Impact Of Exogenous And Endogenous Risks On Systemic Risk In Indonesian Banking

Alfiana, Ernie Tisnawati Sule, Sutisna, Dian Masyita

Abstract: Weaknesses of the Banking Pressure Index and Financial Stability Index as an early detection system were not to involve contagion and bank run. This study aimed at determining impacts of endogenous and exogenous risks on systemic risks. It was a descriptive verificatory study using monthly secondary data of 2011-2014 and multiple regressions. Utilizing credit risk, liquidity risk, market risk, capital adequacy risk, contagion, bank run, inflation, BI rate, exchange rate and systemic risk variables of the 2011-2014 period, it turned out that only endogenous risks of contagion and bank run variables impacted on systemic risk in Indonesian banking. The result showed that after the test of classical linear regression assumption, credit risk, capital adequacy risk, contagion, bank run and inflation variables simultaneously impacted on systemic risk and contributed to the movement of systemic risk. However, our findings suggested that only contagion (CONT), bank run (BR), and inflation (INF) variables significantly impacted on systemic risk in a positive direction.

Index Terms: bank run, contagion, multiple regressions, systemic risk.

1. INTRODUCTION

Endogenous and exogenous risks typically used in financial instability. Multiple sources and invulnerabilities of endogenous risk originated in institution, market and infrastructure, and of exogenous risk consisted of macroeconomic disturbances and event risks (Schinasi, 2005). Sources of endogenous and exogenous risks had potentials to cover weaknesses of the Danareksa Research Institute's Banking Pressure Index (BPI) and the Bank Indonesia's Financial Stability Index (FSI), both of which pointed out similarity regarding Indonesian financial crisis of the 1997-2008 period in that they exceeded the specified thresholds, as Alfiana et al. (2016) investigated. As an early detection system of banking crisis, financial crisis or financial instability in a given country, weaknesses of those indices were not to involve contagion and bank run. The former was the core of systemic risk (Djikman, 2010) and the latter associated with systemic risk (Billio et al., 2012), a classic example of systemic risk (Schwarcz, 2008), and primary banking crises indicator (Bell, 2000), which preceded the crisis (Kaminsky, 1999). This study employed contagion and bank run variables in addition to the frequently used banking risk and macroeconomics variables. This study aimed at determining overview of systemic risk (CRERED), credit risk (CR), liquidity risk, (LR), market risk (MR), capital adequacy risk (CAR), contagion (CONT), bank run, (BR), inflation (INF), interest rate (INT) and exchange rate (ER) during study period. Besides, it also aimed at determining significant simultaneous and partial effects of credit risk (CR), liquidity risk (LR), market risk (MR), capital adequacy risk (CAR), contagion (CONT), bank run (BR), inflation (INF), interest rate (INT), and exchange rate (ER) on systemic risk (CRERED). In one hand, this study had theoretical usefulness of contributing to the development of management science, in particular, the study of banking and financial management. In another hand, this study had practical expected usefulness of becomin g (1) an input and evaluation materials for banking practitioners in order to avoid financial instability that banking performance brought about; (2) an input for the Bank Indonesia in making its policies and for Financial Services Authority as the financial controller; and (3) a comparative model for future study in the related field in terms of framework, methodology and findings by either systemic risk researchers or observers

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2. LITERATURE REVIEW

2.1 Endogenous Risk

The endogenous risk was a risk, which always got along the financial system. This risk depended on behaviours of financial system components. According to Hauben, Kakes and Schinasi (2004), Schinasi (2005), and the Bank Indonesia (2007), the endogenous risk was a financial instability source. Stability of the financial system was required to avoid systemic risk. Therefore, all possible sources of instability in the financial system were systemic risk sources. Hauben et al (2004) and Schinasi (2005) advocated that endogenous risk in a financial system consisted of 3 components — institution, market, and infrastructure. Endogenous risk of financial institution included credit, liquidity, market and capital adequacy risks. In the meanwhile, endogenous risk of the financial market and financial infrastructure included contagion and bank run, respectively.

