Effectiveness of macroprudential policies and their interaction with monetary policy in Indonesia

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1. Introduction: macroprudential policy instruments in Indonesia

Indonesia has been using macroprudential policy instruments since 2011. Currently, there are four macroprudential instruments in Indonesia, namely, the maximum loan-to-value (LTV) ratio, the countercyclical capital buffer (CCB), the macroprudential intermediation ratio (MIR) and the macroprudential liquidity buffer (MPLB). However, this study is limited to examining the impact of the MIR and LTV ratio only. We do not take the CCB and MPLB into account for several reasons. First, the CCB is still being implemented with 0% charge of capital, hence we have not yet observed its impact on the banking system. Second, the MPLB was introduced only recently (in 2018), and thus the historical implementation data is insufficient for this research. A detailed explanation of the MIR and LTV ratio, their design, purpose and formula, and their historical reformulation is given in the following subsections.

1.1 Macroprudential intermediation ratio (MIR)

The MIR was implemented with a view to achieving the optimum level of bank intermediation, while maintaining a sufficient level of liquidity and bank prudentialism. It was introduced on 16 July 2018 for conventional banks and on 1 October 2018 for sharia banks. The MIR is actually a reformulation of a previously known macroprudential instrument called the loan-to-deposit ratio-based reserve requirement (LDR-based RR)[2] and later on the loan-to-funding ratio-based reserve requirement (LFR-based RR), which was first implemented in 2011. Therefore, although the MIR was just introduced recently, we have sufficient historical data for the exercise as we use the data for the LDR- and LFR-based RRs for the period before the implementation of the MIR. Despite the evolution of the instrument, the signals it conveys remain the same: it promotes balanced and high-quality intermediation.

The MIR instrument works by Bank Indonesia (BI) setting a certain range for the MIR that has to be met by banks. This specific range, or the intermediation level, is believed to be the optimum level of bank intermediation in the financial system given the macroeconomic and banking conditions and BI's policy to impose countercyclical measures. An additional RR is imposed on banks that are unable to meet the target range. This RR stands as a disincentive for banks that perform outside the MIR target. BI also has the option of setting the parameters of the disincentives. When BI's policy

[1] The views expressed are those of the authors and do not necessarily represent the views of Bank Indonesia, its Board of Governors or management.

[2] For theoretical background on the LDR-based RR, please refer to Satria et al (2015) and Gunadi and Harun (2011).

preference is to reduce risk appetite for banking intermediation, it can set the disincentive parameter higher for MIRs above the upper bound. Since the MIR was implemented, in order to enhance the prudentialism of banks, BI has charged a higher additional RR for banks which exceed the target compared to banks that have an MIR below the lower bound. However, the disincentive for having an MIR exceeding the upper bound is not applied when a bank has a higher capacity to absorb risks shown by sufficient capital; that is, a capital adequacy ratio (CAR) higher than 14%.

The optimum MIR range is regularly adjusted in consideration of macroeconomic and financial system conditions. If the financial system is overheating, BI would lower the MIR upper bound. Conversely, a slowdown in economic and credit growth would be followed by an increase in the MIR lower bound. Thus, any change in the MIR range target is expected to affect credit growth in the financial system. This instrument currently has a greater impact on bank intermediation than the CCB and CAR. This is because the CCB is still not active and most Indonesian banks have a significantly higher CAR than required. This implies that the CCB will not be binding even if it is activated.

In aggregate, the LDR-/LFR-based RR and MIR are achieved by banks. Graph 1 shows that banks in aggregate comply with the BI's intermediation target.

The formulas to calculate the MIR and its additional charge are as follows:

$$MIR = \frac{Loan + Securities\ Owned}{Deposit + Securities\ Issued} \text{ x } 100\%$$

$$\begin{aligned} &Additional\ RR\ for\ banks\ below\ targets \\ &= 0.1 \text{ x } MIR\ shortage \text{ x } third\ party\ fund \end{aligned}$$

$$\begin{aligned} Additional\ RR\ for\ banks &\text{ exceeding } targets \\ &= 0.2 \text{ x } MIR\ excess \text{ x } third\ party\ fund \end{aligned}$$

Table 1 shows how the MIR has been reformulated in the past.

