Doctoral Dissertation

Banking Crises, Macroprudential Policies and Financial Inclusion

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“Train your mind to be calm in every situation. Everything comes to you at the right time. Be patient.”

(Anonymous)

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Chapter 1: Introduction

The Global Financial Crisis during 2007-2008 has brought about the discussion on the resilience of the international financial system and the roles of financial regulatory and supervisory frameworks, especially, macroprudential policies, in mitigating accumulation of financial vulnerabilities and safeguarding financial stability. Although there is no formally agreed on the definition, the adoption of macroprudential policy is to reduce the accumulation of financial imbalance and systemic risk and their consequence on the real economy. Crockett (2000) states that the objective of macroprudential policies (MPs) can be defined as limiting the costs to the economy of financial distress, including limiting the likelihood of the failure, and the corresponding costs to significant portions of the financial system, which is often loosely referred to as limiting "systemic risk". Systemic risk can be understood as market failure in the financial system or financial crises (Butzbach, 2016). There are many types of financial crisis including banking crises, currency crises, debt crises and inflation crises. However, the accumulation of financial vulnerabilities which generally associated with excessive credit expansion in economy lead to occurrence of a banking crisis (Borio & Lowe, 2002, 2004; Borio & Drehmann, 2009; Babecký et al., 2014, Caprio et al., 2014, Hasanov & Bhattacharya, 2018).

Banking crises often impose enormous negative effects on economic and financial system. Some study show that a banking crisis have a negative effect on output or growth (Demirguc-Kun et al., 2006; Dell'Ariccia et al., 2008; Furceri & Zdzienicka, 2012; Fernandez et al., 2013). However, the existing literature has not fully addressed how financial conditions alter the impact of a banking crisis. Thus, we try to fill this gap by examine the effects of a banking crisis on the credit growth in developing countries in Chapter 2 of this dissertation. Our empirical findings indicate that banking crises during financial boom decrease credit growth more substantial than that during financial slump and the effects of banking crisis are

magnified for the countries with the high level of financial development than the countries with low level of financial development.

Many studies demonstrate that MP is effective in limiting the level of financial indicators associated with financial failure, such as credit growth and housing prices (Alam et al., 2019; Olszak et al., 2018; Cerutti et al., 2017; Fendoğlu, 2017). Credit and asset price booms, however, are not the only driving forces that increase systemic risk and induce banking crises. In the literature, there is very limited evidence on the effect of MP on various factors, such as the externalities generated from the strategy of financial institutions, which are crucial in intensifying systemic risk. One possible reason that these factors are abstract in the literature is the difficulty in measuring them accurately. In contrast to previous studies, our study attempts to evaluate the MP role in limiting systemic risk in the financial system by taking the occurrences of banking crises as the proxy for systemic risk. The results of the empirical findings show that, in addition to the overall MP measured in aggregate, borrower-targeted MP instruments are negatively associated with the likelihood of a banking crisis. The finding also reveals that several specific objective-oriented MP instruments, such as capital, loan supply, and loan related macroprudential policy, also have a significant negative relationship with the likelihood of a banking crisis.

Though, the adoption of macroprudential policy would help achieve financial stability, it may also bring the cost in term of reducing the level of financial inclusion. Nonetheless, the literature on the relationship between MPs and financial inclusion is limited. To contribute to the existing literature, we attempt to examine the relationship between the adoption of MP instruments on financial inclusion in Chapter 4. Our empirical results suggest that the adoption of macroprudential policy cause negative consequence on financial inclusion, particularly the use of financial service in developing countries. We find the adverse effects are asymmetric in developed and developing countries. The dissertation is organized as follow. Chapter 2

provides some insightful finding on the effects of a banking crisis on some macroeconomic conditions i.e., “the effects of a banking crisis on the credit growth in developing countries”. Chapter 3 presents the analysis on the benefit of macroprudential policy titled “Macroprudential policy and banking crises: Targeting borrowers or financial institutions?”. Chapter 4 discusses the cost of the adoption of macroprudential policy i.e., “Macroprudential policy and financial inclusion: Any difference between developed and developing countries?”. The last Chapter provides some conclusions.

Chapter 2: Effects of a banking crisis on credit growth in developing countries

2.1 Introduction

Banking crises often impose tremendous economic costs on the financial system as a whole, one of which is the shrinking of credit. Most related studies have focused on the effect of a banking crisis on output or growth (Demirguc-Kun et al., 2006; Dell'Ariccia et al., 2008; Furceri & Zdzienicka, 2012; Fernandez et al., 2013), but its impact on credit growth has not been examined extensively.[1] Furthermore, while financial conditions such as financial cycles and financial development are highly related to a banking crisis, the existing literature has not fully addressed how financial conditions alter the impact of a banking crisis.[2]

This study empirically examines how a banking crisis affects credit growth while controlling for financial cycles and financial development. For this purpose, we estimate the dynamic effect of a banking crisis on credit growth by using the local projection (LP) method of Jordà (2005). This empirical method is flexible in estimating state-dependence impulse responses and allows us to examine how states of financial conditions alter the effects of banking crises. We are particularly interested in developing countries, as financial development is more relevant to developing countries than developed countries. Financial

[1] An exception may be Demirguc-Kun et al. (2006), which examines the crisis effects on various macroeconomic variables, including output and credit growth. However, their study does not consider how the effects rely on financial conditions, such as financial cycles and financial development, in developing countries.

[2] Although several studies such as Babecký et al. (2014) suggest that banking crises occur during financial booms, a significant portion of banking crises have occurred even during financial slumps. In our dataset, approximately 38% of banking crises occurred during financial slumps. In addition, some studies such as Mathonnat and Minea (2018) and Naceur et al. (2019) have emphasized that financial development is closely associated with banking crises. These arguments demonstrate the possible important roles of financial cycles and financial development in the discussion of the crisis effects.

development is an important policy agenda in developing countries, while developed countries generally have a mature financial system with a relatively high level of financial development.

Our empirical analysis finds that the banking crisis has an adverse impact on credit growth, and this negative effect depends on financial conditions. We demonstrate that the negative effect of a banking crisis during a financial boom is more substantial than that during a financial slump. We also find that the negative effect of a banking crisis is more substantial for countries with a high level of financial development than for those with a low level of financial development. Several sensitivity analyses confirm the empirical validity of our findings.

2.2 Methodology and data

To examine the dynamic effects of a banking crisis on credit growth, this study employs the LP method proposed by Jordà (2005) with panel data of 109 developing countries during 1993–2017.[3] As the LP method is flexible and can easily be extended to estimate state-dependent effects, it is suitable for our analysis. This study uses financial cycles and financial development as the state variables of financial conditions. First, we estimate the following baseline model:

$$Y_{i,t+h} - Y_{i,t} = \beta^h Shock_{i,t+1} + \theta^h X_{i,t} + \lambda_i^h + \delta_t^h + \varepsilon_{i,t}^h, \quad (1)$$

where $Y_{i,t}$ is the log of credits to the private sector in country i in period t; $Shock_{i,t}$ is a banking crisis dummy assumed to be exogenous,[4] $X_{i,t}$ is the set of control variables, including

[3] The LP method has been a popular tool in applied macroeconomic research. Starting with Jordà (2005), this method has been used by researchers as an alternative to other time series methods such as vector autoregressive (VAR) models. The LP method is more robust to omitted variables and misspecification and easily handles nonlinearity. As discussed by Auerbach and Gorodnichenko (2012) and Jordà (2005), the LP technique can easily adapt non-linearly and thus estimate state-dependent models and compute impulse response functions. Moreover, the method does not constrain the shape of the impulse response function, so it is less sensitive to misspecification of the standard VAR models.

[4] In the robustness check, we also check the sensitivity of our finding by estimating a model treating a banking crisis as nonrandom.

lags of the dependent variable, output gap, log of real GDP per capita, and inflation; λ_i^h captures the country fixed effects; δ_t^h captures time fixed effects; and $\varepsilon_{i,t}^h$ is the disturbance term with zero mean and constant variance. We estimate Equation (1) for each horizon h = 1, 2, …, 5. We follow the common practice of using the medium-term 5-year horizon, where h =1 is the year of the shock. Impulse response functions are computed using the estimated coefficients β^h, and the confidence bands associated with the estimated impulse response functions are obtained using the estimated standard errors of the coefficients β^h.

We extend our analysis to investigate whether the responses of credit growth to the banking crisis depend on financial cycles and financial development. First, we introduce a dummy variable that indicates the state of financial cycles (boom versus slump) and financial development (high versus low). Specifically, we estimate the following nonlinear equation:

$$Y_{i,t+h} - Y_{i,t} = \beta_a^h I_{i,t} Shock_{i,t+1} + \beta_b^h (1 - I_{i,t}) Shock_{i,t+1} + \theta^h X_{i,t} + \lambda_i^h + \delta_t^h + \varepsilon_{i,t}^h, \qquad (2)$$

where $I_{i,t}$ is a dummy variable that captures the state of financial cycles or financial development. The dummy variable takes a value of 1 if the status of the country is a financial boom or a high level of financial development, and 0 otherwise. We use credit gap, measured by the cyclical component of credit, to capture the state of financial cycles. If the credit gap is above (below) 0, the state of the country is classified as being in a financial boom (slump).[5] To capture the state of financial development, we use the Financial Development Index constructed by Sahay et al. (2015). If the index is above (below) the mean, the state of the country is classified as being in a high (low) level of financial development.

We then examine how the two states of financial cycles and financial development alter the effect of a banking crisis on credit growth. We consider the following specification:

[5] There are several types of financial cycles (Borio, 2014; Strohsal, 2019). The cyclical component of credit is derived from the Hodrick-Prescott (HP) filter of the log of credit in a real term and is normalized to have zero mean and unit variance.

$$Y_{i,t+h} - Y_{i,t} = I_{i,t}^{FC}[\beta_a^h I_{i,t}^{FD} Shock_{i,t+1} + \beta_b^h (1 - I_{i,t}^{FD}) Shock_{i,t+1}] + (1 - I_{i,t}^{FC})[\beta_A^h I_{i,t}^{FD} Shock_{i,t+1} + \beta_B^h (1 - I_{i,t}^{FD}) Shock_{i,t+1}] + \theta^h X_{i,t} + \lambda_i^h + \delta_t^h + \varepsilon_{i,t}^h, \quad (3)$$

where $I_{i,t}^{FC}$ and $I_{i,t}^{FD}$ are dummy variables that take values of 1 if the status of the country is in a financial boom and a high level of financial development, respectively.

We use panel data from 109 developing countries from 1993 to 2017.[6] The World Bank country classification is used to identify developing countries. In this study, data on credit growth, our dependent variable, are taken from the World Bank's Global Financial Development Database.[7] This study uses the binary index of banking crises constructed by Laeven and Valencia (2018). We choose this database because it is updated and covers a broader sample of countries and periods. The Financial Development Index is taken from the Financial Development Index Database of the International Monetary Fund (IMF) (Sahay et al., 2015). It captures broad aspects of the development of financial institutions and financial markets—depth, access, and efficiency. Data on the control variables used in this study are taken from various sources.

[6] Although this study focuses on developing countries, we also estimate the models for developed countries for reference. We use panel data of 55 developed countries.

[7] We also employ IMF economies groupings to classify developed and developing countries in the robustness check.

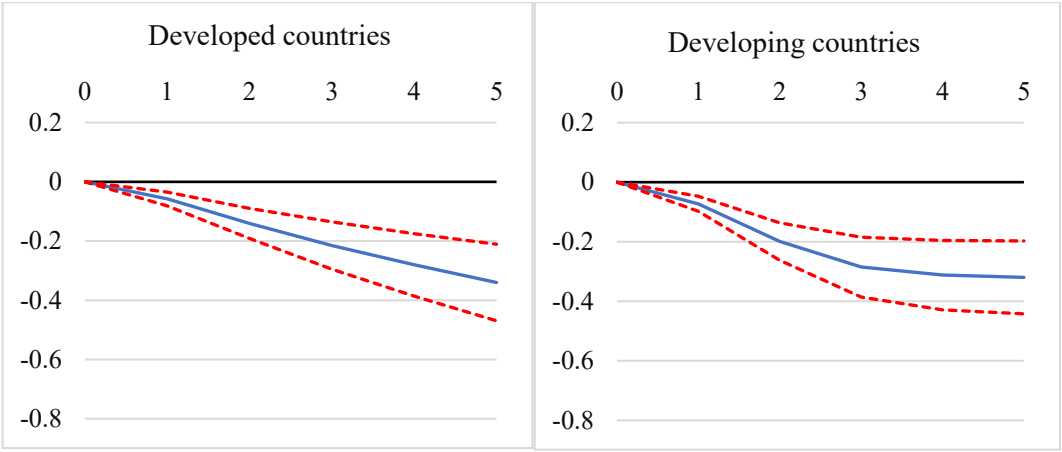
Table 2-A1. Data description and sources of variables

Variable	Definition	Source
Credit	Private credit by deposit money banks	World Bank's Global Financial Development Database (2019)
Banking crisis	A crisis dummy of 1 in the year of banking crisis episode and 0 otherwise.	Laeven and Valencia (2018)
Credit gap	Difference between the log of credit to private sector and its long-run trend derived from the Hodrick-Prescott (HP) filter	World Bank's Global Financial Development Database (2019)
Financial development index	A ranking of countries on the depth, access, and efficiency of their financial institutions and financial markets. It is an aggregate of the Financial Institutions index and the Financial Markets index	Financial Development Index Database-IMF
Output gap	Difference between log of actual real GDP and its long-run trend	Penn World Table 10
Trade to GDP	Ratio of trade flow to GDP	World Development Indicators
Real GDP per capita	Log of real GDP per capita	World Bank's Global Financial Development Database (2019)
Bank concentration	Assets of three largest commercial banks as a share of total commercial banking assets.	World Bank's Global Financial Development Database (2019)
Inflation	Change in consumer price index (2010=100)	World Bank's Global Financial Development Database (2019)
MPI	Overall macroprudential policy instruments	Authors' calculation based on Alam et al. (2019)
Public debt to GDP	The ratio of public debts to GDP	World Economic Outlook database 2019 (IMF)

2.3 Results

Figure 1 shows the estimated impulse responses of credit growth to a banking crisis, obtained by estimating Equation (1). The results confirm the conventional argument that a banking crisis has an adverse impact on credit and demonstrate that the impact for developing countries does not differ from that for developed countries. In developing countries, a banking crisis reduces the credit growth rate by 0.07 in the first year, and the cumulative effect is 0.32 over five years after the crisis (Table A2). These results are consistent with those of Demirguc-Kun et al. (2006), which indicates a substantial slowdown in credit growth during the post-crisis period. The banking system plays an important role in credit markets, and hence, a sudden shock to financial intermediaries in the system would have a disproportionately contractionary impact on credit growth.

Figure 2-1: Effects of banking crisis



Note: t=1 is the year of the shock. Blue solid line is the impulse response of credit growth to banking crisis. Dotted red lines are the 95 percent confidence bands.

Table 2-A2. The effect of banking crisis on credit growth (baseline), developed and developing countries

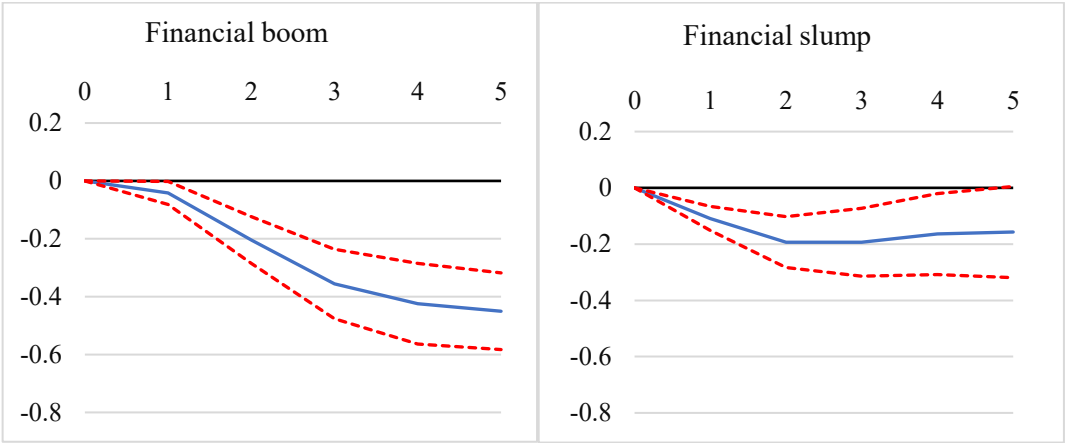
	(1) Year 1	(2) Year 2	(3) Year 3	(4) Year 4	(5) Year 5
World Bank's classification					
Developed countries					
Banking crisis	-0.0577***	-0.1402***	-0.2151***	-0.2802***	-0.3400***
	(0.0118)	(0.0260)	(0.0410)	(0.0538)	(0.0660)
Observations	1,175	1,120	1,065	1,010	955
Developing countries					
Banking crisis	-0.0727***	-0.1990***	-0.2852***	-0.3121***	-0.3199***
	(0.0130)	(0.0321)	(0.0512)	(0.0595)	(0.0625)
Observations	2,356	2,250	2,142	2,034	1,925
IMF's classification					
Developed countries					
Banking crisis	-0.0570***	-0.1341***	-0.2125***	-0.2936***	-0.3672***
	(0.0133)	(0.0276)	(0.0407)	(0.0548)	(0.0697)
Observations	788	752	716	680	644
Developing countries					
Banking crisis	-0.0804***	-0.2205***	-0.3186***	-0.3535***	-0.3695***
	(0.0129)	(0.0324)	(0.0518)	(0.0606)	(0.0644)
Observations	2,677	2,556	2,433	2,310	2,186

Notes: *** p<0.01, ** p<0.05, * p<0.1

Figure 2 shows the state-dependent impulse responses of credit growth to a banking crisis, using financial cycles as the state. A banking crisis during a financial boom has a larger negative impact on credit growth, particularly in the medium term, than that during a financial slump. A banking crisis during a financial boom (slump) decreases the credit growth rate by

0.45 (0.15) over five years after the crisis (Table A3). This result is intuitive. During a financial boom, we typically observe the rapid expansion of economic and financial activities, often associated with excessive credit growth. An unanticipated shock of a banking crisis would inevitably interrupt these activities. Thus, the impact of a banking crisis during a financial boom is more substantial than that during a financial slump.

Figure 2-2: Financial cycles



Note: t=1 is the year of the shock. Blue solid line is the impulse response of credit growth to banking crisis. Dotted red lines are the 95 percent confidence bands.

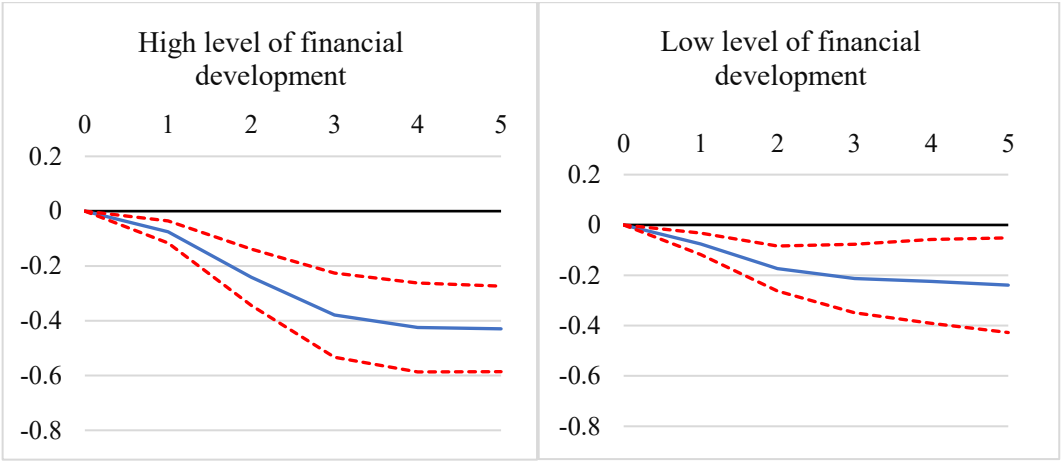
Table 2-A3. The effect of banking crisis on credit growth, financial cycles, developed and developing countries

	(1) Year 1	(2) Year 2	(3) Year 3	(4) Year 4	(5) Year 5
World Bank's classification					
Developed countries					
Banking crisis-boom	-0.0447***	-0.1283***	-0.2130***	-0.2913***	-0.3614***
	(0.0098)	(0.0258)	(0.0433)	(0.0574)	(0.0687)
Banking crisis-slump	-0.0945***	-0.1733***	-0.2209***	-0.2498***	-0.2813***
	(0.0290)	(0.0422)	(0.0503)	(0.0642)	(0.0850)
Observations	1,175	1,120	1,065	1,010	955
Developing countries					
Banking crisis-boom	-0.0417**	-0.2040***	-0.3561***	-0.4243***	-0.4504***
	(0.0205)	(0.0413)	(0.0611)	(0.0711)	(0.0676)
Banking crisis-slump	-0.1089***	-0.1929***	-0.1934***	-0.1640**	-0.1572*
	(0.0219)	(0.0462)	(0.0618)	(0.0735)	(0.0827)
Observations	2,356	2,250	2,142	2,034	1,925
IMF's classification					
Developed countries					
Banking crisis-boom	-0.0499***	-0.1324***	-0.2182***	-0.3101***	-0.3958***
	(0.0111)	(0.0282)	(0.0428)	(0.0561)	(0.0681)
Banking crisis-slump	-0.0803**	-0.1394***	-0.1944***	-0.2417***	-0.2781***
	(0.0310)	(0.0405)	(0.0473)	(0.0668)	(0.0937)
Observations	788	752	716	680	644
Developing countries					
Banking crisis-boom	-0.0474**	-0.2229***	-0.3896***	-0.4682***	-0.5006***
	(0.0186)	(0.0392)	(0.0603)	(0.0709)	(0.0698)
Banking crisis-slump	-0.1192***	-0.2176***	-0.2274***	-0.2033***	-0.2061**
	(0.0227)	(0.0471)	(0.0630)	(0.0741)	(0.0824)
Observations	2,677	2,556	2,433	2,310	2,186

Notes: *** p<0.01, ** p<0.05, * p<0.1

Concerning the state of financial development, Figure 3 presents the impulse responses of credit growth to a banking crisis. The negative effects of a banking crisis in countries with a high level of financial development are more substantial than those with a low level of financial development. A banking crisis decreases the credit growth rate by 0.43 (0.24) over five years for countries with a high (low) level of financial development (Table A4). A possible explanation may be related to the fragile financial systems in developing countries. Some developing countries have enjoyed a high degree of financial depth and rapid economic growth. However, their financial systems are often more vulnerable to an unanticipated shock due to financial fragility, given weak institutions and less effective financial policies; thus, a banking crisis tends to have a more substantial adverse effect in these countries.

Figure 2-3: Financial development



Note: t=1 is the year of the shock. Blue solid line is the impulse response of credit growth to banking crisis. Dotted red lines are the 95 percent confidence bands.

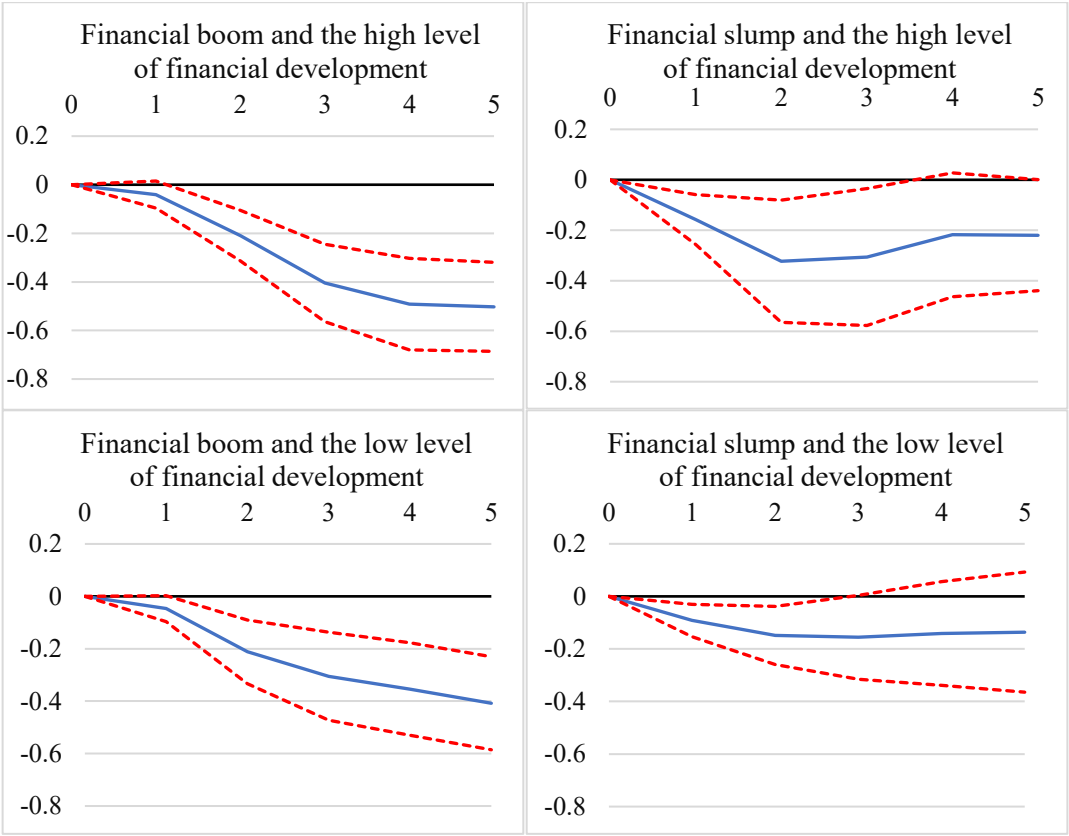
Table 2-A4. The effect of banking crisis on credit growth, financial development, developing countries

	(1) Year 1	(2) Year 2	(3) Year 3	(4) Year 4	(5) Year 5
World Bank's classification					
Banking crisis-HFD	-0.0759***	-0.2412***	-0.3795***	-0.4245***	-0.4296***
	(0.0208)	(0.0523)	(0.0784)	(0.0829)	(0.0795)
Banking crisis-LFD	-0.0751***	-0.1730***	-0.2131***	-0.2239***	-0.2391**
	(0.0218)	(0.0456)	(0.0694)	(0.0850)	(0.0961)
Observations	2290	2188	2084	1980	1875
IMF's classification					
Banking crisis-HFD	-0.0719***	-0.2338***	-0.3702***	-0.4176***	-0.4230***
	(0.0183)	(0.0467)	(0.0695)	(0.0739)	(0.0740)
Banking crisis-LFD	-0.0896***	-0.2063***	-0.2646***	-0.2878***	-0.3159***
	(0.0218)	(0.0496)	(0.0781)	(0.0939)	(0.1025)
Observations	2,677	2,556	2,433	2,310	2,186

Notes: (1) HFD: high financial development and LFD: low financial development. (2) *** p<0.01, ** p<0.05, * p<0.1

Figure 4 shows the impulse responses derived from Equation (3) with the two states of financial cycles and financial development simultaneously. The results confirm our previous findings on the state-dependent crisis effects (Table A5). The negative crisis effect is most substantial when a developing country has a high level of financial development, and a crisis occurs during a financial boom (upper-left panel in Figure 4).

Figure 2-4: Financial cycles and financial development



Note: t=1 is the year of the shock. Blue solid line is the impulse response of credit growth to banking crisis. Dotted red lines are the 95 percent confidence bands.

Table 2-A5. The effect of banking crisis on credit growth, financial cycles and financial development, developing countries

	(1) Year 1	(2) Year 2	(3) Year 3	(4) Year 4	(5) Year 5
World Bank's classification					
Banking crisis-boom-HFD	-0.0405	-0.2100***	-0.4047***	-0.4920***	-0.5028***
	(0.0284)	(0.0530)	(0.0811)	(0.0961)	(0.0935)
Banking crisis-slump-HFD	-0.1581***	-0.3228**	-0.3063**	-0.2178*	-0.2194*
	(0.0504)	(0.1236)	(0.1383)	(0.1251)	(0.1122)
Banking crisis-boom-LFD	-0.0469*	-0.2119***	-0.3049***	-0.3537***	-0.4079***
	(0.0252)	(0.0622)	(0.0856)	(0.0899)	(0.0906)
Banking crisis-slump-LFD	-0.0918***	-0.1485***	-0.1554*	(0.1411)	(0.1360)
	(0.0313)	(0.0563)	(0.0815)	(0.1006)	(0.1166)
Observations	2,290	2,188	2,084	1,980	1,875
IMF's classification					
Banking crisis-boom-HFD	-0.0439*	-0.2112***	-0.3973***	-0.4819***	-0.4979***
	(0.0242)	(0.0465)	(0.0728)	(0.0873)	(0.0875)
Banking crisis-slump-HFD	-0.1335***	-0.2880***	-0.2979***	-0.2399**	-0.2266**
	(0.0434)	(0.1028)	(0.1129)	(0.1063)	(0.0999)
Banking crisis-boom-LFD	-0.0543**	-0.2457***	-0.3760***	-0.4438***	-0.5057***
	(0.0228)	(0.0620)	(0.0975)	(0.1090)	(0.1076)
Banking crisis-slump-LFD	-0.1116***	-0.1822***	-0.1935**	-0.1857*	-0.1969*
	(0.0322)	(0.0590)	(0.0825)	(0.0989)	(0.1131)
Observations	2,677	2,556	2,433	2,310	2,186

Notes: (1) HFD: high financial development and LFD: low financial development. (2) *** p<0.01, ** p<0.05, * p<0.1

2.4 Robustness checks

In this section, we perform sensitivity analyses to check the empirical validity of our baseline finding. First, we apply a smooth transition function to generate states of financial conditions. Second, we use an alternative measure of financial development. Third, we employ the augmented regression-adjusted estimation approach (AIPW), proposed by Jordà and Taylor (2015), to mitigate possible endogeneity problems. Last, we use the IMF economies groupings to classify countries into developed and developing countries.

2.4.1 Smooth transition function approach

We applied binary or dummy variables to capture the states of financial cycles and financial development. This section differentiates the state dependence of financial cycles and financial development by applying a smooth transition function approach, instead of a dummy variable approach, to the estimation of Equation (2). In contrast to the dummy variable, the smooth transition function models the state as a continuous process, allowing to incorporate state-switching behaviors. The smooth transition function is described by:

$$F(z_{i,t}) = \frac{\exp(-\gamma z_{i,t})}{1+\exp(-\gamma z_{i,t})},$$

and $\gamma > 0$, where $z_{i,t}$ is an indicator of financial cycles and financial development normalized to have zero mean and unit variance. The smooth transition function $F(z_{i,t})$ varies between 0 and 1. $F = 0$ corresponds to a situation where the countries experience a financial boom or have a high level of financial development, while $F = 1$ corresponds to a situation where the countries experience a financial slump or have a low level of financial development. We set the $\gamma = 1.0$. The estimated results confirm our findings (Table A6).

Table 2-A6. The effect of banking crisis on credit growth, financial cycles and financial development, developing countries (smooth transition function)

	(1) Year 1	(2) Year 2	(3) Year 3	(4) Year 4	(5) Year 5
World Bank's classification					
Financial cycles					
Banking crisis-boom	0.0512	-0.1545**	-0.4142***	-0.5607***	-0.6019***
	(0.0392)	(0.0677)	(0.1045)	(0.1209)	(0.1171)
Banking crisis-slump	-0.2089***	-0.2494***	-0.1353	-0.0219	0.0041
	(0.0384)	(0.0776)	(0.1077)	(0.1345)	(0.1588)
Observations	2,356	2,250	2,142	2,034	1,925
Financial development					
Banking crisis-HFD	-0.0385	-0.2267***	-0.4150***	-0.4767***	-0.4670***
	(0.0276)	(0.0800)	(0.1186)	(0.1215)	(0.1188)
Banking crisis-LFD	-0.1224***	-0.1820*	-0.1430	-0.1239	-0.1566
	(0.0370)	(0.0927)	(0.1407)	(0.1620)	(0.1772)
Observations	2,290	2,188	2,084	1,980	1,875
IMF's classification					
Financial cycles					
Banking crisis-boom	0.0359	-0.1833***	-0.4571***	-0.6126***	-0.6621***
	(0.0336)	(0.0597)	(0.0945)	(0.1097)	(0.1050)
Banking crisis-slump	-0.2105***	-0.2632***	-0.1552	-0.0465	-0.0277
	(0.0362)	(0.0730)	(0.0990)	(0.1220)	(0.1429)
Observations	2,677	2,556	2,433	2,310	2,186
Financial development					
Banking crisis-HFD	-0.0320	-0.2070***	-0.3882***	-0.4566***	-0.4629***
	(0.0244)	(0.0729)	(0.1078)	(0.1111)	(0.1141)
Banking crisis-LFD	-0.1369***	-0.2362***	-0.2369*	-0.232	-0.2591
	(0.0345)	(0.0884)	(0.1370)	(0.1586)	(0.1725)
Observations	2,677	2,556	2,433	2,310	2,186

Notes: (1) HFD: high financial development and LFD: low financial development. (2) *** p<0.01, ** p<0.05, * p<0.1

2.4.2 Alternative measure of financial development

To capture the level of financial development, we employed the Financial Development Index, taken from the Financial Development Index Database of the IMF (Sahay et al., 2015). Although this index has been used in many studies, several studies, such as Mathonnat and Minea (2018), employ the credit-to-GDP ratio to measure the level of financial development. Thus, to ensure the validity of our findings, we also use credit-to-GDP as an alternative measure of financial development. The estimated results are consistent with our findings (Table A7).

Table 2-A7. The effect of banking crisis on credit growth, financial development (based on the credit to GDP ratio), developing countries

	(1) Year 1	(2) Year 2	(3) Year 3	(4) Year 4	(5) Year 5
World Bank's classification					
Banking crisis-HFD	-0.0334	-0.1846***	-0.3503***	-0.4153***	-0.4265***
	(0.0321)	(0.0633)	(0.0943)	(0.1066)	(0.1026)
Banking crisis-LFD	-0.0939***	-0.2068***	-0.2496***	-0.2578***	-0.2666***
	(0.0181)	(0.0411)	(0.0598)	(0.0715)	(0.0797)
Observations	2,356	2,250	2,142	2,034	1,925
IMF's classification					
Banking crisis-HFD	-0.0528**	-0.2059***	-0.3625***	-0.4449***	-0.4638***
	(0.0255)	(0.0614)	(0.0944)	(0.1104)	(0.1118)
Banking crisis-LFD	-0.0963***	-0.2290***	-0.2930***	-0.3020***	-0.3184***
	(0.0165)	(0.0395)	(0.0591)	(0.0674)	(0.0743)
Observations	2,677	2,556	2,433	2,310	2,186

Notes: (1) HFD: high financial development and LFD: low financial development. (2) *** p<0.01, ** p<0.05, * p<0.1

2.4.3 Augmented regression-adjusted estimation approach

In the previous section, we assumed that a banking crisis is exogenous. However, several studies have emphasized that the occurrence of a banking crisis is endogenously determined by various macroeconomic and financial conditions (Mathonnat & Minea, 2018; Babecký et al., 2014). Thus, the models treating a banking crisis as exogenous may suffer from endogeneity issues. To mitigate this, we apply the augmented regression-adjusted estimation approach (AIPW) proposed by Jordà and Taylor (2015). The logic behind this approach is to apply local projections to a sample that has been re-randomized using propensity scores. The AIPW estimator has the doubly robust property that the consistency of the estimated average treatment effect (ATE) can be proved in the special case where either the probit model or the conditional mean model is correctly specified. Following this approach, we first estimate the propensity scores deriving the probability with which a banking crisis is expected by regressing it on its predictors.[8] We then use the propensity scores to derive an ATE based on

[8] We use credit gap, output gap, log of real GDP per capita, public debts to GDP, and bank concentration as covariates in the probit estimation. The definitions of the variables are provided in Table A1 in the appendix.

inverse probability weighting. The estimated results confirm our findings (Table A8).

