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MACROECONOMICS INDICATORS AND BANK STABILITY: A CASE OF BANKING IN INDONESIA

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Abstract

This paper provides new empirical evidence of the bank stability in relation to the macroeconomic indicator of Indonesia. The bank stability is first calculated using Z-score, and then regressed using Autoregressive distributive lag (ARDL) model on the macroeconomic variables i.e. Gross Domestic Product (GDP) in US dollar, Interest rates (IR) in percentage and Consumer Price Index (CPI). To analyse further the long run relationship and the impact of bank stability, Cholesky standard deviation shock to the model, ARDL and Impulse Response Function (IRF) are used. These ARDL and IRF are carried out independently and repeated over data for three different models: (i) the commercial banks model, (ii) Islamic banks model, and (iii) the overall banking industry model. The empirical findings suggest long run relationship between the stability of commercial banks and macroeconomic factors. The findings also suggest the long run relationship between the stability of overall banking industry and macroeconomic factors. However, there is no evidence of long run relationship between the stability of Islamic banks and macroeconomics factors. Nevertheless, this finding is subject to the limitation of data, on the number of Islamic banks included in the test. The sample of Islamic banks was 5 banks from a total of 10 Islamic banks, due to insufficient data, as compared to the larger number of commercial banks taken into, as the sample.

Keywords: bank stability, Z-score, ARDL, commercial banks, Islamic banks
JEL Classification: E44, E63, G21

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I. INTRODUCTION

The recent global financial crisis has induced a series of failure of many conventional banks and led to an increased interest in the Islamic banking. The financial crisis also calls for a financial system that is stable throughout all time and not affected by any crisis. The issue on the financial stability and bank stability has always been the interest of all central banks around the world. It is paramount important of the sustainability of the banking industry itself. Thus, with the parallel players of Islamic and conventional banks, a comparison between the two is inevitable. According to Hasan & Dridi (2010), Bourkhis & Nabi (2013), Parashar and Venkatesh (2010), the performance and stability of the Islamic banks are better than conventional banks, for the period after and during the crisis. Parashar and Venkatesh (2010) also noted that Islamic banking is safer than conventional banks due to its characteristics including its product structure that is asset backed. In contrast, Beck et al. (2013) found Islamic Banking are less cost-effective but higher intermediation and better capitalized than the conventional banking, in the normal economic.

This paper focuses at the bank's stability in Indonesia. It compares the stability of Islamic banks, commercial banks, and overall banking industry using Z-score[1]. It explores the Z-score as the indicator of bank's stability in Indonesia. A data from BankScope[2] is obtained to include 58 commercial banks and 5 Islamic banks in Indonesia from 1999 to 2013. The bank's Z-score and independent variables such as Gross Domestic Product (GDP) in US dollar, Interest rates (IR) in percentage and Consumer Price Index (CPI) are regressed using Autoregressive distributive lag (ARDL) model and later a shock to the model is analysed using the Impulse Response Function (IRF). These procedures are carried out independently and repeated for 3 models for commercial banks, Islamic banks, and Indonesia banking industry.

The remaining of this paper is structured as follows. Section 2 discussed the development of the Z-score as a measure of bank stability, calculation of Z-score and the effect of macroeconomics factors on bank stability. Section 3 looks at the data and methodology. Section 4 discusses at the findings and lastly the conclusion is drawn in section 5.

II. THEORY

The Z-score as a measure of Bank Stability

Due to the recent global financial crisis, it has become a great interest and draw enormous attention to the bank insolvency risk (Rahman, 2010) thus, the Z-score increased its important

1 Z-score is a measure of the distance-to-default and inversely related to the probability of a bank's insolvency (Rajhi & Hassairi, 2013). Higher score of z-score indicates a more stable bank than the lower score.

2 The main data source is BankScope database produced by the Bureau van Dijk. BankScope reports the data in the original currencies of the respected dual banking countries and provides a choice to convert data in any other currencies, including the US Dollar. (Hassan et. al., 2009). The bank specific data was converted into US Dollar.

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than ever (Strobel, 2011). (Rahman, 2010) also noted that there are 3 other market-based-risk measuring methods: Z-score, CAPM risk measures, and Zrisk index with the rationale that it is the most appropriate measure because Malaysian Islamic banks are relatively small and not publicly traded on the stock exchange. However, a careful look at the formula of Zrisk index will reveal that it is very much similar to Z-score. The empirical evidences of Z-score as a proxy of bank stability are compiled in table 1 below.