1.2 Loan-to-value (LTV) ratio

The LTV ratio is the maximum ratio of the amount of a mortgage loan provided by a bank to the property price. Any increase in the LTV ratio denotes an easing of this instrument, as banks are allowed to lend a higher portion of the property price in the form of mortgage loans. On the other hand, a decrease in the LTV ratio signals a tightening of this instrument, as the proportion of the property price up to which banks can provide loans decreases.

This instrument was first introduced in Indonesia in June 2012 for conventional banks and in November 2012 for sharia banks, in order to dampen the excessive growth in mortgage loans back in 2011. During 2011, housing mortgage loan growth reached 40%, almost twice as high as overall bank loan growth. Therefore, the tightening of the LTV instrument was also intended to prevent a property market bust that could have materialised as a result of excessive mortgage loan growth. The first LTV measure successfully drove down housing mortgage loan growth. However, in the second half of 2013, mortgage loan growth began to accelerate again. Therefore, BI implemented further tightening in 2013 which was quite effective in slowing loan growth.

Against the backdrop of the slow growth in Indonesia's economy in 2015, the LTV rule was eased to boost the economy by increasing housing demand. This change resulted in a small increase in housing mortgage loans. Unfortunately, it did not have a significant effect on overall loan growth and economic growth. Thus, BI implemented a further relaxation of LTV requirements in 2016. This easing was followed by a slight growth in both housing and apartment loans. However, amidst the uncertainty of global and domestic economic conditions, this relaxation did not lead to the expected outcome of boosting the economy. Recently, BI implemented yet another relaxation of the LTV rule: in this case, banks were allowed to determine their own maximum LTV ratio. This easing helped to maintain the growth of housing and apartment loans. Amidst the economic recovery, this also boosted overall credit growth. Graph 2 shows the evolution of mortgage loan growth in Indonesia over the last eight years.

When implementing the LTV rules, BI differentiates the LTV ratio for different mortgage facilities. The more mortgage facilities owned by a borrower, the lower the maximum LTV ratio for the later facilities. For example, a borrower applying for a second mortgage facility will be subject to a lower maximum LTV ratio compared to the first facility. Furthermore, the third facility will be subject to an even lower maximum LTV ratio. This is set so as to mitigate any speculative motives in property purchases. BI also differentiates the LTV ratio for landed houses, apartments and office houses.[3] Furthermore, the LTV ratio applied to loans for purchasing landed houses and apartments can differ by size of housing unit (under 21m^2 , 22–70m^2, larger than 70m^2), with the smallest type subject to the most relaxed regulation. Finally, as an incentive, BI can apply a higher LTV ratio to banks with good credit risk performance.

The LTV ratio is expected to effectively control lending growth, specifically mortgage credit growth. An easing of the LTV limit is expected to increase credit growth. Conversely, any tightening would presumably result in a decrease of credit growth. We can also confidently say that fluctuations in mortgage lending growth can potentially affect overall lending growth. Although mortgage lending itself only accounts for 10% of overall lending value, market participants manage to capture the signals conveyed through the LTV policy on how the central bank assesses financial stability conditions.

The LTV policy is implemented with the awareness that the changes in the actual LTV ratio also affect credit risk. As an easing on the binding LTV limit means more credit is channelled to the economy, credit risk is also expected to increase. By contrast, a tightening of the maximum LTV ratio, which usually takes place during an economic boom, is expected to reduce credit risk. Therefore, an easing of the LTV policy is usually accompanied by additional regulation regarding the prudential aspect. For example, a bank's non-performing loan (NPL) ratio has to be under a certain level in order for it to enjoy the higher maximum LTV ratio.

[3] A "landed house" refers to any house that is not an apartment. An "office house" is a relatively small office building, which is also used as a home for the owner. Therefore, it is different from an office building.

2. Data and methodology

This paper uses quarterly panel data from 104 individual banks, covering a time period from Q1 2010 to Q1 2018. We look at the impact of BI's macroprudential policy on household credit growth and overall credit risk, which is measured by the NPL ratio.

We follow the empirical models suggested by the BIS protocol, which basically uses the generalised method of moments methodology, to deal with endogeneity issues. We run several models in order to gain a deeper understanding of the difference between the impact of an easing and a tightening of the instruments. Interaction terms are also included to obtain a better picture of how banks' characteristics, such as asset size, liquidity condition, capital condition and funding composition, affect the impact of the policy actions. We also capture the different impact of such policy actions along the different phases of the business cycle/financial cycle and on monetary conditions. Table 2 summarises the indicators we use, their definition and the transformation we apply.

