

# The Effectiveness of Monetary Policy Through Indonesian Green Finance

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## ABSTRACT

*Monetary policy controls economic growth and financial stability, the Central Bank needs to control the financial cycle pressure through green finance. The measurement in this study was carried out through the Ed Waves Index development model based on Bank Indonesia's financial report data since the green finance declaration (1980-2024). The results found that there are three types of pressure from financial activity a wave in the financial cycle that affect the monetary policy effectiveness. The first type is depressed 0.027 A economic growth occurs based on a contractionary policy reaction. The second type is depressed -0.002 A is a neutral response based on a contractionary policy reaction. The third type with pressure -0.023 A, economic stability occurs based on an expansionary policy reaction. This study provides a strong contribution to Bank Indonesia in determining an effective monetary policy as a form of anticipation of climate change pressures on changes in the financial cycle in Indonesia.*

*Keywords: Monetary, Green Finance, Banking, Climate Change*

## INTRODUCTION

Monetary Policy is a tool for the Central Bank in maintaining financial and economic stability in Indonesia (Albulescu et al., 2013 ; Ma & Zhang, 2016 ; Irawan, 2018). Financial control is needed because of significant changes in the financial cycle waves movement (El Karfi & Mentagui, 2020 ; Caruana, 2011 ; Papers & Daianu, n.d.). The consequences of the movement significance of the financial cycle indicate the pressures occurrence that affect financial activities, both macroeconomic and microeconomic (Jermann & Quadrini, 2012 ; Laxton et al., 2008 ; Fattorini et al., 2018). On the other hand, financial stress is also a behavior of financial instability that affects changes in financial flows to acute depression (Hafstead & Smith, 2012 ; Bernanke et al., 1999 ; Rochon, 2020 ; McCallum, 2001 ; Basmar et al., 2021 ; Riet, 2017 ; Ardila et al., 2016 ; Shen et al., 2018).

Recently, acute depression in financial distress during climate change effects is a new symptom of financial breakdown in Indonesia and other countries (Nolan & Thoenissen, 2009 ; Rafique et al., 2021 ; Wilson, 2015). The financial distress effects reduce economic activity and the financial markets mobility in general (Claessens et al., 201 ; Albulescu et al., 2013 ; Dib & Christensen, 2005). In response to this situation, an extraordinary monetary policy response is

needed both nationally and internationally (P. R. Agénor et al., 2000 ; Estrella & Mishkin, 1998 ; Nguyen et al., 2021). The relationship between monetary policy as the Central Bank authority in regulating monetary aggregates aims to achieve economic development activities through the financial cycle as the main indicator in measuring economic activities, economic characteristics and fundamental economic factors (Harun et al., 2014; Adam & Padula, 2011; Cúrdia & Woodford, 2009).

Interestingly The Central Bank's monetary policy has an important position in maintaining the Indonesian economy, especially during climate change pressures, where the monetary policy target is to achieve a growing economy and create financial stability (Nolan & Thoenissen, 2009; Liu et al., 2011; Rejeb et al., 2021; L. J. Christiano et al., 2014). Despite, financial stress requires phenomenon the Central Bank to face major consequences during climate change pressures (El Karfi & Mentagui, 2020; Hafstead & Smith, 2012; Abdullah, 2014; Afonso & Alves, 2015). To date, monetary policy tightening is carried out to create a stable financial pattern due to climate change pressures by maintaining institutional and personal autonomy which is the Central Bank's independence part (Pisani-ferry & Ramos, 2011; Devereux et al., 2006; Claudio Borio, 2001; Afonso & Alves, 2015).

