Application of Error Correction Model (ECM) in stabilizing financial inclusion

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Abstract. The study aims to analyze the effect of financial inclusion and macroeconomic indicators on financial system stability in Indonesia. The study uses secondary data obtained from Bank Indonesia, World Bank, International Monetary Fund (IMF) and other sources. The data used is a quarterly time series data from 2007Q1 to 2017Q4 in Indonesia. The method of data analysis is done by building an index to obtain the value of the index, a descriptive analysis of the movement of the index to describe the condition of Indonesia's financial system stability during the evaluation period based on the index value obtained. Econometric validation of index by analyzing the effect of financial inclusion and macroeconomic indicators on the stability of the Indonesia's financial system using Error Correction Model (ECM). The movement of the index is fluctuating shows that in general financial system stability in Indonesia during the observation period is in the corridor of unstable conditions. The results show that financial inclusion in the short term does not affect financial system stability, but in the long run has a significant influence. GDP, IHSG and nominal exchange rate has a positive and significant influence in creating good financial system stability. The growth of the money supply (M2) has a negative and significant influence on the stability of the Indonesian financial system.

1. Introduction

The Financial System is increasingly recognized as having a very important role in the economy of a country. The system helps to reallocate resources, especially funds, so that excess funds in units that are surplus can be utilized by deficit units. The financial system can increase the capacity of the national economy by increasing the efficiency of the use of funds in the economy, in addition to helping fund traffic through payment system services. Therefore, financial system stability is closely related to the sustainability and stability of an economy. If the country's financial system is unstable and inefficient, the fund allocation process will not work properly. Unstable financial systems will be vulnerable to numerous problems that disrupt the economic wheel of a country and are susceptible to economic problems both inside and outside, especially in developing countries such as Indonesia.

The macroeconomic condition of a country is one of the factors that can affect the performance of financial system stability. Macroeconomic indicators used to see or measure the economic stability of a country include economic growth, joint stock price index, growth in the money supply, and exchange rates. These macroeconomic indicators have interrelated relations with each other, when the
capital market is disrupted investors will withdraw their shares from within the country, the exchange rate will decrease. Meanwhile, if the money supply increases, it will not significantly affect the condition of the capital market due to slow economic growth.

According to Mankiw [1], macro analysis of measurements in the economy of a country is the Gross Domestic Product (GDP) or Gross Domestic Product (GDP). GDP measures the flow of income and expenditure in the economy over a period of time. The growth of economy is related to the increasing production process of goods and services in the economic activities of community. Economic growth is measured by the value of GDP based on constant prices (real GDP) so that the growth rate used is real growth due to additional production.

Financial system stability can encourage the operation of the market so that it can improve the economy of a country. One of the instruments that maintain financial system stability is the capital market [2]. One of indicators that influence activity in the money market and the stock market is currency exchange. That indicator will affect investors to be more attentive. Depreciation of the exchange rate between rupiah and foreign currencies, especially the US dollar, has a negative influence on the economy and capital markets [3]. The Asian financial crisis of 1997 to 1998 and the global financial crisis in 2008 were some of the most massive examples which also threatened the stability of the international financial system.

The Asian financial crisis from 1997 to 1998 which was also experienced by Indonesia was one example that showed that weakening the economy of a country would disrupt financial system stability. The exchange rate of rupiah weakened the US dollar, which at the end of 1997 only moved around Rp. 4,850 per US dollar has fallen almost to Rp. 17,000 per US dollar at the beginning of 1998. Economic conditions experienced uncertainties that continued to increase, destabilizing the money market, foreign exchange market and Indonesian capital market and increasing Indonesia's debt burden, especially the private sector, which could potentially cause a large capital outflow. The Composite Stock Price Index (IHSG) fell to its lowest point of 292.12 points in 1998 from 467,339 points in the first semester of 1997. The financial crisis experienced by Indonesia at that time made public confidence in the banking system decline, resulting in massive withdrawals (Bank Runs) community savings in the bank and take a long time to restore the level of public trust in the financial system.