2.2 Exogenous Risk

The exogenous risk was a risk emerging beyond financial system. Financial system components were not controlling their behaviours and the behaviours did not influence the components. Hauben, Kakes and Schinasi (2004), (Schinasi, 2005), and the Bank Indonesia (2007) explained that exogenous risk was a financial instability source. Stability of the financial system was required to avoid systemic risk. Therefore, all possible sources of instability in the financial system represented systemic risk sources. Hauben et al, (2004), Schinasi (2005) broke exogenous risk into macroeconomic disturbances and event risks. Technology innovation, oil price shock, oil price fluctuations, a sudden change of market sentiment, fiscal and monetary policy imbalance, and trade restriction introduction and its abrupt withdrawal were examples of economics disturbances. Hauben et al (2004) and Schinasi (2005)) also supported that framework for the maintenance of financial system stability used macroeconomic model, which could also run to monitor and analyse the systemic risk. Evans et al. (2000), employed macroprudential analysis with macroeconomic indicators of inflation (volatility in inflation), interest and exchange rates (volatility in interest and exchange rates). Event risks broke

into (1) natural disaster, (2) political event and (3) large business failure. All the three could ruin market trust and create imbalance, adversely influencing the overall financial system.

2.3 Systemic Risk

Systemic risk was defined as disruptive risks on financial service induced by reductions in all or part of financial system potentially leading to serious negative consequences for real economics (International Monetary Fund (IMF), Financial Board Stability (FBS), and Bank for International Settlements (BIS) for G20 in Caruana (2010: 2)).

Effects of systemic risk included:

1. Distorted credit and capital supplies to the real economy (Adrian and Brunnermeier, 2008)
2. Potentially harming credit adequacy to the real economy (Adrian and Brunnermeier, 2011)
3. Reduced intermediate capital supply to the real economy (Acharya, 2009) in Eijffinger, (2009).
4. Leading to decreased credit adequacy potential to influence the real economy (Acharya, 2011).

Of all the above effects of systemic risk, a slowdown in credit can be appointed as a proxy of systemic risk in accordance with Alfiana et al. (2015).

3 METHODOLOGY

This was a descriptive verificatory study using monthly secondary data from statistics of the Bank Indonesia and Indonesian Central Statistics Bureau 2011-2014 on Indonesian banking because banking assets accounted for 75-80% of total Indonesian financial system assets. Data processing applied multiple regressions. Independent variables consisted of credit risk, liquidity risk, market risk, capital adequacy risk, contagion, bank run, inflation, BI rate and exchange rate variables, whereas dependent variable only included systemic risks. Proposed hypotheses were as follow:

Partial

Endogenous Risk

H1.1 : Credit risk significantly impacted on systemic risks.
H1.2 : Liquidity risk significantly impacted on systemic risks.
H1.3 : Market risk significantly impacted on systemic risks.
H1.4 : Capital adequacy risk significantly impacted on systemic risk.
H2 : Contagion significantly impacted on systemic risks.
H3 : Bank run significantly impacted on systemic risks.

Exogenous Risk

H4.1 : Inflation significantly impacted on systemic risks.
H4.2 : Interest rate significantly impacted on systemic risks.
H4.3 : Exchange rate significantly impacted on systemic risks.

Simultaneous

H5 : Credit risk, liquidity risk, market risk, capital adequacy risk, contagion, bank run, inflation, and interest and exchange rates simultaneously and significantly impacted on systemic risks.

Multiple Regression Model

$$CRERED = \beta_0 + \beta_1 CR + \beta_2 LR + \beta_3 MR + \beta_4 CAR + \beta_5 CONT + \beta_6 BR + \beta_7 INF + \beta_8 INT + \beta_9 ER + \varepsilon$$

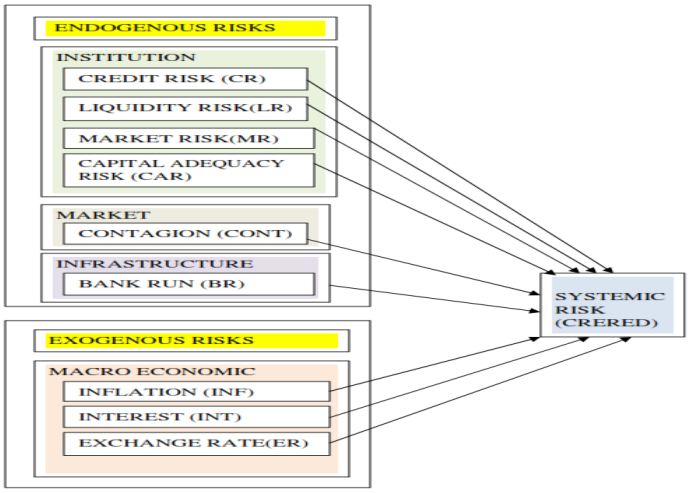

Figure 1: *Framework*

4 ANALYSIS OF RESULT AND DISCUSSION

Overviews of studied data were as follow:

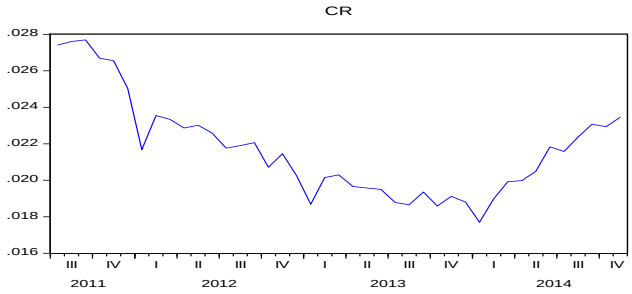

Figure 2. *The movement of credit risk*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

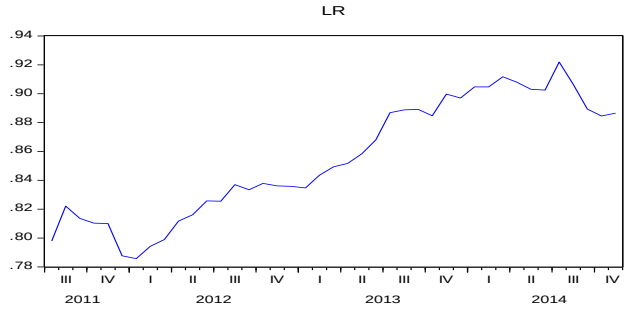

Figure 3. *The movement of liquidity risk*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

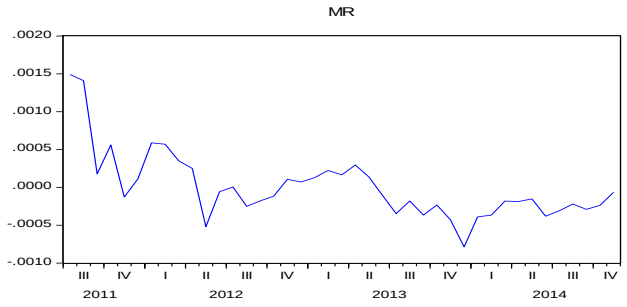

Figure 4. *The movement of market risk*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

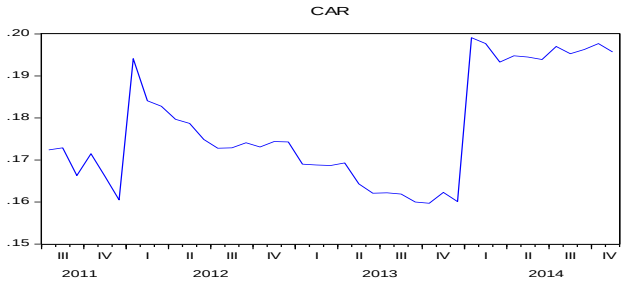

Figure 5. *The movement of capital adequacy risk*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

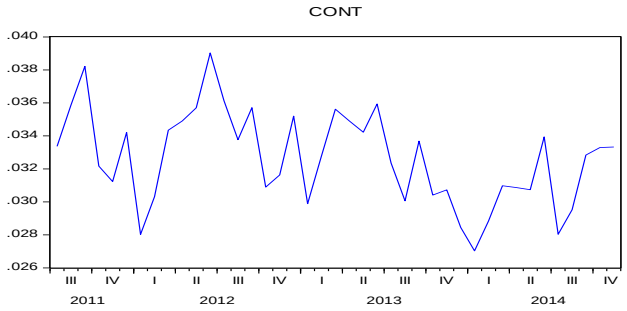

Figure 6. *The movement of contagion*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

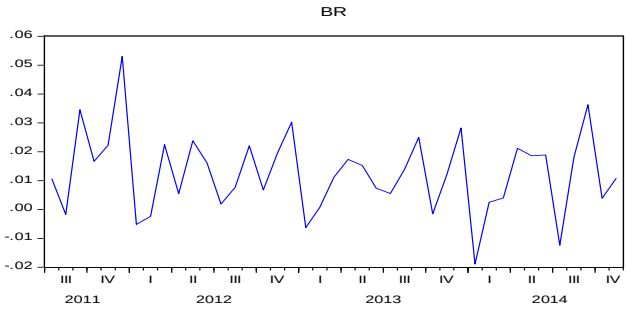

Figure 7. *The movement of bank run*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