Crucially, the adaptation process to the climate change impacts for the future is focused on formulating policies to prevent climate change risks and encourage national economic recovery (Erdem & Tsatsaronis, 2013; Iacoviello, 2015; Aysan et al., 2017). In other words, Controlling financial activities through green finance towards the financial system stability is the main objective of the Central Bank's monetary policy (Céspedes et al., 2013; Borio, 2012; Drehmann et al., 2012). In addition, the monetary policy development occurs through increased coordination between financial institutions and the government, as an effort to support the Central Bank's policies (Carlstrom & Fuerst, 1997; Moore, 2008; L. Christiano et al., 2008; De Bonis & Silvestrini, 2014). Historically, monetary policy in the banking sector is an accommodative policy towards macroeconomic elements, sufficient liquidity for the bank credit development as an effort to achieve recovery of the country's economic activity (Cuciniello & di Iasio, 2021; Schüler et al., 2021; Lim, 2015).

Referring to the previous financial stress pattern (1997-2008), financial stress during climate change is a very crucial risk weight, due to changes in banking and public business credit behavior (Caldara et al., 2016; P.-R. Agénor & Pereira da Silva, 2013 ; Mostaghimi, 2004 ; McKinnon et al., 2010). Consequently, the broad impact of the changes resulted in banks having to maintain their liquidity to avoid acute depression (Orphanides, 2003 ; ECB, 2012). In turn, the acute financial depression resulted in changes in several economic indicators, especially credit and economic growth (Chen et al., 2015 ; Claessens et al., 2011 ; Borio et al., 2018 ; Nasreen & Anwar, 2019). Besides, the stress impact is more immediate than Central Bank intervention in minimizing the climate change risks spread that reduce economic growth and financial activities instability (Orphanides, 2001 ; Bernanke & Gertler, 1995 ; Samad & Manzoor, 2015).

Importantly, the research gap is caused by the previous empirical research findings that economic growth is not the only important economic element in achieving monetary policy targets. Therefore, this study will describe the effectiveness and efficiency of Bank Indonesia towards the monetary policy function when there is strong pressure on financial activities through green finance. Furthermore, the Bank Indonesia independence level towards short-term and long-term liquidity is a form of policy in dealing with financial pressures as an effort to maintain financial stability and economic growth in Indonesia.

**METHODOLOGY**

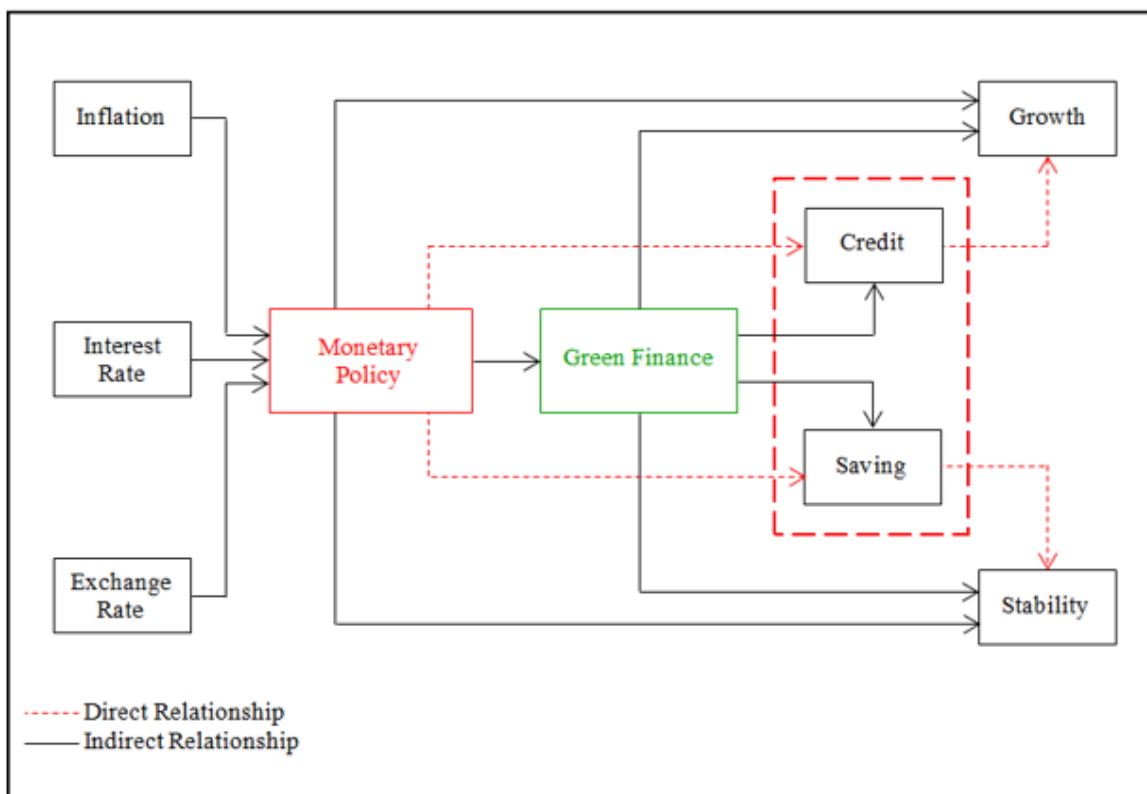
The data used in this study comes from the Bank Indonesia Financial Report from 1980 to 2024, during which period there was strong pressure on monetary policy. The measurement process uses the Ed Waves Index development model through variable partitions as a measure of Bank Indonesia's monetary policy. Generally, the research lies novelty in Figure 1, the derivative model that shows the pressure waves effectiveness through econometric statistical measurements to find the optimal accuracy of financial cycle wave movements, the measurement method is built based on the research framework.