Table 2-A8. The effect of banking crisis on credit growth, financial cycles and financial development (AIPW), developing countries

	(1) Year 1	(2) Year 2	(3) Year 3	(4) Year 4	(5) Year 5
World Bank's classification					
Financial cycles					
ATE_banking crisis_boom	-0.0808***	-0.2085***	-0.3152***	-0.3089***	-0.2594***
	(0.0137)	(0.0221)	(0.0313)	(0.0430)	(0.0526)
ATE_banking crisis_slump	-0.1475***	-0.2733***	-0.2140***	-0.1211***	-0.0673***
	(0.0091)	(0.0086)	(0.0106)	(0.0154)	(0.0179)
Observations	279	264	249	234	219
Financial development					
ATE_banking crisis_HFD	-0.1122***	-0.2282***	-0.3327***	-0.3745***	-0.3811***
	(0.0074)	(0.0188)	(0.0254)	(0.0256)	(0.0240)
ATE_banking crisis_LFD	0.0288***	-0.1450***	-0.2335***	-0.1617***	-0.0671***
	(0.0090)	(0.0121)	(0.0107)	(0.0158)	(0.0192)
Observations	279	264	249	234	219
IMF's classification					
Financial cycles					
ATE_banking crisis_boom	-0.0631***	-0.1811***	-0.2731***	-0.2522***	-0.1900***
	(0.0118)	(0.0183)	(0.0251)	(0.0359)	(0.0455)
ATE_banking crisis_slump	-0.1587***	-0.2689***	-0.2889***	-0.2481***	-0.1553***
	(0.0104)	(0.0100)	(0.0153)	(0.0170)	(0.0152)
Observations	354	335	316	297	278
Financial development					
ATE_banking crisis_HFD	-0.1007***	-0.1945***	-0.2683***	-0.2723***	-0.2460***
	(0.0082)	(0.0158)	(0.0183)	(0.0202)	(0.0282)
ATE_banking crisis_LFD	0.0535***	-0.1040***	-0.1985***	-0.1460***	-0.0687***
	(0.0123)	(0.0166)	(0.0101)	(0.0146)	(0.0169)
Observations	354	335	316	297	278

Notes: (1) HFD: high financial development and LFD: low financial development. (2) *** p<0.01, ** p<0.05, * p<0.1

2.4.4 International Monetary Fund (IMF) economies groupings

We used the World Bank country classification by income level to categorize developed and developing countries. To ensure the validity of the baseline finding, we also use IMF economies groupings to group developed and developing countries. Developed countries in this study are equivalent to advanced economies in the IMF economies groupings. Developing countries consist of emerging market and middle-income economies, and low-income developing countries in the IMF classification. The estimated results generally confirm our

findings. The estimated results using the IMF economies groupings are presented along with the table results based on the World Bank county classification.[9]

2.5 Conclusion

Our empirical results demonstrated that the effects of a banking crisis on credit growth are highly dependent on financial conditions in developing countries. First, the adverse effects of a banking crisis would become more substantial, particularly when a banking crisis occurs during a financial boom. Second, the adverse effects of a banking crisis would be intensified by financial development, which is recognized as a crucial determinant of efficient resource allocation.

The results of this study led to two policy implications for financial regulators. First, to mitigate the negative crisis effect, especially during booms, financial regulators should introduce or establish effective early warning schemes, including the monitoring of excess credit (credit gap), property price gap, and debt-service ratios, which could ease excessive credit and reduce the likelihood of a banking crisis. In addition, the adoption of macroprudential policies, such as countercyclical capital buffer and loan-to-value ratio, helps mitigate the excess boom of credit and systemic risk associated with a banking crisis (Dell'Ariccia et al., 2016; Cerutti et al., 2017).

Second, our results revealed the relatively large negative crisis effects in countries with a high level of financial development. Financial development is widely considered a driving force for economic growth. However, financial authorities in developing countries should realize that once their countries encounter a banking crisis, particularly during a financial

[9] In addition, we conduct two additional robustness checks: (i) adding more control variables (bank concentration, real GDP per capita, macroprudential policy index, monetary and fiscal policy stances) into our baseline specification and (ii) changing the numbers of lags in our baseline specification. The results are generally consistent with our main findings. The results are available upon request.

boom, a high level of financial development could have an unfavorable side effect. Financial regulators should not only emphasize financial development but also enhance the resilience of the financial system. Thus, countries should continuously strive to enhance institutional quality and financial architecture for financial regulators to accommodate the instantaneous development of the financial system.

Our study examined the effects of a banking crisis on credit. However, certain other financial crises, such as currency crises and debt crises, also affect macroeconomic and financial conditions. In addition, the recent COVID-19 pandemic outbreak is another type of crisis that has caused all countries around the world to experience a turbulent period with high uncertainty. More careful studies are required to achieve a comprehensive understanding of the crisis effects.

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Chapter 3: Macroprudential policy and banking crises: Targeting borrowers or financial institutions?

3.1 Introduction

The macroprudential objective can be defined as limiting the costs to the economy of financial distress, including limiting the likelihood of the failure, and the corresponding costs to significant portions of the financial system, which is often loosely referred to as limiting "systemic risk" (Crockett, 2000).[10] Over the past two decades, macroprudential policy (MP) has increasingly become widespread among financial regulators. Nonetheless, banking crises have not stopped happening, and their forms have kept changing over time. This would cast doubts on the roles of MP in limiting the likelihood of financial failure. Many studies demonstrate that MP is effective in limiting the level of financial indicators associated with financial failure, such as credit growth and housing prices (Alam et al., 2019; Olszak et al., 2018; Cerutti et al., 2017; Fendoğlu, 2017; Bruno et al., 2017; Lim et al., 2011). Credit and asset price booms, however, are not the only driving forces that increase systemic risk and induce banking crises.[11]

On the other hand, there is very limited evidence on the effect of MP on various factors, such as the externalities generated from the strategy of financial institutions, which are crucial in intensifying systemic risk.[12] One possible reason that these factors are abstract in the literature is the difficulty in measuring them accurately. In contrast to previous studies, our study attempts to evaluate the MP role in limiting systemic risk in the financial system by

[10] Crockett (2000) also mentions that the micro-prudential objective can be seen as limiting the likelihood of failure of individual institutions, which means limiting "idiosyncratic risk."
[11] Dell'Ariccia et al. (2016) show that a significant portion of credit booms are not followed by banking crises.
[12] The externality includes "fire sales", "strategic complementarities" and "contagion". MP instruments are designed to eliminate these externalities. See the discussion of De Nicolò et al. (2014) in details.

taking the occurrences of banking crises as the proxy for systemic risk.[13] Systemic risk can be understood as market failure in the financial system or financial crises (Butzbach, 2016). Moreover, we evaluate the effects of the major components of MP, which share the same purpose or target. MP consists of various policy instruments, and every instrument may not achieve the expected effects.[14] This exploration is particularly relevant for financial regulators because these instruments also come with costs to economic performance.[15]

We employ the most recent integrated macroprudential policies (iMaPP) database constructed by Alam et al. (2019), which consists of 17 types of MP tools over 134 countries from 1990 to 2016. We group all MP tools into seven types of policy instruments, among which three main groups are (i) overall macroprudential policy (MPI), (ii) financial institution-targeted policy (FINANCIAL) and (iii) borrower-targeted policy (BORROWER). The latter two are subsets of the first. Moreover, since FINANCIAL consists of a large variety of tools, we extend our analysis by constructing another three subgroups of financial institution-targeted policy instructions: (a) capital-targeted policy (CAPITAL), (b) loan supply-targeted policy (LOAN-SUPPLY), and (c) general-targeted policy (GENERAL). In addition, we consider the loan-targeted policy (LOAN-TARGET), which consists of all policy tools (belonging to both FINANCIAL and BORROWER) related to loan policies.

Given the occurrences of banking crises as our binary dependent variable, the estimation is based on a logistic model with time and country fixed effects. As some of MP tools can be triggered in reaction to credit conditions, we also examine the models with the

[13] Although some risk measures, such as the expected default frequency (EDF) and the Z-score, have been developed, the measurement of systemic risk in a comprehensive manner is still rudimentary (Altunbas et al., 2018).

[14] Based on the objective it targets, MP is usually categorized as BORROWER or FINANCIAL (demand- and supply-side MP) (Cerutti et al., 2017; Fendoğlu, 2017; Alam et al., 2019). BORROWER, such as caps on debt-to-income and loan-to-value ratio, may reduce the risks of loans by directing credit flow to borrowers who are less likely to default when an adverse shock arrives. FINANCIAL aims to prevent fire-sales and the propagation of shocks by influencing banks' management strategy.

[15] Richter et al. (2019) show that over a four-year horizon, a 10 percentage point decrease in the maximum LTV ratio leads to a 1.1% reduction in output.

interaction term of MP measures and credit variables. To ensure the robustness of the results, we also conduct several sensitivity analyses. First, we apply factor analysis to categorize the groups of MP instruments. Second, we attempt to mitigate endogeneity problems by employing a linear probability model with instrumental variables. Last, we incorporate monetary and fiscal policy stances into our empirical analysis to control the influence of these polices on the occurrence of banking crises, given the crucial roles of monetary and fiscal policies in mitigating the impact of a shock on economic conditions. The inclusion of these two police stances also lessens the concern of some omitted variable bias.

In line with our arguments, our results show that the MPI (overall index) is effective in reducing the likelihood of banking crises. For the subgroups, BORROWER reduces the possibility of banking crises. However, the effect of BORROWER on the occurrence of banking crises is reduced when credit gap is large. On the other hand, the effect of FINANCIAL is less clear. Nonetheless, two subgroups of FINANCIAL, namely, CAPITAL and LOAN-SUPPLY, have significant influences on reducing the likelihood of banking crises. The other subgroup GENERAL does not have a clear result. The last subgroup, LOAN-TARGET, which includes tools from BORROWER and LOAN-SUPPLY, is negatively correlated with the occurrence of banking crises. Our sensitivity analyses generally confirm the empirical validity of our baseline results.

This study contributes to the literature by evaluating the effectiveness of various instruments of MP in reducing systemic risks. Altunbas et al. (2018) examine the MP effects on banks' risks, which is measured by the expected default frequency (EDF). Although our research topic seems similar, we emphasize the influence of MP on aggregate or systemic risk under our argument that a banking crisis serves as the measurement of risks. In addition, another related study, Dell'Ariccia et al. (2016), explores the effects of MP on credit booms and shows that MP has proven effective in containing booms and in reducing the probability

that booms end badly (with busts or recession). If we take these bad booms as another measure of systemic risks, our findings are in line with theirs. Nonetheless, it is important to note that a large proportion of banking crises are not initiated by credit booms, i.e., a large proportion of the observations of banking crises in our sample are not in their observations. Thus, our findings complement theirs, supporting the effectiveness of MP in reducing systemic risks.

The rest of the study is organized as follows. Section 2 presents a selective literature review on financial crises and macroprudential policies. Section 3 describes the data and methodology in this study. Section 4 presents the empirical results and their implications, and section 5 shows several robustness checks of our baseline results. The last section provides some conclusions.

3.2 Literature review

To better understand the possible impacts of macroprudential policies and their relationship with financial crises, this section overviews past studies on macroprudential policies and financial crises.

3.2.1 Financial crises

Many studies have attempted to identify and classify the types of financial crises (Laeven & Valencia, 2008, 2013, 2018,; Reinhart & Rogoff, 2011; Pescatori & Sy, 2007). Financial crises are classified into several categories, such as banking, currency, inflation, debt, and capital market crises, based on either a certain threshold or chronological events. Moreover, many works have dedicated efforts to identifying possible determinants, including macroeconomic and financial conditions, that give rise to financial crises (Hasanov & Bhattacharya, 2018; Mathonnat & Minea, 2018; Caprio et al., 2014; Feldkircher, 2014; Babecký et al., 2014; Berkmen et al., 2012; Bordo & Meissner, 2012; Baier et al., 2012; Shehzad & De Haan, 2009; Haile & Pozo, 2008; Beck et al., 2006; Kaminsky, 1999). Among them, some studies show a

clear relationship between the likelihood of a banking crisis and the financial structure, such as the concentration of the banking system (Caprio et al., 2014; Beck et al., 2006), and others focus on the role of political channels that may trigger credit booms and banking crises (Hasanov & Bhattacharya, 2018).

In addition, several studies emphasize the role of credit conditions in financial crises. Many of these studies show that the development of credit affects the likelihood of a financial crisis and suggest that financial authorities should monitor credit-related indicators in the framework of the early warning system for financial crises (Borio & Lowe, 2002, 2004; Borio & Drehmann, 2009; BCBS, 2010; Babecký et al., 2014). Hasanov and Bhattacharya (2018) point out that household credit growth has a greater effect on the incidence of a banking crisis. Mathonnat and Minea (2018) reveal that the ratio of money supply to GDP and the ratio of credit to deposits have a positive effect on the prospect of banking crises, but they fail to find a clear relationship between the ratio of credit to GDP and the likelihood of a banking crisis. Although some studies show a positive relationship between credit development, or boom, and the likelihood of a banking crisis, several works, such as Dell'Ariccia et al. (2016), show that banking crises do not always follow credit booms. Using the data of 170 countries from 1970 to 2010, they show that only one-third of credit boom episodes are followed by a banking crisis.[16]

[16] Following the idea of Dell'Ariccia et al. (2016), we attempt to identify the relationship between credit booms and banking crises using banking crisis years in our dataset and credit boom episodes in the dataset of Dell'Ariccia et al. (2016). We find that among 200 banking crises in our sample, there are 66 starting years of banking crises, and 134 are the subsequent periods. Among the 66 starting years of banking crises, 23 banking crises follow credit boom episodes within three years, while 34 banking crises do not follow credit boom episodes within three years. Due to the data unavailability, we cannot identify whether or not the remaining 9 banking crises follow credit boom episodes. This implies that approximately 35% of banking crises follow credit boom episodes. Our analysis might be consistent with the argument in Dell'Ariccia et al. (2016) that not all credit boom episodes are followed by banking crises. Table A1 shows the details of credit boom episodes and banking crises.

3.2.2 Financial crisis and regulatory frameworks

The discussion about how financial regulatory frameworks relate to the likelihood of a banking crisis has triggered a debate among researchers. Kim et al. (2013) show that policies that restrict bank activities and entry requirements mitigate the likelihood of a banking crisis, but those that allow banks to become involved in nontraditional or risky activities fuel the possibility of a banking crisis. Demirgüç-Kunt and Detragiache (2011) examine the relationship between banking soundness and Basel core principles compliance, but they fail to find clear conclusions on the relationship between Basel core principles and bank risk. Caprio et al. (2014) state that the Basel III advisory to increase banks' capital puts more pressure on banks since banks need to find more sources of funds, which may lead to an increase in lending rates and financial instability. However, they also argue that some policies that restrict the risk activities of banks, including real estate and insurance, reduce the likelihood of a banking crisis.

In addition, Lee et al. (2016) show that financial liberalization decreases the probability of a banking crisis, while Chen et al. (2019) argue that a higher level of financial liberalization increases the chance of a banking crisis. Klomp and De Haan (2012, 2015) use seven measures of financial policy and supervision to examine the effects on banks' risk behaviors. They conclude that most of the measures have a negative effect on bank risk, but the effectiveness of the measures depends on banks' structure, such as ownership, size, and level of bank risk. Similarly, Laeven and Levine (2009) analyze the relationship between financial policy and bank risk behavior with the consideration of different structures of bank ownership and indicate that financial policy, such as capital requirements and restrictions on banking activities, has a significant effect on bank risk, although the direction of the effect varies depending on the structure of bank ownership.

3.2.3 Macroprudential policies

The aftermath of the Global Financial Crisis in the late 2000s brings about more debate on the resilience of the international financial system and the roles of MP in mitigating the accumulation of financial vulnerabilities and safeguarding financial stability. Many studies have analyzed the use and effectiveness of MP to manage various financial indicators, including boom-and-bust of credit, property cycles, and international financial flows. Among them, several works, such as Alam et al. (2019), Carreras et al. (2018), Cerutti et al. (2017), Bruno et al. (2017), Dell'Ariccia et al. (2016), and Lim et al. (2011), find that MP is effective in containing credit, particularly household credit.

Although MP is acknowledged as important, Bruno et al. (2017) and Lim et al. (2011) argue that one cannot deny the roles of other financial policies and policies, such as monetary policy. They suggest that the efficacy of MP is more auspicious in reducing credit growth if it is complementarily implemented with monetary policy.

There are plenty of empirical studies examining the effect of MP by its type or target. In particular, the effectiveness of borrower-targeted MP (BORROWER) have been widely explored. For instance, Claessens et al. (2013) demonstrate that the instruments of BORROWER, such as caps on debt-to-income, loan-to-value ratios, limits on credit growth and foreign currency lending, reduce bank risks, particularly in boom periods. Furthermore, several studies, such as Richter et al. (2019) and Kuttner and Shim (2016), show that the use of BORROWER (i.e., loan-to-value ratio and debt-to-income ratio) has a negative effect on housing credit and house prices. Morgan et al. (2019) confirm the effectiveness of demand side-targeted MP (equivalent to BORROWER) by explaining that the use of the loan-to-value ratio is effective in coping with excessive mortgage loans, especially for small banks and banks with a low level of non-performing loans. As for the effect of financial institution-targeted policy (FINANCIAL), Vandenbussche et al. (2015) find that the instruments of FINANCIAL,

such as capital adequacy ratio and marginal reserve requirements on foreign funding, are effective in curbing credit growth and housing prices in 16 European countries. Garbers and Liu (2018) argue that the adoption of the loan-to-value policy in conjunction with capital requirement is an effective method to deal with foreign interest rate shocks. Moreover, when comparing the effectiveness of BOROWER and FINANCIAL, Olszak et al. (2018) and Fendoğlu (2017) show that borrower-based instruments outperform financial institution-based ones in mitigating the procyclicality of loan loss provisions and in limiting excessive credit cycles.

Some studies examine the effect of MP based on country specific evidence. Igan and Kang (2011) on the case of Korea points out that the implementation of the policy on the loan-to-value ratio is more effective than the debt-to-income ratio in stabilizing housing prices through curbing expectations and speculative incentives. Liao et al. (2015) uses a simulation approach based on Northland's data, showing that macroprudential capital requirements can reduce individual and multiple banks default probabilities.

3.3 Data and empirical specification

In this section, we first describe how we construct the measures of macroprudential policy instruments. We also document key features of these instruments. Next, we introduce our empirical model and its specification.

3.3.1 The database of macroprudential policies

Several studies have constructed databases of macroprudential policies.[17] This study employs the most recent integrated macroprudential policies (iMaPP) database constructed by Alam et

[17] Shim et al. (2013) construct a database based primarily on official sources of publications and press releases of the financial authorities over 60 countries during the period from January 1990 to June 2012. Cerutti et al.

al. (2019).[18] It provides the most comprehensive coverage in terms of the number of countries (134), the length of the period covered (January 1990 to December 2016), and the types of policy tools (17). These 17 tools include countercyclical buffer (CCB), capital conservation buffer (Conservation), capital requirement for banks (Capital), limit on leverage of banks (LVR), loan loss provision (LLP), limits on growth or the volume of aggregate credit (LCG), loan restrictions (LoanR), limits on foreign currency lending (LFC), limits of the loan to value ratio (LTV), limits on the debt service to income ratio (DSTI), taxes and levies applied to specified transactions (Tax), measures taken to mitigate systemic liquidity (Liquidity), limits to the loan to deposit ratio (LTD), limits on net or gross open foreign exchange positions (LFX), measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFI), reserve requirements (RR), and other macroprudential measures (OT). Table 1 presents the detailed explanations of each macroprudential policy tool.

(2017) employ a database of macroprudential policies on an annual basis over 119 countries during the period from 2000 to 2013. Instead of referring to official publication sources, their method is based mainly on a survey project with various questionnaires, the Global Macroprudential Policy Instruments (GMPI) survey, conducted by the International Monetary Fund (IMF) during the period of 2013-2014.

[18] It integrates a wide range of previously constructed datasets (i) Lim et al. (2011), (ii) Lim et al. (2013), (iii) Global Macroprudential Policy Instruments (2013), (iv) Shim et al. (2013), (v) European Systemic Risk Board (ESRB) database, (vi) the Bank of International Settlement (BIS) and Financial Stability Board website and IMF official documents, and (vii) the IMF's annual macroprudential policy survey.

Table 3-1. Definitions of macroprudential policy tools

Individual policy tools
1. CCB, A requirement for banks to maintain a countercyclical capital buffer. Implementations at 0% are not considered as a tightening in dummy-type indicators.
2. Conservation, Requirements for banks to maintain a capital conservation buffer, including the one established under Basel III.
3. Capital, Capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements. Countercyclical capital buffers and capital conservation buffers are captured in their sheets respectively and thus not included here. Subcategories of capital measures are also provided, classifying them into household sector targeted (HH), corporate sector targeted (Corp), broad-based (Gen), and FX-loan targeted (FX) measures.
4. LVR, A limit on leverage of banks, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures (e.g., Basel III leverage ratio).
5. LLP, Loan loss provision requirements for macroprudential purposes, which include dynamic provisioning and sectoral provisions (e.g. housing loans).
6. LCG, Limits on growth or the volume of aggregate credit, the household-sector credit, or the corporate-sector credit by banks, and penalties for high credit growth. Subcategories of limits to credit growth are also provided, classifying them into household sector targeted (HH), corporate sector targeted (Corp), and broad-based (Gen) measures.
7. LoanR, Loan restrictions, that are more tailored than those captured in "LCG". They include loan limits and prohibitions, which may be conditioned on loan characteristics (e.g., the maturity, the size, the LTV ratio and the type of interest rate of loans), bank characteristics (e.g., mortgage banks), and other factors. Subcategories of loan restrictions are also provided, classifying them into household sector targeted (HH), and corporate sector targeted (Corp) measures. Restrictions on foreign currency lending are captured in "LFC".
8. LFC, Limits on foreign currency (FC) lending, and rules or recommendations on FC loans.
9. LTV, Limit on the loan to value ratio including those mostly targeted at housing loans, but also includes those targeted at automobile loans, and commercial real estate loans.
10. DSTI, Limit on the debt service to income ratio and the loan-to-income ratio, which restrict the size of debt services or debt relative to income. They include those targeted at housing loans, consumer loans, and commercial real estate loans.
11. Tax, Taxes and levies applied to specified transactions, assets, or liabilities, which include stamp duties, and capital gain taxes.
12. Liquidity, Measures taken to mitigate systemic liquidity and funding risks, including minimum requirements for liquidity coverage ratios, liquid asset ratios, net stable funding ratios, core funding ratios and external debt restrictions that do not distinguish currencies.
13. LTD, Limits to the loan-to-deposit (LTD) ratio and penalties for high LTD ratios.
14. LFX, Limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mismatch policies.
15. SIFI, Measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFIs), which includes capital and liquidity surcharges.
16. RR, Reserve requirements (domestic or foreign currency) for macroprudential purposes. Please note that this category may currently include those for monetary policy as distinguishing those for macroprudential or monetary policy purposes is often not clear-cut. A subcategory of reserve requirements is provided for those differentiated by currency (FCD), as they are typically used for macroprudential purposes.
17. OT, Macroprudential measures not captured in the above categories—e.g., stress testing, restrictions on profit distribution, and structural measures (e.g., limits on exposures between financial institutions).

Notes: The definition of individual instrument used in our analyses are based mainly on iMaPP constructed by Alam et al. (2019).

3.3.2 Measuring macroprudential policy instruments

In the iMaPP database, similar to all other databases, each tool in a given year is recorded as "dummy-type tightening and loosening indices." The index takes the value of 1 when the tool is being tightened, the value of -1 when the tool is being loosened, and zero otherwise. Using monthly indicators, we construct panel data covering the "state" of each macroprudential policy tool for each country in each year. Specifically, the state of macroprudential policy tool i of country j in year t is described by:

$$\mathrm{MP}_{\mathrm{ijt}} = \mathrm{MP}_{\mathrm{ijt-1}} + \Delta\mathrm{MP}_{\mathrm{ijt}},$$

where $\Delta\mathrm{MP}_{\mathrm{ijt}}$ is the indicator of annual policy changes and $\mathrm{MP}_{\mathrm{ijt-1}}$ is the indicator of the state of macroprudential policy tool i in the previous year $\mathrm{t}-1$. We set the initial value of the indicator representing the state of the macroprudential policy tool in the initial year 1990 as zero and use the above formula to construct the state of each policy tool for all years.[19] Note that in our empirical investigation, we use the "state of policy" instead of the "change of policy" as the independent variable. By doing so, the value of the independent variable is not measured as the change of policy *across a period* for a given country (i.e., we implicitly take into account the "level" of MP in each country). The estimated "coefficient" in the empirical model can be interpreted as the influence of tightening (or loosening) one unit of the measure of a state of MP on the occurrence of a banking crisis.

One main objective of this study is to explore the effectiveness of different groups of MP instruments for a similar target. We follow the literature and construct several measures of MP instruments using a total of 17 state of policy tools.[20] The details of each measure of policy instruments are presented in Table 2. Here, we briefly discuss how we construct the

[19] One may be concerned about the initial value (annual indicators of the state of the macroprudential policy instruments), since our dataset is constructed from the indicators representing annual policy changes. However, this issue can be solved by applying the fixed effects estimation in our analysis.

[20] In this study, policy "tool" refers to each of 17 individual policy tools, while policy "instrument" means a group consisting of several policy tools that share the same target or purpose.

measures of different groups of MP instruments. First, the overall macroprudential policy index (MPI) is the sum of the 17 states of policy tools. Then, based on the policy target related to the demand or supply side of credit markets, we categorize all 17 MP tools into two groups: borrower-targeted policy (BORROWER) and financial institution-targeted policy (FINANCIAL) instruments.[21] The measure of BORROWER is the sum of two states of policy tools: LTV and DSTI, while the measure of FINANCIAL is the sum of the other 15 states of policy tools. Next, we group the MP tools by their policy purposes, which gives us another 4 new subgroups of MP instruments: (i) capital-targeted policy instruments (CAPITAL), focusing on the restriction on bank capital; (ii) general-targeted policy instruments (GENERAL), including policy tools to secure systemic liquidity; (iii) loan supply-targeted policy instruments (LOAN-SUPPLY) imposing direct restrictions on financial institutions' loans; and (iv) loan-targeted policy instruments (LOAN-TARGET) covering overall loan-related policy tools. FINANCIAL contains a large variety of tools, and the tools in CAPITAL, GENERAL, and LOAN-SUPPLY are the subsets of FINANCIAL. However, LOAN-TARGET is different and contains all loan-related tools of both financial institutions and borrowers.[22]

Table 3-2. Groups of macroprudential policy instruments

Macroprudential policy indicators		
Overall macroprudential policy instruments	MPI	All 17 policy instruments
Borrower-targeted policy instruments	BORROWER	LTV and DSTI
Financial institutions- targeted policy instruments	FINANCIAL	15 instruments beside LTV and DSTI
Capital-targeted policy instruments	CAPITAL	CCB, Conservation, Capital and LVR
General-targeted policy instruments	GENERAL	Liquidity, LFX, RR
Loans supply-targeted policy instruments	LOAN-SUPPLY	LCG, LLP, LoanR, LFC and LTD
Loan-targeted policy instruments	LOAN-TARGET	LCG, LLP, LoanR, LFC, LTD, LTV and DSTI

Notes: The group and subgroup of macroprudential policy classification used in our analyses are based mainly on iMaPP and Cerutti et al. (2017). Macroprudential policy indicators (MPI, BORROWER, FINANCIAL, CAPITAL, GENERAL, LOAN-SUPPLY, and LOAN-TARGET) are constructed by using the data of iMaPP. Each macroprudential policy instrument is normalized by dividing it by the corresponding number of policy instruments.

[21] The classification of MP instruments into BORROWER and FINANCIAL basically follows the categories in Cerutti et al. (2017).

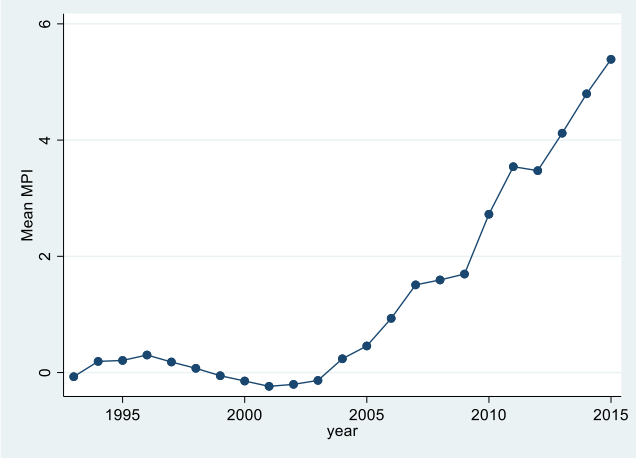
[22] The detailed classification of MP instruments generally follows the work of Alam et al. (2019).

3.3.3 Observations on the MP instruments

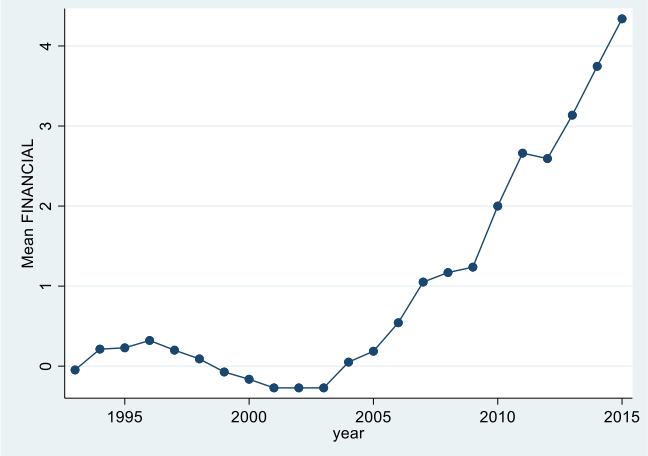
Figure 1 presents the evolution of our 7 MP instruments (MPI, FINANCIAL, BORROWER, CAPITAL, GENERAL, LOAN-SUPPLY, and LOAN-TARGET). Each graph shows the average measure of the state of each group of MP instruments over all sample countries for each year. All measures share an increasing trend, which implies that policymakers gradually adopted more stringent macroprudential policies. For most of the instruments, the increase pattern becomes more significant starting from 2003, and this increasing pattern continues until the 2008-2009 global financial crisis, at which time MP shows a reversal or pause. After 2010, all measures increase again.

Figure 3-1. States of MP instruments

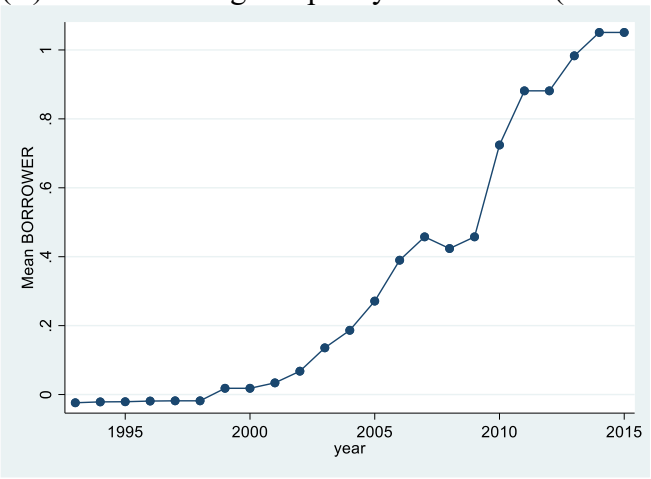
(A) Overall macroprudential policy instruments (MPI)



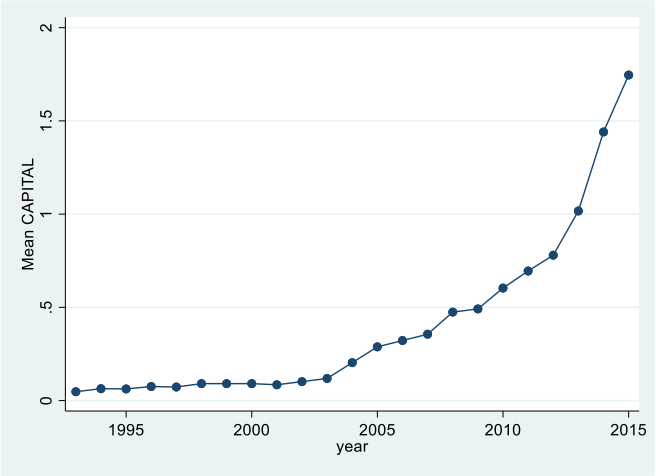
(B) Financial institutions-targeted policy instruments (FINANCIAL)



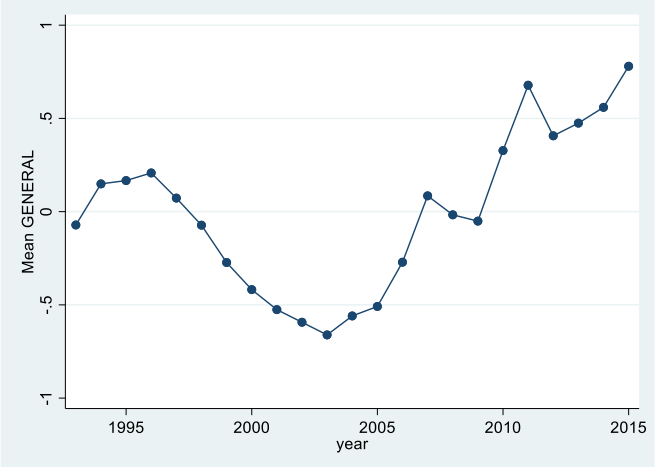
(C) Borrowers-targeted policy instruments (BORROWER)



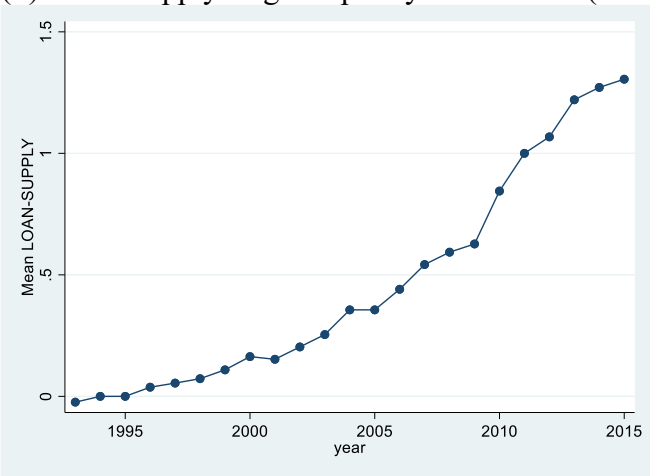
(D) Capital-targeted policy instruments (CAPITAL)



(E) General-targeted policy instruments (GENERAL)



(F) Loans supply-targeted policy instruments (LOAN-SUPPLY)



(G) Loans-targeted policy instruments (LOAN-TARGET)

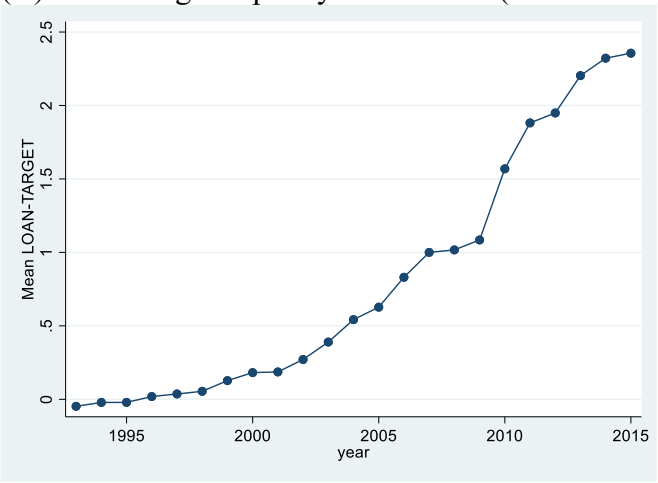


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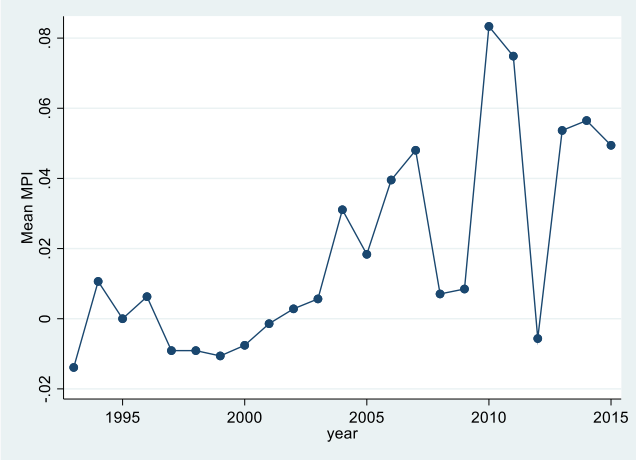
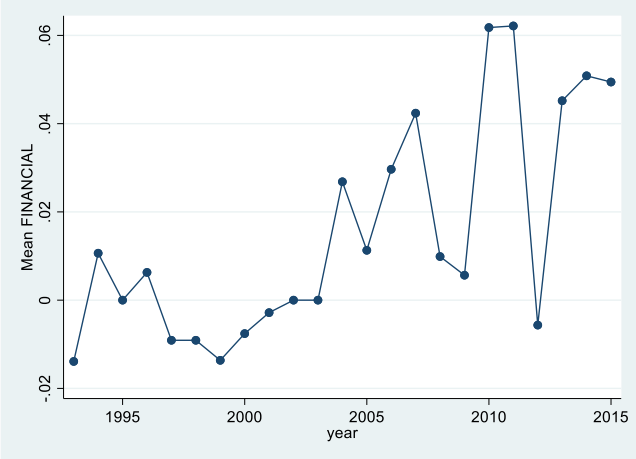
Figure 2 presents the annual change of each measure of MP instruments, which shows more details of the MP instruments. The adaptation of MP starts as early as 1994-95, approximately 3 years immediately before the Asian financial crisis. After the crisis, some instruments, such as FINANCIAL and GENERAL, show a reversal. After 2008, there is an initial reversal—several measures of MP are loosened in 2009. In 2010, due to the introduction of Basel III, most of these measures are tightened on a large scale. It should be noted that the trend described above seems slightly counterintuitive: MP started to be intensified before the financial crisis and was loosened after the crisis. Based on the simple observations of the trend, we cannot conclude whether MP is effective in reducing systemic risk.

