Iranian Economic Review, 2024, 28(1), 111-128
DOI: 10.22059/IER.2024.338797.1007386

RESEARCH PAPER

Central Bank Innovations and Financial Stability in Indonesia: A Threshold Estimation

Cep Jandi Anwar[a,*], Vadilla Mutia Zahara[a], Rah Adi Fahmi Ginanjar[a], Stannia Cahaya Suci[a], Indra Suhendra[a]

a. Department of Economics and Development Studies, Faculty of Economics and Business, Universitas Sultan Ageng Tirtayasa, Banten, Indonesia

[*] Corresponding author, Email: cepjandianwar@untirta.ac.id

Article History: Received: 19 February 2022, Revised: 05 April 2022, Accepted: 05 May 2022
Publisher: University of Tehran Press.
©Author(s).

Abstract

Central bank innovations in terms of monetary and macroprudential policies and their interaction with the economy could have a non-linear effect on financial stability in Indonesia. There exists an optimal threshold level from which the central bank rate and macroprudential policy index affect financial stability. This study employs threshold autoregressive (TAR) methodology on Indonesian data to examine the effect of monetary and macroprudential policies on the growth of credit over the period 1990Q1 to 2020Q4 in Indonesia. The result indicates that TAR regression is significantly better than linear regression. In particular, TAR estimation reveals that the central bank rate and macroprudential policy index threshold levels were 7.3 and 0.145, respectively. Monetary policy tends to promote financial stability when the policy rate is above the threshold. It reveals that in periods with high macroprudential policy index, tight monetary and macroprudential policies promote financial stability. This indicates the need for policy coordination to foster sustained financial stability.

Keywords: Central Bank Interest Rate, Credit Gap, Indonesia, Macroprudential Policy, Threshold Autoregressive.
JEL Classification: E51, E58, F31.

1. Introduction

The experience of the 2008-2009 global financial crisis highlighted to central banks the significant roles of monetary and macroprudential policies in achieving sustained macroeconomic stability. Prior to the crisis, central banks had focused on maintaining price stability and sound financial system with no interest on the micro and macroprudential exposure. The intermediate goal of monetary policy focused on wholesale money market rates, exchange rates, output gap and levels of

unemployment. The relationship between financial and price stability was largely unexplored. Following the experience, the central bank began to utilize both microprudential and macroprudential policies prevent idiosyncratic and systemic risk in financial system, respectively. Macroprudential policy tends to hinder boom and bust in bank credits that often harm the financial system. Macroprudential indicators, such as debt service-to-income (DSTI) and caps on loan-to-value (LTV) ratios, which are useful in managing booms and busts cycles that often trigger instability in financial markets (Cerutti et al., 2017).

Both macroprudential and monetary policies are useful to counter financial shock. Monetary policy is not expected to solely achieve stabilization in financial market effectively or efficiently because its causes are not always related to the degree of liquidity or interest rate level in the system. It is also very blunt at mitigating the effects of financial distortions or the scenario of more acute financial distortions in some economic sectors than in others. Questions arise whether the central bank should implement only one or both policies to create better financial stability. According to Beau et al. (2017), macroprudential and monetary policies' impact tends to raise important coordination issues since they differ in terms of primary goals. For instance, monetary policy focus on a broad policy objective such as price stabilization whereas, macroprudential policies have two primary goals (Kim and Mehrotra, 2017). First, they are used to strengthen the financial systems' resilience through measures that ensure banks have enough liquidity and capital reserves to avoid credit losses. Then, ensures efficient credit utilization to counteract financial imbalances by preventing excessive credit and debt growth (Guibourg et al., 2015).