Based on Figure 1, monetary policy collaboration cannot be separated from banking activities through the bank credit distribution, this relationship leads to the Central Bank's policy decisions. The back and forth flow in banking financial activities reflects the financial cycle wave movement effectiveness in transferring economic variable pressures, this relationship can be expressed in standard dimension

$$\alpha = \beta$$

Equation 1 is the state of the art through the relationship between the Central Bank and banking activities towards strong monetary policy synergy. This relationship describes the banks performance in influencing financial movements in deposits and loan requirements with equation:

$$(\sum \mu_1 + \sum \mu_2 + \sum \mu_3) = (\sum \eta_1 + \sum \eta_2 + \sum \eta_3)$$



**Figure 1.** Research Framework

In addition, the financial performance of the banking sector is accumulated through Equation 2, all financial indicators form a single unit that drives financial activities. The Equation 2 expansion is carried out to create a derivative model to determine the financial cycle wave movement ( $\xi$ ), as in the following equation:

$$\xi = (\alpha + \beta)$$

In Equation 3, it is a standard measure of the financial cycle with basic elements in the financial activity form ( $\zeta$ ) in the banking sector ( $\alpha + \beta$ ), which is then obtained by substituting Equation 1, then the results will appear in the following equation:

$$\xi = \zeta$$

Equation 4 is converted to Equation 2 to measure the variables effectiveness on the financial cycle pressures movement in Indonesia, this measurement can be written as:

$$\xi = \left( \sum (\mu_1 + \mu_2 + \mu_3) \right) + \left( \sum (\eta_1 + \eta_2 + \eta_3) \right)$$

In Equation 5 is the financial cycle wave movement through financial activities as a banking intermediation process. This condition is then formed in a stable motion size which is a new equation, as shown in the following equation:

$$\xi^0 = \sum (\mu_1 + \mu_2 + \mu_3)_{1 \leq 0 \geq -1} + \sum (\eta_1 + \eta_2 + \eta_3)_{1 \leq 0 \geq -1}$$

Moreover, in waves terms, Equation 6 is a model that provides positive pressure as the main indicator of monetary policy taken by the government in achieving economic growth targets, this can be calculated the condition as:

$$\xi^{\max} = \sum (\mu_1 + \mu_2 + \mu_3)_{1 \leq \infty} + \sum (\eta_1 + \eta_2 + \eta_3)_{1 \leq \infty}$$

