



MACROPRUDENTIAL POLICIES AND PORTFOLIO CAPITAL FLOWS: BASED ON FLOW DIRECTION AND HETEROGENEITY

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Abstract: Using a sample that covers 69 economies over the period 2000–2017, we used the system GMM method to examine the effectiveness of macroprudential policies (MPPs) in managing portfolio capital inflows and outflows. We found that tighter macroprudential policies reduce portfolio capital inflows and outflows and have a sustained impact on them. Additionally, according to heterogeneity analysis, we found that other macroprudential policies can reduce portfolio capital inflows and outflows, while macroprudential policies related to foreign exchange can increase portfolio capital inflows and reduce portfolio capital outflows. Macroprudential policies reduce the inflows and outflows of portfolio equity and bonds. Macroprudential policies also reduce portfolio outflows from developed economies and portfolio inflows from emerging economies. Overall, this article has important implications for preventing risks associated with portfolio capital flows under the conditions of China's two-way financial opening up.

Keywords: macroprudential policy; portfolio capital flow; system GMM; local projection method

1. INTRODUCTION

China has accelerated the pace of promoting two-way financial openness recently. In 2002, China introduced the Qualified Foreign Institutional

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Investor (QFII), followed by the Renminbi Qualified Foreign Institutional Investor (RQFII). In 2019, QFII and RQFII investment quota restrictions were completely cancelled. In addition, the ways for foreign capital to enter the domestic securities market include the Shanghai-Hong Kong Stock Connect, Shenzhen-Hong Kong Stock Connect, Bond Connect, Shanghai-London Stock Connect, and so on. Meanwhile, in order to facilitate qualified domestic investment entities to invest in foreign securities markets, China has successively introduced the Qualified Domestic Institutional Investor (QDII) and Renminbi Qualified Domestic Institutional Investor (RQDII) systems. The proportion of overseas investors investing in the domestic financial market has increased. According to data from the People's Bank of China, the RMB assets held by overseas institutions and individuals reached 9.5 trillion yuan in September 2022, increasing 2.3 times compared with 2013. The 14th Five-Year Plan further proposes that China should promote two-way financial opening and cautiously advance the internationalisation of the RMB. With the opening up of China's financial market and the improvement in RMB internationalisation, foreign investors are actively allocating RMB assets, thus leading to a large amount of capital inflows. While bringing positive effects on economic growth, this also increases the difficulty of maintaining macroeconomic stability in China. Once the market situation changes, the short-term capital that previously flowed into the country may withdraw quickly, becoming a source of economic instability. The report of the 20th National Congress of the Communist Party of China points out that China must continue to promote high-standard opening-up to the outside world, while also preventing and resolving major risks. Therefore, in the context of financial openness, exploring the effectiveness of macroprudential policies in managing capital flows is of great practical significance for preventing and resolving the risks brought by portfolio capital flows. Scholars have assessed the effectiveness of macroprudential policies in managing capital inflows (IMF, 2011c). However, the effectiveness of macroprudential policies in managing capital flows remains a subject of debate (Neumann *et al.*, 2009; Bruno *et al.*, 2017). Some scholars believe that macroprudential policies have no significant impact on capital flows (Beirne & Friedrich, 2014; Forbes *et al.*, 2015), while another group of scholars believes that macroprudential policies affect domestic cross-border capital flows (Bruno & Shin, 2014; Takáts & Temesvary, 2017;

Akdogan, 2020; Forbes, 2020). Among these, portfolio capital is characterised by shorter terms and greater liquidity, making it an important disruptive factor in the financial market (Que & Sun, 2021), as well as a key form of cross-border capital flow (Wang *et al.*, 2019). Therefore, this article focuses on exploring the impact of macroprudential policies on portfolio capital inflows and outflows, clarifying the specific effects of macroprudential policies on portfolio capital flows, and providing a reference for risk prevention of cross-border capital flows in the context of China's two-way financial opening-up.

This article assesses the effectiveness of macroprudential policies on portfolio capital inflows and outflows and analyses the duration of their impact. In addition, it also considers different types of macroprudential policies, different types of capital flows, and different types of economies, analysing their impact on portfolio capital inflows and outflows specifically. Finally, this article explores the effects of macroprudential policies on portfolio capital inflows and outflows under different conditions.

2. LITERATURE REVIEW

The existing literature has extensively discussed the impact of macroprudential policies on portfolio capital flows, but scholars have not reached a consensus. Some scholars believe that tighter macroprudential policies can reduce portfolio capital inflows. Zhang and Zoli (2014) find that macroprudential tools can suppress portfolio equity inflows, and the use of macroprudential policies in the Asia Pacific has reduced portfolio bond capital inflows (Bruno & Shin, 2015). Ostry *et al.* (2012) and Qureshi *et al.* (2011) find that prudential measures related to foreign exchange reduced the proportion of portfolio debt in total external debt. The macroprudential policies related to foreign exchange adopted by South Korea reduce the scale of portfolio debt capital flows (Huh & An, 2014). Balakrishnan *et al.* (2012) find that tighter macroprudential policies related to foreign exchange reduce net capital inflows, portfolio capital inflows, and cross-border bank capital inflows. In addition, the implementation of macroprudential policies related to foreign exchange and other macroprudential policies reduces the scale of portfolio capital inflows (Frost *et al.*, 2020), and macroprudential policies can even reduce the scale of medium-term portfolio capital inflows and the possibility of a surge in medium-term portfolio capital inflows (Gelos *et al.*, 2019).

In contrast, some scholars believe that tighter macroprudential policies increase portfolio capital inflows. The use of macroprudential policies leads to more cross-border lending, demonstrating avoidance of macroprudential policies (Cerutti *et al.*, 2017), and companies replace borrowing from banks by issuing corporate bonds (Eller *et al.*, 2021). Ahnert *et al.* (2018) establish a simple theoretical model (parsimonious model) and find that the implementation of macroprudential foreign exchange rules reduces banks' foreign currency borrowing, but causes companies to shift from foreign exchange borrowing to issuing foreign exchange debt to market investors. Ahnert *et al.* (2021) find that macroprudential policies related to foreign exchange can lead risky borrowers to shift from bank lending to issuing foreign exchange bonds to nonbank financial intermediaries. Bacchetta *et al.* (2023) use data from emerging market economies at the corporate level to demonstrate that macroprudential policies related to foreign exchange have increased the issuance of non-financial corporate foreign currency bonds. Zhang and Zoli (2014) find that after tightening macroprudential policies related to foreign exchange, companies would issue foreign exchange debt to the international financial market. In addition, macroprudential policies are also conducive to the inflow of securities investment (Ji *et al.*, 2021).