3. Result and analysis

3.1 Macroprudential policy instruments' impact on household lending

In the first model, we try to examine the impact of our macroprudential policy measures on household lending growth. Table 3 shows that under both specifications (with and without the interaction terms), macroprudential policy instruments can control or limit the growth of household loans. When we add the interaction variables, we find that the macroprudential policy instruments have a larger impact on household loan growth than under the specification with no interaction term. However, the interaction term shows that this impact becomes smaller for banks which have larger assets, more substantial liquidity buffers and greater shares of deposits in their liabilities. We believe that banks with larger assets and more substantial liquidity buffers usually perform better in risk management terms. Furthermore, more substantial liquidity buffers and a larger share of deposits in funding also mean that banks have more room for intermediation. Therefore, the impact of our macroprudential policy instruments is lower for these banks. Nevertheless, further analysis can be conducted to track whether this impact is contributed to by the easing or tightening of instruments. Therefore, we run the second model to see the impact of easing and tightening instruments separately.

In Table 4, we find that the impact of tightening macroprudential policy instruments becomes larger in terms of reducing household loan growth after we introduce the interaction term. The tightening impact becomes bigger as banks' assets and share of deposits grow larger. However, the tightening impact becomes smaller for banks with larger liquidity buffers. This confirms the previous finding which implies that banks with ample liquidity buffers tend to have more room for intermediation, even in a tightening scenario. The coefficient on the dummy variable for easing macroprudential policy instruments is negative, which marks an increase in

loan growth.[4] However, the impact becomes insignificant as we introduce the interaction terms. The loosening impact again becomes significant and larger only for banks with ample liquidity buffers. Looking at these relatable findings, we can conclude that banks with better liquidity conditions have more room for intermediation and thus their lending growth either decreases less in response to tightening actions or increases more in response to easing actions than lending by banks with worse liquidity conditions does.

As policy mix is a pivotal part of central banks' decision-making, we look at the impact of macroprudential policy instruments with regard to the monetary stance. Table 5 shows that without the interaction term, the real policy rate has a negative and statistically significant effect on the growth of household loans, which is an expected result. However, the introduction of the interaction term of the change in macroprudential policy instruments and the real policy rate absorbs the effect and makes the coefficient on the real policy rate statistically insignificant. The impact of the macroprudential instrument alone is also weakened after the introduction of the interaction term, although it is still significant. The positive coefficient on the interaction term shows that when both monetary and macroprudential policies move in the same direction, they tend to increase household loan growth more than when these policies move in opposite directions. If we relate this result from using the interaction term to the results without the interaction term – ie that the tighter policy stance alone and the tightening macroprudential instruments alone significantly decrease household loan growth – we can confirm that our macroprudential policy measures and the monetary policy stance usually move in the same direction and thus reduce the decreasing impact of each policy. Moreover, our statistically significant and positive coefficient on the interaction term is likely to be driven by the periods when the monetary policy stance is loose *and* a macroprudential instrument is eased, not by the periods when monetary policy stance is tight *and* a macroprudential instrument is tightened.

We also investigate whether the implementation of our macroprudential policies in different phases of the business cycle and financial cycle will result in different impacts. In Table 6, we find that the impact of the business cycle becomes insignificant when we introduce an interaction term between the business cycle and macroprudential policy measures. The positive coefficient of this interaction term means that the effect of tightening (or easing) macroprudential measures on dampening (or stimulating) loan growth is weaker when real GDP growth is high. However, we see that the impact of macroprudential policy instruments becomes larger in reducing loan growth after we introduce the interaction term. Hence, we can conclude that tightening (or easing) macroprudential instruments is usually more effective in slowing down (or accelerating) household loan growth when real GDP growth is low. This implies that policymakers need to deploy macroprudential policy measures more actively when real GDP growth is high or more proactively before real GDP growth becomes too high.

Regarding the financial cycle, both specifications in Table 7 show no significant impact of the financial cycle on household lending growth. However, the impact of macroprudential policy instruments becomes insignificant after we introduce the interaction term. The negative coefficient of this interaction term means that the

[4] The easing index takes the value of −1 if monetary policy was eased during that quarter. A negative coefficient here implies an increase in credit growth.

effect of tightening (or easing) macroprudential measures on dampening (or stimulating) loan growth is stronger when the credit-to-GDP gap is large (ie during the financial cycle boom). In addition, we can infer that the negative sign of the interaction term captures the majority of the impact of macroprudential measures.