Indonesia represents unique example as a developing country to examine the relationship between central bank innovations and financial stability for four reasons. First, Indonesia reformed its central bank in 1999; this reform led Bank of Indonesia to become an independent central bank that is free from political interference (Wulandari et al., 2020). This facilitated the desecration of the Bank of Indonesia to set both monetary policy and macroprudential policy to achieve economic and financial stability. Second, Indonesia applied different exchange rate regimes since 1990's. Prior Asian Financial Crisis 1997, Indonesia run a fixed exchange rate system. Under the fixed exchange rate arrangement Bank of Indonesia had a fully control of the monetary base (Rajan, 2012; Warjiyo, 2005) and determine the exchange rate against major currencies. From August 1997, Indonesia switched to a floating exchange rate regime in which the Rupia freely traded against major currencies with the rates being determined by market mechanism. Third, the central bank has been

implementing inflation targeting monetary policy framework since, 2005 (Kuncoro, 2020). Fourth, Indonesia regularly use macroprudential policy such as, DLTI and LTV to stabilize financial market.

Prior empirical studies have investigated the effect of monetary policy, macroprudential policy on financial stability such as Cerutti et al. (2017), Kim and Mehrotra (2017), Drechsler et al. (2018), Venter, (2020). They find a negative effect of monetary policy and macroprudential policy on financial stability. There are some limitations of those studies on the effect of monetary policy, macroprudential policy on financial stability: (i) their studies mostly focus on developed countries; (ii) none of the studies investigate monetary policy and macroprudential policy on financial stability together in a model ; and (iii) Their study used linear estimation and ignore the possibility of non-linear relationship between variables. These issues arise a research gap on the effect of monetary policy, macroprudential policy on financial stability. The main motivation of this paper is to fill this research gap.

This paper has three contributions for the relationship between monetary policies, macroprudential policy on financial stability. First, prior empirical studies, which investigate the relationship between monetary policy and financial stability, macroprudential policy and financial stability, are performing the linear regression model and ignoring the possibility of a non-linear relationship. To conduct a more comprehensive analysis, we construct a non-linear methodology which captures the possibly time varying effect of monetary policy and macroprudential index on financial stability. We expect that the effect of monetary policy and macroprudential policy on financial stability is different when the monetary policy interest rate and macroprudential policy index is high and low. Thus, by performing a threshold non-linear model, we can indicate what level of monetary policy interest rate and macroprudential policy index is considered to be high and increase the financial stability.

This study aims to investigate the effect of monetary and macroprudential policies on financial stability in Indonesia under two scenarios. First, we examine how both policies effect financial stability under tight and loose monetary policy conditions. Then, their effect on financial stability under tight and loose macroprudential policy stance. The used threshold auto regression (TAR) estimation method on quarterly data over the period 1990Q1 to 2020Q4 to examine the non-linearity of these policy interactions on financial stability. The main variables of interest are central bank's policy rate and macroprudential policy index obtained from the Bank of Indonesia.

2. Literature Review

The existing literature suggest there are either synergies or a trade-off between price and financial stability objectives on the economy. The first strand argues that both financial and price stability contend such that monetary policy design (narrow central bank objective and monetary policy independence) achieves price stability and fosters sound financial system. An alternative strand states when the trade-off exists, it becomes difficult to find an inline impact on price and financial stability.

The argument for monetary policy synergies effect on both objectives is based on the view that this policy generates low and stable inflation, creating an economy with stable interest rates, and a lower risk of interest rate mismatches, leading to a minimum inflation risk premium in the long-term interest rate. Hence, affecting financial stability (Venter, 2020; Drechsler et al., 2018; Burlon et al., 2018; Vucinic, 2016). According to Smets (2018) and Blot et al. (2015), price stability is a necessary condition for financial stability. Conversely, Kim and Mehrotra (2017), Leroy and Lucotte (2017), and Adrian et al. (2015) support the argument for a trade-off between price and financial stability. They argued that an increase in interest rate controls inflation, but it has a negative impact on the bank's balance sheets and firms' financial worth. The same opinion was stated by Carlstrom et al. (2015) that a rapid and substantial increase in interest rate is required to control the inflation rate. The interest rate increase produces a different effect on banks' assets and liabilities, contributing to market risk. Another reason for trade-off arises from deflation or inflation that is too low as it reduces banks profit margin and increases non-performing loans in their balance sheet due to default borrower.

