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Macroprudential Policy and Bank Systemic Risk: Does Inflation Targeting Matter? *

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ABSTRACT: This paper investigates macroprudential policy effects on bank systemic risk and the role of inflation targeting in such effects. Using bank-level data for 45 countries comprising various monetary and exchange rate regimes, our regime-dependent dynamic panel regression results point to complementarities between monetary and macroprudential policies. We find that the tightening of most macroprudential tools—including DSTI and LTV limits, and capital requirements—reduces bank systemic risk further under inflation targeting. Our findings lend credence to the view that inflation targeting strengthens macroprudential policy roles in mitigating financial stability risks.

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WORKING PAPERS

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I. Introduction

The global financial crisis (GFC) has demonstrated the importance of adopting regulatory frameworks aimed at addressing systemic financial risks. While traditional microprudential regulations aim at ensuring the safety and soundness of individual financial institutions, macroprudential policies are intended to enhance the resilience of the financial system. There is now widespread recognition that, while necessary, the microprudential approach to regulation is insufficient to ensure financial stability and prevent costly financial crises. More emphasis is thus increasingly placed in both the research literature and the policymaking arena on the use of macroprudential policy to reduce vulnerabilities and risks in financial systems (e.g., Bank of England 2009; Claessens et al. 2011; Hanson et al. 2011; IMF 2013a, 2013b, 2014, and 2021; ESRB 2014; FSB 2014; Claessens and Kodres 2015; Freixas et al. 2015; and Meuleman and Vander Vennet 2020).

However, while countries across the globe have increased their use of macroprudential policies in recent years, there is no clear-cut evidence on the effectiveness of such policies for financial stability. Various countries, regions, periods, and empirical designs have been used in studies that seek to gauge the extent to which the macroprudential policy tools are successful in mitigating systemic financial risk (see Section 2 for a review of this literature). More recently, an increasing body of the literature has turned its attention to the possible interactions between macroprudential and monetary policies. Studies have sought to document whether these two policies complement, or rather conflict with, each other. For instance, the empirical findings of Choi and Cook (2018), Garcia Revelo et al. (2020), Gambacorta and Murcia (2020), and Bruno et al. (2017) point to the complementarity of the two policies (e.g., tighter monetary policy enhances the impact of macroprudential tightening on credit growth). Other findings suggest that macroprudential and monetary policies may go against each other. Garcia Revelo and Levieuge (2022) find that the use of countercyclical capital buffers may increase the volatility of inflation and output, and may, therefore, work against the objectives of monetary policy. In the same vein, Silvo (2019) suggests the need for coordination due to the side effects that the implementation of one policy has on the objectives of the other.

This paper adds to the above strand of literature by empirically investigating whether an inflation targeting (IT) regime reinforces or dilutes the effectiveness of macroprudential instruments in achieving financial stability. Specifically, we assess the potential impact of IT on the relation between macroprudential policy tools and bank systemic risk using bank-level data for 45 countries comprising both advanced economies (AEs) and emerging market economies (EMEs) with various monetary policy regimes. IT may enhance the effectiveness of macroprudential instruments as it is typically viewed as a credible framework that would stick to the objective of monetary policy. The IT regime can be more effective in enhancing banks' risk profiles due to lower uncertainty about economic policy and price levels as policy credibility gains with embedded transparency and accountability under the IT institutional setup (Fazio et al. 2018; and Louati and Boujelbene 2020). Furthermore, if the economy is predominantly hit by shocks that move inflation and credit in the same direction, then monetary policy oriented to price stability may also help mitigate credit growth (Choi and Cook 2018).

Against this backdrop, we expect that the IT regime is well positioned to enhance the effectiveness of most macroprudential policies. Nonetheless, we also recognize some prudential measures which aim at direct controls over bank loans under the IT regime may not be effective in mitigating bank systemic risk. This is because such loan restrictions are counterbalanced by credit extensions that are endogenously determined given the policy rate set by the monetary authority under interest rate policy for IT.

To examine the role of IT in the relation between macroprudential instruments and financial stability, we rely on bank systemic risk as a proxy for financial stability risk. Banks represent the bulk of the financial sector in many of the world's economies, and the degree of their financial risk has important implications for the whole financial system. In line with Meuleman and Vander Vennet (2020), we consider stock market data to gauge the risk that banks pose to financial stability. We highlight the cross-sectional dimension of systemic risk, which captures the interconnectedness among banks that can amplify the spillover of shocks within the financial system. Such interconnectedness may stem from common exposures across banks and/or through financial markets. One of the ultimate goals of macroprudential policy is to lower the cross-sectional dimension of systemic risk. The main hypothesis we empirically test in this paper is that the effectiveness of macroprudential tools in taming bank systemic risk varies depending on whether a country has an IT regime or not.

Like Meuleman and Vander Vennet (2020), this paper analyzes the impact of macroprudential policies on a bank-level measure of systemic risk. However, it differs from Meuleman and Vander Vennet (2020) with respect to five dimensions. First, we employ the SRISK measure proposed by Brownlees and Engle (2017) and Acharya et al. (2017) instead of the MES indicator introduced in Brownlees and Engle (2011). The SRISK measure is defined as the expected capital shortage of a bank during a crisis and reflects a bank's contribution to systemic risk when the market is in the tail of its distribution.[1] As noted in Idier et al. (2013), while the MES is a short-run indicator, the SRISK measure is more forward-looking and provides more valuable early warning signals to bank regulators ahead of a financial turmoil. Second, while Meuleman and Vander Vennet (2020) focus on the effect of macroprudential tools on bank systemic risk, we are rather interested in the impact of IT on the interaction between macroprudential tools and bank systemic risk, also accounting for variations across time in country-specific and global variables. Third, our sample coverage extends beyond the European Union countries considered by Meuleman and Vander Vennet (2020). Specifically, we include both AEs and EMEs from different regions in the world and distinct institutional characteristics and monetary policy regimes. Fourth, our measures of macroprudential policy are different: while Meuleman and Vander Vennet (2020) rely on the European Central Bank's MaPPED database, we employ the IMF's iMaPP database (Alam et al. 2019). Both databases report dummy-type indicators, but the iMaPP database presents several advantages, as it covers 134 countries (vs. 28 for the MaPPED) as well as more specific categories of macroprudential policy measures (17 vs. 11 groups in MaPPED) and allows the sectoral classification of macroprudential policies.

Most notably, extending Meuleman and Vander Vennet (2020), this paper considers the potential specificity of the IT country group via an index variable and estimates a non-linear dynamic panel model using the System GMM method to avoid unobserved heterogeneity issues. Further, this paper also shows estimating extended models how macroprudential policy and monetary policy, in interaction with each other, affect SRISK.

The remainder of the paper is organized as follows. Section II reviews the related literature. Section III describes our empirical methods and data. Section IV presents the estimated main results, along with robustness checks and extensions. Section V concludes.

[1] One of the advantages of relying on market data for the calculation of bank systemic risk is that it enables a forward-looking assessment of bank systemic risk, considering market participants' expectations regarding the effectiveness of macroprudential policies (Meuleman and Vander Vennet 2020).

II. Related Literature

A. Macroprudential Policy and Financial Stability

While many macroprudential tools have been in use for a long time, especially in EMEs (Borio and Shim 2007; McCauley 2009; and Lim et al. 2011), the use of such tools has intensified in the wake of the GFC in both AEs and EMEs (Cerutti et al. 2017a; Akinci and Olmstead-Rumsey 2018; Budnik and Kleibl 2018; Choi and Cook 2018; and Alam et al. 2019).[2] Recent studies on macroprudential policy effects suggest that demand-based measures have significant effects on credit growth (e.g., IMF 2021) and that liquidity requirements, which affect banks' credit cycles, help mitigate financial stability risks (Adrian and Boyarchenko 2018).

The existing empirical findings do not guarantee the effectiveness of macroprudential policies but indicate that certain measures contribute effectively to financial stability. For instance, using IMF survey data, Lim et al. (2011) examine the effect of several macroprudential instruments—such as caps on the loan-to-value (LTV), debt-to-income (DTI), ceilings on credit growth, reserve requirements, countercyclical capital buffer (CCyB) requirements, and caps on foreign currency lending—on the procyclicality of credit growth. Their findings suggest that these tools are effective in reducing credit growth procyclicality by lowering the correlation between credit growth and GDP growth.

More recently, Cerutti et al. (2017a) examine the effectiveness of 12 macroprudential instruments in a sample of 119 countries over the 2000-2013 period. Their results point to the effectiveness of several macroprudential instruments in curbing the growth of real credit and house prices. Bruno et al. (2017) investigate the effectiveness of macroprudential and capital flow management policies in a sample of 12 Asia-Pacific countries. Their findings suggest that macroprudential policies are more successful in taming credit growth when they complement monetary policy by reinforcing monetary tightening than when they act in opposite directions. Fendoglu (2017) assesses the effectiveness of six macroprudential policy tools in eighteen EMEs and finds that borrower-based measures are particularly successful in lowering credit growth. Akinci and Olmstead-Rumsey (2018) focus on the use of seven categories of macroprudential tools in the sample of 57 AEs for 2000Q1 - 2013Q4, with episodes of tightening and loosening recorded separately. Their findings suggest that macroprudential tightening is associated with lower bank credit growth, housing credit growth, and house price appreciation, and that policies targeted at credit growth in certain sectors are more effective.

Another set of cross-country studies focuses on the potential role of macroprudential policy instruments in limiting housing credit and the ensuing house price bubbles. In their review of country experiences with various policy options intended to contain boom-bust cycles in real estate asset markets, Crowe et al. (2013) suggest that LTV and DTI caps can be effective in reducing house price appreciation rates. Analyzing real estate booms in a sample of more than fifty countries, Cerutti et al. (2017b) find that higher LTVs are associated with excessively rapid house-price and credit growth during booms and suggest that LTVs could be a well-targeted tool for limiting real-estate price fluctuations. Zhang and Zoli (2016) investigate the use of macroprudential policy instruments in 13 Asian economies and 33 economies in other regions for the period 2000–2013 and find

[2] For instance, Cerutti et al. (2017a) document that macroprudential policies are used more frequently in EMEs; and Akinci and Olmstead-Rumsey (2018) and Choi and Cook (2018) suggest that macroprudential policies have been used more actively after the GFC in both AEs and EMEs. Focusing on EU countries for 1995-2014, Budnik and Kleibl (2018) document a widespread use of macroprudential regulations in this region before the GFC.

that housing-related macroprudential measures, especially LTV caps, have been used quite extensively in Asia countries. Their analysis also suggests that housing-related macroprudential instruments-particularly LTV caps and housing tax measures—have contributed to the curbing of housing price growth, credit growth, and bank leverage in Asia. Using a sample of 57 countries, Kuttner and Shim (2016) find that housing credit growth is significantly affected by changes in the maximum debt-service-to-income (DSTI), the maximum LTV ratio, limits on exposure to the housing sector and housing-related taxes.

Besides studies using aggregate country-level data, macroprudential policy effectiveness has also been the subject of several studies using bank- and firm-level data. Analyzing the Korean experience with macroprudential policy, Igan and Kang (2011) find that LTV and DTI limits are associated with a decline in house price appreciation and transaction activity. Claessens et al.'s (2013) analysis based on bank balance sheet data in 48 countries over 2000–2010 suggests that macroprudential policy measures aimed at borrowers—DTI and LTV caps and limits on credit growth and foreign currency lending—are effective in reducing bank asset growth. Aiyar et al. (2014) find micro-level evidence that U.K. banks regulated by time-varying, bank-specific minimum capital requirements reduce lending in response to tighter capital requirements. Jiménez et al. (2017) find from bank- and firm-level data in Spain the evidence that dynamic provisioning mitigates credit supply in good times while limiting credit crunches in bad times, helping smooth downturns.

B. Interactions between Macroprudential Policy and Monetary Policy for Financial Stability

A more recent body of literature has turned its focus to the potential interactions between macroprudential instruments and monetary policy and the way they help in promoting or hindering financial stability and real economic activity. Macroprudential policy measures affect credit growth, which may exert influence on aggregate demand, growth, and inflation. Macroprudential policy measures also affect banks' incentives, thus potentially modifying the way interest rates influence the economy. Monetary policy, in turn, influences the extent to which macroprudential policy measures affect the real economy. By changing banks' risk-taking incentives, adjustments in interest rates may also change in the optimal stance of macroprudential policy.

The stance of macroprudential policy can influence the transmission and outcome of monetary policy. Cozzi et al. (2020) show that high levels of capital requirements and a less leveraged financial system make the economy less responsive to monetary policy. Their results also suggest that countercyclical macroprudential policy is likely to have important implications for the appropriate levels of nominal interest rates over the economic and financial cycle. For example, during booms, macroprudential measures restrict lending and cool the economy down, implying lower policy interest rates (and thus less need for tight monetary policy) compared to a world without macroprudential regulation. Examining macroprudential policy intervention in economies with low interest rates, Van der Ghote (2020) finds that tighter macroprudential policy lowers the natural real rate, which is the equilibrium risk-free rate consistent with inflation on target and output at its potential, by mitigating financial stability risk. This result points to a complementarity between financial stability and macroeconomic stabilization. Conversely, if macroprudential policy is accommodative, monetary policy easing can have a stronger effect on bank lending and risk-taking.