3.2 Macroprudential policy instruments' impact on credit risk

In relation to credit risk, we find that under both specifications (with or without the interaction term), the implementation of macroprudential policy instruments effectively reduces the NPL ratio (Table 8). This impact is even larger for banks with larger assets and a larger share of deposits in their liabilities. One possible reason for these banks to have a larger reduction in the NPL ratio is that larger banks usually have better risk mitigation and thus can fulfil the regulation more strictly. Consequently, they show larger reductions in credit risk.

In the model which differentiates between the tightening and easing instruments, we find a relevant outcome for tightening actions in the specification without an interaction term (Table 9). Tightening macroprudential instruments reduces the NPL ratio. Banks with higher regulatory capital, more substantial liquidity buffers, larger assets and a larger share of deposits in their liabilities tend to experience reductions in the NPL ratio. In both models, easing macroprudential instruments alone does not have a significant impact on the NPL ratio. Only banks with better liquidity conditions experience an increase in the NPL ratio. This may hold true as these banks have a higher chance of adopting risk-taking behaviour, due to their larger liquidity buffers.

In relation to monetary policy stance (Table 10), when we do not consider the interaction term, the tighter (or easier) monetary policy stance increases (or decreases) the NPL ratio, while a tightening (or easing) of the macroprudential measures lowers (or increases) the NPL ratio. When we consider the interaction term, the term has a positive and significant coefficient. This means that when both policies move in the same direction (either both tightening or both easing), the NPL ratio will increase. However, in the specification which includes the interaction term, the positive impact of monetary policy stance on the NPL ratio is reduced and insignificant. It implies that when the macroprudential policy instrument moves in the opposite direction to the monetary policy rate, the NPL ratio can be reduced.

The impact of the macroprudential policy instrument and the business cycle is larger in decreasing household loan growth when we include the interaction term (Table 11). The interpretation is similar to the findings from the household loan growth regressions. The positive and significant coefficient of this interaction term means that the impact of tightening (or easing) macroprudential measures on reducing (or increasing) the NPL ratio is smaller when real GDP growth is high. Similar findings can be derived in the model which includes the interaction of the macroprudential policy instrument and the financial cycle (Table 12). In particular, the positive and significant coefficient of this interaction term means that the impact of tightening (or easing) macroprudential measures on reducing (or increasing) the NPL ratio is smaller when the credit-to-GDP gap is high.

References

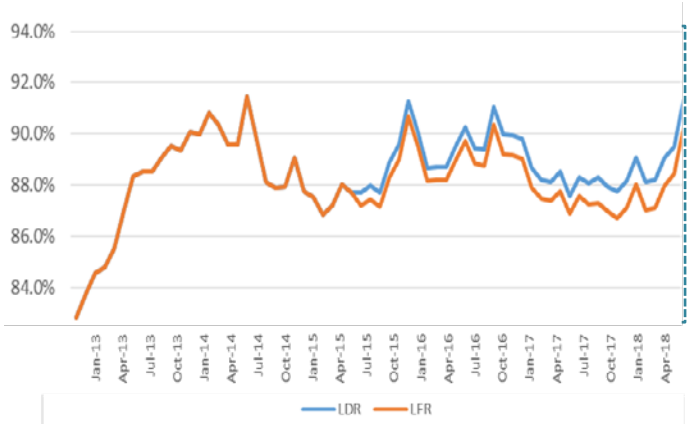
Gunadi, I and C Harun (2011): "Revitalising reserve requirement in banking model: an industrial organisation approach", *SEACEN Occasional Papers*, no 51, January.

Satria, D, C Harun and A Taruna (2015): "The macro-prudential aspects of loan-to-deposit-ratio-linked reserve requirement", *Applied Economics*, vol 48, issue 1, August.

Annex: Graphs and tables

LDR and LFR

Graph 1

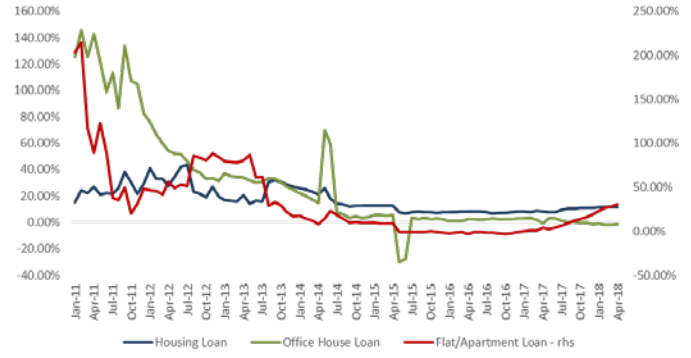


The graph shows that the aggregate level of LDR and LFR is within the target range.