A large number of empirical works have attempted to investigate macroprudential policy effect on financial stability. Cerutti et al. (2017) examined this policy's effect on credit growth for a panel of 119 countries from 2000 to 2013. They established that tightening macroprudential policy results into lower bank credit growth. Their findings indicates that monetary policy is more effective in reducing credit growth among emerging and developing countries. Lee et al. (2016) employed a panel empirical framework to examine the effectiveness macroprudential policy among ten developing Asian countries' credit growth using quarterly data from 2000 to 2013. Their findings indicate that macroprudential policy effectively dampens credit growth in these economies.

Akinci and Olmstead-Rumsey (2018) evaluated macroprudential policy role using quarterly data from 2000 to 2013 for 57 developed and emerging market economies. They established that higher index of macroprudential policy reduces

housing credit growth, house price inflation and overall credit growth. Kim and Mehrotra (2018) investigate monetary and macroprudential policy effect on the macroeconomic variable for four inflation-targeting countries in the Asia Pacific area, specifically Indonesia, Australia, Thailand, and Korea over the period 2000Q1 to 2014Q4. Their findings reveal that both policies significantly reduce credit growth and inflation.

Turning to the literatures on the relations between monetary, and macroprudential policies coordination and their effect on financial stability. The empirical findings from Jiang et al. (2019) use commercial bank data to show that both policies affect the level of financial stability of China's economy. Their findings suggest that tight monetary and macroprudential policies can effectively stabilize financial system. Further, Venter (2020), investigated the relationship between both monetary and macroprudential policies and financial stability, using the data for five countries namely Chile, Colombia, Japan, Portugal and the UK covering the period from 2000 to 2018. The result showed monetary policy successes in reducing credit cycles and macroprudential policy is applicable in stabilizing a financial system as well.

This study extends the literature on the effects of monetary and macroprudential policies on financial stability, measured with credit growth in Indonesia using the non-linear TAR approach. Besides, Stepanyan and Guo (2011) who examined the factors affecting credit growth in 38 emerging market economies from period 2001Q1 to 2010Q2 there has been no research which examine the effect of monetary and macroprudential policies on financial stability in Indonesia. The existing studies focused on the impact of inflation and economic growth. They established that inflation dampen credit growth, while GDP growth increases it, which is consistent with the theoretical literature. Similarly, Saito et al. (2014) examined factors determining credit growth using annual data from a panel of 45 countries' covering the period from 2004 to 2010. They ascertained that inflation impairs credit growth, while market capitalization and financial crisis have a positive effect on the growth of credit for all the sample countries.

Several studies have established a negative relationship between increases in interest rates on credits. For example, Thaker et al. (2013) analysed the role of key macroeconomic variables on credits growth using quarterly data from Malaysia for 1991-2011. In addition, Shingjergji and Hyseni (2015) examined the impact of inflation, GDP growth, unemployment, and interest rate on the growth of credits using quarterly data from Albania over the period 2002 to 2013. They found inflation and

GDP growth have a positive effect on credit growth, while unemployment and interest rates have a negative impact on it.

3. Data and Methodology

3.1 Data

This study uses credit to GDP ratio as a proxy of financial stability as suggested by Schularick and Taylor (2012), Kim and Mehrotra (2018) and Alessi and Detken (2018). They claimed that excessive growth of credit is a signal of potential financial crisis. Excessive private credit growth is a good predictor of banking crises, and the cumulative growth as reflected in the credit per GDP gap. We measure the credit per GDP gap as the difference between the aggregate credit to GDP ratio and its long-run trend. The latter is estimated using Hodrick-Prescott (HP) filter, which decompose the index into trends and cyclical components.

The index developed by Cerutti et al. (2017) was used to document macroprudential policy importance. For each instrument employed, the study assigned 1 when it is implemented and 0 otherwise. The Global macroprudential policy (GMPI) index is the total score for 12 instruments, however there is a disadvantage in just aggregating all the 12. This approach is unweighted provided all instruments have the same scale. Hence, it is rather a mechanical method, while the econometric approach is unclear. This study uses the 12 GMPI developed by Cerutti et al. (2017), a new index that was constructed based on the dynamic factor model (DFM) methodology developed by Stock and Watson (1989) and Garratt and Hall (1996).