Monetary policy can also affect the effectiveness of macroprudential policy. Mendicino et al. (2020) argue that, whereas higher capital requirements strengthen banks' safety and are beneficial in the long run, they have short-run costs as they lower credit supply and aggregate demand. In this case, the extent of monetary policy accommodation is important to smooth the costs of tighter macroprudential policy. Under an accommodative monetary policy stance, capital requirements can be tightened further, with limited short-run negative effects for the economy. However, if accommodation is constrained, the short-run costs of tighter macroprudential policy may be significant. The literature also documents the existence of complementarities between monetary policy and macroprudential policy in shaping the evolution of bank credit (e.g., Altavilla et al., 2020).

Monetary policy and macroprudential policy can support each other when they impact aggregate demand in the same direction, aiming to achieve price and financial stability (Kim and Mehrotra 2018; and Rubio and Yao 2020). For example, Choi and Cook (2018) find complementarities between macroprudential policy and monetary policy objectives in most IT countries, as macroprudential tightening (easing) tends to occur to control excessive credit growth when inflation is below target (overly constrained credit when inflation is above target), based on the estimation of macroprudential policy reaction regressions.

However, there are important cases that that require more policy coordination to address conflicts among policy goals. Gambacota and Shin (2018) find that banks with higher capital are less affected by tighter monetary policy, suggesting some tensions between higher capital for the soundness of banks and the effectiveness of tighter monetary policy in controlling credit growth. Garcia Revelo and Levieuge (2022) analyze the conditions that can lead to conflicts between monetary policy and macroprudential policy by using a Taylor-type rule in a DGSE model. They show that increased inflation volatility and/or a larger output gap can occur when macroprudential policy, specifically CCyB, and monetary policy move in opposite directions in response to an investment efficiency shock. However, they demonstrate that enhancing policy coordination, especially by having central banks react more strongly to the output gap, can alleviate the conflict

In sum, while the literature has examined the approach of monetary policy (in terms of complementarity or substitutability) rather than the type of regime, we investigate whether IT aids in enhancing the effectiveness of macroprudential policy. Our focus is on systemic risk, rather than bank-specific risk, within a comprehensive framework that considers policies and macro-financial factors.

III. Empirical Methods and Data

A. Methodology

As in Meuleman and Vander Vennet (2020), we examine the potential impact that macroprudential tools might have on bank systemic risk, measured by its expected capital shortage in a crisis. A novel feature in our approach is that we also consider the potential effects of the monetary policy framework (in particular, IT or the exchange rate regime) could have on the stabilizing role of macroprudential policy.

A financial institution's capital shortage is a measure of systemic risk because it contributes to the undercapitalization of the financial system, which, in turn, imposes a negative externality on the real economy.[3] In this regard, the GFC and its aftermath have provided compelling evidence for the need to contain such risk. The increased use of macroprudential policy tools across the globe after the GFC (e.g., Cerutti et al. 2017a;

[3] According to Acharya et al. (2017), "Each financial institution's contribution to systemic risk can be measured as its systemic expected shortfall (*SES*), that is, its propensity to be undercapitalized when the system is undercapitalized."

and Akinci and Olmstead-Rumsey 2018) is commonly understood as part of policymakers' efforts to address systemic risk.

Building upon Acharya et al. (2017), Brownlees and Engle (2017) propose a systemic risk measure (*SRISK*) that captures the expected capital shortage of a financial institution during a crisis. *SRISK* is a function of an institution's degree of leverage and its marginal long-run expected shortfall (*LRMES*), which is the tail expectation of the institution's equity returns conditional on a substantial loss in the market in a six-month period. *V-LAB* database reports the SRISK measure in US$ million (*SRISKm*) and in percentage terms (*SRISK*%). Positive values of *SRISKm* are reported when capital shortfalls are expected, while negative values represent capital surpluses. Following Brownlees and Engle (2017), we ignore the contribution of negative capital shortfalls by taking only the positive values of *SRISKm*. Thus, for the financial institution *i* that belongs to country *k*, the annual series of the SRISK measure (*MSRISK*) is computed as the sum of the positive values of *SRISKm* in US$ billions over 12 months within a calendar year.

A cross-country dynamic panel model for bank systemic risk is represented as follows:

$$MSRISK_{i,k,t} = a \cdot MSRISK_{i,k,t-1} + b \cdot MEC_{k,t-1} + c \cdot BSC_{i,k,t-1} + \beta_1 \cdot MPI_{k,t} + \beta_2 \cdot MPI_{k,t-1} + \psi_k + \mu_{i,k,t}\,, \qquad (1)$$

with $i = 1, ..., N$, $k = 1, ..., K$ and $t = 1, ..., T$, where *i* indexes bank, *k* indexes country, and *t* is time at yearly frequency. *MPI* indicates a composite macroprudential index as defined in Cerutti et al. (2017a) and Alam et al. (2019)[4]. A positive (negative) index corresponds to tightening (loosening) of a macroprudential tool/vector of tools (see list of indices in Table 1). *MEC* is a vector of global- and country-level macroeconomic variables (see Table 2 on macroeconomic controls at country level and global macroeconomic controls) intended to disentangle the impact of macroprudential policy tools on systemic risk from global shocks and the effects of other policies (fiscal and monetary). *BSC* is a set of bank-level variables that may influence *SRISK* (see Table 2 on bank specific characteristics). ψ_k represents country fixed effects, and $\mu_{i,k,t}$ is an error term. To avoid endogeneity, all variables used to control for bank-specific characteristics, as well as macroeconomic variables, are one-period-lagged (rather than contemporaneous) values. We also include the lagged *MPI* variables to allow for the potential transmission delay of policy impacts.

To estimate the stabilizing effect of macroprudential rules conditional on the monetary policy regime, model (1) can be extended to a pseudo non-linear dynamic panel form, allowing for a specific impact on IT countries. Hence, our benchmark model is specified as follows:

$$\begin{aligned} MSRISK_{i,k,t} &= a \cdot MSRISK_{i,k,t-1} + b \cdot MEC_{k,t-1} + c \cdot BSC_{i,k,t-1} + d \cdot IT_{k,t-1} + \beta_1 \cdot MPI_{k,t} \\ &+ \beta_2 \cdot MPI_{k,t-1} + \gamma_1 \cdot IT_{k,t} \cdot MPI_{k,t} + \gamma_2 \cdot IT_{k,t} \cdot MPI_{k,t-1} + \psi_k + \mu_{i,k,t}\,, \end{aligned} \qquad (2)$$

where *IT* is an index variable that takes the value of 1 for an IT country and 0 otherwise. The IT-country-specific impact of macroprudential policy is captured by γ_1 and/or γ_2. If the IT regime reinforces the stabilizing role of macroprudential policies, this should be reflected in negative and significant coefficient estimates β_1 and γ_1 (and/or β_2 and γ_2 for the lagged effect).

[4] The Integrated Macroprudential Policy Database (*iMaPP*) is reported monthly, and we calculate the annual indices by averaging the monthly values over a calendar year.

B. Data and Sample Selection

To conduct our analysis, we rely on the macroprudential policy indices available in the Integrated Macroprudential Policy Database (*iMaPP*) constructed by Alam et al. (2019), which is based on the IMF's Annual Macroprudential Policy Survey. The database provides monthly dummy-type indices capturing tightening (+1) and loosening (−1) of macroprudential policies covering 134 countries from January 1990 to December 2018. We include 15 policy instruments and 7 subcategories for which we have observations. Each of these 22-monthly macroprudential policy indices is annualized by calculating the annual average for each country. Table 1 provides the list and definitions of the macroprudential tools we use in the analysis.

Table 1. Definitions of Macroprudential Policy Tools

Variable	Definition
Demand-based	
1. DSTI	Limits to the debt-service-to-income ratio restrict the size of debt services relative to income (targeted at housing loans, consumer loans, and commercial real estate).
2. LTV	Limits to the loan-to-value ratios, including those mostly targeted at housing loans, but also includes those targeted at automobile loans and commercial real estate loans.
Capital requirements	
3. Capital	Bank capital requirements, which include risk weights, systemic risk buffers, and minimum capital requirements. Subcategories: household sector targeted (HH), corporate sector targeted (Corp), and broad-based (Gen).
4. CCyB	A requirement for banks to maintain the countercyclical capital buffer.
5. Conservation	Requirements for banks to maintain a capital conservation buffer, including the one established under Basel III.
6. LVR	A limit on bank leverage, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures.
Loan-supply-based	
7. LCG	Limits on credit 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: household sector targeted (HH) and broad-based (Gen) measures.
8. LoanR	Loan restrictions. They include loan limits and prohibitions, which may be conditioned on loan characteristics, bank characteristics and other factors. Subcategory: household sector targeted (HH).
9. LLP	Loan loss provision requirements for macroprudential purposes, which include dynamic provisioning and sectoral provisions (e.g., housing loans).
10. LTD	Limits to the loan-to-deposit ratio and penalties for high LTD ratios.
11. LFC	Limits on foreign currency lending, and rules or recommendations on FC loans.
Liquidity requirements and other supply-based	
12. Liquidity	Measures 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 are not differentiated across currencies.
13. RR	Reserve requirements (domestic or foreign currency-based) for macroprudential purposes.
14. LFX	Limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mismatch regulations.
15. Tax	Taxes and levies applied to specified transactions, assets, or liabilities, which include stamp duties, and capital gain taxes.

Source: Alam et al. (2019).

To consider the countries listed in the *iMaPP* database, we collect the *SRISK* measure for the banks reported by *V-LAB* (*http://vlab.stern.nyu.edu/*) and updated monthly since July 2000. *V-LAB* database proposes a Global Dynamic MES measure based on Acharya et al. (2017). We select the aggregate market declines in a six-month period used to calculate the Long-Run Marginal Expected Shortfall (*LRMES*) at 40 pp following Brownlees and Engle (2017) and the prudential capital requirement used in calculating the expected capital shortfall if there is another crisis (*SRISKm*) at 8 pp for firms in Africa, Asia, and Americas and 5.5 pp for European firms.

We only include the banks for which at least one bank-control variable is available for the whole sample period. To avoid under-representation bias, we limit the sample to countries with three or more banks. Consequently, we obtain a sample of 539 banks that belong to 45 countries from June 2000 to December 2018.

Seven country-specific macro controls for the 45 countries as well as three global macro controls, both at annual frequency, are also included. The country-specific macro controls are mainly retrieved from the World Bank, BIS, and Bloomberg, and in cases where the panel was not complete, from central banks' websites. As described in Table 2, we consider the year-on-year growth of GDP (*GDP*), gross domestic savings as percent of GDP (*Savings*), consumer price inflation (*CPI*) from the World Bank, and the growth of the exchange rate with respect to US dollars (*FX*) from Bloomberg. To measure the policy rates (*INT*), we take the central bank policy rates from the BIS when available, otherwise the discount, *REPO* or short-term interest rates reported by the IMF, Bloomberg, OECD, or central banks. We add the index of financial development reported by the IMF (*FD*). As the global macro controls, we include the U.S. *VIX* measure from Chicago Board Options Exchange Market reported by FRED, the U.S. Fed's policy rate (*FFR*) from the Haver Analytics, and the Global *GDP* growth at constant prices (Global.GDP) from the World Bank database.[5]

We also include bank-specific variables. They are extracted from *ORBIS* database to capture bank balance sheet structure and income statements. We link the bank names from *V-LAB* database to the identification code reported in *ORBIS*. As reported in Table 2, we select the total assets and customer deposits (*DEP*) in US$ bn (*SIZE*) and other five ratios, i.e., equity to total assets (*CAP*), net loans to total assets (*LTA*), non-performing loans in total loans (*NPL*), and pre-tax income to total assets (*ROA*). Table 2 summarizes the source of data and the description of macroeconomic and bank-specific variables we use in the analysis.

[5] The effect of capital flows on bank systemic risk are largely controlled by VIX and FFR, along with INT, as regressors in our benchmark regressions. We expect that bank systemic risk is positively associated with global stock market volatility (VIX) reflecting global investors' sentiment and the U.S. Fed's policy rate change, both of which are likely to affect adversely capital inflows to most countries. Our empirical results are consistent with these priors, suggesting that capital flows could pose financial stability risk (see Appendix II). As shown by Choi and Cook (2018), however, domestic interest rate policy under IT would respond to capital flows, mindful of their direct impacts on credit growth vs. exchange rate pass-through effects on inflation.

Table 2. Data Source and Variable Description

Variable	Description	Sources	Coverage	Unit
Country-Specific Macroeconomic Controls				
GDP	Real GDP (annual growth)	WEO [1]	45	%
Savings	Gross domestic savings (percent of GDP)	WEO [1]	45	%
FX	Exchange rates per US$ (annual growth)	Bloomberg	45	%
INT	Central bank policy rate (annual difference)	BIS [2]	45	% point
CPI	Consumer Price Index (annual growth)	WEO [3]	45	%
FD	Index of financial development	IMF [4]	45	Index
kaopen	Chinn-Ito index	Chinn-Ito [4]	45	Index
Global Macroeconomic Controls				
VIX	U.S. CBOE Volatility Index (annual average)	FRED		y-avg
FFR	U.S. Fed's policy rate (annual difference) [5]	Haver		% point
Global.GDP	Global real GDP (annual growth)	WEO		%
Bank-Specific Characteristics				
SIZE	Total assets	Orbis	539	US$bn
DEP	Total customer deposits	Orbis	539	US$bn
ROA	Pre-tax income to total assets	Orbis	539	%
NPL	Non-performing loans in total loans	Orbis	539	%
CAP	Equity to total assets	Orbis	539	%
LTA	Net loans to total assets	Orbis	539	%

Notes: Some data sources are country specific as follows.