Figure 3-2. Changes of MP instruments

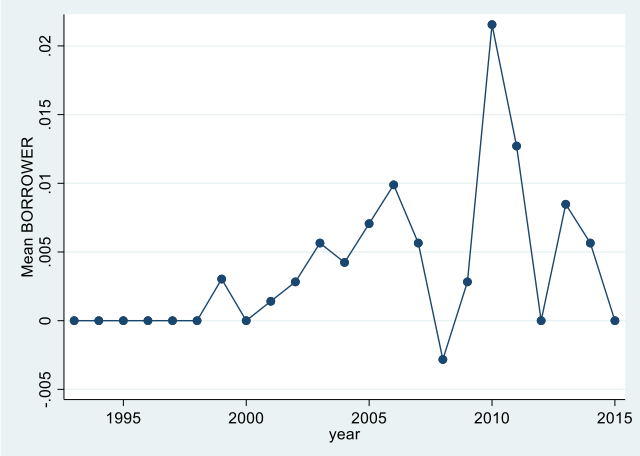
(A) Overall macroprudential policy instruments (MPI)



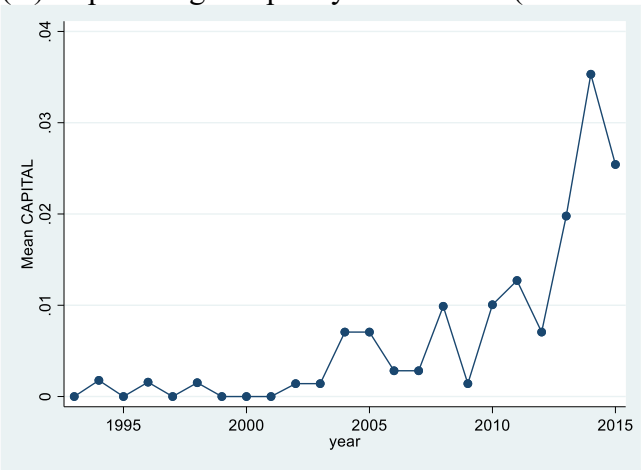
(B) Financial institutions-targeted policy instruments (FINANCIAL)



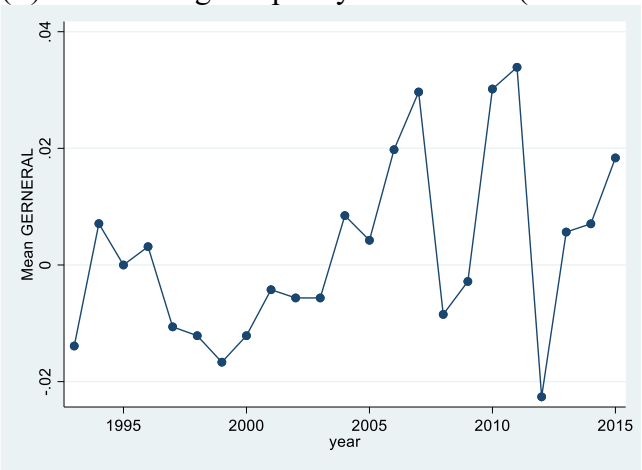
(C) Borrowers-targeted policy instruments (BORROWER)



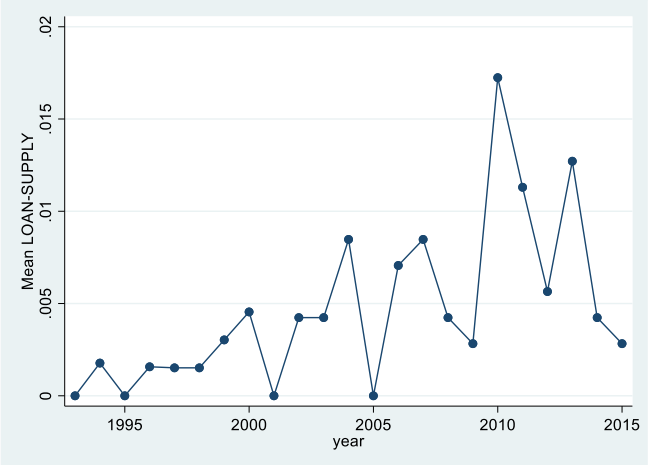
(D) Capital-targeted policy instruments (CAPITAL)



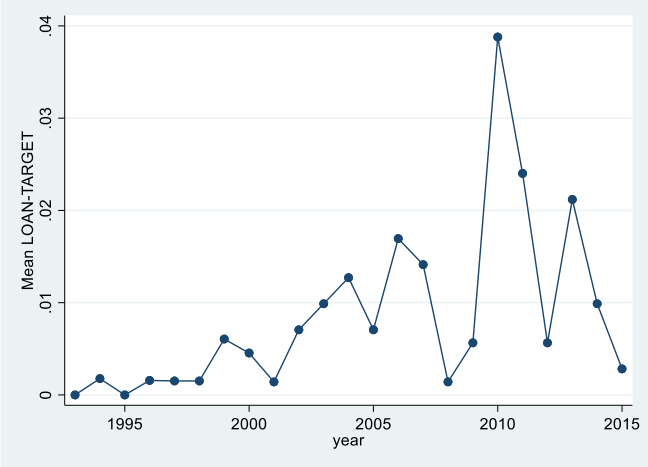
(E) General-targeted policy instruments (GENERAL)



(F) Loans supply-targeted policy instruments (LOAN-SUPPLY)



(G) Loans-targeted policy instruments (LOAN-TARGET)



To discuss a clearer relationship between banking crises and the usage of MP, we provide an additional simple examination. Table 3 reports the mean of "the change of MP instruments" over all sample countries during three types of periods: (i) three years before a banking crisis (pre-crisis periods), (ii) three years after a banking crisis (post-crisis periods), and (iii) years without a banking crisis (non-crisis periods).[23] We observe a similar pattern as in the previous discussion: the average change of overall MP (MPI) is larger during the pre-crisis period (10.18) than during the post-crisis period (2.29). In addition, the average change in MPI is the largest during the non-crisis period (28.64).[24] Countries tend to upgrade MP aggressively during the non-crisis periods and upgrade MP less aggressively during the pre-crisis periods. Once countries experience a banking crisis, they tend to significantly reduce the speed of the upgrading of MP. Given that MP has been upgraded during our sample period, this simple analysis appears to coincide with the conjecture that MP may help reduce the likelihood of a banking crisis and systemic risk in the banking system, although more careful examination is required.

[23] For instance, a country experiences a banking crisis in 2004. In this case, the pre- and post-crisis periods are 2001-2003 and 2004-2006, respectively.

[24] Given the fact that MP has been adapted particularly since around 2010, these figures may be biased. Thus, we compute the average change in MP for a restricted sample period of 1995-2010. Table A2 in the appendix presents a similar pattern to the case of the whole sample period of 1993-2015.

Table 3-3. MP instruments and banking crises (1993-2015)

Variable	Full sample 1993 to 2015					
	Pre-crisis period		Post-crisis period		Non-crisis period	
	Obs	Mean	Obs	Mean	Obs	Mean
CCB	129	0.0000	315	0.0000	784	0.2126
Conservation	127	0.0000	311	0.2680	764	1.8543
Capital	125	2.0000	307	4.0717	750	5.8889
LVR	128	0.0000	314	0.7962	783	1.1707
LLP	123	0.0000	310	2.4194	746	2.2341
LCG	124	0.0000	306	0.0000	749	0.4450
LoanR	124	0.6720	306	-0.2723	749	2.3364
LFC	126	0.6614	316	1.8460	783	1.0643
LTV	128	0.6510	316	0.7911	784	3.9328
DSTI	128	0.6510	322	1.5528	798	1.4620
TAX	125	0.0000	307	0.0000	750	1.3333
Liquidity	128	0.0000	323	-0.2580	820	2.6423
LTD	126	0.0000	316	0.0000	783	0.3193
LFX	128	0.6510	323	1.0320	820	1.8293
RR	128	5.2083	317	-10.7781	806	2.6882
SIFI	129	0.0000	315	0.0000	784	0.2126
MPI	131	10.1781	328	2.2866	835	28.6427
FINANCIAL	131	8.9059	328	0.0000	835	23.5529
BORROWER	131	1.2723	328	2.2866	835	5.0898
CAPITAL	131	1.9084	328	4.8272	835	8.2834
GENERAL	131	5.7252	328	-9.6545	835	6.9860
LOAN-SUPPLY	131	1.2723	328	3.8110	835	5.7884
LOAN-TARGET	131	2.5445	328	6.0976	835	10.8782

Note: We report annual changes of all the values at unit of $1.e^{-3}$.

Table 4 reports the correlation matrix among MP instruments. These instruments are in general positively correlated, while the magnitudes are not very large. For instance, the correlations of CAPITAL with BORROWER, GENERAL, LOAN-SUPPLY, and LOAN-TARGETED are 0.26, 0.17, 0.32, and 0.33, respectively. We also notice that the correlations of some instruments seem large. For instance, the correlation between FINANCIAL and BORROWER is 0.47. Nonetheless, once examining the subcomponents of FINANCIAL (CAPITAL, GENERAL, and LOAN-SUPPLY), we find that only one subcomponent, LOAN-SUPPLY, is (relatively) highly correlated with BORROWER (0.50), but other components

(CAPITAL and GENERAL) are not.[25] The above observations imply that the adaption of each instrument is not simultaneous. Therefore, given the low correlations among the instruments, we may not need to "control" for other MP instruments when examining the effect of a particular MP instrument.[26]

Table 3-4. Correlation matrix of MP instruments

	FINANCIAL	BORROWER	CAPTIAL	GENERAL	LOAN-SUPPLY
FINANCIAL	1.000				
BORROWER	0.473	1.000			
CAPTIAL	0.497	0.257	1.000		
GENERAL	0.870	0.264	0.174	1.000	
LOAN-SUPPLY	0.610	0.499	0.321	0.252	1.000
LOAN-TARGET	0.629	0.850	0.335	0.297	0.881

3.3.4 Empirical specification

Since the outcome variable is a binary measure of the occurrence of a banking crisis, we employ conditional logit/fixed effects logit. The baseline estimated regression model takes the following form:

$$\text{Prob}(BC_{i,t} = 1|MP_{i,t-1}, X_{i,t-1}) = F(\beta MP_{i,t-1} + \gamma X_{i,t-1} + \alpha_i + \lambda_t), \quad (1)$$

where $BC_{i,t}$ is a dummy variable that takes the value one if country i experiences a banking crisis in period t and zero otherwise; $MP_{i,t}$ is the measure of MP instruments, which include MPI, BORROWER, FINANCIAL, CAPITAL, GENERAL, LOAN-SUPPLY, and LOAN-TARGET; $X_{i,t}$ is a set of control variables; and F is the logistic distribution function. The model includes the country fixed effects, α_i, and the year effects, λ_t, to control country- and year-specific effects. The year effects are used to control the implicit common trend of the

[25] The correlation of LOAN-SUPPLY and LOAN-TARGET seems to be very high, but this is because both instruments share several common tools. The same reason also explains the high correlations between MPI and FINANCIAL and between MPI and BORROWER.

[26] In fact, most of the existing studies do not control for the influence of other instruments.

adaption of MP. We use the one-year lag of MP since it may take some time to realize the impacts of policy adoption.[27] Similarly, we also use the one-year lag of other control variables to mitigate some problems of simultaneity.

Several studies have constructed a database of banking crises. We use the one constructed by Laeven and Valencia (2018), which defines the occurrence of a banking crisis by two conditions: (i) significant signs of financial distress in the banking system, as indicated by significant bank runs, losses in the banking system, and/or bank liquidations, and (ii) significant banking policy intervention in response to significant losses in the banking system. We choose this database because it is updated and covers a broader sample of countries.

Some empirical works show that several macroeconomic variables are highly related to the occurrence of a banking crisis. These are selected as our control variables. First, we include the credit gap to control credit health and the accumulation of financial vulnerabilities because it is widely acknowledged as a signal of financial vulnerabilities and a useful early warning indicator for banking crises (Borio & Lowe, 2002, 2004; Borio & Drehmann, 2009; BCBS, 2010; Drehmann & Tsatsaronis, 2014). Moreover, the relationship between MP and credit conditions would vary by the intensity and phase of financial cycle (Cerutti et al., 2017), and some of MP tools can be triggered in reaction to credit conditions, which would call for the interaction term of MP measures and credit variables. Thus, we also examine an additional model that considers the effects of MP conditional on credit condition.

We also incorporate the ratio of credit to GDP, which has a positive relationship with the likelihood of a banking crisis (Demirgüç-Kunt & Detragiache, 1998; Bekaert et al., 2005; Babecký et al., 2014; Hasanov & Bhattacharya, 2019). This variable can also be considered to control the level of financial development (Beck et al., 2014). In addition, we further include the output gap because it has been shown to have a clear relationship with financial crises

[27] This setting is common in related studies. See, e.g., Cerutti et al. (2017) and Altunbas et al. (2018).

(Feldkircher, 2014; Lane & Milesi-Ferretti, 2011). Moreover, we include real GDP per capita and real GDP to capture the income level and size of the economy for each country, respectively. These two variables are also found to be related to banking crises. Rose and Spiegel (2009) show that countries with a low level of income or per capita GDP tend to experience crises. Several studies show that optimistic economic growth is likely to reduce vulnerability to a banking crisis (Davis & Karim, 2008; Hasanov & Bhattacharya, 2019).

Furthermore, we include trade openness, measured by the ratio of trade to GDP, to control the degree of trade integration, given that trade integration might be able to intensify the severity of a financial crisis (Feldkircher, 2014). We also control regional banking crises to capture the contagion or spillover effects of banking crises at the regional level. Mathonnat and Minea (2018) mention that banking crises can be viral events that can propagate at the international or regional level and emphasize the role of spillovers of a crisis from a country to its neighboring countries. Following the idea in Mathonnat and Minea (2018), we construct the variable of regional crises by the number of countries experiencing banking crises in the region to which a country belongs during the past three years.[28] Last, we follow the literature to include the presence of IMF programs (Jensen, 2004; Barro & Lee, 2005; Conway, 2006; Abbott et al., 2010). Table 5 presents the list of countries in our baseline sample. Tables 6 and 7 show the descriptions of variables and the descriptive statistics, respectively.

[28] We use the World Bank regional classification.

Table 3-5. List of countries (60 countries)

Algeria	Kazakhstan
Argentina	Kenya
Armenia	Korea, Rep.
Austria	Kyrgyz Republic
Azerbaijan	Latvia
Belarus	Lebanon
Belgium	Lithuania
Brazil	Macedonia, FYR
Bulgaria	Malaysia
Burundi	Mexico
China	Moldova
Colombia	Mongolia
Costa Rica	Netherlands
Croatia	Norway
Cyprus	Paraguay
Czech Republic	Philippines
Dominican Republic	Poland
Ecuador	Portugal
Finland	Russian Federation
France	Slovak Republic
Germany	Slovenia
Haiti	Spain
Hungary	Sweden
Iceland	Switzerland
India	Thailand
Indonesia	Turkey
Ireland	Uganda
Italy	Ukraine
Jamaica	United Kingdom
Japan	United States

Table 3-6. Data description and sources of variables

Variable	Definition	Source
Banking crisis	A crisis dummy of 1 in the year of crisis episode and 0 otherwise.	Laeven and Valencia (2008, 2013, 2018)
MPI	Overall macroprudential policy instruments	Authors' calculation based on Alam et al. (2019)
BORROWER	Borrower-targeted policy instruments	Authors' calculation based on Alam et al. (2019)
FINANCIAL	Financial institutions- targeted policy instruments	Authors' calculation based on Alam et al. (2019)
CAPITAL	Capital-targeted policy instruments	Authors' calculation based on Alam et al. (2019)
GENERAL	General-targeted policy instruments	Authors' calculation based on Alam et al. (2019)
LOAN-SUPPLY	Loans supply-targeted policy instruments	Authors' calculation based on Alam et al. (2019)
LOAN-TARGET	Loan-targeted policy instruments	Authors' calculation based on Alam et al. (2019)
Credit gap	Difference between the ratio of bank credit private sector credit to GDP and its long-run trend	World Bank's Global Financial Development Database (2018)
Credit to GDP	Bank credit to private sector credit as percentage of GDP	World Bank's Global Financial Development Database (2018)
Output gap	Difference between log of actual real GDP and its long-run trend	Penn World Table 9
Real GDP per capita	Log of real GDP per capita	World Bank's Global Financial Development Database (2018)
Real GDP	Log of real GDP	Penn World Table 9
Trade to GDP	Ratio of trade flow to GDP	World Development Indicators
IMF program	A dummy variable of 1 if there is a present of IMF program and 0 otherwise	IMF-Monitoring of Fund Arrangements (MONA Database)
Regional banking crisis	The number of countries experiencing banking crises in the region to which a country belongs during the past three years	Authors' calculation based on Mathonnat and Minea (2018)

Table 3-7. Descriptive of Statistics

Variables	No of obs.	Mean	Std	Min	Max
Bank crisis	1294	0.155	0.362	0	1
Overall macroprudential policy instruments	1294	0.067	0.304	-0.647	3.118
Financial institutions-targeted policy instruments	1294	0.056	0.294	-0.733	2.867
Borrowers-targeted policy instruments	1294	0.156	0.638	-1.500	5.500
Capital-targeted policy instruments	1294	0.085	0.216	-0.750	1.750
General-targeted policy instruments	1294	-0.013	1.133	-3.667	8.667
Loan supply-targeted policy instruments	1294	0.085	0.269	-0.600	2.400
Loan-targeted policy instruments	1294	0.106	0.330	-0.857	3.286
Credit gap	1294	0.122	7.539	-51.078	85.830
Output gap	1294	-0.002	0.055	-0.296	0.330
Trade to GDP	1294	79.348	37.886	14.731	220.407
Log per capita GDP	1294	8.961	1.390	5.389	11.425
Log real GDP	1294	12.223	1.900	8.247	16.653
IMF program	1294	0.185	0.388	0	1
Credit to GDP	1294	53.757	45.661	0.983	263.268

3.4 Empirical results

Tables 8 and 9 show the estimation results of our baseline models without and with the interaction term of each MP measure and credit gap. The numbers reported are the estimates of the average semi-elasticities (i.e., when the MP instrument increases by one unit, on average, how much the probability of a banking crisis changes).[29] The results of the models without the interaction term, shown in Table 8, reveal that MPI is negatively associated with the likelihood of a banking crisis, so MP could generally reduce the likelihood of a banking crisis. Specifically, when MPI increases by 0.1 points, the probability of a banking crisis is reduced by 14.9 percent.[30] Once we consider the subcomponents FINANCIAL and BORROWER, the influence appears to reveal some difference. The results of the models without the interaction term show a significantly negative coefficient of the indicator of BORROWER but fail to present a significant coefficient of the indicator of FINANCIAL.[31] When BORROWER increases by 0.1 points, the probability of a banking crisis is reduced by 14.5 percent.[32] Table 8 also presents that the results of the models with the interaction term generally coincide with

[29] Kitazawa (2012) presents the calculation formula of the average elasticity of the logit probability with respect to the exponential function of the explanatory variable for the fixed effects logit model.

[30] Our measure of MPI is constructed by the sum of the measures of all 17 tools and normalized by dividing it by the number of tools (17). Thus, a one-unit increase in the use of a tool means that the average over our measures of 17 tools increases by one point. Since the estimated coefficient of MPI in column (1) of Table 8 is -1.4890, a 0.1 point increase in MPI is associated with a 14.9 percent decrease in the probability of a banking crisis.

[31] We also examine the relationship between MP and the likelihood of a banking crisis using the level indicator of MP constructed by Cerutti et al. (2017), although the database of iMaPP (Alam et al., 2019) covers more detailed MP components, more countries, and longer periods than the database of Cerutti et al. (2017). This data set is one of the databases integrated into iMaPP. These two databases provide different features of policy tools. The database of iMaPP provides dummy-type policy actions that a country has taken, while Cerutti et al. (2017) indicate the number of tools a country has adopted in a given year. The database of Cerutti et al. (2017) consists of 12 tools over the period from 2000 to 2013. The measure of overall macroprudential policy instruments takes a value of 0 to 12, which denotes the number of tools a country uses in a given period. The measure of BORROWER takes a value of 0 to 2, which denotes the number of BORROWER measures a country uses. The measure of FINANCIAL takes a value of 0 to 10, which denotes the number of FINANCIAL measures a country uses. Table A3 in the appendix indicates the estimated results of the models using the database of Cerutti et al. (2017). The results show a negative relationship between the measure of BORROWER and the likelihood of a banking crisis but an insignificant relationship between the measure of FINANCIAL and the likelihood of a banking crisis, which are consistent with our baseline results.

[32] Similar to the case of MPI, our measure of BORROWER is constructed by the average over the measures of two borrower-targeted MPs. Since the estimated coefficient of BORROWER in column (5) of Table 8 is -1.4480, a 0.1 point increase in BORROWER is associated with a 14.5 percent decrease in the probability of a banking crisis.

those of the models without the interaction terms. The inclusion of the interaction term presents the insignificant coefficients in most models, except for the model with BORROWER.[33] The significantly positive coefficient of the interaction term of BORROWER and credit gap indicates that as credit gap becomes larger, perhaps in credit boom periods, the favorable effect of BORROWER on the occurrence of banking crises would be reduced.

BORROWER aims to control the demand side of the credit market by imposing financial policies on credit provisions, such as the maximum limits on the loan-to-value ratio and on the debt-service-to-income ratio. Previous studies emphasize the role of BORROWER in mitigating financial system vulnerability by showing that these instruments could reduce excessive movements of financial indicators particularly related to credit conditions, such as household credit, housing credit, leverage and assets, and the non-core to core liabilities ratio in the banking system (Alam et al., Claessens et al., 2013; Kuttner & Shim, 2016; Cerutti et al., 2017; Fendoğlu, 2017; Richter et al., 2019; Carreras et al., 2018). Our results complement the previous findings in the sense that BORROWER helps reduce the probability of a banking crisis, i.e., our proxy for systemic risk, even though some credit-related variables, such as credit gap and credit-to-GDP, are controlled in our models. By imposing policies on the demand side of the credit market, financial regulators help improve the quality of loans and reduce the risk of loans by directing credit to borrowers who are less likely to default, which could mitigate systemic risk in the banking system.[34]

[33] Most models with the interaction terms show the statistically insignificant coefficients of the interaction terms. In addition, the goodness-of-fit tests based on Bayesian Information Criterion (BIC) support the models without interactions term over those with the interaction term. Thus, our explanation is based mainly on the results of the models without the interaction terms.

[34] In addition to adopting dummy-type policy indicators, Alam et al. (2019) construct the average LTV limit to quantify the impact of the policy change. Using the quantitative LTV limit, they find that changes in LTV are effective in coping with household credit, although the impact is less significant in the case that current policy has already been strongly tightened. Following the work of Alam et al. (2019), we also examine the relationship between the average LTV limit and the occurrence of banking crises by constructing the data of the average LTV limit in the empirical model. The estimated results in Table A4 in the appendix show that the average LTV limit has a positive relationship with the likelihood of a banking crisis. A high average LTV limit indicates policy loosening. Thus, the result suggests that the tightening of LTV limits ratio is associated with less likelihood of a banking crisis, which is consistent with the finding of our baseline model.

On the other hand, the insignificant coefficient of FINANCIAL in Table 8 shows less effectiveness of FINANCIAL, which seems to suggest that an attempt to regulate financial institutions, or the supply side of the credit market, would not help mitigate systemic risk. However, once MP are classified into four subgroups, (i) CAPITAL, (ii) GENERAL, (iii) LOAN-SUPPLY, and (iv) LOAN-TARGET, we can identify the policy-crisis relationship in a deeper sense, particularly from the perspective of the supply side of the credit market. Table 9 indicates the results of the models for the indicators of CAPITAL, GENERAL, LOAN-SUPPLY, and LOAN-TARGET, respectively.[35] First, column (1) shows the significantly negative coefficient of CAPITAL, which consists of MP requiring banks to build up more capital buffer with the systemic risk profile of the banks (BCBS, 2012). A tightening of CAPITAL would reduce the possibility of a banking crisis. Previous works reveal the important role of bank capital in enhancing bank performance, measured by bank survival and market share, during banking crisis periods (Berger & Bouwman, 2013). In addition, several studies, such as Laeven and Levine (2009), emphasize stringent capital requirements to maintain the stability of the banking system. Our results related to CAPITAL also strengthen the importance of capital-related policies and their favorable effects on the likelihood of a banking crisis. Second, the result in column (3) fails to provide clear evidence on how GENERAL relates to the likelihood of a banking crisis, which suggests that GENERAL, whose targets include systemic liquidity, may not help reduce systemic risk.

Third, column (5) presents a significantly negative coefficient of LOAN-SUPPLY, which indicates that LOAN-SUPPLY is negatively associated with the occurrence of banking crises. Unlike BORROWER, LOAN-SUPPLY aims at curbing credit expansion from financial institutions or credit suppliers in the credit market. Once banks are restricted, for example, by

[35] Similar to Table 8, Table 9 shows that all models with the interaction terms show the statistically insignificant coefficients of the interaction terms, and the goodness-of-fit tests based on Bayesian Information Criterion (BIC) support the models without interactions term.

policies requiring limits on aggregate credit volume or loan-to-deposit ratios, banks tend to become more cautious about the quality of loan disbursements and seek a better way to acquire more sources of funds, including deposits, to ensure that they can comply with the policies. Consequently, banks tend to be more resilient to risk, so the vulnerability of the overall financial system, i.e., systemic risk, can be mitigated. Alam et al. (2019) find the crucial role of MP targeting the supply side by empirically revealing the negative association with household credit growth. Our result supports the argument that LOAN-SUPPLY also plays a crucial role in reducing the likelihood of a banking crisis and in mitigating systemic risk. Fourth, similar to the result related to LOAN-SUPPLY, column (7) shows the negative coefficient of LOAN-TARGET. Given that LOAN-TARGET covers overall loan-related policy instruments, which consist of BORROWER and LOAN-SUPPLY, this result confirms that loan-related MP targeting borrowers and financial institutions could help reduce the likelihood of a banking crisis.

Table 3-8. Macroprudential policy instruments and banking crises

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MPI	-1.4890**	-1.7722**						
	(0.7097)	(0.7744)						
MPI*Credit gap		0.1037						
		(0.0853)						
FINANCIAL			-0.8687	-1.0676			-0.1646	-0.3332
			(0.6874)	(0.7389)			(0.7509)	(0.7970)
FINANCIAL*Credit gap				0.0824				0.0554
				(0.0863)				(0.1013)
BORROWER					-1.4483***	-1.7434***	-1.4306***	-1.7380***
					(0.5263)	(0.5155)	(0.5327)	(0.5300)
BORROWER*Credit gap						0.0729**		0.0662*
						(0.0351)		(0.0382)
Credit gap	0.0351	0.0331	0.0372	0.0354	0.0271	0.0333	0.0272	0.0320
	(0.0240)	(0.0237)	(0.0239)	(0.0238)	(0.0237)	(0.0222)	(0.0237)	(0.0224)
Credit to GDP	0.0617***	0.0622***	0.0600***	0.0604***	0.0688***	0.0693***	0.0687***	0.0695***
	(0.0101)	(0.0101)	(0.0099)	(0.0099)	(0.0106)	(0.0107)	(0.0106)	(0.0108)
Output gap	-1.6605	-1.6023	-1.5174	-1.5073	-1.9808	-1.9368	-1.9815	-1.9172
	(2.1445)	(2.1464)	(2.1295)	(2.1316)	(2.1482)	(2.1530)	(2.1496)	(2.1548)
Real GDP per capita	-0.1957	-0.4362	-0.4070	-0.5851	-0.4287	-0.5602	-0.3803	-0.6077
	(1.0496)	(1.0743)	(1.0404)	(1.0627)	(1.0130)	(1.0188)	(1.0402)	(1.0677)
Real GDP	-0.8660	-0.7377	-0.8074	-0.7033	-0.8187	-0.7675	-0.8336	-0.7374
	(0.8473)	(0.8559)	(0.8381)	(0.8473)	(0.8521)	(0.8542)	(0.8563)	(0.8646)
Trade to GDP	-0.0040	-0.0038	-0.0047	-0.0045	0.0004	-0.0002	0.0003	-0.0001
	(0.0076)	(0.0077)	(0.0076)	(0.0076)	(0.0078)	(0.0079)	(0.0078)	(0.0079)
IMF program	0.5861**	0.6201**	0.6066**	0.6365**	0.6021**	0.6268**	0.5987**	0.6427**
	(0.2751)	(0.2769)	(0.2751)	(0.2768)	(0.2770)	(0.2786)	(0.2774)	(0.2814)
Regional crises	1.1715***	1.2003***	1.1919***	1.2117***	1.1921***	1.1999***	1.1849***	1.1969***
	(0.3357)	(0.3370)	(0.3359)	(0.3363)	(0.3396)	(0.3427)	(0.3409)	(0.3433)
Observations	1294	1294	1294	1294	1294	1294	1294	1294
Number of countries	60	60	60	60	60	60	60	60
Log likelihood	-249.475	-248.735	-251.012	-250.549	-244.611	-243.016	-244.587	-242.829
McFadden's R-squared	0.436	0.438	0.433	0.434	0.447	0.451	0.447	0.451
BIC	-259.329	-256.714	-256.254	-253.087	-269.056	-268.152	-265.010	-260.337

Notes: The banking crisis dummy is the dependent variable used in the regression. We estimated the regressions using the logistic regression with the country and period fixed effects. The table reports the estimates of the average elasticities of the conditional probability with respect to the regressors and the corresponding standard errors.

*** p<0.01, ** p<0.05, * p<0.1

The estimated results in Table 9 provide additional implications about the effectiveness of each subgroup of FINANCIAL. It should be noted that the measure of each subgroup (CAPITAL, GENERAL, LOAN-SUPPLY, and LOAN-TARGET) is normalized by using the average over the measures of MP in the corresponding subgroup. This allows us to evaluate which subgroup of policy targeting is most effective in reducing the likelihood of a banking crisis.[36] A 0.1 point increase in CAPITAL and LOAN-SUPPLY reduces the probability of a banking crisis by 36.2 percent and 13.9 percent, respectively.[37] This result suggests that among the three subgroups of FINANCIAL, CAPITAL has the most substantial effect on reducing the occurrence of a banking crisis.[38]

[36] Alam et al. (2019) mention that their dummy-type data of MP only indicate the direction of a policy change but lack information about the intensity of the change, which implies that large changes in their index do not necessarily mean large changes in the policy instruments. Although we admit that our data based on iMaPP also cannot fully capture the intensity of each policy change, we attempt to compare the effectiveness among the subgroups of MP as a reference.

[37] In addition, a 0.1 point increase in LOAN-TARGET, which is the measure combining BORROWER and LOAN-SUPPLY, reduces the probability of a banking crisis by 24.4 percent.

[38] In the baseline models we use the data of Laeven and Valencia (2018) to capture banking crises at the country level. We also examine the effect of MP on the likelihood of banking crises using alternative data sources of banking crises constructed by Reinhart and Rogoff (2011). Reinhart and Rogoff (2011) build the data of banking crises based on the two types of events: (i) bank runs leading to the closure, merging, or takeover by the public sector of one or more financial institutions, or (ii) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions. The data of Reinhart and Rogoff (2011) cover a relatively small numbers of countries (70 countries) compared to the data of Laeven and Valencia (2018). We estimate the logit model with country and period fixed effects by replacing the crisis dummy based on the data of Laeven and Valencia (2018) with that based on the data of Reinhart and Rogoff (2011). Table A5 shows the estimated results, which also coincide with the findings of our baseline analysis.

Table 3-9. Subgroup of financial institutions- and loan-targeted policy instruments and banking crises

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CAPITAL	-3.6228***	-4.2503***						
	(1.0897)	(1.3044)						
CAPITAL*credit gap		0.1496						
		(0.1527)						
GENERAL			0.0858	0.0536				
			(0.1516)	(0.1581)				
GENERAL*credit gap				0.0156				
				(0.0183)				
LOAN-SUPPLY					-1.3902**	-1.4699**		
					(0.6478)	(0.6925)		
LOAN-SUPPLY*credit gap						0.0368		
						(0.0974)		
LOAN-TARGET							-2.4429***	-2.8230***
							(0.8548)	(0.8967)
LOAN-TARGET*credit gap								0.1113
								(0.0798)
Credit gap	0.0323	0.0293	0.0379	0.0372	0.0357	0.0351	0.0310	0.0329
	(0.0244)	(0.0244)	(0.0240)	(0.0239)	(0.0241)	(0.0241)	(0.0239)	(0.0230)
Credit to GDP	0.0653***	0.0639***	0.0597***	0.0603***	0.0621***	0.0620***	0.0667***	0.0666***
	(0.0106)	(0.0106)	(0.0100)	(0.0100)	(0.0103)	(0.0103)	(0.0106)	(0.0107)
Output gap	-1.2197	-1.0813	-1.2635	-1.3166	-1.3545	-1.3431	-1.6215	-1.5763
	(2.1703)	(2.1766)	(2.1058)	(2.1064)	(2.1288)	(2.1307)	(2.1537)	(2.1581)
Real GDP per capita	-0.5077	-0.5590	-0.9657	-1.0665	-0.4565	-0.4659	-0.2462	-0.3332
	(1.0058)	(1.0068)	(1.0078)	(1.0179)	(1.0042)	(1.0060)	(1.0165)	(1.0225)
Real GDP	-1.0632	-1.0498	-0.7039	-0.6331	-0.8493	-0.8443	-0.9359	-0.8941
	(0.8751)	(0.8753)	(0.8247)	(0.8320)	(0.8279)	(0.8278)	(0.8376)	(0.8386)
Trade to GDP	-0.0038	-0.0036	-0.0042	-0.0039	-0.0009	-0.0010	0.0022	0.0019
	(0.0078)	(0.0078)	(0.0077)	(0.0077)	(0.0078)	(0.0078)	(0.0080)	(0.0080)
IMF program	0.5461**	0.5385**	0.6272**	0.6628**	0.6195**	0.6157**	0.5986**	0.6041**
	(0.2734)	(0.2738)	(0.2755)	(0.2781)	(0.2746)	(0.2750)	(0.2755)	(0.2765)
Regional crises	1.1825***	1.1899***	1.2549***	1.2600***	1.2747***	1.2839***	1.2671***	1.2840***
	(0.3389)	(0.3383)	(0.3384)	(0.3380)	(0.3386)	(0.3395)	(0.3407)	(0.3426)
Observations	1294	1294	1294	1294	1294	1294	1294	1294
Number of countries	60	60	60	60	60	60	60	60
Log likelihood	-244.600	-244.093	-251.699	-251.324	-249.388	-249.318	-245.249	-244.500
McFadden's R-squared	0.447	0.449	0.431	0.432	0.437	0.437	0.446	0.448
BIC	-269.079	-265.999	-254.880	-251.537	-259.502	-255.548	-267.781	-265.185

Notes: The banking crisis dummy is the dependent variable used in the regression. We estimated the regressions using the logistic regression with the country and period fixed effects. The table reports the estimates of the average elasticities of the conditional probability with respect to the regressors and the corresponding standard errors.

*** p<0.01, ** p<0.05, * p<0.1

Concerning other control variables, the results show that the coefficients of the ratio of credit to GDP are significantly positive, indicating that a high level of the credit-to-GDP ratio is likely to increase the probability of a banking crisis. This result is consistent with the previous findings that excessive credit expansion intensifies risks and accumulates vulnerabilities to the banking system (Demirgüç-Kunt & Detragiache, 1998; Bekaert et al., 2005; Babecký et al., 2014; Hasanov & Bhattacharya, 2018). In addition, the coefficients of the regional banking crisis variable are significantly positive, so a regional spillover effect of the crisis event exists, i.e., once a banking crisis occurs in a country, the crisis tends to spread out regionally and to increase the likelihood of a banking crisis in the neighboring countries in the same region. The evidence of the geographical spillover effects is consistent with the findings of Mathonnat and Minea (2018). Moreover, the estimations reveal that the presence of an IMF program is positively associated with the likelihood of a banking crisis. IMF programs are often conducted during periods of macroeconomic instability, such as financial crisis periods. The drawbacks of IMF programs have been mentioned in several studies (Oberdabernig, 2013; Marchesi & Sirtori, 2011; Przeworski & Vreeland, 2000).[39] Finally, the analysis generally fails to show clear results related to credit gap, output gap, real GDP, per capita GDP, and the ratio of trade to GDP.

