PUAS_{t-p} + \varepsilon t$.……(5)

BSI equation model

Model 3 : $BSI\_K_t = A_0 + A_1 IPI_{t-i} + A_2 INF_{t-j} + A_3 EXC_{t-k} + A_4 BR_{t-l} + A_5 DBK_{t-m} + A_6 CAR_{t-n} + A_7 LDR_{t-o} + A_8 PUAB_{t-p} + \varepsilon t$.…………(6)

$$\text{Model 4 : BSI\_S}_t = A_0 + A_1 \text{ IPI}_{t-i} + A_2 \text{ INF}_{t-j} + A_3 \text{ EXC}_{t-k} + A_4 \text{ BR}_{t-l} + A_5 \text{ DBS}_{t-m} + A_6$$
$$\text{CAR}_{t-n} + A_7 \text{ FDR}_{t-o} + A_8 \text{ PUAS}_{t-p} + \varepsilon t \quad \ldots\ldots\ldots(7)$$

The development of research using Markov switching model has increased. Since Hamilton firstly introduced it in 1989, some researchers were then interested in developing this method to understand the dynamics of econometrics in the business cycle. The Markov switching model that combines the linear autoregressive model with the Markov chain model is the autoregressive Markov switching model. Because the business cycle is one of the dynamics of the macroeconomy that is influenced by several factors, it needs a model that uses several variables as the indicator of the economy. The Markov Switching Vector Autoregressive (MSVAR) model is a nonlinear model that incorporates an autoregressive linear vector model with a Markov chain model using several economic variables that can change conditions to describe the business cycle (Hayuk 2014). Therefore, an appropriate statistical analysis is needed to analyze time series data on the economic and financial variables undergoing regime switching.

By Hans-Martin Krolzig (2006) and Untoro et al. (2014), in this study, the Markov switching model used by the multivariate model is MS-VAR model (Markov Switching-Vector Auto Regression) that can use as an alternative to linear time series model with constant parameters. The general idea of this regime change model is that the parameters of the dimension vector time series K {yt} depend on the unobserved regime variable $\in \{1, ...,\}$, which represented by the chance of a state in a particular regime:

$$p\left(y_t \,|\, Y_{t-1}, X_t, S_t\right) = \begin{cases} f\left(y_t \,|\, Y_{t-1}, X_t \,; \theta_i\right) & \text{if } S_t = 1 \\ \quad\vdots \\ f\left(y_t \,|\, Y_{t-1}, X_t \,; \theta_M\right) & \text{if } S_t = M \end{cases}$$

With $Y_{t-1} = \{y_{t-j}\} = \frac{\infty}{1} =$ is the historical value of y_t, X_t which is an exogenous variable, and is the vector parameter at time of regime m.

The Markov-Switching regression model can be defined as follows:

$$y_t = \begin{cases} X_t \beta_t + u_t, & u_t \,|\, s_t \sim N\left(0, \textstyle\sum_1\right) & \text{if } S_t = 1 \\ \quad\vdots \\ X_t \beta_M + u_t, & u_t \,|\, s_t \sim N\left(0, \textstyle\sum_M\right) & \text{if } S_t = M \end{cases} \tag{8}$$

X_t is the exogenous regressor matrix of size $(K \times R)$, and u_t is the innovation process. The most common forms of the MSVAR process with the p and M order of the regime are:

$$y_t = v\left(s_t\right) + A_1(S_t) y_{t-1} + \ldots + A_p(S_t) y_{t-p} + u_t, \quad u_t \,|\, s_t \sim N(0, \Sigma \, S_t)) \quad (9)$$

With value per sample $y_0, \ldots, y_{1-p}$ is fixed.

There are several specifications of the MS-VAR model in modeling the time series to regime changes. The common notation used for the MS-VAR model specification which indicates which variables are changing against regime change is as follow: M (mean (μ)) ; I (intercept (ν)) ; A (autoregression parameter(A_i)) ; and H (heteroscedasticity (Σ)).