The policy antithesis in Equation 7 shows that the financial cycle movement mutates under negative pressure conditions, resulting in the measurement aspect of the financial cycle being oriented towards the financial stability process, this effort can be described in the following equation:

$$\xi^{\min} = \sum (\mu_1 + \mu_2 + \mu_3)_{-1 \leq \infty} + \sum (\eta_1 + \eta_2 + \eta_3)_{-1 \leq \infty}$$

Furthermore, the Ed Waves Index development model is then calculated mathematically through the financial activity pressures synchronization on the banking sector, the relationship can be translated into the following equation:

$$\xi^0 = \sum (\mu_1 + \mu_2 + \mu_3)_{1 \leq 0 \geq -1} + \sum (\eta_1 + \eta_2 + \eta_3)_{1 \leq 0 \geq -1}$$

In Equation 9, the Climate Change pressure contamination through green finance has not responded significantly to financial activity in the banking sector, this impact has not been able to suppress the financial cycle waves movement. Green financial pressures stimulate the financial cycle movement through a strong relationship between the measurement variables and banking financial activities. The parameters are written in the following statement:

$$\xi^{\max} = \sum (\mu_1 + \mu_2 + \mu_3)_{1 \leq \infty} + \sum (\eta_1 + \eta_2 + \eta_3)_{1 \leq \infty}$$

Next, the Equation 10 effect is a positive and significant movement of the financial cycle on financial activity that is in line with the financial cycle size in the previous Equation 7.

The resistance equation concept through the symptoms withdrawal of banking financial activities in the decrease form in financial cycle stimulus shows a significant negative relationship, in line with the financial cycle pressure in Equation 8, this condition can be described in the following equation:

$$\zeta^{\min} = \sum(\mu_1 + \mu_2 + \mu_3)_{-1 \leq \infty} + \sum(\eta_1 + \eta_2 + \eta_3)_{-1 \leq \infty}$$

Overall, the financial activity movement and financial cycles wave are found through the Ed Waves Index development model. The Ed Waves Index development model is able to find the right monetary policy to be carried out when the economy is under strong pressure from financial influences both internally and externally. The model development effectiveness is then simplified through the following equation:

$$\xi = \Delta \sum_{t=1}^{\max} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum(\mu_1 + \mu_2 + \mu_3)_{1 \leq \infty} \right) + \left( \frac{1}{3} \sum(\eta_1 + \eta_2 + \eta_3)_{1 \leq \infty} \right) \right) \right]$$

$$\xi = \Delta \sum_{t=1}^{\text{nor}} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum(\mu_1 + \mu_2 + \mu_3)_{1 \leq 0 \geq -1} \right) + \left( \frac{1}{3} \sum(\eta_1 + \eta_2 + \eta_3)_{1 \leq 0 \geq -1} \right) \right) \right]$$

$$\xi = \Delta \sum_{t=1}^{\min} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum(\mu_1 + \mu_2 + \mu_3)_{-1 \leq \infty} \right) + \left( \frac{1}{3} \sum(\eta_1 + \eta_2 + \eta_3)_{-1 \leq \infty} \right) \right) \right]$$

Through the flexible financial cycle wave movement balance, the measurement technique refers to Equations 12, 13, and 14, to find the flexible financial activity level, this is shown through the following equation:

$$\zeta = \Delta \sum_{t=1}^{\max} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum(\mu_1 + \mu_2 + \mu_3)_{1 \leq \infty} \right) + \left( \frac{1}{3} \sum(\eta_1 + \eta_2 + \eta_3)_{1 \leq \infty} \right) \right) \right]$$

$$\zeta = \Delta \sum_{t=1}^{\text{nor}} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum(\mu_1 + \mu_2 + \mu_3)_{1 \leq 0 \geq -1} \right) + \left( \frac{1}{3} \sum(\eta_1 + \eta_2 + \eta_3)_{1 \leq 0 \geq -1} \right) \right) \right]$$

$$\zeta = \Delta \sum_{t=1}^{\min} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum(\mu_1 + \mu_2 + \mu_3)_{-1 \leq \infty} \right) + \left( \frac{1}{3} \sum(\eta_1 + \eta_2 + \eta_3)_{-1 \leq \infty} \right) \right) \right]$$

