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THE EFFECTIVENESS OF MACROPRUDENTIAL POLICIES IN MANAGING EXTREME CAPITAL FLOW EPISODES

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Abstract

Against the backdrop of a proliferation of policy tools, ongoing policy uncertainty surrounds the suitability of capital flow management in mitigating systemic risk and financial disruptions. We study the effectiveness of macroprudential policies in managing extreme capital flow episodes (surges, stops, flight, and retrenchment), comparing them to capital controls and foreign exchange interventions. Using propensity score matching, based on a panel of 54 countries spanning 1990Q1 to 2020Q3, we find that macroprudential policy can reduce the likelihood of extreme capital flow episodes at least as effectively as capital controls or foreign exchange interventions. Their relative effectiveness, however, varies considerably across type of instrument, proliferation of tools, country income-development level, and type of extreme capital flow episode.

Key words: *macroprudential policy, capital controls, foreign exchange interventions, extreme capital flows, financial stability*

1. Introduction

Volatile international capital flows are a well-known potential source of domestic financial instability.[2] Yet, open questions remain surrounding how policies related to domestic financial stability have impacted international capital flows. This paper aims to provide a comprehensive overview of capital flow management techniques and

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[2] International capital flows can cause a variety of domestic concerns. For instance, inflows of foreign funds can lead to a surge of lending because of rising collateral values (Eichengreen and Rose, 2014:2). Moreover, a sudden outflow of foreign funds from domestic banks can threaten a liquidity crisis (Eichengreen et al, 2014:2).

international capital flows, and we investigate whether macroprudential policies complement or substitute capital controls and foreign exchange interventions.

We use propensity score matching (PSM) to measure how effective macroprudential policies (MaPPs) are at mitigating systemic risks from international capital flows and contrast them to capital controls (CCs) and foreign exchange interventions (FXIs).[3] The PSM methodology allows one to compare countries that were experiencing similar economic conditions (and therefore had a similar probability of implementing a MaPPs, CCs or FXIs) but did not do so. In other words, PSM sets up a quasi-experiment, separating countries into treatment and control groups, after which the differences in outcomes are measured. We contribute to existing PSM literature measuring the effects of capital flow management techniques on capital flows by examining the proliferation of MaPP tools and by focusing on extreme capital flow types (surges, stops, flights and retrenchments)[4] – not just net inflows and net outflows.[5] We also take a slight departure from comparable literature and group macroprudential policy tools in line with their financial stability objective. This approach allows us to contrast a range of potential financial stability policy actions in the face of volatile or extreme international capital flow episodes.

The reason for our focus on extreme international capital flow episodes is that the literature is unclear on whether (conventional) capital controls or foreign exchange interventions are better suited than MaPP tools to mitigate the build-up of systemic risk.[6]

[3]The term capital controls (CCs) is used in order to differentiate them from MaPPs and capital flow management (CFM) to be a catch-all phrase while investigating MaPPs as tools to manage capital flows. In the literature capital controls are sometimes known as capital flow management measures (CFM). The former, traditional term has negative connotations which led to the adoption of "CFM" by the International Monetary Fund (Arora, Habermeier, Ostry and Brown, 2013). However, the term "capital controls" is still widely used in the literature. To complicate matters, some capital controls have macroprudential intent, because they restrict capital flows to limit systemic risks to financial stability associated with capital flows (Organisation for Economic Co-operation and Development, 2015:17). An example of this intent is when limits are placed on banks' foreign exchange derivative contracts set as a percentage of bank capital.

[4] In other words, capital flows delineated by residency (domestic or foreign) and direction (increase or decrease).

[5] Using Forbes and Warnock's (2021) definitions, capital flows are delineated by residency and direction. Increasing inflows, 'surges' are flows into an economy by foreigners. Decreasing inflows, 'stops' are flows out of an economy by foreigners. Increasing outflows, 'flights' are flows out of an economy by domestic residents. Decreasing outflows, 'retrenchments' are flows into an economy by domestic residents. Flow episodes are calculated from foreign direct investment (FDI), portfolio equity, portfolio debt, and banking flows. We do summarise these in Table 2. Frost, Ito, and van Stralen (2020) did examine surges, but no other flow types.

[6] The literature reviewing the various types of policies (MaPPs or CCs or FXI) and the circumstances and timeframes for which they work is very broad. See Blundell-Wignall and Roulet (2014) who review CFMs as MaPP tools; Magud, Reinhart, and Rogoff (2018) who review the macroeconomic effects of CCs; De Gregorio, Edwards and Valdés (2000) who evaluate the efficacy of CCs on net inflows; Korinek and Sandri

For example, a sudden surge of capital inflows can lead to systemic risks resulting from asset price bubbles, an inefficient allocation of resources, and currency appreciation that hurts export competitiveness (Forbes and Warnock, 2021:2). Similarly, there are increased vulnerabilities when abundant capital inflows reverse and correspond to sharp falls in asset prices and currency depreciations, which in turn feed into high inflation and increased challenges in repaying debt in foreign currency (Forbes et al, 2021:2).

The literature using PSM broadly tests the efficacy of MaPPs in the role of capital controls.[7] However, a large body of literature suggests these policy options are complements, where MaPPs are the first-line defence and capital controls are the second-line defence when MaPPs are not available (Jeanne and Korinek, 2010; Bianchi and Mendoza, 2011; Ostry, Ghosh, Chamon, and Qureshi, 2012; Benigno, Chen, Otrok, Rebucci, and Young, 2016). This tiered approach is taken because CCs are more restrictive; they create an opportunity cost for countries aiming to reap the benefits of capital flows. In contrast, the existing PSM literature concerning the effect of MaPPs on capital flows views these tools as substitutes, which is at odds with theory and practice. To solve this issue, we pool MaPPs into categories corresponding to their financial stability target: (i) capital and reserve requirements, (ii) liquidity tools, (iii) credit instruments, and (iv) those targeting systemically important institutions.[8] This aggregation of macroprudential policies represents a departure from the PSM literature (such as Glick and Hutchinson, 2006; Forbes, Fratzcher, and Straub, 2015; Frost, Ito, and van Stralen, 2020; and Akdogan, 2020) and other empirical literature which allows the focus on the transmission of target-specific MaPP interventions on capital flows. The value-added in this study is in shifting the focus towards financial stability concerns related to the potential buildup of vulnerabilities from different capital flows.[9] Moreover, this study also answers the

(2015) who theoretically compare CCs and MaPPs; as well as Forbes, Fratzscher, and Straub (2015) who compare MaPPs and CCs and their influence on capital flows; Jeanne and Sandri (2023) who consider capital controls and foreign exchange interventions; Neely (2005) who conducted a meta-analysis of foreign exchange interventions; and Cavallino (2019) who examines the effects of foreign exchange interventions on capital flows.

[7] In other words, macroprudential policy versus capital controls (instead of macroprudential policy *and* capital controls).

[8] We use the macroprudential database by Alam et al (2021).

[9] Like previous papers, in this paper the impact of MaPPs on capital flows is examined. However, the focus shifts towards what macroprudential policies are designed to do.

question of why the nature of extreme capital flow episodes has changed from 'waves' to 'ripples' (Forbes and Warnock, 2021).[10]

This paper is most closely related to the PSM literature concerning capital flows and the imposition of capital flow management tools[11] such as Glick et al (2006), who broadly studied the imposition of capital controls and capital account liberalisation on the likelihood of currency crises and Forbes, Fratzcher, and Straub (2015), who classified MaPPs as capital controls and other macroprudential measures and examined how these measures impacted various measures of financial fragility, including capital inflows and outflows. Similarly, Frost, Ito, and van Stralen (2020) classified MaPPs into FX-based and non-FX-based measures, and compared these to capital controls and studied how these measures impacted the volume and composition of capital flows. Akdogan (2020) broadly grouped all MaPP together and also compared this to expansionary and contractionary macroprudential implementations.

The results show how MaPPs have shaped the patterns of extreme capital flow episodes. Surges are dampened by capital/reserves tools, liquidity tools, credit tools, and systemic tools. Stops are dampened by capital/reserves tools but are amplified by liquidity, credit and systemic tools. Flights are dampened by capital/reserves, liquidity and systemic tools, and are amplified by credit tools. Retrenchments are dampened by capital/reserves tools and credit tools, and are amplified by liquidity and systemic tools. The proliferation of tools affects flows countercyclically, dampening the amount of capital coming in and amplifying capital going out of an economy. In emerging markets, capital controls tend to be more impactful (greater magnitude) on capital flows, with particular success at influencing flows coming into an economy (surges and retrenchments). This suggests that capital controls can potentially tame unsustainable capital inflows that are beyond what an emerging market is able to absorb.

The main findings indicate that when two countries have the same likelihood of allowing free movement of capital (controlling for specific global factors, contagion and/or

[10] Forbes et al (2012) described how extreme capital flow movements were 'waves'; however, in the follow-on paper (Forbes et al, 2021) it is found that international capital flows are better characterised as 'ripples' post 2007/2008 financial crisis because of their lower incidence. Specifically, they suggest that the drivers of international capital flows have changed from being correlated to changes in global risk to changes in oil prices (Forbes et al, 2021).

[11] Here the emphasis is simply on situating this paper within the PSM literature, whereas in the next section, a review of the literature is provided. Furthermore, non-PSM studies are considered.

domestic factors) and one country activates a MaPP tool, whilst the other does not, the country that does activate a MaPP tool has a lower likelihood of experiencing a surge or retrenchment.[12] Whereas, the country that does not activate a MaPP tool has a lower likelihood of experiencing a stop or a flight. These results point to the need for macroprudential policy flexibility over the financial cycle. The results also indicate that there are benefits for stability through capital market liberalisation (easing of capital controls) or alternatively by intervening/signalling in the foreign exchange market to stabilise stop flows.

The broad policy implication of the results is that macroprudential policies can prevent disruptions to the financial system and its functioning, which is a precondition for stable economic growth. We find that various MaPP tools can improve an economy's flexibility and resilience to shocks arising from volatile international capital flows. For example, MaPPs can target excessive credit expansion in the face of capital flow surges or strengthen financial system resilience related to systemically important institutions or reduce amplification mechanisms through capital and reserve requirements, as well as with liquidity instruments. In all cases, however, policymakers should be wary of the downside of the proliferation of tools.

The rest of the paper proceeds as follows. Section 2 reviews the literature. Sections 3 and 4 detail the variable construction and empirical methodology. The empirical results are presented in section 5. Section 6 provides a summary and conclusion to this study.

2. Literature review

Macroprudential policies (MaPPs) safeguard the financial system and protect against disruptive financial cycles, whereas capital controls (CCs) are residency-based measures regulating financial flows. Foreign exchange interventions (FXIs) are intended to contain or stabilise excessive fluctuations in foreign exchange rates (Bank of Japan, 2023). On the one hand, capital controls have generally failed to prevent extreme capital outflows that amplify financial disruptions to the broader economy and appear to only be effective under country-specific circumstances (Edwards, 1999:82; Magud, Reinhart and Rogoff, 2018:1). On the other hand, given the proliferation of MaPP tools available to policymakers (see Figure 3) and their relatively recent usage, it is unclear which of these

[12] Using the proliferation result that provides an overview of all MaPP tools activated.

tools will be most effective during such extreme capital flow episodes.[13] There has therefore been renewed attention on macroprudential policies, especially given how, in recent financial crises, externalities gave rise to procyclicality and systemic risk (Claessens, 2015: 400).

Capital flows are the transfer of financial assets across international borders and are thus a manifestation of both trade and financial linkages between economies. The traditional current account view held that capital flows were predominantly the result of trade of goods and services between economies (Borio and Disyatat, 2015:1). Between the turn of the century and the great financial crisis of 2007/2008, however, gross capital flows have become orders of magnitude larger (McQuade and Schmitz, 2017: 190), prompting a reconsideration of the traditional current account view to one that explicitly accounts for financial transmission mechanisms such as spillovers and spillbacks.[14]

In this section the literature on the drivers (for example, push and pull factors) and effects of capital flow surges, flight, retrenchments, and stops is reviewed.[15] The attention then turns to the motivations and techniques behind managing these flows using capital controls, foreign exchange interventions and, more recently, macroprudential policies.

The literature review is structured as follows. Subsection 2.1 considers capital flows. Capital flow management techniques and comparisons of these techniques are discussed in subsections 2.2 and 2.3.

2.1 Capital flows: surges, stops, flights, and retrenchments

A *surge* in capital flows can lead to an increase in the value of a currency (i.e., an appreciation of the exchange rate) and undermine the competitiveness of the tradable sector (Calvo, Leiderman, and Reinhart, 1993: 108). For instance, a boom is usually

[13] Proliferation refers to both the growing number of tools and the frequency of use as documented by authors including Cerutti, Claessons and Laeven (2017); Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier and Wang (2019) and Fendoğlu (2017). Figure 3 and Figure 4 clearly show how the number of MaPP tools implemented – and the frequency of their usage – have increased over time. It can be seen that in recent years approximately 40 percent of countries are activating a MaPP in a given year.

[14] For further evidence of spillovers and spillbacks in the literature see Agénor and Pereira da Silva (2022) and Fang, Jing, Shi, and Zhao (2021).

[15] The literature tends to use the term 'inflows' to describe capital coming into an economy, and 'outflows' to describe capital leaving an economy. However, we follow the definitions of Forbes et al (2021). As a reminder to the reader, *inflows* refer to *foreign flows*: increases of inflows are known as surges, and decreases of inflows are known as stops. *Outflows* refer to *domestic flows*: increases of outflows are known as flights, decreases of outflows are known as retrenchments. This is summarised in the data section in Table 2.

financed by inflows of bank credit. However, for countries with open capital accounts, the amplification of credit surges accompanied by an overvalued currency can lead to banking and then currency crises most notably in emerging market economies as observed through the rapid increase in financial liberalisation since the 1980s (Kaminsky and Reinhart, 1999: 473). The supply of foreign financing can stop for reasons unrelated to the affected county's domestic conditions. However, domestic conditions (such as high fiscal deficits, large current account deficits, and high levels of foreign currency debts) determine how vulnerable an economy is to these stops (Cavallo, 2019). In terms of capital flow reversals, the separability of surges and stops is therefore dependent on domestic conditions.

Capital flows can transmit waves of disruption and domestic instability in the wake of global financial shocks and can therefore also exacerbate and prolong busts (Forbes et al, 2012). For instance, banking, sovereign and currency crises tend to overlap, and all three can even happen simultaneously. These 'triple' crises are substantiated and documented by Laeven and Valencia (2008), Laeven and Valencia (2013), Laeven and Valencia (2020) and Nguyen, Castro and Wood (2022). The key idea is that greater foreign borrowing and foreign currency exposure can exacerbate financial fragilities, and that banking crises tend to increase the likelihood of sovereign crises (Eijffinger and Karataş, 2023). Indeed, surges often precede these crises, but the trigger requires foreign capital to stop flowing in.

In terms of capital flow episodes, capital flow reversals are analogous to surges being followed by stops and flight. Capital flow reversals can subsequently leave economies vulnerable to financial crises. As banks borrow, domestic credit to the non-financial sector surges – which finances an economic boom and generates asset bubbles. When the capital coming into an economy reverses, asset markets crash, the economy goes into recession, and the banking system experiences a crisis (Calvo and Reinhart, 1999:181).[16]

During crisis periods capital tends to flow from emerging market economies to advanced economies, which contrasts with non-crisis periods when global factors drive a more favourable opposite effect (Fratzcher, 2011:341). Similarly, Schmidt and Zwick

[16] In much of the literature, capital flow reversals refer to when net inflows become net outflows (see, for instance, Cavallo, 2019).

(2015:343) find that country-specific risk factors play a more important role than global risk factors in determining extreme capital flow episodes. They also find that during times of crisis and uncertainty foreign and domestic investors both exhibit home bias; that is, they prefer domestic investments over international financial markets. Cavallo, Izquierdo and León-Diaz (2017) confirm the role of retrenchments in dampening the impact of sudden stops. The bias in investor behaviour towards investors' home countries is discussed by Milesi-Feretti and Tille (2011), Jochem and Volz (2011), and Coeurdacier and Rey (2013). Other explanations for this phenomenon are hedging motives in frictionless financial markets, and asset trade costs in international financial markets (Coeurdacier et al, 2013:63).