Some scholars believe that the effectiveness of tighter macroprudential policies on portfolio capital flows is uncertain (Eller *et al.*, 2021), while Zhang and Zoli (2014) find that tighter macroprudential policies are not related to the inflow of portfolio debt capital. Gelos *et al.* (2019) argue that tighter macroprudential policies have no impact on short-term portfolio capital inflows. In addition, some scholars find that the effectiveness of macroprudential policies may be influenced by U.S. monetary policy and global financial cycles. The effectiveness of macroprudential policies varies with changes in external conditions. When the United States implements loose monetary policies, tightening macroprudential policies in various countries lead to an increase in net inflows of cross-border debt capital, weakening the effectiveness of macroprudential policies (Tan & Li, 2021). Macroprudential policies have different effects on portfolio capital flows during the global financial cycle. Stricter macroprudential policies amplify global risk shocks on portfolio equity and bond capital flows, increasing capital outflows during risk-avoidance periods and capital inflows during risk-taking phases (Chari *et al.*,

2022). Macroprudential policies based on borrowers can reduce the sensitivity of bond capital inflows from emerging market countries to global financial cycles (Yu *et al.*, 2023).

Although the existing literature has discussed the impact of macroprudential policies on portfolio capital flows, there are still three shortcomings. First, scholars mainly focus on the impact of macroprudential policies on portfolio capital inflows but lack attention to the impact of macroprudential policies on portfolio capital outflows. At the same time, there is a scarcity of literature that considers the structural characteristics of portfolio capital inflows and outflows. Second, in terms of the heterogeneity of the impact of macroprudential policies on portfolio capital flows, there are relatively few studies that comprehensively consider different types of macroprudential policies, classifications of portfolio capital flows, and related research on different types of economies. Third, the impact of macroprudential policies on portfolio capital flows may vary under different conditions. There is a lack of literature exploring the impact of macroprudential policies on portfolio capital flows in different contexts, and even less research on the duration of their impact.

Our findings complement and make several contributions to the literature. First, the exploration direction of cross-border capital flows is to distinguish them in detail. This article also focuses on the impact of macroprudential policies on portfolio capital inflow and outflow, and explores the duration of the impact. Second, in terms of heterogeneity research, we comprehensively consider the classification of macroprudential policies, types of capital flows, and different levels of economic development, and analyse in detail the impact of macroprudential policies on portfolio capital inflows and outflows. Third, we delve into the moderating effects of capital account openness, financial development, exchange rate systems, and political stability on macroprudential policies and portfolio capital inflows and outflows, and clarify their effectiveness in capital flow management under different conditions.

3. MODEL SETTING AND VARIABLE SELECTION

3.1. Model Setting

To assess the impact of macroprudential policies on the portfolio capital inflow and outflow, this paper uses annual data from 69 economies from 2000 to 2017,

including developed economies, emerging market economies, and developing economies. Following the “pull-push” analysis framework of capital flow used in most literature, we set up the following regression model:

$$\text{Flow}_{it} = \alpha_1 \text{Flow}_{i,t-1} + \alpha_0 + \alpha_2 \text{MacPru}_{it} + \alpha_3 Z_{it} + \alpha_4 X_{it} + \mu_i + \varepsilon_{i,t} \quad (1)$$

In the model, Flow_{it} represents the portfolio capital flow (portfolio capital inflow, portfolio capital outflow) of a country i in the year t , $\text{Flow}_{i,t-1}$ is the first-order lag term of portfolio capital flow, MacPru_{it} represents the macro prudential policy adopted by country i in the year t , Z_{it} is the driving factor at the national level, and X_{it} is the driving factor at the global level, μ_i is the fixed effects for individuals, while $\varepsilon_{i,t}$ is a random disturbance term. If the coefficient α_2 estimated is significantly negative, it indicates that macroprudential policies will reduce portfolio capital inflow and outflow.

3.2. Variable Selection

3.2.1. Explained variable

Portfolio Capital Flow (Flow) refers to portfolio capital inflow and outflow. In heterogeneity analysis, portfolio capital flows are classified into portfolio equity and debt flows. Portfolio equity capital flows include portfolio equity capital inflows and outflows, while portfolio debt capital flows include portfolio bond capital inflows and outflows. The above indicators have all undergone GDP standardisation processing. The capital flow data is sourced from the IMF-BOP database. The GDP data comes from the WEO database.

3.2.2. Core explanatory variable

The macroprudential policy (MacPru) data used in this article comes from Cerutti *et al.* (2017), which covers 12 macroprudential policy tools in 160 countries from 2000 to 2017. Specifically, it includes loan to value ratio (LTV), debt to income ratio (DTI), dynamic loan loss provision (DP), countercyclical capital buffer (CTC), leverage ratio (LEV), systemically important financial institution capital surcharge (SIFI), interbank risk exposure limit (INTER), loan concentration limit (CONS), foreign currency borrowing limit (FC), foreign exchange reserve requirement ratio (RR-REV), domestic loan size limit (CG), and financial institution tax (TAX). Macro prudential policies can be divided into macro prudential policies related to foreign exchange and other

macro prudential policies. Macroprudential policies related to foreign exchange (MacPruFx) include foreign currency loan restrictions (FC) and reserve requirement ratios (RR), while the other 10 are tools for other macroprudential policies (MacPruO). The data are coded such that the use of any particular measure in a given year is 1; otherwise, it is 0. The overall macroprudential policy is the sum of all macroprudential policy tools adopted in each year.