[1] Bloomberg for Korea and Taiwan.

[2] Central Banks for Romania, Malta, and Nigeria. Bloomberg for Taiwan, Ukraine, and United Arab Emirates. IMF for Kuwait, Morocco, Peru, Saudi Arabia, Singapore, Turkey, and Vietnam. OECD for Indonesia, and Greece. WEO for Japan. Bloomberg for Taiwan and United Arab Emirates. The central bank policy rate is based on the average over 12 months within a calendar year.

[3] Bloomberg for Taiwan and central banks for missing periods of Argentina and United Arab Emirates.

[4] Taiwan is not available in the database.

[5] When the Fed's policy rate constrained by the zero lower bound, it is replaced by the shadow short rate that is available from Haver Analytics.

Based on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), we construct two annual dummy variables for the countries that have implemented the IT regime (IT dummy) and the Exchange Rate Anchor regime (ER dummy) during the period considered. The dummy variables take the value of 1 if the country has the respective regime during the year considered, and zero otherwise. Following the IMF's classification, we construct the ER dummy for the period in which the exchange rate is the main monetary policy anchor. Based on the AREAER annual database, we include the countries and the corresponding year under the Exchange Rate Anchor category by considering the hard peg and then the soft peg periods in accordance with the IMF's classification. The monetary and exchange rate regime classification is summarized in Table 3.

Table 3. List of Countries and Periods under Inflation Targeting or Exchange Rate Anchor Regimes

	Country	ER	IT	Economy
1	Argentina	1999-2007	2015-2018	EME
2	Australia	-	1999-2018	AE
3	Austria	1999	2000-2018	AE
4	Belgium	1999	2000-2018	AE
5	Brazil	-	1999-2018	EME
6	Canada	-	1999-2018	AE
7	Chile	-	1999-2018	EME
8	China	1999-2018	-	EME
9	Colombia	-	1999-2018	EME
10	Denmark	1999-2018	-	AE
11	France	1999	2000-2018	AE
12	Germany	1999	2000-2018	AE
13	Greece	1999	2000-2018	AE
14	Hong Kong	1999-2018	-	AE
15	India	-	2014-2018	EME
16	Indonesia	-	2005-2018	EME
17	Israel	-	1999-2018	AE
18	Italy	1999	2000-2018	AE
19	Japan	-	2013-2018	AE
20	Jordan	1999-2018	-	EME
21	Korea	-	2000-2018	AE
22	Kuwait	1999-2018	-	EME
24	Mexico	-	2001-2018	EME
25	Morocco	1999-2018	-	EME
26	Netherlands	1999	2000-2018	AE
27	Nigeria	2006	-	EME
28	Norway	1999	2001-2018	AE
29	Peru	1999-2001	2002-2018	EME
30	Philippines	-	1999-2018	EME
31	Poland	-	1999-2018	EME
32	Russia	2007-2010	2018	EME
33	Saudi Arabia	1999-2018	-	EME
34	Singapore	2007-2018	-	AE
35	South Africa	-	1999-2018	EME
36	Spain	1999	2000-2018	AE
37	Sweden	-	1999-2018	AE
38	Switzerland	-	2009-2010	AE
39	Taiwan	1999-2014	-	AE
40	Thailand	1999	2000-2018	EME
41	Turkey	1999	2002-2018	EME
42	United Emirates	1999-2018	-	EME
43	United Kingdom	-	1999-2018	AE
44	U.S.	-	-	AE
45	Vietnam	1999-2018	-	EME

Sources: World Economic Outlook (WEO) OCT-2019 classification and IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).

Notes: Economy grouping corresponds to WEO OCT-2019 classification: a) AE denotes Advanced Economy; and b) EME denotes Emerging Market Economy. ER and IT are the pegged exchange rate and inflation targeting regimes, respectively. Missing years correspond to other regimes.

Table 4 reports summary statistics for the main variables used in the multivariate analysis. It shows that there is a great deal of variation in both the dependent variable (*SRISK*) and the independent variables, as suggested by the standard deviations. We also report the range of each key variable, indicating substantial variations across countries and overtime.

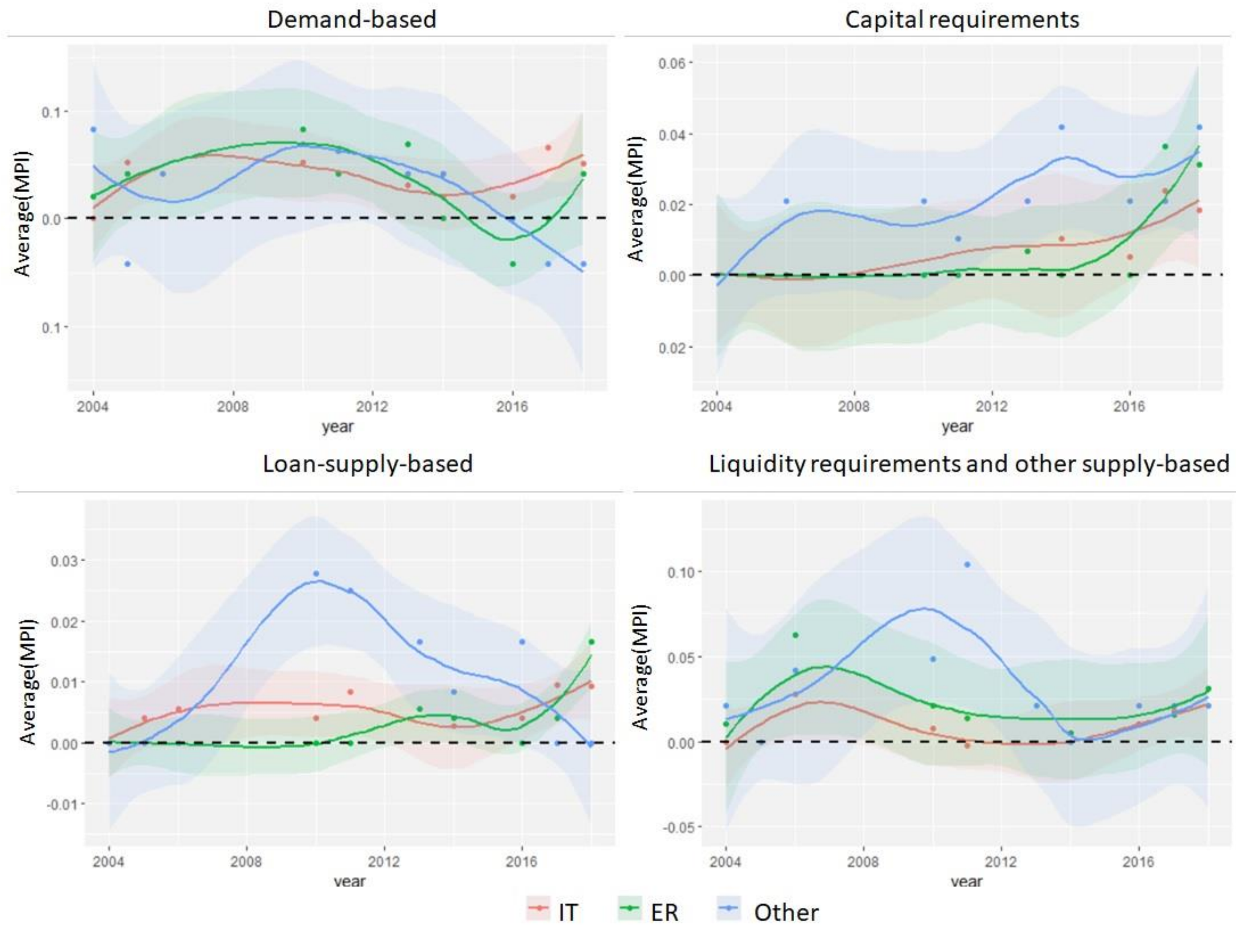
Table 4. Summary Statistics

	Mean	SD	Min	Max
SRISK(US$bn)	64.074	209.645	0.000	2,015.247
$\text{SRISK}_0(US\$bn)$	131.697	285.395	0.001	2,015.247
GDP (%)	2.781	2.509	-9.130	11.110
Savings (%)	25.650	9.746	-6.150	61.290
FX (%)	0.017	0.089	-1.890	1.023
INT (% point)	0.981	0.135	-124.200	113.230
CPI (%)	2.591	3.256	-1.740	42.80
FD	67.643	23.740	0.000	97.671
Global.GDP (%)	3.552	0.507	-0.140	5.420
VIX	16.828	4.080	11.090	32.620
FFR (% point)	-0.169	1.520	-3.150	1.854
SIZE(US$bn)	172.707	421.412	0.020	3,397.690
DEP(US$bn)	104.262	255.066	0.010	2,531.200
ROA (%)	1.941	3.914	-85.000	39.000
NPL (%)	4.612	7.786	1.000	100.000
CAP (%)	13.763	14.806	-44.000	100.000
LTA (%)	55.576	20.530	1.000	99.000
DSTI	0.003	0.022	-0.083	0.083
LTV	0.003	0.034	-0.167	0.167
Capital	0.014	0.040	-0.083	0.250
Capital.HH	0.004	0.027	-0.083	0.250
Cap.Corp	0.002	0.014	-0.083	0.083
Capital.Gen	0.010	0.032	-0.083	0.167
CCyB	0.001	0.019	-0.083	0.167
Conservation	0.016	0.035	-0.083	0.083
LVR	0.008	0.025	0.000	0.083
LCG	0.000	0.006	-0.083	0.167
LCG.HH	0.000	0.003	0.000	0.083
LCG.Gen	0.000	0.006	-0.083	0.167
LoanR	0.005	0.023	0.000	0.250
LoanR.HH	0.004	0.022	0.000	0.250
LoanR.Corp	0.001	0.010	0.000	0.083
LLP	0.003	0.020	-0.083	0.167
LTD	0.000	0.009	-0.083	0.083
LFC	0.001	0.008	0.000	0.083
Liquidity	0.027	0.046	-0.083	0.250
RR	-0.004	0.059	-0.583	0.500
LFX	0.001	0.017	-0.083	0.167
TAX	0.001	0.028	-0.133	0.255

Notes: The table reports the descriptive statistics Mean, SD (standard deviation), Min (minimum), and Max (Maximum). MSRISK_0 corresponds to the MSRISK variable for which zero is excluded. Savings are calculated as GDP minus final consumption expenditure (total consumption) and can have negative values. Macroprudential tools also include subgroup classifications, i.e., household sector targeted (HH), corporate sector targeted (Corp), broad-based (Gen) measures. The minimum and maximum of the INT variable are attributable to the 2000-2001 financial crisis in Turkey.

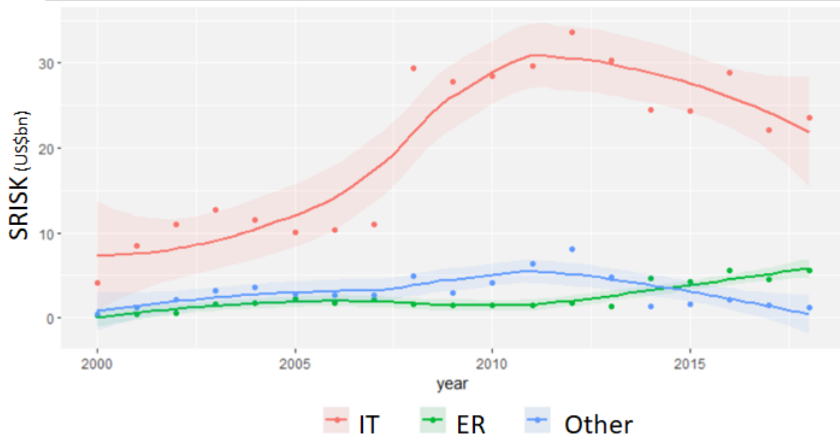
The evolutions of macroprudential policies are broadly aligned with those of SRISK over years 2004 – 18: Figures 1 and 2. The pre-GFC period sees overall relatively loose macroprudential policies amid rising SRISK. After the GFC, lower SRISK tends to be associated with tighter macroprudential policies (except liquidity requirement and other supply-based tools under IT and ER regimes). Following monetary policy normalization started in the U.S. from end-2015, tighter macroprudential policies (except for other regimes where demand-based measures and loan and credit growth related measures became less tight) accompanied rather tempered SRISK under IT and other regimes but rising SRISK under the ER regime.

Figure 1. Average of iMapp Indices per Macroprudential Tool Type and Country Group



Notes: The dots report the simple average of the iMapp indices belonging to the corresponding type of tools (see list in Table 1) over the 45 countries considered under Inflation Targeting (red), Exchange Rate anchor (green) or Other (blue) regimes. The shaded area corresponds to the locally estimated scatterplot smoothing (LOESS) within a span at 0.75.