Shocks to global economic stability can threaten domestic economic stability in a country through trade relations and cooperation in other economic fields such as foreign loans, direct and indirect investments. The crisis then spread systemically in the financial system of each country, especially through financial institutions where the banking sector dominated the Indonesian financial market with an asset share of around 80% [5].

Aside from maintaining macroeconomic conditions, Bank Indonesia as the monetary authority, banking and payment system also has a duty to maintain financial system stability (banking and payment systems). Financial system stability is a condition where the financial system is able to allocate its funds efficiently, able to withstand economic shocks and be able to encourage economic growth. To create a stable financial system, one of the policies used to encourage economic growth is through financial inclusion.

According to Bank Indonesia, financial inclusion is an effort to exclude all forms of price and non-price barriers, towards people's access to financial services. Financial inclusion programs have a goal of achieving economic growth through reducing poverty, increasing development or equitable distribution of income, and improving financial system stability [6].

Considering the strategic role of financial system in the economy, it is necessary to study various tools for monitoring and evaluating financial system stability. One of them is the creation of a
financial system stability index, namely an indicator in monitoring developments and identifying factors that can affect the financial system stability of an economy. The existence of one index will help the financial authority to obtain an overview of the performance of the financial system as a whole by gathering a number of indicators into one indicator that represents the overall performance of the financial system. The existence of one measurement will facilitate the search for the performance of the financial system from time to time, especially to the condition of the episode of the financial crisis.

2. Literature Review
According to Nasution (2003) [7], financial system stability has a direct link with price stability as a reference for monetary stability and financial sector stability in which there are financial institutions and financial markets that support the running of the financial system as a whole. The definition of financial system stability is the condition of the financial system consisting of intermediary institutions, financial markets, and market infrastructure that are resistant to pressure and are able to overcome unbalanced financial problems due to the significant intermediation process [6]. Albulescu and Goyeau (2010) [8] define a stable financial system as a system that always makes adjustments towards balance, after being affected by internal and external shocks, then being able to carry out traditional functions related to efficient allocation of resources, to correct price distortions and guarantee the payment system and adequate settlement, as a function that contributes to overall economic growth and prosperity. In other words, a stable financial system will be robust and resistant to numerous economic disruptions so that it is capable to carry out the intermediary function and support economic growth.

Financial inclusion programs are defined as efforts to increase public access to formal financial institutions that can provide benefits to improving welfare [9]. Financial inclusion is also reflected when every individual has the right to access variety of quality of financial services in a timely, convenient, clear manner at affordable costs in order to improve their economic and financial capabilities. Financial inclusion is a macro national strategy to encourage economic growth through equitable distribution of income, poverty alleviation and financial system stability.

Good financial inclusion and the role of a balanced economy will have an impact on strengthening the financial stability system, especially for developing countries such as Indonesia, which is also still very vulnerable to global economic turmoil. Unstable financial systems can be caused by failures in structural or behavioral factors. These failures can come from internal failures or external failures. In general, the source of financial sector instability is forward looking, this is due to knowing the risks that will affect the financial system in the future. From the results of the identification, a risk analysis will be carried out that can endanger, expand and be systemic which can disrupt the economy (Awanti, 2017).

Based on research conducted by H. Khan (2011) which states that the negative impact of increasing financial inclusion will lead to a decrease in credit standards because banks try to reach unbankable communities by reducing loan terms [10]. Hanning and Jansen (2010) in their research on financial stability and financial inclusion said that financial inclusion can overcome income inequality in a country besides being able to improve financial stability, this is because access of the poor to formal institutional savings can increase household capacity in managing financial vulnerability which was a result of the crisis [11]. In addition, the study conducted by Morris (2010) econometric results reinforces the sensitivity of the financial system stability index to the variables included in macroeconomic indicators [12].