The home bias explains the *retrenchment* of capital flows by domestic investors, which through their substitutionary effects offset contractions in global liquidity with returning domestic capital. For example, during the global financial crisis multiple countries experienced stop/flight and retrenchment episodes simultaneously (Forbes and Warnock, 2012) whereby domestic investors liquidated foreign assets (retrenchments) while international liquidity contracted (stops/flights).

The magnitude of the retrenchment of international capital flows is linked to the extent of international financial integration (Milesi-Feretti et al, 2011: 289).[17] This suggests that policies targeting retrenchment episodes are more likely to be stabilising in more financially integrated countries – presumably the more advanced economies – this is because there are fewer impediments to retrenchments in these economies in the first place. The retrenchment episodes tend to happen over a shorter period in emerging market economies as compared to advanced economies. Banking flows tend to be the most sensitive to crises (Milesi-Feretti et al, 2011).

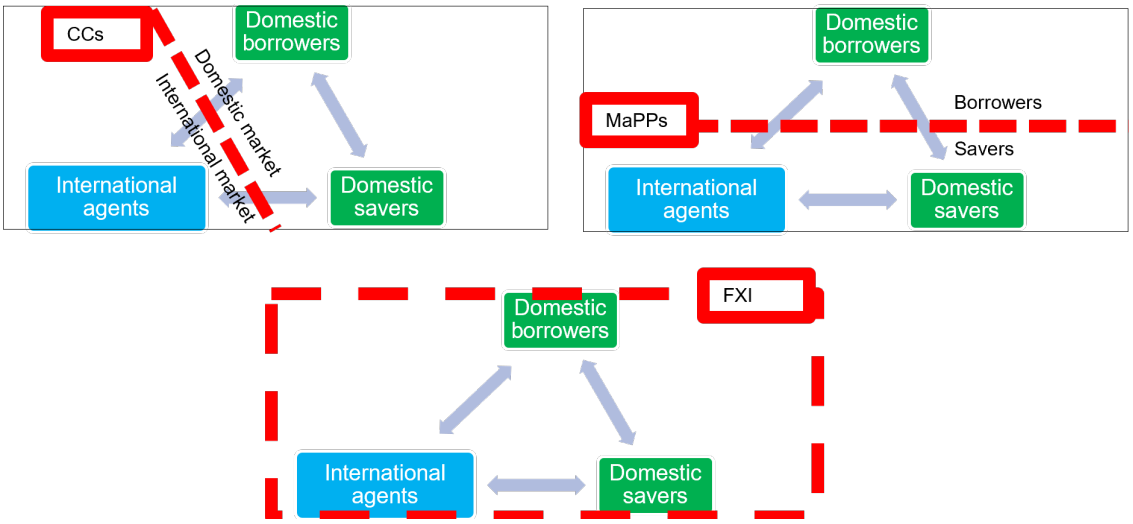
2.2 Capital flow management

To prevent the occurrence and spread of financial crises, policymakers can generally choose between macroprudential regulations, with more of a domestic focus, foreign

[17] Financial integration refers to how connected the domestic financial system is to the international financial monetary and financial system, in a sense how many paths capital can flow, whereas financial liberalisation typically refers to capital account liberalisation. Kose and Prasad (2017) suggest that a liberalised capital account may be interpreted as a signal of commitment good economic policies, because a perceived deterioration in a country's policy environment would be punished by foreign and domestic investors. Capital account liberalisation incentivises policymakers to adopt sound policies.

exchange interventions and capital controls which regulate international capital flows (Gelos, et al, 2022). Figure 1 illustrates and delineates these different policy options.[18]

Figure 1: Delineation of capital controls, macroprudential policies and foreign



This figure delineates different types of capital flow management measures. The arrows represent international capital flow movements. The red lines indicate the space in which the CFM operates. Sources: Capital controls versus macroprudential regulation (recreated and adapted from Korinek and Sandri, 2015) MaPPs segment borrowers (domestic) and lenders of all types (international agents and domestic savers) (top right panel). Whereas capital controls discriminate based on the residency of the parties involved in a financial transaction, therefore separating the domestic market (domestic savers and borrowers) and the international market (international agents) (top left panel). FXIs permeate through all transactions between the domestic and international market (bottom panel).

Generally, MaPPs segment borrowers (domestic) and lenders of all types (international agents and domestic savers), whereas capital controls discriminate based on the residency of the parties involved in a financial transaction, therefore separating the domestic market (domestic savers and borrowers) and the international market (international agents). FXIs permeate through all transactions between the domestic and international market.

The objective of MaPP policies is to safeguard the domestic financial system against systemic crises – which can come about because of capital flow surges, stops, and flight (Frost et al, 2020:5). Capital controls, in contrast, are residency-based tools directly used to prevent capital flow episodes of external or internal origin from spreading domestically. Foreign exchange interventions (FXI) are changes in a central banks' net

[18] It is essential to note that when MaPPs are categorised in this study they are mutually exclusive. However, there is overlap embedded in the MaPP and CC variables in what would strictly speaking be considered a MaPP versus a CC.

foreign asset positions and involve active efforts by a central bank to stabilise a currency in the face of such disruptions. This also includes building liquidity buffers because of precautionary motives. Furthermore, liquidity provision during a crisis is known to safeguard financial stability and to minimise central banks own financial risks (Bindseil and Jabłecki, 2013:5). Given that there is a wide range of policies, the literature is sparse in relation to linking which capital flow management techniques are best at safeguarding a domestic economy against extreme capital flow episodes. For instance, using the same dataset, the capital and reserve requirements category combined with the systemic categories of MaPPs are termed 'capital controls' in Forbes et al (2015).

The appropriate policy response to capital inflows and outflows is dependent on the nature of the circumstances facing a country, and the main macroeconomic concerns relating to financial fragilities. Typical macro-financial concerns are related to exchange rate appreciation, levels of reserves, and inflation sterilisation (Ostry et al 2011:566). In turn, the specific monetary and fiscal policy responses, given the specific macro-financial circumstances around these concerns, can themselves have unintended consequences and lead to further concerns (Ostry et al, 2011:566). This in turn motivates the creation of many new tools to deal with specific concerns. For instance, if an undervalued exchange rate is a concern, the response is passively allowing the nominal exchange rate to appreciate. However, a more proactive policy response is required if the exchange rate is already overvalued (or roughly in equilibrium), and there are concerns about the impact of an appreciation on competitiveness (Ostry et al 2011:567).

Optimal policy is sensitive to different conditions of exchange rate pass-through when there are excessive capital inflows (Corsetti, Debola, and Leduc, 2023). The optimal size of capital flows in emerging markets is greater than the non-intervention (laissez-faire) world (Jeanne and Sandri, 2023).[19] It is further suggested that by expanding (rather than restricting) capital flows emerging markets can protect themselves from the global financial cycle (Korinek et al, 2023). Offsetting capital leaving an economy can buffer the volatility of capital coming into an economy. In terms of capital flows this type of liquidity management manifests itself as the feedback between stops and retrenchments.

[19] Jeanne and Sandri's (2023) model and results do suggest that the private sector tends to under-invest in liquidity because it does not internalise how the country's balance sheet affects asset prices, therefore leading to a sub-optimal outcome.

Capital controls

Capital controls have a long history and have been used extensively to mitigate capital flows because there were no alternatives. The literature generally argues that capital controls are ambiguous (at best) or ineffective at protecting economies from economic crises arising from capital flows.[20] Moreover, capital controls come at the price of mitigating the positive impacts of capital flows (Forbes, 2007a:173). Capital controls are often associated with greater vulnerability to a crisis (as opposed to lower vulnerability); however, this can be attributed to self-selection (Glick, Guo, and Hutchinson, 2006:698). Countries that have imbalances, those that are likely not financially developed enough to be financially integrated, and countries with institutional issues are also those that are more likely to use capital controls to avoid a crisis.[21] The results of Glick et al (2006) suggest that it is the pre-existing economic environment in which countries allow international capital movements that ultimately determines whether they will be prone to financial crises.

Capital controls should be used to moderate short-term flows. The slower speculative capital arrives, the less likely it is to go out suddenly (Edwards, 1999: 82). Furthermore, Edwards (1999: 83) suggests that controls on inflows may sometimes be an improvised short-term solution – but that the long-term solution for a nation concerned with its vulnerability to flows of international capital is to pursue sound economic policies.[22]

The spillover effects of capital controls have economic costs, because they reduce both good and bad financial flows. Greater use of capital controls crowds out less distortionary policies to manage flows, drives global imbalances and contributes to contagion (Ostry et al, 2011:577). Contagion refers to the spread and transmission of negative shocks. Furthermore, besides increased vulnerability to crisis, capital controls also have other costs. For example, capital controls (and MaPPs) disproportionally affect small and medium enterprises (SMEs) in emerging markets. The problems of smaller firms, which tend to experience financial constraints such as having a harder time borrowing, are in

[20] De Gregorio, Edwards and Valdés (2000) highlight how the effects of capital controls are elusive. More recent literature indicates that capital controls are effective only under country-specific circumstances, implying that more often than not they do not work (Magud, Reinhart, and Rogoff, 2018: 1).
[21] Table 5 indicates that CFMs are not independent of extreme capital flow episodes.
[22] The conditions under which controls on capital inflows are appropriate are if the economy is operating near potential, reserves are adequate, the exchange rate not undervalued, and if the flows are transitory (Ostry, Ghosh, Chamon, and Qureshi, 2011:562).

turn exacerbated by capital controls (Forbes, 2007:173). This suggests that the imposition of controls negatively influences the level of investment and economic activity, as well as growth of smaller firms.

Foreign exchange intervention

Foreign exchange intervention (FXI) as a policy tool is controversial (Fratzcher, Gloede, Menkhoff, Sarno, and Stöhr, 2019:154).[23] There is a view that FXI is potentially an effective policy instrument for macroeconomic management, complementing monetary policy (Adler, Lisack, and Mano 2019).[24] In the literature, the direction of FXIs is also under debate. Some suggest that the optimal FXIs oppose short-term trends and stabilise the path of the exchange rate (Neely, 2005:3; Cavillino, 2019:166). This in turn reduces exchange rate misalignments. In contrast, Fratzcher et al (2019) find that FXI is sometimes effective when it follows prevailing trends. The three channels identified in the literature as to how FXI can affect exchange rates is through signalling, the portfolio balance channel and the order-flow channel (Chutasripanich and Yetman, 2015:7). Jeanne et al (2023) suggest that governments in countries with an intermediate level of financial development can use their own balance sheets to amplify gross capital flows in order to smooth external financial shocks.[25]

Macroprudential policies

All macroprudential policies are likely to increase resilience and mitigate financial shocks. For instance, a greater capital buffer requirement will make banks more resilient to solvency shocks, whereas liquidity tools increase resilience to liquidity stress; similarly, a tighter LTV ratio will increase borrowers' resilience to asset price corrections

[23] The FX market is the largest financial market in the world by volume, and it is also seen as efficient in that fundamental news is incorporated quickly. Therefore, the main argument is that central banks are too small a player to intervene in the FX market in a meaningful way. Using FXI, authorities have an estimated success rate of around 60 percent, but only under specific conditions (Fratszcher et al. 2019)

[24] Adler et al (2019) find that a purchase of foreign currency of 1 percentage point of GDP causes a depreciation of the nominal and real exchange rate in the ranges of 1.7-2.0 percent and 1.4-1.7 percent respectively. However, this trade-off is relatively expensive and therefore likely to be an unaffordable policy recommendation in countries that do not have large foreign exchange reserves. Given these results, we suggest that FXI should be focused on managing the consequences of flows, over the actual flows themselves, especially since there is considerable debate around the efficacy of foreign exchange intervention (Chutasripanich et al. 2015:9). In other words, the costs of intervention may outweigh the benefits of said intervention.

[25] The private sectors in advanced countries are large enough to offset capital flow volatility. Furthermore, in practice, emerging markets do tend to have a bias towards purchasing foreign currencies, whereas the usage of FXI is largely limited in advanced economies (Adler, Chang, and Wang, 2021).

and will in turn protect banks from borrower default (International Monetary Fund, 2014:14).

By enabling the efficient functioning of the financial system in response to disruptions, macroprudential policies aim to mitigate the downside risks to economic growth.[26] These policies have a broad range of targets such as increasing bank capital and liquidity, reducing leverage in various sectors, preventing currency mismatches, and other tools such as restrictions on profit distribution and other structural measures. A range of MaPPs have been created to enhance macroeconomic resilience and reduce the build-up of systemic risks.[27] Cerutti et al (2017) evaluate MaPPs and find that they dampen the financial cycle during booms but work less well in busts. This suggests MaPPs can influence surges better than stops. Furthermore, Cerutti et al (2017) find that MaPPs are less effective in more developed and open economies. They also observe that emerging economies tend to use foreign exchange related MaPPs as compared to borrower based MaPPs in advanced economies (Cerutti et al, 2017).

The efficacy of MaPP tools is dependent on the type of financial shock. Forbes (2019:471) lists three broad objectives for MaPPs as: (i) addressing excessive credit expansion; (ii) reducing amplification mechanisms of systemic risk; and (iii) mitigating structural vulnerabilities related to the role of important institutions and key markets. MaPPs are evaluated by pooling them into categories related to their financial stability targets: (i) capital and reserve requirements; (ii) credit instruments; (iii) liquidity instruments and another category for including policies targeting; and (iv) structurally important financial institutions. The pooling is in contrast to Frost et al (2020) who split MaPPs into FX- versus non-FX-based, and Forbes et al (2015) who pool MaPPs as those related to cross-border financial activity, relabelled as 'capital controls', and other macroprudential measures.[28]

[26] See Lim, Columba, Costa, Kongsamut, Otani, Saiyid, Wezel and Wu (2011) for an overview of macroprudential policy instruments and suggestions how to use them; and Bruno, Shim, and Shin (2015) for a comparative assessment of macroprudential policies.

[19] It is noted here that macroprudential tools are not always necessarily stabilising, and there are several criticisms of MaPPs in the literature. For instance, Aiyar Calomiris and Wieladek (2015) argue that MaPP tools can undermine the various channels of monetary policy and therefore the credibility and accountability of central banks.

[28] The 'liquidity' and 'credit instruments' variables combined correspond to the macroprudential category in Forbes et al (2015), and the 'capital' and 'other category' correspond to their 'capital controls category'.

As outlined in the previous section, the pooling aims to shift the focus of the CFM-PSM literature towards the financial stability objectives of macroprudential policy. In the literature, there is a view that macroprudential policies complement capital controls, and that the latter should be implemented only if an appropriate macroprudential policy is not in place (Eichengreen and Rose, 2014).

Broadly speaking, MaPPs can influence capital flows. Although global conditions are outside the control of policymakers, domestic factors are not. Internal MaPPs can set low levels of liability dollarisation, exchange rate flexibility, inflation targeting regimes, and a solid institutional background. In this way macroprudential policies therefore reduce systemic risks. Domestic investors perceive reduced risk in bringing resources in at a time of an external shock, thus insulating the country from this shock. MaPPs shape a feedback mechanism that stabilises an economy. In the remainder of this subsection, we discuss macroprudential literature under the categories used in this study.

Capital and reserve requirements

Historically, prior to the great financial crisis of 2007/2008, capital and reserve requirements were largely the only MaPPs used, and this was done to support capital controls (Brei and Moreno, 2018:2).[29] In a sample of Latin American economies, capital and reserve requirements are shown to moderate capital inflows and lead to stable domestic credit growth (Brei et al, 2018:17). This is further evidenced in Figure 3, where the almost non-existence of other MaPPs prior to 2007 is shown. For instance, banks have long been mandated to hold capital with central banks holding reserves on the asset side of their balance sheets. The issue here is that it is unclear in the data how to distinguish reserves for macroprudential versus monetary purposes. Finally, Basel III requires banks to maintain a capital conservation buffer, and countercyclical capital buffers were largely phased in at the same time, post the great financial crisis in 2007/2008 (Hoevelmann, 2020). Reserve requirements have at least three objectives: reduce bank and solvency risks (microprudential), affect market rates and monetary aggregates (monetary

[29] We use the IMF's iMaPP database which cannot identify whether capital and/or reserves requirements were put in place for prudential purposes or not. Following this fact, we therefore follow their classifications and retroactively relabel all capital and reserve requirements as being for prudential purposes.

control), and manage system-wide liquidity (macroprudential/financial stability) (Brei et al, 2018:4).