3.2.3. Control variables

Referring to the “pull-push” framework of capital flow, this article selects the following control variables: (1) Domestic economic growth rate (GDPGrow), with “per capita GDP growth rate” as a proxy variable. The data is sourced from the World Bank WDI database. (2) Current account balance (CA), this article uses “current account balance/GDP” as a proxy variable, and the data comes from the World Bank WDI database. (3) Domestic credit scale (Credit), this article uses “private sector credit scale/GDP” as a proxy variable, and the data comes from the World Bank WDI database. (4) Capital account openness (Kai) is used as a proxy variable for capital controls in this article. Adopting the capital control database constructed by Fernández *et al.* (2016). (5) Financial Development (FD) refers to the financial development level index constructed by Svirydzienka (2016) for various countries, which measures the development status of financial institutions and financial markets at two levels. (6) Economic growth rate of developed countries (WorGDP) is represented by the proxy variable of “industrial output growth rate of developed economies” in this article. The data is sourced from the IMF International Financial Statistics Database. (7) Global interest rate (GloRate), measured by the US federal funds rate, is sourced from the Wind database. (8) Global liquidity (M2) is measured by the year-on-year growth rate of the combined broad money supply (M2) of the United States, the United Kingdom, Japan, and the Eurozone (G4 economies). The data is sourced from the IMF’s IFS database. (9) The Global Financial Cycle (VIX), measured by the US Standard and Poor’s (S&P) 500 index, can gauge investors’ risk aversion and global financial market volatility. The data is sourced from the Chicago Board Options Exchange.

3.2.4. Adjusting variables

(1) Capital Account Openness (Kai), using the capital control database constructed by Fernández *et al.* (2016). (2) Financial Development (FD),

using the financial development level indicators constructed by Svirydenka (2016) for various countries. (3) The exchange rate system (Regime) ranges from 1 to 15, with larger values indicating more flexible exchange rate systems. This indicator is from Ilzetzki *et al.* (2019). (4) Government stability, the larger the value, the higher the government stability. This indicator is from the ICRG database.

3.3. Descriptive statistics of variables

Table 1 presents the descriptive statistics of each variable in this article.

Table 1: Descriptive statistics of variables

<i>Variable</i>	<i>Obs.</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min.</i>	<i>Max.</i>
Flowin	1224	0.4402	0.5669	0.0005	2.9624
Flowout	1215	0.5422	1.2165	0.0000	9.0746
Equityin	1177	0.1692	0.3074	0.0000	2.4735
Debtin	1187	0.2929	0.4317	0.0000	3.9983
Equityout	1175	0.3173	1.0779	0.0000	12.6949
Debtout	1188	0.2616	0.4439	0.0000	4.9702
MacPru	1242	2.1304	1.7693	0.0000	8.0000
MacPruO	1242	1.8663	1.6375	0.0000	7.0000
MacPruFx	1240	0.2629	0.5116	0.0000	2.0000
GdpGrow	1224	2.5538	3.6155	-14.7590	18.9115
FD	1242	0.4530	0.2514	0.0594	1.0000
Kai	1008	0.2487	0.2672	0.0000	1.0000
Credit	1035	75.0717	52.0646	0.1862	304.5751
CA	1224	-2.7156	10.2334	-52.7841	24.6821
Worgdp	1242	3.0927	1.3592	-1.3414	4.5408
GloRate	1242	1.7611	1.9627	0.0900	6.2400
M2	1242	13.5368	4.2217	5.2355	21.0657
VIX	1242	19.8728	6.3599	11.0900	32.6900
Regime	1240	6.1766	4.4931	1.0000	15.0000
Stability	1170	8.0958	1.5003	4.0417	11.5000

4. ESTIMATION RESULTS

4.1. Baseline results

To address potential endogeneity issues in the model, this paper employs the two-step System GMM method for estimation. In addition, to ensure

the robustness and validity of the model estimation, over-identification and autocorrelation tests were conducted.

Table 2 reports the regression results of the impact of macroprudential policies on portfolio capital flows. Columns (1) and (2) show the impact of macroprudential policies on portfolio capital inflows. Column (1) only includes pull factors as control variables, while column (2) includes both pull and push factors as control variables. The coefficient of macroprudential policies in columns (1) and (2) is significantly negative at the 1% significance level, indicating that macroprudential policies reduce portfolio capital inflows. Columns (3) and (4) show the impact of macroprudential policies on portfolio capital outflows. Column (3) only includes the pull factor as the control variable, while column (4) controls for both the pull and push factors. The macroprudential policy coefficient is significantly negative at the 1% level, indicating that macroprudential policies reduce portfolio capital outflows. The p-values of all AR (2) in the model are greater than 0.1, indicating that there is no second-order sequence correlation in the perturbation term. The instrumental variable Sargan test p-values are all greater than 0.1, indicating that the instrumental variable is valid. Therefore, using system GMM estimation is appropriate.

In theory, there are two main channels through which macroprudential policies affect capital flows, including direct and indirect channels. Direct channels directly affect capital inflows and outflows, while indirect channels affect capital flows through other macroeconomic variables. In terms of direct channels, macroprudential measures for cross-border capital flows, such as foreign currency borrowing restrictions and foreign exchange reserve ratios, directly affect capital flows, and such policy tools can reduce international capital inflows. In terms of indirect channels, tighter macroprudential policies led to a decrease in asset prices (Cerutti *et al.*, 2017; Nier & Kang, 2016), such as the loan-to-value ratio and loan-to-income ratio, which can suppress asset price overheating (Sheng & Li, 2019), resulting in a reduction in portfolio capital inflows. In addition, the main goal of macroprudential policies is to reduce systemic financial risks, which is conducive to long-term economic stability and thus increases attractiveness to investors, leading to a reduction in portfolio capital outflows.