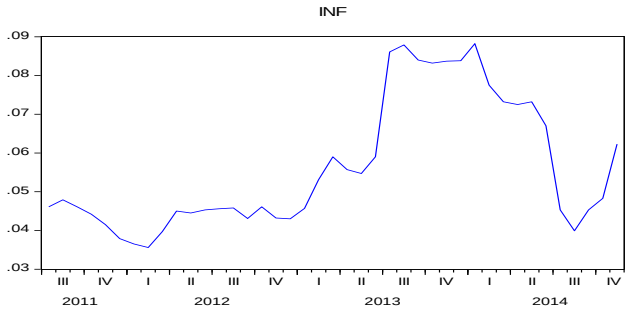

Figure 8. *The movement of inflation*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

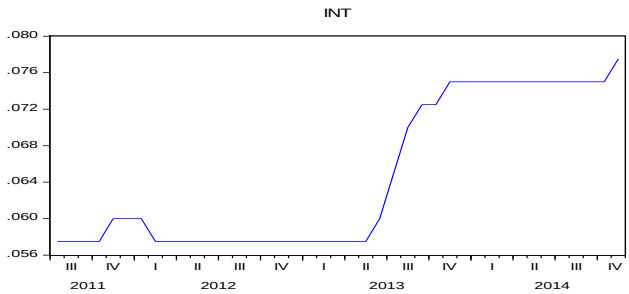

Figure 9. *The movement of interest rate*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

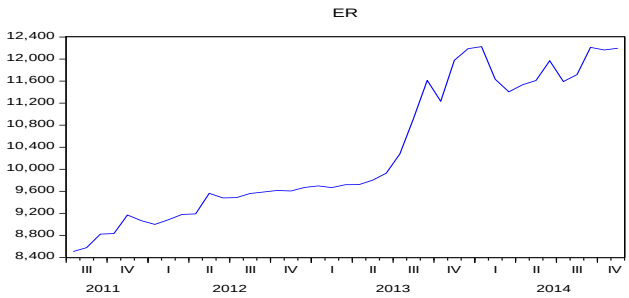

Figure 11. *The movement of exchange rate*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

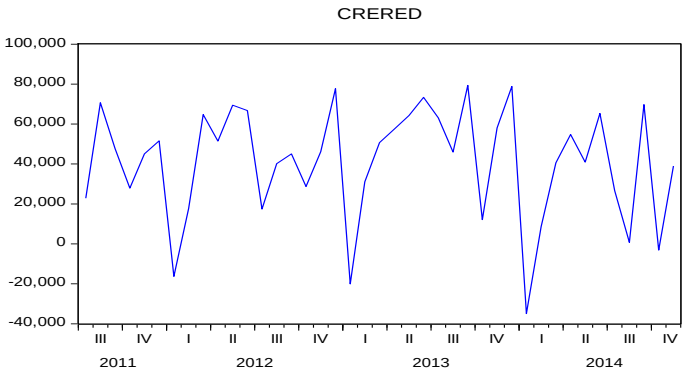

Figure 12. *The movement of systemic risk*
Source: *Data processing results from Indonesian banking statistics July 2011 - November 2014.*

Those graphics represent changes in each of variables that systemic risk influenced. Data processing results present in below tables.

Table 1 Coefficients of multiple regressions, t-Statistics, and Probability before and after the test of Classical Linear Regression (CRL) Assumption

	The Test of Classical Linear Regression (CLR) Assumption						Conclusion
	Before			After			
Variable	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.	
C	-334696.4	-2.156	0.03	-93757.54	-1.004	0.32	
CR	327151.2	0.125	0.90	-692305.2	-0.367	0.71	Approved H_0
LR	416314.1	1.873	0.07				Approved H_0
MR	3205241.	0.271	0.78				Approved H_0
CAR	-206438.0	-0.538	0.59	-200519.6	-0.825	0.41	Approved H_0
CONT	3716396.	2.152	0.03	4515514.	3.311	0.00	Rejected H_0
BR	1113488.	3.671	0.00	973370.4	2.876	0.00	Rejected H_0
INF	331285.6	0.792	0.43	453618.5	1.718	0.09	Approved H_0
INT	-832656.7	-0.365	0.71				Approved H_0
ER	-4.952902	-0.346	0.73				Approved H_0

Source: *Data processing results*

Table 2 *R^2 Test and F Test before and after the test of Classical Linear Regression (CRL) Assumption*

	The Test of Classical Linear Regression (CRL) Assumption			
	After		Before	
	Value	Prob	Value	Prob
R Square	0.6497		0.6089	
F	6.3900	0.000	10.901	0.000