Liquidity instruments

Global liquidity is viewed as a driver of cross-border spillovers in financial conditions and credit growth (Shin, 2014).[30] Theoretically, abundant liquidity aggravates the risk-taking moral hazard at banks, giving rise to excessive lending and asset price bubbles (Acharya and Naqvi, 2012:350). Liquidity creation increases systemic risk; therefore, regulating bank liquidity creation enhances financial stability (Zhang, Fu, Wang and Zhang, 2021). Similarly, the destruction of private liquidity is linked to the dynamics of gross international capital flows and can also be a source of instability because it amplifies cyclical movements in domestic financial conditions and intensifies domestic imbalances (Landou, 2011:1). Furthermore, global liquidity is particularly sensitive to the monetary policies of the United States (Avdjiev, Gamacorta, Goldberg and Schiaffi, 2017:1).

The aforementioned examples illustrate how liquidity issues can be a source of vulnerability to the global financial system. Liquidity instruments concern regulations to contain maturity and currency mismatch. These tools mitigate systemic liquidity and funding risks, limit loan-to-deposit (LTD) ratios, and also limit foreign exchange positions, exposures and funding. However, MaPPs targeting liquidity have led to significant cross-border bank credit spillovers (Buch, Bussiere, and Goldberg, 2017: 505). Liquidity instruments can therefore cause macroprudential policies related to credit to proliferate.

Credit instruments

Although raising bank reserve requirements reduces aggregate credit growth, credit policies target vulnerabilities to the risk associated with loans, such as caps to loan-to-value and debt-to-income ratios. MaPPs related to credit limit the growth of credit. This focus characterises how they are distinct from liquidity and capital/reserve requirements. Cerutti, Claessens and Laeven (2017) find that these types of policies are favoured by advanced economies and that they are associated with greater cross-border borrowing, suggesting that countries are facing issues of avoidance. In other words, the

[30] The term 'global liquidity' is often used by emerging market policymakers in connection with monetary policy spillovers from advanced economies.

capital flows are redirected and not halted entirely. Fendoğlu (2017) finds that domestic-focused borrower-based tools are effective at containing portfolio inflows in emerging markets suggesting that credit instruments can mitigate surges and stops in emerging market economies.

Other tools and structurally important financial institutions

In this paper, this is a residual category covering macroprudential measures not captured in the other categories. However, they still do protect against the vulnerabilities related to important financial institutions and markets. It covers resolution plans, additional cushions and surcharges to systemically important institutions, rules for key intermediaries, and taxes that have macroprudential purposes. It is noted that the choice of macroprudential policy activation by a country is dependent on its prior policy history, its institutions, and the types of crises the country is likely to face (Forbes, 2019:472).[31] The intuition is that countries with weaker institutions and financial systems experience the impositions from volatile capital flows to a greater extent.

The leakages and spillovers of policies can have an array of unintended consequences (Forbes, 2017:471), which in turn lead to more policies. MaPP tools proliferate due to leakages and spillovers. Leakages refer to how economic agents redirect money around regulations in the same country, and spillovers are shifts to other countries, both ultimately motivating more MaPPs. Spillovers from MaPP can have unintentional consequences. For instance, applying prudential measures to domestic banks may cause flows to migrate to unregulated parts of the financial system as a result of regulatory arbitrage (Ostry et al, 2012:420). This implies that the systemic risks spread to other parts of the financial system. For example, Buch et al (2017:505) found that MaPP tools targeting liquidity in particular sectors lead to significant cross-border bank credit spillovers. International spillovers vary across instruments and are heterogenous across banks (Buch et al, 2017: 508). The magnitude of these spillovers is moderate, implying that the MaPPs dissipate the risk. Nevertheless, this in turn can lead to MaPP proliferation as policymakers try and protect the system from new risks arising from circumvention of

[31] Fully controlling for these factors would inhibit the ability to match treatment and control using the PSM methodology, However, domestic variables are used to account for the different of extreme capital flow episodes a country is likely to face.

regulations.[32] The fact that so many MaPP tools are used indicates that there is further scope to study how best they can be calibrated.

2.3 Comparisons of MaPPs, capital controls and FX interventions

There have been a number of comparisons of MaPPs and capital controls in the literature. Korinek and Sandri (2016) differentiate between macroprudential regulation and capital controls by distinguishing between domestic and foreign lending (Similar to Figure 1). This study is an empirical counterpart to those across many countries, in that the goal is to evaluate the impact of different capital flow management techniques on various types of capital flow episodes. The literature in this subsection indicates that, in general, authors find in favour of implementing MaPPs, CCs, and FXIs to reduce financial fragilities. In comparing these policies, most papers have a narrow view and do not account for which financial stability objectives, and thus vulnerabilities, these policies target.[33]

Recent literature indicates that capital controls have rarely been imposed or removed by governments for financial stability considerations (Eichengreen and Rose, 2014:1). Capital controls are only plausibly significant between banking crises and the incidence of restrictions on financial credits and derivatives. This is due to the view that capital controls are less suited for this role and are thus considered somewhat inferior in these macroprudential contexts, particularly over the medium and long terms.

Korinek and Sandri (2016:27) find that both MaPPs and CCs make emerging market economies more stable and reduce the incidence of financial crises after a sudden stop episode.[34] They also suggest that the optimal balance between macroprudential policies and capital controls varies over time and is dependent on the risk of financial instability.[35] MaPPs are seen as the first line of defence, and CCs as the second line – when there are no MaPP tools available. This suggestion is similar to that of Jeanne et al (2010) as well

[32]For further discussions of the spillovers of macroprudential policy, see Nie (2022), Ostry et al (2012) and Buch et al (2017).

[33] Common objectives include: (i) maintaining resilience such that the financial system can provide credit to the economy under adverse conditions; contain the build-up of systemic vulnerabilities through reducing procyclicalities between asset prices and credit; and (iii) control structural vulnerabilities, including individual institutions that are 'too important to fail' (International Monetary Fund, 2014:1).

[34] Crises here refer to sudden stops (foreign outflows) as being part of a feedback loop with exchange rate depreciations and tightening constraints on capital flows.

[35] Especially instabilities associated from being vulnerable to sudden stops.

as Bianchi et al (2011). Nevertheless, MaPPs and CCs are seen as being complementary to one another.

Some literature evaluating MaPPs and CCs in influencing capital flows is suggestive of a view that MaPPs and CCs are substitutes. For example, Forbes et al (2015) group tools as (i) capital controls, (ii) FX-based prudential measures, and (iii) other prudential measures. They employ a cross sectional regression of the indices of the policy variables against a set of controls to determine the efficacy of the policy. The findings relevant to the study are that MaPPs can be effective at influencing their targets and thus mitigate financial vulnerabilities (such as reducing bank leverage, inflation expectations, bank credit growth, and exposure to portfolio liabilities) (Forbes et al, 2015:S92). Moreover, to prevent currency crises, removing controls on capital leaving an economy are more effective than controls on capital coming to an economy (Forbes et al, 2015). With a similar classification, Frost et al (2020) categorise MaPPs into FX-based and non-FX-based measures, and contrast these to capital controls and study how these measures impact the volume and composition of capital flows. Their main finding is that macroprudential regulation (reduce inflow volumes) are superior to capital controls (which have no significant effect) in mitigating capital inflows.

Non-PSM related studies have also compared the efficacy of different types of CFMs, finding that a broad set of macroprudential regulations can significantly dampen the macroeconomic impacts of global financial shocks on emerging markets. Capital controls are not found to provide similar gains, no matter their stringency (Bergant, Grigoli, Hansen and Sandri, 2020). Theoretically, macroprudential policy can complement monetary policy in the face of a shock from capital inflows. Furthermore, MaPP tools improve welfare and those that target shocks are shown to be more effective than capital controls (Unsal, 2013: 233-234).

In a similar vein, Jeanne and Sandri (2023) argue that in less financially developed countries, foreign exchange intervention may be preferable to capital controls. In order to protect against the global financial cycle, emerging markets should expand capital flows, and thus accumulate foreign liquid assets when global liquidity is high, to then buy back domestic assets at a discount when global financial conditions tighten. Gelos, Gornicka, Koepke, Sahay, and Sgherri (2022) use an ‘at-risk’ framework to evaluate how

effective various CFMs are at taming capital flows. The main finding is that FXIs and MaPPs are broadly effective at mitigating downside risks, whereas capital controls are counterproductive (Gelos et al, 2022:2). Other papers, such as Jeanne et al (2023), find that CCs are less effective than FXIs in emerging market economies, and that large private sectors in advanced economies negate the need for government FXIs. In a theoretical model, Benigno, Chen, Ortok, Rebucci and Young (2016: 145) find that in trying to prevent financial crises, if exchange rate policy has no cost, there is no need for capital controls; however, if exchange rate policy has a cost, capital controls become part of the optimal policy mix.

Prudential policies and capital controls enhance economic resilience over the boom-bust phases of foreign capital flows (Ostry, Ghosh, Chamon and Qureshi, 2012:408). Both types minimise the financial-stability risks associated with capital surges during booms and help mitigate the damage that can occur during busts.

3. Variable construction

In essence the impact of various capital flow management techniques on the likelihood of extreme capital flow episodes is being estimated. The panel spans 1990Q1 to 2020Q3 and consists of 54 countries.[36] Several data sources which are used are discussed below. In this section 3 the data is described and the methodology in constructing the main variables is discussed. Subsections 3.1-3.3 detail the capital flow management measures, and subsection 3.4 details the capital flows data. In the section that follows (Section 4), the empirical methodology is presented.

3.1 Macroprudential data

The IMF's integrated MaPP database constructed by Alam et al (2019) is converted from monthly to quarterly and the 27 MaPP tools are grouped into four categories in relation to their broad target, and a set of dummy variables (treatment) are created (see Table 1). Specifically, policies are grouped into those related to (i) capital and reserve requirements, (ii) credit instruments, (iii) liquidity instruments, and (iv) a residual category for including policies targeting systemically important financial institutions. We

[36] USA, UK, Austria, Denmark, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, Canada, Japan, Finland, Iceland, Ireland, Portugal, Spain, Turkey, Australia, New Zealand, South Africa, Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Israel, Bangladesh, Sri Lanka, Taiwan, Hong Kong, India, Indonesia, South Korea, Malaysia, Philippines, Singapore, Thailand, Russia, China, Czech Republic, Slovak Republic, Estonia, Latvia, Hungary, Lithuania, Croatia, Slovenia, Poland and Romania.

therefore use four separate categories, as opposed to one or two categories typical of other PSM studies such as Forbes et al (2015), Frost et al (2020) and Akdogan (2020). For example, the 'liquidity' and 'credit instruments' variables combined corresponds to the broader macroprudential category in Forbes et al (2015), and the 'capital' and 'other category' correspond to their 'capital controls category'. Additionally, the 'proliferation' corresponds to Akdogan's (2020) 'macroprudential measures'.

Table 1: MaPP instrument categories, description, example policies

Capital and reserve requirements (i)	Regulations to contain maturity and currency mismatch
Liquidity (ii)	Policies targeting vulnerabilities to mortgage risk: caps to loan-to-value and debt-to-income ratios
Credit instruments (iii)	Policies targeting vulnerabilities to mortgage risk: caps to loan-to-value and debt-to-income ratios
Systemic institutions and other (iv)	Resolution plans, additional cushions and surcharges to systemically important institutions, rules for key intermediaries

Notes: Full descriptions of these variables are in Appendix B.

Using Alam et al (2019), a dummy variable is created equal to '1' if a policy in that category is activated, else it is '0'. To go from monthly to quarterly, if a MaPP was used in any monthly observation within a particular quarter then the quarterly value is '1'. The proliferation dummy variable is '1' when any macroprudential policy of any category was implemented, else '0'.[37]

On the one hand, a more heterogenous grouping better accounts for how MaPP preferences structurally changed over the sample period. Structural changes refer to the creation of new tools, especially post 2007/2008 financial crisis. For instance, as we can see in Figure 4, capital conservation buffers are much more commonplace post-crisis. Nevertheless, this retroactive relabelling implies the sample starts in 1990Q1 instead of 2010Q1. A similar issue arises in data of how to distinguish reserves for macroprudential versus monetary purposes. However, the data source is trusted. On the other hand, grouping policies partially accounts for selection bias arising from country-specific

[37] This variable construction in the empirical methodology is a similar measure to what some authors, such as De Schreyder and Opitz (2021), refer to as a macroprudential 'shock'.

differences. That is, there is the potential for unobserved selection bias distorting empirical findings because MaPP implementation is country-specific – reflecting histories, institutions, political priorities, and perceived vulnerabilities.

The pooling of MaPPs increases the sample size of these MaPPs. For instance, instead of asking whether a limit on growth in credit and whether a limit on foreign currency lending individually affected the likelihood of an extreme capital flow episode, these are grouped under the banner of credit instruments. The broader question of whether credit instruments reduced the likelihood of an extreme capital flow episode is thus asked.[38] This implies that the variable construction allows the testing of the joint hypothesis of all credit instruments. Appendix B includes results on the individual hypotheses of each of the tools. It is noted here that, especially in the pre-great financial crisis period, there is not enough implementations (small sample issues) of particular individual MaPPs in order to run the model.

The results are compared to the implementation of MaPPs to other datasets, foreign exchange interventions, alternative stratifications, and individual MaPP tools. These comparisons are based on distinct instruments, quantity of instruments; transmission channels, and previous literature. It is noted that measuring the impact of individual tools is possible, but there are several instances of small sample size hampering such estimations.

3.2 Capital controls data

MaPPs are also compared to the historical use of capital controls. For this the easing and tightening of capital controls in the dataset created by Pasricha, Falagiarda, Bijsterbosch, and Aizenman (2018) is used. It is emphasised here that this dataset has some overlap with the MaPP dataset. The focus is on the tightening and easing of capital controls, and in the appendices we also make estimations restricted to the easing and tightening of inflows for the surges and stops (inflows) and easing and tightening of outflows for flight and retrenchments (outflows). We do not use the breakdown into specific types of flows because the definitions do not correspond to the extreme capital flow episodes.

[38] The underlying assumption here is that limit on credit growth acts as a signal and impacts credit flows.

3.3 Foreign exchange interventions data

The dataset from Adler et al (2021) is used to compare MaPPs to FX interventions.[39] In that paper, FXI proxy variables are estimated relying on the change in the (net) foreign asset position of the central bank. A Hodrick-Prescott filter is used to remove endogeneity arising from movements in the U.S. dollar value of nominal GDP (Adler et al, 2021). A dummy variable equal to '1' is created if an intervention exceeded 2 percent of GDP (rolling average) then it is considered substantial, otherwise, it is considered normal FX activity by the central bank and the dummy variable is equal to '0'. The spot and derivative proxy variables are chosen over the official published statistics because they span more countries than official published data. Proxies are focused on both spot and derivative transactions that alter the central banks' foreign currency position.

3.4 Capital flow episodes data

Extreme capital flows are heterogeneous and are delineated in terms of residency and direction of flow (see Table 2).[40] Extreme episodes are two standard deviations above their 5-year rolling mean. Episodes of surges and stops (sharp increases and decreases, respectively, of gross flows) by foreign investors; and flight and retrenchment (sharp increases and decreases, respectively, of gross flows) by domestic investors are identified. The flow episodes are calculated from foreign direct investment (FDI), portfolio equity, portfolio debt, and banking flows. The share of countries experiencing extreme episodes is plotted in Figure 2. After the global financial crisis, occurrences of surges and flights have dampened, whereas stops and retrenchments have not.[41] This suggests that MaPPs are better at mitigating extreme *increases* in flows.

Forbes and Warnock's (2021) extreme capital flow episodes are modelled using macroeconomic variables: global risk (VIX) – which accounts for overall economic uncertainty and both the riskiness of financial assets and investor risk aversion; liquidity (change in global M2); interest rates (US, UK, Japan, Eurozone) control for monetary policy; global growth (IMF estimate); contagion (dummy if a country in same group has

[39] FXI interventions are measured from any policy-induced changes in the FX position of the consolidated public sector.

[40] Earlier studies, which only distinguish between two types of flows (inflows and outflows), typically lumped what here is referred to as surges and retrenchments as inflows, and stops and retrenchments as outflows. For the reader it is perhaps intuitive to focus on the "double positives and double negatives": surges (*in*creases of *in*flows) and retrenchments (*de*creases of *outf*lows). With this in mind, Table 2 is colour coded.