3.5 Robustness checks

We perform several sensitivity analyses to check the empirical validity of our baseline results in the previous section. First, we apply factor analysis to construct an alternative measure of

[39] The moral hazard hypothesis, initially proposed by Vaubel (1983), suggests that IMF lending may be interpreted as a (subsidized) income insurance against adverse shocks. The insurance could induce potential recipients to excessively lower their precautions against future damages or even to intentionally generate a crisis (Dreher & Vaubel, 2001). Moreover, critics point out that the IMF might give misguided policy advice, which might in fact increase the risk of crises (Stiglitz, 2002; Dreher & Walter, 2010).

MP. Second, to mitigate possible endogeneity issues, we estimate the binary choice models using linear two-stage least squares (2SLS), which corresponds to the estimation of a linear probability model with instrumental variables (Mylonidis et al., 2019). As a final robustness check, we incorporate monetary and fiscal policy stances into the models.

3.5.1 Factor analysis

To check the robustness of our findings in the previous section, we re-examine how MP relates to the likelihood of a banking crisis by using an alternative continuous indicator of MP that is constructed through factor analysis with various MP. Several studies apply factor analysis to construct indicators of interest from the original sets of data in the field of financial economics. As examples, Quinn et al. (2011) generate de jure and de facto indicators of the capital account and financial account openness of 187 countries over the period from 1950 to 2007, and Klomp and De Haan, (2009) construct a financial instability indicator of 60 countries over the period from 1985 to 2005. Gilbert and Meijer (2006) use Canadian data to generate money and credit indictors over the period from 1981 to 2004, and Stock and Watson (2002) construct and forecast the Federal Reserve Board's Index of Industrial Production from 1970 to 1997.

Factor analysis is a statistical method to explain variability among observed, correlated variables in terms of a potentially fewer number of unobserved random variables, which are called factors (Kim & Mueller, 1978). The method models the observed variables as linear combinations of the potential factors plus error terms. Each factor captures a certain amount of the overall variance in the observed variables. The eigenvalue for a given factor measures how much of the variance of the observed variables the particular factor explains. A factor with a low eigenvalue may be ignored since other factors are more important in explaining the variance. According to the scree test based on the visualization of a scree plot showing a line plot of the eigenvalues of factors, we find the "elbow" point of the graph, where the

eigenvalues level off, and then retain factors to the left of this point for the subsequent analysis (Cattell, 1966). In this study, we apply factor analysis to each of the following seven datasets of indicators: (i) MPI, (ii) FINANCIAL, (iii) BORROWER, (iv) CAPITAL, (v) GENERAL, (vi) LOAN-SUPPLY, and (vii) LOAN-TARGET. The scree tests suggest that each group or subgroup of MP can be represented as a one-dimensional construct. Thus, we apply a one-factor model in the analysis, i.e., one factor is retained, and the rest of the factors are dropped off. Table 10 reports the estimations of the models with the indicators based on factor analysis. The estimated results are consistent with the baseline findings in the previous section.

Table 3-10. Factor analysis of macroprudential policy instruments

	Model 1 (1)	Model 2 (2)	Model 3 (3)	Model 4 (4)	Model 5 (5)	Model 6 (6)	Model 7 (7)	Model 8 (8)	Model 9 (9)	Model 10 (10)	Model 11 (11)	Model 12 (12)	Model 13 (13)	Model 14 (14)	Model 15 (15)	Model 16 (16)
MPI	-0.4609***	-0.5842***														
	(0.1768)	(0.2134)														
MPI*Credit gap		0.0322														
		(0.0235)														
FINANCIAL			-0.0819	-0.1192			0.0475	0.0793								
			(0.1916)	(0.2049)			(0.2502)	(0.2689)								
FINANCIAL*Credit gap				0.0262				0.0053								
				(0.0300)				(0.0308)								
BORROWER					-0.6326**	-0.8196***	-0.6415**	-0.8263***								
					(0.2522)	(0.2670)	(0.2583)	(0.2817)								
BORROWER*Credit gap						0.0403*		0.0401*								
						(0.0211)		(0.0238)								
CAPITAL									-1.1565***	-1.1529***						
									(0.3669)	(0.3673)						
CAPITAL*credit gap										-0.0072						
										(0.0389)						
GENERAL											0.0643	0.0663				
											(0.1577)	(0.1677)				
GENERAL*credit gap												-0.0006				
												(0.0182)				
LOAN-SUPPLY													-0.3509**	-0.3498*		
													(0.1782)	(0.1915)		
LOAN-SUPPLY*credit gap														-0.0006		
														(0.0417)		
LOAN-TARGET															-0.5756***	-0.6258***
															(0.2149)	(0.2238)
LOAN-TARGET*credit gap																0.0223
																(0.0184)
Credit gap	0.0308	0.0371	0.0376	0.0415*	0.0286	0.0426*	0.0286	0.0430*	0.0339	0.0317	0.0377	0.0376	0.0347	0.0346	0.0322	0.0396*
	(0.0241)	(0.0237)	(0.0239)	(0.0244)	(0.0238)	(0.0240)	(0.0239)	(0.0242)	(0.0242)	(0.0268)	(0.0240)	(0.0242)	(0.0239)	(0.0253)	(0.0234)	(0.0238)
Credit to GDP	0.0659***	0.0656***	0.0596***	0.0602***	0.0667***	0.0673***	0.0667***	0.0674***	0.0647***	0.0651***	0.0597***	0.0597***	0.0614***	0.0614***	0.0652***	0.0653***
	(0.0105)	(0.0105)	(0.0099)	(0.0099)	(0.0104)	(0.0105)	(0.0104)	(0.0106)	(0.0105)	(0.0108)	(0.0100)	(0.0100)	(0.0101)	(0.0101)	(0.0103)	(0.0104)
Output gap	-2.4894	-2.5428	-1.4221	-1.4372	-2.0244	-1.9712	-2.0337	-1.9915	-1.7379	-1.7252	-1.3309	-1.3279	-0.6737	-0.6739	-2.0195	-1.9577
	(2.1499)	(2.1556)	(2.1159)	(2.1171)	(2.1423)	(2.1466)	(2.1410)	(2.1445)	(2.1480)	(2.1497)	(2.1035)	(2.1053)	(2.1461)	(2.1461)	(2.1496)	(2.1521)
Real GDP per capita	-0.4052	-0.4161	-0.6747	-0.7787	-0.4702	-0.6084	-0.5059	-0.6903	-0.4413	-0.4415	-0.9207	-0.9177	-0.5543	-0.5547	-0.5330	-0.6283
	(1.0025)	(1.0080)	(1.0192)	(1.0310)	(1.0069)	(1.0141)	(1.0218)	(1.0296)	(1.0105)	(1.0114)	(1.0076)	(1.0114)	(0.9998)	(1.0000)	(1.0237)	(1.0291)
Real GDP	-0.6661	-0.6055	-0.7422	-0.6679	-0.7603	-0.6971	-0.7425	-0.6512	-0.9144	-0.9260	-0.7001	-0.7017	-1.0002	-0.9999	-0.7336	-0.6887
	(0.8271)	(0.8261)	(0.8308)	(0.8359)	(0.8441)	(0.8475)	(0.8478)	(0.8524)	(0.8594)	(0.8625)	(0.8269)	(0.8281)	(0.8398)	(0.8400)	(0.8460)	(0.8462)
Trade to GDP	-0.0001	-0.0007	-0.0046	-0.0043	0.0002	-0.0002	0.0002	-0.0001	-0.0043	-0.0043	-0.0044	-0.0044	-0.0003	-0.0003	-0.0017	-0.0019
	(0.0078)	(0.0079)	(0.0076)	(0.0076)	(0.0078)	(0.0078)	(0.0078)	(0.0079)	(0.0077)	(0.0077)	(0.0076)	(0.0076)	(0.0079)	(0.0079)	(0.0078)	(0.0078)
IMF program	0.5898**	0.5798**	0.6235**	0.6522**	0.5998**	0.6265**	0.6023**	0.6361**	0.5442**	0.5449**	0.6229**	0.6213**	0.6296**	0.6297**	0.6110**	0.6283**
	(0.2750)	(0.2758)	(0.2753)	(0.2770)	(0.2764)	(0.2782)	(0.2767)	(0.2798)	(0.2737)	(0.2737)	(0.2752)	(0.2793)	(0.2766)	(0.2766)	(0.2757)	(0.2772)
Regional crises	1.2968***	1.3190***	1.2216***	1.2292***	1.2046***	1.2088***	1.2113***	1.2212***	1.1912***	1.1919***	1.2605***	1.2607***	1.2134***	1.2131***	1.1643***	1.1740***
	(0.3393)	(0.3412)	(0.3361)	(0.3362)	(0.3389)	(0.3414)	(0.3411)	(0.3434)	(0.3394)	(0.3396)	(0.3423)	(0.3424)	(0.3346)	(0.3353)	(0.3361)	(0.3378)
Observations	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294
Number of countries	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Log likelihood	-247.373	-246.580	-251.757	-251.357	-245.715	-244.356	-245.697	-244.273	-244.949	-244.932	-251.775	-251.775	-249.352	-249.352	-247.402	-246.786
McFadden's R-squared	0.441	0.443	0.431	0.432	0.445	0.448	0.445	0.448	0.447	0.447	0.431	0.431	0.437	0.437	0.441	0.442
BIC	-263.532	-261.024	-254.765	-251.471	-266.850	-265.472	-262.791	-257.451	-268.381	-264.321	-254.728	-250.635	-259.575	-255.480	-263.475	-260.612

Notes: The banking crisis dummy is the dependent variable used in the regression. We estimated the regressions using the logistic regression with the country and period fixed effects. The table reports the estimates of the average elasticities of the conditional probability with respect to the regressors and the corresponding standard errors.

*** p<0.01, ** p<0.05, * p<0.1

3.5.2 Instrumental variables estimation

One crucial concern is that our empirical model may suffer from possible endogeneity issues. For instance, the occurrence of a banking crisis influences regulators' decision to adopt the specific dimensions of MP. Several past studies suggest the crisis-begets-reform hypothesis (Hlaing & Kakinaka, 2018; Waelti, 2015; Abiad & Mody, 2005; Lora & Olivera, 2004). The origin of a financial crisis is a key factor that drives policy reforms and influences regulators' decisions regarding regulatory and supervisory measures in the banking sector (Waelti, 2015). Financial liberalization normally hastens when an economy comes across financial crises, including banking crises (Hlaing & Kakinaka, 2018). We attempt to mitigate potential endogeneity issues by applying an instrumental variable (IV) approach. It is a difficult challenge to find valid IVs that satisfy the two main conditions: (i) the instrument must be closely related to the endogenous explanatory variables, MP in our study, conditional on the other covariates, and (ii) this instrument must not be correlated with the error term in the equation, conditional on the other covariates (exclusion restriction).

We employ a country's MP adopted by other countries in the same geographical region that the country belongs to (regional MP) as an instrument of the country's MP. Specifically, we construct the indicator of regional MP by using the number of countries adopting macroprudential policy instruments in the region. Past studies emphasize the presence of policy diffusion, especially among geographically neighboring countries or countries with similar ideological positions (Simmons & Elkins, 2004; Volden et al., 2008; Hlaing & Kakinaka, 2018). Simmons and Elkins (2004) show that domestic governments tend to adopt policies that were successfully implemented by other countries; i.e., international economic policy relates to domestic policy. Thus, regional MP may be closely related to a country's MP. There may be some concerns about the violation of the exclusion restriction. Since we control financial and economic conditions, including regional crises, in our empirical models, this

problem may be mitigated so that the likelihood of a banking crisis in a country may not be directly associated with the adoption of MP in neighboring countries. This study estimates the empirical binary choice models using 2SLS, which corresponds to the estimation of a linear probability model (LPM) with instrumental variables (Mylonidis et al., 2019).[40] Table 11 reports the results of IV estimations, which generally confirms our baseline findings in the previous section.

[40] Although there are some issues in using LPMs, such as the heteroscedasticity and the non-zero one predicted probabilities, LPMs often provide good estimates of underlying non-linear models (Wooldridge, 2016; Angrist & Pischke, 2009). Our purpose for the use of the LPM estimation is to check the sensitivity of the baseline results about the relationship between the occurrence of banking crises and MP. In addition, it may be noticed that our samples of the IV estimations cover 107 countries (Table A6 in the appendix), which are larger than those of the baseline logistic regression models with fixed effects in the previous section, since fixed effects models look at the elements of within-subject variability. Some sampled countries in our analysis did not experience any banking crises during the sample period, so we can regain many observations by employing the LPMs with an instrumental variable.

Table 3-11. Macroprudential policies and banking crises (Linear probability model)

	Model 1 (1)	Model 2 (2)	Model 3 (3)	Model 4 (4)	Model 5 (5)	Model 6 (6)	Model 7 (7)	Model 8 (8)	Model 9 (9)	Model 10 (10)	Model 11 (11)	Model 12 (12)	Model 13 (13)	Model 14 (14)	Model 15 (15)	Model 16 (16)
MPI	-0.3839**	-0.3536*														
	(0.1908)	(0.1977)														
MPI*Credit gap		-0.0263														
		(0.0465)														
FINANCIAL			-0.3228	-0.3069			0.2100	0.2381								
			(0.2258)	(0.2264)			(0.2821)	(0.2807)								
FINANCIAL*Credit gap				-0.0195				-0.0124								
				(0.0418)				(0.0325)								
BORROWER					-0.2073***	-0.1923***	-0.2514***	-0.2558***								
					(0.0605)	(0.0647)	(0.0659)	(0.0680)								
BORROWER*Credit gap						-0.0084		-0.0012								
						(0.0124)		(0.0063)								
CAPITAL									-0.3441**	-0.3430**						
									(0.1352)	(0.1351)						
CAPITAL*credit gap										0.0069						
										(0.0317)						
GENERAL											0.0512	0.0346				
											(0.0652)	(0.0700)				
GENERAL*credit gap												-0.0149				
												(0.0161)				
LOAN-SUPPLY													-0.5556	-0.3609		
													(0.3902)	(0.5445)		
LOAN-SUPPLY*credit gap														-0.0614		
														(0.1291)		
LOAN-TARGET															-0.4166**	-0.3473*
															(0.1639)	(0.2043)
LOAN-TARGET*credit gap																-0.0313
																(0.0534)
Credit gap	0.0041**	0.0047***	0.0043**	0.0047***	0.0036**	0.0040**	0.0036**	0.0039**	0.0041**	0.0038**	0.0044***	0.0038*	0.0041**	0.0062	0.0038**	0.0049**
	(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0019)	(0.0017)	(0.0017)	(0.0017)	(0.0018)	(0.0017)	(0.0021)	(0.0016)	(0.0041)	(0.0017)	(0.0021)
Credit to GDP	0.0048***	0.0047***	0.0047***	0.0046***	0.0051***	0.0050***	0.0051***	0.0051***	0.0050***	0.0049***	0.0046***	0.0045***	0.0047***	0.0044***	0.0049***	0.0047***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0007)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0008)	(0.0006)	(0.0007)
Output gap	0.2258*	0.2170*	0.2616**	0.2580**	0.1666	0.1545	0.1713	0.1655	0.2485**	0.2469**	0.3266***	0.3332***	0.2218*	0.1946	0.1795	0.1560
	(0.1221)	(0.1225)	(0.1203)	(0.1202)	(0.1184)	(0.1196)	(0.1215)	(0.1216)	(0.1133)	(0.1139)	(0.1126)	(0.1152)	(0.1327)	(0.1468)	(0.1235)	(0.1299)
Real GDP per capita	0.0636	0.0566	0.0374	0.0375	0.0182	0.0044	-0.0355	-0.0408	-0.0390	-0.0410	-0.1259	-0.0869	0.0841	0.0143	0.0639	0.0282
	(0.0809)	(0.0814)	(0.0876)	(0.0868)	(0.0570)	(0.0606)	(0.0968)	(0.0965)	(0.0474)	(0.0474)	(0.0771)	(0.0899)	(0.1190)	(0.1835)	(0.0725)	(0.0957)
Real GDP	-0.0782**	-0.0830**	-0.0836***	-0.0882***	-0.0695**	-0.0679**	-0.0704**	-0.0729**	-0.0591*	-0.0579*	-0.0904***	-0.1073***	-0.0764**	-0.0746**	-0.0707**	-0.0681**
	(0.0325)	(0.0332)	(0.0318)	(0.0330)	(0.0325)	(0.0325)	(0.0327)	(0.0335)	(0.0333)	(0.0338)	(0.0302)	(0.0356)	(0.0339)	(0.0343)	(0.0330)	(0.0333)
Trade to GDP	-0.0009***	-0.0008**	-0.0010***	-0.0010***	-0.0003	-0.0001	0.0000	0.0000	-0.0007**	-0.0007**	-0.0005	-0.0007	-0.0007**	-0.0007**	-0.0004	-0.0003
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0003)	(0.0003)	(0.0004)	(0.0005)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
IMF program	0.0649***	0.0560**	0.0676***	0.0602**	0.0672***	0.0666***	0.0714***	0.0668**	0.0620***	0.0631***	0.0811***	0.0537	0.0680***	0.0651***	0.0665***	0.0647***
	(0.0233)	(0.0276)	(0.0234)	(0.0279)	(0.0224)	(0.0225)	(0.0236)	(0.0266)	(0.0229)	(0.0233)	(0.0228)	(0.0367)	(0.0240)	(0.0251)	(0.0228)	(0.0232)
Regional crises	0.0524***	0.0497***	0.0477***	0.0457***	0.0595***	0.0587***	0.0587***	0.0575***	0.0469***	0.0473***	0.0382***	0.0350**	0.0553***	0.0486**	0.0594***	0.0563***
	(0.0166)	(0.0170)	(0.0161)	(0.0165)	(0.0164)	(0.0164)	(0.0167)	(0.0168)	(0.0146)	(0.0147)	(0.0148)	(0.0152)	(0.0195)	(0.0231)	(0.0176)	(0.0180)
Observations	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250
Number of iso3	107	107	107	107	107	107	107	107	107	107	107	107	107	107	107	107
R-squared	0.091	0.096	0.103	0.109	0.081	0.078	0.072	0.073	0.133	0.135	0.133	0.070	0.041	0.041	0.075	0.067

Note: The banking crisis dummy is the dependent variable used in the regression. For the instrumental variables, we construct the regional macroprudential policy instruments by summing up all macroprudential policy instruments adopted by countries in the same geographical region as the instrument for country i's overall macroprudential policy instruments and other group of policies. We estimate by using linear probability regression with robust standard errors in brackets.

*** p<0.01, ** p<0.05, * p<0.1

3.5.3 Monetary and fiscal policy stances

Several studies have pointed out that the adoption of MP instruments in conjunction with monetary and fiscal policy tools can be more effective than the stand-alone policies (Bruno et al., 2017; Lim et al., 2011). The combination of policies helps achieve the objectives of MP in mitigating systemic risk, particularly during the periods when risks in financial sectors are closely related to those in other sectors or when the financial cycle is closely related to the business cycle (Lim et al., 2011). Given these arguments, we estimate an empirical model that includes the measures of monetary and fiscal policy stances. This step seems necessary because it helps the estimation to identify the direct effects of MP. But the drawback of incorporating the measures of monetary and fiscal policy stances into the model is that the sample size is reduced largely. [41] Thus, we regard this estimation as a robustness check. Following the work of Dell'Ariccia et al. (2016), we construct the measure of monetary policy stance by computing the error term by which the money market rate exceeds its predicted level based on a regression of money market rate on inflation and real GDP growth. We also construct the measure of fiscal policy stance by computing the error term by which the general government net lending (revenue minus expenditure) in percent of GDP deviates from its predicted level based on a regression of the net lending on real GDP growth. Table 12 shows the estimated results, which generally supports the findings of our baseline analysis.

[41] Our sample of the estimation models with monetary and fiscal policy stances cover only 30 countries. One possible reason for the large drop of the sample is that many developing countries have many missing data of money market rates due to less mature short-term markets. Table A7 in the appendix shows the list of the sample countries for the models with monetary and fiscal policy stances.

Table 3-12. Macroprudential policies and banking crises with monetary and fiscal policy stances

	Model 1 (1)	Model 2 (2)	Model 3 (3)	Model 4 (4)	Model 5 (5)	Model 6 (6)	Model 7 (7)	Model 8 (8)	Model 9 (9)	Model 10 (10)	Model 11 (11)	Model 12 (12)	Model 13 (13)	Model 14 (14)	Model 15 (15)	Model 16 (16)
MPI	-3.2021**	-3.9684**														
	(1.6173)	(1.7291)														
MPI*Credit gap		0.2325														
		(0.1639)														
FINANCIAL			-2.4979*	-2.6518*			-0.8975	-1.1227								
			(1.5075)	(1.5787)			(1.5722)	(1.6905)								
FINANCIAL*Credit gap				0.0604				-0.0242								
				(0.1549)				(0.1754)								
BORROWER					-2.8190***	-2.6846***	-2.6635**	-2.4826**								
					(1.0622)	(0.9532)	(1.0911)	(1.0147)								
BORROWER*Credit gap						0.1260***		0.1268***								
						(0.0394)		(0.0398)								
CAPITAL									-2.4096	-3.6772*						
									(1.7553)	(2.1064)						
CAPITAL*credit gap										0.4323						
										(0.2944)						
GENERAL											-0.4053	-0.4191				
											(0.3213)	(0.3306)				
GENERAL*credit gap												0.0056				
												(0.0289)				
LOAN-SUPPLY													-0.5729	-0.5612		
													(0.9598)	(1.0048)		
LOAN-SUPPLY*credit gap														-0.0047		
														(0.1230)		
LOAN-TARGET															-1.9660	-3.2659**
															(1.3574)	(1.3908)
LOAN-TARGET*credit gap																0.2212**
																(0.0957)
Credit gap	0.0054	0.0125	0.0074	0.0081	-0.0060	0.0318	-0.0040	0.0340	0.0028	-0.0041	0.0072	0.0076	0.0069	0.0069	0.0060	0.0231
	(0.0307)	(0.0298)	(0.0313)	(0.0313)	(0.0278)	(0.0324)	(0.0281)	(0.0326)	(0.0320)	(0.0309)	(0.0315)	(0.0316)	(0.0313)	(0.0313)	(0.0299)	(0.0297)
Credit to GDP	0.0808***	0.0802***	0.0780***	0.0777***	0.0941***	0.0926***	0.0931***	0.0918***	0.0793***	0.0756***	0.0771***	0.0770***	0.0759***	0.0759***	0.0788***	0.0800***
	(0.0165)	(0.0166)	(0.0162)	(0.0162)	(0.0183)	(0.0191)	(0.0183)	(0.0192)	(0.0166)	(0.0173)	(0.0159)	(0.0158)	(0.0160)	(0.0161)	(0.0165)	(0.0172)
Output gap	8.3836*	9.3020**	8.7858**	8.9560**	9.2658**	9.4148**	9.0019**	9.0091**	8.8313**	9.6326**	9.4022**	9.4699**	9.7994**	9.8041**	9.3191**	9.5920**
	(4.4994)	(4.5410)	(4.4643)	(4.4747)	(4.3373)	(4.4032)	(4.4226)	(4.5529)	(4.3689)	(4.4444)	(4.3353)	(4.3441)	(4.2195)	(4.2216)	(4.2758)	(4.3201)
Real GDP per capita	-0.8858	-1.3398	-0.9995	-1.0870	-1.2559	-1.9120	-1.0649	-1.7260	-2.2742	-2.7105	-1.1601	-1.1640	-1.3656	-1.3633	-0.9154	-1.3399
	(2.7906)	(2.8314)	(2.7662)	(2.7774)	(2.7194)	(2.7881)	(2.7785)	(2.8518)	(2.6339)	(2.7256)	(2.7250)	(2.7257)	(2.6069)	(2.6062)	(2.6697)	(2.7218)
Real GDP	-0.6981	-0.4142	-0.7736	-0.7290	-1.4299	-1.1205	-1.2092	-0.7613	-0.6703	-0.5690	-1.1175	-1.1185	-1.2649	-1.2693	-1.1867	-0.8282
	(2.4662)	(2.5874)	(2.4529)	(2.4772)	(2.3129)	(2.4336)	(2.3986)	(2.5596)	(2.4385)	(2.5079)	(2.3446)	(2.3504)	(2.3083)	(2.3113)	(2.3495)	(2.4489)
Trade to GDP	-0.0252	-0.0288	-0.0252	-0.0259	-0.0285	-0.0349*	-0.0281	-0.0343*	-0.0254	-0.0259	-0.0277*	-0.0282*	-0.0245	-0.0246	-0.0218	-0.0249
	(0.0174)	(0.0180)	(0.0171)	(0.0173)	(0.0174)	(0.0183)	(0.0175)	(0.0185)	(0.0171)	(0.0171)	(0.0167)	(0.0169)	(0.0173)	(0.0174)	(0.0173)	(0.0180)
IMF program	2.0290***	2.1822***	2.0221***	2.0449***	2.1828***	2.1449***	2.2130***	2.1677***	1.8185***	1.8851***	2.1072***	2.1199***	1.9939***	1.9947***	1.9831***	2.0719***
	(0.6284)	(0.6455)	(0.6133)	(0.6155)	(0.6505)	(0.6445)	(0.6608)	(0.6641)	(0.6045)	(0.6198)	(0.6127)	(0.6159)	(0.5947)	(0.5949)	(0.6173)	(0.6336)
Regional crises	1.2469**	1.3262**	1.2773**	1.3013**	1.2830**	1.3138**	1.2529**	1.2740*	1.3290**	1.4507**	1.3016**	1.3115**	1.4087**	1.4078**	1.4108**	1.4373**
	(0.6033)	(0.6052)	(0.5966)	(0.5992)	(0.6335)	(0.6531)	(0.6342)	(0.6549)	(0.5911)	(0.6114)	(0.5934)	(0.5953)	(0.5921)	(0.5926)	(0.6020)	(0.6141)
Monetary policy stance	0.0466	0.0478	0.0476	0.0478	0.0461	0.0494	0.0450	0.0481	0.0496	0.0500	0.0487	0.0488	0.0484	0.0484	0.0458	0.0452
	(0.0331)	(0.0338)	(0.0329)	(0.0331)	(0.0329)	(0.0339)	(0.0330)	(0.0340)	(0.0330)	(0.0330)	(0.0325)	(0.0326)	(0.0320)	(0.0320)	(0.0319)	(0.0317)
Fiscal policy stance	-0.1090*	-0.1149*	-0.1098*	-0.1121*	-0.0997	-0.0782	-0.0972	-0.0756	-0.1139*	-0.1115*	-0.1114*	-0.1123*	-0.1105*	-0.1106*	-0.1043*	-0.0945
	(0.0643)	(0.0646)	(0.0643)	(0.0648)	(0.0635)	(0.0658)	(0.0640)	(0.0664)	(0.0638)	(0.0640)	(0.0641)	(0.0643)	(0.0633)	(0.0633)	(0.0629)	(0.0611)
Observations	591	591	591	591	591	591	591	591	591	591	591	591	591	591	591	591
Number of countries	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Log likelihood	-82.889	-81.882	-84.028	-83.951	-80.254	-76.636	-80.083	-76.363	-84.553	-83.305	-84.794	-84.775	-85.467	-85.467	-83.848	-81.802
McFadden's R-squared	0.624	0.628	0.619	0.619	0.636	0.652	0.637	0.654	0.616	0.622	0.615	0.615	0.612	0.612	0.620	0.629
BIC	-162.761	-161.375	-160.484	-157.237	-168.032	-171.868	-164.974	-165.610	-159.433	-158.529	-158.953	-155.588	-157.605	-154.205	-160.844	-161.535

Notes: The banking crisis dummy is the dependent variable used in the regression. We estimated the regressions using the logistic regression with the country and period fixed effects. The table reports the estimates of the average elasticities of the conditional probability with respect to the regressors and the corresponding standard errors.

*** p<0.01, ** p<0.05, * p<0.1

3.6 Conclusion

The adverse consequences arising from the occurrences of a banking crisis are costly and highly disruptive, leading to the failure of economic activities and a substantial decline in social welfare. For this reason, academicians and policymakers dedicate much effort to modeling and designing sound policies to mitigate such unfavorable impacts on the economy. In this study, we utilized the newly constructed macroprudential policy instrument database (iMaPP) to investigate the effectiveness of MP in reducing systemic risk. We used the occurrence of a banking crisis to measure systemic risk. This approach differs from most of the existing studies, which mostly focus on MP's effect on the "observable" channel of financial failure, such as credit growth and the boom of asset prices. By contrast, our focus is MP's effect on unobservable factors, such as externalities generated by financial sectors. Thus, our findings could help answer the direct question "would these policy tools be useful?", although we may not be able to answer questions such as "why are they useful?".

Our analysis contributes to the literature by discussing crucial insights into the efficacy roles of overall MP and different subgroups of MP instruments in mitigating systemic risk or the occurrence of a banking crisis while controlling for various macroeconomic conditions, such as credit variables. Several previous studies have focused mostly on examining the role of MP in mitigating credit growth or credit-related issues. Most of them argue that MP has proven effective in containing booms and in decreasing the probability that booms end badly. Although excessive credit booms could be considered a measure of systemic risk, a large proportion of banking crises have not followed credit booms (Dell'Ariccia et al., 2016). This suggests that the use of credit variables as a risk measure may not be comprehensive to discuss the link of MP to systemic risk. Rather than focusing on the MP effects on credit conditions, this study has emphasized the link of MP to the likelihood of a banking crisis under the

argument that the occurrence of a banking crisis can be considered the actual realization of systemic risk. Our empirical results, suggesting the favorable role of MP, could complement the findings in previous studies and confirm the effectiveness of MP. Our analysis has also revealed that several specific objective-oriented MP instruments, CAPITAL, LOAN-SUPPLY and LOAN, have a significant negative relationship with the likelihood of a banking crisis. Moreover, we have confirmed our empirical results by conducting various sensitivity analyses, including using different measures of crises, instrumental variables, and a different way to construct the MP instruments, such as factor analysis.

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Appendix

Table 3-A1. Credit booms and banking crises

Country	Banking crisis years (Laeven & Valencia, 2018)	Credit boom episodes (Dell'Ariccia et al., 2016): 3 years before crisis	Does a crisis follow a credit boom?
Algeria	1993-1994	-	No
Argentina	1995	1992-1994	Yes
Argentina	2001-2003	-	No
Armenia	1994	No data	Not identified
Austria	2008-2011	-	No
Azerbaijan	1995	No data	Not identified
Belarus	1995	No data	Not identified
Belgium	2008-2011	2006-2007	Yes
Brazil	1993-1998	1992-1994	Yes
Bulgaria	1996	No data	Not identified
Burundi	1994-1998	-	No
China	1998	-	No
Colombia	1998-2000	-	No
Costa Rica	1994-1995	1992-1993	Yes
Croatia	1998-1999	-	No
Cyprus	2011-2015	2006-2008	Yes
Czech Republic	1996-2000	-	No
Dominican Republic	2003-2004	1999-2000	Yes
Ecuador	1998-2002	-	No
Finland	1993-1995	-	No
France	2008-2011	-	No
Germany	2008-2011	-	No
Haiti	1997	-	No
Hungary	1993-1995	-	No
Hungary	2008-2011	2000-2007	Yes
Iceland	2008-2011	2003-2006	Yes
India	1993	-	No
Indonesia	1997-2001	-	No
Ireland	2008-2011	2004-2006	Yes
Italy	2008-2011	-	No
Jamaica	1996-1998	-	No
Japan	1997-2001	-	No
Kazakhstan	1996	No data	Not identified
Kazakhstan	2008-2011	-	No
Kenya	1993-1994	-	No
Korea, Rep.	1997-1998	1996-2002	Yes
Latvia	2011	2002-2006	No
Lebanon	1993	No data	Not identified
Lithuania	1996	2003-2007	No
Macedonia, FYR	1994-1995	No data	Not identified
Malaysia	1997-1999	1995-1997	Yes
Mexico	1994-1996	1989-1994	Yes
Moldova	2014-2015	No data	Not identified
Mongolia	2008-2011	-	No
Netherlands	2008-2011	-	No
Norway	1993	-	No
Paraguay	1995	1991-1994	Yes
Philippines	1997-2001	1992-1997	Yes
Poland	1993-1994	-	No
Portugal	2008-2011	-	No
Russian Federation	1998	-	No
Russian Federation	2008-2011	2003-2007	Yes
Slovak Republic	1998-2002	1996-1997	Yes
Slovenia	2008-2011	2004-2007	Yes
Spain	2008-2011	2003-2007	Yes
Sweden	1993-1995	-	No
Sweden	2008-2011	-	No
Switzerland	2008-2011	2002-2006	Yes
Thailand	1997-2000	1987-1995	Yes
Turkey	2000-2001	1995-1997	Yes
Uganda	1994	-	No
Ukraine	1998-1999	-	No
Ukraine	2008-2010	2002-2007	Yes
Ukraine	2014	No data	Not identified
United Kingdom	2007-2011	2006-2008	Yes
United States	2007-2011	-	No

Notes: The information of credit boom episodes is obtained from Dell'Ariccia et al. (2016). For the details about the definition of credit boom episodes and their characteristics, see Dell'Ariccia et al. (2016). Among 200 banking crises in our sample, there are 66 starting years of banking crises and 134 are the subsequent periods. Among the 66 starting years of banking crises, 23 banking crises follow credit boom episodes within three years, while 34 banking crises do not follow credit boom episodes within three years. Due the data unavailability, we cannot identify whether or not the remaining 9 banking crises follow credit boom episodes.

Table 3-A2. MP instruments and banking crises (1993-2010)

Variable	1993 to 2010					
	Pre-crisis period		Post-crisis period		Non-crisis period	
	Obs	Mean	Obs	Mean	Obs	Mean
CCB	124	0.0000	224	0.0000	545	0.0000
Conservation	122	0.0000	220	0.0000	531	0.0000
Capital	121	2.0661	221	2.2624	517	2.0954
LVR	124	0.0000	228	1.0965	538	0.3098
LLP	119	0.0000	224	2.2321	513	2.1118
LCG	120	0.0000	220	0.0000	516	0.3230
LoanR	120	0.0000	220	-0.7576	516	1.2920
LFC	122	0.6831	230	1.0870	538	0.7745
LTV	123	0.6775	225	-1.1111	545	2.7523
DSTI	123	0.6775	231	0.7215	553	1.3562
TAX	121	0.0000	221	0.0000	517	0.8059
Liquidity	124	0.0000	237	-0.7032	563	0.5921
LTD	122	0.0000	230	0.0000	538	0.1549
LFX	124	0.6720	237	1.0549	563	1.6282
RR	124	5.3763	231	-12.9870	555	0.1502
SIFI	124	0.0000	224	0.0000	545	0.0000
MPI	126	9.9206	237	-7.0323	578	13.9850
FINANCIAL	126	8.5979	237	-6.6807	578	10.0923
BORROWER	126	1.3228	237	-0.3516	578	3.8927
CAPITAL	126	1.9841	237	3.1646	578	2.1626
GENERAL	126	5.9524	237	-12.3066	578	2.3068
LOAN-SUPPLY	126	0.6614	237	2.4613	578	4.1811
LOAN-TARGET	126	1.9841	237	2.1097	578	8.0738

Note: We report annual changes of all the values at unit of $1.e^{-3}$.

Table 3-A3. Macroprudential policy (Cerutti et al., 2017) and banking crises

Variables	Model 1 (1)	Model 2 (2)	Model 3 (3)	Model 4 (4)
MPI	-7.0250			
	(4.5860)			
FINANCIAL		-3.2050		-3.6170
		(5.7740)		(6.4500)
BORROWER			-3.5430***	-3.4930***
			(1.0530)	(1.0410)
Credit gap	-0.1800***	-0.1740***	-0.2100***	-0.2070***
	(0.0613)	(0.0597)	(0.0691)	(0.0682)
Credit to GDP	0.1910***	0.1860***	0.2170***	0.2160***
	(0.0442)	(0.0436)	(0.0491)	(0.0483)
Output gap	-3.1290	-4.8260	-1.1790	-1.1290
	(7.0290)	(7.0160)	(7.4620)	(7.3330)
Real GDP per capita	-8.1130	-6.2020	-12.1000**	-12.5300**
	(5.3910)	(5.1700)	(6.1250)	(6.0950)
Real GDP	0.9840	0.3880	2.9870	3.1980
	(3.6250)	(3.5150)	(4.1980)	(4.2090)
Trade to GDP	-0.0091	-0.0086	-0.0034	-0.0030
	(0.0247)	(0.0246)	(0.0263)	(0.0261)
IMF program	1.3670*	1.4720*	1.6430**	1.5940**
	(0.7770)	(0.7570)	(0.7910)	(0.7990)
Regional crises	3.7670*	3.8690*	3.9470*	3.8920*
	(1.9320)	(1.9810)	(2.1440)	(2.1360)
Observations	424	424	424	424
Number of countries	31	31	31	31
Log likelihood	-45.560	-46.607	-41.475	-41.320
McFadden's R-squared	0.748	0.742	0.770	0.771

Notes: The banking crisis dummy is the dependent variable used in the regression. We estimated the regressions using the logistic regression with the country and period fixed effects. The table reports the estimates of the average elasticities of the conditional probability with respect to the regressors and the corresponding standard errors.