3. Research Method
The scope of this study discusses financial inclusion and financial system stability in Indonesia during 2007-2017 periods and analyzes several macroeconomic indicators that influence financial system stability. Data type used is panel data. Data compiled from 2007Q1 to 2017Q4 is secondary data obtained from various agencies and literature. Financial system stability is measured using the
Aggregate Financial Stability Index (AFSI) referring to research conducted by Albulescu and Goyeau (2010) while financial inclusion is measured using the Financial Inclusion Index (IFI) based on research conducted by Sarma (2012) [13].

The method of data analysis is done in several stages, namely to build an index to obtain the value of the index. Descriptive analysis of the index movement to describe the condition of Indonesia's financial system stability during the observation period based on the index value obtained and the validity test of the index to find out how well the index can explain the actual conditions and see the effect of financial inclusion and macroeconomic indicators on Indonesia's financial system stability with econometric analysis using models error correction (Error Correction Model = ECM).

3.1. Building the financial system stability index

Indicators of selected individuals are grouped into sub-indices, each of which describes the development, vulnerability, institutional health and international economic climate. Then each selected indicator is normalized. Data normalization is done using empirical normalization methods. The normalization method makes the indicator values range from "0" to "1". The value "0" is the worst value and "1" is the value with the best stability conditions. So, the greater the index value shows the better financial system stability. The whole formula refers to the calculations built by Albulescu and Goyeau (2010), where the Aggregate Financial Stability Index (AFSI) equation as berkut:

$$AFSI = 0.2D_t + 0.4 V_t + 0.25 S_t + 0.15 W_t$$

3.2. Calculation of financial inclusion

The method of analysis of the Index of Financial Inclusion (IFI) in this study, refers to the method developed by Sharma (2012), as follows:

$$IFI = 1 - \sqrt{\frac{(1-d1)^2+(1-d2)^2+\cdots+(1-dn)^2}{n}}$$

The index of each dimension can be calculated using the following equation:

$$d_i = \frac{wi (Ai - mi)}{Mi - mi}$$

Where:
- $Wi$: weights for dimensions i, $0 \leq wi \leq 1$
- $Ai$: the current value of the change i
- $mi$: minimum value (lower limit)
- $Mi$: maximum value (upper limit)

From the formulation above, the following categories will be obtained:

- $0.5 \leq IFI \leq 1$ - high financial inclusion
- $0.3 \leq IFI < 0.5$ - medium financial inclusion
- $0.0 \leq IFI < 0.3$ - low financial inclusion

3.3. Econometric validation index: Error Correction Model (ECM)

The Aggregate Financial Stability Index (AFSI) and selected selected macroeconomic indicators were tested using the root test of the Augmented Dickey-Fuller (ADF) unit test. Then econometric validity is done by regressing indices that have been aggregated with several macroeconomic indicators and seeing their influence on financial system stability in Indonesia using an error correction model (Error
Correction Model = ECM), the error correction model is known as the Engle-Granger two-step model (two-Engle-Granger step error correction model). In principle, the error correction model has a fixed balance in the long run between the variables. If in the short term there is an imbalance in one period, then the error correction model will correct it in the next period (Engle and Granger, 1987). To declare the ECM model used valid or not, then the coefficient of resid (-1) (ECT) must be significant. If the coefficient is not significant, then the model is considered to be unsuitable and it is necessary to change the model specifications. In this study, the equation for the short-term estimation model of the ECM used is:

$$\Delta AFSI_t = b_0 + b_1 \Delta IFI_t + b_2 \Delta \ln GDP_t + b_3 \Delta \ln HSG_t + b_4 \Delta \ln M2_t + b_5 \ln NER_t + b_6 ECT_{t-1} + \mu_t$$

Where:

- $AFSI_t$ = Aggregate Financial Stability Index period t
- $IFI_t$ = Index of Financial Inclusion period t
- $GDP_t$ = Natural logarithm GDP period t
- $\ln HSG_t$ = Natural logarithm The Composite Stock Price Index period t
- $M2_t$ = Natural logarithm of the money supply (M2) period t
- $\ln NER_t$ = Natural logarithm Nominal Exchange Rate (NER) period t
- $ECT_t$ = Imbalance error
- $b_0$ = Intercept
- $b_t$ = Slop each variable is free
- $\mu_t$ = Error term
- $\Delta$ = First difference (variable)