Table 2: Regression results of benchmark model

	(1)	(2)	(3)	(4)
	<i>Flowin</i>	<i>Flowin</i>	<i>Flowout</i>	<i>Flowout</i>
L.Flowin	0.7329***	0.7639***		
	(-0.0029)	(-0.0178)		
L.Flowout			0.8375***	0.8335***
			(-0.0006)	(-0.0047)
MacPru	-0.0088***	-0.0133***	-0.0052***	-0.0437***
	(-0.0013)	(-0.0029)	(-0.0019)	(-0.0037)
GdpGrow	-0.0073***	-0.0019***	-0.0024***	0.0164***
	(-0.0005)	(-0.0005)	(-0.0003)	(-0.0013)
FD	-0.0571*	0.0691	-0.8614***	-0.8443***
	(-0.0303)	(-0.0579)	(-0.0391)	(-0.0886)
Kai	-0.1841***	-0.0842	-0.1787***	-0.1643***
	(-0.0142)	(-0.0539)	(-0.0337)	(-0.0367)
Credit	0.0050***	0.0044***	0.0062***	0.0062***
	(-0.0001)	(-0.0002)	(-0.0001)	(-0.0003)
CA	0.0012**	-0.0018***	0.0026***	0.0008
	(-0.0005)	(-0.0006)	(-0.0004)	(-0.0012)
Worgdp		-0.0656***		-0.1012***
		(-0.0021)		(-0.0036)
GloRate		-0.0144***		-0.0125***
		(-0.0008)		(-0.0013)
M2		0.0146***		0.0066***
		(-0.0005)		(-0.0009)
VIX		-0.0154***		-0.0195***
		(-0.0004)		(-0.0006)
Constant	-0.1300***	0.1338***	0.1621***	0.8163***
	-0.01	(-0.0323)	(-0.0212)	(-0.0351)
AR (2)	-1.293	-1.2506	-1.0887	-1.0857
	(0.196)	(0.2111)	(0.2763)	(0.2776)
Sargan	46.70545	51.07756	47.4344	51.33666
	(1)	(1)	(1)	(1)
Observations	824	824	816	816

Note: The standard deviation is in parentheses, and the values in parentheses corresponding to AR (2) and Sargan statistic are their P-values. *, **, and *** describe significance levels at 10%, 5%, and 1%, respectively. Same below.

4.2. Robustness test

This article conducts robustness testing through the following four methods. First, lag control variables by one period- to address the endogeneity issue of control variables, all control variables are lagged by one period. The regression results of this test are reported in columns (1) and (2) of Table 3. Second, delete the sample data from the United States because the United States is an international financial centre with developed financial markets; its portfolio capital flows are not easily affected by macroprudential policies. The regression results of this test are reported in columns (3) and (4) of Table 3. Third, carry out tail reduction treatment on portfolio capital flows. To prevent the impact of extreme values in portfolio capital flows, bilateral 1% truncation is applied to the data of portfolio capital flows. The regression results of this test are reported in columns (5) and (6) of Table 3. Fourth, we used post-crisis data. Macroprudential policies have received widespread attention after the global financial crisis, and this article uses post-crisis data to conduct robustness tests. The regression results of this test are reported in columns (7) and (8) of Table 3. The robustness tests of the above four methods indicate that the main conclusions of this article are still robust.

4.3. Heterogeneity analysis

4.3.1. *Different types of macroprudential policies*

Macroprudential policies can be divided into two categories: macroprudential policies related to foreign exchange, and other macroprudential policies. This article studies the heterogeneity of the impact of two types of macroprudential policies on portfolio capital flows. Table 4 reports the impact of different types of macroprudential policies on portfolio capital flows. We divided macroprudential policies into other types of macroprudential policies and macroprudential policies related to foreign exchange. Columns (1) and (2) show the impact of other macroprudential policies on portfolio capital flows. The coefficient of the impact of other macroprudential policies on portfolio capital inflows in column (1) is significantly negative, indicating that other macroprudential policies will reduce a country's portfolio capital inflows. The coefficient of the impact of other macroprudential policies on portfolio capital outflows in column (2) is significantly negative, indicating that other

Table 3: Robustness test

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>Flowin</i>	<i>Flowout</i>	<i>Flowin</i>	<i>Flowout</i>	<i>Flowin</i>	<i>Flowout</i>	<i>Flowin</i>	<i>Flowout</i>
L.Flowin	0.7134*** (0.0123)		0.7609*** (0.0141)		0.6871*** (0.0096)		0.6269*** (0.0198)	
L.Flowout		0.8172*** (0.0015)		0.8296*** (0.0020)		0.9327*** (0.0111)		0.9365*** (0.0019)
MacPru	-0.0120*** (0.0033)	-0.0297*** (0.0031)	-0.0111*** (0.0025)	-0.0408*** (0.0035)	-0.0091*** (0.0034)	-0.0489*** (0.0042)	-0.0503*** (0.0024)	-0.0557*** (0.0018)
control variables	YES							
Constant	-0.0938*** (0.0324)	0.4150*** (0.0552)	0.1424*** (0.0270)	0.7597*** (0.0405)	0.1918*** (0.0236)	0.7554*** (0.0362)	0.4010*** (0.0299)	0.8648*** (0.0353)
AR (2)	-1.2746 (0.2024)	-1.2394 (0.2152)	-1.2472 (0.2123)	-1.083 (0.2788)	-1.0052 (0.3148)	-1.3568 (0.1748)	-1.7032 (0.0885)	-1.2039 (0.2286)
Sargan	48.01492 (1.0000)	45.02894 (1.0000)	49.32758 (1.0000)	49.79342 (1.0000)	50.89227 (1.0000)	49.55091 (1.0000)	49.08957 (0.9594)	49.78582 (0.9525)
Observations	800	793	807	799	824	816	516	516

macroprudential policies reduce portfolio capital outflows. Columns (3) and (4) report the impact of macroprudential policies related to foreign exchange on portfolio capital flows. The coefficient of the impact of macroprudential policies related to foreign exchange on portfolio capital flows in column (3) is significantly positive, indicating that macroprudential policies related to foreign exchange increase portfolio capital inflows. The macroprudential policy related to foreign exchange is a macroprudential policy aimed at differentiating the pricing of different currencies by the banking sector (Zang, 2016). Tighter macroprudential policy for the banking sector leads to increase in credit costs and decrease in credit availability for micro market entities, which will cause them to seek alternative financing channels (Tan & Li, 2021), such as financing through nonbanking sectors such as the stock market, bond market, and investment funds (Bruno *et al.*, 2017; Ahnert *et al.*, 2018), resulting in an increase in portfolio capital inflows. Column (4) shows a significant negative impact of macroprudential policies related to foreign exchange on portfolio capital outflows, indicating that macroprudential policies related to foreign exchange reduce a country's international portfolio capital outflows.