*** p<0.01, ** p<0.05, * p<0.1

Table 3-A4. Quantitative LTV_average and banking crises

Variables	Model 1 (1)
LTV_average	0.12900** (0.0610)
Credit gap	-0.3280*** (0.0920)
Credit to GDP	0.2330*** (0.0552)
Output gap	-6.0940 (8.8360)
Real GDP per capita	-17.2000** (8.6760)
Real GDP	2.0220 (6.5490)
Trade to GDP	-0.0797* (0.0429)
IMF program	2.4070** (1.0140)
Regional crises	3.7990 (4.0220)
Observations	395
Number of countries	27
Log likelihood	-24.970
McFadden's R-squared	0.854

Notes: The banking crisis dummy is the dependent variable used in the regression. We estimated the regressions using the logistic regression with the country and period fixed effects. The table reports the estimates of the average elasticities of the conditional probability with respect to the regressors and the corresponding standard errors.

*** p<0.01, ** p<0.05, * p<0.1

Table 3-A5. Macroprudential policies and banking crises (Reinhart and Rogoff, 2011)

Variables	Model 1 (1)	Model 2 (2)	Model 3 (3)	Model 4 (4)	Model 5 (5)	Model 6 (6)	Model 7 (7)	Model 8 (8)
MPI	-1.2060							
	(0.8830)							
FINANCIAL		-0.5540		-0.0050				
		(0.9350)		(0.9720)				
BORROWER			-0.9270**	-0.9260**				
			(0.4670)	(0.4710)				
CAPITAL					1.3830			
					(0.9270)			
GENERAL						0.0547		
						(0.2130)		
LOAN-SUPPLY							-1.7340**	
							(0.7910)	
LOAN-TARGET								-2.2740**
								(0.9680)
Credit gap	0.1190***	0.1180***	0.1190***	0.1190***	0.1190***	0.1180***	0.1250***	0.1240***
	(0.0335)	(0.0333)	(0.0333)	(0.0333)	(0.0333)	(0.0332)	(0.0340)	(0.0337)
Credit to GDP	0.0498***	0.0497***	0.0509***	0.0509***	0.0499***	0.0498***	0.0484***	0.0495***
	(0.0102)	(0.0101)	(0.0104)	(0.0104)	(0.0102)	(0.0101)	(0.0103)	(0.0104)
Output gap	2.9490	3.4900	3.3560	3.3530	5.006*	4.0630	3.2090	2.9690
	(2.8960)	(2.9030)	(2.8150)	(2.9000)	(2.8920)	(2.8380)	(2.8240)	(2.8250)
Real GDP per capita	-1.4600	-1.7190	-1.3640	-1.3630	-2.2430	-1.8960	-1.1500	-0.9300
	(1.4850)	(1.4710)	(1.4750)	(1.4930)	(1.4820)	(1.4440)	(1.4940)	(1.5100)
Real GDP	-3.8790***	-4.1060***	-4.1650***	-4.1630***	-4.8240***	-4.3840***	-3.950***	-3.8750***
	(1.4350)	(1.4450)	(1.4040)	(1.4530)	(1.4520)	(1.4140)	(1.4220)	(1.4270)
Trade to GDP	0.0170	0.0166	0.0205*	0.0204*	0.0184	0.0175	0.0217*	0.0230*
	(0.0114)	(0.0114)	(0.0116)	(0.0117)	(0.0112)	(0.0114)	(0.0118)	(0.0120)
IMF program	0.5900*	0.6040*	0.6460*	0.6460*	0.6440*	0.6320*	0.6030*	0.6270*
	(0.3410)	(0.3430)	(0.3460)	(0.3470)	(0.3490)	(0.3450)	(0.3430)	(0.3450)
Regional crises	2.1680***	2.2010***	2.1990***	2.1990***	2.2820***	2.2330***	2.2290***	2.2190***
	(0.4180)	(0.4190)	(0.4200)	(0.4220)	(0.4260)	(0.4190)	(0.4200)	(0.4210)
Observations	879	879	879	879	879	879	879	879
Number of iso3	42	42	42	42	42	42	42	42
Log likelihood	-170.028	-170.809	-167.811	-167.811	-169.891	-170.951	-168.327	-166.685
McFadden's R-squared	0.531	0.529	0.537	0.537	0.531	0.528	0.536	0.540

Notes: The banking crisis dummy is the dependent variable used in the regression. We estimated the regressions using the logistic regression with the country and period fixed effects. The table reports the estimates of the average elasticities of the conditional probability with respect to the regressors and the corresponding standard errors.

*** p<0.01, ** p<0.05, * p<0.1

Table 3-A6. List of countries (107 countries)

Albania	Dominican Republic	Latvia	South Africa
Algeria	Ecuador	Lebanon	Spain
Angola	El Salvador	Lesotho	Sri Lanka
Argentina	Estonia	Lithuania	St. Kitts and Nevis
Armenia	Fiji	Macedonia, FYR	Sudan
Australia	Finland	Malaysia	Sweden
Austria	France	Malta	Switzerland
Azerbaijan	Gambia, The	Mauritius	Tajikistan
Bahamas, The	Georgia	Mexico	Thailand
Bahrain	Germany	Moldova	Tunisia
Bangladesh	Ghana	Mongolia	Turkey
Belarus	Haiti	Montenegro	Uganda
Belgium	Honduras	Morocco	Ukraine
Bhutan	Hong Kong SAR, China	Mozambique	United Arab Emirates
Bosnia and Herzegovina	Hungary	Nepal	United Kingdom
Botswana	Iceland	Netherlands	United States
Brazil	India	New Zealand	Zambia
Brunei Darussalam	Indonesia	Norway	
Bulgaria	Ireland	Pakistan	
Burundi	Israel	Paraguay	
Cabo Verde	Italy	Peru	
Cambodia	Jamaica	Philippines	
Canada	Japan	Poland	
Chile	Jordan	Portugal	
China	Kazakhstan	Russian Federation	
Colombia	Kenya	Saudi Arabia	
Costa Rica	Korea, Rep.	Serbia	
Croatia	Kuwait	Singapore	
Cyprus	Kyrgyz Republic	Slovak Republic	
Czech Republic	Lao PDR	Slovenia	

Table 3-A7. List of countries (30 countries)

Brazil	Lithuania
China	Malaysia
Colombia	Mexico
Croatia	Moldova
Czech Republic	Mongolia
Dominican Republic	Paraguay
Finland	Philippines
Iceland	Russian Federation
India	Slovenia
Indonesia	Spain
Ireland	Sweden
Italy	Thailand
Japan	Ukraine
Korea, Rep.	United Kingdom
Kyrgyz Republic	United States

Chapter 4: Macroprudential policy and financial inclusion: Any difference between developed and developing countries?

4.1 Introduction

Since the onset of the 2008 financial crisis, many countries have adopted macroprudential policies (MPs) as a novel means to increase the resilience of their financial sectors. By controlling the banking sector's risks in aggregate, this approach has been effective in curbing the growth of credit and reducing the possibility of financial crises. However, similar to any other policies, MP may discourage financial development while achieving stability. One possible pitfall for policymakers is that these newly developed instruments might jeopardize financial inclusion, which has been recognized as one of the most important development targets. This study aims to provide evidence of this issue. Specifically, we explore the extent to which MP may affect financial inclusion. How do the influences differ across different types of policies? Does the effect differ by country groups?

MP might deteriorate the degree of financial inclusion by reducing the opportunity to receive a loan. For instance, the limit on loan-to-value (LTV) ratio and the loan-to-income ratio reduces the accessibility of credit, particularly for the economically disadvantaged (Akinci & Olmstead-Rumsey, 2018, De Araujo et al., 2020). Moreover, some MP tools require banks to prepare additional capital (e.g., countercyclical capital and capital conservation buffers). The additional requirement of capital is based on banks' risk exposure. This type of policy is equivalent to levying costs on bank loans, which allows banks to raise the credit bar. The above examples show how MP could result in fewer people accessing the credit market. Such adverse effects may disproportionately hurt the poor and those living in rural areas who have difficulty accessing financial services.

MP might also exert a positive influence on financial inclusion. It is perhaps inevitable that MP harms banks' profits – it increases their costs by requiring them to preserve more capital and reduces revenues due to restrictions imposed on leverage ratios and credit supply. In response to these negative impacts, banks adopt several strategies including geographical expansion to increase productivity by diversifying their risks (Goetz et al., 2016; Levine et al., 2016). Moreover, by expanding service coverage, banks increase profits by engaging in nontraditional banking activities or noninterest, income-based fees and services (Allen & Santomero, 2001; Elsas et al., 2010; Demirgüç-Kunt & Huizinga, 2010; Goddard et al., 2013; Saunders et al., 2020). These responses increase access to banking services and reduce the extent of the unbanked population.

In this study, we also explore the influence of MP on mobile banking services. Mobile banking has played a critical role in promoting financial inclusion. In particular, it provides a cost-efficient way to reach the unbanked poor in remote areas. One feature of the mobile banking industry is its economies of scale due to its high fixed costs. The break-even transaction, as estimated by Osafo-Kwaako et al. (2018), is around US$ 2–3 billion in annual transactions. Therefore, if transaction volumes are restricted by financial policy, even inadvertently, this may harm the development of mobile banking. We discuss the possible negative link between MP and credit supply in developing countries, which also results in impediments to mobile banking services.

In our empirical investigation, we first concentrate on the case of developing countries, using a penal data set consisting of 71 countries over the period 2004 to 2015. We then change the measure of financial inclusion, from the conventional indicators (geographical access to banking outlets) to measures based on mobile banking. Lastly, we examine the case of developed countries. The developed and developing countries are separately investigated because the problems of financial inclusion they face, and the implementation of MP are very

different. These differences are related to the forces at work discussed earlier. And in fact, as later shown in our empirical results, we find the influences in developed and developing countries are significantly different.

Following the work of Beck et al. (2007), we use eight indicators of financial inclusion, divided equally between access to and use of banking services. To measure MP we adapted the latest integrated MP database (iMaPP) constructed by Alam et al. (2019), in which MP is classified into 17 types of policy tools. We construct an aggregate measure of overall macroprudential policy (MPI). Moreover, we evaluate the effects of several major components of MP, which share a common purpose or target which clarifies the means by which MP affects financial inclusion. The two major indices are financial institution-targeted policy (FINANCIAL) and borrower-targeted policy (BORROWER), which represent the policy on the supply and demand sides of the financial markets, respectively. Since FINANCIAL consists of a relatively large number of tools for a variety of purposes, we consider two additional subgroups indexes: capital-targeted policy (CAPITAL) and loans supply-targeted policy (LOAN-SUPPLY). The former includes policies on banks' capital requirements, while the latter represents the policy on banks' credit supply. As explained earlier, policies on these two aspects have direct impacts on financial inclusion.

Our empirical results suggest that for developing countries, MP deteriorates financial inclusion in terms of the use of banking services. Among all the categories, BORROWER, which consists of all restrictions for borrowers on acquiring credit, has a significantly negative influence on several measures of financial inclusion. This conclusion also holds for the case of mobile banking. This finding is in line with the earlier argument that MP reduces the opportunity of receiving a loan. This seemingly intuitive finding, however, does not necessarily hold for developed countries. MPs (BORROWER, LOAN-SUPPLY) also have a negative influence on the use of banking services, but some tools (FINANCIAL, CAPITAL,

LOAN-SUPPLY) *positively* influence access to banking services. That is, more stringent policies decrease the unbanked population. This finding seems puzzling at first, but it is entirely possible to give the arguments and evidence provided earlier, in response to the policies, banks increase the geographical convergence and conduct more nontraditional banking activities.

We provide policy implications in two crucial aspects. First, the macroprudential literature mainly focuses on its beneficial effect—the effectiveness in reducing the systemic risks. In comparison, this study provides evidence on its costs, i.e., potential adverse influences on financial inclusion. This information is crucial for financial regulators, given that financial inclusion is the top priority policy agenda of many countries. Second, our results show that MP leads to asymmetric effects in developed and developing countries, highlighting the fact that the problems of financial inclusion in different countries are not identical. The rest of this study is organized as follow. Section 2 presents selective literature review on financial inclusion and MP. Section 3 provides details on the data and explains the econometric specification. Section 4 presents the empirical findings of the cases of developing countries, including the mobile banking, and developed countries. The last section provides conclusion and discussion.

4.2 Related Literature

Several studies have shown that MPs reduce excessive credit growth for both intensive and extensive margins (Alam et al., 2019; Cerutti et al., 2017; Bruno et al., 2017; Lim et al., 2011), which prevents borrowers from accessing and using financial services. This is achieved by policies using two different approaches—the credit demand side (borrowers) and the supply side (financial intermediaries) of the credit market. The policies targeting the borrowers' side

include limits on the LTV ratio and the debt-service-to-income ratio (DSTI). Several empirical studies have provided evidence of their negative influences on housing prices and mortgage demand. Kuttner and Shim (2016) show that a reduction of the DSTI has significant negative effects on housing credit, with a typical tightening action lowering the real credit growth rate by 4–6 percentage points. Allen et al. (2020) use a calibrated model based on the Canadian dataset to evaluate policy effects. The simulation results indicate that a tightening of the loan-to-value ratio (from 100% to 95%) has a significant negative impact on mortgage demand (8.2%), the number of first-time house buyers (7.9%), and number of households qualified for mortgages (51.5%). Other important studies include Richter et al. (2019) and Morgan et al. (2019), which provide similar evidence.

The policies on the supply side include restrictions on the capital requirement ratio and restrictions on credit supply. The effects of the capital requirement are less clear. Gambacorta and Murcia (2020) used loan-level data for five Latin American countries (Argentina, Brazil, Colombia, Mexico, and Peru) to evaluate the effects of various types of MP. They conclude that policies aimed at curbing the cycle and increasing capital requirements are both effective in reducing credit growth. Alternatively, Basten (2020) find that countercyclical capital buffers (CCBs) have a larger impact on the composition of credit suppliers; but the influences on market-wide mortgage growth is not significant. Fang et al. (2018) find that an increase in capital requirements lead to a short-term, negative impact on bank credit in Peru, but this effect becomes statistically insignificant after about six months. Stringent capital requirements as a part of MP deteriorates the banking sector's performance, which may lead to the fragility of the financial system (Vinhado & Divino, 2019).

Imposing MPs that aim to constrain excessive credit growth, targeting either the supply or demand side of the credit markets, would unavoidably affect the credit disbursements of financial institutions. One possible way to deal with restrictive policies is for banks to change

their management strategies, including geographic and service coverage expansion. Goetz et al. (2016) examine the net effect of geographic expansion on bank holding companies throughout US metropolitan areas and indicate that geographic expansion decreases bank risk. Similarly, Levine et al. (2016) indicate that geographic expansion would provide banks with the chance to diversify risk thereby lowering their funding costs. Geographical expansion offers opportunities for banks to diversify their risks, while engaging in more nontraditional banking or noninterest generating activities. Saunders et al. (2020) claim that a higher proportion of noninterest income is correlated with a bank's higher profitability.

The literature on the relationship between MPs and financial inclusion is limited. Sarma and Pais (2011) provide indirect evidence that a healthy banking system (represented by a low capital asset ratio or low nonperforming assets) is associated with low financial inclusion. Since stringent financial policy may contribute to a healthy banking system, this evidence implies a negative relationship between MP and financial inclusion. Anarfo et al. (2020) examine the impact of financial policy on financial inclusion in sub-Saharan Africa and find that stringent policies negatively impact access to financial services. Other studies use a single country dataset to discuss this relationship. Using data from Kenya, Kodongo (2018) indicates that capital and liquidity MPs could harm financial inclusion. Yoshino and Morgan (2017) present descriptive evidence on financial policies and the degree of financial inclusion in eight countries.

4.3 Methodology

This study examines how the adoption of MP relates to financial inclusion. Developed and developing countries are separately investigated because the problems of financial inclusion and the implementation of MP differ substantially between them. Our empirical analysis first concentrates on the case of developing countries given that financial inclusion is a priority.

We use panel data from 71 developing countries from 2004 to 2015. We then change the measure of financial inclusion from conventional indicators (geographical access to banking outlets) to those based on mobile banking as this is widely acknowledged to be important in developing countries. We evaluate how MP relates to mobile money accounts as a measure of financial inclusion, using panel data from 24 developing countries over the period 2009 to 2015.[42] Lastly, we examine the case of developed countries, covering 44 countries over the period 2004 to 2015, which enables us to compare the roles of MP between developing and developed countries. We classify developing and developed countries based on the World Bank income classification.[43]

4.3.1 Empirical model

To examine the relationship between MPs and financial inclusion, we estimate the following empirical model:

$$FI_{i,t} = \beta MP_{i,t-1} + \gamma X_{i,t-1} + \lambda_i + \delta_t + \varepsilon_{i,t},$$

where $FI_{i,t}$ is the indicator of financial inclusion, $MP_{i,t}$ is the indicator of MP, $X_{i,t}$ is a set of control variables, and $\varepsilon_{i,t}$ is the error term. The model includes the country fixed effects, λ_i, and the year fixed effects, δ_t, to control country and year specific effects. The year fixed effects are used to control the implicit common trend of the adaption of MPs. We use the one-year lag of MP since it may take some time to realize the impacts of policy adoption.[44] Similarly, we also use the one-year lag of other control variables to mitigate some problems of simultaneity. In this study, we estimate the empirical model for developing and developed countries separately.

[42] The sample in the analysis of the mobile banking in developing countries is reduced due to the data limitation.
[43] The group of developing countries consist of three income groups—low, lower-middle, and upper-middle income countries—while the group of developed countries consists of high-income countries.
[44] This setting is common in related studies (Cerutti et al., 2017; Altunbas et al., 2018).

4.3.2 Financial inclusion

We employ eight indicators of financial inclusion for our dependent variables, following the work of Beck et al. (2007). Four indicators measure access to banking services: (i) demographic branch penetration—branches per 100,000 adults (Access 1), (ii) geographic branch penetration—bank branches per 1,000 km^2 (Access 2), (iii) demographic ATM penetration—ATMs per 100,000 adults (Access 3), and (iv) geographic ATM penetration—ATMs per 1,000 km^2 (Access 4). The other four indicators measure the use of banking services: (i) loan accounts per capita—loan accounts per 1,000 adults (Use 1), (ii) deposit accounts per capita—deposit accounts per 1,000 adults (Use 2), (iii) number of borrowers per capita—borrowers per 1,000 adults (Use 3), and (iv) deposits per capita— deposits per 1,000 adults (Use 4).[45] The latter two indicators are reasonable measures for the banked population as one person may have more than one account. All eight indicators of financial inclusion are taken from the IMF's Financial Access Survey database. Our choice of indicators is commonly used by international organizations such as the World Bank, IMF, and G20.[46] We apply the log transformation to all indicators of financial inclusion as they are distributed with fat tails, following the work of Beck et al. (2007).

The eight indicators of financial inclusion may not fully capture an important aspect of the recent development of mobile banking. The innovation of financial products, such as mobile money or mobile banking, has grown rapidly over several decades.[47] Several studies

[45] The last two indicators were absent in the past (Beck et al., 2007; Sarma, 2008). Although the two indicators are now available from the IMF's Financial Access Survey (FAS), the number of observations is relatively limited compared to the other six indicators.

[46] There are several other indicators that measure the level of financial inclusion, e.g., policies holders with insurance cooperation, number of debit/credit cards, disputes resolution, which are listed in the G20 Financial Inclusion Indicators. Although the adoption of MP may affect other financial institutions, such as insurance companies, this study focuses on the indicators of financial inclusion that are primarily related to banking activities.

[47] Many studies suggest that mobile money has significantly contributed to poverty alleviation in developing countries. For example, M-PESA, a mobile money service in Kenya, has lifted 194,000 household or around 2% of poor Kenyans out of poverty (Suri & Jack, 2016). Similarly, Blauw and Franses (2016) and Aker et al. (2016) claim that mobile money is positively associated with income levels.

have shown the essential role of mobile money or mobile banking in promoting financial inclusion (Jack & Suri, 2011; Demirgüç-Kunt & Kapper, 2012; Mbiti & Weil, 2013; Munyegera & Matsumoto, 2016; Suri & Jack, 2016; Lashitew et al., 2018; Kochar, 2011. In developing countries, commercial banks tend to cover mainly urban or populated areas while excluding a large portion of the population in rural areas due to the lack of infrastructure and high operational costs. Mobile money enables previously unbanked customers to access various financial services, such as utilities and bill payments, money transfers, savings, and even borrowing. This important role encourages financial intermediaries, including banks, to switch their outreach from physical branches and ATMs to more cost-effective business strategies focusing on mobile banking. Thus, examining the effect of MP on the prevalence of the mobile banking should be required to discuss its effect on financial inclusion, particularly in developing countries.

To complement to the eight indicators of financial inclusion, our study employs alternative measures based on mobile banking, in the case of developing countries. Specifically, we use four indicators of mobile banking, two of which capture access to banking services: (i) mobile money agent outlets active per 1,000 km^2 and (ii) mobile money agent outlets active per 100,000 adults, and the other two indicators measure the use of banking services, (iii) mobile money accounts active per 1,000 adults, and (iv) mobile money transactions number per 1,000 adults. The data on these mobile money accounts are also sourced from the IMF Financial Access Survey.[48]

[48] Although the mobile banking plays an important role in promoting financial inclusion, the country-level data is very limited. We apply the log transformation to all indicators of mobile banking.

4.3.3 Macroprudential policy

We construct the measures of MP using the most recent integrated macroprudential policy (iMaPP) database constructed by Alam et al. (2019).[49] Although several studies have constructed databases of MPs,[50] iMaPP provides the most comprehensive coverage in terms of the number of countries (134), the length of the period covered (January 1990 to December 2016), and the types of policy tools (17). These 17 tools include countercyclical buffer (CCB), capital conservation buffer (Conservation), capital requirement for banks (Capital), limit on leverage of banks (LVR), loan loss provision (LLP), limits on growth or the volume of aggregate credit (LCG), loan restrictions (LoanR), limits on foreign currency lending (LFC), limits of the loan-to-value ratio (LTV), limits on the debt-service-to-income ratio (DSTI), taxes and levies applied to specified transactions (Tax), measures taken to mitigate systemic liquidity (Liquidity), limits to the loan-to-deposit ratio (LTD), limits on net or gross open foreign exchange positions (LFX), measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFI), reserve requirements (RR), and other MP tools (OT). Table 1 presents the detailed explanations of each MP tool.

[49] It integrates a wide range of previously constructed datasets (i) Lim et al. (2011), (ii) Lim et al. (2013), (iii) Global MP Instruments (2013), (iv) Shim et al. (2013), (v) European Systemic Risk Board (ESRB) database, (vi) the Bank of International Settlement (BIS) and Financial Stability Board website and IMF official documents, and (vii) the IMF's annual MP survey.

[50] Shim et al. (2013) construct a database based primarily on official sources of publications and press releases of the financial authorities over 60 countries during the period from January 1990 to June 2012. Cerutti et al. (2017) employ a database of MPs on an annual basis over 119 countries during the period from 2000 to 2013. Instead of referring to official publication sources, their method is based mainly on a survey project with various questionnaires, the Global Macroprudential Policy Instruments (GMPI) survey, conducted by the International Monetary Fund (IMF) during the period of 2013 to 2014.

Table 4-1. Definitions of macroprudential policy tools

Individual policy tools
1. CCB, A requirement for banks to maintain a countercyclical capital buffer. Implementations at 0% are not considered as a tightening in dummy-type indicators.
2. Conservation, Requirements for banks to maintain a capital conservation buffer, including the one established under Basel III.
3. Capital, Capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements. Countercyclical capital buffers and capital conservation buffers are captured in their sheets respectively and thus not included here. Subcategories of capital measures are also provided, classifying them into household sector targeted (HH), corporate sector targeted (Corp), broad-based (Gen), and FX-loan targeted (FX) measures.
4. LVR, A limit on leverage of banks, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures (e.g., Basel III leverage ratio).
5. LLP, Loan loss provision requirements for macroprudential purposes, which include dynamic provisioning and sectoral provisions (e.g. housing loans).
6. LCG, Limits on growth or the volume of aggregate credit, the household-sector credit, or the corporate-sector credit by banks, and penalties for high credit growth. Subcategories of limits to credit growth are also provided, classifying them into household sector targeted (HH), corporate sector targeted (Corp), and broad-based (Gen) measures.
7. LoanR, Loan restrictions, that are more tailored than those captured in "LCG". They include loan limits and prohibitions, which may be conditioned on loan characteristics (e.g., the maturity, the size, the LTV ratio and the type of interest rate of loans), bank characteristics (e.g., mortgage banks), and other factors. Subcategories of loan restrictions are also provided, classifying them into household sector targeted (HH), and corporate sector targeted (Corp) measures. Restrictions on foreign currency lending are captured in "LFC".
8. LFC, Limits on foreign currency (FC) lending, and rules or recommendations on FC loans.
9. LTV, Limit on the loan to value ratio including those mostly targeted at housing loans, but also includes those targeted at automobile loans, and commercial real estate loans.
10. DSTI, Limit on the debt service to income ratio and the loan-to-income ratio, which restrict the size of debt services or debt relative to income. They include those targeted at housing loans, consumer loans, and commercial real estate loans.
11. Tax, Taxes and levies applied to specified transactions, assets, or liabilities, which include stamp duties, and capital gain taxes.
12. Liquidity, Measures taken to mitigate systemic liquidity and funding risks, including minimum requirements for liquidity coverage ratios, liquid asset ratios, net stable funding ratios, core funding ratios and external debt restrictions that do not distinguish currencies.
13. LTD, Limits to the loan-to-deposit (LTD) ratio and penalties for high LTD ratios.
14. LFX, Limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mismatch policies.
15. SIFI, Measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFIs), which includes capital and liquidity surcharges.
16. RR, Reserve requirements (domestic or foreign currency) for macroprudential purposes. Please note that this category may currently include those for monetary policy as distinguishing those for macroprudential or monetary policy purposes is often not clear-cut. A subcategory of reserve requirements is provided for those differentiated by currency (FCD), as they are typically used for macroprudential purposes.
17. OT, Macroprudential measures not captured in the above categories—e.g., stress testing, restrictions on profit distribution, and structural measures (e.g., limits on exposures between financial institutions).

Notes: (1) The definition of individual instrument used in our analyses are based mainly on iMaPP constructed by Alam et al. (2019). (2) Each MP indicator is normalized by dividing it by the corresponding number of policy instruments.

In the iMaPP database, similar to other databases, each tool in a given year is recorded as dummy-type tightening and loosening indices. The index takes the value of 1 when the tool is being tightened, -1 when the tool is being loosened, and zero otherwise. Using monthly indicators, we construct the panel data of the state of each MP tool for each country in each year. Specifically, the state of the MP tool i of country j in year t is described by

$$\mathrm{MP_{ijt}} = \mathrm{MP_{ijt-1}} + \Delta\mathrm{MP_{ijt}}$$

where $\Delta\mathrm{MP_{ijt}}$ is the indicator of annual policy changes of the MP tool i from year $\mathrm{t}-1$ to year t, and $\mathrm{MP_{ijt-1}}$ is the indicator of the state of the MP tool i in the previous year $\mathrm{t}-1$. We set the initial value of the indicator representing the state of the MP tool in the initial year 1990 as zero to construct the state of each MP tool for all years.[51] We use the *state of policy* instead of the *change of policy* as the independent variable so that its value is not measured as the change in policy across a period for a given country—we implicitly take into account the *level* of MP in each country. The estimated coefficient of MP, β, in the empirical model can be interpreted as the influence of tightening (or loosening) one unit of the measure of a state of MP on the level of financial inclusion.

One main objective of this study is to explore the effectiveness of different groups of MP tools for a similar target. We follow the literature and construct several MP instrument measures using a total of 17 MP tools.[52] The details are presented in Table 2. The overall MP index (MPI) is the sum of the 17 states of the MP tools. Based on the policy targets of the demand or supply side of credit markets, we categorize these tools into two groups: borrower-

[51] One may be concerned about the initial value (annual indicators of the state of the MP instruments), since our dataset is constructed from the indicators representing annual policy changes. However, this issue can be solved by applying the fixed effects estimation in our analysis.

[52] In this study, "tool" refers to each of 17 individual MP tools, while "instrument" means a group consisting of several MP tools that share the same target or purpose.

targeted MP (BORROWER) and financial institution-targeted MP (FINANCIAL) instruments.[53] The measure of BORROWER is the sum of two states of MP tools: LTV and DSTI, while the measure of FINANCIAL is the sum of the other 15 states of MP tools. We then divide the financial institution-targeted MP (FINANCIAL) instrument into two new subgroups based on policy purpose: (i) capital-targeted MP instruments (CAPITAL), focusing on the restrictions on bank capital and (ii) loan supply-targeted MP instruments (LOAN-SUPPLY) imposing direct restrictions on the loans of financial institutions.[54]

Table 4-2. Groups of macroprudential policy (MP) instruments

Macroprudential policy indicators		
Overall MP instruments	MPI	All 17 policy instruments
Borrower-targeted MP instruments	BORROWER	LTV and DSTI
Financial institutions- targeted MP instruments	FINANCIAL	15 instruments beside LTV and DSTI
Capital-targeted MP instruments	CAPITAL	CCB, Conservation, Capital and LVR
Loans supply-targeted MP instruments	LOAN-SUPPLY	LCG, LLP, LoanR, LFC and LTD

Notes: The group and subgroup of MP classification used in our analyses are based mainly on iMaPP and Cerutti et al. (2017). MP indicators (MPI, BORROWER, FINANCIAL, CAPITAL, and LOAN-SUPPLY) are constructed by using the data of iMaPP.

4.3.4 Other control variables

Our choice of control variables reflects the relationship between the level of financial inclusion and macroeconomic conditions in past studies. Our study includes real GDP and real per capita GDP to capture the size of the economy and the income level of the country, respectively. Lashitew et al. (2019) state that GDP growth drives greater financial inclusion. Numerous studies have discussed the relationship between real per capita GDP and financial inclusion, indicating that a higher level of real per capita GDP is associated with greater financial inclusion (Lashitew et al., 2019; Grohmann et al., 2018; Owen & Pereira, 2018; Kumar et al., 2018; Chakravarty & Pal, 2013; Sarma & Pais, 2011; Beck et al., 2007). Following past works such as Allen et al. (2016), Kumar et al. (2018), and Sarma and Pais (2011), which claim that

[53] The classification of MP instruments into BORROWER and FINANCIAL basically follows the categories in Cerutti et al. (2017).
[54] The detailed classification of MP instruments generally follows the work of Alam et al. (2019).

unemployment rate plays an important role for financial inclusion, we also incoporate the unemployment rate in the model. In addition, we include the bank cost-to-income ratio variable to capture the association of banking activities with the level of financial inclusion. A higher cost of financial intermediation is associated with low financial inclusion (Allen et al., 2016; Nurbekyan & Hovanessian, 2018).

We include secondary and tertiary education levels in the model. Higher education is associated with higher financial inclusion (Grohmann et al., 2018; Allen et al., 2016; Zins & Weill, 2016; Fungáčová & Weill, 2014). Following studies on the role of institutional quality and political risk in promoting financial inclusion (Lashitew et al., 2019; Kabakova & Plaksenkov, 2018; Allen et al., 2016), including Allen et al. (2016) who show that a more stable political environment encourages greater financial inclusion, we also incorporate political stability into the model. Table 3 provides a brief description of the definitions and sources of all variables used in our analysis; Table 4 is the list of 71 developing and 24 developed countries in the empirical model; and Table 5 presents a summary of the statistics for all variables used in our study.

Table 4-3. Data description and sources of variables

Variable	Definition	Source
Dependent variable		
Demographic branch penetration	Number of branches per 100,000 adults	Financial Access Survey-IMF
Geographic branch penetration	Number of branches per 1,000 km2	Financial Access Survey-IMF
Demographic ATM penetration	Number of ATMs per 100,000 adults	Financial Access Survey-IMF
Geographic ATM penetration	Number of ATMs per 1,000 km2	Financial Access Survey-IMF
Loan account per capita	Number of loan account per 1,000 adults	Financial Access Survey-IMF
Deposit account per capita	Number of deposit account per 1,000 adults	Financial Access Survey-IMF
Borrower per capita	Number of borrowers per 1,000 adults	Financial Access Survey-IMF
Depositor per capita	Number of depositors per 1,000 adults	Financial Access Survey-IMF
Independent variable		
MPI	Overall MP instruments	Authors' calculation based on Alam et al. (2019)
BORROWER	Borrower-targeted MP instruments	Authors' calculation based on Alam et al. (2019)
FINANCIAL	Financial institutions- targeted MP instruments	Authors' calculation based on Alam et al. (2019)
CAPITAL	Capital-targeted MP instruments	Authors' calculation based on Alam et al. (2019)
LOAN-SUPPLY	Loans supply-targeted MP instruments	Authors' calculation based on Alam et al. (2019)
Real GDP per capita	Log of real GDP per capita	World Bank's Global Financial Development Database (2018)
Real GDP	Log of real GDP	Penn World Table9
Unemployment	Unemployment refers to the share of the labor force that is without work but available for and seeking employment. Unemployment, total (% of total labor force) (modeled ILO estimate).	The World Bank Data
Bank cost to income ratio	Operating expenses of a bank as a share of sum of net-interest revenue and other operating income.	World Bank's Global Financial Development Database (2018)
Secondary school education	Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Secondary education completes the provision of basic education that began at the primary level and aims at laying the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialized teachers.	World Bank Data
Tertiary school education	Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Tertiary education, whether or not to an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level.	World Bank Data
Political stability	Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism.	Worldwide Governance Indicators

Table 4-4. List of developing and developed countries

Developing countries			Developed countries
Albania	Georgia	Niger	Argentina
Algeria	Ghana	Nigeria	Austria
Angola	Honduras	Pakistan	Belgium
Armenia	India	Paraguay	Brunei Darussalam
Bangladesh	Indonesia	Peru	Canada
Belarus	Jamaica	Philippines	Chile
Benin	Jordan	Romania	Croatia
Bhutan	Kazakhstan	Russian Federation	Cyprus
Botswana	Kenya	Senegal	Czech Republic
Brazil	Kyrgyz Republic	Serbia	Denmark
Bulgaria	Lao PDR	South Africa	Estonia
Burkina Faso	Lebanon	Sri Lanka	Finland
Burundi	Lesotho	Sudan	Korea, Rep.
Cabo Verde	Macedonia, FYR	Tajikistan	Kuwait
Cambodia	Malaysia	Thailand	Latvia
China	Mali	Togo	Lithuania
Colombia	Mauritania	Tunisia	Luxembourg
Congo, Dem. Rep.	Mauritius	Turkey	Malta
Costa Rica	Mexico	Uganda	Netherlands
Côte d'Ivoire	Moldova	Ukraine	New Zealand
Dominican Republic	Mongolia	Yemen, Rep.	Norway
Ecuador	Montenegro		Oman
El Salvador	Morocco		Poland
Ethiopia	Mozambique		Portugal
Gambia, The	Nepal		

Table 4-5. Descriptive of Statistics

Variables	No of Observations	Mean	Std.Dev.	Min	Max
Access to financial service indicators					
Demographic branch penetration	549	2.168	1.075	-.908	4.524
Geographic branch penetration	549	1.413	1.835	-3.848	4.717
Demographic ATM penetration	518	2.632	1.597	-4.425	5.222
Geographic ATM penetration	518	1.987	2.041	-5.173	5.173
Use of financial service indicators					
Loan account per capita	260	5.203	1.259	.351	7.741
Deposit account per capita	358	6.426	1.208	2.476	8.453
Borrower per capita	296	4.408	1.450	-.676	6.771
Depositor per capita	288	5.665	1.387	1.581	8.126
Indicator of Macroprudential policy instruments					
Overall MP instruments	549	3.122	5.505	-9	53
Financial institutions-targeted MP instruments	549	2.652	4.71	-9	42
Borrowers-targeted MP instruments	549	.47	1.17	-1	11
Capital-targeted MP instruments	549	.548	1.036	0	6
Loan supply-targeted MP instruments	549	.696	1.636	-3	12
Control variables					
Real GDP	549	11.33	1.859	7.885	16.582
Real GDP per capita	549	7.764	1.051	5.268	9.496
Unemployment	549	8.844	6.774	.32	37.25
Bank cost to income ratio	549	56.617	12.395	23.377	103.786
Secondary school education	549	69.856	26.074	7.228	120.328
Tertiary school education	549	28.445	20.741	.898	92.512
Political stability	549	11.33	1.859	7.885	16.582

4.4 Empirical results

This section discusses the results of the relationship between MP instruments and financial inclusion of each subsample for developing and developed countries. Table 6 summarizes the main results of our estimations.

