2020 Asia–Pacific Statistics Week
A decade of action for the 2030 Agenda: Statistics that leaves no one and nowhere behind
15-19 JUNE 2020 | Bangkok, Thailand

Review of E-Money Contribution for a Better Quality of Financial System Stability Measurements in Indonesia

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Abstract:

Financial system stability needs to be a special concern for policymakers because a weak financial system harms the real economy. But the financial system involves complex indicators to be examined one by one, so we need a certain value or size. So far, the measurement of financial system stability in Indonesia has been measured through the ISSK (Financial System Stability Index) but this index has not been considered capable enough to be used as a measure of financial system stability because it does not involve the effect of the world economy. Meanwhile, developing countries like Indonesia are easily affected by world economic conditions. Therefore, we need a measure that already involves the influence of the world economy, which is called AFSI (Aggregate Financial Stability Index). The measurement of financial system stability using AFSI has been widely carried out by other countries in the world. However, the calculation has not involved the e-money component as a digital financial service and a financial system infrastructure in Indonesia. The rapid increase in volume and value of e-money transactions makes this component need to be involved to produce information related to financial system stability that is more up-to-date. In weighting, AFSI measurements in some countries use equal weighting where weights are assumed the same for each AFSI's indicator. However, its use was considered not able to capture the real condition of a country's financial system, therefore unequal weighting is needed. One of the better ones is UCM (Unobserved Components Model) because it can handle the non-stationary data, the outlier data, the construction of index integrated efficiently and statistical significance can be shown when making comparisons. All these efforts in this paper are expected to contribute to a better quality of financial system stability measurements.

Keywords: *AFSI*; *E-Money*; *Financial System Stability*; *UCM*

1. Introduction:

In supporting sustainable economic growth, a country needs financial system stability where economic shock conditions can be absorbed to prevent economic disturbance, especially the monetary crisis. However, to measure the stability of the financial system, no standard definition has been accepted internationally. Bank Indonesia has constructed the Financial System Stability Index (ISSK) to solve this issue, but ISSK has not considered the global economic effect. Therefore, this study aims to develop the AFSI (Aggregate Financial Stability Index), introduced by Albulescu (2008) for the Romanian financial system, which has considered the global economy and ISSK dimensions at once. The Unobserved Components Model (UCM) approach was used in this study because it is one of the better weighting methods, which can handle non-stationary data (Harvey, 2006), the outlier data (West and Harrison, 1999), the construction of index integrated efficiently and statistical significance can be shown when making comparisons (Kaufmann et al., 1999).

In the era of digital development increasing rapidly, resulting in many transactions done cashless, one of them with electronic money (e-money). Based on Bank Indonesia data in October 2019, the volume of transactions with e-money has reached 510 million transactions with a value of 16.37 trillion rupiahs, which is among the fastest-growing compared to other non-cash payment instruments in Indonesia. Görmez (2004) in the study of the *Central Bank of the Republic of Turkey, Research and Monetary Policy Department* implies that the existence of e-money is related to the function of the central bank which is ensuring the integrity of money that refers to the ability of money to stay stable and reliable cover for purchasing power from time to time, where this naturally leads to keep the

financial system stability. Thus, researchers are interested in examining the contribution of e-money as a component in measuring financial stability in Indonesia.

2. Methodology:

This study uses secondary data which is quarterly data from 2009 quarter I until 2018 quarter IV collected from various sources including from Bank Indonesia (BI), Financial Services Authority (OJK), International Monetary Fund (IMF), and Center for Economic Studies & Institute for Economic Research (CESIfo). The procedure for establishing the Aggregate Financial Stability Index (AFSI) refers to the OECD, 2008.

To find out the stationarity of each indicator used in this study, stationarity was identified through the Augmented Dickey-Fuller (ADF) test. This test rejects H_0 when ADF < c; where c is the critical value from the ADF table with the significance level alpha = 5%.

$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + e_t$; where $\Delta Y_{t-1} = Y_{t-1} - Y_{t-2}$, $\Delta Y_{t-2} = Y_{t-2} - Y_{t-3}$, etc.