The central bank interest rate is the nominal policy interest rate set by central bank of Indonesia to indicate monetary policy stance and drive rates in the wholesale money markets. We add some control variables that have a significant effect to the credit gap in line with the findings from existing literatures. The additional control variables include; exchange rate, economic growth, inflation, and broad money per GDP.

3.2 Econometrics Methodology

The econometric models used is based on the time series regression techniques. Furthermore, to ensure robustness and accuracy of the estimated results, this paper developed four different models by adding or replacing some control variables and re-estimating the model. The first model is:

$$Credit\ Gap_t = \alpha_0 + \alpha_1 Central\ Bank\ Rate_t + \alpha_2 Mapp_t + \alpha_3 Exchange\ Rate_t + \alpha_4 Inflation_t + \varepsilon_t \quad (1)$$

The second model is:

$$Credit\ Gap_t = \alpha_0 + \alpha_1 Central\ Bank\ Rate_t + \alpha_2 Mapp_t + \alpha_3 Exchange\ Rate_t + \alpha_4 Growth_t + \varepsilon_t \quad (2)$$

The third model is:

$$Credit\ Gap_t = \alpha_0 + \alpha_1 Central\ Bank\ Rate_t + \alpha_2 Mapp_t + \alpha_3 Exchange\ Rate_t + \alpha_4 Growth_t + \alpha_5 Money\ per\ GDP_t + \varepsilon_t \quad (3)$$

The fourth model is:

$$Credit\ Gap_t = \alpha_0 + \alpha_1 Central\ Bank\ Rate_t + \alpha_2 Mapp_t + \alpha_3 Exchange\ Rate_t + \alpha_4 Inflation_t + \alpha_5 Growth_t + \alpha_6 Money\ per\ GDP_t + \varepsilon_t \quad (4)$$

where Credit Gap is a dependent variable, Central Bank Rate is central bank policy rate, Mapp is macroprudential policy index, Exchange Rate is bilateral exchange rate, inflation is the inflation rate, Growth is economic growth, openness is trade openness, Money per GDP is broad money per GDP, and ε is error disturbance.

In this paper, employs Sami et al. (2020) approach by performing threshold autoregressive (TAR) estimation using a two-regime structural equation model:

$$y_t = \theta_1' x_t + \varepsilon_{1t} \quad if\ q_t \leq \gamma \quad (5)$$

$$y_t = \theta_2' x_t + \varepsilon_{2t} \quad if\ q_t > \gamma \quad (6)$$

Here, q_t is the threshold variable (central bank rate and macroprudential policy index) dividing all the observed values into two regimes. Also, x_t denotes the vector of explanatory variables, while ε_{1t} is the associated error term assumed to be serially uncorrelated and γ as the threshold value. Then, the TAR model will be the following equation:

$$y_t = \theta' x_t + \delta' x_t(\gamma) + \varepsilon_t \quad (7)$$

In this case, $\varepsilon_t \sim iid\ (0, \sigma_t^2), \theta = \theta_2, \delta = \theta_1 - \theta_2, \varepsilon_t = [\varepsilon_{1t}\ \varepsilon_{2t}]'$ and $\theta, \delta\ and\ \gamma$ are the regression parameters to be estimated. The residual sum of squares on the parameters $\theta, \delta\ and\ \gamma$ estimation result is written as follows:

$$S_1(\gamma) = \hat{u}_t(\gamma)' \hat{u}_t(\gamma) \quad (8)$$

The optimum value is written as follows:

$$\hat{\gamma} = arg\ min\ S_1(\gamma) \quad (9)$$

The residual variance is expressed as:

$$\hat{\sigma}^2 = \frac{1}{T}\,\hat{u}_t\,\hat{u}_t = \frac{1}{T}\,S_1(\gamma) \quad (10)$$