Table 4: Heterogeneity analysis: different types of macroprudential policies

	(1)	(2)	(3)	(4)
	<i>Flowin</i>	<i>Flowout</i>	<i>Flowin</i>	<i>Flowout</i>
	<i>Other macroprudential policies</i>	<i>Other macroprudential policies</i>	<i>Macro prudential policies related to foreign exchange</i>	<i>Macro prudential policies related to foreign exchange</i>
L.Flowin	0.7570*** (-0.008)		0.7519*** (-0.0045)	
L.Flowout		0.8366*** (-0.0043)		0.8408*** (-0.0009)
MacPruO	-0.0232*** (-0.0025)	-0.0301*** (-0.0045)		
MacPruFx			0.0839*** (-0.0235)	-0.1506*** (-0.0102)
GdpGrow	-0.0033*** (-0.0006)	0.0157*** (-0.0018)	-0.0025*** (-0.0006)	0.0166*** (-0.0008)
FD	0.1352*** (-0.041)	-0.7674*** (-0.071)	0.2791*** (-0.0409)	-1.4163*** (-0.0637)
Kai	-0.0418 (-0.0459)	-0.1686*** (-0.0405)	0.0263 (-0.0291)	-0.2376*** (-0.0216)
Credit	0.0041***	0.0058***	0.0043***	0.0066***

	(1)	(2)	(3)	(4)
	(-0.0002)	(-0.0002)	(-0.0001)	(-0.0002)
CA	-0.0030***	-0.0002	-0.0032***	0.0034***
	(-0.0006)	(-0.0009)	(-0.0008)	(-0.0006)
Worgdp	-0.0632***	-0.1044***	-0.0704***	-0.1213***
	(-0.0015)	(-0.0038)	(-0.0017)	(-0.0012)
GloRate	-0.0137***	-0.0100***	-0.0162***	-0.0122***
	(-0.0009)	(-0.0011)	(-0.0006)	(-0.0012)
M2	0.0126***	0.0087***	0.0215***	0.0196***
	(-0.0005)	(-0.0009)	(-0.0005)	(-0.0004)
VIX	-0.0155***	-0.0197***	-0.0151***	-0.0232***
	(-0.0004)	(-0.0004)	(-0.0003)	(-0.0003)
Constant	0.1558***	0.7530***	-0.1215***	0.9960***
	(-0.0298)	(-0.0335)	(-0.0308)	(-0.0349)
AR (2)	-1.256	-1.0863	-1.2251	-1.0884
	(0.2091)	(0.2773)	(0.2206)	(0.2764)
Sargan	50.98086	52.44432	52.70873	52.60084
	(1)	(1)	(0.9999)	(0.9999)
Observations	824	816	822	814

4.3.2. Different types of capital flows

Portfolio capital flows are divided into portfolio equity (including stocks and investment funds) and debt capital flows. The impact of macroprudential policies on equity and debt capital flows may exhibit heterogeneity. Therefore, this article divides the sample into portfolio equity capital flows and portfolio debt capital flows, studying the impact of macroprudential policies on equity and debt capital flows, respectively. Table 5 reports the impact of macroprudential policies on different types of capital flows. Columns (1) and (2) report on the impact of macroprudential policies on portfolio equity capital flows. The coefficient of the impact of macroprudential policies on portfolio equity capital inflows in column (1) is significantly negative, indicating that macroprudential policies reduce portfolio equity capital inflows. The regression coefficient of the impact of macroprudential policies on portfolio equity capital outflows in column (2) is significantly negative, indicating that macroprudential policies can reduce portfolio equity capital outflows. Columns (3) and (4) report the impact of macroprudential policies on portfolio debt capital flows. The coefficient of the impact of macroprudential policies on portfolio debt capital inflows in column (3) is significantly negative, indicating that macroprudential

policies reduce a country’s portfolio debt capital inflows. Column (4) shows that the coefficient of the impact of macroprudential policies on portfolio debt capital outflows is significantly negative, indicating that macroprudential policies have reduced portfolio debt capital outflows.

Table 5: Heterogeneity analysis: different types of capital flows

	(1)	(2)	(3)	(4)
	<i>Equityin</i>	<i>Equityout</i>	<i>Debtin</i>	<i>Debtout</i>
	<i>portfolio equity capital inflow</i>	<i>portfolio equity capital outflow</i>	<i>portfolio debt capital inflow</i>	<i>portfolio debt capital outflow</i>
L.Equityin	0.6213***			
	(-0.0198)			
L.Equityout		0.9325***		
		(0.0012)		
L.Debtin			0.8346***	
			(-0.0021)	
L.Debtout				0.7894***
				(-0.0148)
MacPru	-0.0192***	-0.0084***	-0.0097***	-0.0281***
	(-0.0015)	(0.0015)	(-0.0018)	(-0.0021)
GdpGrow	0	0.0105***	0.0001	0.0082***
	(-0.0003)	(0.0010)	(-0.0004)	(-0.0006)
FD	0.3543***	-0.2665***	-0.0931*	0.2340***
	(-0.0402)	(0.0376)	(-0.0493)	(-0.0429)
Kai	-0.0793***	-0.0587***	-0.1209***	-0.1376***
	(-0.0163)	(0.0122)	(-0.0294)	(-0.0267)
Credit	0.0025***	0.0012***	0.0027***	0.0008***
	(-0.0001)	(0.0001)	(-0.0002)	(-0.0001)
CA	-0.0015***	-0.0001	0.0031***	-0.0019***
	(-0.0003)	(0.0004)	(-0.0006)	(-0.0004)
Worgdp	-0.0158***	-0.0655***	-0.0383***	-0.0489***
	(-0.0012)	(0.0016)	(-0.0014)	(-0.0017)
GloRate	-0.0071***	-0.0021***	-0.0029***	-0.0037***
	(-0.0006)	(0.0003)	(-0.0005)	(-0.0005)
M2	0.0026***	0.0062***	0.0081***	0.0049***
	(-0.0002)	(0.0003)	(-0.0004)	(-0.0004)

	(1)	(2)	(3)	(4)
VIX	-0.0072***	-0.0118***	-0.0061***	-0.0078***
	(-0.0004)	(0.0002)	(-0.0003)	(-0.0002)
Constant	-0.0598***	0.4701***	0.0703***	0.2131***
	(-0.0223)	(0.0179)	(-0.0262)	(-0.0166)
AR (2)	-1.7339	-1.2032	-1.2438	-1.0516
	(0.0829)	(0.2289)	(0.2136)	(0.293)
Sargan	44.06473	52.03906	49.0565	49.24315
	(1)	(1)	(1)	(1)
Observations	786	780	796	794