Table 1. Types of MS-VAR Model

Notation	μ	ν	Σ	A_i
MSM(M)-VAR(p)	Changed	-	Not changed	Not changed
MSMH(M)-VAR(p)	Changed	-	Changed	Not changed
MSI(M)-VAR(p)	-	Changed	Not changed	Not changed
MSIH(M)-VAR(p)	-	Changed	Changed	Not changed
MSIAH(M)-VAR(p)	-	Changed	Changed	Changed

Source: Untoro et al. (2014)

In all MS-VAR specifications, it assumed that unobserved state S_t follows a process of first-order Markov Chain process, which explains that the current regime (S_t) depends only on the regime of one previous period S_{t-1}.

This study uses latent variables that follow the first derivation of Markov two-state, i.e. $\{St\}_{t=1}^{T}$. Where $S_t = 1$ is the crisis state and $S_t = 0$ is tranquil state. Even in this model S is not directly observed, the behavior of the dependent variable (Y_t) is free from S_t that can be notated as follow:

$$Yt \mid St \overset{iid}{\sim} N\,(\mu S_t, \sigma_{St}^2) \qquad (10)$$

This study tries to compare two measurement models on dual banking. Therefore, there are two dependent variables (Y_t) used in each model of this study. Dependent variables are the measure of banking stability, such as: Z-Score and BSI. Referring to Simorangkir's study (2012), in the MS model, the mean and variance of Y_t may change according to the regime. The density (density) of S_t can be formulated as follows:

$$f\,(y_t \mid S_t) = \frac{1}{\sqrt{2\,\pi\sigma\,s_t}} \exp \frac{\lfloor -(y_t - \mu_{St})^2 \rfloor}{2\,\sigma_{St}^2} \qquad (11)$$

For $S_t = 0, 1$

Latent variables of regime switching (S_t) are derived from the following P_t probability transition matrix. Where p_{ij}^{t} is the possibility of displacement of state i in period t-1 to state j in period t and F is the nominal cumulative function cdf

component of vector kx1. Meanwhile, X_{t-1} is an early warning indicator that may affect the chance of transition.

To run this model, it needs the initial value that is p_1^1 = Pr(s = 1) which is the unconditional probability to state 1 in period 1. The treatment of its value depends on whether x_t is stationary or not. If x_t is stationary then the probability of long-term $P_1^1 = S_1$ = 1 and it is also a function of (β_0, β_1). If x_t is not stationary, it means an additional parameter that must be estimated. In practice, if the time series data is long enough, the likelihood function will not be affected either by calculating the function of (β_0, β_1) separately or by fixing the values—it will not make a significant difference (Simorangkir, 2012).

## Result and Discussion

Result

Based on the outcome of stationary test, the variable of stability of banking system either sharia or conventional is stationary at first difference level, except BSI_S. The stationary macroeconomic variables at the level are IPI (InIPI) and inflation, while the exchange rate variable (InER) and interest rate (IR) are stationary at the first difference level. In the micro variables, both sharia and conventional banks are almost all stationary at first difference level, except for sharia capital adequacy (CARS) and interbank money market variables (InPUAB).

The results of this test, all models of banking stability (sharia and conventional) experience a structural shift during the period of this study. It can see from the F statistic value of each model which is significant at 5% real level, which shows that the null hypothesis (H0) which states there is no structural shift had rejected. Based on the tests, on the model of Sharia Z-score, Conventional Z-score, and Conventional BSI, there are heteroscedasticity. While on Sharia BSI model, there is no heteroscedasticity. Through the smallest LR Linearity Test values, the best MSVAR model for each model can identify. The models in each equation are: Z-score_S (MSMH), Z-score_K (MSIH), BSI_S (MSI), BSI_K (MSMH).

In measuring the stability of dual banking in this study, as has been explained earlier, it uses the value of Z-score and BSI as indicators of the banking stability size. These calculations result from different values between the level of stability of sharia banking and the conventional one. Both index values are obtained by using data composition by previous studies, which become the reference in this study. The Z-score values are derived from the components of total equity data and reserves / total assets, average return on assets (ROA) and standard deviations from ROA,

with the formulation Z = (k + ROA) / σROA as has been conducted by Čihák et al. (2008). While the values of BSI were obtained from data components, such as: capital adequacy ratio (CAR), profitability ratio (ROA) and NPL/NPF. This result also found by Segoviano (2008). The values obtained from the calculation of each banking system are as follows:

Figure 3. The Average of Z-score and BSI of Double-Banking in Indonesia
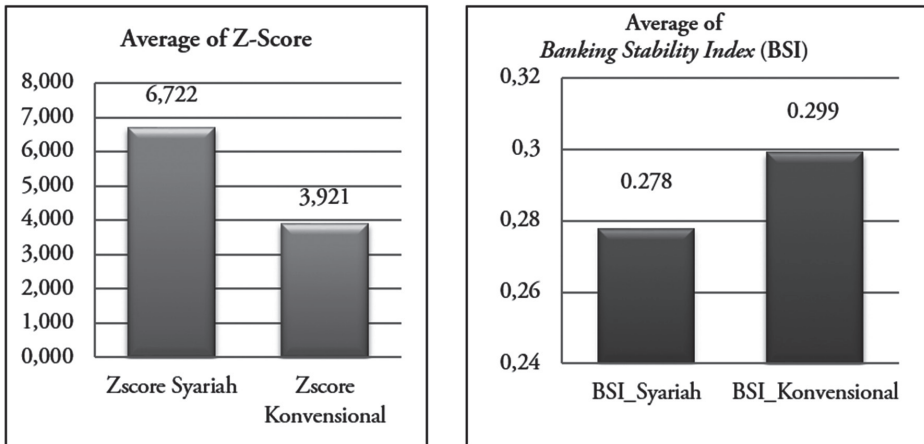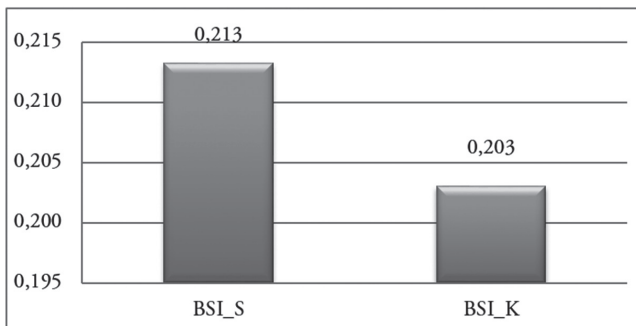

Source: SPS-SPI Data (Processed)

Based on the calculation of stability measurement by using z-score, on Figure 3, it can see that the average of Z-score of sharia banks (6,722) is higher than conventional bank z-score (3,921). According to Čihák et al. (2008: 7), higher z-score values have implications for a lower possible risk of insolvency. It shows that based on the measurement of the amount of Z-score, sharia banking is more stable than conventional banking. This result of this study is by some previous studies such as Čihák et al. (2007: 2008), Beck et al. (2010), Anisak (2010), Akhter et al. (2011), Rahim (2013), Nurfalah (2015). All of that research states that sharia banks are more stable than conventional banks.

The high value of this z-score, according to (Čihák et al., 2008), can be caused by an increase in bank assets, low loan to asset ratio, cost-to-income ratio and increased income diversity that obtained. Thus, banks are advised to expand the network not only operate in the sector of distribution / loan, but also look for other sources of income. The level of banking stability in Indonesia, seen from the results of measurements using Banking Stability Index (BSI), it shows that the value of BSI conventional bank (0.299) is higher than the amount of BSI sharia bank (0.299)

indicating that conventional banking is more stable than sharia banks. This result is by previous studies conducted by Ichsan (2012).

Regarding these different values, the researcher looks for something that causes the difference between the values of these two indexes. Thus, in the second calculation phase, the researcher tries to see from the side of the forming component of the two stability indexes. Then, calculating the stability indicator with the same elements continues it. Through the second calculation process, the BSI stability index (Sharia and Conventional) calculated by excluding NPL / NPF data components into BSI calculations. The results are shown in Figure 4, which show that the value of BSI_S (sharia banking) (0.213) is greater than BSI_K (conventional banking) (0.203). These results are in line with the amount of Z-score, which clarify that the level of stability of sharia banking is higher than conventional. The difference of forming components of both stability indexes influences the difference in results of both measurements.