In fact, the linear regression in equation (1) is expressed as a non-linear estimation with two-regime TAR estimation. Central bank rate threshold variable is as follow:

$$Credit\ Gap_t = (\alpha_0 + \alpha_{11} Central\ Bank\ Rate_t + \alpha_{21} Mapp_t + \alpha_{31} Exchange\ Rate_t + \alpha_{41} Inflation_t).d[CB\ Rate_t \leq \gamma] + (\alpha_{20} + \alpha_{21} Central\ Bank\ Rate_t + \alpha_{22} Mapp_t + \alpha_{23} Exchange\ Rate_t + \alpha_{24} Inflation_t).d[CB\ Rate_t > \gamma] + \varepsilon_t \quad (11)$$

Macroprudential policy index threshold variable is as follow:

$$Credit\ Gap_t = (\alpha_0 + \alpha_{11} Central\ Bank\ Rate_t + \alpha_{21} Mapp_t + \alpha_{31} Exchange\ Rate_t + \alpha_{41} Inflation_t).d[Mapp_t \leq \gamma] + (\alpha_{20} + \alpha_{21} Central\ Bank\ Rate_t + \alpha_{22} Mapp_t + \alpha_{23} Exchange\ Rate_t + \alpha_{24} Inflation_t).d[Mapp_t > \gamma] + \varepsilon_t \quad (12)$$

The optimal threshold value is obtained by minimizing the residual sum of squares. This paper's objective is to investigate central bank's policy rate and macroprudential policy index threshold level and the monetary and macroprudential policy interaction effect on financial stability in Indonesia. Prior to conducting the non-linear estimation for all models, we first conduct a linearity test to compare a better estimation between the non-linear and the linear estimations.

4. Results

4.1 Descriptive Statistics

Table 1 reveals the descriptive statistics for quarterly data obtained from 1990Q1 to 2020Q4.

Table 1. Descriptive Statistic

Variable	Mean	Std Dev.	Min.	Max.
Credit Gap	-4.0998	14.942	-37.600	13.200
CB Rate	8.1759	3.3702	3.7500	17.620
Mapp	0.1472	0.1263	0.0000	0.3398
Exchange Rate	10,855	2,211.1	7,580.0	16,449
Economic Growth	4.9717	1.9563	-5.3200	7.9564
Inflation	6.0549	3.5249	-0.5957	16.366
Money per GDP	41.954	5.1273	36.001	57.261

Source: Research finding.

Note: This table provides descriptive statistic of all variables considered in this paper.

Table 1 shows the variables used and the minimum value for credit gap was found to be -37.60 while the highest was 13.20. Moreover, the Central Bank policy rate was recorded to have a minimum value of 3.7% and a maximum value of 17.62%. An additional fact was related to the macroprudential policy index with the average value found to be 0.1472 with a maximum of 0.3398 and a minimum of 0.00. Meanwhile, the average of the exchange rate was 10,855 with a maximum of 16,499 and a minimum of 7,580.

It was also discovered that even though the average economic growth achieved by Indonesia was relatively high, in the region of 4.9717%, the maximum value was 7.9564% while the minimum was -5.3200. The average inflation during the study period was 6.0459 with a minimum value of -0.5957 and a maximum of 16.366. Meanwhile, the money per GDP had an average growth rate of 41.954% with the highest ratio recorded to be 57.261% while the lowest was 36.001%.

4.2 Result of Unit Root Tests

The next set of tables summarizes the unit root tests result. The table presents the ADF, PP and KPSS tests statistics of the variables under study considering for with trend but no constant category. The optimal lag length the in the augmented Dickey-Fuller test, has been determined with the Schwarz criterion being the default. Schwarz's criterion has in this case chosen maximum 12 lags to perform the ADF test. All seven variables were found to be stationary at level.

Table 2: Unit Root Tests (Level)

Variable	ADF	PP	KPSS
Credit Gap			
CB Rate	-2.9382**	-2.9115**	0.5464**
Mapp	-2.9206**	-3.1202**	0.5638**
Exchange Rate	-5.9196***	-4.2706***	1.0031***
Economic Growth	-4.0048***	-5.1864***	1.1444***
Inflation	-4.6614***	-3.0871**	0.5398**
Money per GDP	-4.6835***	-5.2710***	0.8390***

Source: Research finding.

Note: symbols *, **, *** denote statistical significance at the 10%, 5% and 1% level.