Figure 2. SRISK Measure Adjusted by Bank Size per Country Group



Notes: The dots report the simple average of the ratio SRISK measure adjusted by the total assets of the corresponding bank over the countries under Inflation Targeting (red), Exchange Rate anchor (green) or Other (blue) regimes. The shaded areas correspond to the locally estimated scatterplot smoothing (LOESS) within a span at 0.75

The sample distribution of each MPI measure also suggests that, without implicating causal relationships, lower SRISK observations tend to be associated with macroprudential tightening for most MPI tools: see Appendix I for the synchronicity between SRISKm and macroprudential policy stances. In the period considered, IT countries do not tighten limits on credit growth tools (LCG). Likewise, limits on foreign currency (LFC) and limits on credit growth targeted to the household sector (LCG.HH) are not tightened in non-IT countries (see Figure A.3 in Appendix I).

IV. Empirical Results of Macroprudential Policy Effects on Bank Systemic Risk

Our benchmark model, model (2), is estimated for each of the MPI measures (i.e., 22 regression equations) using a 2-step GMM approach á la Arellano and Bond (1991) to avoid potential unobserved heterogeneity. The GMM instruments are selected to be the second lag of the global- and country-level macroeconomic variables (MEC), the set of bank-level variables (BSC), and the corresponding macroprudential index (MPI). The Hansen test of overidentifying restrictions (*J*−test) is also performed and reported to evaluate the adequacy of the instruments. The Hansen test for overidentification suggests that the regression model of each MPI measure is correctly specified and that the validity of the instruments cannot be rejected at any meaningful significance level. As the Arellano-Bond estimator assumes no second-order autocorrelation of the residuals, the serial correlation test for each regression does not indicate misspecification. As model (2) is a dynamic nonlinear model (estimated by GMM), it is possible to interpret the significance of the variables, including MPI, as causal (in the sense of Granger) if GMM instruments used to control for endogeneity are valid.

Tables 5 to 11 report our estimations of the impact of macroprudential tools on bank systemic risk and the potential role of the IT regime. The magnitude of the total effect of an MPI-related variable is the sum of current and lagged coefficients on the variable. We organize the interpretation of results across types of macroprudential tools. As discussed in more detail in Appendix II, we also find that the signs of our macroeconomic control variables, especially on the external front, as well as bank-specific control variables, are consistent with our expectations across the 22 regressions. Notably, our results indicate that bank systemic risk is significantly reduced under the IT regime: the coefficient estimate on the IT regime index is significantly negative in all benchmark regressions. This finding is consistent with existing studies suggesting that the IT regime can be more effective in enhancing banks' risk profiles, potentially due to embedded transparency and accountability under the IT institutional setup (Fazio et al. 2018; and Louati and Boujelbene 2020).

A. Demand-Based Measures

According to Kuttner and Shim (2016), limits on the DSTI ratio are effective in reducing the procyclicality of credit growth. However, results reported in Table 5 suggest that imposing stricter limits on the DSTI ratio mitigates bank systemic risk only under an IT regime, as the coefficient estimate on the interaction term between DSTI, and IT is negative and statistically significant at the 5 percent level while the coefficient estimate on DSTI is insignificant. This result suggests that IT enhances the effectiveness of the DSTI ratio in limiting banks' exposure to systemic risk. Also, tightening the LTV ratio mitigates with a lag bank systemic risk only under an IT regime, as the coefficient estimate on the lagged interaction term between LTV and IT are negative and statistically significant at the 5 percent level whereas that on LTV is statistically positive and smaller.

Table 5. Estimation Results: Demand-Based Measures

	DSTI	LTV
$SRISK_{t-1}$	0.44***	0.44***
GDP_{t-1}	0.08	−0.60
$Savings_{t-1}$	0.68	0.81
FX_{t-1}	−44.93**	−29.02
INT_{t-1}	−2.43*	−1.02
CPI_{t-1}	0.13	0.29
FD_{t-1}	4.73***	4.61***
$kaopen_{t-1}$	−25.10*	−14.34
$Global.GDP_{t-1}$	12.25***	11.39***
VIX_{t-1}	1.92***	1.89***
FFR_{t-1}	2.45**	0.62
$SIZE_{t-1}$	0.47***	0.46***
DEP_{t-1}	−0.76***	−0.76***
ROA_{t-1}	−0.09	−0.14
NPL_{t-1}	−0.04	0.15
CAP_{t-1}	−0.04	−0.04
LTA_{t-1}	0.46	0.56
IT_{t-1}	−31.69***	−28.85**
DSTI	85.71	
$DSTI_{t-1}$	−53.28	
IT.DSTI	−387.86**	
$IT.DSTI_{t-1}$	∅	
LTV		−22.97
LTV_{t-1}		92.44**
IT.LTV		−173.86
IT.LTV-1		−198.80**
Observations	539	539
J test p.value	0.9833	0.9851
Arellano-Bond p.value	0.2436	0.2103

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively.

B. Capital Requirements

Capital buffers (Capital, CCyB, and Conservation) are expected to moderate systemic risk as they are intended to absorb bank losses in times of stress and help maintain the flow of credit during a downturn (under the Basel III framework). Tighter monetary policy in response to higher inflation or a larger output gap which tend to accompany a credit boom will help attenuate excessive credit risk but raise the funding cost of capital and thus increase the cost of capital buffers (Cozzi et al. 2020; and Garcia Revelo et al. 2020). However, macroprudential tools oriented to regulate the capital banks are required to hold, such as CCyB, may conflict with the objectives of monetary policy, including inflation targeting (Garcia Revelo and Levieuge 2022). Also, sector-specific capital requirements could have limited effects on bank systemic risk owing to a spillover effect across sectors.

The estimated results reported in Table 6 show that capital requirements (covering all sectors) and household-sector-targeted capital (Capital.HH) requirements are effective in attenuating systemic risk under IT regimes but not under other regimes. In addition, the effects of corporate-sector-targeted capital (Capital.Corp) requirements and broad-based capital (Capital.Gen) requirements on systemic risks are mixed but insignificant under both IT and other regimes.

The estimated results reported in Table 7 suggest that conservation capital helps mitigate bank systemic risks but CCyB and limits on bank leverage (LVR) do not. We find that the CCyB does not reveal any pronounced effects perhaps due to limited observations, reflecting that only a few advanced economies implemented a positive cycle neutral CCyB rate and changed CCyB rates within a range in response to excessive credit growth (BIS 2022). Conservation buffers are effective with a lag (significant at the 1 percent level) in attenuating systemic risk under the IT regime but not under other regimes. LVR limits are intended to reduce loan losses upon debt but could entail a side effect which counters the intended effect of the decline in losses upon debt (Choi and Cook 2012) by increasing the ability of banks to take on debt increasing the likelihood of default. The estimated positive effects of LVR on bank systemic risk may reflect that the side effect more than offsets the intended effect, more strongly under the IT regime than other regimes.

Table 6. Estimation Results: Capital Requirements (1/2)

	Capital	Capital.HH	Capital.Corp	Capital.Gen
$SRISK_{t-1}$	0.44^{***}	0.44^{***}	0.45^{***}	0.44^{***}
GDP_{t-1}	-0.91	-0.55	-1.35	-1.09
$Savings_{t-1}$	1.32	1.52	1.36	1.06
FX_{t-1}	-38.49^{*}	-29.96	-33.34	-36.85^{*}
INT_{t-1}	-0.45	-0.93	-0.56	-0.48
CPI_{t-1}	-0.53	0.49	-0.22	-0.17
FD_{t-1}	4.46^{***}	3.55^{***}	4.05^{***}	4.13^{***}
$kaopen_{t-1}$	-25.46^{*}	-30.53^{**}	-10.21	-26.53^{**}
$Global.GDP_{t-1}$	12.02^{***}	12.63^{***}	12.60^{***}	12.93^{***}
VIX_{t-1}	1.56^{***}	1.83^{***}	2.19^{***}	1.70^{***}
FFR_{t-1}	-0.07	1.81^{*}	1.53	-0.05
$SIZE_{t-1}$	0.47^{***}	0.47^{***}	0.45^{***}	0.47^{***}
DEP_{t-1}	-0.77^{***}	-0.74^{***}	-0.74^{***}	-0.76^{***}
ROA_{t-1}	0.08	0.32	0.04	0.11
NPL_{t-1}	-0.11	-0.17	0.12	-0.07
CAP_{t-1}	-0.004	-0.05	0.29	-0.03
LTA_{t-1}	0.26	0.34	0.74	0.38
IT_{t-1}	-29.10^{**}	-25.49^{**}	-21.38^{*}	-25.85^{**}
Capital	40.23			
$Capital_{t-1}$	46.36			
IT.Capital	-182.09^{***}			
$IT.Capital_{t-1}$	30.22			
Capital.HH		30.46		
$Capital.HH_{t-1}$		-1.18		
IT.Capital.HH		-220.97^{**}		
$IT.Capital.HH_{t-1}$		-314.55^{***}		
Capital.Corp			-549.09	
$Capital.Corp_{t-1}$			463.25	
IT.Capital.Corp			269.92	
$IT.Capital.Corp_{t-1}$			-322.31	
Capital.Gen				3.45
$Capital.Gen_{t-1}$				93.69
IT.Capital.Gen				-72.01
$IT.Capital.Gen_{t-1}$				42.32
Observations	539	539	539	539
J test p.value	0.9645	0.9620	0.9545	0.9125
Arellano-Bond p.value	0.2123	0.2614	0.2751	0.2236

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively.

Table 7. Estimation Results: Capital Requirements (2/2)

	CCyB	Conservation	LVR
SRISK_{t-1}	0.45^{***}	0.45^{***}	0.44^{***}
GDP_{t-1}	-0.66	-0.68	0.40
Savings_{t-1}	1.22	1.64	0.01
FX_{t-1}	-22.36	-31.29	-44.54^{**}
INT_{t-1}	-0.12	-0.10	0.48
CPI_{t-1}	-0.57	0.45	1.03
FD_{t-1}	3.25^{**}	6.40^{***}	4.61^{***}
kaopen_{t-1}	-0.11	-8.11	-22.20
Global.GDP_{t-1}	12.78^{***}	10.44^{**}	11.27^{***}
VIX_{t-1}	2.22^{***}	2.11^{***}	1.90^{***}
FFR_{t-1}	1.54^{*}	1.39	-0.33
SIZE_{t-1}	0.44^{***}	0.45^{***}	0.47^{***}
DEP_{t-1}	-0.70^{**}	-0.79^{***}	-0.74^{***}
ROA_{t-1}	0.02	0.12	0.17
NPL_{t-1}	0.17	0.01	0.10
CAP_{t-1}	0.02	0.05	0.06
LTA_{t-1}	0.50	0.80	0.31
IT_{t-1}	-11.11	-32.75^{***}	-28.99^{**}
CCyB	-153.48		
CCyB_{t-1}	64.95		
IT.CCyB	-82.96		
IT.CCyB_{t-1}	$\emptyset$		
Conservation		-78.60	
$\text{Conservation}_{t-1}$		418.34^{**}	
IT.Conservation		36.94	
$\text{IT.Conservation}_{t-1}$		-556.46^{***}	
LVR			-11.68
LVR_{t-1}			198.44^{**}
IT.LVR			346.42^{**}
IT.LVR_{t-1}			61.29
Observations	539	539	539
J test p.value	0.9345	0.9742	0.9675
Arellano-Bond p.value	0.2348	0.2213	0.2321

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

C. Loan-Supply-Based Measures

Limits on credit growth (LCG) may constrain credit expansions (along the trend or departures from the trend) if it is deployed in a countercyclical manner. Estimates on LCG reported in Table 8 are, however, insignificant or have the incorrect sign when marginally significant (at the 10 percent level for the LCG_{t-1}). Results with subcategory credit growth measures suggest that broad-based measures (LCG.Gen) and household-targeted measure (LCG.HH) do not have pronounced effects on bank systemic risks.

Loan restrictions (LoanR) reduce significantly systemic risk. As expected, estimates turn out to be significantly negative especially for households that have limited access to alternative funding sources in contrast with corporate firms that have access to capital markets (see Table 9). This negative effect, however, is muted under the IT regime, more than offset possibly by circumventions or leakages, which render loan restrictions ineffective in mitigating systemic risk because overall credit is provided on demand (given the policy rate) under the IT regime. This result is consistent with the finding of Bhargava et al. (2021) on a spillover effect that a tightening of household-specific macroprudential tools shifts bank loans away from households to nonfinancial corporations, leading to deteriorations in overall credit quality.

The last three supply-loan tools are reported in Table 10. Loan loss provision (LLP) requirements, especially when they are preemptive, can help reduce runs for deposit withdrawals and attenuate the impact of the probability of default and loss given default on systemic risk, while they are somewhat prone to procyclicality (say, banks could be required to increase LLP in the face of the rising risk of default). The estimated results suggest that LLP requirements have overall insignificant effects on systemic risk, although negative contemporaneous and lagged effects under the IT regime.

Limits on the loan-to-deposit (LTD) ratio help contain excessive credit and credit risk, attenuating systemic risk. Our results are not pronounced but largely consistent with this prior: systemic risk declines insignificantly with tightening of the LTD ratio, and the IT regime does not significantly alter the (contemporaneous) LTD impact on systemic risk.