The hypotheses for this test are:

$H_0: \delta = 0$ (Nonstationary)

$H_1: \delta < 0$ (Stationary)

Then, for constructing AFSI, there are several stages:

1. Developing a theoretical framework and selecting variables

   The phenomenon that will be measured is the stability of the Indonesian financial system using AFSI. The selection of indicators and grouping of the dimensions refers to Albulescu (2008) and adjusted to the availability of data and conditions in Indonesia. There are 4 dimensions explained in this study: Financial Soundness Index (FSI), Financial Development Index (FDI), Financial Vulnerability Index (FVI), World Economic Climate Index (WECI). The FSI consists of 4 indicators: Non-Performing Loan Ratio (NPL), Capital Adequacy Ratio (CAR), Bank Capital to Total Assets (BCTA), Return on Assets (ROA). FDI consists of 4 indicators: Market Capitalization/GDP (MC), Rupiah Credit/GDP (RC), Bank Concentration (BC), Interest Rate Spread (IRS). FVI consists of 7 indicators: Current Account/GDP (CA), Private Credits/Total Credit (PC), Deposits/M2 (DM), (Reserves/Deposits)/(M1/M2), Inflation (INF), Real Exchange Rate Growth (REER), Loans/Deposits (LDR), and then WECI consists of 3 indicators: World Inflation (WINF), World Economic Growth (WEG), Economic Climate Index (ECI). In this study, 1 indicator was added to the FVI dimension which is E-Money Transaction Ratio (EMTR).
2. Normalization of data, using the min-max normalization method.

$$I_k^t = \frac{x_k^t - \min(x_k)}{\max(x_k) - \min(x_k)}$$

   k = 1st, 2nd, … 18th indicator (without EMTR) or 1st, 2nd, … 19th indicator (with EMTR)
   t = period (2009Q1 until 2018Q4)
   I_k^t = normalized value of the k-indicator at t-time
   x_k^t = original value of the k-indicator at t-time
   $\min(x_k)$ = minimum value of the k-indicator
   $\max(x_k)$ = minimum value of the k-indicator
3. Weighting for indicators and sub-index, using UCM.

$$w_k = \frac{\sigma_k^{-2}}{1 + \sum_{i=1}^{q_j} \sigma_k^{-2}}$$

   w_k = weight of k-indicator
   σ_k = variance of k-indicator
   q_j = number of indicators at j-sub-index
4. Aggregation and index presentation
   - The aggregation formula for sub-indexes is:

$$I_j^t = \sum_{k=1}^{q_j} w_{jk} \times I_k^t$$

I_j^t = value of j-sub-index at t-time
w_{jk} = weight of k-indicator at j-sub-index
I_k^t = normalized value of the k-indicator at t-time

- The aggregation formula for AFSI is:

$$AFSI_t = \sum_{j=1}^{4} w_j \times I_j^t$$

$AFSI_t$ = value of AFSI at t-time
w_j = weight of j-sub-index
I_j^t = j-sub-index value at t-time

The formed AFSI is presented in graphs so that the difference between AFSI with and without e-money indicators can be seen visually. Then to find out whether the data from the two series have compatible movements or not, a compatibility test will be done with the following hypothesis:
H_0: $\mathrm{E}(\mathbf{M}|\mathbf{N}) = \mathbf{N}$ (series of m and n are compatible);
H_1: $\mathrm{E}(\mathbf{M}|\mathbf{N}) \neq \mathbf{N}$ (series of m and n are not compatible).
Then the test statistic:

$$K = \frac{(\boldsymbol{M} - \boldsymbol{N})' (\boldsymbol{M} - \boldsymbol{N})}{\sigma^2_{(\boldsymbol{M}-\boldsymbol{N})}} \sim \chi^2_{(\alpha;\, n)}$$

K = value of test statistic
M = first data series (in matrix form)
N = second data series (in matrix form)
$\sigma^2_{(\boldsymbol{M}-\boldsymbol{N})}$ = variance of the difference between the first and second data series values.
This test rejects H_0 when $K > \chi^2_{(\alpha;\, n)}$; where α = 5% and n = number of observations.

3. Result:

Through Table 1 it can be seen that almost all AFSI-constructing indicators are not stationary at the level, except for two indicators which are the deposit ratio (DM) and world economic growth (WEG). Therefore, the weighting with the UCM approach is good enough when used for index construction.