Table 1
Empirical Evidences of Z-score

Author(s) / Year	Identity of Z-score	Findings
Roy, 1952	Upper bound of probability of disaster	x_i = [(best estimate of price of ith asset when all other prices equal to d/k) - d/k] / (Standard error of best estimates of ith asset's price when all other prices are equal to d/f) d/f - critical price
Lepetit, Nys, Rous, & Tarazi, 2008	ADZ / Z-score	Modified the method by (Boyd & Graham, 1986): ADZ or Z-score, ROE and the standard deviation of ROE is expressed in percentage. The formula is ADZ= (100+average ROE) / SD ROE.
Ahmad, Ariff, & Skully, 2008	Zrisk	The usage of zrisk as a measure of risk
Rahman, 2010	Zrisk index	Extended the work by (Hannan & Hanweck, 1988), Zrisk = E(ROA) + CAP / σROA, where E(ROA) is the expected return on assets, CAP is the ratio of equity capital to total assets, and σROA is the standard deviation of ROA.
Strobel, 2011	Probability of insolvency	Improvised method: the measure of probability of insolvency - by identifying the downward biasness in using the (weighted) average of Z-scores thus a potential flaw measuring of systemic soundness. The downward bias was eliminated if the percentiles of bank-level Z-scores are weighted by total bank assets.
Lepetit& Strobel, 2013	Time-varying Z-score	The time-varying Z-score measures was further improvise using a simple root mean squared error criterion where it uses mean and standard deviation estimates of the return on assets calculated over full samples combined with current values of the capital-asset ratio, and is thus straightforward to implement.
Bourkhis & Nabi, 2013	Bank Soundness	Noted Z-score ratio is an important measure for bank soundness because it is inversely related to the probability of bank's insolvency. Z-score is denoted as follows: Z=(μ+K)/σ where μ denotes the bank's average return on assets (ROA), K the equity capital in percentage of total assets and σ is the standard deviation of the ROA as a proxy for return volatility.
Beck, Demirgüç-Kunt, Merrouche, 2013	Bank Soundness	Z-score is an average return on asset plus equity divided assets divided by standard deviation of return on assets.
Hsieh, Chen, & Lee, 2013	Bank Stability, Z-index	Z-index=ROA+ E/TA / σ_{ROA} where, ROA is the ratio of return to total assets, E/TA is the equity percent of assets, and σROA is standard deviation of return

Source: Author's own tabulation of literatures.

Macroeconomics Effects on the financial and bank's stability

Previous researches like Sufian & Habibullah (2012), Köhler (2014), Bourkhis & Nabi (2013) and Cihák & Hesse (2007) have used macroeconomic factors as the control variables in explaining the variations in the response variables. Sufian & Habibullah (2012), examined the effects of bank specific characteristics and macroeconomic factors on the bank's performance. These macroeconomics factors include gross domestic product and inflation. Similarly, Bourkhis &

Nabi (2013) examined the bank's soundness using Z-score and look at the macroeconomics factors such as GDP growth, inflation and exchange rate as some of the explanatory variables. In addition, Cihák & Hesse (2007) in their research adjusted the of the macroeconomic cycle by including control variables from macroeconomic variables such as GDP growth, inflation, interest rate, and exchange rate appreciation. Diaconu & Oanea (2014) investigated factors influencing the bank stability using Z-score, and employed 4 variables: inflation, gross domestic products, BET rate, and interbank offering rate for 3 months. The relationships between these macroeconomics variables and bank or financial stability are discussed in table 2 below.

Table 2
The Relationships between Macroeconomic variables and Bank / Financial Stability

Authors (Year)	Variables	Findings
Diaconu & Oanea (2014)	GDP, interest rate, bank stability (of co-operative bank vs commercial bank)	Model for co-operative banks indicate that financial stability is influenced by gross domestic product and interest rate whereas none of the variables affect the stability of the commercial banks.
Pan & Wang (2013)	Economic growth, housing prices, bank stability	Low economic growth caused an undesirable demand for housing and hence affecting the housing market. This affecting the bank stability, as evidence in the US sub-prime financial crisis.
Soedarmono, Machrouh, & Tarazi (2011)	Economic growth, bank risk/ stability	Economic growth has the capacity to mitigate the bank risk taking behaviour and hence lead to a more stable conditions of the banks.
Creel, Hubert, & Labondance (2014)	Economic growth, financial stability	Financial instability has a negative effect on economic growth.
Akram & Eitrheim (2008)	Interest rate, bank stability	Keeping a stable and low interest rates does not increase the stability of the banks.
Driffill, Rotondi, Savona, & Zazzara (2006)	Interest rate, bank stability	Central bank's action on smoothing the interest rate has increase the stability of banks.
Kraft & Galac (2007)	Interest rate, bank stability	Using a logit models, it is noted that high deposit interest rate couple with weak supervision may result in instability in the banks, hence lead to bank failure.
Akram & Eitrheim (2008)	Inflation, bank stability	Volatility in the price of general prices could lead to high interest rates and hence decreases the stability of the financial sectors.
J. H. Boyd, Levine, & Smith (2001)	Inflation	There is a nonlinear negative relationship between inflation and the financial stability.
Criste & Lupu (2014)	Inflation	There is a trade-off between inflation and financial stability.