Limits on foreign currency lending (LFC) could help tame systemic risk for open economies facing risk of sudden reversals. LFC would have more significant negative effect on SRISK under the IT regime (or flexible exchange rate regimes), where exchange rate changes are driven by capital flows and currency mismatch problems. However, due to the lack of observations in the sample period considered, the IT.LFC index had to be excluded.

Table 8. Estimation Results: Loan-Supply-Based Measures (1/3)

	LCG	LCG.HH	LCG.Gen
SRISK_{t-1}	0.46***	0.45***	0.45***
GDP_{t-1}	−0.95	−0.88	−0.91
Savings_{t-1}	1.47	1.05	1.06
FX_{t-1}	−31.87	−21.62	−26.04
INT_{t-1}	−1.23	0.06	−0.48
CPI_{t-1}	0.66	0.26	0.08
FD_{t-1}	5.03***	4.00***	4.47***
kaopen_{t-1}	−24.91*	−12.84	−19.31
Global.GDP_{t-1}	12.57***	12.31***	12.61***
VIX_{t-1}	2.60***	1.88***	2.19***
FFR_{t-1}	2.47**	1.54*	1.78**
SIZE_{t-1}	0.44***	0.44***	0.45***
DEP_{t-1}	−0.73***	−0.74***	−0.74***
ROA_{t-1}	0.16	−0.14	0.06
NPL_{t-1}	−0.11	0.09	−0.12
CAP_{t-1}	0.22	−0.08	0.06
LTA_{t-1}	0.50	0.52	0.37
IT_{t-1}	−22.69*	−24.77**	−23.27**
LCG	1,065.89		
LCG_{t-1}	1,279.23*		
IT.LCG	−908.73		
IT.LCG_{t-1}	∅		
LCG.HH		−774.66	
LCG.HH_{t-1}		∅	
IT.LCG.HH		∅	
IT.LCG.HH_{t-1}		∅	
LCG.Gen			−101.19
LCG.Gen_{t-1}			806.11
IT.LCG.Gen			∅
IT.LCG.Gen_{t-1}			∅
Observations	539	539	539
J test p.value	0.9817	0.9713	0.9780
Arellano-Bond p.value	0.1689	0.2449	0.2651

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

Table 9. Estimation Results: Loan-Supply-Based Measures (2/3)

	LoanR	LoanR.HH	LoanR.Corp
SRISK_{t-1}	0.43***	0.43***	0.45***
GDP_{t-1}	0.44	0.91	−0.23
Savings_{t-1}	0.76	0.70	1.03
FX_{t-1}	−39.34*	−44.34**	−32.36
INT_{t-1}	0.77	0.51	−0.85
CPI_{t-1}	−0.31	−0.04	−0.37
FD_{t-1}	2.27**	2.02*	3.87***
kaopen_{t-1}	−9.46	−12.55	−28.02*
Global.GDP_{t-1}	11.32***	11.38***	12.54***
VIX_{t-1}	1.88***	1.89***	2.00***
FFR_{t-1}	1.71*	2.21**	1.65*
SIZE_{t-1}	0.47***	0.47***	0.46***
DEP_{t-1}	−0.80***	−0.82***	−0.74***
ROA_{t-1}	−0.003	−0.04	0.05
NPL_{t-1}	−0.16	−0.18	−0.09
CAP_{t-1}	−0.20	−0.08	−0.04
LTA_{t-1}	0.24	0.30	0.39
IT_{t-1}	−24.56**	−26.72**	−24.70**
LoanR	−850.19**		
LoanR_{t-1}	−174.58		
IT.LoanR	793.18*		
IT.LoanR_{t-1}	505.87		
LoanR.HH		−1,100.31*	
LoanR.HH_{t-1}		−463.18	
IT.LoanR.HH		918.25*	
IT.LoanR.HH_{t-1}		768.23	
LoanR.Corp			295.67*
LoanR.Corp_{t-1}			−53.87
IT.LoanR.Corp			∅
$\text{IT.LoanR.Corp}_{t-1}$			∅
Observations	539	539	539
J test p.value	0.9421	0.9581	0.9335
Arellano-Bond p.value	0.1155	0.1612	0.2511

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

Table 10. Estimation Results: Loan-Supply-Based Measures (3/3)

	LLP	LTD	LFC
SRISK_{t-1}	0.45^{***}	0.45^{***}	0.45^{***}
GDP_{t-1}	-0.84	-1.11	-0.49
Savings_{t-1}	1.12	0.91	1.43
FX_{t-1}	-34.81	-24.14	-23.32
INT_{t-1}	0.33	-0.15	-0.33
CPI_{t-1}	-0.18	0.27	-0.06
FD_{t-1}	3.83^{***}	3.97^{***}	4.16^{***}
kaopen_{t-1}	-21.02	-24.33^{*}	-13.36
Global.GDP_{t-1}	12.52^{***}	13.21^{***}	13.10^{***}
VIX_{t-1}	1.92^{***}	1.89^{***}	2.10^{***}
FFR_{t-1}	1.25	1.63	1.69^{*}
SIZE_{t-1}	0.46^{***}	0.45^{***}	0.45^{***}
DEP_{t-1}	-0.75^{***}	-0.73^{***}	-0.74^{***}
ROA_{t-1}	0.08	0.02	0.01
NPL_{t-1}	-0.10	0.03	-0.15
CAP_{t-1}	-0.001	-0.04	-0.12
LTA_{t-1}	0.40	0.43	0.22
IT_{t-1}	-23.59^{*}	-27.07^{**}	-23.78^{**}
LLP	101.63		
LLP_{t-1}	-20.76		
IT.LLP	-145.19		
IT.LLP_{t-1}	-257.55		
LTD		-648.95	
LTD_{t-1}		-267.03	
IT.LTD		392.95	
IT.LTD_{t-1}		$\emptyset$	
LFC			50.53
LFC_{t-1}			323.05
IT.LFC			$\emptyset$
IT.LFC_{t-1}			$\emptyset$
Observations	539	539	539
J test p.value	0.9613	0.9555	0.9612
Arellano-Bond p.value	0.2752	0.2112	0.2133

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

D. Liquidity Requirements and Other Supply-Based Measures

Liquidity requirements (such as the LCR and NSFR ratios), when they affect banks' leverage cycle, help reduce systemic risk. However, the estimates reported in Table 11 suggest that tighter liquidity requirements increase systemic risk with a lag under IT relative to other regimes, as the coefficient estimate on the lagged interaction term between IT and Liquidity appears positive and significant at the 1 percent level.

While tightened reserve requirements seem to raise bank systemic risk, potentially due to adverse effects on banks' cost of funding and profitability, this effect is mitigated under IT. In particular, the coefficient estimate on the lagged interactive term between RR and IT is negative and significant at the 5 percent level, suggesting that the IT regime helps reserve requirements contain bank systemic risk.[6] In addition, limits on foreign currency exposures turn out to lower bank systemic risk. The coefficient estimates on both the contemporaneous and lagged values of LFX are negative and significant. This result potentially reflects that large open foreign currency positions in banks' balance sheets are perceived as a source of vulnerability that increases exposures to the risk of domestic currency depreciation or devaluation. Limiting such exposures enhances banks' risk profiles and reduces their systemic risk.[7] Tax-based measures do not show pronounced effects on bank systemic risk, while taxes (including stamp duties, e.g., on real estates) and bank levies (e.g., on non-core bank liabilities) could help reduce systemic risk in the long run (see Hahm et al. 2013).[8]

[6] RR can affect the level of loan creation, as indicated by the original conception of RR as a liquidity and credit tool. RR under a modernized monetary framework, particularly under IT, can also be utilized to enhance bank portfolios by controlling wholesale funding and FX-denominated deposits (e.g., Garcia-Escribano et al. 2012), thereby reducing systemic risk. However, this negative effect on systemic risk could be counterbalanced by the positive effect of RR, which raises banks' funding costs and creates adverse pressures on bank profits. Garcia-Escribano et al. (2012) find that RR have a moderate and transitory effect in slowing the pace of credit growth in Latin America.

[7] Foreign-currency exposures of a country's banks may jeopardize financial stability when the exchange rate depreciates (is devalued) in floating (fixed) exchange rate regimes and, especially, in small open economies (Georgiadis et al. 2021).

[8] Also, macroprudential tools may take time to achieve the desired goal. For example, Davidoff et al. (2013) note that the effect of stamp duties on dimming house sales is observed with a three-year lag. The effect in the first two-years is opposite to the desired impact.

Table 11. Estimation Results: Liquidity Requirements and Other Supply-Based Measures

	Liquidity	RR	LFX	Tax
$SRISK_{t-1}$	0.44^{***}	0.44^{***}	0.45^{***}	0.44^{***}
GDP_{t-1}	-0.50	0.73	-0.37	1.33
$Savings_{t-1}$	0.21	0.04	1.20	0.11
FX_{t-1}	-30.17	-41.05^{*}	-24.89	-23.26
INT_{t-1}	2.24^{**}	0.33	-0.70	2.32
CPI_{t-1}	-0.71	0.58	0.40	-0.60
FD_{t-1}	2.94^{**}	4.13^{***}	4.09^{***}	2.23^{*}
$kaopen_{t-1}$	-22.66	-28.51^{**}	-13.54	9.21
$Global.GDP_{t-1}$	11.88^{***}	10.78^{**}	12.23^{***}	11.19^{***}
VIX_{t-1}	2.16^{***}	1.90^{***}	1.93^{***}	1.91^{***}
FFR_{t-1}	1.62^{*}	1.08	1.51^{*}	-0.45
$SIZE_{t-1}$	0.45^{***}	0.47^{***}	0.45^{***}	0.45^{***}
DEP_{t-1}	-0.71^{**}	-0.78^{***}	-0.75^{***}	-0.76^{**}
ROA_{t-1}	0.13	0.19	0.04	0.03
NPL_{t-1}	-0.21	-0.32	-0.02	-0.05
CAP_{t-1}	0.09	0.08	-0.03	-0.30
LTA_{t-1}	0.53	0.48	0.38	0.10
IT_{t-1}	-20.71^{**}	-32.37^{***}	-33.21^{**}	-19.07
Liquidity	-7.76			
$Liquidity_{t-1}$	-60.73			
IT.Liquidity	-17.35			
$IT.Liquidity_{t-1}$	168.85^{***}			
RR		176.23		
RR_{t-1}		260.60^{***}		
IT.RR		3.36		
$IT.RR_{t-1}$		-220.37^{**}		
LFX			-254.24^{*}	
LFX_{t-1}			-182.35^{***}	
IT.LFX			$\emptyset$	
$IT.LFX_{t-1}$			$\emptyset$	
Tax				-258.99
Tax_{t-1}				103.73
IT.Tax				696.43
$IT.Tax_{t-1}$				-427.98
Observations	539	539	539	539
J test p.value	0.9441	0.9823	0.9551	0.8785
Arellano-Bond p.value	0.2516	0.2235	0.2178	0.2121

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

E. Robustness Checks and Extensions

This sub-section starts with the robustness checks of our main results. Table 12 presents a summary of the regression results for alternative samples, comparing them with the benchmark results (first column).

The first robustness check compares the estimated results for the post-GFC period (2011−2018) with the benchmark results. The contemporaneous effect of corporate-sector-targeted capital (Capital.Corp) requirements seems significant and negative. Broad-based capital (Capital.Gen) effectively reduces systemic risk under the IT regime but not under other regimes. In addition, the contemporaneous term of loan loss provision (LLP) requirements is significant and positive, whereas under the IT regime it is negative and significant. In this sense, LLP, especially when they are preemptive, can help reduce runs for deposit withdrawals and attenuate the impact of the probability of default and loss given default on systemic risk. However, they are somewhat prone to procyclicality (for example, banks could be required to increase LLP in the face of the rising risk of default). Limits on the LTD ratio and tax help contain excessive credit and credit risk, attenuating systemic risk.

In the second robustness check, we re-estimate all the models using all available banks and bank control variables, ending up with 576 banks that belong to 60 countries for the period 2000–2018 (ignoring the restriction applied earlier that a country must have at least three banks). In this unrestricted sample, we find that most MPIs except LTD under the IT regime are at least as effective as under other regimes. Specifically, Capital.Corp is effective in attenuating systemic risk under IT regimes but not under other regimes. DSTI and LTV limits contribute to mitigating systemic risk but do not have additional contribution under the IT regime. In addition, LVR, LLP, and liquidity requirements appear to help mitigate SRISK under the IT regime, whereas they do not in the benchmark results.

The third robustness check re-estimates the benchmark model separately for AEs and EMEs as defined by the World Bank's classification.[9] The effect of macroprudential policies on bank systemic risk tend to be more pronounced for EMEs than for AEs. Exceptions are LTV, liquidity requirements, and LFC which appear to be effective only for AEs.

Next, as extensions of the benchmark model, we consider interactions between monetary policy and macroprudential policy. We additionally include in model (2) the interactive terms of the monetary policy stance measured by (domestic) policy rate change and the macroprudential policy stance measured by each of MPIs. We find that this exercise largely preserves the results of the benchmark regressions their qualitative consistency (see Tables A.1 – A.7 in Appendix III).

We find that the estimated coefficients on the interactive term of monetary policy and macroprudential policy are largely positive with some statistical significance (Tables A.1 – A.7).[10] This finding is consistent with our expectation that tighter monetary policy and tighter macroprudential policy are conducive to financial stability.

[9] The IT dummy is not included in this case.