Figure 4. The average of Sharia and Conventional BSI

Source: SPS-SPI data (processed)

From the results of BSI calculations, indirectly, it can be taken a hypothesis that the use of NPF variables have an adverse effect and can trigger a decline in the level of stability of sharia banking system in Indonesia. This condition is in line with the movement of NPF data of sharia banking in Indonesia, which is more volatile than NPL during period of this study. NPF increased mainly in 2014 to early 2015. However, NPF ratio began to tend to lead to a decline back in 2015, and NPL of conventional banking appeared to have a slightly increasing trend since 2014 to 2015-- an increase only in the small number percentage. The rise of NPF and NPL ratio occurs as the impact of slowing global economic growth, depreciating of the exchange rate and declining

domestic demand starting in 2013 with the introduction of quantitative easing policy, which affected the sluggishness of the real sector and increased the ratio of non-performing financing.

Based on Figure 5, it can see that the movement of NPF and NPL representing credit/financing risk acts as one of the assessors of stability of dual banking system in Indonesia. The fluctuating NPL / NPF condition positively affects the level of banking stability in performing the financial intermediation function. From the results of the calculation, it knows that in the z-score measurement model information on NPF fluctuations cannot be captured. Also, it also is known that despite the increase in problem financing (percentage of NPF) of banks occurs; sharia banking still tries to strengthen on the side of capital seen by the number of assets and CAR which continue to increase to remain in stable condition. It is possible because of the other income (income diversity) obtained by sharia banking. As stated by Čihák et al. (2008), the high level of stability of sharia banking also influenced by the existence of income diversity. It is also supported by research Rahim et al. (2013) that among of different factors of dual banking system stability is the income diversity obtained by banking.

Figure 5. Movement of NPL and NPF 2006 – 2015
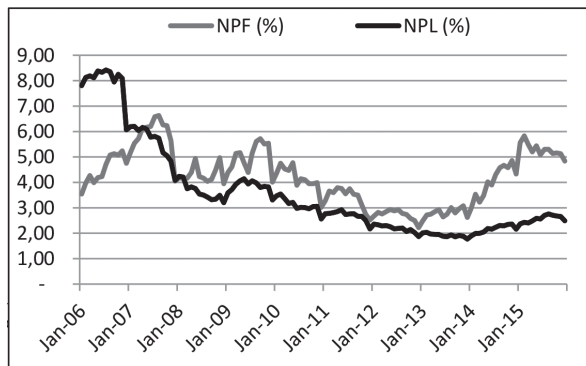
Source: SPS-SPI data OJK

Nevertheless, at this measurement, it is essential to consider the size scale of both banking systems. In this study, the data are the overall data of banks contained in both types of banking systems in Indonesia. Thus, when it measured in the form of percentage, sharia banking has a higher value compared with the conventional banking system.

Compared to other methods, this MS-VAR method has advantages such as providing information on the index value of the crisis (threshold). Hence the crisis period and the duration of the crisis become one of the estimated results. Such information can see from the shift from stable conditions (regime 1) to unstable conditions (regime 2). This fact is given that the banking industries, as financial institution, usually experience the conditions up and down like a business cycle. When bank is resistant to macro-turbulence, it is in stable condition. In reverse, if it decreases because of the influence of macroeconomic turbulence, it is an unstable situation. The results from OxMetric5 show the differences in probability and duration of regime transitions that occur in sharia and conventional banking, as shown in the following table:

Table 2. Probability and Duration Transition Regime on Z-score Model

Regime	Z-score_S Model		Zscore_K Model	
	Prob	Duration	Prob	Duration
Regime 1	0.5985	34.76	0.5131	12.01
Regime 2	0.4015	23.32	0.4869	11.39

Source: processed by the researcher

Z-score_S = sharia banking z-score, Z-score_K = conventional banking a-score

Based on Table 2, the z-score measurement model shows that the probability of sharia banking in stable condition (regime 1) is 59, 85% that is bigger than the probability of unstable condition (regime 2) that is equal to 40,15%. Similarly, the duration of tranquil condition of sharia banks (34.76 months) is longer than the conditions of the crisis-- 23.32 months. If it is compared with the conventional banking system, sharia banking has a greater probability of regime 1 (stable condition) and smaller regression probability (unstable condition). The same results also are shown in the BSI model, which state that the probability level of sharia banking is in stable condition (55.12%) that is greater than conventional banking (50.47%). Also, the probability of unstable conditions in sharia banking (44.88%) is also smaller than the existing unstable conditions in conventional banking (49.53%). Seen from its duration, stable condition of sharia bank is also longer. The results can see in Table 3.