Efforts to determine the policies effectiveness under conditions of green financial stress are determined by measuring the following equation:

$$\left[ \Delta \sum_{t=1}^{\max} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum(\mu_1 + \mu_2 + \mu_3)_{1 \leq \infty} \right) + \left( \frac{1}{3} \sum(\eta_1 + \eta_2 + \eta_3)_{1 \leq \infty} \right) \right) \right] \right]$$

$$= \left[ \Delta \sum_{t=1}^{\min} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum(\mu_1 + \mu_2 + \mu_3)_{-1 \leq \infty} \right) + \left( \frac{1}{3} \sum(\eta_1 + \eta_2 + \eta_3)_{-1 \leq \infty} \right) \right) \right] \right]$$

In Equation 18 guides the monetary policy measurement on the financial cycle waves reaction, the financial cycle movement process has a positive and significant effect on the financial activities movement, financial pressure tends to increase overall economic growth. The monetary policy effectiveness can be applied to green financial pressure conditions by suppressing the credit

expansion rate (contractionary policy), because the non performing loans impact can be prevented as early as possible.

Another condition is that there is a movement in the financial cycle that reacts significantly negatively to the financial activity movement, resulting in financial depression pressure that disrupts financial stability. This condition is described in the following equation:

$$\left[ \Delta \sum_{t=1}^{\min} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum (\mu_1 + \mu_2 + \mu_3)_{-1 \leq \infty} \right) + \left( \frac{1}{3} \sum (\eta_1 + \eta_2 + \eta_3)_{-1 \leq \infty} \right) \right) \right] \right]$$

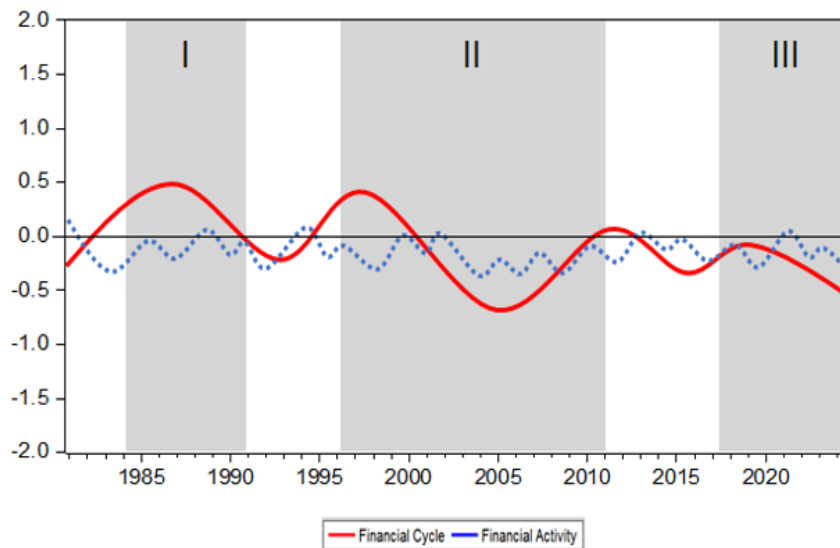
$$= \left[ \Delta \sum_{t=1}^{\max} \left[ \frac{1}{2} \left( \left( \frac{1}{3} \sum (\mu_1 + \mu_2 + \mu_3)_{1 \leq \infty} \right) + \left( \frac{1}{3} \sum (\eta_1 + \eta_2 + \eta_3)_{1 \leq \infty} \right) \right) \right] \right]$$

Last. In Equation 19, it can be seen that the financial cycle movement is less stable, efforts to reduce the damage impact to financial activities by providing financial stimulus (expansionary monetary policy), make the positive response of the business sector experience a strong reduction during times of green financial pressure. The treating financial activities process is measured based on the financial cycle waves movement that affect financial fluctuations in the banking sector, referring to the the Central Bank's dynamics performance in achieving optimal levels of growth and financial stability as the ultimate goal of Bank Indonesia, especially amidst green financial pressures in Indonesia.