Source: Author's own tabulation of literatures

ARDL and ECM

Abduh & Omar (2012) and Abduh (2013) used ARDL to investigate the short run and long run relationship between: (i) stock market and economic growth, and, (ii) Islamic banking and economic growth, respectively. The ARDL model consists of an autoregressive part and a regression with distributed lags over a set of other variables. The ARDL model regresses a

variable over its own past plus the present and past values of a number of exogenous variables (Abduh & Omar, 2012). Nevertheless, the ARDL method excludes pre-testing variables, because as highlighted in numerous literatures, problem of unit root-cointegration exists where the power of the unit root tests is typically very low and there is a switch in the distribution function of the test statistics.(Abduh & Omar, 2012). The ARDL approach is to test the existence of a relationship between variables in levels is applicable regardless the underlying regressors are purely I(0), purely I(1), or mixed (Abduh & Omar, 2012). Without having any prior information about the direction of the long-run relationship among the variables, the ARDL approach to cointegration involves estimating the conditional error correction (EC) version of the ARDL (Abduh & Omar, 2012).

III. METHODOLOGY

The data gathered from BankScope, a global database on various types of banking. There are a total of 60 commercial and 10 Islamic banks in Indonesia in 2014. However, only banks with at least two observations are included. Finally, we only included 58 commercial and 5 Islamic banks due to insufficient data. Meanwhile, the macroeconomic data are obtained from the World Bank Reports (World Development Indicators). The banking data and macroeconomic data are annual data for the period from 1999 to 2013. First, the measurement of bank's stability is measured using Z-score and calculated using the well-used formula,

$$Z = (ROA + CAP) / \sigma ROA.$$

The descriptive statistics is presented in the Table 3 below.

Table 3
Descriptive Statistics and calculation of Z-score on annual basis

	Mean CAP			Mean ROA			Standard Deviation ROA			Z-score		
Year	CB	IB	Industry	CB	IB	Industry	CB	IB	Industry	CB	IB	Industry
1999	11,09	7,67	10,95	-5,86	1,89	-5,65	11,40	0,94	11,07	0,46	10,14	0,48
2000	25,56	67,52	28,56	0,98	-10,72	0,35	2,57	10,49	3,87	10,33	5,41	7,48
2001	21,15	44,39	22,81	1,03	2,14	1,09	2,20	1,17	2,13	10,06	39,77	11,19
2002	29,44	39,29	29,77	1,01	2,36	1,05	2,33	1,05	2,25	13,08	39,48	13,71
2003	29,22	16,96	28,48	1,60	0,66	1,55	1,64	0,36	1,59	18,84	48,29	18,95
2004	27,91	70,92	31,60	1,68	2,96	1,79	1,80	2,34	1,84	16,48	31,51	18,19
2005	24,52	48,03	26,24	1,99	3,36	2,09	1,93	3,04	2,02	13,71	16,93	14,05
2006	24,95	41,40	26,02	1,65	2,20	1,69	1,31	1,86	1,35	20,24	23,43	20,59
2007	25,90	10,69	25,58	1,56	3,83	1,70	1,28	3,77	1,58	21,45	3,86	17,25
2008	20,74	46,15	22,27	-0,14	2,47	0,02	9,76	1,78	9,38	2,11	27,25	2,38
2009	23,79	13,51	23,24	1,12	0,78	1,10	2,47	0,61	2,38	10,08	23,39	10,23
2010	21,96	18,03	21,70	1,40	0,81	1,36	1,89	0,61	1,83	12,38	31,11	12,63
2011	20,48	27,08	21,01	1,42	1,24	1,40	1,36	0,98	1,33	16,07	29,02	16,84
2012	18,92	22,95	19,24	1,56	1,32	1,54	0,94	0,54	0,91	21,86	44,78	22,80
2013	18,31	24,30	18,80	1,44	1,14	1,42	1,67	0,43	1,61	11,82	58,65	12,57

CB-Commercial BankIB-Islamic BankROA-Return on AssetCAP-Equity/Total Asset
Source: Author's own calculation

From table 3 above, it is noted that the Z-score of conventional banks and whole banking industry have similar trends in the movement. This is understandable as conventional banks represent majority of banks in the whole banking industry. From 1999 to 2013, the Islamic banks are more stable than the conventional banks and the whole banking industry, given higher Z-score, in general. According to Rajhi & Hassairi (2013) the Z-score is a measure of the distance-to-default, thus, higher Z-score increases the bank's distance to default, hence more stable the bank will be. However, this higher Z-score is with the exception on year 2000 and 2007. It should be noted that the year 2001 is the end of Asian Financial Crisis, for Indonesia, whereas year 2007 is the beginning of Global Financial Crisis or also known as systemic crisis (Laeven & Valencia, 2013). Thus, crisis affected the Islamic banks, either later or first than the conventional banks or the whole banking industry. Interestingly, in 2006, prior to Global Financial Crisis, high Z-score was consistently reported across all Islamic, conventional and the whole banking industry.