Table 1. Stationarity test results of AFSI's indicators

Indicators	P-value	Conclusions	Indicators	P-value	Conclusions	Indicators	P-value	Conclusions
NPL	0.6282	Nonstationary	IRS	0.2175	Nonstationary	REER	0.4197	Nonstationary
CAR	0.4514	Nonstationary	CA	0.5784	Nonstationary	LDR	0.6185	Nonstationary
BCTA	0.9210	Nonstationary	PC	0.3576	Nonstationary	EMTR	0.9900	Nonstationary
ROA	0.3640	Nonstationary	DM	0.0123	Stationary	WINF	0.2017	Nonstationary
MC	0.4723	Nonstationary	RD	0.9387	Nonstationary	WEG	0.0100	Stationary
RC	0.6568	Nonstationary	INF	0.3176	Nonstationary	ECI	0.0640	Nonstationary
BC	0.9002	Nonstationary						

Then, through Figure 1 it can be seen that AFSI with the unobserved components model approach (ucm-AFSI) tend to have higher values than AFSI with the equal weighting approach (eq-AFSI). This result indicates that there is a need to provide weighting in the construction of AFSI because it causes value between ucm-AFSI and eq-AFSI is quite far. AFSI that uses the unobserved components model approach can be said to be a good measure of financial system stability because it follows the same pattern as eq-AFSI. Besides, ucm-AFSI looks more sensitive than eq-AFSI in measuring financial system stability. When viewed in the period from the 4th quarter of 2011 to the 4th quarter of 2012, eq-AFSI recorded that the stability of the Indonesian financial system was in a stable condition which was in the range of 0.46. On the other hand, ucm-AFSI recorded that the stability of Indonesia's financial system fluctuated where at the 1st quarter of 2012 it was at 0.56, then in the 2nd quarter, it rose to 0.58, while in the 3rd quarter of 2012 it dropped to 0.54. The calculation of the stability of the Indonesian

financial system using the UCM approach is more able to describe what is happening, which during the period, capital market instability occurred on the Indonesia Stock Exchange due to a less conducive global market.

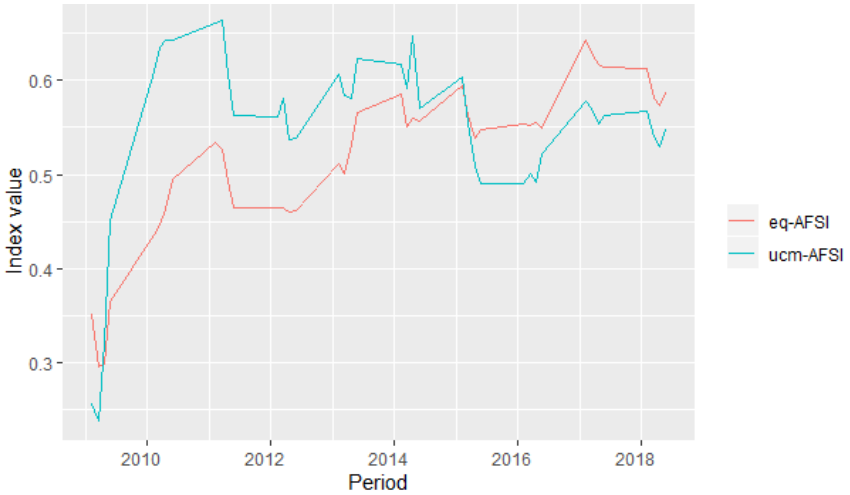

Figure 1. Comparison of equal AFSI and UCM AFSI Indonesia (2009Q1 to 2018Q4)

Other interesting information that can be obtained through Figure 1 is starting from the 2nd quarter of 2015, the results of AFSI calculations using UCM have a lower value than using equal weighting. In this period, UCM still better to capture the phenomena that occur. According to Sari and Supriadi (2015) starting in 2015, the Indonesian economy is increasingly affected by global events, such as decreasing in the Chinese economy, rising interest rates on the US Central Bank, falling oil prices and the weakening of the rupiah against the US dollar.