4.3.3. Different types of economies

The implementation effect of macroprudential policies exhibits heterogeneity between developed and emerging economies (Cerutti *et al.*, 2017; Takáts & Temesváry, 2017). Therefore, this article divides the sample into developed economies and emerging economies to study the impact of macroprudential policies on portfolio capital flows. Table 6 reports the impact of macroprudential policies on portfolio capital flows in different types of economies. Columns (1) and (2) show the impact of macroprudential policies on portfolio capital flows in developed economies. Column (1), the coefficient of macroprudential policies on portfolio capital inflows is not significant. This may be because developed economies often have more advanced financial systems that provide alternative sources of funding and make it easier to evade regulation (Belkhir *et al.*, 2020), making the impact of macroprudential policies on portfolio capital inflows less significant. The coefficient of the impact of macroprudential policies on portfolio capital outflows in column (2) is significantly negative, indicating that macroprudential policies have a significant impact on portfolio capital outflows in developed economies. Columns (3) and (4) show the impact of macroprudential policies on portfolio capital flows in emerging economies. The coefficient of the impact of macroprudential policies on portfolio capital inflows in column (3) is significantly negative, while the impact of macroprudential policies on portfolio capital outflows in column (4) is not significant, indicating that macroprudential policies are more significant in managing portfolio capital inflows from emerging economies.

Table 6: Heterogeneity analysis: different types of economies

	(1)	(2)	(3)	(4)
	<i>Flowin</i>	<i>Flowout</i>	<i>Flowin</i>	<i>Flowout</i>
	<i>Developed economies</i>	<i>Developed economies</i>	<i>Emerging economies</i>	<i>Emerging economies</i>
L.Flowin	0.6957***		0.6375***	
	(-0.0613)		(-0.0377)	
L.Flowout		0.9152***		0.7763***
		(-0.0371)		(-0.0345)
MacPru	-0.0042	-0.0846***	-0.0315***	-0.0069
	(-0.0101)	(-0.0148)	(-0.0103)	(-0.0158)
GdpGrow	-0.004	0.0211***	0.0008	0.0054**
	(-0.0043)	(-0.0039)	(-0.0011)	(-0.0026)
FD	0.1321	0.3867	0.7881***	0.3593
	(-0.3243)	(-0.4786)	(-0.1501)	(-0.5695)
Kai	0.4189	-0.4035	-0.1702**	-0.3652
	(-0.3877)	(-0.5143)	(-0.0849)	(-0.2549)
Credit	0.0041***	0.0014**	0.0007	0.0088***
	(-0.0007)	(-0.0006)	(-0.0004)	(-0.0025)
CA	-0.0047	-0.0120**	-0.0026***	-0.0034
	(-0.0045)	(-0.0058)	(-0.0007)	(-0.0023)
Worgdp	-0.0746***	-0.0978***	-0.0389***	-0.0786***
	(-0.0087)	(-0.0088)	(-0.0083)	(-0.0206)
GloRate	-0.0067**	-0.0122**	-0.0153***	0.001
	(-0.0032)	(-0.006)	(-0.0026)	(-0.0047)
M2	0.0147***	-0.0074***	0.0080***	0.0238***
	(-0.0023)	(-0.0025)	(-0.0018)	(-0.0062)
VIX	-0.0201***	-0.0207***	-0.0070***	-0.0130***
	(-0.0018)	(-0.0014)	(-0.0012)	(-0.0033)
Constant	0.0925	0.7130**	0.1325*	-0.0794
	(-0.2242)	(-0.3068)	(-0.0798)	(-0.135)
AR (2)	-2.0275	-1.4699	-0.99924	-1.0158
	(0.0426)	(0.1416)	(0.3177)	(0.3097)
Sargan	21.36922	22.25622	18.77353	14.16996
	(1)	(1)	(1)	(1)
Observations	420	420	404	396

5. FURTHER ANALYSIS

5.1. Local Projection Method

In order to analyse the sustained impact of macroprudential policies on portfolio capital flows, this paper uses the Local Projection Method proposed by Jordà (2005) to estimate the impulse response of macroprudential policies to portfolio capital flows, and constructs the following model:

$$Flow_{i,t+h} - Flow_{i,t} = \alpha_h MacPru_{i,t} + \sum_{p=1}^n \phi_h X_{i,t-p} + \mu_{i,h} + \varepsilon_{i,t+h} \quad (2)$$

Where, $Flow_{it}$ represents portfolio capital flows (portfolio capital inflows, portfolio capital outflows), $MacPru_{it}$ represents macroprudential policies, and its coefficient α_h represents the response of portfolio capital flows to the impact of macroprudential policies in period t after period h (year). X_{it} includes portfolio capital flows, macroprudential policies, all control variables used in the benchmark model equation (1), and the lagged terms of the above variables (maximum lagged term $n=4$).

Figure 1 and Figure 2 show the dynamic response of macroprudential policies to portfolio capital flows. Figure 1 shows that the negative impact of macroprudential policies on portfolio capital inflows will last for about 1.5 years, with the maximum impact occurring one year later. Figure 2 indicates that the negative impact of macroprudential policies on portfolio capital outflows will last for about 3.5 years and reach its maximum after 3 years. This indicates that macroprudential policies have stronger sustainability in managing portfolio capital outflows.

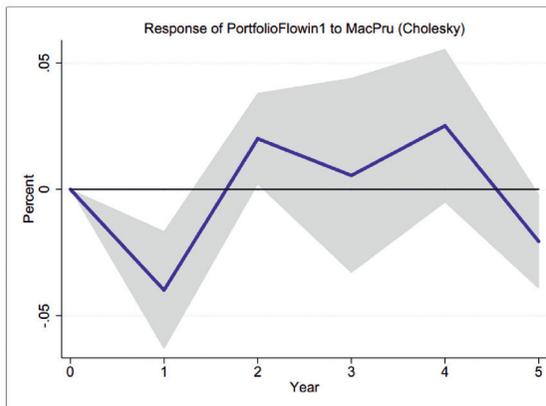


Figure 1: The dynamic impact of macroprudential policies on portfolio capital inflows