4.3 Result of Linearity Test

To proof the TAR estimation is better than the linear model, a log-likelihood ratio test was performed. The linearity test result of four models is shown in Table 3.

Table 3: Linearity Test

	L_U	L_R	L_R Statistic	χ^2	Summary
Model 1	-432.31	-468.86	73.10	10.6	Reject null hypothesis
Model 2	-424.64	-457.22	65.2	10.6	Reject null hypothesis
Model 3	-392.73	-404.43	23.4	12.6	Reject null hypothesis
Model 4	-385.79	-403.33	17.5	15.5	Reject null hypothesis

Source: Research finding.

The l_U is obtained from the non-linear model, but the l_R is from the linear. The LR ratio is obtained from log-likelihood ratio test, while the χ^2(df) with 5% significance is from the χ^2 table. In addition, this ratio is higher than χ^2 statistic, therefore the null hypothesis is rejected at the 5% level. The result indicated the threshold regression model was significantly better than the linear model.

4.4 Result of Threshold Regression

In Table 3, regression results are observed using TAR estimation for the independent variables in the credit gap with the central bank policy rate threshold variable. The empirical results indicate that, the central bank policy rate threshold level is 7.3% for Indonesia over the period. This means when the rate is less than or equal 7.3%, it is a low regime, but when above to 7.3%, it is high regime. This implies that any rate above high this policy rate is considered high whereas policy rates below the 7.3% threshold are considered low or lose monetary policy. The central bank policy rate has a negative and significant effect on the credit gap (indicator of financial stability) under tight monetary policy (high rate) stance but has a positive and significant effect under loose monetary policy rate conditions.

Table 3. Estimation of Threshold Regression (Threshold variable is Central Bank Policy Rate)

Variable	Model 1		Model 2		Model 3		Model 4	
	High Regime	**Low Regime**	**High Regime**	**Low Regime**	**High Regime**	**Low Regime**	**High Regime**	**Low Regime**
Central Bank Rate	-2.5973***	1.0223***	-1.5858***	2.3534***	-0.8240***	1.5902***	-1.6825***	0.5791**
	(0.2118)	(0.1008)	(0.2537)	(1.0892)	(0.1812)	(0.8491)	(0.2422)	(0.2766)
Macroprudential Policy	125.69***	60.625***	142.42***	74.631***	73.093***	77.431***	83.926***	77.212***
	(8.9057)	(17.371)	(13.122)	(23.977)	(10.498)	(15.595)	(9.9616)	(14.820)
Exchange Rate	-0.0005**	-0.0015**	-0.0008*	-0.0021**	-0.0021***	-0.0030***	-0.0018***	-0.0030***
	(0.0002)	(0.0006)	(0.0004)	(0.0008)	(0.0004)	(0.0006)	(0.0003)	(0.0006)
Inflation	1.2777***	1.0640***					0.7421***	0.5219***
	(0.1522)	(0.1676)					(0.1568)	(0.0605)
Economic Growth			0.2749	0.1287	1.9223***	0.1285	1.0526***	0.1230
			(0.4836)	(0.3417)	(0.3520)	(0.2235)	(0.3619)	(0.2397)
Money per GDP					-0.9069***	0.5106**	-0.6168***	-0.5078***
					(0.0906)	(0.1649)	(0.1009)	(0.1610)
Threshold Level	7.3000		7.3000		7.3000		7.3000	
R^2	0.9661		0.9329		0.9729		0.9793	

Source: Research finding.

Note: symbols *, **, *** denote statistical significance at the 10%, 5% and 1% level. Standard errors are in parentheses.

The effect of central bank policy rate on the credit gap for the high regime is negative and significant but positive and significant for the low regimes in all models. In addition, the effect of macroprudential policy on the credit gap is positive and significant for both regimes in all models. The effect of exchange rate on the credit gap is negative and significant for both regimes in all models. The effect of inflation on the credit gap is positive and significant for both regimes. The effect of economic growth on the credit gap is positive and significant only for the high regime in models 3, and 4 but it is not significant for the low regime. The effect of money per GDP on the credit gap is negative and significant for both regimes in models 3 and 4. Meanwhile, determination coefficient (R-square) results had a value of between 0.9329 and 0.9793.