Table 2. Results of the weighting calculation for indicators and sub-indexes (without EMTR)

Sub-indexes	Indicators	Weights of indicator	Weights of sub-index
FSI	NPL	0.2608	0.1742
	CAR	0.1012	
	BCTA	0.0775	
	ROA	0.5594	
FDI	MC	0.6619	0.1957
	RC	0.0813	
	BC	0.1096	
	IRS	0.1464	
FVI	CA	0.1007	0.1705
	PC	0.1152	
	DM	0.0870	
	RD	0.0365	
	INF	0.0840	
	REER	0.5185	
	LDR	0.0575	
WECI	WINF	0.1823	0.4583
	WEG	0.4048	
	ECI	0.4123	

Table 3. Results of the weighting calculation for indicators and sub-indexes (with EMTR)

Sub-indexes	Indicators	Weights of indicator	Weights of sub-index
FSI	NPL	0.2608	0.1805
	CAR	0.1012	
	BCTA	0.0775	
	ROA	0.5594	
FDI	MC	0.6619	0.2029
	RC	0.0813	
	BC	0.1096	
	IRS	0.1464	
FVI	CA	0.0867	0.1400
	PC	0.0992	
	DM	0.0749	
	RD	0.0315	
	INF	0.0723	
	REER	0.4465	
	LDR	0.0495	
	EMTR	0.1389	
WECI	WINF	0.1823	0.4751
	WEG	0.4048	
	ECI	0.4123	

Because AFSI with the UCM approach is better, the construction of AFSI in this study uses the Unobserved Components Model (UCM) approach in providing weights both before and after the addition of the E-money Transaction Ratio (EMTR) indicator. Based on Table 2 and Table 3 that show the results of the weighting calculation, it can be seen that in the Financial Soundness Index (FSI) dimension, the indicator that has the highest weight value of 0.5594 is Return on Assets (ROA). While on the dimension of the Financial Development Index (FDI), the Market Capitalization/GDP (MC) indicator has the highest weight of 0.6619. In the Financial Vulnerability Index (FVI) dimension, the indicator of Real Exchange Rate Growth (REER) becomes the indicator with the highest weighting both before and after the addition of the E-money Transaction Ratio (EMTR) indicator with the respective weight values of 0.5185 and 0.4465. In the last dimension, the World Economic Climate Index (WECI), the indicator that has the highest weight is the Economic Climate Index (ECI) with a value of 0.4123. So overall, the indicator that has the highest weighting among all dimensions which construct the AFSI is Market Capitalization/GDP. Then, the dimension that has the highest weighting is WECI which shows that the global economy has a great influence on Indonesia's financial stability.

Then, Figure 2 shows the AFSI comparison before and after the addition of the E-money Transaction Ratio (EMTR). It can be seen that the addition of the EMTR indicator tends to have the same pattern as before the addition but produces an index value (AFSI) which tends to be higher in the last four periods. This is due to the increasing contribution of e-money transactions to total transactions using cards (ATM cards, debit cards, credit cards, and e-money) in 2018. Then, it indicates that e-money positively contributes to the AFSI value which means that if the ratio of e-money transactions increases, the financial system will become more stable. Therefore, the addition of this indicator is important to consider so that it is more relevant to the current times and will produce a higher quality financial stability index which can properly describe the actual condition of the financial system.