[10] We find significantly positive coefficient estimates on policy rate change interacting with most macroprudential tools including CCyB (Table A.3), loan restrictions (Table A.5), limits on FX lending (Table A.6), and tax (Table A.7). However, we find negative or mixed signs for policy rate change interacting with demand-based measures (Tables A.1) and sectoral capital requirements (Table A.2), possibly reflecting that tighter macroprudential policy targeted to reduce excessive borrowing or lending may help reduce SRISK while higher policy rates tend to accompany higher credit demand.

Table 12. Robustness Check: Coefficient Signs for the Significant MPIs (at p<0.1)

	Benchmark		[1]		[2]		[3]	
MPI	All	IT	All	IT	All	IT	AE	EME
Demand Based								
DSTI								
t		-		-	-			
t-1		∅		∅		∅		-
LTV								
t				-	-		-	
t-1	+	-						
Capital Requirements								
Capital								
t		-		-				
t-1							+	+
Capital.HH								
t		-		-	-			
t-1		-		-		-		-
Capital.Corp								
t			-		+	-	-	-
t-1					+	-		+
Capital.Gen								
t			+	-				
t-1					+		+	+
CCyB								
t						-		
t-1		∅		∅		∅	+	∅
Conservation								
t		-						-
t-1	+			-	+	-		
LVR								
t		+			-	+		
t-1	+		-		+	-	∅	∅
Loan-supply-based								
LCG								
t					-		∅	
t-1	+	∅		∅	-	∅	∅	
LCG.HH								
t		∅		∅	-	∅	∅	
t-1	∅	∅	∅	∅	∅	∅	∅	
LCG.Gen								
t		∅		∅		∅	∅	
t-1		∅		∅		∅	∅	
LoanR								
t	-	+			-			-
t-1							∅	∅
LoanR.HH								
t	-	+			-		∅	-
t-1							∅	∅
LoanR.Corp								
t	+	∅		∅	+	∅		-
t-1		∅		∅	+	∅	∅	∅
LLP								
t			+	-	+	-		
t-1					+	-		-
LTD								
t			-		-	+	∅	
t-1		∅		∅	-	∅	∅	∅
LFC								
t		∅		∅		∅	∅	
t-1		∅		∅	-	∅	∅	∅
Liquidity requirements and other supply-based								
Liquidity								
t						-	-	+
t-1		+					+	+
RR								
t					-	-		
t-1	+	-			-	-		
Tax								
t								
t-1				-	-		-	
LFX								
t	-	∅		∅	+	∅	∅	
t-1	-	∅		∅		∅	∅	∅
Banks	539		534		576		539	
Countries	45		45		60		45	
Period	2000-2018		2010-2018		2000-2018		2000-2018	

Notes: The benchmark column corresponds to the main results reported in Section IV; and others corresponds to (1) the post-GFC period, (2) unrestricted sample, and (3) AE vs. EME grouping. The sign of the MPI coefficient significant at p < 1% is reported: a negative (positive) sign in green (red). Ø indicates that the variable has been excluded in the corresponding sample due to the lack of observations. For sake of space, we do not report the whole estimated coefficients but only their signs. Complete tables are available from the authors upon request.

For example, during monetary policy normalization since 2015 in IT countries as shown in Figure 1, SRISK rose because macroprudential tightening raises bank funding costs amid increased policy rates. Also, monetary policy loosening accompanied by macroprudential tightening could reduce SRISK, e.g., when capital buffers are high (Gambacorta and Shin 2018), as in the post-GFC prior to policy normalization: see Figures 1 and 2.

IV. Conclusion

This paper investigates the effects of individual macroprudential tools on systemic risk at the bank level, which are specific to IT countries. Extending Meuleman and Vander Vennet (2020), we consider a larger sample of 45 countries at the bank level which comprises various monetary and exchange rate regimes to uncover the potential specificity of the IT country group using a regime-dependent dynamic panel model.

We empirically show that macroprudential policy can reduce systemic risk further when a central bank pursues IT. This synergy effect under the IT regime may be attributable not only to the transparency and accountability of this policy framework but also to the conduct of monetary policy that focuses on interest rates and funding costs for price stability given endogenous liquidity, conducive to preventing excessive credit growth.

Our findings indicate that while macroprudential policy alone helps reduce bank systemic risk by itself, IT enhances the effectiveness of most macroprudential tools including DSTI and LTV limits, and capital requirements. Furthermore, our extended regression analysis reveals that monetary policy has the potential to reinforce the effectiveness of several macroprudential policies

This paper hence provides additional empirical support to the existing analyses that have highlighted the importance of coordination between monetary and macroprudential policies to mitigate financial stability risks. Our empirical findings provide supportive evidence to the view that the IT regime reinforces the effectiveness of macroprudential policies by mitigating bank systemic risk. However, further research could be conducted to help understand the inter-linkages between monetary policy and macroprudential policy, shedding light on the transmission channels through which each monetary policy regime can amplify or mitigate the effect of different macroprudential tools on financial stability.

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Appendix I. Macroprudential Policy and SRISK Metrics: IT vs. Non-IT Countries

This appendix provides information about the SRISK measure and the macroprudential policy stance of each MPI (Figures A.1-A.4). Remarkably, very high SRISK observations are mostly associated with loose macroprudential policies (without implying a causal link).

Figure A.1. Synchronicity between SRISKm and Macroprudential Policy: Demand-Based Measures

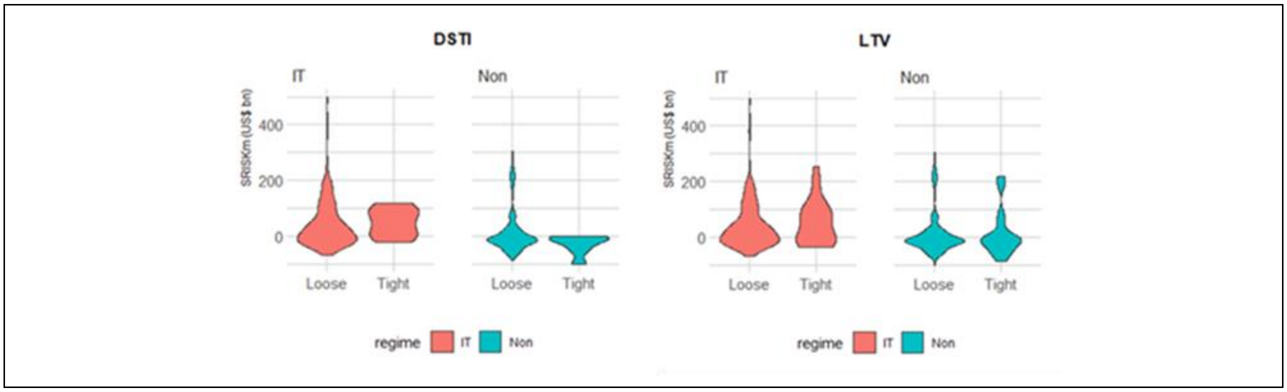


Figure A.2. Synchronicity between SRISKm and Macroprudential Policy: Capital Requirements

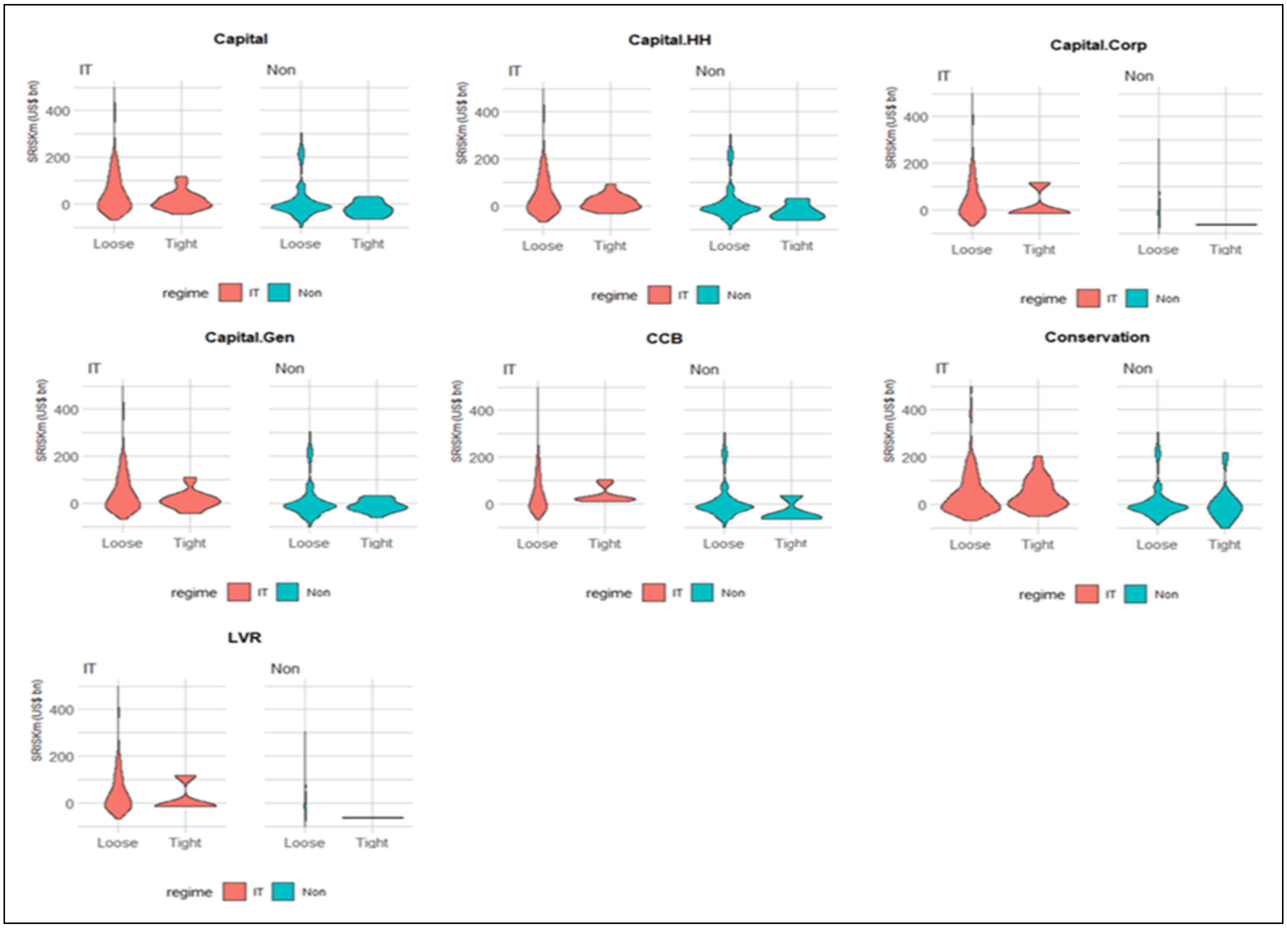


Figure A.3. Synchronicity between SRISKm and Macroprudential Policy: Loan-Supply-Based Measures