While for the long-term model can be written as follows:

$$AFSI_t = \beta_0 + \beta_1 IFI_t + \beta_2 GDP_t + \beta_3 HSG_t + \beta_4 \ln M2_t + \beta_5 \ln NER_t + e_t$$

Where:

- $AFSI_t$ = Aggregate Financial Stability Index period t
- $IFI_t$ = Index of Financial Inclusion period t
- $GDP_t$ = Logaritma natural GDP period t
- $HSG_t$ = Logaritma natural The Composite Stock Price Index period t
- $M2_t$ = Logaritma natural of the money supply (M2) period t
- $\ln NER_t$ = Logaritma natural Nominal Exchange Rate (NER) period t
- $\beta_0$ = Intercept
- $\beta_t$ = Slop each variable is free
- $e_t$ = Error Term

Then the model evaluation is done with the classic assumption test, ramsey RESET, Jarque-Bera, heteroscedasticity, and autocorrelation.

4. Analysis

Financial system stability in Indonesia continued to experience improvements, although it still fluctuated in 2007 to 2017 seen in Figure 1. AFSI values at the beginning of the year of observation reached the highest 0.61 during the observation period. When viewed from its constituent index, the highest number during the observation period was due to the improvement of the global climate which then had an impact on the development of the financial system in Indonesia. Meanwhile, the lowest AFSI value is at index 0.42 in 2008 as a result of the economic crisis experienced by Indonesia.
During the observation period, financial system stability was reflected, as reflected in the AFSI index at 0 index, which means that in 2007 to 2017 the condition of the financial system in Indonesia was unstable.

The results of estimated financial system stability using the Aggregate Financial Stability index is attached in the figure below.

![Figure 1](image1.png)

**Figure 1.** Movement of the aggregate financial system stability index and compiler sub-index.

The level of financial inclusion is measured using the financial inclusion index or IFI, which refers to research conducted by Sharma (2008) who built a financial inclusion index on three main indicators, namely penetration, availability and use of financial services. The following data on inclusive financial indices in Indonesia from 2007 to 2017 can be seen in the picture below.

![Figure 2](image2.png)

**Figure 2.** Movement of financial inclusion index in Indonesia in 2007-2017.

According to Figure 2, the trend of Financial Inclusion Index in Indonesia from 2007 to 2017 is increased. During the observation period, financial inclusion in Indonesia was at the low financial inclusion level from the beginning of the second quarter of 2012, only around 0.1 index. In the third quarter of 2012, the development of financial inclusion was at the 0.2. It is still at the level of low financial inclusion. This situation is happened until the second quarter of 2017, which was indexed 0.29. In the third and fourth quarters of 2017, financial inclusion began at the level of high financial inclusion with sequential index numbers 0.30 and 0.31. Although financial inclusion has increased every year, the rate is still low, so there is should be more efforts to increase financial inclusion. Then the data stationarity will be tested using the ADF unit root test, the results are as follows.
In Table 1 the results of the unit root test show that only the AFSI variable is stationary at the level of the level or rejects the null hypothesis while the IFI, GDP, IHSG, M2, and NER variables cannot reject the null hypothesis or not stationary at the level, so that it will cause regression false. Then the data differentiation process is then performed to obtain stationary data. Unit root test results at the level of the first difference of the AFSI and IHSG variables are stationary, while the IFI, GDP, M2, and NER variables cannot reject the null hypothesis or not stationary using the ADF test.

Table 1. ADF unit root test.

| Variable | Level | First Difference |
|----------|-------|------------------|
| AFSI     | -4.5822* | -3.2168*         |
| IFI      | 2.09682  | -0.9918          |
| GDP      | -1.8336  | -2.0204          |
| IHSG     | -1.0635  | -3.441*          |
| M2       | -2.3842  | -1.5353          |
| NER      | -2.1124  | -1.5863          |

Remarks: significant or indicate reject the Null hypothesis at the level of 10%, 5%, and 1%.