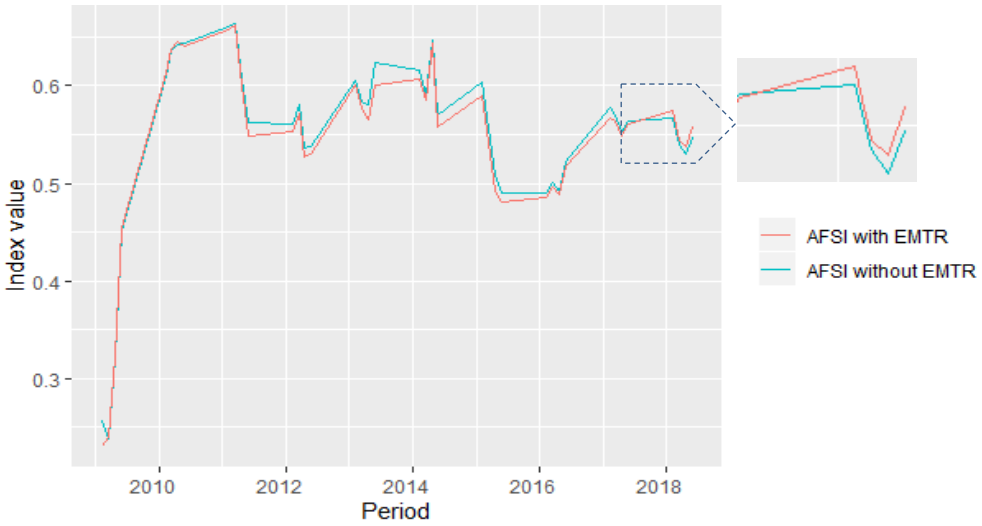

Figure 2. Comparison of AFSI with and without e-money transaction ratio (EMTR) indicator

To find out whether the data from the two series have compatible movements or not, we can do the compatibility test. The results can be seen in Table 4, it can be concluded that in the period 2009-2018, AFSI with and without EMTR has shown different movements. It indicates that the presence of e-money as a component of AFSI calculation can change the movement of financial system stability indexes, so it needs to be aware that the rapid increase in e-money transactions should not be ignored in measuring financial system stability in Indonesia.

Table 4. Comparison of AFSI compatibility tests

Periods	2009-2018	2009-2011	2012-2018
Number of observations (n)	40	12	28
Test statistic values (K)	58.20	12.75	47.30
Table values $\chi^2_{(0,05\,;\,n)}$	55.76	21.03	41.34
Decisions	Reject H0	Do Not Reject H0	Reject H0
Conclusions	Not Compatible	Compatible	Not Compatible

Furthermore, if we divide the period into 2009-2011 and 2012-2018, it cannot be proven that AFSI with and without EMTR has different movements in 2009-2011. It means that the existence of the e-money transaction ratio as a component in the calculation of AFSI has not been able to significantly affect the value of the financial system stability index before 2012. However, starting in 2012 it can be seen that with a significance level of 5% there is sufficient evidence that the AFSI series between before and after the addition of EMTR is not compatible. It indicates that the existence of the e-money transaction ratio starting in 2012 has been able to change the movements of the financial system stability index. Therefore, it can be concluded that the e-money transaction ratio indicator in calculating the stability index of the financial system in Indonesia needs to be involved, which in the coming years, e-money transactions are expected to continue to increase so this indicator should not be ignored.

4. Discussion, Conclusion and Recommendations:

The existence of GNNT (National Non-Cash Movement) launched by Bank Indonesia on August 14, 2012, and the issuance of Bank Indonesia Regulation No.14/2/PBI/2012 about Implementation of Card-Based Payment Instrument Activities on January 6, 2012, has been able to have an impact on increasing e-money transaction ratio (EMTR) began in 2012, which in previous periods the value of EMTR tended to be constant. Thus, to find out whether starting from 2012 the EMTR has proven to be able to change the movement of the financial system stability index or not, a compatibility test is conducted which is divided into before and after 2012 as shown in Table 4.

Based on the results and analysis, it can be concluded that: (1) Aggregate Financial Stability Index (AFSI) can be used as an alternative to measuring Indonesia's financial stability because it can accommodate the dimensions in the ISSK and the dimensions of the global economy; (2) Unobserved Components Model (UCM) is better to be used as a weight in the construction of AFSI because it is more sensitive and suitable for non-stationary data; (3) The most influential indicators are market capitalization/GDP while the most influential dimensions on Indonesia's financial stability are the World Economic Climate Index (WECI); (4) The E-money Transaction Ratio (EMTR) indicator contributes positively to financial stability and needs to be added in the construction of AFSI so the AFSI is more relevant to the current times and will produce a higher quality financial stability index which can properly describe the actual conditions of the financial system.

Recommendations that can be given are: (1) In monitoring or analyzing financial stability, e-money indicators should be included from now onwards; (2) To reduce the pressure on the global economy, Indonesia should be improving the quality of domestic goods to improve the competitiveness of Indonesian goods so that export revenues increase, then improving the development of infrastructure, technology, quality of human resources, and a conducive business climate which is still a challenge for Indonesia so that the benefits of economic development increase; (3) For further research, we can make AFSI by using different methods of normalization, weighting, and aggregation so that it can be used as a comparison and then forecasting AFSI for the next period.

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