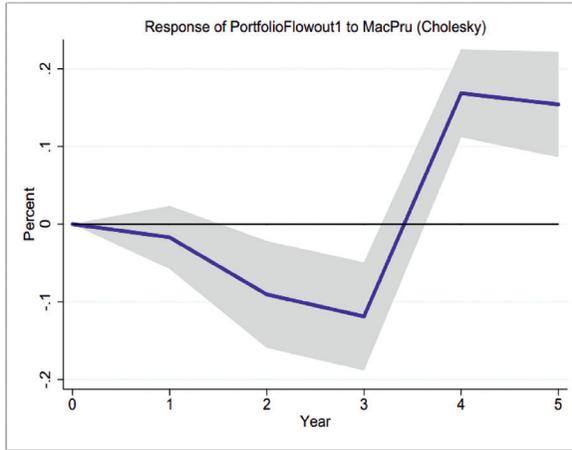


Figure 2: The dynamic impact of macroprudential policies on portfolio capital outflows

5.2. The moderating effects of capital account opening, financial development, exchange rate system, and political stability

To study the moderating effects of capital account openness, financial development, exchange rate system, and political stability on the impact of macroprudential policies on portfolio capital flows, the following moderation effect model was constructed based on benchmark model (1):

$$Flow_{it} = \alpha_1 Flow_{i,t-1} + \alpha_0 + \alpha_2 MacPru_{it} + \phi MacPru_{it} \times T_{it} + \eta T_{it} + \alpha_3 Z_{it} + \alpha_4 X_{it} + \mu_i + \varepsilon_{i,t} \quad (3)$$

Where, T_{it} represents capital account openness, financial development, exchange rate system, and political stability. $MacPru_{it} \times T_{it}$ represents the moderating effect of moderating variables on macroprudential policies and portfolio capital flows. We focus on the ϕ sign of the coefficient of the interaction term. If the ϕ sign is positive, it indicates that the policy weakens the negative impact of macroprudential policies on portfolio capital flows, and vice versa. Z_{it} and X_{it} keep the settings consistent with the benchmark model (1).

Table 7 reports the moderating effect of capital account opening, financial development, exchange rate system, and political stability on the impact of macroprudential policies on portfolio capital flows.

The moderating effect of macroprudential policies is influenced by the opening of capital account (Forbes *et al.*, 2015; Aizenman *et al.*, 2020). Columns

(1) and (2) illustrate the moderating effect of capital account liberalisation on the relationship between macroprudential policies and portfolio capital flows. The interaction term between macroprudential policies and capital account openness is significantly positive, indicating that an increase in the level of capital account openness weakens the impact of macroprudential policies on portfolio capital flows. Conversely, the higher the degree of capital control, the stronger the impact of macroprudential policies on portfolio capital inflows and outflows. Because macroprudential policies are more effective in economies with lower levels of openness, while economies with higher levels of openness can avoid macroprudential policies (Cerutti *et al.*, 2015), such as through cross-border financing in nonbanking sectors such as the stock market, bond market, and investment funds.

The moderating effect of macroprudential policies is influenced by financial development (Lim *et al.*, 2013). Columns (3) and (4) illustrate the moderating effect of financial development on the relationship between macroprudential policies and portfolio capital flows. The interaction term between macroprudential policies and financial development in column (3) has no significant impact on portfolio capital inflows, while the interaction term between macroprudential policies and financial development in column (4) is significantly negative. This indicates that financial development can strengthen the management level of macroprudential policies on portfolio capital outflows. This may be due to the improvement of a country's financial development level, which reduces adverse selection and moral hazard, thereby facilitating stable capital flows (Broner & Rigobon, 2004). Therefore, the improvement of financial development level has strengthened the impact of macro prudential policies on portfolio capital outflows.

The moderating effect of macroprudential policies is influenced by exchange rate regimes (Lim *et al.*, 2013; Alam *et al.*, 2019). Columns (5) and (6) illustrate the moderating effect of exchange rate regimes on the relationship between macroprudential policies and portfolio capital flows. The interaction term between macroprudential policies and exchange rate regimes in column (5) is significantly negative, indicating that the more flexible the exchange rate regime, the stronger the impact of macroprudential policies on portfolio capital inflows. The flexible exchange rate system is conducive to increasing the possibility of reducing the surge in capital inflows through overall

Table 7: Adjustment effect model: capital account openness, financial development, exchange rate system, political stability

	Capital account opening		Financial development		exchange rate system		Political stability	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Flowin	Flowout	Flowin	Flowout	Flowin	Flowout	Flowin	Flowout
LFlowin	0.7574*** (-0.0101)		0.7566*** (-0.0119)		0.7498*** (-0.0083)		0.5592*** (-0.0216)	
LFlowout		0.8337*** (-0.0025)		0.8232*** (-0.0092)		0.8388*** (-0.0015)		0.9441*** (-0.011)
MacPru	-0.0381*** (-0.0047)	-0.1079*** (-0.0072)	0.0077 (-0.0178)	0.0982*** (-0.0124)	0.0175** (-0.0079)	-0.1896*** (-0.0052)	-0.0963*** (-0.016)	-0.0549*** (-0.0158)
MacPru_Kai	0.1006*** (-0.0173)	0.2555*** (-0.0274)						
MacPru_FD			-0.0258 (-0.0308)	-0.2228*** (-0.0224)				
MacPru_Regime					-0.0042*** (-0.0011)	0.0237*** (-0.0009)		
MacPru_Stability							0.0109*** (-0.0018)	0.001 (-0.002)
Regime					0.0174*** (-0.0045)	-0.1174*** (-0.006)		
Stability							-0.0170*** (-0.006)	0.0218*** (-0.0062)
Kai	-0.3848*** (-0.0846)	-0.9670*** (-0.1448)	-0.0813* (-0.0488)	-0.1331*** (-0.041)	-0.1113** (-0.0501)	-0.0088 (-0.0599)	-0.1146*** (-0.0386)	0.0494* (-0.0271)
FD	-0.023	-0.8919***	0.0831	-0.1566	0.0558	-0.5682***	0.2392***	-0.0002