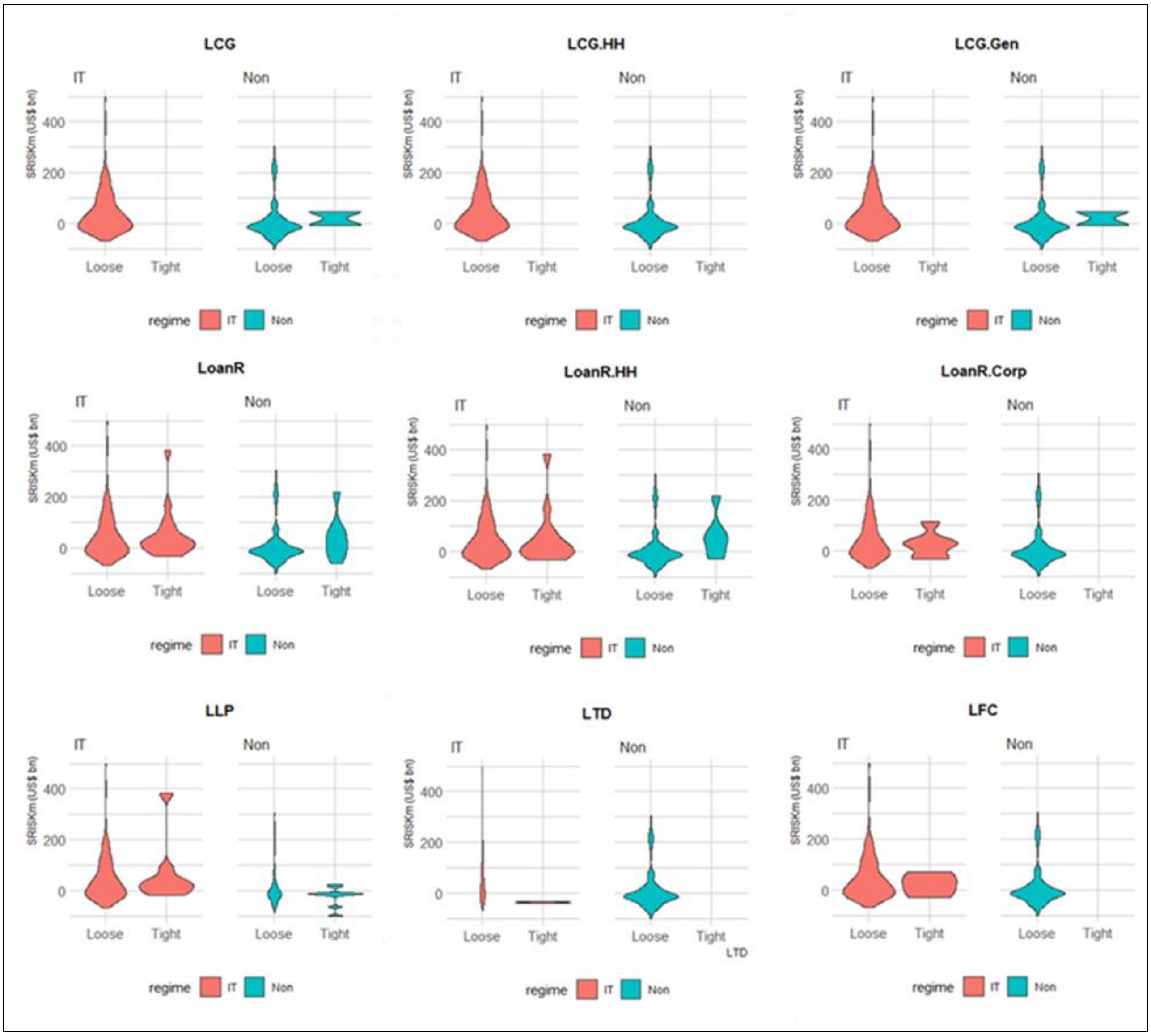
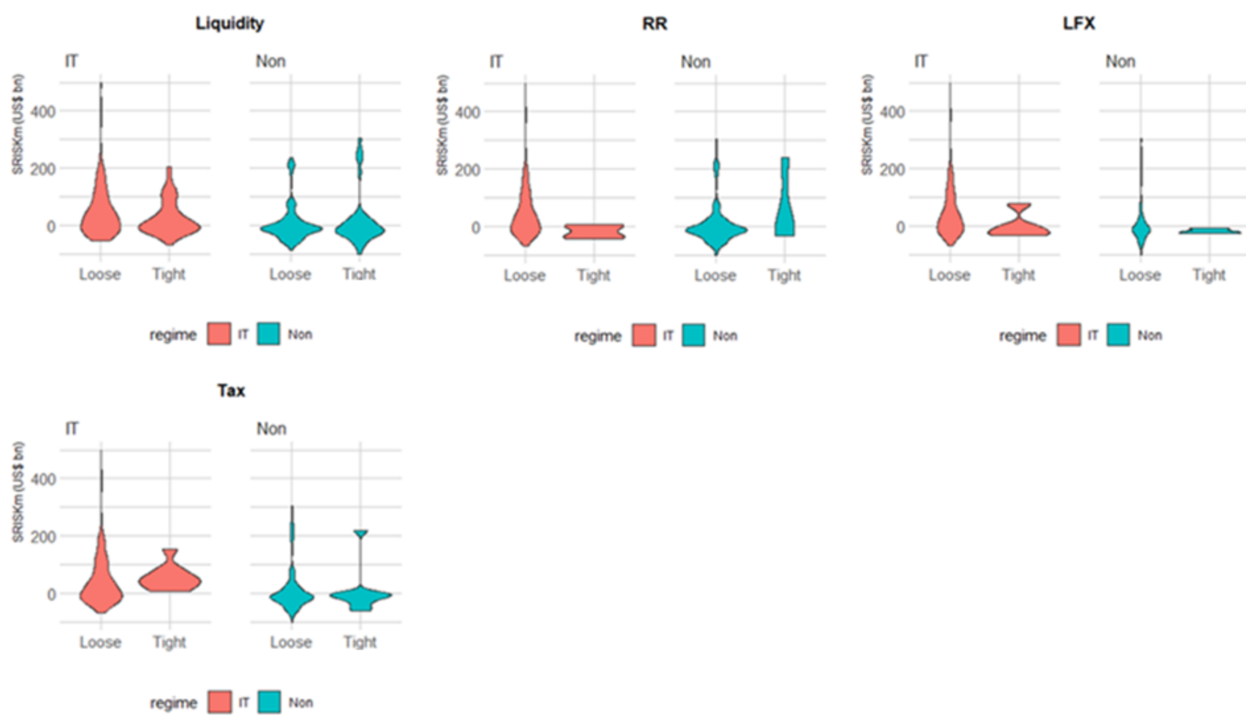


Figure A.4. Synchronicity between SRISKm and Macroprudential Policy: Liquidity and Other Measures



Notes: The graph shows the observational synchronicity between the SRISKm (US$ bn) and each MPI. The red figures correspond to IT countries, and the blue ones to OT (other regimes). The width of the figure corresponds to the number of times the corresponding level of SRISKm at the moment when the MPI is loosened or tightened. In almost all cases, higher levels of SRISKm (not controlled for bank size) are observed when the MPIs are loosened.

Appendix II. Interpretation of the Results Related to Macroeconomic and Bank-Specific Variables

We find that the signs of macroeconomic variables, especially on the external front, are consistent across the 22 regression results, in line with our expectations. We briefly discuss below the estimated results for bank-specific variables, which are included as controls for bank-level analysis.

With cross-border interconnectivity through financial and trade channels for open economies, systemic risk is associated with global monetary policy, global investors' risk aversion, exchange rate depreciation, and global GDP growth, as suggested by our estimated results. First, tighter U.S. monetary policy increases systemic risk as shown by the significant and positive estimates of the one-period-lagged FFR in all regressions, as it reduces cross-border credit flows and increase banks' funding costs. Second, VIX has a positive and significant effect on systemic risk in all regressions, implying that risk sentiment in the U.S. stock market influences the global financial market's impact on banks' financial fragility. Third, global GDP growth has significant and positive effects on systemic risk, which may capture rising investment sentiment and credit demand that portend credit quality deteriorations.[11] Fourth, and last, the coefficient of exchange rate growth (FX) is

[11] The negative impact of global GDP growth on systemic risk reflects the "volatility paradox" (Brunnermeier and Sannikov 2014) and intertemporal trade-offs between short-term benefits and long-term risks (Adrian et al. 2022).

significantly negative in seven of the 22 regressions. This may reflect that the positive effect on systemic risk of depreciations through adverse impacts on bank balance sheets with foreign-currency-denominated liabilities (Choi and Cook 2004) tend to be outweighed by the negative effect of depreciations on systemic risk through favorable impacts on the competitiveness of exporters (as borrowers) and on bank balance sheets with foreign-currency-denominated assets.

As regards domestic factors, only financial development and capital account openness show significant effects on systemic risk. Financial development, prone to abrupt capital flows in the early stage of development, increases systemic risk, while capital account openness tends to reduce systemic risk. Other domestic macro-financial variables have no pronounced effects due to offsetting movements on systemic risk.[12]

Next, the pronounced effects of bank-specific variables are twofold. First, systemic risk is positively and significantly associated with bank size, reflecting banks' systemic importance and incentives to take on more risk (e.g., Laeven et al. 2016 Second, systemic risk declines significantly with deposits, which constitute the core funding of bank credit—more stable than non-core funding such as wholesale funding—and contribute to bank liquidity management. While the NPL ratio is an indicator of banks' exposure to credit risk and rises at the onset of a banking crisis (e.g., Kaminsky and Reinhart 1999; and Nkusu 2011), the NPL ratio appears to have insignificant effects on bank systemic risk. Remaining bank-specific factors have insignificant effects on systemic risk, possibly reflecting the confluence of two offsetting effects:[13] for example, as Meuleman and Vander Vennet (2020) find a non-significant impact of ROA, we also find that the coefficient of ROA (as a measure of bank profitability) appears insignificant, possibly reflecting that the positive effect of the bank's risk taking for higher profits on future systemic risk offsets the negative effect of the bank's profits that foster its resilience to shocks.

[12] Specifically, systemic risk decreases with GDP growth, which enhances borrower capacity, but is likely to increase over time due to GDP growth driven by credit expansions, as indicated by intertemporal trade-offs (Adrian et al. 2022), implying an uncertain overall effect of GDP growth. Systemic risk decreases with income-driven savings but increases with consumption-driven savings (as a precaution against future distress). Refer to Gross et al. (2022) for household savings and default risk. Tighter monetary policy will contain credit supply and bank exposures to credit risk (mitigating systemic risk) but increase borrowers' funding cost (increasing systemic risk). CPI inflation can lower systemic risk by reducing the real outstanding debt burden of borrowers and thus attenuating default risk on the one hand but increase systemic risk by reducing the real value of existing loans and thus deteriorating bank assets on the other.

[13] The equity to total asset ratio (CAP) could help mitigate bank runs and insolvency risk (a negative effect), but it may also incentivize banks to take on more risk in their bank portfolio allocations (a positive effect). The loan-to-asset (LTA) ratio, which represents the bank's leverage position, can capture both the positive impact of loan creation capacity and the negative impact of credit risk exposure.

Appendix III. Results of Extended Regressions with Interactions between Monetary Policy and Macroprudential Policy

This appendix reports the estimated results of extended regressions, which additionally include the interactive term of the monetary policy variable (INT) and the macroprudential variable (MPI), in the benchmark regression (Tables A.1 – A.7). The results are discussed in section III.E.

Table A.1. Estimation Results: Demand-Based Measures Interacting with Monetary Policy

	DSTI	LTV
SRISK_{t-1}	0.44^{***}	0.44^{***}
GDP_{t-1}	-0.47	-1.30
Savings_{t-1}	0.97	0.81
FX_{t-1}	-44.02^{***}	-32.97
INT_{t-1}	-2.41	-1.73
CPI_{t-1}	0.07	0.30
FD_{t-1}	5.68^{***}	4.59^{***}
kaopen_{t-1}	8.64	-9.02
Global.GDP_{t-1}	10.62^{**}	10.70^{**}
VIX_{t-1}	1.74^{***}	1.69^{***}
FFR_{t-1}	0.91	0.36
SIZE_{t-1}	0.50^{***}	0.45^{***}
DEP_{t-1}	-0.80^{***}	-0.75^{***}
ROA_{t-1}	-0.09	-0.09
NPL_{t-1}	0.61	0.26
CAP_{t-1}	-0.06	0.02
LTA_{t-1}	0.42	0.63
IT_{t-1}	-35.82^{***}	-28.33^{**}
DSTI	122.61	
DSTI_{t-1}	37.25	
IT.DSTI	-911.75^{***}	
IT.DSTI_{t-1}	$\emptyset$	
INT.DSTI	478.61	
INT.DSTI_{t-1}	-646.41^{**}	
LTV		-12.76
LTV_{t-1}		47.76
IT.LTV		-190.54
IT.LTV_{t-1}		-151.63
INT.LTV		-59.14
INT.LTV_{t-1}		-82.46
Observations	539	539
J test p.value	0.9125	0.9128
Arellano-Bond p.value	0.2522	0.2788

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

Table A.2. Estimation Results: Capital Requirements Interacting with Monetary Policy (1/2)

	Capital	Capital.HH	Capital.Corp	Capital.Gen
SRISK_{t-1}	0.43^{***}	0.44^{***}	0.44^{***}	0.43^{***}
GDP_{t-1}	-0.87	-0.06	-1.15	-0.85
Savings_{t-1}	1.02	0.63	0.48	0.47
FX_{t-1}	-35.17	-32.71	-31.34	-42.44^{*}
INT_{t-1}	-2.14	-2.21	-0.61	-2.21
CPI_{t-1}	-0.54	0.84	-0.30	-0.75
FD_{t-1}	5.04^{***}	3.95^{***}	4.36^{***}	4.78^{***}
kaopen_{t-1}	-27.61^{*}	-38.58^{***}	-23.28	-34.06^{**}
Global.GDP_{t-1}	11.51^{**}	11.60^{***}	11.13^{**}	11.82^{**}
VIX_{t-1}	1.56^{***}	1.91^{***}	2.08^{***}	1.60^{***}
FFR_{t-1}	-0.79	2.21^{*}	1.63^{*}	-0.94
SIZE_{t-1}	0.48^{***}	0.48^{***}	0.49^{***}	0.47^{***}
DEP_{t-1}	-0.78^{***}	-0.75^{***}	-0.78^{***}	-0.77^{***}
ROA_{t-1}	0.01	0.30	0.01	0.12
NPL_{t-1}	-0.12	-0.33	0.06	-0.11
CAP_{t-1}	0.05	0.24	0.25	0.09
LTA_{t-1}	0.38	0.87	0.86	0.67
IT_{t-1}	-33.48^{**}	-28.25^{***}	-26.75^{***}	-30.63^{***}
Capital	55.57			
Capital_{t-1}	59.10			
IT.Capital	-42.91			
IT.Capital_{t-1}	49.34			
INT.Capital	262.48^{*}			
INT.Capital_{t-1}	98.24			
Capital.HH		28.20		
Capital.HH_{t-1}		-0.48		
IT.Capital.HH		-219.65^{**}		
$\text{IT.Capital.HH}_{t-1}$		-256.26^{*}		
INT.Capital.HH		-227.38		
$\text{INT.Capital.HH}_{t-1}$		37.59		
Capital.Corp			8.72	
$\text{Capital.Corp}_{t-1}$			$1,394.84^{*}$	
IT.Capital.Corp			$-1,033.51$	
$\text{IT.Capital.Corp}_{t-1}$			$-1,259.03$	
INT.Capital.Corp			$-1,122.16^{*}$	
$\text{INT.Capital.Corp}_{t-1}$			-618.20	
Capital.Gen				26.34
Capital.Gen_{t-1}				75.73
IT.Capital.Gen				-21.57
$\text{IT.Capital.Gen}_{t-1}$				71.67
INT.Capital.Gen				165.85
$\text{INT.Capital.Gen}_{t-1}$				-43.41
Observations	539	539	539	539
J test p.value	0.9125	0.9875	0.9871	0.9321
Arellano-Bond p.value	0.2357	0.2154	0.2112	0.1981