Table 3. Probability and Duration of Transitions Regime on BSI model

Regime	BSI_S model		BSI_K model	
	Prob	**Duration**	**Prob**	**Duration**
Regime 1	0.5512	25.39	0.5047	19.68
Regime 2	0.4488	20.67	0.4953	19.32

Source: processed by the researcher

BSI_S= sharia banking BSI, BSI_K= conventional banking BSI

Looking at the results of both stability measurement models, it known that the possibility of sharia banking system in stable condition is higher than conventional banking system. This measurement indicates that sharia banking by using the revenue sharing system has more significant potential to run in excellent condition. The sharia financial system is more stable than the conventional interest-based financial system. It based on the argument that the profit-sharing scheme underlying the operation of the Islamic financial system acts as a shock absorber to shocks (Ascarya, 2009).

It had explained early that this study consists of two groups of regimes, namely regime 1 (stable condition) and regime 2 (unstable situation). Through Markov switching method, the determination of the period of unsettled conditions occurrence is one of the estimation results. In this study, each banking system uses two-equation models. Based on estimated data, the duration of switching regime of each banking system is different. In this case, the differences in banking conditions based on the expected results of each stability model.

Discussion

At the beginning period of study i.e. 2006, the condition of sharia banking is in regime 2, which means unstable. The unstable situation because economic conditions in early 2006 were still strongly influenced by the continued impact of the fuel price hike in 2005 marked by high inflation and interest rates, increased production costs and weakening purchasing power. Thus its condition led to a climate that was less conducive to the business world including sharia banking. Nevertheless, in line with the increasing macroeconomic stability, in the second semester of 2006, the broader economic expansion began to increase, so that the performance of sharia banking industry again found its momentum, marked by the high growth of business volume (Progress Report of Sharia Banking (LPPS) 2006).

This increase is in line with the estimated results showing in October 2006 (2006) where sharia banking was even more stable again.

On the other hand, although sharia banks have experienced pressure from macroeconomic conditions, the sharia banking industry continues to expand its network. The increasing number of banks conducting business based on sharia principles, namely an Islamic Business Units and 13 sharia rural banks, proved it. Along with its increase, the share of sharia banking industry increased from 1.4% to 1.6%. Moreover, the network of sharia bank offices has also grown by 40 offices to 636 offices at the end of 2006. Growth in deposits, financing and financial ratios also was continuing in that year. Furthermore, banks began to be stable again during 2007 to 2008.

At the end of 2008, the crisis caused by subprime mortgage in the United States had a negative impact on the condition of the Indonesian economy, including financial institutions such as banks. Sharia banks up to the beginning of 2009 felt this impact. It can see from the total assets of the sharia banking industry that although overall experienced a positive growth, they still suffered a slowdown. According to Bank Indonesia's report (2009), the deceleration is affected by the real sector condition, such as the national economic downturn; lack of public purchasing power, and high economic costs that impact on business expansion limitation and reduction of consumption.

However, the slowdown in the sharia banking industry is relatively minor if it is compared with the downturn in the national financial industry in general. Overall, it can say that the sharia banking industry in 2009 tends to decrease the growth rate of business activities and the level of profitability. In the following years, sharia banking is back on stable condition.

In mid-2013 (second semester), financial stability in Indonesia suffered high pressure due to tapering off plan from the Federal Reserve amid a slowing global economy marked by declining global commodity prices. The existence of Quantitative Easing (QE) policy caused investors to divert their investment (capital outflow) from the emerging market countries. Thus it was impacting on the depreciation of the emerging market's exchange rate, including Indonesia. The rupiah was depreciated against the US dollar by 22.1% from June to December 2013 (KSK, 2014). The high uncertainty of the global economy is probably very influential on the stability of Indonesia's financial system, including the sharia banking industry as a financial institution. This uncertainty can be seen from the increased liquidity risk, as credit growth rate is higher than the growth of deposits. Also, the increasing market risk due to the weakening of the rupiah exchange rate remains also indicates. Therefore, in the second semester of 2013, sharia banking was

in the position of regime 2 (unstable). The end of 2015 still felt the uncertainty of the global economy, weakening commodity prices and declining domestic demand. Thus, many of those countries were again slowing their economic growth by issuing monetary policies to control rising risks in financial markets for economic recovery.