Once, the bank's stability is established, the unit root test is then carried out using Augmented Dickey Fuller and Phillip Peron tests for all the four variables to ensure that these economic time series do not have unit root and stationary. These tests for stationary are carried out with and without intercept at level and first difference. Upon completion of these tests, the Z-score of commercial banks (ZC), Z-score of Islamic Banks (ZI), Z-score of banking industry (ZALL) and independent variables such as Gross Domestic Product (GDP) in US dollar, Interest rates (IR)

in percentage and Consumer Price Index (CPI) are regressed using Autoregressive distributive lag (ARDL) model, and later a shock to the model is analysed using the Impulse Response Function (IRF). These processes are replicated over for 3 different models, that is, firstly, to test the bank's stability of commercial banks with the macroeconomic variables, secondly to test the bank's stability of Islamic banks with the macroeconomic variables and finally, to test the bank's stability of overall banks(banking industry in Indonesia) with the macroeconomic variables.

The models initially tested are

$$ZALL_t = \beta_0 + \beta_1 GDP_t + \beta_2 IR_t + \beta_0 CPI_t + \varepsilon_t \quad (1)$$

$$ZI_t = \beta_0 + \beta_1 GDP_t + \beta_2 IR_t + \beta_0 CPI_t + \varepsilon_t \quad (2)$$

$$ZC_t = \beta_0 + \beta_1 GDP_t + \beta_2 IR_t + \beta_0 CPI_t + \varepsilon_t \quad (3)$$

where $ZALL_t$ is the Z-score (bank stability) of banking industry in Indonesia; ZI_t is the Z-score (bank stability) of Islamic Banks in Indonesia; ZC_t is the Z-score (bank stability) of commercial banks; GDP_t is Gross Domestic Product; IR_t is the Interest rates and CPI_t is the Consumer Price Index, while ε_t is error term.

Pesaran, Shin, & Smith (2001) suggested a bound testing method with the equation of any long-run relationship may be given by the following equations:

(Equation 4 for Industry)

$$DZALL_t = \alpha_0 + \sum_{j=0}^{p} \beta_j DGDP_{t-j} + \sum_{j=0}^{p} \gamma_j DIR_{t-j} + \sum_{j=0}^{p} \emptyset_j DCPI_{t-j} + \alpha_1 GDP_{t-1} + \alpha_2 IR_{t-1} + \alpha_3 CPI_{t-1} + \mu_t$$

(Equation 5 for Commercial Banks)

$$DZC_t = \alpha_0 + \sum_{j=0}^{p} \beta_j DGDP_{t-j} + \sum_{j=0}^{p} \gamma_j DIR_{t-j} + \sum_{j=0}^{p} \emptyset_j DCPI_{t-j} + \alpha_1 GDP_{t-1} + \alpha_2 IR_{t-1} + \alpha_3 CPI_{t-1} + \mu_t$$

(Equation 6 for Islamic Banks)

$$DZI_t = \alpha_0 + \sum_{j=0}^{p} \beta_j DGDP_{t-j} + \sum_{j=0}^{p} \gamma_j DIR_{t-j} + \sum_{j=0}^{p} \emptyset_j DCPI_{t-j} + \alpha_1 GDP_{t-1} + \alpha_2 IR_{t-1} + \alpha_3 CPI_{t-1} + \mu_t$$

where *p* is the optimal lag length and *D* refers to the first difference of variables.

Finally, an analysis on the shock upon the variables are conducted. An impulse response functions using Cholesky one standard deviations traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables.

IV. RESULT AND ANALYSIS

Test for Unit Root

The test for unit root and non-stationary are carried out for all variables employed in the model : (i) Z-score of commercial banks (ZC), (ii) Z-score of Islamic Banks (ZI), (iii) Z-score of banking industry(ZALL), (iv) gross domestic product (GDP), (v) interest rates(IR), and (vi) consumer price index (CPI) using Augmented Dickey Fuller (ADF) and Phillip Peron (PP) tests for stationary with and without intercept at level and first difference. Table 4 shows that variables like Z-score for Commercial Banks, Islamic Banks and Industry in Indonesia, Gross Domestic Product, and Interest Rates are all non-unit root and stationary at a significance level of 1% but at first difference for tests under ADF and PP. For CPI, it does not unit root problem and stationary at a significance level of 5% for both ADF and PP tests for stationary.