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

Table A.3. Estimation Results: Capital Requirements Interacting with Monetary Policy (2/2)

	CCyB	Conservation	LVR
$SRISK_{t-1}$	0.46^{***}	0.45^{***}	0.43^{***}
GDP_{t-1}	-0.89	-1.05	0.21
$Savings_{t-1}$	1.10	1.54	-0.14
FX_{t-1}	-39.94^{*}	-31.73	-55.12^{**}
INT_{t-1}	-3.50	-1.68	-0.85
CPI_{t-1}	-0.42	0.64	0.81
FD_{t-1}	2.79	7.07^{***}	4.43^{***}
$kaopen_{t-1}$	-1.19	5.47	-24.42^{*}
$Global.GDP_{t-1}$	12.13^{***}	10.12^{**}	10.94^{***}
VIX_{t-1}	1.93^{***}	2.03^{***}	1.79^{***}
FFR_{t-1}	1.43	1.15	-0.13
$SIZE_{t-1}$	0.42^{***}	0.45^{***}	0.47^{***}
DEP_{t-1}	-0.70^{**}	-0.79^{***}	-0.75^{***}
ROA_{t-1}	-0.35	0.25	0.18
NPL_{t-1}	0.13	0.01	0.18
CAP_{t-1}	-0.39	0.24	0.23
LTA_{t-1}	0.33	0.81	0.46
IT_{t-1}	-26.26^{*}	-35.99^{***}	-29.72^{***}
CCyB	-124.74		
$CCyB_{t-1}$	506.84		
IT.CCyB	-238.88		
IT.CCyBt-1	$\emptyset$		
INT.CCyB	-868.84		
INT.CCyBt-1	$1,516.30^{***}$		
Conservation		-117.19	
$Conservation_{t-1}$		357.42^{*}	
IT.Conservation		73.47	
$IT.Conservation_{t-1}$		-552.24^{***}	
INT.Conservation		37.86	
$INT.Conservation_{t-1}$		-108.86	
LVR			-34.36
LVR-1			171.90^{**}
IT.LVR			406.84^{***}
$IT.LVR_{t-1}$			21.65
INT.LVR			69.08
$INT.LVR_{t-1}$			118.24
Observations	539	539	539
J test p.value	0.9221	0.9331	0.9311
Arellano-Bond p.value	0.1678	0.1847	0.2105

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

Table A.4. Estimation Results: Loan-Supply-Based Measures Interacting with Monetary Policy (1/3)

	LCG	LCG.HH	LCG.Gen
SRISK_{t-1}	0.46^{***}	0.46^{***}	0.46^{***}
GDP_{t-1}	-1.23	-1.19	-1.19
Savings_{t-1}	1.58	1.50	1.50
FX_{t-1}	-21.15	-23.20	-23.21
INT_{t-1}	-1.01	-0.97	-0.97
CPI_{t-1}	0.50	0.65	0.65
FD_{t-1}	5.16^{***}	5.38^{***}	5.38^{***}
kaopen_{t-1}	-19.27	-21.43	-21.43
Global.GDP_{t-1}	12.37^{***}	12.06^{***}	12.06^{***}
VIX_{t-1}	2.61^{***}	2.59^{***}	2.59^{***}
FFR_{t-1}	2.40^{***}	2.18^{**}	2.18^{**}
SIZE_{t-1}	0.44^{***}	0.44^{***}	0.44^{***}
DEP_{t-1}	-0.73^{***}	-0.73^{***}	-0.73^{***}
ROA_{t-1}	0.13	0.12	0.12
NPL_{t-1}	-0.07	-0.08	-0.08
CAP_{t-1}	0.17	0.19	0.19
LTA_{t-1}	0.40	0.46	0.46
IT_{t-1}	-24.69^{**}	-24.19^{**}	-24.19^{**}
LCG	$1,155.43$		
LCG_{t-1}	$1,224.07^{**}$		
IT.LCG	-892.46		
IT.LCG_{t-1}	$\emptyset$		
INT.LCG	$\emptyset$		
INT.LCG_{t-1}	$\emptyset$		
LCG.HH		$1,029.03$	
LCG.HH_{t-1}		$\emptyset$	
IT.LCG.HH		$\emptyset$	
IT.LCG.HH_{t-1}		$\emptyset$	
INT.LCG.HH		$4,404.37^{**}$	
INT.LCG.HH_{t-1}		$\emptyset$	
LCG.Gen			$1,028.81$
LCG.Gen_{t-1}			$1,277.31^{**}$
IT.LCG.Gen			$\emptyset$
IT.LCG.Gen_{t-1}			$\emptyset$
INT.LCG.Gen			$-2,835.25$
INT.LCG.Gen_{t-1}			$\emptyset$
Observations	539	539	539
J test p.value	0.9311	0.9125	0.9623
Arellano-Bond p.value	0.2101	0.2018	0.2088

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

Table A.5. Estimation Results: Loan-Supply-Based Measures Interacting with Monetary Policy (2/3)

	LoanR	LoanR.HH	LoanR.Corp
SRISK_{t-1}	0.43^{***}	0.43^{***}	0.44^{***}
GDP_{t-1}	0.39	1.05	−0.57
$\mathrm{Savings}_{t-1}$	0.74	0.49	1.01
FX_{t-1}	-45.21^{**}	-48.58^{**}	−29.93
INT_{t-1}	−0.80	−0.87	−0.98
CPI_{t-1}	−0.14	0.02	−0.10
FD_{t-1}	2.30^{**}	2.50^{*}	3.96^{***}
kaopen-1	4.48	−4.21	−15.05
$\mathrm{Global.GDP}_{t-1}$	11.02^{***}	10.49^{**}	12.47^{***}
VIX_{t-1}	1.69^{***}	1.68^{***}	1.96^{***}
FFR_{t-1}	0.54	0.91	1.19
SIZE_{t-1}	0.47^{***}	0.47^{***}	0.46^{***}
DEP_{t-1}	-0.80^{***}	-0.82^{***}	-0.75^{***}
ROA_{t-1}	−0.46	0.06	0.08
NPL_{t-1}	0.05	0.03	0.08
CAP_{t-1}	0.12	0.13	0.23
LTA_{t-1}	0.64	0.54	0.73
IT_{t-1}	-25.50^{**}	-26.41^{**}	-26.12^{**}
LoanR	$-1,012.97^{**}$		
LoanR_{t-1}	−292.97		
IT.LoanR	840.13^{*}		
$\mathrm{IT.LoanR}_{t-1}$	548.61		
INT.LoanR	553.92^{***}		
$\mathrm{INT.LoanR}_{t-1}$	341.25^{**}		
LoanR.HH		$-1,152.72^{**}$	
$\mathrm{LoanR.HH}_{t-1}$		−542.72	
IT.LoanR.HH		873.93	
$\mathrm{IT.LoanR.HH}_{t-1}$		733.54	
INT.LoanR.HH		497.99^{**}	
$\mathrm{INT.LoanR.HH}_{t-1}$		300.04^{*}	
LoanR.Corp			47.84
$\mathrm{LoanR.Corp}_{t-1}$			−111.91
IT.LoanR.Corp			∅
$\mathrm{IT.LoanR.Corp}_{t-1}$			∅
INT.LoanR.Corp			261.93
$\mathrm{INT.LoanR.Corp}_{t-1}$			292.33
Observations	539	539	539
J test p.value	0.9622	0.9204	0.9621
Arellano-Bond p.value	0.2314	0.3105	0.3069

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

Table A.6. Estimation Results: Loan-Supply-Based Measures Interacting with Monetary Policy (3/3)

	LLP	LTD	LFC
$SRISK_{t-1}$	0.44***	0.44***	0.45***
GDP_{t-1}	−0.77	−0.98	−0.81
$Savings_{t-1}$	0.91	0.03	1.76
FX_{t-1}	−30.53	−11.69	−11.06
INT_{t-1}	−0.07	−1.05	−0.34
CPI_{t-1}	0.14	0.04	−0.27
FD_{t-1}	4.24***	4.09***	4.23***
$kaopen_{t-1}$	−14.85	−11.01	−22.89
$Global.GDP_{t-1}$	11.83***	13.74***	13.88***
VIX_{t-1}	1.80***	1.97***	2.18***
FFR_{t-1}	0.90	1.75	1.91**
$SIZE_{t-1}$	0.45***	0.45***	0.44***
DEP_{t-1}	−0.75***	−0.75***	−0.74***
ROA_{t-1}	0.10	−0.02	−0.04
NPL_{t-1}	0.14	0.17	−0.12
CAP_{t-1}	−0.003	0.18	−0.16
LTA_{t-1}	0.36	0.74	0.10
IT_{t-1}	−25.57*	−30.82**	−25.48**
LLP	55.03		
LLP_{t-1}	−45.12		
IT.LLP	−109.52		
$IT.LLP_{t-1}$	−244.98		
INT.LLP	−136.41		
$INT.LLP_{t-1}$	−37.35		
LTD		−1,186.13	
LTD_{t-1}		122.65	
IT.LTD		1,375.85	
$IT.LTD_{t-1}$		∅	
INT.LTD		−459.89	
$INT.LTD_{t-1}$		27.36	
LFC			360.83*
LFC_{t-1}			278.39
IT.LFC			∅
$IT.LFC_{t-1}$			∅
INT.LFC			738.05**
$INT.LFC_{t-1}$			134.68
Observations	539	539	539
J test p.value	0.9811	0.9001	0.9312
Arellano-Bond p.value	0.2781	0.2699	0.2711

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

Table A.7. Estimation Results: Liquidity Requirements and Other Supply-Based Measures Interacting with Monetary Policy (2/3)

	Liquidity	RR	LFX	Tax
SRISK_{t-1}	0.44^{***}	0.44^{***}	0.44^{***}	0.45^{***}
GDP_{t-1}	-0.94	1.23	-0.51	1.26
Savings_{t-1}	0.51	-0.28	1.43	0.56
FX_{t-1}	-28.88	-42.52^{*}	-19.85	-25.91
INT_{t-1}	2.75	-0.02	-2.36^{*}	0.14
CPI_{t-1}	-0.59	0.23	0.32	-0.58
FD_{t-1}	3.18^{***}	4.05^{***}	3.96^{***}	2.53^{**}
kaopen_{t-1}	-7.90	-31.80^{**}	-12.53	12.11
Global.GDP_{t-1}	11.27^{**}	10.03^{**}	12.35^{***}	10.39^{***}
VIX_{t-1}	2.08^{***}	1.75^{***}	1.82^{***}	2.02^{***}
FFR_{t-1}	1.53	1.26	1.22	-0.19
SIZE_{t-1}	0.46^{***}	0.48^{***}	0.46^{***}	0.45^{***}
DEP-1	-0.72^{**}	-0.80^{***}	-0.75^{***}	-0.77^{**}
ROA_{t-1}	0.11	0.14	-0.05	0.14
NPL_{t-1}	-0.11	-0.40	0.16	-0.04
CAP_{t-1}	0.18	-0.11	0.05	-0.53
LTA_{t-1}	0.45	0.29	0.47	-0.08
IT_{t-1}	-21.92^{**}	-37.11^{***}	-34.88^{**}	-19.27^{*}
Liquidity	8.93			
Liquidity_{t-1}	-61.49			
IT.Liquidity	-57.35			
$\text{IT.Liquidity}_{t-1}$	158.53^{**}			
INT.Liquidity	-18.47			
$\text{INT.Liquidity}_{t-1}$	-2.13			
RR		195.99		
RR_{t-1}		230.26^{*}		
IT.RR		-99.18		
IT.RR_{t-1}		-227.50^{**}		
INT.RR		105.62		
INT.RR_{t-1}		68.01		
LFX			-387.88^{***}	
LFX_{t-1}			-214.21^{**}	
IT.LFX			$\emptyset$	
IT.LFX_{t-1}			$\emptyset$	
INT.LFX			51.67	
INT.LFX_{t-1}			60.11	
Tax				-138.32
Tax_{t-1}				215.51
IT.Tax				$1,235.30^{*}$
IT.Tax_{t-1}				-425.03
INT.Tax				$1,719.11^{*}$
INT.Tax_{t-1}				675.49
Observations	539	539	539	539
J test p.value	0.9511	0.9621	0.9051	0.9322
Arellano-Bond p.value	0.2311	0.2447	0.2991	0.3015

Notes: Each column displays the coefficients obtained from the GMM (two-step) estimation when regressing the dependent variable, SRISK, on the corresponding MPI one by one. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively; and Ø indicates that the variable has been excluded due to the lack of observations.

PUBLICATIONS

Macroprudential Policy and Bank Systemic Risk: Does Inflation Targeting Matter?

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