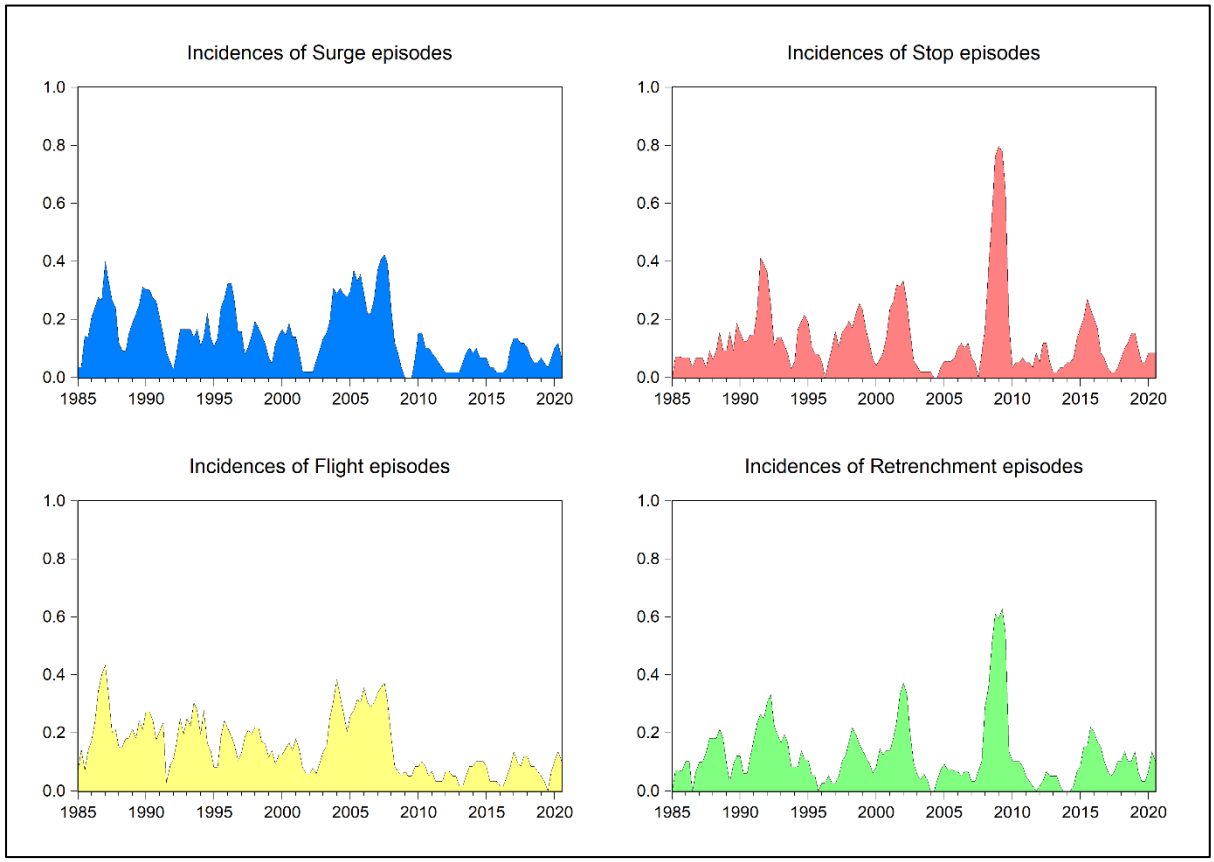
[41] See Forbes and Warnock (2021) for further discussion of the extreme capital flow episodes.

an episode) – this is based on geographic proximity and trade linkages; and domestic GDP growth – which controls for the business cycle. The descriptive statistics of these macroeconomic variables are presented in Table 4.

Table 2: Heterogenous capital flows

Residency / Direction	Foreign	Domestic
Increase	Surge	Flight
Decrease	Stop	Retrenchment

Figure 2: Incidences of surges, stops, flight and retrenchments



Notes: Full sample; (1985Q1-2020Q3). Sources: Authors' calculations (2022) using Forbes and Warnock (2021)

3.5 Descriptive statistics

Table 3 shows how policy implementation is distributed and has proliferated. The average share of countries implementing a type of CFM in a given quarter over the period is calculated. The percentages presented in the post-GFC column (far right) exceed the

pre-GFC column in every case, with one exception for easing capital controls by advanced economies.

Table 3: Distribution of MaPPs, capital controls and FX interventions

Instrument categories	Years / Sample	1990-2020	Pre- GFC	Post- GFC
Capital and reserve requirements	**Full**	**6,4**	**4,5**	**10,3**
	AE	6,7	4,2	11,2
	EME	6,2	4,6	9,8
Liquidity	**Full**	**3,5**	**1,3**	**7,5**
	AE	3,2	0,7	7,9
	EME	3,6	1,8	7,3
Credit instruments	**Full**	**3,8**	**1,9**	**7,5**
	AE	4,7	2,3	9,9
	EME	3,2	1,7	6,1
Systemically important institutions	**Full**	**2,4**	**0,4**	**6,1**
	AE	3,8	0,5	10,3
	EME	1,5	0,4	3,6
Proliferation of MaPP instruments	**Full**	**13,6**	**7,2**	**22,7**
	AE	15,5	7,8	25,9
	EME	12,4	6,8	20,7
Capital controls easing	**Full**	**14,4**	**14,2**	**15,2**
	AE	5,7	6,1	5,7
	EME	29,8	28,3	32,0
Capital controls tightening	**Full**	**7,3**	**4,8**	**10,0**
	AE	3,0	1,4	5,2
	EME	14,8	10,7	18,5
FX spot interventions	**Full**	**12,6**	**11,5**	**10,3**
	AE	14,6	12,9	13,6
	EME	11,4	10,6	8,6
FX derivative interventions	**Full**	**1,2**	**0,8**	**0,8**
	AE	5,9	4,2	5,4
	EME	2,0	1,3	1,1

Notes: The values represent the mean number of times a particular instrument was activated. Full sample; (1985Q1-2020Q3); AE and EME denote advanced economies and emerging market economies; Full sample for capital controls (2001Q1-2015Q4); Full sample for FX interventions (2000Q1-2020Q3). GFC denotes great financial crisis of 2007/2008. Authors' calculations (2023) using Pasricha, Falagiarda, Bijsterbosch, and Aizenman (2018); IMF iMaPP database (2022); and Adler, Chang, Mano, and Shao (2021).

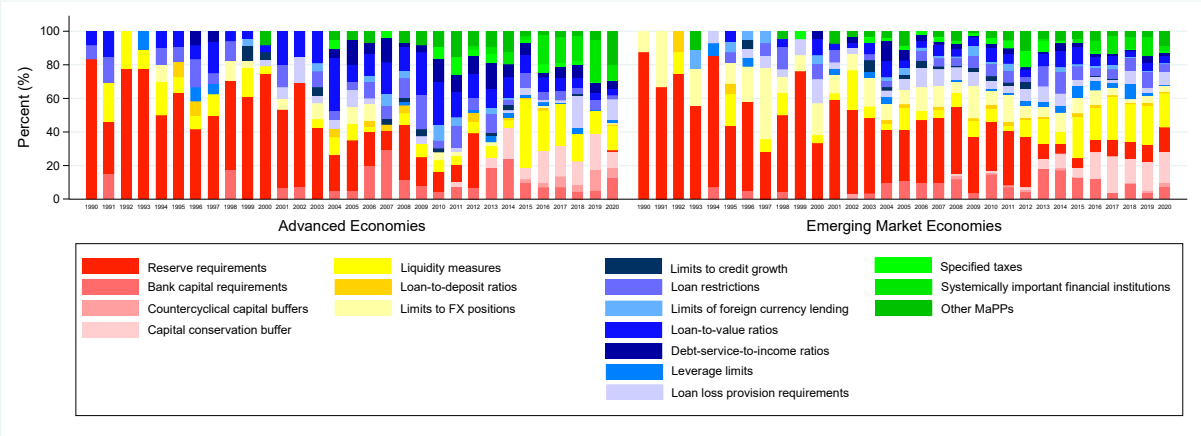
Table 4: Descriptive statistics and correlation matrix with heatmap

		Mean	Standard deviation	Skewness	Kurtosis	Surge	Stop	Flight	Retrenchments	Risk	Liquidity	Interest rates	Global growth	Domestic GDP growth	Capital and reserve	Liquidity instruments	Credit instruments	Systemic instruments	Easing	Tightening	Spot	Derivatives
Capital flow episodes	Surge	0,14	0,35	2,21	2,10	1,00																
	Stop	0,14	0,35	2,03	2,37	-0,16	1,00															
	Flight	0,15	0,36	2,32	1,78	0,47	-0,11	1,00														
	Retrenchments	0,14	0,34	2,09	2,51	-0,12	0,53	-0,15	1,00													
Macroeconomic controls 3	Risk	0,00	9,19	-0,27	5,63	-0,02	0,26	-0,01	0,17	1,00												
	Liquidity	6,00	5,76	0,35	0,12	0,00	0,32	0,02	0,27	0,39	1,00											
	Interest rates	5,00	3,10	0,81	-0,17	0,24	0,06	0,31	0,09	0,03	0,20	1,00										
	Global growth	3,00	1,39	-2,18	7,29	0,21	-0,52	0,18	-0,37	-0,32	-0,38	0,03	1,00									
	Domestic GDP growth	3,00	4,96	5,91	137,37	0,15	-0,35	0,10	-0,24	-0,11	-0,14	0,13	0,47	1,00								
Instruments	Capital and reserve	0,06	0,25	3,56	10,65	-0,03	-0,01	-0,03	-0,03	0,09	0,05	-0,02	-0,02	0,16	1,00							
	Liquidity	0,03	0,18	5,07	23,72	-0,04	-0,04	0,01	-0,04	0,04	0,00	-0,17	0,03	0,01	0,04	1,00						
	Credit	0,07	0,44	4,87	21,70	-0,06	0,01	0,00	-0,01	0,03	-0,01	-0,13	0,02	0,02	0,08	0,04	1,00					
	Systemic	0,02	0,15	6,27	37,29	-0,04	0,01	-0,05	-0,03	0,01	0,03	-0,09	0,00	0,02	0,03	0,01	0,11	1,00				
Capital controls	Easing	0,14	0,35	2,05	5,20	-0,04	-0,07	-0,02	-0,07	0,06	-0,02	-0,04	0,01	0,08	0,09	0,03	0,03	0,04	1,00			
	Tightening	0,07	0,26	3,34	12,14	-0,03	-0,05	0,00	-0,05	-0,02	0,03	-0,06	0,06	0,09	0,19	0,18	0,05	0,09	0,18	1,00		
FX interventions	Spot	0,16	0,37	1,83	4,36	0,08	0,04	0,03	0,07	0,09	0,11	0,00	-0,07	-0,01	0,03	0,06	-0,01	-0,03	-0,04	0,01	1,00	
	Derivatives	0,01	0,11	9,26	86,73	-0,01	0,06	-0,03	0,05	0,11	0,13	0,03	-0,07	-0,04	-0,01	-0,01	-0,01	-0,03	0,02	0,03	0,18	1,00

Sources: Authors' calculations (2022) using Forbes and Warnock (2021); Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier and Wang (2019); Pasricha, Falagiarda, Bijsterbosch, and Aizenman (2018) and Adler, Chang, Mano, and Shao (2021). To create the instruments, the frequency of the series is converted from monthly to quarterly, and the various macroprudential policies are pooled, based on the ultimate target of these policies. A dummy variable is created which is '1' whenever a tool is implemented, else '0'. Similarly, we create a '1' '0' dummy variable for whenever a capital control is implemented. The FX intervention dummy is '1' if the proxy of FX interventions as a percentage of GDP > 2%, else '0'. The threshold is selected because the average FXI activity is ~0.33% per quarter, a measure above regular baseline activity is selected.

Approximately 40 percent of countries (both advanced and emerging) have activated MaPP tools since the global financial crisis of 2007/2008. Figure 3 further illustrates the proliferation of the MaPP toolkit and number of interventions – on average activation rate of 2,0% of the time before the 2007/2008 financial crisis versus 7,9% post the same crisis. The distributions between advanced and emerging economies have also diverged.

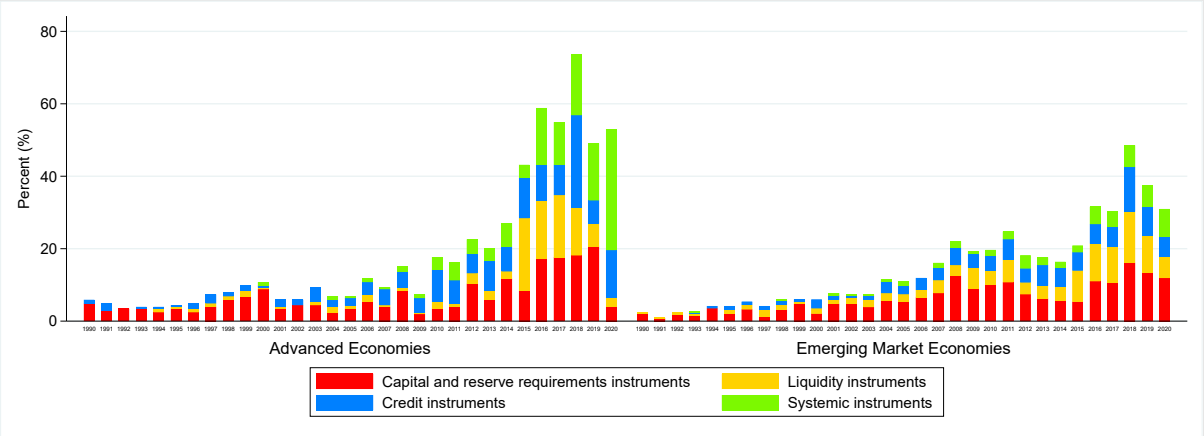
Figure 3: Relative use of macroprudential policies (1990-2020), by income level



The figure illustrates the shares of usage of the 17 different MaPP tools, and their usage relative to all MaPP usage, in both advanced and emerging market economies. Individual tools are colour coded as follows: (i) capital and reserve requirements are red, (ii) liquidity instruments are yellow, (iii) credit instruments are blue, and (iv) systemic instruments are green. Sources: Authors' calculations (2022); IMF iMaPP database (2022).

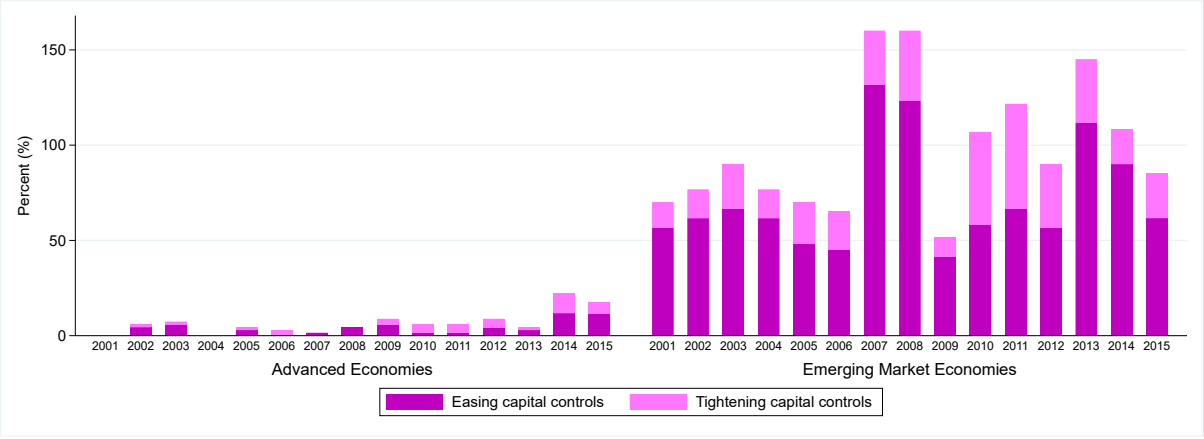
In Figure 3 and Figure 4 it can be seen that the usage of each specific tool and the quantity of tools used are dependent on income-development level. Advanced economies tend to have more tools in the toolkit, as is evident from the more variegated nature of their bars in Figure 3. Advanced economies also tend to reach for the MaPP toolkit more frequently on average than emerging market economies, as shown in the much taller bars for advanced economies in Figure 4. However, Figure 5 shows that the opposite can be said about capital controls, with emerging market economies tending to implement capital controls or even multiple controls in the same year.