Source: *Data processing results*

1. Table 1 and Table 2 before the test of Classical Linear Regression (CRL) Assumption
   a. Presented that independent variables simultaneously impacted on the movement of systemic risk, as shown by F test of 6.3900 with a probability of 0.000 and shown by statistical analysis, and only contagion and bank run significantly impacted on systemic risk in a positive direction. Liquidity risk impacted on systemic risk with the significance of 10%.
   b. Movement of independent variables, such as credit risk, liquidity risk, market risk, capital adequacy risk, contagion, bank run, inflation, interest rate and exchange rate contributed to the movement of systemic risk of 64.9% and other variables beyond this study impacted on the rest.
2. Table 1 and Table 2 after the test of Classical Linear Regression (CRL) Assumption including Normality Test, Multicollinearity Test, Heteroscedasticity Test, and Autocorrelation Test,
   a. Only independent variables, such as credit risk, capital adequacy risk, contagion, bank run and inflation, simultaneously impacted on systemic risk as seen from F test result by 10.90171 with a probability of 0.000. In the meantime, t-statistics test showed that contagion and bank run variables significantly impacted on systemic risk in a positive direction. Inflation impacted on systemic risk with the significance of 10%.
   b. The movement of independent variables, such as credit risk, capital adequacy risk, contagion and bank run, contributed to the movement of systemic risk by 60.89% and other variables beyond this study impacted on the rest. The higher coefficient of determination, the better the model was in the elucidating correlation between independent and dependent variables.

Table 3 *Directional relationship between systemic risk and other variables from previous studies*

Author	CR	LR	MR	CAR	CONT	BR	INF	IR	ER
Demirguc Kunt, Detragiache (1998,95 & 96)							+	+	
Eichengreen dan Rose (1998,41-57)								+/-	_
Kaminsky and Reinhart (1999,9)						+		+	
Glick , Hutchison (1999,36)							+/-		
Gonzalez, Hermosillo (1999,48-49)	+	+	+					+	+
Edison (2003,57)		+				+		+	+
Cihak , Slaeck (2007,22&26)	+/ -						+/-		+/-
Moshirian, Wu (2009,25)							_	+	
Poghosyan, Cihak (2009,20)	+/-			+	+		+		
Oet, et al (2013,13&14)	_			+	+			_	+
Alfiana et al (2015a,1)	+/-								
Alfiana et al (2015b,1)						+/-			
Alfiana (2015c,1)					+/-				
Alfiana (2015d,1)							+		
Alfiana (2015,e,1)								-	
Alfiana (2015f,1)									-
Alfiana (2015g,1)		+/-							-
Alfiana (2015h,1)								-	-
Alfiana (2015i, 1)			+/-						
Alfiana (2016,a1)				+/-					
Alfiana (2016b,1)		+/-							
Alfiana (2016c,1)			+						

Source: *Alfiana et al (2016)*

Based on previous studies in Table 3, credit risk (CR) variable positively and negatively influenced systemic risk variables. Gonzalez and Hermosillo (1999a)'s study found that bank collapse occurred due to credit risk condition, so did Hauben et al (2004), and Schinasi (2005) suggesting that credit risk was one of the possible sources of financial instability. The Bank Indonesia (2007) and Evan et al. (2000) monitored financial stability to measure risk pressure potentially arising, particularly systemic or crisis-inducing disturbances. Monitoring microprudential indicators suggested potential credit risk of the financial institution. In this study, credit risk, simultaneous with other variables, influenced systemic risk but it did not significantly influence systemic risk according to t test. Table 3 shows that liquidity risk (LR) positively and negatively influences systemic risk variables. Gonzalez and Hermosillo (1999a)'s study found that bank collapse occurred due to liquidity risk condition, so did Hauben et al (2004) and Schinasi (2005) suggesting that liquidity risk was one of the possible sources of financial instability. The Bank Indonesia (2007) and Evan et al. (2000) monitored financial stability to measure potentially emerging risk pressure, in particular, systemic or crisis-inducing disturbances. This study put aside liquidity risk because of high correlation to other independent variables and of complying with collinearity test. Table 3 indicates that market risk (MR) positively influences systemic risk variables. Gonzalez and Hermosillo (1999a)'s study found that bank collapse occurred due to market risk condition, so