Then a cointegration test was performed using the Johansen test to see whether there is a balance in the long run. The Johansen cointegration test results are as follows:

Table 2. Johansen’s cointegration test results.

| No. of CE(s) | Eigenvalue | Statistic | Critical Value | Prob.** |
|--------------|------------|-----------|----------------|---------|
| None *       | 0.721983   | 155.972   | 95.75366       | 0       |
| At most 1 *  | 0.627267   | 102.209   | 69.81889       | 0       |
| At most 2 *  | 0.517554   | 60.7592   | 47.85613       | 0.002   |
| At most 3 *  | 0.297663   | 30.146    | 29.79707       | 0.0456  |
| At most 4    | 0.25049    | 15.3056   | 15.49471       | 0.0534  |
| At most 5    | 0.073262   | 3.19552   | 3.841466       | 0.0738  |

The cointegration test shows the long-term balance in the economic system, if a shock occurs then the economy will recover back to the equilibrium system. The cointegration test results as in table 2 show that there are at least four cointegrated variables which can be used as an error correction model to correct the tendency for an imbalance of short-term relationships between variables.

According to the result in Table 3, the results of short-term ECM from the perspective of R-squared is 0.602134, which means that variations of IFI, GDP, IHSG, money supply (M2) and Nominal Exchange Rate (NER) are able to explain variations in financial system stability (AFSI) amounting to 60.21 percent and 39.79 percent is explained by factors other than these variables. The F-statistics produced in the short term are 9.080450 greater than F tables with free degrees (5) and (38) at the level of 5 percent which are 2.46 percent are significant. That is, it shows that there is at least one independent variable that has a simultaneous effect on the dependent variable, namely financial system stability (AFSI).
Table 3. Results of short-term Error Correction Model (ECM)

| Variable | Coefficient | Std. Error | t-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| C        | 0.010667    | 0.009875   | 1.080186    | 0.2872 |
| D(IFI)   | 0.535387    | 0.811967   | 0.65937     | 0.5139 |
| D(LNGDP) | 0.085386    | 0.195844   | 0.435992    | 0.0654 |
| D(LNIHSG)| 0.061091    | 0.02766    | 2.208669    | 0.0336 |
| D(LNM2)  | -0.574788   | 0.092792   | -6.194358   | 0     |
| D(LNNER) | 0.087686    | 0.27803    | 0.315384    | 0.1043 |
| ECT      | 0.277849    | 0.133623   | 2.079348    | 0.0048 |

Still in Table 3, the error correction variable (ECT) is significant at the level of 1 percent with a value of 2.079348 with probability below 1 percent which indicates that the ECM specification used is valid. While the balance value of 0.277849 can be interpreted that the process of adjusting for the imbalance of financial system stability for the period 2007 to 2017 is relatively fast. If there is an imbalance in the past period of 100 percent, financial system stability measured using AFSI will adjust to increase by 27.78 percent.

The estimate results of regression indicates that nearly all macroeconomic indicators are significant at 10 percent except the Index of Financial Inclusion (IFI), meanwhile the relationship of each dependent variable used in the model is almost all the variables except the IFI does not have a short-term effect on financial system stability. So that regardless of the increase or decrease that occurs at the level of financial inclusion, this will not affect financial system stability.

Based on Table 4, the R-squared value for long-term estimation is 0.691212, which means that variations of IFI, GDP, IHSG, money supply (M2) and Nominal Exchange Rate (NER) can explain the variation in financial system stability (AFSI) by 69.12 percent and 30.88 percent is explained by factors other than these variables. The R-squared value in the long term is relatively high. This illustrates how well the variables selected in the model are able to influence financial system stability, including economic indicators that make up AFSI. The F-statistics produced in the long run of 17.01237 are greater than F tables with free degrees (5) and (38) at the level of 5 percent which are 2.46 percent are significant. This means that simultaneously influencing independent variables on the dependent variable, namely financial system stability (AFSI).