Source: Monthly Bank Report to Bank Indonesia.

Mortgage loan growth

Graph 2



The graph shows the growth rate of each type of mortgage loans, which are housing loans, flat/apartment loans and office house loans.

Source: Monthly Bank Report to Bank Indonesia.

Historical change in loan to deposit-based reserve requirement, loan to funding-based reserve requirement and macroprudential intermediation ratio Table 1

Date	Instrument	Formula	Tightening (T) / Easing (E)	LDR/LFR/MIR target	Rationale for reformulation
Mar 2011	LDR-based RR	$\frac{Loan}{Deposit} \text{x } 100\%$	T	78–100%	-
Dec 2013	LDR-based RR		T	78–92%	Upper target lowered to limit credit growth in 2013.
Aug 2015	LFR-based RR	$\frac{Loan}{Deposit+Securities\ Issued} \text{x } 100\%$	E	78–92%	To boost slow credit growth, BI expands banks' source of funding. Thus, LDR is reformulated into the LFR, which includes both deposits and securities issuance as sources of funding. For banks with NPL ratio < 5%, the range is set at 78–94%.
Aug 2016	LFR-based RR		E	80–92%	BI aims to boost credit growth by increasing the lower bound of the LFR band to 80%.
Jul 2018	MIR	$\frac{Loan + Securities\ Owned}{Deposit + Securities\ Issued} \text{x} 100\%$	E	80–92%	BI includes securities owned (issued by non-financial corporations) as the numerator, to take into account a broader type of bank intermediation.

List of indicators Table 2

Variables	Explanation	Transformation
Dependent variables		
Household loan	Covers all unproductive loans, including mortgage loans, automotive loans, and uncollateralised loans.	Dlog
Credit risk (%)	Overall credit risk, calculated as the ratio of non-performing loans to total loans.	Logit function ln[NPL ratio/(1-NPL ratio)].
Independent variables		
Policy variables		
Dummy for macroprudential policy measures	1 denotes a tightening in policy; −1 an easing; and 0 no change.	
Dummy for tightening macroprudential policy measures	1 denotes a tightening in policy; and 0 otherwise.	
Dummy for easing macroprudential policy measures	−1 denotes an easing in policy; and 0 otherwise.	
Monetary policy condition	The real policy rate is calculated by dividing the BI Rate by the inflation rate.	delta
Bank characteristics variables		
Total assets	A bank's total assets	Log
Liquidity ratio (%)	The ratio of high-quality liquid assets (HQLA) to total assets. HQLA is measured using the definition of the liquidity coverage ratio.	-
Capital ratio (%)	Ratio of total bank capital to risk-weighted assets.	-
Deposits to total liabilities ratio (%)	Ratio of third-party funds to total liabilities. Measures banks' funding composition.	-
Macroeconomic control variables		
Real GDP	Calculated as the growth rate of constant price GDP.	Dlog
Policy rate (%)	BI Rate.	delta
REER	Real effective exchange rate data from the BIS, seasonally adjusted.	delta
Financial cycle	Gap of the credit-to-GDP ratio to its long-term trend. The trend is calculated using an HP filter.	-
Business cycle	Measured with the sequence of real GDP growth.	dlog

Impact of macroprudential policy instruments on household loan growth		Table 3
Variables	No interaction term	With interaction terms
Δln(Loans) (sum of k lags)	–0.238***	–0.225***
ΔMaP (sum of contemporaneous and k lags) Dummy: −1,0,+1	–0.005***	–0.094***
ΔMaP x ln(Total assets, t-1) (sum of contemporaneous and four lags)		0.562***
ΔMaP x Liquidity ratio(t-1) (sum of contemporaneous and four lags)		2.792***
ΔMaP x Capital ratio(t-1) (sum of contemporaneous and four lags)		–0.605***
ΔMaP x Deposits to total liabilities ratio(t-1) (sum of contemporaneous and four lags)		0.475**
Δln(Real GDP) (t)	0.414***	6.005***
ΔPolicy rate (t)	–0.639***	–2.806***
ΔReal effective exchange rate (t)	0.203***	0.040
ln(Total assets) (t-1)	–0.068***	–0.190***
Liquidity ratio (t-1)	0.049***	0.103***
Capital ratio (t-1)	0.045***	0.126***
Deposits to total liabilities ratio (t-1)	0.009***	0.085***
Number of banks	103	103
Observations	2,948	2,948
Serial correlation test	0.8351	0.1489
Hansen test	0.3849	0.075
Notes: (**) and (***) indicate statistically significant at 5% and 1% levels, respectively.		