Figure 4: Share of countries using macroprudential policies (1990-2020) by income level



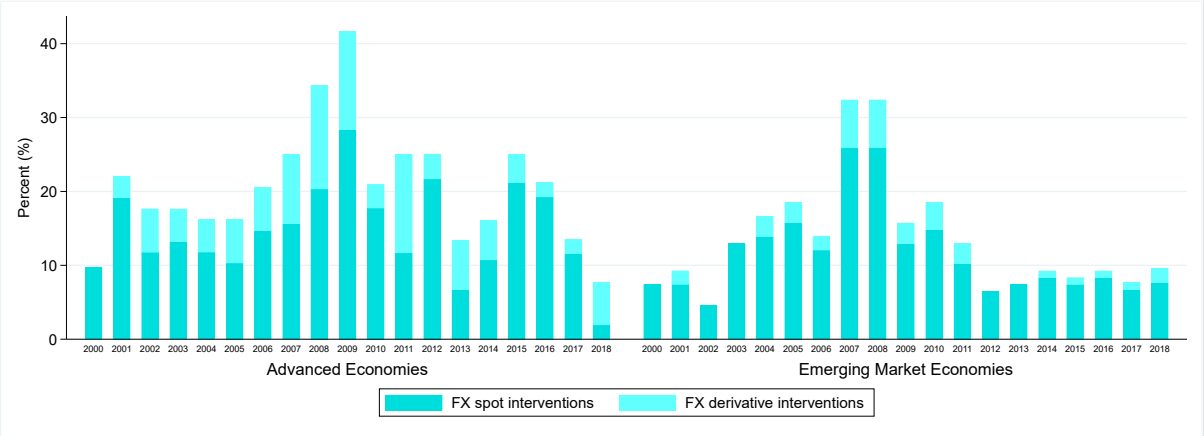
This figure illustrates how macroprudential policies have proliferated. In fact, between 2015-2020, approximately 40 percent of countries have activated MaPP tools since the global financial crisis of 2007/2008. The figure illustrates the four categories of policies: (i) capital and reserve requirements, (ii) liquidity instruments, (iii) credit instruments, and (iv) systemic instruments. The y-axis indicates the share of countries implementing any tool from a particular category of tools. Sources: Authors' calculations (2023); IMF iMaPP database (2022).

Figure 5: Share of countries using capital controls (2001-2015) by income level



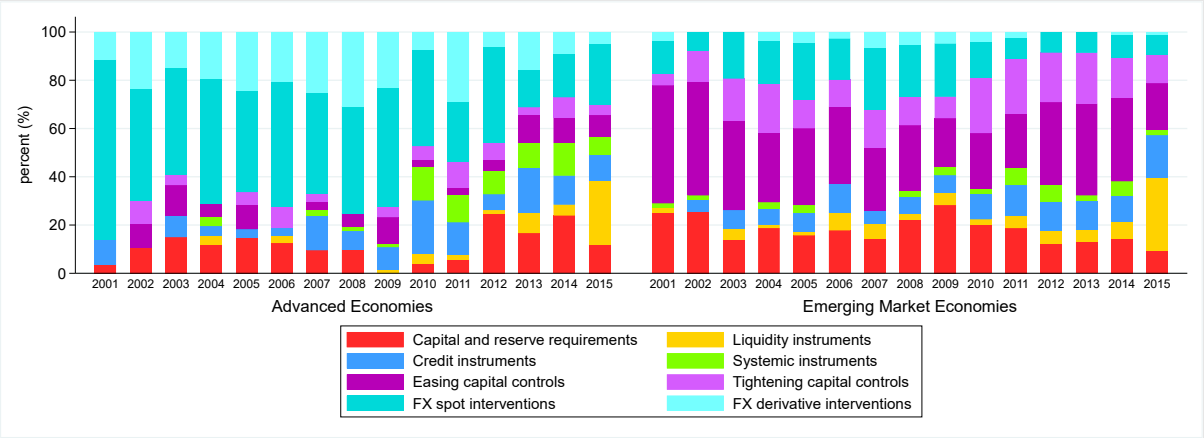
This figure illustrates the easing and tightening of capital controls in advanced and emerging market economies in a particular year. The y-axis indicates the share of countries easing or tightening a capital control. Because a country may ease and/or tighten multiple capital controls within a year, percentages exceed 100 percent. Sources: Authors' calculations (2023); Pasricha, Falagiarda, Bijsterbosch, and Aizenman (2018).

Figure 6: Share of countries using foreign exchange interventions (2001-2015) by income level



This figure illustrates the dummy variable of the use of foreign exchange interventions. An intervention is considered an intervention if it exceeds 2% of GDP.[42] *The y-axis indicates the share of countries implementing such a policy. Sources: Authors' calculations (2023); Adler, Chang, Mano, and Shao (2021).*

Figure 7: Capital flow management techniques (2001-2015) by income level



This figure indicates the share of usage of different capital flow management measures (macroprudential policies, capital controls and foreign exchange interventions) in advanced economies and emerging market economies.[43] *Sources: Authors' calculations (2023); Pasricha, Falagiarda, Bijsterbosch, and Aizenman (2018); IMF iMaPP database (2022); Adler, Chang, Mano, and Shao (2021).*

Figure 7 compares how the distribution of all capital flow management techniques has shifted across advanced and emerging market economies. Advanced economies have favoured FX interventions over MaPPs and CCs, whereas emerging market economies tend to favour CCs. However, it is noted here that once the disparate datasets are combined, namely (1) macroprudential policies, (2) capital controls, and (3) foreign

[42] The FXI threshold is chosen because the proxy of interventions series indicates baseline foreign exchange intervention activity all the time, meaning that the dummy variables '1' and the plot would at would be 100 percent all the time.

[43] There is overlap between MaPPs and CCs, however, the goal of Figure 7 is to show how prevalent each type of policy usage is in comparison to the other policy types.

exchange interventions, the sample size is reduced. The econometric strategy unintentionally has the added benefit of evaluating these three polices separately.

4. Propensity score matching methodology

The effectiveness of policies is both instrument and country specific (Cerutti, Claessons, and Laeven 2017: 217). This suggests that standard panel methodologies may be less appropriate, since they generally assume that there is a random selection of countries and policy implementation. Estimating the effectiveness or success of a particular policy is difficult because it requires a counterfactual scenario of a crisis that never happened. Since MaPPs, CCs, and FXIs can be implemented in response to changes in the variables that they are intended to influence, they are likely correlated with capital flows and crises. The naïve model may find that policies are ineffective or that they increase the likelihood of crises, instead of preventing them (Frost et al, 2020:18).[44] Furthermore, there is the potential for selection bias because countries that are inclined (or have the means) to reach for the policy toolkit have different characteristics to countries that do not (Forbes et al, 2015:77). In general, countries tend to activate tools in response to changes in macroeconomic variables which allows for a distinguishable treatment group when several countries face the same type of external shock.[45]

The goal is to estimate the impact of MaPPs (and other CFMs) on extreme capital flow episodes. The main challenges are to disentangle such policy effects from the development of macroeconomic fundamentals. Because of the interaction between gross flows and policy variables, direct estimates where all countries are estimated together, are subject to endogeneity. Panel models with policy actions as independent variables may suffer from attenuation biases such as results indicating ineffective policies, or that MaPPs increase the probability of an extreme capital flow episode.[46]

Countries that implement MaPP tools in any given period may have different characteristics to countries which do not make these policy choices (Forbes et al. 2015:10). This selection bias makes it difficult to determine if differences in outcome

[44] Frost, Ito and van Stralen (2020) find that logit models on the probability of surges and panel models of the volume and composition of inflows have empirical issues relating to endogeneity and attenuation bias. We discuss the empirical strategy of propensity score matching (PSM) and how it overcomes these empirical issues below.
[45] In Table 5 we illustrate how CFM implementation and extreme capital flow episodes are not independent.
[46] Simply because MaPPs are typically implemented during extreme capital episodes they tend to be correlated.

variables (an extreme capital flow episode) between countries that activated a MaPP tool and those that do not are driven by the MaPPs or by underlying differences in the two sets of countries. A method to adjust for this selection bias is to use PSM, which was developed by Rubin (1977) and Rosenbaum and Rubin (1983). PSM simulates the effect of a randomised experiment on non-random observed data by creating comparable groups based on their propensity scores, which estimate the likelihood of receiving a treatment. Moreover, matching methods such as PSM convincingly address legitimate criticisms of causal interference from cross-country data (Persson and Tabellini, 2002).

By matching individuals or units with similar propensity scores, the bias introduced by non-random treatment assignment and potential confounding variables can be reduced (Austin, 2011:400). Matching methods like PSM attempt to provide a way to create a more plausible counterfactual scenario, where treated and control groups are similar in terms of observed characteristics, thus allowing for a more robust causal analysis. In turn, this can help mitigate concerns regarding selection bias and other sources of endogeneity commonly encountered when analysing cross-country data. However, it is important to note that matching methods rely on strong assumptions and therefore have limitations. Moreover, their effectiveness depends on the quality of the data and the accuracy of the underlying models used for matching (World Bank, 2023b).

Based on macroeconomic controls (covariates), without the imposition of MaPPs (treatment), countries will have a similar likelihood of extreme capital flow episodes. Propensity score matching takes the covariates, estimates a maximum likelihood model (such as a logit) of the conditional probability of treatment. The logit ensures fitted values are bounded between 0 and 1. The predicted values from that estimation are used to collapse those covariates into a single scalar called the propensity score. All comparisons between the treatment and control group are then based on that value, and this allows the separation of the sample into a treatment group and a control group.

PSM quantitatively matches countries that imposed MaPPs (treatment group) to countries that had a similar predicted probability of instituting these MaPPs but did not do so (control group). The PSM sets up a counterfactual outcome – an outcome a group would have obtained had that group received a different level of treatment. The average treatment effect is the average difference in outcomes between the treatment group and

the control group – a measure of the efficacy of MaPPs intervention on extreme capital flow episodes.

In the first stage the probability a country will implement MaPPs instruments in year t is estimated. Based on macroeconomic controls in year $t-1$. This is used to generate a propensity score, and separate the sample into treatment and control. A treated observation is defined as $M_{i,t} = 1$, which is any quarter a country i changes a MaPP at time t. For a control ('untreated') observation, $M_{i,t} = 0$ is any quarter a country i does not change a MaPP at time t. The variable construction is similar for proliferation and capital controls and is described in section 3.

The propensity score calculated in the first stage can be expressed as:

$$p(x_{i,t}) \equiv \Pr(M_{i,t} = 1 | x_{i,t}) = \Phi(\alpha_1 + \beta_1 x_{i,t} + \varepsilon_{i,t})$$

where $p(\cdot)$ is the propensity score, defined as the probability that the dummy variable $M_{i,t}$ is equal to one. This dummy variable denotes policy action in country i in month t. The probability of policy action is estimated based on $x_{i,t}$, a vector of macroeconomic control variables. $\Phi(\cdot)$ is the cumulative distribution function of the standard normal distribution. α_1 and β_1 are estimated coefficients. The error term is denoted by $\varepsilon_{i,t}$.

In the second stage, the outcomes, in time t and subsequent years, in countries with similar predicted scores in the treatment and control group (no MaPPs) are compared and matched to one another (Frost et al, 2020:6). The matching is done where a policy action was taken to the country-year observation with observations with similar estimated probabilities of policy action but where policy action was not taken in year t. Here the difference in outcomes between treatment and control is estimated. Conditional on the macroeconomic controls ($x_{i,t}$), if two countries have the same probability of being treated, then it is said that they have similar propensity scores, and all remaining variation in treatment assignment is due to chance. And insofar as the two countries have the same propensity score, but one is the treatment group and one is not, and the conditional independence assumption credibly holds in the data, then differences between their observed outcomes are attributable to the treatment (Cunningham, 2021: 242). Implicit in this is the common support assumption. Common support simply

requires that there be units in the treatment and control group across the estimated propensity score (Cunningham, 2021: 243).

The average treatment affect (ATE) is computed by taking the average of the difference between the observed and potential outcomes for each subject. The variable of interest is the 'average treatment effect' or ATE, which is not observed, and represents the scenario that every country in the sample is treated. Finally, observations are matched with nearest neighbour matching.

The propensity score matching methodology relies on the following assumptions: (i) the confidence-independence assumption restricts the dependence between the treatment model and the potential outcomes; (ii) the overlap assumption, which ensures that each individual could receive any treatment level; and (iii) the independent and identically distributed sampling assumption ensures that the potential outcomes and the treatment status of individuals are not related to the potential outcomes and the treatment statuses of all other individuals in the population (Austin, 2011). Therefore, when evaluating a specific MaPP tool, there is often issues surrounding the satisfaction of assumptions needed for estimation. The evidence of satisfaction of these assumptions is reported in the results section and the Appendix. Further specific issues, from not satisfying the above assumptions, include (i) perfectly correlated dependent and independent variables, (ii) perfect predictor variables, and (iii) violation of the treatment overlap assumption.[47] In multiple cases, in order to obtain results, it is therefore necessary to drop independent variables.[48] Nevertheless, results on specific MaPP tools are included within the Appendix.

4.1 Criteria of propensity score matching

PSM has several advantages over regular ordinary least squares regression. However, there are also disadvantages and criteria that need to be satisfied. Specifically, (i) that one is able to predict the implementation of a MaPP, CC, or FXI, i.e. the conditional-independence assumption (ii) that there is treatment overlap, and (iii) the independence

[47] The requirement that each individual has a positive probability of receiving each treatment level.
[48] Dropping an independent variable increases the likelihood of finding matches, since there are now fewer criteria to satisfy.

and identically distributed sampling assumption which is tested using the balancing test (Forbes, Fratzcher, and Straub, 2015:17-18).

It is also noted that other techniques were used to increase the number of matches. For instance, where this study makes use of quarterly data (over annual data), it increases the sample size fourfold. Secondly, MaPPs are pooled into categories – this increases the potential number of matches – removing strain on the selection on observables assumption (which can be prevalent in a small sample). Moreover, the categories in this study cover more breadth than similar studies also evaluating macroprudential policies, which highlighted before, have fewer categories.

4.1.1 First stage regressions

The first stage should involve a strong enough goodness of fit that observations can be accurately matched with similar observations, but not so strong to perfectly divide the group into treated observations with high probability of treatment and non-treated observations with low probability (Frost et al, 2020:8). Results from the first stage regressions are presented which confirm the ability to predict the imposition of MaPPs and are in the Appendix Tables A1. This result holds for the full sample and when the sample is stratified based on income-development level. The likelihood that a country will implement a MaPP is regressed against various macroeconomic controls. Here interesting findings related to these results are highlighted. Contagion is less likely to influence the likelihood of MaPP implementation. Global interest rates are significant predictors of CFM implementation in both emerging market and advanced economies. Global as well as domestic growth are major contributors to affecting the likelihood of CFM activation in advanced economies, however not in emerging markets.

4.1.2 Treatment overlap

Using the PSM methodology is of concern within the international/macroeconomic literature, because of the limited number of countries for which there is data, there may be an issue in having a sufficient number of "similar" observations to form a control group (Forbes et al, 2015:11).[49] To evaluate whether there are overlapping observations for treatment and control, Appendix Table A2 is presented. There it is illustrated that the

[49] This criterion is unlikely to be met in standard cross-country, annual datasets which only have data on the key "observable" variables for a limited set of countries and years (Forbes et al, 2015:11).

treatment overlaps and that there is no evidence that the overlap assumption is violated for each CFM. Specifically, these indicate that there are observations for both treatment and control across the distribution. This implies that the PSM methodology is appropriate for the sample.

4.1.3 Independence assumption

Another disadvantage of the PSM methodology, is satisfying the independence assumption. This is related to the fact that matching ought to remove any significant differences between treated and control groups. In Appendix Table A3 the Balancing Test results are reported. The Balancing Test or Independence Assumption is necessary to test whether propensity score matching methodology is an appropriate methodology to use. The goal of the Balancing test is to verify whether the matching was able to remove any significant differences between the treated and control groups that existed in the unmatched samples (Forbes et al, 2015:18).