## RESULTS AND DISCUSSION

Green financial pressure has affected the economic aspect through the business sector financial activities which have undergone significant changes. The negative impact of green finance has resulted in the economic activities cessation both internationally and nationally. This is crucial, the damage scale that occurs refers to the financial cycle wave movement through banking intermediary institutions. Furthermore, the basis for changing the financial cycle wave is by determining Bank Indonesia's policy decisions, this can be seen in Figure 2 and Table 1.

In Figure 2, the financial cycle waves movement is very dynamic with various pressures in each period, this movement arises due to changes in banking credit waves. In addition, the relationship between the two waves is very strong, marked by significant changes in the financial cycle waves based on the effectiveness of credit pressure in the economy, the pressure effect is a real response that forms a freely moving conjuncture wave. Meanwhile, the strong reaction to the changes influence in banking credit waves is due to several factors that are indicated to provide a significant response to the financial cycle. The Appendix in Figure 2 shows that there are three types of wave pressures with characteristics and movement patterns that have a strong reaction during the green financial period in Indonesia.



**Figure 2.** The Monetary Pressure to Financial Activity

**Table 1.** The Reaction of Financial Green

Type	$\Sigma\zeta$		$\Sigma\xi$	Reaction	Effect
	$\alpha$	$\beta$			
I	.007 A	.020 A	.027 A	Contraction	Growth
II	.010 A	-.012 A	-.002 A	Contraction	Netral
III	-.003 A	-.020 A	-.023 A	Expansion	Stabil

Source: Processed Data

Type 1 is identified by a continuous wave of banking credit pressure, a slowing trend in line with increasing green finance spreads, a positive and contradictory slowdown reaction to financial cycle movements, resistance occurs due to a delay in the financial cycle's reaction in responding to financial shocks, change detection is process part. Economic growth has not experienced a strong decline due to changes in bank lending behavior.

Type 2, the relationship between bank credit and the financial cycle wave moves with strong depression due to the green finance reaction that worsens economic activity, this reaction is in the negative area direction resulting in a significant decline in financial activity, the pressure weakens concentration due to the slowing rate of credit distribution, the wave measurement effectiveness has negative pressure with a neutral reaction over a fairly long period of time, because the green finance impact is difficult to predict.

Type 3, the relationship between banking credit waves and financial cycle waves in an uncertain period of time causes both waves to move irregularly, the movement focus shows symptoms of increasing in the positive area, banking credit reacts positively to financial activity, but the massive green finance impact that suppresses financial condition activity causes the rate of the pressure reduction process and the wave movement duration to slow down with a stable pressure level.

Finally, changes in the effectiveness level of banking credit waves and financial cycles in the three types, and can be described through differences in the pressure magnitude in each type of wave, as shown in Table 1. Overall, Table 1 explains that the economic growth process at the green finance beginning can still be controlled, financial stability is in line with the financial cycle wave, however, the economic growth reaction has experienced a change in the good category, because

the green financial pressure effect will be felt if the green finance reaction is in the long term. Next, The behavior between financial activities and the financial cycle in the initial reaction (Type I) when green finance shows a positive relationship with a strong reaction, financial activities, movement ( $\alpha = 0.007 A$  and  $\beta = 0.020 A$ ) makes the financial cycle movement reaction at a positive growth point ( $\xi = 0.027 A$ ), supported by the large distribution of bank credit, this concept affects economic growth. More precisely, measurement of financial behavior illustrates that green financial pressure has not had a significant effect, financial activities run normally with the pressure relevance on the financial transmission process in the banking sector to the industrial sector is still in normal condition, this condition is responded positively to the financial turnover in the financial cycle and the economic growth process is still optimal.