Table 4-6. Macroprudential policy and financial inclusion

	Developing countries				Developed countries	
	Access to banking Services	Use of banking services	Mobile banking		Access to banking services	Use of banking services
			Access to banking services	Use of banking services		
MPI	–	–	–	–	Positive	–
BORROWER	–	Negative	Negative	Negative	–	Negative
FINANCIAL	–	–	–	–	Positive	–
CAPITAL	–	–	–	–	Positive	–
LOAN-SUPPLY	–	Negative	–	–	Positive	Negative

Notes: “Negative” (“positive”) implies the significantly negative (positive) relationship between MP instrument and financial inclusion, and “–“ implies no significant relationship between them.

4.1 Developing countries

Table 7 shows the estimated results of overall MP (MPI) for access to (columns 1–4) and use of (columns 5–8) banking services, and Table 8 shows the estimated results of BORROWER and FINANCIAL. First, we do not find any significant relationship between the aggregate measure of MP (MPI) and financial inclusion. Second, Table 8 presents that the coefficients of BORROWER are significantly negative for the use of banking services, but not significant for access to banking services. This finding suggests that demand side MP discourage people's use of banking services. For instance, with a lower maximum loan-to-value ratio, some potential customers who do not have enough income and collateral may not be able to open bank accounts to obtain loans, including mortgage loans. The primary objective of borrower-targeted MP is to prevent rapid credit expansion from the demand side of the credit market and hence to reduce the systemic risk and the accumulation of the vulnerabilities of the financial system. This favorable effect is generally substantial in developing countries (Certutti et al., 2017; Ayyagari et al., 2017; Fendoğlu, 2017; Alam et al., 2019). Our results show the presence of the costs of MP. Borrower-targeted MPs would bring about a negative side effect on the use of banking services, that is, the reduction of systemic risk at the expense of financial inclusion in developing countries.

Table 4-7. Overall measure of MP (developing countries)

	Access to the banking services				Use of banking services			
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
MPI	0.0028	-0.0008	-0.0026	-0.0044	-0.0072	-0.0020	-0.0338*	-0.0043
	(0.0085)	(0.0087)	(0.0117)	(0.0115)	(0.0134)	(0.0068)	(0.0181)	(0.0043)
Real GDP	0.2497	0.3957**	0.9143***	1.0243***	0.0142	0.3692	0.3238	0.5949
	(0.1524)	(0.1524)	(0.3388)	(0.3527)	(0.3677)	(0.3347)	(0.6203)	(0.3538)
Real GDP per capita	0.2584	0.0176	2.0603**	1.8954**	1.2943	1.1736**	1.0954	0.7009*
	(0.2948)	(0.3016)	(0.8879)	(0.9317)	(0.7729)	(0.4430)	(0.8502)	(0.4018)
Unemployment	-0.0045	-0.0060	0.0035	0.0008	0.0402	0.0204	0.0232	0.0157
	(0.0097)	(0.0100)	(0.0122)	(0.0122)	(0.0245)	(0.0137)	(0.0212)	(0.0101)
Bank cost to income ratio	-0.0047**	-0.0057***	0.0062*	0.0051	-0.0035	-0.0016	0.0001	-0.0013
	(0.0019)	(0.0019)	(0.0036)	(0.0037)	(0.0034)	(0.0026)	(0.0036)	(0.0034)
Secondary school education	0.0185***	0.0197***	0.0201**	0.0205**	0.0046	0.0047	0.0069	0.0135**
	(0.0049)	(0.0054)	(0.0098)	(0.0097)	(0.0060)	(0.0048)	(0.0097)	(0.0055)
Tertiary school education	-0.0085*	-0.0097*	-0.0183***	-0.0196***	-0.0115	-0.0031	-0.0039	-0.0143***
	(0.0044)	(0.0049)	(0.0059)	(0.0062)	(0.0135)	(0.0055)	(0.0052)	(0.0053)
Political stability	0.0869	0.0598	-0.0310	-0.0570	0.2280*	-0.0400	0.2917	-0.0275
	(0.0613)	(0.0654)	(0.1040)	(0.1077)	(0.1155)	(0.0637)	(0.1916)	(0.0619)
Observations	549	549	518	518	260	358	296	288
Number of countries	71	71	70	70	37	48	41	43
R-squared	0.4547	0.5429	0.7067	0.7288	0.4901	0.5705	0.6063	0.6004

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 4-8. Borrower- and financial institution-targeted MP (developing countries)

	BORROWER								FINANCIAL							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
BORROWER	-0.0420	-0.0394	-0.0544	-0.0493	-0.0734	-0.0705**	-0.1937***	-0.0406								
	(0.0377)	(0.0392)	(0.0475)	(0.0474)	(0.0697)	(0.0270)	(0.0637)	(0.0289)								
FINANCIAL									0.0050	0.0009	-0.0007	-0.0032	-0.0038	0.0009	-0.0230	-0.0037
									(0.0095)	(0.0099)	(0.0133)	(0.0130)	(0.0154)	(0.0086)	(0.0212)	(0.0055)
Real GDP	0.2578*	0.4029***	0.9113***	1.0237***	0.0078	0.3729	0.2720	0.5969*	0.2504	0.3957**	0.9164***	1.0260***	0.0155	0.3742	0.3065	0.5972*
	(0.1500)	(0.1502)	(0.3383)	(0.3522)	(0.3645)	(0.3166)	(0.6095)	(0.3479)	(0.1520)	(0.1522)	(0.3386)	(0.3526)	(0.3705)	(0.3352)	(0.6496)	(0.3546)
Real GDP per capita	0.2755	0.0145	2.0980**	1.9015**	1.2255	1.2736***	0.7798	0.7338*	0.2461	0.0079	2.0334**	1.8736**	1.2436	1.1204**	1.0513	0.6762*
	(0.2839)	(0.2858)	(0.8491)	(0.8954)	(0.7544)	(0.4129)	(0.7776)	(0.3908)	(0.2958)	(0.3053)	(0.8950)	(0.9383)	(0.7706)	(0.4388)	(0.8644)	(0.4013)
Unemployment	-0.0052	-0.0064	0.0030	0.0005	0.0400	0.0160	0.0257	0.0151	-0.0043	-0.0058	0.0037	0.0009	0.0417*	0.0207	0.0247	0.0156
	(0.0092)	(0.0096)	(0.0123)	(0.0123)	(0.0278)	(0.0133)	(0.0214)	(0.0103)	(0.0096)	(0.0100)	(0.0122)	(0.0121)	(0.0246)	(0.0135)	(0.0212)	(0.0099)
Bank cost to income ratio	-0.0045**	-0.0056***	0.0062*	0.0051	-0.0027	-0.0014	0.0016	-0.0014	-0.0048**	-0.0058***	0.0061*	0.0051	-0.0036	-0.0017	0.0003	-0.0013
	(0.0019)	(0.0020)	(0.0036)	(0.0037)	(0.0031)	(0.0027)	(0.0033)	(0.0034)	(0.0019)	(0.0019)	(0.0036)	(0.0037)	(0.0035)	(0.0026)	(0.0035)	(0.0034)
Secondary school education	0.0184***	0.0197***	0.0204**	0.0208**	0.0045	0.0051	0.0071	0.0137**	0.0185***	0.0197***	0.0200**	0.0205**	0.0046	0.0047	0.0068	0.0134**
	(0.0049)	(0.0054)	(0.0097)	(0.0097)	(0.0058)	(0.0044)	(0.0090)	(0.0053)	(0.0049)	(0.0054)	(0.0098)	(0.0097)	(0.0060)	(0.0047)	(0.0098)	(0.0055)
Tertiary school education	-0.0079*	-0.0094*	-0.0180***	-0.0194***	-0.0112	-0.0023	-0.0047	-0.0139**	-0.0086*	-0.0098**	-0.0184***	-0.0197***	-0.0115	-0.0033	-0.0047	-0.0145***
	(0.0045)	(0.0050)	(0.0059)	(0.0062)	(0.0130)	(0.0056)	(0.0046)	(0.0054)	(0.0043)	(0.0049)	(0.0059)	(0.0063)	(0.0135)	(0.0055)	(0.0055)	(0.0053)
Political stability	0.0876	0.0608	-0.0373	-0.0611	0.2102*	-0.0620	0.2791	-0.0334	0.0871	0.0599	-0.0293	-0.0555	0.2313*	-0.0379	0.3063	-0.0253
	(0.0612)	(0.0649)	(0.0995)	(0.1035)	(0.1233)	(0.0664)	(0.1866)	(0.0643)	(0.0611)	(0.0651)	(0.1039)	(0.1077)	(0.1167)	(0.0635)	(0.1928)	(0.0614)
Observations	549	549	518	518	260	358	296	288	549	549	518	518	260	358	296	288
Number of countries	71	71	70	70	37	48	41	43	71	71	70	70	37	48	41	43
R-squared	0.4586	0.5456	0.7081	0.7297	0.4971	0.5846	0.6221	0.6028	0.4556	0.5429	0.7067	0.7287	0.4889	0.5703	0.5997	0.6000

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets.

*** p<0.01, ** p<0.05, * p<0.1

Third, for all indicators of access to and use of banking services, the coefficients of FINANCIAL are insignificant. Financial institution-targeted MP are composed of several policy tools with different objectives, so that each tool could have different effects on financial inclusion. Thus, we extend our analysis to the efficacy of the two subgroups of FINANCIAL (CAPITAL and LOAN-SUPPLY). Table 9 reports the estimated results. The estimations show that CAPITAL fails to show a clear relationship with any indicators of financial inclusion.[55] Conversely, LOAN-SUPPLY is negatively correlated with the use of banking services (loan accounts and the number of borrowers per capita). Once banks' loan supply activities are restricted by policies, such as limits on aggregate credit volume, they become more cautious about the quality of loan disbursements. To comply with such policiess, banks need to limit loan applications, which consequently deteriorates the use of banking services. Accounting for the results of the negative relationship between the demand side MP instruments (BORROWER) and the use of banking services, our analysis indicates that both demand and supply side loan-related MP instruments (BORROWER and LOAN-SUPPLY) hinder financial inclusion, particularly the use of banking services in developing countries. Loan-related MPs incur costs in the context of financial inclusion, although they mitigate rapid credit expansion and its associated systemic risk (Aiyar et al., 2014; Cerutti et al., 2017; Fendoğlu, 2017; Richter et al., 2019; Alam et al., 2019).

[55] Anarfo et al. (2020) and Sarma and Pais (2011) show that capital adequacy ratio (CAR) is negatively associated with financial inclusion. There are some possible reasons for this difference. The previous studies use only single tool, CAR, while our study considers a group of tools which share similar policy targets. In addition, we employ different measures of financial inclusion indicators.

Table 4-9. Capital- and loan supply-targeted MP (developing countries)

	CAPITAL								LOAN-SUPPLY							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
CAPITAL	0.0012	-0.0138	-0.0514	-0.0642	-0.0151	0.0175	-0.0799	-0.0221								
	(0.0256)	(0.0286)	(0.0399)	(0.0399)	(0.0456)	(0.0363)	(0.0516)	(0.0369)								
LOAN-SUPPLY									-0.0064	-0.0057	0.0456	0.0443	-0.1248***	0.0044	-0.1225***	-0.0066
									(0.0238)	(0.0271)	(0.0518)	(0.0539)	(0.0235)	(0.0216)	(0.0381)	(0.0226)
Real GDP	0.2504	0.3923**	0.9058**	1.0148***	0.0034	0.3828	0.2618	0.6029*	0.2537	0.3989**	0.8948**	1.0073***	0.1678	0.3709	0.3943	0.6036*
	(0.1541)	(0.1531)	(0.3433)	(0.3577)	(0.3799)	(0.3325)	(0.6550)	(0.3519)	(0.1552)	(0.1542)	(0.3436)	(0.3560)	(0.3182)	(0.3361)	(0.5698)	(0.3520)
Real GDP per capita	0.2727	0.0280	2.0714**	1.8936**	1.2275	1.1062***	1.0176	0.6440*	0.2767	0.0155	1.9189**	1.7324*	1.4423**	1.1219**	0.9577	0.6379
	(0.2831)	(0.2848)	(0.8640)	(0.9042)	(0.7525)	(0.4067)	(0.8721)	(0.3821)	(0.2916)	(0.2935)	(0.8786)	(0.9208)	(0.6294)	(0.4198)	(0.7538)	(0.3798)
Unemployment	-0.0047	-0.0068	0.0008	-0.0025	0.0415	0.0216	0.0253	0.0145	-0.0051	-0.0063	0.0055	0.0029	0.0206	0.0209	0.0211	0.0151
	(0.0099)	(0.0104)	(0.0123)	(0.0123)	(0.0248)	(0.0132)	(0.0218)	(0.0103)	(0.0098)	(0.0101)	(0.0121)	(0.0119)	(0.0228)	(0.0133)	(0.0195)	(0.0099)
Bank cost to income ratio	-0.0046**	-0.0056***	0.0068*	0.0059	-0.0035	-0.0018	0.0007	-0.0012	-0.0046**	-0.0058***	0.0065*	0.0054	-0.0046	-0.0017	-0.0007	-0.0013
	(0.0019)	(0.0020)	(0.0037)	(0.0038)	(0.0036)	(0.0025)	(0.0033)	(0.0034)	(0.0019)	(0.0020)	(0.0037)	(0.0038)	(0.0031)	(0.0025)	(0.0038)	(0.0035)
Secondary school education	0.0184***	0.0198***	0.0204**	0.0210**	0.0048	0.0047	0.0081	0.0134**	0.0184***	0.0197***	0.0197**	0.0202**	0.0072	0.0046	0.0066	0.0133**
	(0.0049)	(0.0053)	(0.0097)	(0.0096)	(0.0063)	(0.0047)	(0.0102)	(0.0053)	(0.0049)	(0.0053)	(0.0097)	(0.0096)	(0.0055)	(0.0048)	(0.0098)	(0.0055)
Tertiary school education	-0.0084*	-0.0096*	-0.0176***	-0.0187***	-0.0118	-0.0037	-0.0050	-0.0138**	-0.0083*	-0.0097*	-0.0190***	-0.0203***	-0.0154	-0.0034	-0.0044	-0.0146***
	(0.0045)	(0.0050)	(0.0056)	(0.0059)	(0.0136)	(0.0054)	(0.0053)	(0.0053)	(0.0044)	(0.0049)	(0.0060)	(0.0063)	(0.0118)	(0.0054)	(0.0048)	(0.0054)
Political stability	0.0868	0.0580	-0.0398	-0.0670	0.2262*	-0.0348	0.2838	-0.0251	0.0848	0.0582	-0.0026	-0.0279	0.1340	-0.0355	0.2225	-0.0237
	(0.0625)	(0.0670)	(0.1025)	(0.1065)	(0.1130)	(0.0630)	(0.2028)	(0.0653)	(0.0603)	(0.0635)	(0.1087)	(0.1122)	(0.1005)	(0.0615)	(0.1805)	(0.0634)
Observations	549	549	518	518	260	358	296	288	549	549	518	518	260	358	296	288
Number of countries	71	71	70	70	37	48	41	43	71	71	70	70	37	48	41	43
R-squared	0.4543	0.5436	0.7087	0.7315	0.4891	0.5714	0.6029	0.601	0.4546	0.5431	0.7102	0.7316	0.5716	0.5704	0.6254	0.5997

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets.

*** p<0.01, ** p<0.05, * p<0.1

To ensure the robustness of our baseline findings, we also conduct several sensitivity analyses by (i) employing the system GMM estimator, (ii) estimating the relationship between MPs and financial inclusion with a constructed multidimensional index of financial inclusion, and (iii) estimating the models with additional control variables.[56] The results are generally consistent with our baseline findings.

4.4.2 Mobile banking

Given that mobile banking plays a crucial role in developing countries, we extend our analysis by using the four indicators of mobile banking as alternative measures of financial inclusion in developing countries.[57] Tables 10 and 11 report the estimated results. The results are generally in line with the results based on the conventional measures—BORROWER is negatively associated with the use of banking services. Interestingly, BORROWER is also negatively associated with access to banking services. This finding implies that as the MP become more stringent, fewer loans are provided. Since more people are excluded from the use of banking services, less money agents' outlets are required. The results provide further evidence that mobile banking has become important compared with traditional banks' outreach, such as branches and ATMs, in developing countries.

[56] See the appendix for the discussions and the results of the sensitivity analyses for developing countries (Tables A1–A7).

[57] Mobile banking becomes more important for both developing and developed countries. However, due to the data limitation for developed countries, we can only estimate the relationship between MP and mobile banking in developing countries. Thus, the relationship between all MP instruments and mobile banking in developed countries is still an open discussion for future research.

Table 4-10. Mobile money agent outlets and MP in developing countries (access to banking services)

	Mobile money agent outlets: active per 1,000 km2					Mobile money agent outlets: active per 100,000 adults				
MPI	-0.0556					-0.0538				
	(0.0985)					(0.0980)				
BORROWER		-1.4709***					-1.4628***			
		(0.4137)					(0.4138)			
FINANCIAL			-0.0190					-0.0174		
			(0.1164)					(0.1159)		
CAPITAL				-0.4324					-0.4262	
				(0.3547)					(0.3537)	
LOAN-SUPPLY					0.5181					0.5186
					(0.3877)					(0.3875)
Real GDP	10.9824***	11.2489***	11.1054***	11.0629***	10.5853***	10.8101***	11.0701***	10.9324***	10.8861***	10.4064***
	(3.4175)	(3.1256)	(3.4523)	(3.2891)	(3.3657)	(3.3805)	(3.0887)	(3.4151)	(3.2514)	(3.3271)
Real GDP per capita	1.3158	2.6023	1.0248	0.9510	3.7241	1.4973	2.7874	1.2095	1.1449	3.9214
	(7.7802)	(7.5821)	(7.6599)	(7.8754)	(6.4935)	(7.7542)	(7.5671)	(7.6330)	(7.8510)	(6.4728)
Unemployment	0.1347	0.1451	0.1315	0.1532	0.0270	0.1383	0.1486	0.1350	0.1566	0.0306
	(0.1405)	(0.1367)	(0.1433)	(0.1378)	(0.1514)	(0.1403)	(0.1364)	(0.1430)	(0.1375)	(0.1507)
Observations	70	70	70	70	70	70	70	70	70	70
R-squared	0.7445	0.7677	0.7432	0.7492	0.7827	0.7312	0.7556	0.7299	0.7361	0.7719
Number of countries	23	23	23	23	23	23	23	23	23	23

Notes: Eight indicators of financial inclusion of which two indicators measure access to the banking services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-11. Mobile money agent outlets and MP in developing countries (use of banking services)

	Mobile money accounts: active per 1,000 adults					Mobile money transactions: number per 1,000 adults				
MPI	0.1474					-0.1905**				
	(0.1266)					(0.0816)				
BORROWER		-2.0208***					-0.8446***			
		(0.5611)					(0.2180)			
FINANCIAL			0.1941					-0.1869		
			(0.1316)					(0.1290)		
CAPITAL				-0.4208					-0.7456	
				(0.6005)					(0.4482)	
LOAN-SUPPLY					0.6563					-0.0306
					(0.6369)					(0.4417)
Real GDP	5.3703*	4.5172	5.6081*	4.4632	3.8619	4.8545*	3.8104	5.1101*	4.2918	5.0393
	(2.8812)	(2.8324)	(2.8511)	(2.8622)	(2.9688)	(2.6647)	(2.5265)	(2.9540)	(3.0471)	(4.0600)
Real GDP per capita	-4.7855	-2.7728	-4.9012	-3.9605	-1.2304	9.9216	10.9273*	9.3349	8.4314	8.3545
	(7.1402)	(8.0180)	(7.0942)	(7.7403)	(8.1149)	(6.7175)	(6.3568)	(6.8270)	(6.6670)	(7.3375)
Unemployment	0.1745	0.1863	0.1756	0.1941	0.0599	0.3208*	0.2930*	0.3332*	0.3892**	0.3488*
	(0.1922)	(0.1890)	(0.1911)	(0.1890)	(0.1409)	(0.1706)	(0.1605)	(0.1736)	(0.1771)	(0.1750)
Observations	87	87	87	87	87	131	131	131	131	131
R-squared	0.5314	0.5526	0.5363	0.5283	0.5641	0.6863	0.7047	0.6752	0.6732	0.6571
Number of countries	24	24	24	24	24	32	32	32	32	32

Notes: Eight indicators of financial inclusion of which two indicators measure use of banking services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

4.4.3 Developed countries

Financial inclusion or exclusion from financial services is a crucial agenda for developing countries, but this issue is also a challenge for developed countries (Mylonidis et al., 2019; Sarma & Pais, 2011; Simpson & Buckland, 2009; Carbo et al., 2007; Devlin, 2005; Kempson et al., 2004). The nature of the MP effects are different, depending on their developmental stages. Thus, we extend our analysis to developed countries and compare our results to developing countries with those in developed countries. Tables 12, 13, and 14 present the estimated results of the models using MPI, BORROWER, FINANCIAL, CAPITAL, and LOAN-SUPPLY in developed countries, which indicate similarities and differences in the effects of MPs on financial inclusion between the two country groups.[58]

[58] See the appendix for the discussions and the results of the sensitivity analyses for developed countries (Tables A8−A14).

Table 4-12. Overall measure of MP (developed countries)

	Access to banking services				Use of banking services			
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
MPI	0.0137**	0.0181***	0.0104	0.0144*	-0.0171	-0.0003	-0.0150	-0.0140*
	(0.0054)	(0.0054)	(0.0075)	(0.0072)	(0.0240)	(0.0059)	(0.0097)	(0.0067)
Real GDP	0.0507	0.3928***	0.5042***	0.8377***	0.4868	0.3322**	0.1650	0.0592
	(0.1290)	(0.1441)	(0.1537)	(0.1714)	(0.3436)	(0.1258)	(0.1314)	(0.1025)
Real GDP per capita	-0.2115	-0.7712***	0.2293	-0.3290	0.9833	0.8117***	0.7148**	1.2266***
	(0.2142)	(0.2365)	(0.3540)	(0.3449)	(0.8899)	(0.2774)	(0.3181)	(0.2703)
Unemployment	-0.0162***	-0.0224***	-0.0088	-0.0146**	0.0054	0.0022	0.0013	0.0076
	(0.0054)	(0.0056)	(0.0063)	(0.0060)	(0.0130)	(0.0068)	(0.0087)	(0.0097)
Bank cost to income ratio	-0.0003	-0.0001	-0.0006	-0.0004	-0.0003	-0.0009	-0.0033*	-0.0004
	(0.0007)	(0.0007)	(0.0008)	(0.0008)	(0.0023)	(0.0007)	(0.0017)	(0.0019)
Secondary school education	-0.0024	-0.0030	0.0025	0.0018	-0.0066	0.0011	-0.0032	-0.0014
	(0.0019)	(0.0020)	(0.0019)	(0.0020)	(0.0077)	(0.0015)	(0.0028)	(0.0037)
Tertiary school education	0.0057***	0.0073***	0.0032	0.0047**	0.0046	-0.0003	0.0026	0.0087**
	(0.0021)	(0.0022)	(0.0020)	(0.0020)	(0.0039)	(0.0021)	(0.0028)	(0.0031)
Political stability	0.0348	0.0134	0.0523	0.0414	0.1352	-0.1226*	0.0524	-0.0386
	(0.0679)	(0.0653)	(0.0619)	(0.0583)	(0.1342)	(0.0653)	(0.0635)	(0.0956)
Observations	437	437	417	417	163	247	131	93
Number of countries	44	44	42	42	18	27	16	13
R-squared	0.4694	0.4693	0.5603	0.6667	0.5081	0.5645	0.7163	0.7842

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 4-13. Borrower- and financial institution-targeted MP (developed countries)

	BORROWER								FINANCIAL							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
BORROWER	0.0140	0.0171	0.0162	0.0172	-0.0477*	0.0000	-0.0378	-0.0538**								
	(0.0133)	(0.0121)	(0.0156)	(0.0140)	(0.0256)	(0.0116)	(0.0395)	(0.0235)								
FINANCIAL									0.0184***	0.0247***	0.0118	0.0178*	-0.0103	-0.0004	-0.0160	-0.0137
									(0.0064)	(0.0071)	(0.0094)	(0.0094)	(0.0294)	(0.0068)	(0.0106)	(0.0079)
Real GDP	0.0848	0.4362***	0.5039***	0.8347***	0.5052	0.3312***	0.1580	0.0348	0.0234	0.3557**	0.4994***	0.8316***	0.5048	0.3328**	0.1658	0.0703
	(0.1293)	(0.1412)	(0.1597)	(0.1799)	(0.3504)	(0.1108)	(0.1364)	(0.1351)	(0.1292)	(0.1478)	(0.1530)	(0.1696)	(0.3415)	(0.1297)	(0.1348)	(0.0992)
Real GDP per capita	-0.1725	-0.7172***	0.2753	-0.2590	0.8601	0.8110***	0.6471*	1.2421***	-0.1993	-0.7564***	0.2349	-0.3292	1.0194	0.8119***	0.7323**	1.2055***
	(0.2235)	(0.2560)	(0.3465)	(0.3512)	(0.8946)	(0.2761)	(0.3270)	(0.2838)	(0.2072)	(0.2270)	(0.3552)	(0.3440)	(0.8919)	(0.2773)	(0.3181)	(0.2740)
Unemployment	-0.0175***	-0.0242***	-0.0096	-0.0158**	0.0037	0.0022	0.0013	0.0103	-0.0165***	-0.0228***	-0.0090	-0.0147**	0.0071	0.0022	0.0019	0.0079
	(0.0054)	(0.0058)	(0.0062)	(0.0060)	(0.0113)	(0.0068)	(0.0094)	(0.0111)	(0.0051)	(0.0053)	(0.0065)	(0.0063)	(0.0129)	(0.0067)	(0.0086)	(0.0093)
Bank cost to income ratio	-0.0002	0.0001	-0.0005	-0.0003	-0.0006	-0.0010	-0.0034*	-0.0008	-0.0002	0.0002	-0.0005	-0.0003	-0.0002	-0.0010	-0.0033*	-0.0005
	(0.0008)	(0.0008)	(0.0008)	(0.0009)	(0.0024)	(0.0007)	(0.0017)	(0.0019)	(0.0007)	(0.0007)	(0.0008)	(0.0008)	(0.0021)	(0.0007)	(0.0017)	(0.0020)
Secondary school education	-0.0024	-0.0030	0.0024	0.0016	-0.0069	0.0011	-0.0029	-0.0006	-0.0022	-0.0026	0.0025	0.0019	-0.0073	0.0011	-0.0034	-0.0012
	(0.0020)	(0.0021)	(0.0019)	(0.0019)	(0.0081)	(0.0014)	(0.0030)	(0.0039)	(0.0019)	(0.0019)	(0.0020)	(0.0020)	(0.0078)	(0.0015)	(0.0027)	(0.0038)
Tertiary school education	0.0056**	0.0071***	0.0032	0.0046**	0.0037	-0.0003	0.0022	0.0080**	0.0056***	0.0072***	0.0029	0.0043**	0.0050	-0.0003	0.0028	0.0087**
	(0.0021)	(0.0024)	(0.0020)	(0.0020)	(0.0037)	(0.0021)	(0.0028)	(0.0034)	(0.0020)	(0.0021)	(0.0020)	(0.0020)	(0.0039)	(0.0020)	(0.0029)	(0.0031)
Political stability	0.0488	0.0316	0.0640	0.0584	0.1321	-0.1222*	0.0672	-0.0677	0.0269	0.0025	0.0524	0.0396	0.1422	-0.1227*	0.0501	-0.0265
	(0.0696)	(0.0668)	(0.0618)	(0.0569)	(0.1313)	(0.0675)	(0.0710)	(0.1094)	(0.0686)	(0.0658)	(0.0638)	(0.0608)	(0.1370)	(0.0653)	(0.0634)	(0.0931)
Observations	437	437	417	417	163	247	131	93	437	437	417	417	163	247	131	93
Number of countries	44	44	42	42	18	27	16	13	44	44	42	42	18	27	16	13
R-squared	0.4441	0.4251	0.5515	0.6494	0.5177	0.5645	0.7025	0.7799	0.4715	0.475	0.5572	0.6659	0.4965	0.5645	0.7136	0.7784

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 4-14. Capital- and loan supply-targeted MP (developed countries)

	CAPITAL								LOAN-SUPPLY							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
CAPITAL	0.0300**	0.0344***	0.0089	0.0137	0.0116	-0.0143	-0.0253	-0.0269								
	(0.0117)	(0.0124)	(0.0169)	(0.0171)	(0.0347)	(0.0107)	(0.0200)	(0.0154)								
LOAN-SUPPLY									0.0363**	0.0405**	0.0527**	0.0545**	-0.0945*	-0.0087	-0.1043***	-0.0506**
									(0.0174)	(0.0156)	(0.0235)	(0.0213)	(0.0453)	(0.0158)	(0.0237)	(0.0198)
Real GDP	0.0454	0.3899***	0.4925***	0.8209***	0.5079	0.3487***	0.1603	0.0928	0.0237	0.3664**	0.5212***	0.8524***	0.4673	0.3517**	0.0621	0.0114
	(0.1248)	(0.1428)	(0.1598)	(0.1815)	(0.3558)	(0.1121)	(0.1541)	(0.1057)	(0.1285)	(0.1490)	(0.1409)	(0.1640)	(0.3545)	(0.1375)	(0.1155)	(0.1054)
Real GDP per capita	-0.1324	-0.6693**	0.2970	-0.2350	1.0223	0.7411***	0.6595*	1.0760***	-0.1841	-0.7275***	0.1503	-0.3879	1.0838	0.8345***	0.8170**	1.3206***
	(0.2313)	(0.2646)	(0.3486)	(0.3567)	(0.9425)	(0.2319)	(0.3613)	(0.2749)	(0.2236)	(0.2493)	(0.3140)	(0.3125)	(0.8495)	(0.2810)	(0.2788)	(0.2801)
Unemployment	-0.0182***	-0.0250***	-0.0100	-0.0162**	0.0075	0.0019	0.0017	0.0074	-0.0172***	-0.0239***	-0.0086	-0.0148***	0.0064	0.0024	0.0023	0.0111
	(0.0053)	(0.0055)	(0.0068)	(0.0067)	(0.0121)	(0.0061)	(0.0091)	(0.0088)	(0.0050)	(0.0053)	(0.0056)	(0.0053)	(0.0111)	(0.0069)	(0.0080)	(0.0103)
Bank cost to income ratio	0.0001	0.0005	-0.0003	-0.0001	-0.0003	-0.0010	-0.0037*	-0.0012	-0.0001	0.0003	-0.0006	-0.0003	0.0002	-0.0009	-0.0034**	-0.0006
	(0.0007)	(0.0008)	(0.0008)	(0.0009)	(0.0022)	(0.0007)	(0.0018)	(0.0020)	(0.0007)	(0.0008)	(0.0008)	(0.0008)	(0.0021)	(0.0007)	(0.0013)	(0.0018)
Secondary school education	-0.0019	-0.0023	0.0025	0.0018	-0.0081	0.0012	-0.0038	-0.0016	-0.0021	-0.0026	0.0028	0.0020	-0.0087	0.0010	-0.0040	-0.0013
	(0.0019)	(0.0020)	(0.0019)	(0.0019)	(0.0081)	(0.0014)	(0.0026)	(0.0042)	(0.0020)	(0.0020)	(0.0019)	(0.0019)	(0.0076)	(0.0014)	(0.0026)	(0.0037)
Tertiary school education	0.0050**	0.0064***	0.0026	0.0038*	0.0048	0.0001	0.0029	0.0085**	0.0061***	0.0077***	0.0036*	0.0049**	0.0040	-0.0005	0.0014	0.0061*
	(0.0020)	(0.0022)	(0.0020)	(0.0020)	(0.0039)	(0.0018)	(0.0031)	(0.0031)	(0.0022)	(0.0025)	(0.0019)	(0.0020)	(0.0040)	(0.0021)	(0.0025)	(0.0030)
Political stability	0.0149	-0.0075	0.0581	0.0481	0.1450	-0.1200*	0.0594	0.0060	0.0338	0.0145	0.0419	0.0356	0.1423	-0.1272**	0.0122	-0.0685
	(0.0687)	(0.0667)	(0.0600)	(0.0570)	(0.1371)	(0.0627)	(0.0624)	(0.0875)	(0.0661)	(0.0638)	(0.0592)	(0.0565)	(0.1474)	(0.0615)	(0.0653)	(0.0876)
Observations	437	437	417	417	163	247	131	93	437	437	417	417	163	247	131	93
Number of countries	44	44	42	42	18	27	16	13	44	44	42	42	18	27	16	13
R-squared	0.4543	0.4369	0.5457	0.6457	0.4939	0.5696	0.7035	0.7749	0.4652	0.4489	0.5939	0.6843	0.5209	0.5663	0.7445	0.7809

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Similarly, the use of banking services is negatively associated with BORROWER and LOAN-SUPPLY, but it has an insignificant relationship with FINANCIAL and CAPITAL. As in developing countries, loan-related MP limit the use of banking services, so that they achieve the goal of mitigating systemic risk at the expense of financial inclusion, particularly the use of banking services, in developed countries. In contrast to the findings in developing countries, access to banking services is positively correlated with FINANCIAL and its two subsets, CAPITAL and LOAN-SUPPLY, in developed countries, while it has insignificant relationships with any type of MP instrument in developing countries—financial institution-targeted MPs promote access to banking services in developed countries, but not in developing countries.

Since FINANCIAL corresponds to MP targeting the supply side of credit markets, they restrict the credit expansion of financial institutions. To comply with the restrictive effects of MP, banks may choose to promote coverage to seek other sources of income. By expanding the service coverage and establishing more branches and ATMs, banks can mobilize more deposits and diversify their activities to nontraditional banking activities or noninterest income-based fees and services.[59] These results support the discussions in several studies on banks' income diversification and the increasing trend toward their noninterest income activities, such as investment banking, venture capital, security brokerage, insurance underwriting, and asset securitization (Allen & Santomero, 2001; Elsas et al., 2010; Demirgüç-Kunt & Huizinga, 2010; Goddard et al., 2013; Saunders et al., 2020).[60] The increasing trend of banks' income diversification overlaps with their adoption of MP in our sample, which could justify our findings that banks attempt to look for noninterest income once they are constrained by the adoption of MP, and particularly financial institution-

[59] An article published by The Financial Brand in 2018 state that even the giant financial institutions like Bank of America and JP Morgan Chase, which have rapidly expanded their non-branch channels, still realize that they will not effectively grow without the appropriate establishment of physical branches. It also emphasizes that JP Morgan Chase and Bank of America plan to build 400 to 500 new branches across states and nationwide to provide financial services in new domestic markets.

[60] The proportion of service charges, including overdraft fee, ATM fees, and maintenance charges to total noninterest income has significantly increased from 14 % in 2001 to 25 % in 2018 (Haubrich & Young, 2019). They also find that banks have increased their income from services charges to compensate for lost interest income.

targeted MP. This management strategy is only possible in developed countries that generally enjoy a mature financial system, but not in developing countries.[61]

4.4.4 Other control variables

Concerning other control variables, our analysis shows some findings, although some estimated results are less clear depending on the model specifications. For developing countries, access to banking services is positively associated with the size of the economy (measured by real GDP), income level (measured by real GDP per capita), and secondary school education, but it is negatively associated with the bank cost-to-income ratio and tertairy school education. In addition, the use of banking services is positively correlated with income level (measured by real GDP per capita). For developed countries, access to banking services is positively associated with real GDP and tertiary school education and is negatively associated with the unemployment rate. In addition, the use of banking services is positively associated with real GDP per capita.

4.5 Conclusion

This study explored how MP relates to financial inclusion. Our contention is that MP influences financial inclusion through two channels: (1) credit contracts and (2) cost expansion. The former happens because the more prudential policies tend to restrict banks' credit supply and reduce the number of qualifying borrowers. As a result, less people are able to access banks' (credit) services. As for the second channel, a more stringent MP requires banks to prepare more capital and implicitly impose the costs of risky capital. These increase banks' operational costs, in response to which banks may broaden their scope of service and acquire

[61] The results of the sensitivity analysis for developed countries in this study is shown in Appendix. In general, the results confirm with our baseline findings.

revenues from noninterest income activities. This requires banks' geographical expansion, which leads to an increased access to banking services.

Our empirical findings are generally consistent with our argument. The conclusion, however, is not identical for developing and developed countries. In the case of developing countries, some instruments of MP such as those targeting borrowers (BORRROWER) and those targeting financial institutions related to loan supply (LOAN-SUPPLY)) are negatively related to the use of banking services. This result remains robust when we change the measure using the indicators of mobile banking, which plays a more important role in most developing countries. In the case of developed countries, these instruments (BORRROWER and LOAN-SUPPLY) are still negatively related to the use of banking services. However, instruments targeting financial institutions are positively associated with access to banking services. This implies that the channel of cost-expansion only holds for developed countries. This conclusion is not counter-intuitive because the bank's geographic expansion depends on the country's degree of financial development.