In this study, the central bank policy rate has negative effect on the credit gap, meaning tight monetary policy promotes financial stability when central bank interest rate exceeds the threshold. The result implies that an increase of 1% in the policy rate leads to a decrease in the credit gap of around 0.8 to 2.6% for the high regime. This is in line with Venter (2020), Drechsler et al. (2018), Burlon et al. (2018), Smets (2018), Vucinic (2016), Kiss et al. (2016), Blot et al. (2015) and Cocris and Elena (2013). Tighter monetary policy measured as an increase in central bank interest rate leads to an increase of lending rates, which reduces demand for credits both among banking in the wholesale market and retail borrowers (i.e., households and firms). Another channel through which tight monetary policy affects the economy according to Venter (2020) is by weakening economic conditions, which reduces demands for credits by agents.

The result showed that when central bank interest rate is below its threshold, monetary policy increases credit growth. This is relevance with prior studies of Suhendra and Anwar (2021) and Kim and Mehrotra (2018). The reason for the policy rate's positive effect on the credit gap it is a base rate for commercial banks in determining the cost loanable funds. As a result, when the central bank interest rate increases, lead to an increase in the lending or credit rates. Consequently, the bank is triggered to increase the credit supply to achieve it profit maximization objective but must be cognizant of adverse selection that could lead to high default rate.

Macroprudential and monetary policies interaction and its effect on financial stability were also analysed. The macroprudential policy was found to have a positive effect on the credit gap, meaning when there is an increase of 1 percentage point in the policy, there is an increase in the credit gap of around 0.98 to 3.45% for the high regime and approximately 0.96 to 1.32 % for the low. The result showed

macroprudential policy has limited impact on financial stability when the central bank interest rate is high or low. Furthermore, monetary and macroprudential policies' interaction failed to stabilize the financial system, probably because tightening both policies only stabilize one objective due to the appearance of a trade-off between price and financial stability. This is relevance with prior studies, such as Gelain and Ilbas (2017) and Fahr and Fell (2017).

Table 4. Estimation of Threshold Regression (Threshold Variable is Macroprudential Policy Index)

Variable	Model 1		Model 2		Model 3		Model 4	
	High Regime	**Low Regime**	**High Regime**	**Low Regime**	**High Regime**	**Low Regime**	**High Regime**	**Low Regime**
Central Bank Rate	-1.2883***	2.3694***	-1.7713***	1.6999***	-0.1286***	1.8534***	-0.0843***	1.1285***
	(0.4222)	(0.2459)	(0.5885)	(0.1826)	(0.4633)	(0.3551)	(0.0272)	(0.1286)
Macroprudential Policy	-8.2980***	170.80***	-2.5694***	228.03***	-5.6866***	107.90***	-6.3003***	108.51***
	(3.4873)	(11.034)	(0.9124)	(15.102)	(1.7753)	(6.3323)	(2.1437)	(6.3795)
Exchange Rate	0.0002	0.0005	-0.0001	-0.0002	-0.0005	0.0012***	-0.0006	-0.0016***
	(0.0013)	(0.0003)	(0.0006)	(0.0003)	(0.0003)	(0.0002)	(0.0004)	(0.0004)
Inflation	1.0209***	0.8015***					1.1359***	0.5110***
	(0.2249)	(0.2024)					(0.3609)	(0.0997)
Economic Growth			0.2216	-0.9562**	0.3504***	-0.0739	0.4034***	-3.2517***
			(0.2357)	(0.3832)	(0.1210)	(0.2098)	(0.1605)	(0.4050)
Money per GDP					0.1012	-1.1518	0.2099	-0.8786***
					(0.1768)	(0.0670)	(0.2313)	(0.1098)
Threshold Level	0.1450		0.1450		0.1450		0.1450	
R^2	0.9747		0.9628		0.9924		0.9925	

Source: Research finding.

Note: The symbols *, **, *** denote statistical significance at the 10%, 5% and 1% level. Standard errors are in parentheses.