	Capital account opening		Financial development		exchange rate system		Political stability	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>Flowin</i>	<i>Flowout</i>	<i>Flowin</i>	<i>Flowout</i>	<i>Flowin</i>	<i>Flowout</i>	<i>Flowin</i>	<i>Flowout</i>
	(-0.0513)	(-0.1084)	(-0.0959)	(-0.0969)	(-0.0662)	(-0.1256)	(-0.071)	(-0.0719)
GdpGrow	-0.0020***	0.0155***	-0.0024***	0.0163***	-0.0021***	0.0115***	-0.0037***	0.0012
	(-0.0006)	(-0.0017)	(-0.0008)	(-0.0011)	(-0.0008)	(-0.0012)	(-0.0006)	(-0.0009)
Credit	0.0045***	0.0059***	0.0044***	0.0059***	0.0044***	0.0048***	0.0050***	0.0012***
	(-0.0002)	(-0.0004)	(-0.0002)	(-0.0005)	(-0.0003)	(-0.0003)	(-0.0002)	(-0.0001)
CA	-0.0011*	0.0020*	-0.0017***	0.0017	-0.0025***	0.0024*	0.0018***	-0.0099***
	(-0.0007)	(-0.0012)	(-0.0006)	(-0.0011)	(-0.0007)	(-0.0014)	(-0.0007)	(-0.0013)
Worgdp	-0.0628***	-0.0984***	-0.0640***	-0.1003***	-0.0630***	-0.0949***	-0.0376***	-0.0440***
	(-0.0031)	(-0.004)	(-0.0026)	(-0.0038)	(-0.0027)	(-0.005)	(-0.0034)	(-0.0025)
GloRate	-0.0141***	-0.0138***	-0.0131***	-0.0135***	-0.0145***	-0.0034***	-0.0041***	-0.0020**
	(-0.0011)	(-0.0012)	(-0.0008)	(-0.0013)	(-0.0011)	(-0.0012)	(-0.0013)	(-0.0009)
M2	0.0133***	0.0050***	0.0146***	0.0085***	0.0146***	0.0078***	0.0073***	-0.0024***
	(-0.0007)	(-0.0007)	(-0.0007)	(-0.0007)	(-0.0007)	(-0.0008)	(-0.0007)	(-0.0006)
VIX	-0.0148***	-0.0192***	-0.0148***	-0.0178***	-0.0149***	-0.0175***	-0.0120***	-0.0133***
	(-0.0006)	(-0.0005)	(-0.0004)	(-0.0008)	(-0.0005)	(-0.001)	(-0.0009)	(-0.0006)
Constant	0.2428***	1.0527***	0.0915	0.3292***	0.0227	1.3647***	0.1611**	0.3085***
	(-0.0376)	(-0.0535)	(-0.0591)	(-0.0453)	(-0.0418)	(-0.0888)	(-0.0809)	(-0.0574)
AR (2)	-1.2422	-1.0835	-1.2439	-1.0779	-1.2508	-1.0812	-2.0838	-1.4731
	(0.2142)	(0.2786)	(0.2135)	(0.2811)	(0.211)	(0.2796)	(0.0372)	(0.1407)
Sargan	48.54624	48.99472	50.10143	47.20265	49.93118	45.32033	40.95632	39.90816
	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Observations	824	816	824	816	822	814	780	779

macroprudential policy tools (Chen *et al.*, 2022). This may be due to the fact that countries implementing floating exchange rate systems have more effective monetary policies, which help reduce the volatility of cross-border capital flows (Eller *et al.*, 2020). The combination of monetary policy and macroprudential policy can more effectively manage portfolio capital inflows. The interaction term between macroprudential policies and exchange rate regimes in column (6) is significantly positive, indicating that a flexible exchange rate regime will weaken the management role of macroprudential policies in portfolio capital outflows. This may be due to the fact that countries implementing floating exchange rate systems are unable to fully achieve monetary policy independence when their capital accounts are open (Rey, 2015), and the ability of monetary policy and macroprudential policy to jointly manage capital outflows is weakened.

The moderating effect of macroprudential policies is influenced by institutional factors (Lim *et al.*, 2013), and political stability may play a regulatory role in the relationship between macroprudential policies and portfolio capital flows. Columns (7) and (8) illustrate the moderating effect of political stability on the relationship between macroprudential policies and portfolio capital flows. The coefficient of macroprudential policy and political stability in column (7) is significantly positive, indicating that an increase in political stability will weaken the regulatory effect of macroprudential policy on portfolio capital inflows. This may be because the higher the political stability, the lower the investment risk, thereby increasing the investment willingness of foreign investors and reducing the management role of macroprudential policies on portfolio capital inflows. The interaction term between macroprudential policies and political stability in column (8) has no significant moderating effect on portfolio capital outflows.

6. CONCLUSION

This article is based on data from 69 economies from 2000 to 2017, and uses the system GMM method to empirically explore the impact of macroprudential policies on portfolio capital inflows and outflows. We draw the following conclusions. First, macroprudential policies reduce portfolio capital inflows and outflows. Further research using Local Projection Method finds that the negative impact of macroprudential policies on portfolio capital inflows

lasts for about 1.5 years, and the negative impact of macroprudential policies on portfolio capital outflows lasts for about 3.5 years. Second, there is a heterogeneity impact of macroprudential policies on portfolio capital flows. By dividing macroprudential policies into those related to foreign exchange and other macroprudential policies, we find that macroprudential policies related to foreign exchange increase portfolio capital inflows and decrease portfolio capital outflows, while other macroprudential policies reduce portfolio capital inflows and outflows. Dividing portfolio capital flows into portfolio equity capital flows and portfolio debt capital flows, we find that macroprudential policies reduce the inflow and outflow of a country's portfolio equity capital and portfolio debt capital flows. Dividing economies into developed economies, emerging economies, and developing economies, we find that macroprudential policies reduce portfolio capital outflows from developed economies, but decrease portfolio capital inflows from emerging economies. Third, capital account opening, financial development, exchange rate system, and government stability have a moderating effect on the relationship between macroprudential policies and portfolio capital flows. The higher the level of capital account openness, the smaller the negative impact of macroprudential policies on portfolio capital flows. Financial development strengthens the negative impact of macroprudential policies on portfolio capital outflows. Exchange rate flexibility strengthens the negative impact of macroprudential policies on portfolio capital inflows and weakens the negative impact of macroprudential policies on portfolio capital outflows. Political stability weakens the negative impact of macroprudential policies on portfolio capital inflows. All economies should strengthen the monitoring and early warning of portfolio capital flows, establish a dynamic indicator monitoring system, closely monitor the phenomenon of large inflows and outflows of portfolio capital, improve the macro prudential policy management framework in the process of capital account opening, and timely detect and dispose of systemic financial risks caused by large portfolio capital flows.

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