The classification of regime transfer period from the data processing through OxMetrics5 is shown more clearly in Table 4. Similar with sharia banking, in 2006, the conventional banking system was also in an unstable condition, but in line with the improvement of the macroeconomy, in the second semester, precisely in October 2006, banks began to stabilize again. However, from November 2006 to the beginning of 2008 (2006: 10 - 2008: 1), banks have experienced shocks due to the unstable macroeconomic conditions. In September 2008, banks again suffered a precarious situation due to the emergence of several challenges encountered, including rising world oil prices and financial crises stemming from subprime mortgage problems so that the impact was disruptive to the stability of the financial system, both in developed countries and developing countries including Indonesia. Various financial transactions that tended to have high levels of speculation lead to deterioration in the conventional financial system. Furthermore, banks were trying to control their stability to return the transition to stable conditions.

Table 4. Classification of the Sharia Banking Regime Period

Z-score_S model	
Regime 1	**Regime 2**
2006:10 - 2008:6	2006:1 - 2006:9
2009:4 - 2013:5	2008:7 - 2009:3
	2013:6 - 2015:12

Source: OxMetric5

The existence of Quantitative Easing (QE) policy in 2013, which caused the devaluation of rupiah and emerging market currencies, has also affected the decline of conventional banking stability, precisely since July 2013. The unstable macro condition also had an impact on increasing global risk and domestic risks thereby it increased the risk of the domestic financial system, such as slowing economic growth impacting on slowing credit growth, as banks were more cautious in lending. Nevertheless, banks were still trying to manage the risks they faced and strived to maintain their stability through capital strengthening, improvements in credit, and others to decrease the potential for instability.

Table 5. Classification of Conventional Bank Regime Periods

Z-score_K model	
Regime 1	**Regime 2**
2006:10 - 2006:11	2006:1 - 2006:9
2008:2 - 2008:8	2006:12 - 2008:1
2008:11 - 2008:12	2008:9 - 2008:10
2009:4 - 2012:10	2009:1 - 2009:3
2012:12 - 2013:6	2012:11 - 2012:11
	2013:7 - 2015:12

Source: OxMetric5

In line with the global economic slowdown and declining commodity demand due to the depreciation of the exchange rate, the banking institutions also experienced a slowdown in 2014 to 2015. Also, Indonesia's financial system also faced with unbalanced financial conditions that potentially pose a systemic risk. According to the report of Financial System Stability Review (2015), the sources of the identifiable imbalances are: the contraction of financial cycles and the proliferation of bank lending, increased private foreign debt, falling commodity prices, the Fed's normalization plan and the strengthening trend of the USD, and the continuing increase in property prices. The higher non-performing loan ratio and the declining probability level also prove the condition of instability since 2014. It also happened on sharia banking system on that year.

The estimated result almost the same as the Z-score model shown by the modeling result of Banking Stability Index (BSI). Based on this BSI model, sharia banking from 2006 to October 2007 is in the position of regime 2 (unstable). This phenomenon because the slowing national economic condition characterized by: high inflation and interest rates and falling demand for domestic commodities. Besides, according to the estimation model of sharia BSI was also affected by the global crisis from October 2008 to September 2009. In this case, the global crisis that occurred is sufficient; it gave a significant impact on the state of the Indonesian economy. This crisis gave negative sentiment to the Indonesian financial market, as reflected by the drop in the JCI to 1400, which simultaneously pushed the rupiah exchange rate beyond the psychological limit of Rp 9,500.00 per US dollar. Pressures on national exports and foreign investment and the uncertainty over commodity

prices affected the outlook for inflation. In the end, its global crisis had a negative impact on the financial system and national economy, including the stability of sharia banks at a certain level.

In 2009 the sluggish economic condition also occurred in the real sector realm with the decreasing of people's purchasing power, which caused the economic growth to slow down and influenced the slowing growth of sharia banking. This condition is also evident from the increasing NPL ratio in that year. Furthermore, sharia banking was starting to stabilize again in October 2009.