Table 4
Test for Unit Root at level and first difference

Variables	ADF		PP		Decisons
	At Level	1st Difference	At Level	1st Difference	
ZC	-0.769	-4.594***	-0.593	-7.160***	I(1)
ZI	0.019	-4.258***	0.259	-4.232***	I(1)
ZALL	-0.610	-3.812***	-0.539	-4.322***	I(1)
GDP	-0.126	-9.058***	0.066	-9.543***	I(1)
IR	-2.306**	-5.226***	-2.351**	-5.588***	I(0) / I(1)
CPI	9.345	-3.893**	8.314	-3.893**	I(1)

* - significant level of 0.10 (10%), ** - significance level of 0.05 (5%) and
*** - significance level of 0.01 (1%). ADF, PP and KSS represents the Augmented Dickey Fuller and Phillip Peron tests for stationary with and without intercept at level and first difference.

Commercial Bank's Stability and Macroeconomic Variables

The results for overall banking industry is displayed in Table 5 and 6 Based on Table 4.2, the optimal model can be selected using the model selection criteria like Schwartz-Bayesian Criteria and (SBC) and Akaike Information Criteria (AIC), where the AIC is -1.35 and SBC is -0.83. The optimal derived is at first difference and at lagged equal to 1. All the coefficients of the variables are significant at least 5% significance level except first difference of Interest rate. The model above can be rewritten as:

Table 5
Estimation of the Model ARDL - Commercial Bank's Stability and Macroeconomic Variables

Dependent Variable: DZC, Method : Least Squares

Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	-3639.811	105.919	-34.364	0.019
ZC(-1)	-2.498	0.060	-41.715	0.015
LGDP(-1)	147.807	4.327	34.158	0.019
IR(-1)	1.746	0.031	55.470	0.012
CPI(-1)	-3.921	0.119	-33.058	0.019
DZC(-1)	1.114	0.024	45.626	0.014
DLGDP	22.694	1.851	12.258	0.052
DLGDP(-1)	-78.172	1.875	-41.701	0.015
DIR	-0.220	0.046	-4.821	0.130
DIR(-1)	-0.873	0.037	-23.887	0.027
DCPI	0.735	0.095	7.720	0.082
DCPI(-1)	7.154	0.140	51.022	0.013
Adjusted R^2	0.999461	Akaike Information Criteria (AIC)		-1.35367
Durbin Watson	3.3848	Schwartz-Bayesian Criteria (SBC)		-0.83218

Table 6 shows the value of F-statistic of 1655.751, and the values of (k + 1) = 4 variables which are Z-score (ZC), (Gross Domestic Product (GDP), Interest rates (IR), and Consumer Price Index (CPI)) in our model. Thus, for the Bounds Test tables of critical values, the value of is k = 3. To ascertain the critical values, the Table CI (iii) of Pesaran et.al (2001) is used since there is no constrain on the intercept of the model and no linear trend term. The lower and upper bounds for the F-test statistic at the 10%, 5%, and 1% significance levels are [2.72 , 3.77], [3.23 , 4.35], and [4.29 , 5.61] respectively. It is noted that the F-statistic exceed the upper bound at the 1% significance level. Thus, it is concluded that there is evidence of a long-run relationship between the four time-series at 1% significance level.

Table 6
Bound Testing for ARDL co-integration

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	1655.751	(4, 1)	0.0184
Chi-square	6623.005	4	0

An Impulse response function (IRF) as shown in figure 4.1 above revealed that a shock of one standard deviation Cholesky to GDP, IR and CPI on the Z-score of commercial banks reach its equilibrium after year 6. Both GDP and CPI reported a positive response to the shock in the

short run as compared to a negative shock for IR. This prediction confirmed to the previous empirical findings that GDP and price stability have positive relationship. Similarly the previous findings on interest rate reaffirmed that higher interest rates causes instability among commercial banks as depicted by blue line as negative.