Impact of tightening and easing macroprudential policy instruments on household loan growth

Table 4

Variables	No interaction term	With interaction terms
Δln(Loans) (sum of k lags)	–0.069***	0.256***
ΔMaP_easing (sum of contemporaneous and k lags) Dummy: −1,0	–0.232***	–0.060
ΔMaP_tightening (sum of contemporaneous and k lags) Dummy: +1,0	–0.049***	–0.190**
ΔMaP_easing x ln(Total assets, t-1) (sum of contemporaneous and k lags)		–0.781
ΔMaP_easing x Liquidity ratio(t-1) (sum of contemporaneous and k lags)		–5.192***
ΔMaP_easing x Capital ratio(t-1) (sum of contemporaneous and k lags)		2.133***
ΔMaP_easing x Deposits to total liabilities ratio(t-1) (sum of contemporaneous and k lags)		–0.720
ΔMaP_tightening x ln(Total assets, t-1) (sum of contemporaneous and k lags)		–0.286*
ΔMaP_tightening x Liquidity ratio(t-1) (sum of contemporaneous and k lags)		2.385***
ΔMaP_tightening x Capital ratio(t-1) (sum of contemporaneous and k lags)		0.308
ΔMaP_tightening x Deposits to total liabilities ratio(t-1) (sum of contemporaneous and k lags)		–1.919***
Δln(Real GDP) (t)	10.896***	3.024
ΔPolicy rate (t)	–0.452*	3.151
ΔReal effective exchange rate (t)	0.051**	0.190
ln(Total assets) (t-1)	–0.215***	–0.159***
Liquidity ratio (t-1)	0.106***	–1.209***
Capital ratio (t-1)	0.326***	0.032
Deposits to total liabilities ratio (t-1)	0.030*	0.185***
Number of banks	99	99
Observations	2,628	2,628
Serial correlation test	0.803	0.920
Hansen test	0.122	0.146

Notes: (*), (**) and (***) indicate statistically significant at 10%, 5% and 1% levels, respectively.

Impact of macroprudential policy instruments on household loan growth with regard to monetary policy stance

Table 5

Variables	No interaction term	With interaction terms
Δln(Loans) (sum of k lags)	–1.095***	–0.802***
ΔMaP (sum of contemporaneous and k lags) Dummy: −1,0,+1	–0.059***	–0.030**
r (sum of contemporaneous and k lags)	–0.029***	–0.058
ΔMaP x *r* (sum of contemporaneous and k lags)		0.057**
Δln(Real GDP) (t)	4.814***	6.086**
ΔPolicy rate (t)	–0.009***	–0.022***
ΔReal effective exchange rate (t)	0.146***	–0.088
ln(Total assets) (t-1)	–0.111***	–0.084***
Liquidity ratio (t-1)	–0.017	–0.027
Capital ratio (t-1)	0.306***	0.151**
Deposits to total liabilities ratio (t-1)	0.017	0.016***
Time period	Q2 2010–Q1 2018	Q2 2010–Q1 2018
Number of banks	99	99
Observations	2,627	2,627
Serial correlation test	0.753	0.323
Hansen test	0.162	0.104

r: real policy rate as a proxy for monetary policy stance.

Notes: (**) and (***) indicate statistically significant at 5% and 1% levels, respectively.

Impact of macroprudential policy instruments on household loan growth with regard to different phases of the business cycle

Table 6

Variables	No interaction term	With interaction terms
ΔIn(Loans) (sum of k lags)	–0.323***	–0.311***
ΔMaP (sum of contemporaneous and k lags) Dummy: −1,0,+1	–0.004**	–0.091***
ΔIn(GDP) (sum of contemporaneous and k lags)	3.858***	0.985
ΔMaP x ΔIn(GDP) (sum of contemporaneous and k lags)		6.868***
ΔIn(Real GDP) (t)	3.249***	3.196***
ΔPolicy rate (t)	–0.182**	–0.193
ΔReal effective exchange rate (t)	0.139***	0.123***
In(Total assets) (t-1)	–0.050***	–0.060***
Liquidity ratio (t-1)	–0.007	–0.009
Capital ratio (t-1)	0.083***	0.085***
Deposits to total liabilities ratio (t-1)	0.009***	0.011***
Time period	Q2 2010–Q1 2018	Q2 2010–Q1 2018
Number of banks	99	99
Observations	2,825	2,825
Serial correlation test	0.113	0.296
Hansen test	0.285	0.302

Notes: (**) and (***) indicate statistically significant at 5% and 1% levels, respectively.