Also, according to the estimation of BSI model, it also shows that the existence of Quantitative Easing (QE) policy in 2013 hurt banking stability in Indonesia through instability of macroeconomic conditions such as depreciation of rupiah exchange rate. The implications of these unstable macro conditions had an impact on increasing the risks in the financial system, including the effect on risks that exist in the banking industry as part of the national financial system. To be more specific, this transition regimes period of sharia banking shown in Table 6.

Table 6. The classification of sharia bank regime period

BSI_S Model	
Regime 1	Regime 2
2007:11 - 2008:9	2006:1 - 2007:10
2009:10 - 2013:6	2008:10 - 2009:9
	2013:7 - 2015:12

Source: OxMetric5

It shows that in the early period of this study conventional banking was in an unstable position because of the influence of national economic conditions. The banking industry was able to stabilize again in March 2008. Also, the conventional banking system re-experienced a transition to unstable conditions in 2008 to March 2009 as a financial institution that also experienced the impact of the bubble economy in the United States with the collapse of Lehman Brothers. Mainly, those consequences were significant to speculative and interest-based transactions.

Another fact that shows the effect of macroeconomic conditions on banking stability can also see in the mid of 2013. The existence of Quantitative Easing policy indirectly influenced the decline in stability of the Indonesian banking industry, whether it was a sharia bank or a conventional bank. This impact still occurred until the following

year due to the unstable macroeconomic turmoil, especially emerging market countries. It shows that banking institutions again experience the light condition. This is also evident in the slowing banking growth. Calcification of this of conventional banking transition period shown in Table 7.

Table 7. The Classification of Conventional banking Regime Period

Model BSI_K	
Regime 1	**Regime 2**
2008:3 - 2008:9	2006:1 - 2008:2
2008:11 - 2008:12	2008:10 - 2008:10
2009:4 - 2013:6	2009:1 - 2009:3
	2013:7 - 2015:12

Source: OxMetric5

Based on the overall exposure of the estimated results from the two models described above, it can see that the dual banking transition periods in the Z-score and BSI models obtain similar results. Also, the level of stability of the dual banking system in Indonesia is influenced by the existing macroeconomic conditions. So that when there is a phenomenon of financial instability both global and domestic, the banking stability decreases and its growth also experience a slowdown. Nevertheless, in line with the increasing economic growth, banking growth has also increased.

Conclusion

This study measures the level of dual banking stability in Indonesia against macro and microeconomic variables for ten years (2006 - 2015) using two measurement models namely Z-score and Banking Stability Index (BSI). Based on calculations from banking data, it shows that the stability level of sharia and conventional banking in Indonesia is different. Through the calculation of z-score values, the sharia banking system has a higher level of stability (6,722) than the conventional banking system (3,921). However, through the calculation of Banking Stability Index (BSI), the stability of the sharia banking system (0.278) is lower than that of conventional banking (0.299). This calculation occurs because of differences in the components of both conventional banking and sharia banking. When the constituent components of Z-score and BSI equated, the result shows that sharia banking is more stable than conventional banking.

Also, according to Markov Switching's results through the estimated probability and duration of switching regime on dual banking system in Indonesia using two models (z-score and BSI) show similar results for each banking system. In general, sharia banking is considered more stable in facing macro and microeconomic shocks than conventional banking.

The policy recommendations that offered by this study are: First, to maintain the stability of the banking system, banks should be more careful and improve strategies in dealing with uncertain financial conditions, either in capital strengthening or credit/financing. Second, results of the study prove that sharia banking is more stable in facing the crisis shock compared to conventional banking, regarding this, government policy that continues to support in increasing market share of sharia banking is needed.

Besides that, this research also suggests some research recommendations such as: First, the variables used in this study are still limited to macroeconomic and micro variables, which are the internal financial ratios of banks. However, many other factors affect the stability of the financial system beyond the variables used in this study. Therefore, it is recommended in further studies to use other variables that are qualitative, for example, the business conduct sector, customer behavior, and others. Second, also, the data used in this study only within ten years. For subsequent reaches, it is recommended using a more extended period in research observation to obtain maximum results.

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