Countries were significantly more likely to implement capital and reserve requirements when experiencing surges if there was global risk, higher global interest rates, regional contagion, and higher levels of domestic growth. These significant differences across the treated and unmatched control groups highlight that selection bias is important; countries which chose to implement capital and reserve requirements had significantly different characteristics than countries which did not adjust their controls.

The results indicate that matching removes significant differences between the treated and matched control groups. Results of this balancing test are similar for other CFMs. In each case, there are significant differences in the means of variables between the treated and unmatched control groups, but after matching, there are no longer any significant differences.

5. Empirical results

The average treatment effects of MaPP interventions, MaPP proliferation, capital controls, and FX interventions are shown in Table 5.[50] It suggests, for example, when controlling for similar macroeconomic conditions, implementing liquidity instruments

[50] The average treatment effects, which are is the difference in average outcomes between the treatment and matched control groups, and altogether present an overview for selecting and applying CFMs to reduce the systemic risks imposed by extreme capital flow episodes.

reduces the probability of surges by 6.09% of GDP. Further results are included in Appendix A.[51] Subsection 5.1 highlights the patterns of the main results related to MaPPs, and then main results of the initial comparisons, namely, other CFMs. Section 5.2 further discusses these results in more depth and relates the results to the literature.

To simplify the discussion, the term 'flows' refers to 'extreme capital flow episodes', and because the terms 'increase' and 'decrease' are used to define the direction of flows, the terms 'raise' and 'reduce' are used to refer to the changes in the likelihood of flows. Furthermore, the reader is reminded that *inflows* refer to *foreign flows*: increases of inflows are known as surges, and decreases of inflows are known as stops. Outflows refer to domestic flows: increases of outflows are known as flights, decreases of outflows are known as retrenchments.

5.1.1 Effects of macroprudential policy tools

The main findings are that (i) capital and reserve requirements, reduce the likelihood of all four types of flows (surges, stops, flights, and retrenchments); (ii) liquidity tools reduce the likelihood of increases of flows (surges and flights), but raise the likelihood of decreases of flows (stops and retrenchments); (iii) credit instruments reduce the likelihood of increases of inflows (surges) and decreases of outflows (retrench), and raise the likelihood of both decreases of inflows (stops) and increases of outflows (flight) – implying that credit instruments affect flows countercyclically, dampening capital coming in, and amplifying capital going out of an economy; and (iv) tools targeting systemically important institutions reduces the likelihood of increases (surges and flights) of flows, but raises the likelihood of decreases (stops and retrenchments) of flows.

5.1.2 Tool proliferation, capital controls and foreign exchange interventions

Similar to credit instruments, the proliferation of tools and the tightening of capital controls, affect flows countercyclically – dampening the amount of capital coming in, and amplifying capital going out of an economy. The easing capital controls and foreign exchange derivative interventions reduce the likelihood of all flows except flights (increases in outflows), whose likelihood is raised by these instruments. This finding supports that of Ostry et al (2011). Foreign exchange interventions in the spot market

[51] To test the robustness of the results, further estimations stratified by income level are made. This is also repeated for each individual MaPP, and again pre- and post- great financial crisis. All these results are tabulated in the Appendices.

raise the likelihood of increases in flows (surges and flight) and reduce the likelihood of decreases in flows (stops and retrenchments). This suggest that FXIs dampen the effect of inflows on the exchange rate.

Table 5: PSM estimations for average treatment effects of MaPPs, CCs, and FXIs on extreme capital flow episodes

Instrument	Sample	Surge	Stop	Flight	Retrenchment
Capital and reserve instruments	**Full**	**-0.0379* (0.0224)**	**-0.0409** (0.0190)**	**-0.0142 (0.0248)**	**-0.0414* (0.0219)**
	AE	-0.0274 (0.0369)	-0.0797*** (0.0230)	-0.0551* (0.0312)	-0.0789*** (0.0263)
	EM	-0.0482** (0.0233)	-0.0329 (0.0221)	-0.0298 (0.0283)	-0.0244 (0.0293)
Liquidity instruments#	**Full**	**-0.0609*** (0.0200)**	**0.0642*** (0.0150)**	**0.0364 (0.0456)**	**0.1951** (0.0772)**
	AE	0.130 (0.2518)	-0.1237*** (0.0081)	-0.0776** (0.0370)	-0.1366*** (0.0078)
	EM	-0.0819** (0.0376)	0.0587 (0.0375)	0.0348 (0.0515)	0.1779*** (0.0681)
Credit instruments	**Full**	**-0.0306 (0.0286)**	**0.0685 (0.0567)**	**0.0473 (0.0610)**	**-0.0604* (0.0317)**
	AE	-0.0758 (0.0561)	0.0298 (0.0749)	-0.0370 (0.1003)	-0.0403 (0.0270)
	EM	0.0290 (0.0738)	0.0040 (0.0456)	-0.0165 (0.0357)	-0.0285 (0.0529)
Systemically important institutions	**Full**	**-0.0295 (0.0449)**	**0.0601 (0.0705)**	**-0.0018 (0.0735)**	**-0.0674*** (0.0166)**
	AE	0.0654 (0.1044)	-0.0094 (0.0400)	0.0651 (0.0995)	-0.0686 (0.0455)
	EM	-0.0418 (0.0323)	0.1607* (0.0923)	-0.0613 (0.0490)	-0.0585** (0.0293)
Proliferation of MaPP instruments	**Full**	**-0.0281* (0.0164)**	**-0.0016 (0.0169)**	**0.0207 (0.0218)**	**0.0258 (0.0164)**
	AE	-0.0196 (0.0204)	-0.0023 (0.0293)	-0.0155 (0.0346)	-0.0245 (0.0295)
	EM	-0.0482** (0.0203)	-0.0261 (0.0219)	0.0256 (0.0286)	-0.0051 (0.0205)
Easing capital controls	**Full**	**-0.0442 (0.0299)**	**-0.0168 (0.0376)**	**0.0145 (0.0394)**	**-0.0500* (0.0293)**
	AE	-0.1354*** (0.0162)	-0.0725 (0.1047)	-0.1186*** (0.0296)	-0.0939*** (0.0323)
	EM	-0.0338 (0.0311)	-0.0443 (0.0282)	0.0221 (0.0380)	-0.0591* (0.0304)
Tightening capital controls	**Full**	**-0.0375 (0.0313)**	**-0.0129 (0.0371)**	**-0.0078 (0.0446)**	**0.0397 (0.0411)**
	AE	0.0059 (0.0952)	0.0127 (0.1000)	-0.0079 (0.1661)	0.0432 (0.1119)
	EM	0.0013 (0.0377)	-0.0418 (0.0256)	0.0286 (0.0490)	-0.0664** (0.0318)
FX interventions: spot	**Full**	**0.1010*** (0.0299)**	**-0.0396*** (0.0151)**	**0.0205 (0.0315)**	-0.0091 (0.0199)
	AE	0.0189 (0.0405)	-0.0198 (0.0250)	0.0357 (0.05587)	-0.0635*** (0.0205)
	EM	0.1145*** (0.0402)	-0.0613** (0.0244)	0.0529 (0.0466)	0.0096 (0.0288)
FX derivatives interventions	**Full**	**-0.0058 (0.0160)**	**-0.0493** (0.0233)**	**0.0297 (0.0955)**	**0.0608 (0.1014)**
	AE	-0.1194*** (0.0353)	-0.0702*** (0.0160)	0.0768 (0.2661)	-0.0662** (0.0288)
	EM	0.0454 (0.0391)	-0.0962*** (0.0328)	-0.0688 (0.0594)	0.0543 (0.0886)

*Notes: Each number represents the average treatment effect on the treated for a tool (left hand column) on an extreme capital flow episode (top row). Full sample (1990Q1-2020Q3). 4437 observations for all estimates. AI robust standard errors in parentheses. '***' denotes significance at the 99% confidence level; '**' denotes significance at the 95% confidence level; '*' denotes significance at the 90% confidence level. Logit treatment model estimated using 2 nearest neighbours. For CCs, sample spans 2001Q1-2015Q4. For FXIs, sample spans 2000Q1-2020Q3.*

5.2.1 Discussion of specific results

Capital and reserve requirements instruments dampen *all* flow types. This suggests that these type of instruments (reserve requirements, bank capital requirements, conservation buffers, and counter cyclical capital buffers) can generally be used to mitigate all the negatives associated with capital flows, however also mitigating any positives of capital flows.

Liquidity tools and tools targeting systemically important institutions enhance the stabilising nature of flows – when (foreign) stop episodes are counteracted by (domestic) retrenchments – thus building on the results of authors such as Cavallo et al (2017) who documented the stabilising nature of capital flows. Furthermore, surges are counteracted by retrenchments. Specific policies referred to here include liquidity measures, loan-to-deposit ratios and limits to FX positions, as well as specified taxes, and policies targeting systemically important financial institutions. The results suggest that FXI spot interventions have the opposite effect to liquidity instruments, and tools targeting systemically important financial institutions. This implies these FX activities amplify extreme capital flow episodes. This finding supports those of Jeanne et al (2023) and Gelos et al (2022), who suggest the use of FXI to enhance the effect capital flows. However there is the important caveat that FXI may work contrary to MaPP policies.

Credit instruments, overall MaPP tool proliferation, and the tightening of capital controls, are found to dampen the amount of capital coming in and amplify the amount of capital going out of an economy.[52] The magnitude of the effects of tightening of capital controls on domestic flows is greater than the effect of credit instruments. This is a reflection of the fact that capital controls insulate an economy more than prudential policies. These results show that the credit instrument related MaPPs work in the same thrust as tightening CCs. The lower magnitude suggests that credit instruments are reducing flows, but still permitting some of those flows. This finding is different to that of Korinek et al (2016) who suggested that borrower-based tools reduce the incidence of stops.[53] The effects of tool proliferation are more muted for all flow types other than the effects of credit instruments, and tightening capital controls. This suggests that the non-credit instrument MaPPs moderate the response of credit instruments.

FX derivative interventions and the easing of capital controls dampen inflows (surges and stops). However, they amplify outflows: a rise of increasing outflows (flight) and reduce decreasing outflows (retrenchments). Moreover, the FX derivative interventions are significant for all flow types and have a greater magnitude than the easing of capital controls. This means that offsetting currency risks through off-balance sheet operations

[52] These aforementioned CFMs are significant for both surges and retrenchments, i.e. increases in flows, and not significant for decreases in flows.
[53] Significant evidence of this mitigation in advanced economies is found.

is effective across all flow types, whereas, the easing of capital controls is only significant for flows coming into an economy (surges and retrenchments). i.e. stimulating flow activity is more likely to lead to flows than opening a country for flows.

5.2.2 Further results related to the stratified samples

This subsection is concerned with results related to results contained in the Appendices, where the sample is divided as pre- and post- great financial crisis. Furthermore, it is considered how the results change when the sample is divided into advanced and emerging economies. These results are included in the Appendix.

5.2.2.1 Macroprudential policy

The relationship between flights and MaPP imposition is dynamic over time. Before the recent financial crisis of 2007/2008, MaPP imposition often raised the likelihood of flights, but reduced flight likelihood post the crisis. This indicates that in the full sample, results are cancelling one another out. On the other hand, lack of evidence on flights (increase in domestic outflows) is consistent with Edwards' (1999) historical evidence that controls on outflows are largely unable to curb outflows.

5.2.2.2 Capital controls

Concerning capital controls, it is noted that no capital control intervention significantly influenced capital flights over the full sample period. This result holds when the sample includes a pre- and post- financial crisis period. Policymakers should be cognisant of what stage of the economic cycle they are in when implementing capital controls because easing capital controls reduce the likelihood of stops, and tightening capital controls reduces the likelihood of surges.

5.2.2.3 Foreign exchange interventions

Similar to Jeanne et al (2023) evidence is found of differential impacts of FXI in advanced and emerging market economies. FXI can be used by emerging market economies to insulate from the global financial cycle, especially foreign flows.

5.2.2.4 Income-development level

Table 5 indicates that there are many differences in the distribution of the effects of MaPPs. In the full sample, the measured affects tend to be dominated by AEs. With regards to decreases in flows (stops and retrenches), liquidity instruments tend to have

a stronger effect in EMs. The same can be said regarding capital leaving the economy (stops and flights), and the proliferation of tool and decreases of inflows (stops).

Credit instruments have the complete opposite effects on all flows (stops, flight and retrenchments) except increases in inflows (surges) in EMs over AEs. More broadly, the easing of capital controls has the opposite effects for all four flows, i.e. the loosening of CFMs signal different things across income-development levels. Tightening of capital controls also influence increases of flows (surges and flights) oppositely in AEs and EMs.

Income level influences the distribution of capital flow management measures. In advanced economies, when significant, imposition of MaPPs, the proliferation of MaPPs, and capital controls always reduce the likelihood of flows. In emerging markets, all MaPPs significantly decrease the likelihood of surges, whereas capital controls significantly raise the likelihood of surges. Furthermore, credit instruments raise the likelihood of stops, and liquidity instruments raise the likelihood of retrenchments.

There are fundamental differences in institutions across income-development levels. In the full sample, instruments targeting structurally important financial institutions do not significantly impact flows. This suggests that these institutions are not as directly vulnerable to flows, or that MaPPs targeting these institutions have no influence on international capital movements. However, when one restricts the sample to emerging market economies and advanced economies, instruments targeting systemically important institutions are now significant in reducing surges, and flights (and also stops for emerging market economies).

5.3.1 Discussion of overall results

Overall, the results suggest that MaPPs are effective tools at mitigating extreme capital flows, this in line with Frost et al (2020) who found that FX-based MaPPs reduce capital inflow volumes, and lower the probability of surges. In contrast to Frost et al (2020) who found that CCs are not statistically significant in influencing surges, we find that they are significant in reducing the probability of surges. The findings are also in contrast with Forbes et al (2015) who found that MaPPs do not significantly affect capital flows – however this is attributed to the fact that their "MaPP" category is more of a residual category for policies without any FX- or CC ability. Similarly, analogous to the finding that the proliferation of MaPP tools reduces the probability of surges and retrenchments (in

other words, MaPP tools are effective at reducing net inflows), Akdogan (2020) found that decreased MaPPs are effective for capital inflows.

Compared to non-PSM previous studies, the findings are broadly consistent with existing literature which generally found that macroprudential tool are superior to capital controls in mitigating adverse economic phenomena such as extreme capital inflows (Bergant et al, 2020; Fendoğlu, 2017; Cerutti, Claessons, and Laeven, 2017). The findings contribute to this literature in that it is shown how MaPPs (and other CFMs) are distributed across heterogenous flows.

Nevertheless, the results are somewhat consistent with Bergant et al (2020), who, using a regression model, find that tightening MaPPs reduces the sensitivity of GDP shocks. However, they find that capital controls do not provide such gains. Firstly, we add to the literature by establishing the distribution of MaPPs over the distribution of gross capital flows. Secondly, because the methodology accounts for selection bias, we are able to find that tightening capital controls are in fact successful at reducing inflows and are more likely to be significant at influencing outflows in emerging market economies. This last result is similar to Ostry et al (2011), who used a regression model, who found that capital controls can be implemented to manage inflows and contribute towards systemic stability. Furthermore, similar to Fendoğlu (2017), who used a dynamic panel model, we also find that in EMs, credit/borrower- MaPP instruments significantly influence the likelihood of net inflows. As concluded by Cerutti, Claessons and Laeven (2017) our findings indicate that that EMs are more likely to use macroprudential polices.

6. Summary and conclusions

In this paper the literature concerning capital flows and techniques to manage these flows is briefly reviewed. The literature suggests that MaPPs and CCs are complementary policies, forming the first and second line of defences against the instabilities arising from capital flows respectively. However, estimating the effectiveness or success of a particular policy is difficult because it requires a counterfactual scenario of a crisis that never happened. Challenges in the literature include the need to disentangle policy effects from the development of macroeconomic fundamentals. Since MaPPs, CCs, and FXIs can be implemented in response to changes in the variables that they are intended to

influence (i.e., countries activate policy tools in response to changes in macroeconomic variables), they are likely correlated with capital flows and crises.