did Hauben et al (2004), and Schinasi (2005) suggesting that market risk was one of the possible sources of financial instability. The Bank Indonesia (2007) and Evan et al. (2000) monitored financial stability to measure potentially emerging risk pressure, in particular, systemic or crisis-inducing disturbances. This study put aside market risk because of not fulfilling data normality test. Table 3 suggests that capital adequacy risk (CAR) positively and negatively influences systemic risk variables. Hauben et al. (2004) and Schinasi (2005) suggested that capital adequacy risk is one of the possible sources of financial instability. In this study, capital adequacy risk, simultaneous to the other variables, influenced systemic risk despite its statistical insignificance according to T test. Table 3 points out that Contagion (CONT) positively and negatively influences systemic risk variables. Contagion was the core of systemic risk (Djikman, 2010). Hauben et al (2004) and Schinasi (2005) suggested that contagion was one of the possible sources of financial instability. The Bank Indonesia (2007) and Evan et al. (2000) monitored financial stability to measure potentially emerging risk pressure, in particular, systemic disturbance or crisis-inducing disturbances. In this study, contagion, simultaneous to other variable, influenced systemic risk and, partially based on the t-statistic test, significantly influenced systemic risk in a positive direction. Table 3 displays that bank run (BR) positively and negatively influences systemic risk variables. Bell (2000) utilized bank run as a primary indicator of the banking crisis. Kaminsky (1999) expressed that bank run preceded banking crisis. Hauben et al (2004) and Schinasi (2005) mentioned that collapse of confidence leading to bank run was one of the possible sources of financial instability. In this study, bank run, together with another variables, influenced systemic risk and, partially based on the t-statistic test, significantly influenced systemic risk in a positive direction. Table 3 pointed outs that inflation (INF) positively and negatively influences systemic risk variables. Hauben et al (2004) and Schinasi (2005) suggested that macroeconomic disturbance was one of the possible sources of financial instability. The Bank Indonesia (2007) and Evan et al. (2000) monitored financial stability to measure potentially emerging risk pressure, in particular, systemic or crisis-inducing disturbances. In this study, inflation, together with another variables, influenced systemic risk and, partially based on the t-statistic test, significantly influenced systemic risk in a positive direction at α = 10%. Table 3 points out that interest rate (INT) positively and negatively influences systemic risk variables. Gonzalez and Hermosillo (1999) engaged in interest rate to detect bank collapse. Hauben et al (2004) and Schinasi (2005) suggested that macroeconomic disturbances were one of the possible sources of financial instability. The Bank Indonesia (2007) and Evan et al. (2000) monitored financial stability to measure potentially emerging risk pressure, in particular, systemic or crisis-inducing disturbances. In this study, interest rate failed in satisfying Data Normality Test so as to be excluded from the equation. Table 3 expresses that exchange rate (ER) positively and negatively influences systemic risk variables. Gonzalez and Hermosillo (1999) used the exchange rate to detect bank collapse. Hauben et al (2004) and Schinasi (2005) suggested that macroeconomic disturbance was one of the possible sources of financial instability. The Bank Indonesia (2007) and Evan et al. (2000) monitored financial stability to measure potentially emerging risk pressure, in particular, systemic or crisis-inducing disturbances. Reinhart and Rogoff (2009) proposed that real exchange rate constituted early warning indicator of banking and currency crises. This study excluded exchange rate from the equation because of high correlation to other independent variables and of complying with collinearity test.

5. CONCLUSION

Systemic risk during study period fluctuated along with fluctuation of credit risk (CR), liquidity risk, (LR), market risk (MR), capital availability risk (CAR), contagion (CONT), bank run (BR), inflation (INF), interest rate (INT) and exchange rate variables (ER). All the variables simultaneously and significantly influenced Systemic Risk but this study only used credit risk (CR), capital availability risk (CAR), contagion (CONT), bank run (BR), and inflation variables (INF) in order to comply with data normality test and multicollinearity test. All the variables simultaneously impacted on systemic risk although only contagion (CONT), bank run (BR), and inflation variable (INF) variables significantly impacted on systemic risk in a positive direction at α = 5%, α = 5%, and α = 10%, respectively. This result was an innovation for and contributing to Indonesian economics because Indonesia did not have the law of Financial System Safety Net as a legal basis in case of bank failure and, subsequently, its systemic impacts. In order to avoid systemic risk in the financial system, banking practitioners Bank Indonesia, Financial Service Authority, and Government should pay attention to endogenous and exogenous risks. Financial researchers and observers would be recommended to study other factors or financial institutions, which impacted on systemic risk with consideration of data availability because this study only accounted for 60.89% of the entire systemic risk.

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