Impact of macroprudential policy instruments on household loan growth with regard to different phases of the financial cycle

Table 7

Variables	No interaction term	With interaction terms
ΔIn(Loans) (sum of k lags)	–0.622***	–0.988***
ΔMaP (sum of contemporaneous and k lags) Dummy: −1,0,+1	–0.016***	0.004
CreditGap (sum of contemporaneous and k lags)	0.001	0.001
ΔMaP x CreditGap (sum of contemporaneous and k lags)		–0.013***
ΔIn(Real GDP) (t)	0.879	2.318***
ΔPolicy rate (t)	0.411	0.222
ΔReal effective exchange rate (t)	0.036	0.011
In(Total assets) (t-1)	–0.080***	–0.094***
Liquidity ratio (t-1)	–0.013	–0.003
Capital ratio (t-1)	0.215***	0.339***
Deposits to total liabilities ratio (t-1)	0.018***	0.021***
Time period	Q2 2010–Q1 2018	Q2 2010–Q1 2018
Number of banks	99	99
Observations	2,726	2,726
Serial correlation test	0.595	0.642
Hansen test	0.173	0.340

Notes: (***) indicate statistically significant at 1% level.

Impact of macroprudential policy instruments on credit risk — Table 8

Variables	No interaction term	With interaction terms
NPL (sum of k lags)	0.765***	0.740***
ΔMaP (sum of contemporaneous and k lags) Dummy: −1,0,+1	–0.062***	–0.055***
ΔMaP x ln(Total assets, t-1) (sum of contemporaneous and k lags)		–0.169***
ΔMaP x Liquidity ratio(t-1) (sum of contemporaneous and k lags)		–0.454
ΔMaP x Capital ratio(t-1) (sum of contemporaneous and k lags)		0.127
ΔMaP x Deposits to total liabilities ratio(t-1) (sum of contemporaneous and k lags)		–2.189***
Δln(Real GDP) (t)	–3.149	–2.139
ΔPolicy rate (t)	–0.619	–0.937
ΔReal effective exchange rate (t)	0.283	0.337***
ln(Total assets) (t-1)	0.194***	0.282***
Liquidity ratio (t-1)	–0.142	0.076
Capital ratio (t-1)	0.436***	0.366**
Deposits to total liabilities ratio (t-1)	–0.031	–0.125**
Time period	Q2 2010–Q1 2018	Q2 2010–Q1 2018
Number of banks	101	101
Observations	2,931	2,931
Serial correlation test	0.210	0.935
Hansen test	0.087	0.260

Notes: (**) and (***) indicate statistically significant at 5% and 1% levels, respectively.

Impact of tightening and easing macroprudential policy instruments on credit risk

Table 9

Variables	No interaction term	With interaction terms
NPL (sum of k lags)	0.874***	0.626***
ΔMaP_easing (sum of contemporaneous and k lags) Dummy: −1,0	0.023	0.166
ΔMaP_tightening (sum of contemporaneous and k lags) Dummy: +1,0	–0.138***	–0.034*
ΔMaP_easing x ln(Total assets, t-1) (sum of contemporaneous and k lags)		0.061
ΔMaP_easing x Liquidity ratio(t-1) (sum of contemporaneous and k lags)		5.469***
ΔMaP_easing x Capital ratio(t-1) (sum of contemporaneous and k lags)		0.043
ΔMaP_easing x Deposits to total liabilities ratio (t-1) (sum of contemporaneous and k lags)		1.026
ΔMaP_tightening x ln(Total assets, t-1) (sum of contemporaneous and k lags)		0.439***
ΔMaP_tightening x Liquidity ratio(t-1) (sum of contemporaneous and k lags)		4.239***
ΔMaP_tightening x Capital ratio(t-1) (sum of contemporaneous and k lags)		1.313***
ΔMaP_tightening x Deposits to total liabilities ratio(t-1) (sum of contemporaneous and k lags)		1.359***
Δln(Real GDP) (t)	–13.997***	–2.563
ΔPolicy rate (t)	–1.926	–2.772
ΔReal effective exchange rate (t)	0.514**	0.344**
ln(Total assets) (t-1)	0.131***	0.162***
Liquidity ratio (t-1)	–0.218	–0.576***
Capital ratio (t-1)	0.360**	0.367**
Deposits to total liabilities ratio (t-1)	–0.001	–0.266***
Number of banks	101	98
Observations	2,932	2,914
Serial correlation test	0.8698	0.9999
Hansen test	0.1310	0.2106