The literature suggests that there is the potential for selection bias because countries that are inclined (or have the means) to reach for the policy toolkit have different characteristics to countries that do not. PSM is therefore used to overcome these empirical challenges. The existing capital flow waves literature is built upon by evaluating the effectiveness of capital flow management techniques at safeguarding against the systemic risks that extreme capital flow episodes introduce. Specifically, propensity scores of the probability that each country activates a MaPP tool based on a set of domestic and global variables are estimated. The propensity scores are used to match each policy change with a control group to create a counterfactual against which to assess the effect of the policy change on the outcome variables.

The type and implementation of MaPP tools vary significantly across countries, and this in turn means that it is challenging to estimate the effects of individual tools. MaPP instruments are grouped as follows: (i) capital and reserves, (ii) liquidity, (iii) credit, and (iv) those targeting systemically important institutions. Where possible tests are/were performed on the individual MaPPs, the proliferation of MaPPs, and to compare their efficacy in both easing and tightening of capital controls, as well as FX interventions. The macroprudential instrument categories in this study are a departure from the literature which considers broader categories of CFMs.

Considering MaPP tools with broad financial stability objectives. When two countries have the same likelihood of allowing free movement of capital (global conditions, contagion variables, and country specific conditions) – and one country activates a MaPP tool, whilst the other does not – the country that does activate a MaPP has a lower likelihood of experiencing a surge or retrenchment. Whereas the country that does not activate a MaPP has a lower likelihood of experiencing a stop or a flight. However, specific MaPP tools are effective at mitigating stops and flights. Moreover, the results indicate that there are benefits for stability through capital market liberalisation (easing of capital controls) or alternatively by using foreign exchange interventions to influence stops and flights.

The results suggest that macroprudential policies tentatively explain the findings of Forbes et al (2021), as to why extreme capital flows have gone from being waves to ripples in recent years. The proliferation of macroprudential polices is associated with the reduction in the incidence of extreme capital flow movements. The effects of macroprudential policies on surges and retrenchments is fairly congruent, the effects of macroprudential policies on flights is less congruent.

The results indicate that, in addressing excessive credit expansion and strengthening the financial systems resilience, reducing amplification mechanisms (through capital and reserve requirements, as well as with liquidity instruments), and mitigating structural vulnerabilities related to important institutions, improve an economy's resilience to shocks arising from volatile international capital flows. Therefore, macroprudential policies prevent reduce systemic financial sector vulnerability.

6.1 Main findings

The results show that MaPPs are better suited than CCs at taming capital flows across both AEs and EMs. The main gains from tightening CCs are only there for EMs, which is suggestive of how CCs are complementary to MaPPs. CCs can insulate EMs at times when there are not appropriate MaPPs. For policymakers, from a theoretical perspective to enable stability, sound macroeconomic policies should be safeguarded by the first line of defence, macroprudential policy. Temporary (during times of crisis) capital controls and foreign exchange interventions are the second line of defence. This will enable economies to reap the benefits of international capital flows, but avoid the costs of speculative flows.

MaPP tools can reduce extreme capital flow episodes, even though this might not be their direct focus. This finding is consistent with authors such as Ostry et al (2011), Ostry et al (2012), Forbes et al (2015) and Gelos et al (2022). In most cases, MaPPs and other CFMs reduce the likelihood of surge and retrenchment episodes (capital coming into an economy) but are less likely to affect capital flowing out of an economy (stops and flight). Capital and reserve requirements dampen all extreme capital flow episodes. Liquidity instruments and tools targeting systemic institutions dampen increases of, and amplify decreases of, extreme capital flow episodes. Credit tools dampen surges and retrenchments and amplify stops and flights.

My findings are similar to those of Fendoğlu (2017) reflecting that in EMs, credit instruments significantly influence the likelihood of foreign flows. The proliferation of tools and the tightening of capital controls dampen the amount of capital coming in and amplify capital going out of an economy. The proliferation of MaPP tools also diminishes the positive feedback mechanism between surges and retrenchments. The easing of capital controls and foreign exchange derivative interventions reduce the likelihood of all extreme capital flow episodes, except flights, whose likelihood is raised by these instruments. Foreign exchange interventions in the spot market raise the likelihood of increases in flows (surges and flight) and reduce the likelihood of decreases in flows (stops and retrenchments).

The results indicate that the outcome of implementing CFMs is often different in advanced and emerging market economies. In advanced economies all CFMs reduce the likelihood of extreme capital flow episodes.[54] In emerging markets, the evidence of CFMs are mixed. Moreover, the findings suggest that there are fundamental differences in institutions across the income-development level. Similar to Jeanne et al (2023), evidence of differential impacts of FXI in advanced and emerging market economies is found. The results suggest that FXI can be used by emerging market economies to insulate from the global financial cycle, especially foreign flows.

6.2 Policy implications

In this section the policy implications of the findings are discussed. In this study it is established that capital flow management techniques are more suited at influencing capital flows into an economy (surges and retrenchments), than flows out of an economy (stops and flights). This is reflected in the proliferation of MaPP tools (which reduces surges and retrenchments). In emerging markets activating multiple tools tends to dampen all domestic flows – since tool proliferation additionally reduces flights. This suggests that emerging markets have more scope to manage domestic flows.

The main implications are that CFMs can be used to prevent macroeconomic imbalances (such as economic overheating, and currency overvaluation) and minimise financial vulnerabilities (such as domestic credit growth, bank leverage, foreign currency-denominated lending) that stem from international capital flows. Imbalances and

[54] The single exception being FXI interventions on flight episodes (increases of outflows).

vulnerabilities are country specific, therefore they require country specific solutions in order to minimise systemic risks.

6.2.1 Surges

CFMs influence surges, and the literature indicates that a surge in capital flows, can lead to an increase in the value of the currency and undermine the competitiveness of the tradable sector. The implications of the findings are that MaPP tools can be used to indirectly influence the trade competitiveness of an economy. Furthermore, the dampening of surges in credit flows imply a lower risk of banking and currency crises.

6.2.2 Feedback between stops and retrenchments

Following Forbes et al (2012) who showed that financial crisis multiple countries experienced sudden stops and retrenchment episodes simultaneously, in this paper it is identified which policies amplify and dampen this feedback mechanism. Interestingly, it manifests itself differently in advanced and emerging markets. In EMs, liquidity tools and the easing of capital controls reinforce the feedback between stops and retrenchments. This suggests that the incidence of financial crises is reduced by these CFMs. This result is analogous to Korinek et al (2016), as well as Jeanne et al (2023) and Cavallo et al (2017) who highlighted the stabilising influence of CFMs. Emerging markets can amplify this through liquidity tools[55] as well as easing capital controls and FX interventions. Capital and reserve requirement tools and tightening capital controls in emerging markets negatively amplify this feedback, similarly in advanced economies tools targeting structurally important financial institutions and easing capital controls negatively amplify this feedback mechanisms.

The mirrored nature of capital controls across EMs and AEs in relation to the feedback mechanism is suggestive of the home bias identified by Fratzcher (2011), Schmidt et al (2015), Milesi-Fererri et al (2011) and Jochem et al (2011). When easing capital controls, the home bias stabilises EMs, but destabilises AEs. Prior to the great financial crisis, FX spot interventions tended to have a destabilising influence since it reduced the feedback, while FX derivative interventions were useful at hedging against this risk. However, post the crisis this, relationship does not hold. Nevertheless, once factoring in the

[55] This includes limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mismatch regulations

heterogeneity of capital flows the results support the notion that emerging markets can use FXI to protect themselves from the global financial cycle by expanding (rather than restricting) capital flows (offsetting capital leaving an economy can buffer the volatility of capital coming into an economy).

6.2.3 Flights

How CFM techniques mitigate flight episodes differs in advanced and emerging economies, but this does not hold in the full sample. This implies that the distribution of policies affecting flights differs across income-development level. The tools targeting systemically important financial institutions reduce flight episodes in advanced economies and in emerging market economies, but not the full sample, pointing to institutional idiosyncrasies. It suggests that, in their development process, emerging markets should not fully imitate advanced economies if they want to prevent capital flight episodes. In emerging market economies, other significant results indicate that the easing of capital controls, raises the likelihood and credit tools reduce the likelihood of flights.

6.2.4 Tool proliferation

The literature and data suggest that MaPP tools led to leakages and spillovers, changing the drivers of extreme episodes and MaPP tool proliferation. The results also offer a guide to policymakers as to prevent the over proliferation of macroprudential tools. General MaPP tool proliferation is only effective at reducing capital entering an economy.

6.3 Limitations of the study

There are several limitations and avenues for improvement of this study. Although mainly done to help overcome small sample issues in the financial crisis period, the main drawback of the pooling of MaPP tools around a broad target concerns the transmission channels of the different tools. However, this is partially overcome in the results in the Appendix.

The empirical methodology does not allow control of either the magnitude and direction of a given policy nor the frequency of policy change, because it essentially employs equal weights. However, in reality, for example, investors are more likely to pay attention, and react to major changes in CFMs affecting portfolio flows. The analysis does not capture the costs associated with policies. Policymakers should compare the costs and benefits before activating a MaPP tool.

References

Acharya, V. Naqvi, H. 2012. The seeds of a crisis: A theory of bank liquidity and risk taking over the business cycle. *Journal of Financial Economics*, 106(2): 349-366. DOI: https://doi.org/10.1016/j.jfineco.2012.05.014

Adler, G. Chang, K.S. Mano, R. Shao, Y. 2021. Foreign exchange intervention: A dataset of public data and proxies. IMF Working Paper No. 2021/047. Washington, DC: International Monetary Fund. [Online] Available: https://www.imf.org/-/media/Files/Publications/WP/2021/Datasets/wp2147.ashx [Accessed 2023/03/02].

Adler, G. Chang, K.S. Wang, Z. 2021. Patterns of foreign exchange intervention under inflation targeting. *Latin American Journal of Central Banking,* 2(4): 100045. DOI: https://doi.org/10.1016/j.latcb.2021.100045

Adler, G. Lisack, N. Mano, R.C. 2015. Unveiling the effect of foreign exchange intervention: A panel approach. IMF Working Paper, WP/15/130. Washington, DC: International Monetary Fund. [Online]. Available: https://www.imf.org/-/media/Websites/IMF/imported-full-text-pdf/external/pubs/ft/wp/2015/_wp15130.ashx [Accessed 2023/03/05].

Adler, G. Lisack, N. Mano, R.C. 2019. Unveiling the effects of foreign exchange intervention: A panel approach. *Emerging Markets Review*, 40: 100620. DOI: https://doi.org/10.1016/j.ememar.2019.100620

Agénor, P. Pereira da Silva, L.A. 2018. Financial spillovers, spillbacks, and the scope for international macroprudential policy coordination. *BIS Papers*, No 97. Basel: Bank for International Settlements. [Online]. Available: https://www.bis.org/publ/bppdf/bispap97.pdf [Accessed 2021/05/27].

Agénor, P. Pereira da Silva, L.A. 2022. Financial spillovers, spillbacks, and the scope for international macroprudential policy coordination. *International Economics and Economic Policy,* 19: 79-127. DOI: https://doi.org/10.1007/s10368-021-00522-5

Aiyar, S. Calomiris. C.W. Wieladek, T. 2015. Bank capital regulation: Theory, empirics, and policy. *IMF Economic Review*, 63(4): 955-983, November. DOI: https://doi.org/10.1057/imfer.2015.18

Akdogan, I.U. 2020. The effects of macroprudential policies on managing capital flows. *Empirical Economics,* 58: 583-603. DOI: https://doi.org/10.1007/s00181-018-1541-5

Alam, Z. Alter, M.A. Eiseman, J. Gelos, M.R. Kang, M.H. Narita, M.M. Nier, E. Wang, N. 2019. *Digging deeper--Evidence on the effects of macroprudential policies from a new database*. Washington, D.C.: International Monetary Fund. DOI: https://doi.org/10.5089/9781498302708.001

Arora, V. Habermeier, K. Ostry, J.D. Brown, W.R. 2013. The liberalization and management of capital flows: An institutional view. *Revista de Economia Institucional*, 15(28):205-255.

Austin, P.C. 2011. An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behavioural Research,* 46(3): 399-424. DOI: https://www.doi.org/10.1080/00273171.2011.568786

Avdjiev, S. Gambacorta, L. Goldberg, L.S. Schiaffi, S. 2020. The shifting drivers of global liquidity. *Journal of International Economics*, 125: 103324. DOI: https://doi.org/10.1016/j.jinteco.2020.103324

Bank of Japan. 2023. *About the bank: What is foreign exchange intervention? Who decides and conducts foreign exchange intervention?* [Online]. Available: https://www.boj.or.jp/en/about/education/oshiete/intl/g19.htm#:~:text=Foreign%20exchange%20intervention%20is%20conducted,rates%20and%20to%20stabilize%20them. [Accessed 2023/03/05].

Benigno, G. Chen, H. Otrok, C. Rebucci, A. Young, E.R. 2016. Optimal capital controls and real exchange rate policies: A pecuniary externality perspective. *Journal of Monetary Economics*, 84: 147-165. DOI: https://doi.org/10.1016/j.jmoneco.2016.10.004

Bergant, K. Grigoli, M.F. Hansen, M.N.J.H. Sandri, M.D. 2020. Dampening global financial shocks: can macroprudential regulation help (more than capital controls)?. IMF Working Paper No. WP/20/106. Washington, DC: International Monetary Fund. [Online]. Available: https://www.imf.org/en/Publications/WP/Issues/2020/06/26/Dampening-Global-Financial-Shocks-Can-Macroprudential-Regulation-Help-More-than-C [Accessed 2023/06/19].

Bianchi, J. Mendoza, E. 2011. Overborrowing, financial crises and 'macro-prudential' policy*. IMF Working Paper 11/24, Washington, DC: International Monetary Fund. [Online] Available: https://www.imf.org/external/pubs/ft/wp/2011/wp1124.pdf [Accessed 2023/01/01].

Bindseil, U. Jabłecki, J. 2013. Central bank liquidity provision, risk-taking and economic efficiency. ECB Working Paper series, No 1542. Frankfurt: Germany. [Online]. Available: https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1542.pdf [Accessed 2023/05/30].

Blundell-Wignall, A. Roulet, C. 2014. Macro-prudential policy, bank systemic risk and capital controls, *OECD Journal: Financial Market Trends*, 2013/2: 7-28. DOI: https://doi.org/10.1787/fmt-2013-5jzb2rhkhks4.

Borio, C. Disyatat, P. 2015. Capital flows and the current account: Taking financing (more)seriously. BIS Working Papers, No 525. Basel: Bank for International Settlements. [Online]. Available: https://www.bis.org/publ/work525.pdf [Accessed 2023/09/02].

Brei, M. Moreno, R. 2018. Reserve requirements and capital flows in Latin America. BIS Working Papers, No 741. Basel: Bank for International Settlements. [Online]. Available: https://www.bis.org/publ/work741.pdf [Accessed 2023/06/02].

Bruno, V. Shim, I. Shin, H.S. 2015. Comparative assessment of macroprudential policies. BIS Working Papers, No. 502. Basel: Bank for International Settlements.

[Online]. Available: https://www.bis.org/publ/work502.pdf [Accessed 2023/03/08].

Buch, C.M. Bussiere, M. Goldberg, L. 2017. International prudential policy spillovers: Evidence from the international banking research network. *International Journal of Central Banking*, 13(2): 505-558. DOI: https://doi.org/10.3386/w22874

Calvo, G. Leiderman, L. Reinhart, C. 1993. Capital inflows and real exchange rate appreciation in Latin America: The Role of External Factors. *IMF Economic Review,* 40: 108-151. DOI: https://doi.org/10.2307/3867379

Calvo, G. Reinhart, C. 1999. When capital inflows suddenly stop: Consequences and policy options. In Kenen, P.B. Swoboda, A.K. (eds.) *Reforming the International Monetary and Financial System*. Washington, D.C.: International Monetary Fund. 175-201.

Cavallino, P. 2019. Capital flows and foreign exchange intervention. *American Economic Journal: Macroeconomics,* 11(2): 127-170. DOI: https://doi.org/10.1257/mac20160065

Cavallo, E. 2019. *Oxford Research Encyclopedia of Economics and Finance*. DOI: https://doi.org/10.1093/acrefore/9780190625979.013.303

Cavallo, E. Izquierdo, A. León-Díaz, J.J. 2017. Domestic antidotes to sudden stops. Inter-American Development Bank Working Paper, IDB-WP-851. DOI: https://doi.org/10.2139/ssrn.3103801

Cerutti, E. Claessens, S. Laeven, L. 2017. The use and effectiveness of macroprudential policies: New evidence. *Journal of Financial Stability*, *28*: 203-224. https://doi.org/10.1016/j.jfs.2015.10.004.