Herein, The reaction to the financial cycle movement is the basis for Bank Indonesia in determining policies by looking at the reaction and pressure of banks to green financial turmoil, the Bank Indonesia's contractionary policy determination as part of maintaining economic growth, as well as financial defense against green financial pressures that have an impact on economic growth and financial stability in Indonesia. Considering these findings, the financial activity movement through the financial cycle wave in Type II during green finance in Table 1, shows that fluctuating reaction changes spur the financial activity movement to become increasingly depressed ( $\alpha = 0.010 A$  and  $\beta = -0.012 A$ ), negative reactions are based on the economic movements uncertainty, the market responds to changes in uncertainty that result in the financial cycle movement becoming very depressed ( $\xi = -0.002 A$ ), great pressure causes the banking sector to be careful in responding to changes in financial market and business behavior, in line with the finance use in transactions as an effort to prevent damage to the financial system resulting in a financial crisis, the weakening concept occurs due to the unexpected green finance impact, and has an impact on the financial cycle movement. The financial cycle waves in Figure 2 and Table 1 have slowly reduced the effectiveness and efficiency of financial activities with a neutral duration, the delay in the financial cycle response to changes in financial activities through credit distribution has caused serious obstacles to financial stability and economic growth during the green financial period. Although. Bank Indonesia has taken an expansionary policy by relaxing banking sector policies during the green financial period to improve slowing financial performance, in line with the economic growth targets achievement, expansionary policies are efforts part to prevent and control financial crises, although the non performing loans risk has increased in line with the contractionary policy taken by Bank Indonesia.

Interestingly, the relationship between financial activities and the financial cycle in the final reaction in Table 1 shows a stable movement, marked by the market inability to respond to green financial pressure, the pressure contained in magnitude in type III ( $\alpha = -0.010 A$  and  $\beta = -0.020 A$ ) shows the financial activities ability to respond to pressure and uncertain duration resulting in financial activities moving unnaturally with a downward pressure response, but the banking interaction process with financial markets and the business world provides a good response, this makes it easier for banks to predict and anticipate all risks, financial stability is supported by the Central Bank's policy to banks which provides convenience in the achieving economic growth process and financial stability at times that are difficult to predict.

The intriguing, the interaction process stimulates a wave of financial activity and the financial cycle moves positively even amidst the strong green financial pressure uncertainty, the Central Bank's policy concept in controlling financial activity through the financial sector diversion to financial flow problems is carried out by providing an injection of banking credit expansion, to reduce financial pressure on the business sector by encouraging economic growth and the financial cycle when financial stability weakens during the green financial period. It is not merely, fluctuations indications in the financial cycle during the green financial period pressure the business sector to generate large profits, but government regulations are getting stricter to achieve economic growth and financial stability targets in a short time. Considering these findings, the implication is that the economic sector income is reduced, involvement with the banking sector shows indications of a decline in the ability to repay loans that have been made before the green finance existence.

These findings provide a more comprehensive view of the damage to the financial system has an impact on government policies, especially Bank Indonesia, to suppress the financial cycle rate which is experiencing acute depression. Furthermore, pressure is anticipated through monetary policy easing from the credit channel side which makes financial activities support economic growth. Additionally, it is important to consider the monetary policy implementation reacts quickly in the short term, in order to dampen the deepening wave pressure contraction, this condition is in line with Borio's findings, strengthening the policy shows the effectiveness and efficiency of monetary policy in suppressing the financial cycle wave movement due to green financial pressure in Indonesia.

## CONCLUSION

The monetary policy effectiveness in the Indonesian economy through the Ed Waves Index development model has three types of pressure on financial activities through banking green finance. Findings of significant responses to economic growth and financial stability in the wave financial cycle. Changes in these pressures react effectsto Bank Indonesia's policies in controlling green finance pressures. This study can be used as a basis for consideration by the Central Bank and other financial sectors in anticipating green finance pressures. These pressures effects are able to suppress the financial activities movement into deeper negative areas with a stronger level of risk to Indonesia's financial stability and economic growth.

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