In Table 4, regression results are observed using threshold estimation for the independent variables in the credit gap with the threshold variable of macroprudential policy index. The macroprudential policy threshold level is 0.1450, meaning when the policy index is above 0.1450, it is a high regime, but when less than or equal to 0.1450, it is low. This implies that any macropridential index that exceeds this threshold is a high regime. The TAR estimates indicate that high macroprudential policy index has a negative and significant effect on financial stability and vice versa for low macroprudential policy index.

The effect of central bank policy rate on the credit gap is negative and significant for the high regime but positive and significant for the low regimes in all models. In addition, the effect of macroprudential policy on the credit gap is negative and significant for the high regime but positive and significant for the low regimes in all models. The effect of exchange rate on the credit gap is negative for both regimes in all models, but it is only significant for the low regime in models 3 and 4. The effect of inflation on the credit gap is positive and significant for both regimes. The effect of economic growth on the credit gap is positive for the high regime but a negative for the low regime. The effect of money per GDP on the credit gap is positive for the high regime but negative for low regime. Meanwhile, determination coefficient (R-square) values are between 0.9628 and 0.9925.

Based on the analysis of macroprudential and monetary policies interaction and its effect on financial stability for macroprudential policy index threshold, the central bank policy rate has negative effect on the credit gap, meaning tight monetary policy promotes financial stability when the index exceeds the threshold. This implies an increase of 1% in the policy rate causes decrease in the credit gap of around 0.08 to 1.77% for the high regime. The result showed tight monetary policy when macroprudential policy is high leads to financial stability, thereby supporting the synergy effect of coordination between monetary and financial stability. This also supported previous studies such as Aikman et al., (2020), Jiang et al. (2019), Agur and Demertzis (2019), as well as Klingelhöfer and Sun (2019) that stated that monetary and macroprudential policies' coordination effect fosters financial stability. However, a positive coordination effect was detected when macroprudential policy index was below the threshold, while tight monetary policy increases credit growth when macroprudential policy is loos.

Based on the above results, macroprudential policy has negative effect on the credit gap, meaning tight monetary policy promotes financial stability when macroprudential policy index exceeds the threshold. Furthermore, tightening

macroprudential policy when it is high leads to financial stability. However, the effect of macroprudential policy on credit gap is positive when macroprudential policy below the threshold. This means an increase in the policy causes an increase in the credit gap for the low regime that is in line with the work of Mester (2017), Bruno et al. (2017), and Tillmann (2015).

5. Conclusion

This paper uses the threshold autoregressive estimation approach, a novel strategy to investigate implications of monetary and macroprudential policies interactions on Indonesia's financial stability over the period 1990Q1 to 2020Q4. The results of linearity test suggested the existence of non-linear relationship between the two policy interactions on financial stability. The TAR estimates indicate that central bank rate enhance financial stability when the rate is set below 7.3%, while macroprudential policy index contributes to enhances financial stability below the 0.145% threshold.

In general, the findings suggest that, tight monetary policy promotes financial stability but tight macroprudential policy appears to be counterintuitive. However, when the policy rate and index are below the threshold level, the tightening of both policies reduces financial stability. This finding is in line with Venter (2020), Drechsler et al. (2018), Burlon et al. (2018), Smets (2018), Vucinic (2016), Kiss et al. (2016), Blot et al. (2015), and Cocris and Elena (2013). Moreover, when macroprudential policy index is high, the tightening of both policies promotes financial stability. In contrast, when the index is below the threshold level, tight monetary and macroprudential policies lowers financial stability. This result supported previous studies such as Aikman et al. (2020), Jiang et al. (2019), Agur and Demertzis (2019), as well as Klingelhöfer and Sun (2019). To foster sustained financial stability, there is need for policy coordination between monetary and macroprudential policies within the central bank of Indonesia. It is recommended that, policymakers should first tighten macroprudential policy before adjusting monetary policy to maintain financial stability.

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Cite this article: Anwar, C. J., Zahara, V. M., Ginanjar, R. A. F., Suci, S. C., & Suhendra, I. (2024). Central Bank Innovations and Financial Stability in Indonesia: A Threshold Estimation. *Iranian Economic Review, 28*(1), 111-128.