Our results remain robust after being tested by various methods, including (i) applying the system GMM estimator, (ii) replacing the index of financial inclusion with a constructed multidimensional index, and (iii) incorporating more controls (including bank concentration). Thus, we have concluded that stringent MP harms financial inclusion in developing countries, perhaps by preventing people from accessing the credit markets, although MP might bring about beneficial effects in developed countries. Given that in recent years MP has been regarded as a new policy tool towards financial stability, this study contributes by warning policymakers of the cons of these favorable policies.

We posit two areas affecting policy. First, the macroprudential literature mainly focuses on its beneficial effect— its effectiveness in reducing systemic risks. In comparison, this study provides evidence of its costs, that is, potential adverse influences on financial

inclusion. This information is crucial for financial regulators, given that financial inclusion is the top priority policy agenda of many countries. Second, our results show that MP leads to asymmetric effects in developed and developing countries, highlighting the fact that the problems of financial inclusion in different countries are not identical.

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Appendix

In our baseline analysis, we have examined the relationship between the adoption of MP instruments and various indicators of financial inclusion, the access to and the use of banking services, using the fixed effects estimation. This appendix first provides further analysis of the relationship by employing the system GMM estimator. Second, we construct a multidimensional index of financial inclusion using factor analysis to ensure the sensitivity of the results of our baseline model. Last, we add two more control variables related to the banking system structure to ensure the robustness of our baseline findings.

A1. System GMM estimator

Dynamic panel data models include some lags of the dependent variable as covariates, so that the model allows for a partial adjustment mechanism, and they also contain unobserved panel level fixed or random effects. By construction, the lagged dependent variables are correlated with the unobserved panel level effects. In addition, explanatory variables are not strictly

exogenous, so that they are correlated with past and possibly current realizations of the error. Moreover, the model may contain heteroskedasticity and autocorrelation within individual units' errors, but not across them. In such cases, standard estimators become inconsistent. Arellano and Bond (1991) develop a consistent GMM estimator for the model. However, the Arellano-Bond estimator performs poorly if the autoregressive parameters or the ratio of the variance of the panel level effect to the variance of idiosyncratic error are relatively large. Poor instruments in the difference GMM estimator cause the inefficient and biased coefficient estimates (Arellano and Bond, 1991; Bound et al., 1995; Baltagi, 2008).

Following the work of Arellano and Bover (1995), Blundell and Bond (1998) develop a system GMM estimator that includes additional moment conditions, which is designed for panel data with many panels and short periods, under the assumption that there is no autocorrelation in the idiosyncratic errors and the panel level effects are uncorrelated with the first difference of the first observation of the dependent variable. The system GMM estimator combines the use of lagged levels of the series as instruments for the pre-determined and endogenous variables in equations in first differences and the use of lagged differences of the dependent variable as instruments for equations in levels. The system GMM estimator derives more efficient results. Thus, this study employs the two-step system GMM estimator to estimate the empirical model.

Lacking valid instruments for the indicators of MP instruments, we cannot claim to have fully resolved all endogeneity issues, but the system GMM estimator mitigates some of them since this methodology is suitable for the adjustment process of the dependent variable with independent variables that are not strictly exogenous. Tables A1-A3 and A8-A10 present the estimated results of the two-step system GMM estimators for the models with all MP instruments in our study for developing and developed countries, respectively (due to data limitation, we do not estimate the models with Use 4 for developed countries). When applying

the system GMM estimators, we need to confirm first- but not for second-order serial correlation. As the tests for the specification for the absence of serial correlation, the AR(1) and AR(2) statistics show that in every model, the null hypothesis of no second-order serial correlation cannot be rejected, but the null hypothesis of no first-order serial correlation can be rejected, as required by the specification. In addition, the Hansen tests for the exogeneity show that the J-statistic has a p-value greater than 0.10 in all models, so that we cannot reject the null hypothesis that instruments as a group are exogenous in the system GMM estimation, as required by the specification. The estimated results are generally consistent with the baseline findings.

A2. Alternative index of financial inclusion

To check the robustness of our findings, we re-examine how MP instruments relate to the level of financial inclusion by applying an alternative continuous indicator of financial inclusion which is constructed by using factor analysis. There are several studies in the field of financial economics, which utilize factor analysis to construct indicators of their interests from the original sets of the data. For example, Anarfo et al. (2020) use six variables of financial inclusion of 217 countries from 1990 to 2014 to construct the index of financial inclusion. Similarly, using the data for 86 countries for the period 2004 to 2012, Ahamed and Mallick (2017) generate the financial inclusion index by using two dimensions, financial outreach and usage. Quinn et al. (2011) construct de jure and de facto indicators of capital account and financial account openness of 187 countries over the period from 1950 to 2007, and Klomp and de Haan, (2009) construct the financial instability indicator of 60 countries over the period from 1985 to 2005. Using the Canadian data, Gilbert and Meijer (2006) generate money and credit indictors over the period from 1981 to 2004, and Stock and Watson (2002) construct the Federal Reserve Board's Index of Industrial Production from 1970 to 1997.

Factor analysis is a statistical method to explain variability among observed, correlated variables in terms of a potentially fewer number of unobserved random variables, which are called factors (Kim & Mueller, 1978). The method models the observed variables as linear combinations of the potential factors plus error terms. Each factor represents a specific amount of the overall variance in the observed variables. The eigenvalue for a given factor measures how much of the variance of the observed variables the particular factor explains. A low eigenvalue factor is ignored, since other factors are more significant in explaining the variance. According to the eyeballing of a scree plot that showing a line plot of the eigenvalues of factors, we notify the 'elbow' point of the graph, where the eigenvalues level off, and then retain factors to the left of this point for the subsequent analysis (Cattell, 1966). In this study, we apply factor analysis to generate the index of financial inclusion by using all the eight variables, demographic and geographic bank branches and ATMs penetration, loan and deposit accounts per capita and number of borrowers and depositors per capita. Based on the scree tests, the index of financial inclusion can be represented as a one-dimensional construct. Thus, this study applies one-factor model in the analysis. Tables A4 and A11 show the estimations of the models with the index of financial inclusion based on factor analysis for developing and developed countries, respectively. The results generally confirm our baseline findings.

A3. Additional controls

Several studies have discussed about the roles of the banking system structure, such as bank concentration (Cetorelli & Gambera, 2001; Carbo-Valverde et al., 2009; Beck et al., 2010; Leon, 2015; Chauvet & Jacolin, 2017; Owen & Pereira, 2018; Wang et al., 2020) and the presence of foreign banks (Clarke et al., 2006; Detragaiche et al., 2008; Gormley, 2010; Cull & Peria 2010; Claessens & Horen, 2014), and their effects on bank's risk-taking behavior and financial services. Among them, Wang et al. (2020) indicate that banking concentration is negatively associated with credit availability, i.e., Small and medium enterprises (SMEs)

credit availability is more constrained, while Cetorelli and Gambera (2001) find that firms' financial access is positively correlated with the concentrated banking system. On the other hand, the presence of foreign banks could also constrain credit provision in the market, particularly risky firms or companies, since foreign banks may target only large and low-risk ones which results in forcing local banks out of the market (Detragaiche et al. 2008). Nonetheless, Claessens and Horen (2014) show that the influence of foreign banks is dependent on host countries' characteristics, such as regulatory framework quality, the nationality of ownership, and information asymmetries. For low-income countries, where there is a limited market share and enormous information asymmetries, the presence of foreign banks has a negative effect on credit (Claessens & Horen, 2014). Taking all the discussion together, we extend our analysis by adding two additional control variables related to the banking system structure, bank concentration and the share of foreign banks to total banks, into our models. Tables A5-A7 and A12-A14 present the estimations of the models with additional control variables for developing and developed countries, respectively. The results are generally consistent with our baseline findings.

Table 4-A1. Overall measure of MPs (developing countries): system-GMM

	Access to banking services				Use of banking services			
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
Lag dependent	0.9962***	0.9990***	0.7567***	0.8645***	0.7058***	0.9274***	0.6878***	0.7839***
	(0.0404)	(0.0296)	(0.0902)	(0.0517)	(0.1882)	(0.0659)	(0.1246)	(0.0991)
MPI	-0.0050	-0.0018	-0.0164	-0.0051	-0.0151	0.0051	-0.0143*	-0.0048
	(0.0041)	(0.0043)	(0.0171)	(0.0079)	(0.0160)	(0.0088)	(0.0080)	(0.0069)
Real GDP	0.0520*	0.0562**	0.1895*	0.1233**	0.0850*	-0.0642	0.0713	-0.0967
	(0.0304)	(0.0239)	(0.1123)	(0.0588)	(0.0496)	(0.0470)	(0.0544)	(0.0783)
Real GDP per capita	-0.0633	-0.0828	-0.0483	-0.0455	0.5383*	0.1660**	0.1502	0.2033*
	(0.0593)	(0.0667)	(0.2376)	(0.1781)	(0.3226)	(0.0837)	(0.1722)	(0.1219)
Unemployment	0.0077	0.0060	0.0063	0.0085	0.0222	0.0066	-0.0093	0.0022
	(0.0099)	(0.0085)	(0.0120)	(0.0108)	(0.0175)	(0.0193)	(0.0165)	(0.0262)
Bank cost to income ratio	-0.0025*	-0.0021*	0.0074*	0.0066*	0.0008	0.0029	0.0008	-0.0049
	(0.0015)	(0.0011)	(0.0038)	(0.0038)	(0.0082)	(0.0024)	(0.0035)	(0.0056)
Secondary school education	0.0007	0.0000	0.0089	0.0020	-0.0008	0.0045	0.0108	0.0005
	(0.0019)	(0.0025)	(0.0078)	(0.0073)	(0.0109)	(0.0048)	(0.0078)	(0.0059)
Tertiary school education	-0.0034	-0.0026	-0.0036	-0.0002	-0.0114	-0.0038	0.0001	0.0012
	(0.0026)	(0.0019)	(0.0049)	(0.0043)	(0.0089)	(0.0052)	(0.0049)	(0.0053)
Political stability	0.1094***	0.0890**	0.1576**	0.1562**	-0.0714	-0.0446	-0.1351	0.1533**
	(0.0402)	(0.0372)	(0.0715)	(0.0656)	(0.1413)	(0.0988)	(0.1137)	(0.0759)
Observations	505	505	472	472	235	328	268	261
Number of countries	71	71	70	70	36	48	41	42
Number of instruments	46	50	45	43	35	40	39	40
AR2	0.464	0.454	0.477	0.336	0.67	0.173	0.247	0.285
Hansen test	0.451	0.630	0.415	0.207	0.612	0.308	0.857	0.373

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the system GMM estimator with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A2. Borrower- and financial institution-targeted MPs (developing countries): system-GMM

	BORROWER								FINANCIAL							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
Lag dependent	0.9981***	0.9963***	0.7008***	0.8715***	0.4082*	0.5796***	0.5779***	0.7790***	0.9962***	0.9714***	0.7836***	0.8679***	0.7483***	0.9215***	0.6474***	0.7842***
	(0.0320)	(0.0311)	(0.0731)	(0.0550)	(0.2335)	(0.1974)	(0.1137)	(0.0716)	(0.0404)	(0.0360)	(0.1090)	(0.0499)	(0.1159)	(0.0594)	(0.1695)	(0.0914)
BORROWER	-0.0074	-0.0013	-0.0440	-0.0166	-0.1518	-0.1199**	-0.0952**	-0.0163								
	(0.0215)	(0.0170)	(0.0278)	(0.0319)	(0.1235)	(0.0521)	(0.0484)	(0.0290)								
FINANCIAL									-0.0056	0.0002	-0.0236	-0.0064	-0.0102	0.0072	0.0073	-0.0053
									(0.0044)	(0.0053)	(0.0207)	(0.0107)	(0.0186)	(0.0114)	(0.0184)	(0.0071)
Real GDP	0.0540*	0.0418**	0.1350*	0.1408**	0.0814	-0.0476	0.1435**	-0.1057	0.0484*	0.0408*	0.2016*	0.1186*	0.0441	-0.0588	-0.0198	-0.1109
	(0.0308)	(0.0209)	(0.0707)	(0.0583)	(0.0909)	(0.1270)	(0.0663)	(0.0731)	(0.0282)	(0.0220)	(0.1086)	(0.0644)	(0.0470)	(0.0486)	(0.0732)	(0.0746)
Real GDP per capita	-0.0485	-0.0694	0.0451	-0.0390	1.0095**	0.3836*	0.3247*	0.2451*	-0.0570	-0.0853	-0.1119	-0.0447	0.4909**	0.1861*	0.3660*	0.2228*
	(0.0613)	(0.0541)	(0.2119)	(0.1686)	(0.4641)	(0.2315)	(0.1802)	(0.1328)	(0.0594)	(0.0590)	(0.2652)	(0.1768)	(0.2376)	(0.0990)	(0.2086)	(0.1315)
Unemployment	0.0065	0.0033	0.0036	0.0046	0.0223	-0.0061	0.0030	0.0058	0.0076	0.0064	0.0047	0.0088	0.0186	0.0081	-0.0172	0.0033
	(0.0078)	(0.0074)	(0.0106)	(0.0089)	(0.0418)	(0.0131)	(0.0228)	(0.0162)	(0.0095)	(0.0095)	(0.0124)	(0.0114)	(0.0153)	(0.0213)	(0.0354)	(0.0257)
Bank cost to income ratio	-0.0016*	-0.0019**	0.0069**	0.0082**	-0.0066	-0.0028	0.0028	-0.0038	-0.0025*	-0.0027**	0.0077**	0.0063*	0.0036	0.0033	0.0010	-0.0058
	(0.0009)	(0.0009)	(0.0034)	(0.0040)	(0.0099)	(0.0069)	(0.0060)	(0.0046)	(0.0015)	(0.0013)	(0.0039)	(0.0038)	(0.0060)	(0.0030)	(0.0078)	(0.0063)
Secondary school education	-0.0008	-0.0013	0.0078	0.0025	-0.0030	0.0091	0.0086	0.0004	0.0008	0.0002	0.0089	0.0016	0.0019	0.0040	0.0042	-0.0007
	(0.0019)	(0.0024)	(0.0063)	(0.0065)	(0.0078)	(0.0057)	(0.0057)	(0.0049)	(0.0020)	(0.0029)	(0.0069)	(0.0076)	(0.0071)	(0.0048)	(0.0170)	(0.0059)
Tertiary school education	-0.0023	-0.0016	-0.0001	-0.0008	-0.0114	0.0027	-0.0009	0.0007	-0.0035	-0.0011	-0.0030	0.0001	-0.0133	-0.0041	0.0002	0.0022
	(0.0021)	(0.0024)	(0.0033)	(0.0035)	(0.0089)	(0.0109)	(0.0054)	(0.0052)	(0.0027)	(0.0020)	(0.0045)	(0.0046)	(0.0083)	(0.0052)	(0.0057)	(0.0046)
Political stability	0.0842**	0.0913**	0.1520**	0.1590**	-0.1609	-0.0116	-0.0726	0.1145*	0.1071***	0.0723*	0.1513**	0.1586***	-0.1353	-0.0508	-0.1532	0.1389*
	(0.0334)	(0.0377)	(0.0663)	(0.0712)	(0.1438)	(0.0992)	(0.1223)	(0.0605)	(0.0415)	(0.0394)	(0.0744)	(0.0610)	(0.1348)	(0.0985)	(0.1396)	(0.0752)
Observations	505	505	472	472	235	328	268	261	505	505	472	472	235	328	268	261
Number of countries	71	71	70	70	36	48	41	42	71	71	70	70	36	48	41	42
Number of instruments	43	49	45	43	33	40	35	41	46	50	45	43	35	40	36	39
AR2	0.469	0.436	0.34	0.268	0.369	0.319	0.133	0.251	0.464	0.499	0.479	0.341	0.826	0.173	0.382	0.279
Hansen test	0.526	0.520	0.311	0.175	0.522	0.196	0.871	0.693	0.472	0.752	0.475	0.214	0.605	0.293	0.526	0.312

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the system GMM estimator with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A3. Capital- and loan supply-targeted MPs (developing countries): system-GMM

	CAPITAL								LOAN-SUPPLY							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
Lag dependent	0.9966***	0.9987***	0.7131***	0.8817***	0.6900***	0.7893***	0.5979***	0.8103***	0.9916***	0.9928***	0.7824***	0.8500***	0.5363***	0.7760***	0.6377***	0.8248***
	(0.0423)	(0.0313)	(0.0703)	(0.0508)	(0.1635)	(0.1323)	(0.1069)	(0.0980)	(0.0407)	(0.0402)	(0.0656)	(0.0586)	(0.2028)	(0.1221)	(0.1319)	(0.0816)
CAPITAL	0.0051	0.0019	-0.0271	-0.0091	-0.0030	-0.0303	-0.0023	0.0210								
	(0.0142)	(0.0174)	(0.0341)	(0.0300)	(0.0636)	(0.0365)	(0.0489)	(0.0344)								
LOAN-SUPPLY									-0.0004	-0.0025	0.0204	0.0212	-0.0650*	0.0143	-0.0661**	-0.0155
									(0.0094)	(0.0096)	(0.0295)	(0.0351)	(0.0356)	(0.0359)	(0.0276)	(0.0278)
Real GDP	0.0526*	0.0380*	0.1169**	0.1693**	-0.0055	-0.0534	-0.0301	-0.0574	0.0495*	0.0568**	0.0964*	0.1462**	0.0922*	-0.0575	0.1231*	-0.0863
	(0.0302)	(0.0230)	(0.0542)	(0.0827)	(0.1387)	(0.0733)	(0.0646)	(0.0815)	(0.0262)	(0.0281)	(0.0584)	(0.0719)	(0.0557)	(0.0731)	(0.0683)	(0.0670)
Real GDP per capita	-0.0730	-0.0593	0.0775	-0.0211	0.6348**	0.2975**	0.4182**	0.2653*	-0.0652	-0.0731	0.1742	0.0244	0.7601**	0.2958*	0.3272*	0.2165*
	(0.0558)	(0.0571)	(0.1527)	(0.1728)	(0.3013)	(0.1495)	(0.1934)	(0.1586)	(0.0612)	(0.0670)	(0.2622)	(0.2046)	(0.3620)	(0.1721)	(0.1756)	(0.1280)
Unemployment	0.0080	0.0040	-0.0014	0.0126	0.0107	0.0061	-0.0248	-0.0133	0.0086	0.0080	0.0121	0.0134	0.0228	0.0090	0.0130	-0.0008
	(0.0081)	(0.0091)	(0.0148)	(0.0093)	(0.0236)	(0.0169)	(0.0162)	(0.0171)	(0.0068)	(0.0068)	(0.0126)	(0.0105)	(0.0198)	(0.0163)	(0.0225)	(0.0200)
Bank cost to income ratio	-0.0020**	-0.0020*	0.0085**	0.0082**	-0.0018	0.0058	0.0023	-0.0043	-0.0017*	-0.0021**	0.0070*	0.0084**	-0.0087	0.0067	0.0029	-0.0036
	(0.0010)	(0.0010)	(0.0037)	(0.0041)	(0.0043)	(0.0059)	(0.0051)	(0.0057)	(0.0010)	(0.0010)	(0.0036)	(0.0043)	(0.0079)	(0.0054)	(0.0052)	(0.0059)
Secondary school education	-0.0009	-0.0017	0.0072	0.0006	-0.0050	0.0063	0.0040	-0.0020	0.0000	-0.0002	0.0009	0.0032	-0.0008	0.0071	0.0083	0.0014
	(0.0020)	(0.0026)	(0.0054)	(0.0074)	(0.0106)	(0.0043)	(0.0076)	(0.0054)	(0.0024)	(0.0024)	(0.0061)	(0.0076)	(0.0106)	(0.0053)	(0.0074)	(0.0046)
Tertiary school education	-0.0016	-0.0016	0.0000	-0.0015	-0.0074	-0.0032	0.0015	-0.0023	-0.0026	-0.0026	-0.0019	-0.0023	-0.0159	-0.0031	-0.0043	0.0005
	(0.0021)	(0.0024)	(0.0031)	(0.0044)	(0.0099)	(0.0056)	(0.0062)	(0.0036)	(0.0025)	(0.0024)	(0.0051)	(0.0044)	(0.0141)	(0.0057)	(0.0068)	(0.0042)
Political stability	0.0714**	0.1007**	0.1148*	0.1895***	-0.0130	-0.0506	-0.1269	0.1113*	0.0847**	0.0851*	0.1379**	0.1486*	-0.1128	-0.0198	-0.1789	0.0847***
	(0.0343)	(0.0425)	(0.0631)	(0.0671)	(0.1340)	(0.1073)	(0.0953)	(0.0676)	(0.0389)	(0.0441)	(0.0648)	(0.0874)	(0.1553)	(0.1301)	(0.1139)	(0.0308)
Observations	505	505	472	472	235	328	268	261	505	505	472	472	235	328	268	261
Number of countries	71	71	70	70	36	48	41	42	71	71	70	70	36	48	41	42
Number of instruments	49	50	47	43	35	47	34	41	49	49	45	46	35	45	33	41
AR2	0.496	0.421	0.268	0.231	0.655	0.199	0.350	0.360	0.453	0.472	0.219	0.246	0.304	0.215	0.252	0.360
Hansen test	0.671	0.432	0.528	0.224	0.345	0.229	0.891	0.662	0.433	0.428	0.232	0.315	0.531	0.115	0.745	0.662

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the system GMM estimator with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A4. Factor analysis (developing countries)

	Access to banking services					Use of banking services					Index of financial inclusion				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
MPI	-0.0018					-0.0107					0.0083				
	(0.0016)					(0.0117)					(0.0387)				
BORROWER		-0.0020					-0.0056					0.0315			
		(0.0018)					(0.0145)					(0.0411)			
FINANCIAL			0.0003					-0.0671					-0.2665**		
			(0.0079)					(0.0426)					(0.1018)		
CAPITAL				-0.0082					-0.0297					-0.0322	
				(0.0055)					(0.0312)					(0.0709)	
LOAN-SUPPLY					0.0027					-0.0864***					-0.1716***
					(0.0047)					(0.0208)					(0.0459)
Real GDP	0.1348***	0.1345***	0.1332***	0.1320***	0.1309***	0.2898	0.3009	0.2303	0.2608	0.4596***	0.3940**	0.4400**	0.2531	0.3068***	0.5386**
	(0.0306)	(0.0305)	(0.0304)	(0.0303)	(0.0297)	(0.2228)	(0.2326)	(0.2274)	(0.2415)	(0.1502)	(0.1863)	(0.1697)	(0.1836)	(0.1021)	(0.2110)
Real GDP per capita	-0.0645	-0.0633	-0.0719	-0.0663	-0.0712	0.7238	0.6499	0.6357	0.6961	0.6184	0.9216	0.6823	1.1974**	1.1300	1.0076*
	(0.0687)	(0.0690)	(0.0702)	(0.0657)	(0.0700)	(0.6718)	(0.6755)	(0.6107)	(0.6883)	(0.5550)	(0.8321)	(0.8675)	(0.5509)	(0.8051)	(0.5024)
Unemployment	-0.0027*	-0.0026*	-0.0024	-0.0029*	-0.0022	0.0409***	0.0426***	0.0450***	0.0424***	0.0273**	0.0882	0.0909	0.0619	0.0841	0.0375
	(0.0014)	(0.0014)	(0.0014)	(0.0015)	(0.0013)	(0.0135)	(0.0140)	(0.0148)	(0.0125)	(0.0116)	(0.0564)	(0.0529)	(0.0504)	(0.0502)	(0.0457)
Bank cost-income ratio	-0.0009***	-0.0009***	-0.0009**	-0.0008**	-0.0009**	-0.0022	-0.0020	-0.0016	-0.0020	-0.0041	-0.0071	-0.0077	-0.0088	-0.0068	-0.0056
	(0.0003)	(0.0003)	(0.0004)	(0.0003)	(0.0004)	(0.0028)	(0.0028)	(0.0024)	(0.0027)	(0.0025)	(0.0103)	(0.0101)	(0.0095)	(0.0108)	(0.0056)
Secondary education	0.0019**	0.0019**	0.0019**	0.0020**	0.0019**	0.0061	0.0058	0.0058	0.0065	0.0070	0.0008	-0.0006	0.0017	0.0029	0.0040
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0010)	(0.0040)	(0.0040)	(0.0037)	(0.0039)	(0.0041)	(0.0076)	(0.0074)	(0.0055)	(0.0061)	(0.0059)
Tertiary education	-0.0015	-0.0015	-0.0016*	-0.0014	-0.0016*	-0.0001	-0.0003	0.0008	-0.0009	-0.0039	-0.0040	-0.0022	-0.0078	-0.0062	-0.0062
	(0.0010)	(0.0009)	(0.0009)	(0.0010)	(0.0009)	(0.0078)	(0.0078)	(0.0073)	(0.0079)	(0.0067)	(0.0249)	(0.0224)	(0.0203)	(0.0219)	(0.0213)
Political stability	-0.0067	-0.0066	-0.0060	-0.0076	-0.0049	0.1162**	0.1266**	0.0973	0.1076*	0.0513	0.1806	0.1996*	0.0650	0.1464	0.0767
	(0.0108)	(0.0108)	(0.0110)	(0.0115)	(0.0100)	(0.0551)	(0.0576)	(0.0650)	(0.0594)	(0.0569)	(0.1142)	(0.1038)	(0.0975)	(0.0982)	(0.1041)
Observations	499	499	499	499	499	167	167	167	167	167	103	103	103	103	103
Number of countries	70	70	70	70	70	25	25	25	25	25	18	18	18	18	18
R-square	0.6959	0.6963	0.6924	0.6996	0.6936	0.6327	0.6284	0.6464	0.6324	0.7185	0.488	0.5017	0.5768	0.4895	0.6076

Notes: Access, Use and Index of financial inclusion constructed by using factor analysis are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 4-A5. Overall measure of MPs with additional controls (developing countries)

	Access to banking services				Use of banking services			
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
MPI	0.0018	-0.0003	-0.0064	-0.0071	0.0044	-0.0032	-0.0275	-0.0021
	(0.0096)	(0.0098)	(0.0119)	(0.0119)	(0.0120)	(0.0065)	(0.0180)	(0.0042)
Real GDP	0.1366	0.3162	0.7473	0.8964*	-0.6795**	-0.0872	-1.3296*	0.1220
	(0.1930)	(0.1996)	(0.4911)	(0.5043)	(0.2614)	(0.3458)	(0.7539)	(0.2739)
Real GDP per capita	0.4605	0.1693	1.9184**	1.7108*	1.3639***	1.3101***	1.9938**	0.7645**
	(0.2955)	(0.3265)	(0.9220)	(0.9659)	(0.4639)	(0.4719)	(0.7622)	(0.3439)
Unemployment	-0.0024	-0.0040	0.0027	0.0000	0.0390	0.0162	0.0200	0.0016
	(0.0112)	(0.0113)	(0.0126)	(0.0125)	(0.0276)	(0.0147)	(0.0243)	(0.0114)
Bank cost to income ratio	-0.0052***	-0.0062***	0.0065	0.0054	-0.0061*	-0.0016	-0.0003	-0.0032
	(0.0017)	(0.0017)	(0.0048)	(0.0048)	(0.0030)	(0.0028)	(0.0036)	(0.0025)
Secondary school education	0.0223***	0.0237***	0.0227**	0.0234**	0.0004	0.0056	0.0075	0.0175***
	(0.0053)	(0.0056)	(0.0100)	(0.0098)	(0.0084)	(0.0058)	(0.0125)	(0.0050)
Tertiary school education	-0.0093*	-0.0110**	-0.0155**	-0.0172***	-0.0103	-0.0019	0.0012	-0.0157**
	(0.0047)	(0.0052)	(0.0059)	(0.0062)	(0.0120)	(0.0063)	(0.0059)	(0.0062)
Political stability	0.0616	0.0307	-0.1059	-0.1334	0.1988	-0.0667	0.2365	-0.0192
	(0.0527)	(0.0539)	(0.1063)	(0.1062)	(0.1414)	(0.0539)	(0.1901)	(0.0530)
Bank concentration	0.0026	0.0024	-0.0012	-0.0013	0.0100***	0.0007	0.0021	0.0025
	(0.0019)	(0.0021)	(0.0037)	(0.0037)	(0.0036)	(0.0015)	(0.0029)	(0.0024)
Foreign banks to total banks	0.0004	-0.0006	0.0197**	0.0182*	0.0133***	0.0032	0.0218**	-0.0025
	(0.0024)	(0.0025)	(0.0089)	(0.0093)	(0.0047)	(0.0037)	(0.0094)	(0.0034)
Observations	455	455	422	422	210	311	235	232
R-squared	0.5092	0.5914	0.7178	0.738	0.6258	0.576	0.6469	0.6478
Number of countries	62	62	62	62	31	43	35	36

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A6. Borrower- and financial institution-targeted MPs with additional controls (developing countries)

	BORROWER								FINANCIAL							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
BORROWER	-0.0309	-0.0234	-0.0496	-0.0411	0.0226	-0.0677**	-0.1387**	-0.0179								
	(0.0440)	(0.0464)	(0.0575)	(0.0581)	(0.0554)	(0.0274)	(0.0590)	(0.0205)								
FINANCIAL									0.0034	0.0008	-0.0056	-0.0068	0.0036	-0.0008	-0.0192	-0.0018
									(0.0107)	(0.0109)	(0.0133)	(0.0133)	(0.0131)	(0.0082)	(0.0182)	(0.0056)
Real GDP	0.1390	0.3194	0.7494	0.9038*	-0.6796**	-0.0851	-1.3961*	0.1226	0.1383	0.3172	0.7518	0.8998*	-0.6801**	-0.0783	-1.3623*	0.1245
	(0.1889)	(0.1961)	(0.4947)	(0.5079)	(0.2543)	(0.3197)	(0.7371)	(0.2700)	(0.1929)	(0.1997)	(0.4903)	(0.5039)	(0.2617)	(0.3484)	(0.7727)	(0.2749)
Real GDP per capita	0.4788*	0.1720	1.9030**	1.6672*	1.4084***	1.4121***	1.8317**	0.7841**	0.4504	0.1624	1.8943**	1.6927*	1.3819***	1.2536**	1.9839**	0.7515**
	(0.2804)	(0.3084)	(0.8923)	(0.9413)	(0.4520)	(0.4153)	(0.7206)	(0.3135)	(0.3001)	(0.3330)	(0.9284)	(0.9716)	(0.4565)	(0.4698)	(0.7867)	(0.3483)
Unemployment	-0.0033	-0.0045	0.0021	-0.0003	0.0384	0.0116	0.0207	0.0010	-0.0023	-0.0039	0.0030	0.0002	0.0385	0.0166	0.0217	0.0017
	(0.0107)	(0.0109)	(0.0128)	(0.0128)	(0.0274)	(0.0137)	(0.0236)	(0.0111)	(0.0112)	(0.0113)	(0.0126)	(0.0124)	(0.0281)	(0.0146)	(0.0242)	(0.0114)
Bank cost to income ratio	-0.0050***	-0.0062***	0.0065	0.0053	-0.0064**	-0.0015	0.0014	-0.0033	-0.0052***	-0.0062***	0.0065	0.0053	-0.0060*	-0.0016	-0.0001	-0.0032
	(0.0017)	(0.0017)	(0.0047)	(0.0047)	(0.0024)	(0.0029)	(0.0035)	(0.0024)	(0.0017)	(0.0017)	(0.0048)	(0.0048)	(0.0030)	(0.0027)	(0.0035)	(0.0025)
Secondary school education	0.0222***	0.0236***	0.0229**	0.0235**	0.0007	0.0059	0.0068	0.0175***	0.0224***	0.0237***	0.0226**	0.0233**	0.0004	0.0055	0.0078	0.0174***
	(0.0053)	(0.0057)	(0.0099)	(0.0098)	(0.0080)	(0.0053)	(0.0124)	(0.0050)	(0.0052)	(0.0056)	(0.0099)	(0.0098)	(0.0085)	(0.0057)	(0.0127)	(0.0050)
Tertiary school education	-0.0089*	-0.0108**	-0.0156**	-0.0173***	-0.0107	-0.0015	-0.0006	-0.0157**	-0.0093**	-0.0111**	-0.0156**	-0.0172***	-0.0103	-0.0021	0.0006	-0.0158**
	(0.0047)	(0.0052)	(0.0060)	(0.0063)	(0.0120)	(0.0061)	(0.0066)	(0.0062)	(0.0046)	(0.0052)	(0.0059)	(0.0062)	(0.0121)	(0.0062)	(0.0063)	(0.0062)
Political stability	0.0590	0.0288	-0.1139	-0.1380	0.2050	-0.0994*	0.2332	-0.0239	0.0614	0.0307	-0.1032	-0.1309	0.1968	-0.0631	0.2515	-0.0178
	(0.0536)	(0.0548)	(0.1019)	(0.1031)	(0.1422)	(0.0550)	(0.1900)	(0.0547)	(0.0527)	(0.0539)	(0.1062)	(0.1062)	(0.1415)	(0.0541)	(0.1928)	(0.0527)
Bank concentration	0.0024	0.0023	-0.0014	-0.0015	0.0104***	0.0003	0.0011	0.0024	0.0025	0.0024	-0.0011	-0.0012	0.0099***	0.0007	0.0024	0.0025
	(0.0020)	(0.0022)	(0.0036)	(0.0036)	(0.0036)	(0.0014)	(0.0027)	(0.0024)	(0.0019)	(0.0021)	(0.0037)	(0.0037)	(0.0034)	(0.0015)	(0.0030)	(0.0024)
Foreign banks to total banks	0.0008	-0.0005	0.0196**	0.0180*	0.0132***	0.0034	0.0199**	-0.0026	0.0004	-0.0007	0.0196**	0.0181*	0.0133***	0.0031	0.0213**	-0.0025
	(0.0026)	(0.0028)	(0.0089)	(0.0093)	(0.0048)	(0.0036)	(0.0090)	(0.0034)	(0.0023)	(0.0024)	(0.0089)	(0.0093)	(0.0047)	(0.0038)	(0.0093)	(0.0034)
Observations	455	455	422	422	210	311	235	232	455	455	422	422	210	311	235	232
R-squared	0.5114	0.5924	0.7184	0.7381	0.6259	0.5902	0.6542	0.6484	0.5097	0.5915	0.7176	0.7378	0.6256	0.5752	0.6429	0.6477
Number of countries	62	62	62	62	31	43	35	36	62	62	62	62	31	43	35	36

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A7. Capital- and loan supply-targeted MPs with additional controls (developing countries)