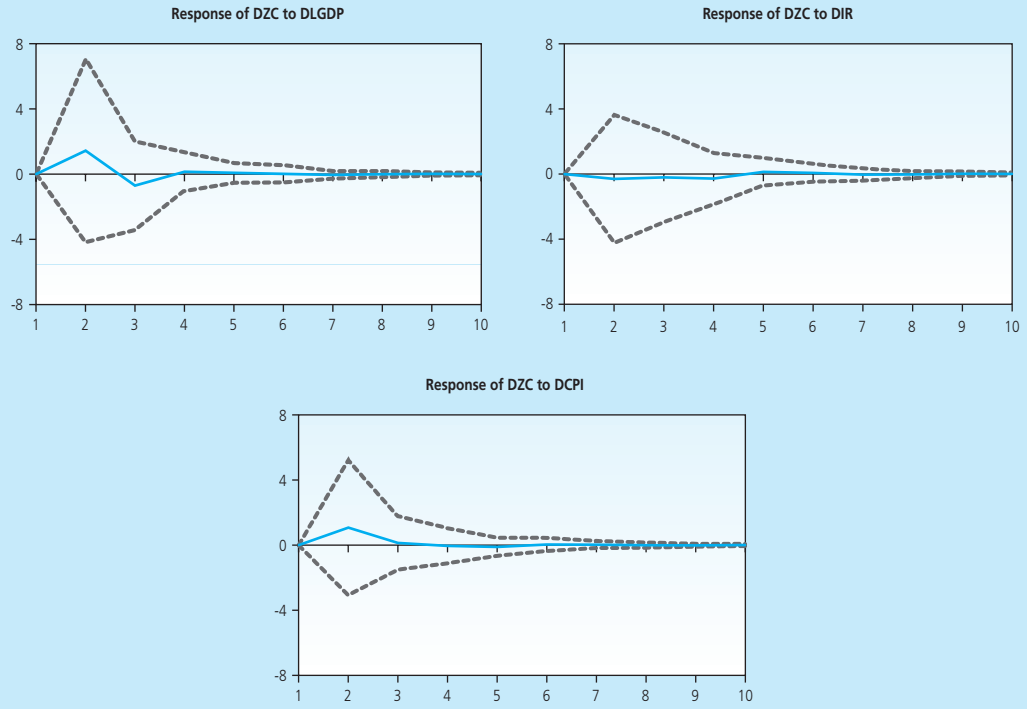

Figure 1. Response to Cholesky One S.D. Innovations ± 2 S.E

Islamic Bank's Stability and Macroeconomic Variables

The results for overall banking industry is discussed in Table 7 and 8. Based on Table 7, the optimal model can be selected using the model selection criteria like Schwartz-Bayesian Criteria and (SBC) and Akaike Information Criteria (AIC), where the AIC is 5.97 and SBC is 6.5. The optimal derived is at first difference and at lagged equal to 1. All the coefficients of the variables are not significant even at 10% significance level. The model above can be rewritten as:

$$DZI_t = -51.7DGDP_{t-1} + 12.1IR_{t-1} + 1.9CPI_{t-1} + 1258.8$$

Table 7 Estimation of the Model ARDL - Islamic Bank's Stability and Macroeconomic Variables

Dependent Variable: DZI, Method : Least Squares

Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	1258.872	2861.303	0.440	0.736
ZI(-1)	-3.180	1.813	-1.753	0.330
LGDP(-1)	-51.655	116.463	-0.444	0.734
IR(-1)	12.107	7.297	1.659	0.345
CPI(-1)	1.906	3.025	0.630	0.642
DZI(-1)	0.689	0.868	0.794	0.573
DLGDP	-24.601	81.188	-0.303	0.813
DLGDP(-1)	-100.145	161.898	-0.619	0.647
DIR	3.673	0.944	3.892	0.160
DIR(-1)	-3.588	3.762	-0.954	0.515
DCPI	2.266	3.462	0.654	0.631
DCPI(-1)	2.676	6.576	0.407	0.754
Adjusted R^2	0.812296	Akaike Information Criteria (AIC)		5.976263
Durbin Watson	2.130368	Schwartz-Bayesian Criteria (SBC)		6.497755

Table 8
Bound Testing for ARDL co-integration - Islamic Bank's Stability and Macroeconomic Variables

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	1.498086	(4, 1)	0.5402
Chi-square	5.992345	4	0.1997

From the Table 8 above, the value of F-statistic is 1.498, and the values of (k + 1) = 4 variables which are Z-score (ZI), (Gross Domestic Product (GDP), Interest rates (IR), Money Supplies (M2) and Consumer Price Index (CPI)) in our model. Thus, for the Bounds Test tables of critical values, the value of is k = 3. To ascertain the critical values, the Table CI (iii) of Pesaran et.al (2001) is used since there is no constrain on the intercept of the model and no linear trend term. The lower and upper bounds for the F-test statistic at the 10%, 5%, and 1% significance levels are [2.72 , 3.77], [3.23 , 4.35], and [4.29 , 5.61] respectively. It is noted that the F-statistic is smaller than the lower bound at the 10% significance level. Thus, it is concluded that there is no evidence of a long-run relationship between the Z-score and all the three variables at 10% significance level. This suggests that the stability Islamic banks in Indonesia is not affected by the macroeconomic factors but rather could be affected by the real economic activities itself.