The estimation results of long-term regression shows that all macroeconomic indicators used are significant at the 5 percent level. The relationship of each dependent and independent variable used in the model is entirely in accordance with the hypothesis. The imbalance that occurs for IFI variables in the short term can be overcome in the long run, which then has a long-term influence on financial system stability in the observation period from 2007 to 2017.

Furthermore, to evaluate the model used in this study a classical assumption test was conducted. The results of Ramsey Test RESET show the probability of F with free degrees (1.37) of 0.0020 is smaller than the significance level of 10 percent, thus it was rejecting the hypothesis that the model has linearity problems. In other words, the relationship between dependent and independent variable in the model is linear in the parameters. The probability produced from the Jaque-Bera Test is 0.572045
greater than the 10 percent significance level. Thus, it rejects the null hypothesis that the residuals are normally distributed. Breusch-Pagan-Godfrey heteroscedasticity test shows the probability of Chi Square with a free degree of 0.9052 greater than the significance level of 10 percent. The model rejects the null hypothesis data. It indicates that there has no problem with heteroscedasticity. Autocorrelation test using Breusch-Godfrey Serial Correlation LM shows that the probability of Chi-Square with a free degree 2 of 0.0000 is smaller than the significance level of 10 percent. It means that the model has no problem of autocorrelation. Overall, the independent and dependent variable in the model are valid based on the classic assumption test, there is no problem assumption on the model.

Table 4. Results of long term estimates.

| Variable | Coefficient | Std. Error | t-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| IFI      | 2.103563    | 0.461736   | 4.555767    | 0.0001 |
| LNGDP    | 0.335054    | 0.138829   | 2.413427    | 0.0207 |
| LNIHSG   | 0.137562    | 0.025788   | 5.334262    | 0      |
| LNM2     | -0.719514   | 0.177201   | -4.060439   | 0.0002 |
| LNNER    | 0.34811     | 0.15239    | 2.284331    | 0.028  |
| C        | -2.722704   | 2.641329   | -1.030808   | 0.3091 |

R-squared | 0.691212  
Adj R-squared | 0.650582  
Durbin-Watson stat | 0.51386  
F-statistic | 17.01237  

5. Conclusion and Suggestion

According to the research results, financial system stability during the observation period is in an unstable condition. It can be seen on the results of calculations using the Aggregate Financial Stability Index (AFSI), which is quite good in describing the condition of financial system stability. Furthermore, based on the estimation results, financial inclusion in the short term has no effect on financial system stability, while in the long run it has a positive and significant effect on Indonesia's financial system stability in the period 2007-2017. In the end of the observation period, the level of financial inclusion in Indonesia is high.

In addition, the estimation results also show that the GDP and IHSG variables and exchange rates in the short and long term have a positive and significant effect in creating good financial system stability in the 2007-2017 observation period. Stable economic growth with increased output is able to create stability in the financial system, as well as maintaining the condition of the capital market will increase investment so as to sustain the Indonesian economy to maintain financial system stability. The same thing also happened to the exchange rate variable which greatly affected financial system stability, especially in exports, imports, and payment of foreign debt which could potentially lead to a current account deficit which could drain foreign exchange reserves.

Finally, the estimation results of the variable growth in the money supply (M2) in the short and long term have a negative and significant impact on the stability of the Indonesian financial system during the 2007-2017 observation period. Increasing the money supply will cause inflation. Very high inflation can affect the exchange rate, so that it will cause instability in the financial system.

The recommendation given regarding the results of this study, which is related to the Aggregate Financial Stability Index (AFSI) index built in this study can be used as an alternative for monetary authorities in this case Bank Indonesia to be able to strengthen the results of the Financial System Stability Index (ISSK) that has been used in observing Indonesia's financial system stability. In addition, the government or related authorities need to release financial inclusion index data with a longer lead time and complete regional coverage of each province, as well as determining a permanent
measurement indicator in calculating the financial inclusion index to be used by future researchers. To create a stable financial system, the government or related authorities really need to pay attention to economic growth (GDP), the JCI, the growth of the money supply, and the exchange rate that are very influential both long and short term, positive or negative towards financial system stability in Indonesia.

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