Notes: (*), (**) and (***) indicate statistically significant at 10%, 5% and 1% levels, respectively.

Impact of macroprudential policy instruments on credit risk with regard to monetary policy stance

Table 10

Variables	No interaction term	With interaction terms
ΔMaP (sum of contemporaneous and k lags) Dummy: −1,0,+1	–0.069***	–0.097***
r (sum of contemporaneous and k lags)	0.091***	0.057
ΔMaP x *r* (sum of contemporaneous and k lags)		0.119***
Δln(Real GDP) (t)	–12.096***	–11.731***
ΔPolicy rate (t)	0.012	0.041**
ΔReal effective exchange rate (t)	–0.037	0.020
ln(Total assets) (t-1)	0.121***	0.123***
Liquidity ratio (t-1)	–0.069	–0.012
Capital ratio (t-1)	0.490***	0.496***
Deposits to total liabilities ratio (t-1)	–0.026	–0.009
Time period	Q2 2010–Q1 2018	Q2 2010–Q1 2018
Number of banks	98	98
Observations	2,724	2,724
Serial correlation test	0.910	0.859
Hansen test	0.229	0.254

Notes: (**) and (***) indicate statistically significant at 5% and 1% levels, respectively.

Impact of macroprudential policy instruments on credit risk with regard to different phases of the business cycle

Table 11

Variables	No interaction term	With interaction terms
NPL (sum of k lags)	0.847***	0.841***
ΔMaP (sum of contemporaneous and k lags) Dummy: −1,0,+1	–0.037**	–0.277**
Δln(GDP) (sum of contemporaneous and k lags)	–12.553*	–13.930*
ΔMaP x Δln(GDP) (sum of contemporaneous and k lags)		18.051*
Δln(Real GDP) (t)	–13.451***	–14.609***
ΔPolicy rate (t)	–2.694**	–1.185
ΔReal effective exchange rate (t)	0.282**	0.449***
ln(Total assets) (t-1)	0.075***	0.072***
Liquidity ratio (t-1)	–0.095	–0.058
Capital ratio (t-1)	0.416***	0.459***
Deposits to total liabilities ratio (t-1)	0.001	0.002
Time period	Q2 2010–Q1 2018	Q2 2010–Q1 2018
Number of banks	98	98
Observations	2,724	2,724
Serial correlation test	0.951	0.960
Hansen test	0.264	0.296

Notes: (*), (**) and (***) indicate statistically significant at 10%, 5% and 1% levels, respectively.

Impact of macroprudential policy instruments on credit risk with regard to different phases of the financial cycle

Table 12

Variables	No interaction term	With interaction terms
NPL (sum of k lags)	0.241***	0.222***
ΔMaP (sum of contemporaneous and k lags) Dummy: −1,0,+1	–0.051***	–0.118***
CreditGap (sum of contemporaneous and k lags)	–0.097***	–0.104***
ΔMaP x CreditGap (sum of contemporaneous and k lags)		0.029***
Δln(Real GDP) (t)	–1.919	–0.605
ΔPolicy rate (t)	1.062	–0.680
ΔReal effective exchange rate (t)	–0.189*	0.124
ln(Total assets) (t-1)	–0.098**	–0.064
Liquidity ratio (t-1)	–0.054	–0.064
Capital ratio (t-1)	0.401***	0.394***
Deposits to total liabilities ratio (t-1)	0.079**	0.074**
Time period	Q1 2010–Q1 2018	Q1 2010–Q1 2018
Number of banks	98	98
Observations	2,917	2,917
Serial correlation test	0.105	0.128
Hansen test	0.229	0.267

Notes: (*), (**) and (***) indicate statistically significant at 10%, 5% and 1% levels, respectively.