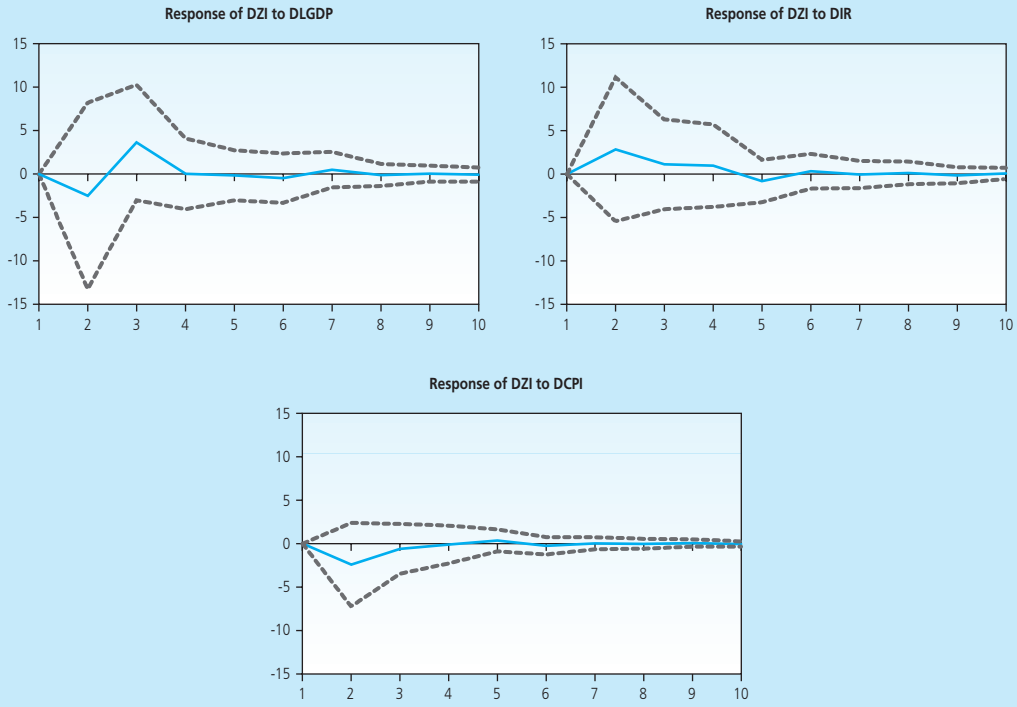

Figure 2. Response to Cholesky One S.D. Innovations + 2 S.E

A shock of one standard deviation Cholesky to GDP and CPI on the Z-score of Islamic banks revealed negative response, as shown in figure 4.2 above. Negative response for GDP and CPI are contrary to the previous empirical result. However, IR reported a positive response to the shock and hence this is also contrary to the previous empirical result. It is also noted that the equilibrium is only reach later after year 8 for GDP and CPI whereas IR seem to be later than year 10.

Indonesian Banking Industry's Stability and Macroeconomic Variables

The result for overall banking industry is discussed in Table 9 and 10 Based on Table 9, the optimal model can be selected using the model selection criteria like Schwartz-Bayesian Criteria and (SBC) and Akaike Information Criteria (AIC), where the AIC is 2.39 and SBC is -2.91. The optimal derived is at first difference and at lagged equal to 1. Only the coefficient of interest rates variable is significant at 10% significance level. The model above can be rewritten as

$$DZALL_t = 213{,}7DGDP_{t-1} + 3IR_{t-1} - 3.65CPI_{t-1} - 5270.96$$

Table 9
Estimation of the Model ARDL - Banking Industry's Stability and Macroeconomic Variables

Dependent Variable: DZALL, Method : Least Squares

Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	-5270.96	937.864	-5.620	0.112
ZI(-1)	-3.712	0.607	-6.113	0.103
LGDP(-1)	213.706	38.167	5.599	0.113
IR(-1)	3.000	0.319	9.420	0.067
CPI(-1)	-5.652	1.032	-5.478	0.115
DZI(-1)	1.753	0.303	5.790	0.109
DLGDP	14.509	12.053	1.204	0.441
DLGDP(-1)	-113.941	20.457	-5.570	0.113
DIR	-0.745	0.389	-1.914	0.307
DIR(-1)	-1.245	0.181	-6.891	0.092
DCPI	2.829	0.832	3.401	0.182
DCPI(-1)	10.171	1.708	5.954	0.106
Adjusted R^2	0.972002	Akaike Information Criteria (AIC)		2.393333
Durbin Watson	3.478119	Schwartz-Bayesian Criteria (SBC)		2.914825

From Table 10, the value of F-statistic is 28.493, and the values of (k + 1) = 4 variables which are Z-score (ZALL), (Gross Domestic Product (GDP), Interest rates (IR), and Consumer Price Index (CPI)) in our model. Thus, for the Bounds Test tables of critical values, the value of is k = 3. To ascertain the critical values, the Table CI (iii) of Pesaran et.al (2001) is used since there is no constrain on the intercept of the model and no linear trend term. The lower and upper bounds for the F-test statistic at the 10%, 5%, and 1% significance levels are [2.72 , 3.77], [3.23 , 4.35], and [4.29 , 5.61] respectively. It is noted that the F-statistic exceed the upper bound at the 1% significance level. Thus, it is concluded that there is evidence of a long-run relationship between the four time-series at 1% significance level.