	CAPITAL								LOAN-SUPPLY							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
CAPITAL	0.0007	-0.0107	-0.0644	-0.0733	-0.0453	0.0092	-0.1113***	-0.0146								
	(0.0260)	(0.0288)	(0.0491)	(0.0486)	(0.0332)	(0.0362)	(0.0359)	(0.0320)								
LOAN-SUPPLY									0.0028	0.0051	0.0581	0.0618	-0.0664**	0.0111	-0.0622*	0.0072
									(0.0268)	(0.0287)	(0.0515)	(0.0523)	(0.0272)	(0.0233)	(0.0321)	(0.0202)
Real GDP	0.1356	0.3090	0.7114	0.8550	-0.7533***	-0.0643	-1.4592*	0.1256	0.1329	0.3125	0.7469	0.8969*	-0.5330**	-0.0803	-1.2411	0.1410
	(0.1952)	(0.2015)	(0.5011)	(0.5146)	(0.2690)	(0.3440)	(0.7577)	(0.2737)	(0.1904)	(0.1959)	(0.4929)	(0.5047)	(0.2472)	(0.3448)	(0.7871)	(0.2768)
Real GDP per capita	0.4715*	0.1874	1.9278**	1.7244*	1.5969***	1.2124***	2.0949***	0.7437**	0.4721	0.1662	1.6416*	1.4109	1.5994***	1.1913***	1.8857**	0.6736*
	(0.2718)	(0.2956)	(0.9124)	(0.9538)	(0.3901)	(0.4176)	(0.7523)	(0.3016)	(0.2913)	(0.3189)	(0.9191)	(0.9646)	(0.3895)	(0.4352)	(0.7789)	(0.3363)
Unemployment	-0.0026	-0.0049	-0.0018	-0.0052	0.0316	0.0172	0.0183	0.0005	-0.0025	-0.0037	0.0065	0.0040	0.0268	0.0168	0.0209	0.0016
	(0.0120)	(0.0123)	(0.0124)	(0.0123)	(0.0284)	(0.0146)	(0.0250)	(0.0116)	(0.0113)	(0.0113)	(0.0127)	(0.0125)	(0.0257)	(0.0142)	(0.0227)	(0.0113)
Bank cost to income ratio	-0.0052***	-0.0061***	0.0070	0.0059	-0.0058**	-0.0016	0.0004	-0.0031	-0.0051***	-0.0062***	0.0070	0.0059	-0.0060**	-0.0016	-0.0007	-0.0032
	(0.0017)	(0.0017)	(0.0049)	(0.0049)	(0.0028)	(0.0027)	(0.0035)	(0.0025)	(0.0018)	(0.0018)	(0.0049)	(0.0049)	(0.0027)	(0.0027)	(0.0035)	(0.0025)
Secondary school education	0.0223***	0.0236***	0.0218**	0.0224**	0.0009	0.0057	0.0076	0.0171***	0.0223***	0.0237***	0.0219**	0.0226**	0.0032	0.0053	0.0076	0.0173***
	(0.0053)	(0.0057)	(0.0097)	(0.0095)	(0.0079)	(0.0057)	(0.0128)	(0.0053)	(0.0053)	(0.0056)	(0.0098)	(0.0097)	(0.0077)	(0.0057)	(0.0128)	(0.0050)
Tertiary school education	-0.0092*	-0.0109**	-0.0151***	-0.0166***	-0.0118	-0.0024	0.0003	-0.0154**	-0.0092**	-0.0111**	-0.0164***	-0.0181***	-0.0119	-0.0024	0.0008	-0.0163**
	(0.0046)	(0.0052)	(0.0055)	(0.0059)	(0.0124)	(0.0062)	(0.0061)	(0.0060)	(0.0046)	(0.0051)	(0.0059)	(0.0061)	(0.0120)	(0.0061)	(0.0070)	(0.0062)
Political stability	0.0617	0.0291	-0.1185	-0.1480	0.1770	-0.0589	0.1925	-0.0196	0.0625	0.0326	-0.0552	-0.0792	0.1419	-0.0533	0.2129	-0.0097
	(0.0528)	(0.0539)	(0.1085)	(0.1079)	(0.1415)	(0.0543)	(0.1829)	(0.0540)	(0.0534)	(0.0542)	(0.1119)	(0.1110)	(0.1195)	(0.0513)	(0.1928)	(0.0519)
Bank concentration	0.0026	0.0025	-0.0003	-0.0003	0.0102***	0.0006	0.0032	0.0027	0.0026	0.0024	-0.0004	-0.0005	0.0086**	0.0008	0.0016	0.0026
	(0.0018)	(0.0020)	(0.0037)	(0.0037)	(0.0034)	(0.0015)	(0.0030)	(0.0024)	(0.0018)	(0.0019)	(0.0036)	(0.0036)	(0.0037)	(0.0015)	(0.0029)	(0.0023)
Foreign banks to total banks	0.0005	-0.0005	0.0204**	0.0189**	0.0140***	0.0028	0.0229**	-0.0023	0.0005	-0.0007	0.0184**	0.0168*	0.0120**	0.0030	0.0200**	-0.0027
	(0.0025)	(0.0026)	(0.0090)	(0.0093)	(0.0046)	(0.0037)	(0.0091)	(0.0033)	(0.0023)	(0.0024)	(0.0087)	(0.0091)	(0.0047)	(0.0038)	(0.0093)	(0.0034)
Observations	455	455	422	422	210	311	235	232	455	455	422	422	210	311	235	232
R-squared	0.509	0.5918	0.72	0.7406	0.6306	0.5754	0.6524	0.6482	0.5091	0.5916	0.7226	0.7428	0.6461	0.5761	0.6461	0.6479
Number of countries	62	62	62	62	31	43	35	36	62	62	62	62	31	43	35	36

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A8. Overall measure of MPs (developed countries): system-GMM

	Access to banking services				Use of banking services		
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3
Lag dependent	0.9731***	0.9933***	0.9337***	0.9834***	0.8940***	0.9509***	0.7727***
	(0.0729)	(0.0159)	(0.0448)	(0.0114)	(0.2324)	(0.0865)	(0.1015)
MPI	0.0064**	0.0091*	-0.0003	0.0047*	-0.0095	0.0104	0.0137
	(0.0027)	(0.0053)	(0.0034)	(0.0026)	(0.0587)	(0.0103)	(0.0118)
Real GDP	0.0429*	0.0603***	0.0697**	0.0229*	-0.0129	0.0417*	-0.0765
	(0.0257)	(0.0225)	(0.0314)	(0.0136)	(0.0790)	(0.0216)	(0.0562)
Real GDP per capita	-0.0811	-0.1116***	-0.1088**	-0.0588***	0.3419*	-0.0798	0.1399*
	(0.0594)	(0.0429)	(0.0491)	(0.0223)	(0.1752)	(0.1102)	(0.0832)
Unemployment	0.0053	0.0081	0.0015	0.0007	-0.0124	0.0042	-0.0072
	(0.0065)	(0.0077)	(0.0030)	(0.0028)	(0.0342)	(0.0074)	(0.0207)
Bank cost to income ratio	0.0011	0.0012	0.0004	0.0018	-0.0037	-0.0005	-0.0039
	(0.0017)	(0.0011)	(0.0023)	(0.0014)	(0.0107)	(0.0023)	(0.0041)
Secondary school education	0.0038	0.0053	0.0024*	-0.0011	-0.0197	0.0025	0.0147
	(0.0026)	(0.0036)	(0.0013)	(0.0011)	(0.0169)	(0.0022)	(0.0101)
Tertiary school education	-0.0008	-0.0016	-0.0014	-0.0003	-0.0005	0.0020	-0.0053
	(0.0012)	(0.0015)	(0.0012)	(0.0009)	(0.0061)	(0.0014)	(0.0076)
Political stability	0.0590	0.0969	0.0868	0.0561	-0.2057	0.0767	-0.0649
	(0.0809)	(0.0683)	(0.0822)	(0.0593)	(0.3171)	(0.0931)	(0.2844)
Observations	400	400	379	379	147	224	116
Number of iso3	44	44	42	42	18	27	16
Number of instruments	38	42	38	39	24	26	26
AR2	0.147	0.132	0.369	0.513	0.669	0.755	0.665
Hansen test	0.424	0.442	0.325	0.347	1.000	0.110	1.000

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the system GMM estimator with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A9. Borrower- and financial institution-targeted MPs (developed countries): system-GMM

	BORROWER							FINANCIAL						
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3
Lag dependent	0.9960***	0.9973***	0.9381***	0.9972***	0.8757***	0.8704***	0.8198***	0.9965***	0.9985***	0.9296***	0.9797***	0.9008***	0.9633***	0.8734***
	(0.0622)	(0.0091)	(0.0497)	(0.0214)	(0.0915)	(0.1866)	(0.3011)	(0.0735)	(0.0148)	(0.0386)	(0.0105)	(0.2556)	(0.0591)	(0.1524)
BORROWER	0.0035	0.0033	0.0026	-0.0076	-0.1441**	-0.0362	0.0433							
	(0.0080)	(0.0079)	(0.0080)	(0.0069)	(0.0703)	(0.0389)	(0.0494)							
FINANCIAL								0.0081**	0.0111**	0.0004	0.0069***	-0.0102	0.0105	-0.0219
								(0.0039)	(0.0052)	(0.0055)	(0.0025)	(0.0624)	(0.0082)	(0.0324)
Real GDP	0.0413*	0.0416*	0.0585***	0.0510***	-0.0091	0.0903*	-0.1090	0.0411*	0.0561***	0.0565**	0.0238*	-0.0162	0.0405*	0.0063
	(0.0245)	(0.0233)	(0.0214)	(0.0177)	(0.0740)	(0.0526)	(0.2437)	(0.0221)	(0.0216)	(0.0278)	(0.0143)	(0.0641)	(0.0239)	(0.1608)
Real GDP per capita	-0.0982**	-0.0619**	-0.1135**	-0.1004**	0.4692**	-0.0343	0.2620*	-0.0783	-0.1075***	-0.0887*	-0.0398	0.3416*	-0.0856	0.2183*
	(0.0499)	(0.0308)	(0.0449)	(0.0393)	(0.2048)	(0.2698)	(0.1564)	(0.0563)	(0.0403)	(0.0527)	(0.0253)	(0.1756)	(0.0935)	(0.1167)
Unemployment	0.0029	0.0009	0.0041	-0.0012	0.0067	0.0045	-0.0387	0.0040	0.0071	-0.0001	-0.0003	-0.0146	-0.0022	0.0286
	(0.0059)	(0.0048)	(0.0035)	(0.0037)	(0.0122)	(0.0087)	(0.0505)	(0.0063)	(0.0065)	(0.0026)	(0.0034)	(0.0407)	(0.0064)	(0.0435)
Bank cost to income ratio	0.0007	0.0006	0.0009	-0.0009	-0.0080	-0.0072	0.0035	0.0007	0.0005	-0.0004	0.0014	-0.0036	0.0000	-0.0032
	(0.0009)	(0.0008)	(0.0049)	(0.0013)	(0.0051)	(0.0057)	(0.0162)	(0.0015)	(0.0008)	(0.0020)	(0.0010)	(0.0104)	(0.0019)	(0.0052)
Secondary school education	0.0023	0.0014	0.0010	0.0006	-0.0326	-0.0015	0.0005	0.0038	0.0055	0.0018*	-0.0004	-0.0197	0.0056	-0.0155
	(0.0024)	(0.0026)	(0.0020)	(0.0023)	(0.0203)	(0.0029)	(0.0432)	(0.0027)	(0.0038)	(0.0010)	(0.0012)	(0.0173)	(0.0037)	(0.0140)
Tertiary school education	-0.0009	-0.0006	-0.0012	-0.0011	0.0000	0.0009	0.0001	-0.0007	-0.0015	-0.0007	-0.0005	0.0000	0.0012	0.0038
	(0.0009)	(0.0016)	(0.0015)	(0.0013)	(0.0045)	(0.0025)	(0.0056)	(0.0013)	(0.0015)	(0.0010)	(0.0008)	(0.0063)	(0.0020)	(0.0108)
Political stability	0.0553	0.0339	0.1046*	0.0388	0.0221	0.2787	-0.1471	0.0446	0.1005	0.0477	0.0095	-0.2042	0.0612	-0.6457*
	(0.0754)	(0.0866)	(0.0616)	(0.0899)	(0.2876)	(0.2309)	(0.6681)	(0.0618)	(0.0719)	(0.0674)	(0.0829)	(0.2972)	(0.0601)	(0.3325)
Observations	400	400	379	379	147	224	116	400	400	379	379	147	224	116
Number of iso3	44	44	42	42	18	27	16	44	44	42	42	18	27	16
Number of instruments	36	41	36	40	26	26	28	37	42	41	39	24	26	26
AR2	0.204	0.259	0.452	0.422	0.105	0.308	0.608	0.158	0.18	0.356	0.356	0.671	0.647	0.771
Hansen test	0.224	0.603	0.275	0.126	1.000	0.179	1.000	0.448	0.419	0.434	0.232	1.000	0.386	1.000

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the system GMM estimator with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A10. Capital- and loan supply-targeted MPs (developed countries): system-GMM

	CAPITAL							LOAN-SUPPLY						
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3
Lag dependent	0.9660***	0.9989***	0.9448***	0.9946***	0.8279***	0.9931***	0.8856***	0.9935***	0.9953***	0.9217***	0.9886***	0.7081***	0.9896***	0.8867***
	(0.0606)	(0.0086)	(0.0232)	(0.0169)	(0.1056)	(0.0940)	(0.1425)	(0.0339)	(0.0151)	(0.0455)	(0.0096)	(0.2664)	(0.1381)	(0.1510)
CAPITAL	0.0206*	0.0130*	0.0006	-0.0050	-0.0151	-0.0093	0.1703							
	(0.0124)	(0.0074)	(0.0121)	(0.0137)	(0.0396)	(0.0197)	(0.1300)							
LOAN-SUPPLY								0.0064*	0.0139*	0.0127**	0.0124**	-0.1948*	0.0134	-0.0987**
								(0.0039)	(0.0075)	(0.0058)	(0.0062)	(0.1154)	(0.0278)	(0.0428)
Real GDP	0.0243*	0.0456**	0.0496**	0.0470***	-0.1167	0.0285*	-0.2121	0.0351**	0.0507**	0.0265*	0.0296*	-0.0024	0.0389**	-0.0019
	(0.0142)	(0.0218)	(0.0193)	(0.0178)	(0.1685)	(0.0173)	(0.1564)	(0.0169)	(0.0247)	(0.0148)	(0.0165)	(0.0724)	(0.0186)	(0.0638)
Real GDP per capita	-0.0400	-0.0955***	-0.0789**	-0.0625	0.4402**	-0.0583	0.3668*	-0.0861***	-0.1100**	-0.0215	-0.0466	-0.0024	-0.0592	0.0048
	(0.0478)	(0.0358)	(0.0326)	(0.0407)	(0.2155)	(0.0735)	(0.1939)	(0.0299)	(0.0548)	(0.0242)	(0.0287)	(0.2001)	(0.0743)	(0.1134)
Unemployment	-0.0003	0.0035	0.0000	-0.0014	-0.0084	-0.0028	0.0128	0.0048	0.0062	0.0005	-0.0043*	-0.0247	-0.0018	-0.0163
	(0.0035)	(0.0038)	(0.0023)	(0.0025)	(0.0226)	(0.0066)	(0.0291)	(0.0059)	(0.0079)	(0.0038)	(0.0026)	(0.0227)	(0.0100)	(0.0149)
Bank cost to income ratio	-0.0001	0.0003	-0.0006	0.0001	-0.0004	-0.0023	-0.0068	0.0002	0.0008	-0.0021	0.0000	-0.0066	-0.0016	0.0017
	(0.0018)	(0.0013)	(0.0022)	(0.0012)	(0.0127)	(0.0018)	(0.0072)	(0.0007)	(0.0019)	(0.0016)	(0.0013)	(0.0090)	(0.0033)	(0.0084)
Secondary school education	0.0019	0.0017	0.0009	-0.0006	-0.0165	0.0006	0.0039	0.0023	0.0033	0.0004	0.0004	0.0205	0.0052	0.0107
	(0.0014)	(0.0018)	(0.0019)	(0.0021)	(0.0134)	(0.0063)	(0.0095)	(0.0020)	(0.0023)	(0.0020)	(0.0007)	(0.0162)	(0.0038)	(0.0081)
Tertiary school education	0.0008	-0.0010	-0.0007	-0.0009	-0.0005	0.0007	-0.0046	-0.0009	-0.0016	-0.0010	-0.0013	0.0079	0.0006	-0.0029
	(0.0007)	(0.0010)	(0.0010)	(0.0009)	(0.0055)	(0.0019)	(0.0048)	(0.0010)	(0.0014)	(0.0011)	(0.0010)	(0.0053)	(0.0020)	(0.0052)
Political stability	-0.0188	0.0799	0.0327	-0.0272	-0.2864	0.1005	-0.3781	0.0681	0.0524	-0.0136	-0.0301	-0.0257	0.0259	-0.3390
	(0.0607)	(0.0670)	(0.0442)	(0.0666)	(0.2569)	(0.0948)	(0.2866)	(0.0720)	(0.0841)	(0.0542)	(0.0542)	(0.4092)	(0.0893)	(0.5162)
Observations	400	400	379	379	147	224	116	400	400	379	379	147	224	116
Number of iso3	44	44	42	42	18	27	16	44	44	42	42	18	27	16
Number of instruments	43	40	41	40	24	26	26	41	40	38	41	26	26	25
AR2	0.269	0.36	0.368	0.341	0.467	0.414	0.647	0.33	0.315	0.436	0.312	0.686	0.536	0.888
Hansen test	0.523	0.491	0.431	0.154	1.000	0.15	1.000	0.357	0.671	0.556	0.326	1.000	0.225	1.000

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the system GMM estimator with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A11. Factor analysis (developed countries)

	Access to banking services					Use of banking services					Index of financial inclusion				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
MPI	0.0041***					-0.0107					-0.0008				
	(0.0012)					(0.0098)					(0.0145)				
FINANCIAL		0.0059***					-0.0103					-0.0005			
		(0.0017)					(0.0117)					(0.0170)			
BORROWER			0.0023					-0.0380**					-0.0045		
			(0.0020)					(0.0154)					(0.0245)		
CAPITAL				0.0059*					-0.0227					-0.0051	
				(0.0031)					(0.0176)					(0.0261)	
LOAN-SUPPLY					0.0054					-0.0724**					-0.0779*
					(0.0042)					(0.0233)					(0.0408)
Real GDP	0.2385***	0.2365***	0.2358***	0.2319***	0.2368***	0.3689*	0.3733*	0.3825*	0.4408*	0.3186	0.3313	0.3328	0.3213	0.3412	0.2808
	(0.0540)	(0.0535)	(0.0544)	(0.0559)	(0.0543)	(0.1850)	(0.1913)	(0.1945)	(0.2142)	(0.1848)	(0.4380)	(0.4390)	(0.4361)	(0.4367)	(0.4411)
Real GDP per capita	-0.3844***	-0.3873***	-0.3633***	-0.3585***	-0.3748***	-0.1208	-0.1136	-0.1312	-0.2332	0.0114	0.7527	0.7610	0.7803	0.7028	0.6232
	(0.0620)	(0.0592)	(0.0675)	(0.0691)	(0.0627)	(0.2556)	(0.2657)	(0.3015)	(0.3441)	(0.2564)	(0.6412)	(0.6839)	(0.4853)	(0.6112)	(0.5049)
Unemployment	-0.0052***	-0.0052***	-0.0057***	-0.0057***	-0.0056***	-0.0031	-0.0026	-0.0024	-0.0029	-0.0019	0.0176	0.0178	0.0179	0.0169	0.0124
	(0.0010)	(0.0009)	(0.0011)	(0.0010)	(0.0011)	(0.0059)	(0.0063)	(0.0058)	(0.0066)	(0.0051)	(0.0128)	(0.0131)	(0.0096)	(0.0115)	(0.0099)
Bank cost-income ratio	0.0001	0.0001	0.0001	0.0002	0.0001	-0.0013	-0.0013	-0.0012	-0.0016	-0.0008	-0.0029	-0.0029	-0.0028	-0.0030	-0.0022
	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0014)	(0.0014)	(0.0011)	(0.0016)	(0.0010)	(0.0022)	(0.0023)	(0.0021)	(0.0026)	(0.0021)
Secondary education	-0.0007*	-0.0007*	-0.0008**	-0.0007**	-0.0007*	-0.0003	-0.0004	-0.0003	-0.0011	-0.0010	-0.0060	-0.0060	-0.0062	-0.0059	-0.0039
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0033)	(0.0035)	(0.0035)	(0.0036)	(0.0030)	(0.0065)	(0.0069)	(0.0066)	(0.0067)	(0.0064)
Tertiary education	0.0015***	0.0014***	0.0014***	0.0012***	0.0014***	0.0028	0.0029	0.0022	0.0027	0.0017	-0.0024	-0.0024	-0.0022	-0.0025	-0.0033
	(0.0005)	(0.0004)	(0.0005)	(0.0005)	(0.0005)	(0.0020)	(0.0021)	(0.0019)	(0.0022)	(0.0020)	(0.0056)	(0.0057)	(0.0065)	(0.0059)	(0.0064)
Political stability	-0.0047	-0.0062	0.0010	-0.0044	-0.0012	0.0537	0.0518	0.0740	0.0626	0.0152	0.0645	0.0650	0.0601	0.0692	-0.0083
	(0.0125)	(0.0124)	(0.0110)	(0.0112)	(0.0119)	(0.0495)	(0.0504)	(0.0561)	(0.0526)	(0.0430)	(0.1009)	(0.1026)	(0.1106)	(0.1086)	(0.0672)
Observations	411	411	411	411	411	100	100	100	100	100	56	56	56	56	56
Number of countries	42	42	42	42	42	12	12	12	12	12	8	8	8	8	8
R-square	0.6777	0.6934	0.6255	0.6359	0.6341	0.6603	0.6494	0.6595	0.6469	0.7011	0.7225	0.7225	0.7226	0.7231	0.7525

Notes: Access, Use and Index of financial inclusion constructed by using factor analysis are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 4-A12. Overall measure of MPs with additional controls (developed countries)

	Access to banking services				Use of banking services			
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
MPI	0.0114**	0.0157***	0.0036	0.0075	-0.0121	0.0019	-0.0160	-0.0048
	(0.0047)	(0.0049)	(0.0060)	(0.0061)	(0.0221)	(0.0051)	(0.0104)	(0.0050)
Real GDP	-0.0179	0.3604**	0.3677**	0.7577***	0.5406	0.3560***	0.1583	0.1684**
	(0.1156)	(0.1355)	(0.1594)	(0.1999)	(0.3224)	(0.1211)	(0.1315)	(0.0678)
Real GDP per capita	-0.2304	-0.8273***	0.6225**	0.0127	0.5968	1.0624***	0.8384**	1.3485***
	(0.2201)	(0.2411)	(0.2593)	(0.2961)	(0.7222)	(0.2659)	(0.3221)	(0.2235)
Unemployment	-0.0173***	-0.0233***	-0.0050	-0.0101**	0.0026	0.0067	0.0001	0.0237***
	(0.0049)	(0.0051)	(0.0051)	(0.0047)	(0.0095)	(0.0061)	(0.0097)	(0.0049)
Bank cost to income ratio	-0.0001	0.0001	-0.0004	-0.0003	0.0009	-0.0014**	-0.0020	-0.0023*
	(0.0006)	(0.0006)	(0.0006)	(0.0007)	(0.0020)	(0.0006)	(0.0016)	(0.0013)
Secondary school education	-0.0011	-0.0015	0.0015	0.0007	0.0022	0.0000	-0.0024	0.0020
	(0.0017)	(0.0017)	(0.0020)	(0.0021)	(0.0048)	(0.0018)	(0.0029)	(0.0022)
Tertiary school education	0.0056**	0.0069***	0.0034*	0.0045**	0.0055*	-0.0016	0.0019	0.0056
	(0.0021)	(0.0022)	(0.0020)	(0.0020)	(0.0026)	(0.0026)	(0.0028)	(0.0033)
Political stability	0.0243	0.0053	0.0548	0.0494	0.2095**	-0.0925	0.0642	-0.0827
	(0.0731)	(0.0688)	(0.0620)	(0.0549)	(0.0779)	(0.0555)	(0.0708)	(0.0836)
Bank concentration	0.0006	0.0002	0.0011	0.0006	-0.0030	0.0021*	0.0009	0.0024**
	(0.0010)	(0.0010)	(0.0011)	(0.0010)	(0.0022)	(0.0012)	(0.0017)	(0.0010)
Foreign banks to total banks	0.0028	0.0022	0.0032	0.0027	0.0061	0.0016	0.0003	-0.0124**
	(0.0019)	(0.0018)	(0.0025)	(0.0025)	(0.0038)	(0.0032)	(0.0046)	(0.0043)
Observations	375	375	355	355	131	205	111	71
R-squared	0.4363	0.4604	0.6279	0.7054	0.6178	0.6294	0.7422	0.9033
Number of countries	42	42	40	40	16	25	15	11

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 4-A13. Borrower- and financial institution-targeted MPs with additional controls (developed countries)

	BORROWER								FINANCIAL							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
BORROWER	0.0091	0.0130	0.0083	0.0091	-0.0349	0.0020	-0.0793	-0.0253								
	(0.0125)	(0.0117)	(0.0142)	(0.0131)	(0.0267)	(0.0103)	(0.0463)	(0.0197)								
FINANCIAL									0.0158**	0.0215***	0.0030	0.0088	-0.0081	0.0023	-0.0161	-0.0048
									(0.0059)	(0.0065)	(0.0077)	(0.0082)	(0.0270)	(0.0061)	(0.0115)	(0.0062)
Real GDP	0.0134	0.4040***	0.3699**	0.7558***	0.5813	0.3641***	0.1937	0.1904**	-0.0446	0.3241**	0.3646**	0.7523***	0.5560*	0.3535***	0.1507	0.1652**
	(0.1086)	(0.1245)	(0.1622)	(0.2062)	(0.3620)	(0.1094)	(0.1323)	(0.0723)	(0.1162)	(0.1402)	(0.1595)	(0.1999)	(0.3113)	(0.1246)	(0.1358)	(0.0667)
Real GDP per capita	-0.1825	-0.7626***	0.6343**	0.0584	0.4603	1.0613***	0.8490**	1.3635***	-0.2130	-0.8028***	0.6355**	0.0238	0.6047	1.0662***	0.8201**	1.3451***
	(0.2173)	(0.2416)	(0.2517)	(0.2898)	(0.8041)	(0.2631)	(0.2962)	(0.2025)	(0.2164)	(0.2378)	(0.2521)	(0.2872)	(0.7046)	(0.2629)	(0.3403)	(0.2262)
Unemployment	-0.0183***	-0.0247***	-0.0051	-0.0105**	0.0011	0.0066	0.0017	0.0254***	-0.0175***	-0.0236***	-0.0051	-0.0101**	0.0034	0.0066	0.0000	0.0238***
	(0.0048)	(0.0051)	(0.0050)	(0.0046)	(0.0094)	(0.0061)	(0.0089)	(0.0054)	(0.0047)	(0.0048)	(0.0051)	(0.0048)	(0.0093)	(0.0061)	(0.0101)	(0.0051)
Bank cost to income ratio	0.0001	0.0004	-0.0004	-0.0002	0.0004	-0.0014*	-0.0019	-0.0026*	0.0000	0.0003	-0.0004	-0.0002	0.0010	-0.0014*	-0.0021	-0.0023
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0022)	(0.0007)	(0.0016)	(0.0014)	(0.0006)	(0.0006)	(0.0006)	(0.0007)	(0.0017)	(0.0007)	(0.0016)	(0.0013)
Secondary school education	-0.0012	-0.0017	0.0014	0.0005	0.0024	0.0000	-0.0019	0.0021	-0.0009	-0.0012	0.0014	0.0007	0.0018	-0.0001	-0.0025	0.0021
	(0.0017)	(0.0017)	(0.0020)	(0.0021)	(0.0049)	(0.0017)	(0.0028)	(0.0022)	(0.0016)	(0.0017)	(0.0020)	(0.0021)	(0.0051)	(0.0018)	(0.0029)	(0.0023)
Tertiary school education	0.0054**	0.0066***	0.0036*	0.0046**	0.0045	-0.0016	-0.0006	0.0045	0.0054**	0.0066***	0.0033	0.0042**	0.0056**	-0.0017	0.0025	0.0058*
	(0.0022)	(0.0023)	(0.0020)	(0.0020)	(0.0027)	(0.0026)	(0.0026)	(0.0034)	(0.0021)	(0.0021)	(0.0020)	(0.0020)	(0.0026)	(0.0025)	(0.0030)	(0.0032)
Political stability	0.0275	0.0100	0.0577	0.0540	0.2197**	-0.0954*	0.0966	-0.0700	0.0155	-0.0068	0.0544	0.0473	0.2088**	-0.0924	0.0588	-0.0876
	(0.0753)	(0.0710)	(0.0624)	(0.0557)	(0.0797)	(0.0545)	(0.0817)	(0.0778)	(0.0734)	(0.0694)	(0.0625)	(0.0563)	(0.0826)	(0.0567)	(0.0722)	(0.0818)
Bank concentration	0.0000	-0.0007	0.0010	0.0002	-0.0030	0.0020*	0.0002	0.0021**	0.0006	0.0001	0.0010	0.0004	-0.0031	0.0021*	0.0009	0.0024**
	(0.0012)	(0.0013)	(0.0013)	(0.0013)	(0.0021)	(0.0011)	(0.0020)	(0.0008)	(0.0009)	(0.0009)	(0.0010)	(0.0010)	(0.0023)	(0.0011)	(0.0017)	(0.0009)
Foreign banks to total banks	0.0022	0.0014	0.0031	0.0024	0.0045	0.0015	0.0011	-0.0119**	0.0028	0.0024	0.0031	0.0027	0.0063	0.0016	-0.0002	-0.0128**
	(0.0020)	(0.0019)	(0.0025)	(0.0025)	(0.0041)	(0.0033)	(0.0048)	(0.0043)	(0.0020)	(0.0019)	(0.0025)	(0.0026)	(0.0038)	(0.0033)	(0.0047)	(0.0043)
Observations	375	375	355	355	131	205	111	71	375	375	355	355	131	205	111	71
R-squared	0.4148	0.4231	0.6279	0.7011	0.6238	0.6288	0.7381	0.9031	0.44	0.4661	0.627	0.7047	0.6105	0.6294	0.7381	0.9028
Number of countries	42	42	40	40	16	25	15	11	42	42	40	40	16	25	15	11

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4-A14. Capital- and loan supply-targeted MPs with additional controls (developed countries)

	CAPITAL								LOAN-SUPPLY							
	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4	Access 1	Access 2	Access 3	Access 4	Use 1	Use 2	Use 3	Use 4
CAPITAL	0.0249**	0.0283*	0.0044	0.0086	-0.0097	0.0009	-0.0274	-0.0019								
	(0.0123)	(0.0143)	(0.0172)	(0.0181)	(0.0385)	(0.0119)	(0.0264)	(0.0197)								
LOAN-SUPPLY									0.0297**	0.0336**	0.0336*	0.0346*	-0.1028**	-0.0044	-0.1296***	-0.0214
									(0.0142)	(0.0133)	(0.0177)	(0.0172)	(0.0455)	(0.0150)	(0.0219)	(0.0224)
Real GDP	-0.0191	0.3640***	0.3615**	0.7451***	0.5934	0.3626***	0.1385	0.1717**	-0.0403	0.3402**	0.3902**	0.7763***	0.5118	0.3758***	0.0368	0.1633**
	(0.1094)	(0.1308)	(0.1636)	(0.2090)	(0.3985)	(0.1081)	(0.1556)	(0.0743)	(0.1196)	(0.1435)	(0.1534)	(0.1965)	(0.3405)	(0.1342)	(0.0905)	(0.0678)
Real GDP per capita	-0.1335	-0.6994***	0.6585***	0.0873	0.5359	1.0702***	0.7439*	1.3379***	-0.2032	-0.7782***	0.5348**	-0.0427	0.6611	1.0708***	0.9681***	1.3578***
	(0.2311)	(0.2581)	(0.2357)	(0.2776)	(0.8615)	(0.2758)	(0.3893)	(0.2484)	(0.2307)	(0.2501)	(0.2456)	(0.2824)	(0.6964)	(0.2677)	(0.3086)	(0.2183)
Unemployment	-0.0187***	-0.0252***	-0.0053	-0.0107**	0.0035	0.0065	-0.0013	0.0254***	-0.0181***	-0.0246***	-0.0047	-0.0101**	0.0030	0.0065	0.0030	0.0244***
	(0.0049)	(0.0051)	(0.0051)	(0.0049)	(0.0095)	(0.0061)	(0.0113)	(0.0066)	(0.0046)	(0.0049)	(0.0046)	(0.0042)	(0.0086)	(0.0061)	(0.0089)	(0.0052)
Bank cost to income ratio	0.0002	0.0006	-0.0003	-0.0001	0.0009	-0.0013*	-0.0023	-0.0024	0.0000	0.0004	-0.0006	-0.0004	0.0013	-0.0013*	-0.0022*	-0.0025*
	(0.0006)	(0.0007)	(0.0006)	(0.0007)	(0.0018)	(0.0007)	(0.0017)	(0.0014)	(0.0006)	(0.0006)	(0.0006)	(0.0007)	(0.0018)	(0.0006)	(0.0012)	(0.0013)
Secondary school education	-0.0010	-0.0013	0.0013	0.0004	0.0018	-0.0001	-0.0026	0.0025	-0.0008	-0.0012	0.0020	0.0011	-0.0012	-0.0002	-0.0039	0.0020
	(0.0017)	(0.0018)	(0.0020)	(0.0021)	(0.0054)	(0.0017)	(0.0030)	(0.0029)	(0.0016)	(0.0017)	(0.0020)	(0.0021)	(0.0047)	(0.0017)	(0.0026)	(0.0023)
Tertiary school education	0.0047**	0.0057**	0.0031	0.0040*	0.0055*	-0.0018	0.0023	0.0054	0.0058**	0.0069***	0.0037*	0.0046**	0.0051	-0.0019	0.0009	0.0044
	(0.0021)	(0.0021)	(0.0020)	(0.0020)	(0.0027)	(0.0025)	(0.0031)	(0.0031)	(0.0022)	(0.0023)	(0.0019)	(0.0020)	(0.0031)	(0.0025)	(0.0027)	(0.0037)
Political stability	-0.0012	-0.0243	0.0525	0.0452	0.2114**	-0.0962*	0.0653	-0.0951	0.0144	-0.0065	0.0432	0.0389	0.2239**	-0.0993*	0.0548	-0.0682
	(0.0749)	(0.0716)	(0.0610)	(0.0563)	(0.0850)	(0.0552)	(0.0722)	(0.0759)	(0.0724)	(0.0685)	(0.0578)	(0.0529)	(0.0910)	(0.0525)	(0.0715)	(0.1002)
Bank concentration	0.0000	-0.0007	0.0009	0.0000	-0.0033	0.0020*	0.0007	0.0025**	0.0006	-0.0001	0.0018*	0.0010	-0.0028	0.0018	-0.0003	0.0018
	(0.0011)	(0.0013)	(0.0011)	(0.0012)	(0.0023)	(0.0011)	(0.0020)	(0.0009)	(0.0011)	(0.0011)	(0.0009)	(0.0009)	(0.0019)	(0.0011)	(0.0019)	(0.0012)
Foreign banks to total banks	0.0025	0.0018	0.0031	0.0024	0.0063	0.0015	0.0003	-0.0139***	0.0017	0.0009	0.0026	0.0018	0.0073*	0.0015	0.0017	-0.0107
	(0.0021)	(0.0020)	(0.0026)	(0.0026)	(0.0037)	(0.0032)	(0.0050)	(0.0040)	(0.0019)	(0.0018)	(0.0023)	(0.0023)	(0.0036)	(0.0034)	(0.0038)	(0.0062)
Observations	375	375	355	355	131	205	111	71	375	375	355	355	131	205	111	71
R-squared	0.424	0.4318	0.6265	0.7004	0.6084	0.6287	0.7279	0.9004	0.4325	0.4416	0.6443	0.7145	0.6421	0.6291	0.7758	0.9028
Number of countries	42	42	40	40	16	25	15	11	42	42	40	40	16	25	15	11

Notes: Eight indicators of financial inclusion of which four indicators measure access to and four indicators measure use of financial services are the dependent variables used in the regression. We estimated the regressions using the fixed effects estimation with robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Chapter 5: Conclusion

Financial crises, particularly banking crisese bring about numerous costs to economic development such as decline of output or growth and the shrinking of credit. Several studies show that banking crises have a negative impact on output or growth (Demirguc-Kun et al., 2006; Dell'Ariccia et al., 2008; Furceri & Zdzienicka, 2012; Fernandez et al., 2013). Laeven and Valencia (2013) estimate that a median output loss caused by banking crises amounts to 19.74 percent of trend GDP. Our empirical finding on the effect of banking crises on credit growth in developing countries indicates that a banking crisis during a financial boom has more substantial effects on credit growth than that of a banking crisis during financial slump. The effects of a banking crisis on credit growth are more magnified in the countries with high financial development than that of low financial development.

To mitigate the likelihood of banking crises, financial regulators have introduced macroprudential policy which aim at mitigating the accumulation of the vulnerability in the financial system. The primary objective of macroprudential policies, although there is no formally agreed definition, is to reduce the accumulation of financial imbalance and systemic risk and their consequence on the real economy. Some macroprudential policy tools have been introduced to target financial institutions, the supply side of credit market, such as counter cyclical buffer, capital requirement, reserve requirement, while other tools have been adopted to target borrowers, the demand side of credit market including maximum loan to value ratio and debts to income ratio. The adoption of macroprudential policy would help mitigate the vulnerability in the financial system and achieve financial stability, the implementation of

these polices could also bring along the unfavorable consequence or cost for the whole financial system, particularly the decline of the level of financial inclusion.

Our empirical results suggest that the adoption of macroprudential policy instruments, borrower-targeted and some financial institution-targeted instruments help lessen the likelihood of banking crises. However, the adoption of macroprudential policy also bring about the negative consequence on financial inclusion, particularly the use of banking service in, particularly developing countries. Drawing upon these finding, we posit two areas affecting policy. First, the macroprudential literature mainly focuses on its beneficial effect— its effectiveness in reducing systemic risks. Meanwhile, empirical study on the adoption of macroprudential policy also provides evidence of its costs, that is, potential adverse influences on financial inclusion. This information is crucial for financial regulators, given that financial inclusion is the top priority policy agenda of many countries. Our finding suggest that once financial regulators impose specific type of policy instruments which intended to reduce the systemic risk or the accumulation of the vulnerabilities of financial system, they would also induce negative consequences on the level of financial inclusion, the access to and the use of financial services. Therefore, when a country faces specific type of risks or crises, financial regulators or policy makers should evaluate the cost and benefits of each policy instruments and choose the optimal combination of policy dimensions to preserve financial stability and to lessen the adverse effects on other policy goals, i.e., financial inclusion.

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