Table 10
Bound Testing for ARDL co-integration - Islamic Bank's Stability and Macroeconomic Variables

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	28.49322	(4, 1)	0.1395
Chi-square	113.9729	4	0

From figure 3, a shock of one standard deviation Cholesky to GDP, IR and CPI on the Z-score of overall banking industry revealed that most of the shocks reach its equilibrium after year 8. Both GDP and CPI reported a positive response to the shock in the short run as compared

to a negative response to the shock for IR. This prediction confirmed to the previous empirical findings that GDP and price stability have positive relationship. Similarly the previous findings on interest rate reaffirmed that higher interest rates causes instability among banking industry as depicted negative by blue line.

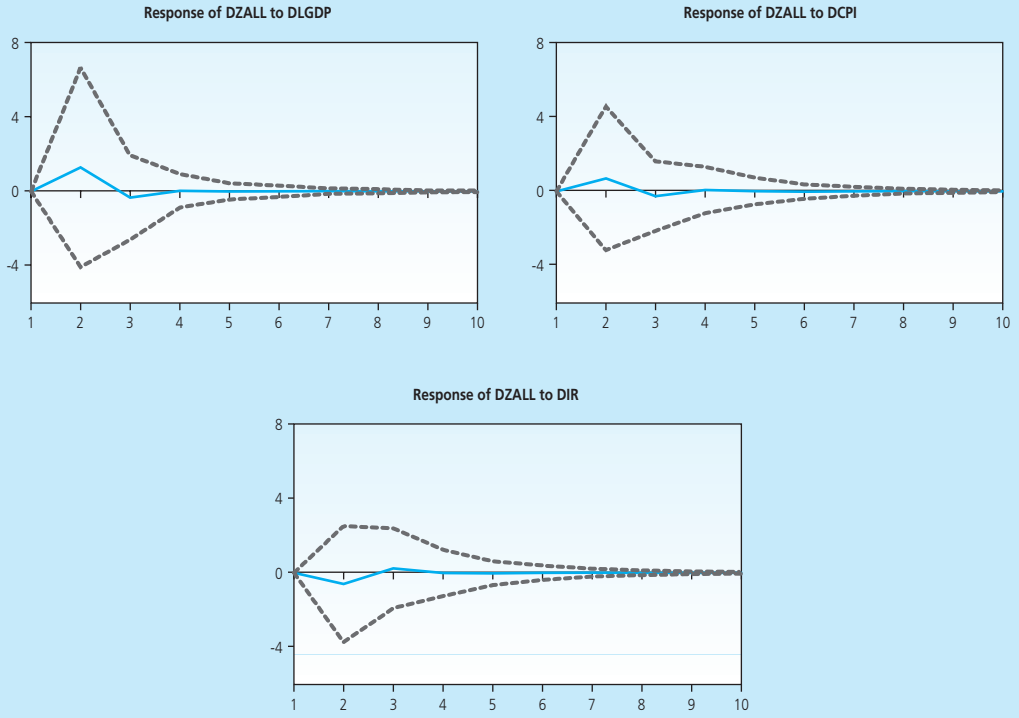

Figure 3. Response to Cholesky One S.D. Innovations + 2 S.E

5. CONCLUSIONS

The ARDL models for commercial and overall banking industry show similar findings with the evidences for long run relationship between the stability (of both commercial banks and the whole banking industry) and the macroeconomic factors, as shown in the bound-test. The IRF on both models also reveal almost similar findings that confirming to the previous empirical results. The reasons of similar findings for both commercial and overall banking industry are the samples of commercial banks are 58 banks from 60 commercial banks. These commercial banks are in fact the majority players in the Indonesia banking industry.

As for the Islamic banks, it is concluded that the ARDL model found no evidence of a long-run relationship between the Z-score of Islamic banks and macroeconomic factors at 10% significance level. This suggests that the stability Islamic banks in Indonesia is not affected by the macroeconomic factors but rather could be affected by the real economic activities itself. The limitation of the analysis is on the number of Islamic banks included in the test as 5 banks from a total of 10 Islamic banks, due to insufficient data.

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