Chutarsipanich, N. Yetman, J. 2015. Foreign exchange intervention: Strategies and effectiveness. BIS Working Papers, No.499. Basel: Bank for International Settlements. [Online]. Available: https://www.bis.org/publ/work499.pdf [Accessed 2023/09/03].

Claessens, S. 2015. An overview of macroprudential policy tools. *Annual Review of Financial Economics*, 7: 97-422. DOI: https://doi.org/10.1146/annurev-financial-111914-041807

Coeurdacier, N. Rey, H. 2013. Home bias in open economy financial macroeconomics. *Journal of Economic Literature*, 51(1): 63-115. DOI: https://doi.org/10.1257/jel.51.1.63

Corsetti, G. Debola, L. Leduc, S. 2023. Exchange rate misalignment and external imbalances: What is the optimal monetary policy response? *Journal of International Economics,* 103771. DOI: https://doi.org/10.1016/j.jinteco.2023.103771

Cunningham, S. 2021. *Causal Inference: The mixtape*. New Haven, Connecticut: Yale University Press.

De Gregorio, J. Edwards, S. Valdés, R.O. 2000. Controls on capital inflows: Do they work?. *Journal of Development Economics*, 63(1): 59-83. DOI: https://doi.org/10.1016/S0304-3878(00)00100-0

De Schryder, S. Opitz, F. 2021. Macroprudential policy and its impact on the credit cycle. *Journal of Financial Stability,* 53: 100818. DOI: https://doi.org/10.1016/j.jfs.2020.100818

Edwards, S. 1999. How effective are capital controls?. *Journal of Economic Perspectives*, 13(4): 65-84. DOI: https://doi.org/10.1257/jep.13.4.65

Eichengreen, B. Rose, A. 2014. Capital controls in the 21st century. *Journal of International Money and Finance*, 48: 1-16. https://doi.org/10.1016/j.jimonfin.2014.08.001

Eijffinger, S.C. Karataş, B. 2023. Three sisters: The interlinkage between sovereign debt, currency, and banking crises. *Journal of International Money and Finance*, 131: 102798. DOI: https://doi.org/10.1016/j.jimonfin.2022.102798

Fang, Y. Jing, Z. Shi, Y. Zhao, Y. 2021. Financial spillovers and spillbacks: New evidence from China and G7 countries. *Economic modelling*, 94: 184-200. DOI: https://doi.org/10.1016/j.econmod.2020.09.022

Fendoğlu, S. 2017. Credit cycles and capital flows: Effectiveness of the macroprudential policy framework in emerging market economies. *Journal of Banking and Finance,* 79: 110-128. DOI: http://dx.doi.org/10.1016/j.jbankfin.2017.03.008

Forbes, K.J. 2019. Macroprudential policy: what we've learned, don't know, and need to do. *AEA Papers and Proceedings*, 109: 470-475. DOI: https://doi.org/10.1257/pandp.20191056

Forbes, K.J. Fratzscher, M. Straub, R. 2015. Capital-flow management measures: What are they good for?. *Journal of International Economics*, 96: S76-S97. DOI: https://doi.org/10.1016/j.jinteco.2014.11.004

Forbes, K.J. Warnock, F.E. 2012. Capital flow waves: Surges, stops, flight and retrenchment. *Journal of International Economics.* 88(2): 235-251, DOI: https://doi.org/10.1016/j.jinteco.2012.03.006

Forbes, K.J. Warnock, F.E. 2021. Capital flow waves—or ripples? Extreme capital flow movements since the crisis. *Journal of International Money and Finance*. 116: 102394-, DOI: https://doi.org/10.1016/j.jimonfin.2021.102394

Fratzscher, M. Gloede, O. Menkhoff, L. Sarno, L. Stöhr, T. 2019. When Is Foreign Exchange Intervention Effective? Evidence from 33 Countries. *American Economic Journal: Macroeconomics*, 11(1): 132-56. DOI: https://doi.org/10.1257/mac.20150317

Fratzscher, M. 2011. Capital flows, push versus pull factors and the global financial crisis. *Journal of International Economics*, 88(2): 341-356. DOI: https://doi.org/10.1016/j.jinteco.2012.05.003

Frost, J. Ito, H. van Stralen, R. 2020. The effectiveness of macroprudential policies and capital controls against volatile capital inflows. BIS Working Papers, No 867. Basel: Bank for International Settlements. DOI: https://dx.doi.org/10.2139/ssrn.3623036

Gelos, G. Gornicka, L. Koepke, R. Sahay, R. Sgherri, S. 2022. Capital flows at risk: Taming the ebbs and flows. *Journal of International Economics*, 134: 103555. DOI: https://doi.org/10.1016/j.jinteco.2021.103555

Glick, R. Guo, X. Hutchison, M. 2006. Currency crises, capital account liberalization, and selection bias. *Review of Economics and Statistics*, 88(4): 698-714. DOI: https://doi.org/10.1162/rest.88.4.698

Hoevelmann, K. 2020. *Federal Reserve Bank of St. Louis: What's a countercyclical capital buffer? Here's a rundown.* [Online]. Available: https://www.stlouisfed.org/open-vault/2020/february/what-is-countercyclical-capital-buffer-ccyb [Accessed 2023/01/14].

International Monetary Fund. 2014. *Staff guidance note on macroprudential policy.* [Electronic]. Available: https://www.imf.org/en/Publications/Policy-Papers/Issues/2016/12/31/Staff-Guidance-Note-on-Macroprudential-Policy-PP4925 [Accessed: 2023/04/30].

Jeanne, O. Korinek, A. 2010. Excessive volatility in capital glows: A Pigouvian taxation approach. *American Economic Review*, 100(2): 403-407. DOI: https://doi.org/10.1257/aer.100.2.403

Jeanne, O. Sandri, D. 2023. Global financial cycle and liquidity management. *Journal of International Economics*. 103736. DOI: https://doi.org/10.1016/j.jinteco.2023.103736

Jochem, A. Volz, U.B., 2011. Portfolio holdings in the euro area-home bias and the role of international, domestic and sector-specific factors. *Domestic and Sector-Specific Factors*. DOI: https://dx.doi.org/10.2139/ssrn.2785398.

Kaminsky, G.L. Reinhart, C.M. Végh, C.A. 2003. The unholy trinity of financial contagion. *Journal of Economic Perspectives,* 17(4): 51-74. DOI: https://doi.org/10.1257/089533003772034899

Korinek, A. Sandri, D. 2016. Capital controls or macroprudentil regulation?. *Journal of International Economics,* 99: S27-S42. DOI: https://doi.org/10.1016/j.jinteco.2016.02.001

Laeven, L. Valencia, F. 2008. Systemic banking crises: A new database. IMF Working Paper 08/224, Washington, DC: International Monetary Fund. [Online] Available: https://www.imf.org/external/pubs/ft/wp/2008/wp08224.pdf [Accessed 2023/02/26].

Laeven, L. Valencia, F. 2013. Systemic banking crises database. *IMF Economic Review*, 61(2): 225-270. DOI: https://doi.org/10.1057/imfer.2013.12

Laeven, L. Valencia, F. 2020. Systemic banking crises database II. *IMF Economic Rev*iew, 68: 307-361. DOI: https://doi.org/10.1057/s41308-020-00107-3

Landou, J.P. 2011. Global liquidity – concept. Measurement and policy implications. *CGFS Papers,* No 45. Basel: Bank for International Settlements. [Online]. Available*:* https://www.bis.org/publ/cgfs45.pdf [Accessed 2023/06/01].

Lim, C. Columba, F. Costa, A. Kongsamut, P. Otani, A. Saiyid, M. Wezel, T. Wu, X. 2011. Macroprudential policy: What instruments and how to use them? IMF Working Paper, WP/11/238. Washington, DC: International Monetary Fund. [Online]. Available: https://www.imf.org/external/pubs/ft/wp/2011/wp11238.pdf [Accessed 2023/03/07].

Magud, N.E. Reinhart, C.M. Rogoff, K.S. 2018. Capital controls: Myth and reality, *Annals of Economics and Finance,* 19(1): 1-47. DOI: https://doi.org/10.3386/w16805

McQuade, P. Schmitz, M. 2017. The great moderation in international capital flows: A global phenomenon?. *Journal of International Money and Finance*, 73*:* 188-212. DOI: http://dx.doi.org/10.1016/j.jimonfin.2017.02.027

Milesi-Ferretti, G.-M. Tille, C. 2011. The great retrenchment: international capital flows during the global financial crisis. *Economic Policy*. 26(66): 289-346. DOI: https://doi.org/10.1111/j.1468-0327.2011.00263.x.

Neely, C.J. 2005. An analysis of recent studies of the effect of foreign exchange intervention. Federal Reserve Bank of St. Louis Working Paper No. 2005-

030B. [Online]. Available: http://research.stlouisfed.org/wp/2005/2005-030.pdf [Accessed 2023/03/05].

Nguyen, T.C. Castro, V. Wood, J. 2022. A new comprehensive database of financial crises: Identification, frequency, and duration. *Economic Modelling*, 108: 105770. DOI: https://doi.org/10.1016/j.econmod.2022.105770

Nie, O. 2022. The information content of capital controls. *Journal of International Money and Finance,* 127: 102681. DOI: https://doi.org/10.1016/j.jimonfin.2022.102681

Organisation for Economic Co-operation and Development. 2015. *Future work on the review of the OECD Codes of Liberalisation.* [Online]. Available: https://one.oecd.org/document/DAF/INV(2015)11/en/pdf [Accessed 2023/04/27].

Ostry, J.D. Ghosh, A.R. Chamon, M. Qureshi, M.S. 2011. Capital controls: When and why?. *IMF Economic Review,* 59: 562-580. DOI: https://doi.org/10.1057/imfer.2011.15

Ostry, J.D. Ghosh, A.R. Chamon, M. Qureshi, M.S. 2012. Tools for managing financial-stability risks from capital inflows. *Journal of International Economics*, 88(2): 407-421 DOI: https://doi.org/10.1016/j.jinteco.2012.02.002

Pasricha, G.K. Falagiarda, M. Bijsterbosch, M. Aizenman, J. 2018. Domestic and multilateral effects of capital controls in emerging markets. *Journal of International Economics*, 115: 48-58. DOI: https://doi.org/10.1016/j.jinteco.2018.08.005.

Persson, T. Tabellini, G. 2002. Do constitutions cause large governments? Quasi-experimental evidence. *European Economic Review*, 46(4-5): 908-918. DOI: https://doi.org/10.1016/S0014-2921(01)00224-0

Rey, H. 2015. Dilemma not trilemma: The global financial cycle and monetary policy independence. NBER Working Paper Series, 21162. Cambridge: National Bureau of Economic Research, Inc. DOI: https://doi.org/10.3386/w21162.

Rosenbaum, P.R. Rubin, D.B. 1983. The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70 (1): 41-55. DOI: https://doi.org/10.2307/2335942

Rosenbaum, P.R. Rubin, D.B. 1985. Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *American Statistician,* 39: 33-38. DOI: https://doi.org/10.2307/2683903

Rubin, D.B. 1977. Assignment to treatment group on the basis of a covariate. *Journal of Educational Statistics*, 2: 1-26. DOI: https://doi.org/10.2307/1164933

Schmidt, T. Zwick, L. 2015. Uncertainty and episodes of extreme capital flows in the Euro Area. *Economic Modelling,* 48: 343-356. DOI: https://doi.org/10.1016/j.econmod.2014.10.047

Shin, H.S. 2014. The second phase of global liquidity and its impact on emerging economies. In: Chung, K, Kim. S. Park, H. Choi, C. Shin, H.S. (eds) *Volatile Capital Flows in Korea*. Palgrave Macmillan, New York. DOI: https://doi.org/10.1057/9781137368768_10

Unsal, D.F. 2018. Capital flows and financial stability: monetary policy and macroprudential responses. *International Journal of Central Banking*, 9(1): 233-285. [Online]. Available: https://www.ijcb.org/journal/ijcb13q1a10.htm

Visconti, G. Zubizarrta, J.R. 2018. Handling limited overlap in observational studies with cardinality matching. Observational studies. 4(1): 217-249. DOI: https://doi.org/10.1353/obs.2018.0012

World Bank. 2023b. *Dimewiki: Matching.* [Online]. Available: https://dimewiki.worldbank.org/Matching [Accessed 2023/09/08].

Zhang, X. Fu, Q. Lu, L. Wang, Q. Zhang, S. 2021. Bank liquidity creation, network contagion and systemic risk: Evidence from Chinese listed banks. *Journal of Financial Stability*, 53: 100844. DOI: https://doi.org/10.1016/j.jfs.2021.100844

Appendix

Table A1a: Logit regressions for the implementation of capital flow management techniques: Full sample

	Capital and reserve requirements	Liquidity	Credit	Systemic	Proliferation	Easing	Tightening	FX spot interventions	FX derivative interventions
Risk	0.0125**	0.0245**	0.0137*	0.0038	0.0092**	0.0240***	-0.0062	0.0096	0.0226*
	(0.0052)	(0.0100)	(0.0078)	(0.0104)	(0.0043)	(0.0090)	(0.0092)	(0.0064)	(0.0136)
Liquidity	-0.0425***	-0.0079	-0.0456***	-0.0038	0.0183**	-0.0637***	0.0174	-0.0350**	-0.1039***
	(0.0106)	(0.0196)	(0.0157)	(0.0726)	(0.0089)	(0.0231)	(0.0264)	(0.0162)	(0.0318)
Interest rates	-0.39964***	-1.2285***	-0.8007***	-1.1995***	-0.4688***	-0.5859***	-0.8268***	-0.4428***	-0.9078***
	(0.0260)	(0.0698)	(0.0452)	(0.0726)	(0.0228)	(0.0591)	(0.0719)	(0.0423)	(0.0894)
Global Growth	-0.2505****	-0.0945*	-0.2101***	-0.1847***	-0.0795***	-0.2279***	-0.1625***	-0.2975***	-0.5596***
	(0.0279)	(0.0507)	(0.0387)	(0.0539)	(0.0245)	(0.0514)	(0.0561)	(0.0382)	(0.0714)
Regional contagion	-0.1784*	0.0208	-0.0350	-0.1580	0.0980	-0.0045	-0.2759	0.3406***	0.4038
	(0.0980)	(0.1544)	(0.1353)	(0.1714)	(0.0801)	(0.1723)	(0.1947)	(0.1271)	(0.2544)
GDP growth	0.0412***	0.0436**	0.0393***	0.0407*	0.0357***	0.1065***	0.0869***	0.0197	0.0118
	(0.0082)	(0.0184)	(0.0117)	(0.0211)	(0.0077)	(0.0186)	(0.0199)	(0.0178)	(0.0358)
Wald $chi^2(6)$	1723.95	1038.53	1397.25	1011.19	1502.60	680.35	655.50	904.58	626.38
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log likelihood	-1556.1758	-651.7437	-883.0706	-556.4532	-2155.12	-585.1551	-466.2572	-956.9956	-288.6647

*First Stage logit regressions are used to calculate propensity scores. Observations: 4789 for MaPPs 1796 for capital controls. 2507 for FX interventions. '***' denotes significance at the 99% confidence level; '**' denotes significance at the 95% confidence level; '*' denotes significance at the 90% confidence level.*

Table A1b: Logit regressions for the implementation of capital flow management techniques: Emerging market economies

	Capital and reserve requirements	Liquidity	Credit	Systemic	Proliferation	Easing	Tightening	FX spot interventions	FX derivative interventions
Risk	0.0112 (0.0085)	0.0482** (0.0190)	0.0176 (0.0146)	-0.0097 (0.0178)	0.0139* (0.0079)	0.0276*** (0.0105)	-0.0096 (0.0105)	0.0193** (0.0088)	0.0105 (0.0183)
Liquidity	-0.0024 (0.0179)	-0.0225 (0.0357)	-0.0197 (0.0294)	-0.0538 (0.0391)	0.0389** (0.0157)	-0.0658** (0.0277)	0.0418 (0.0319)	-0.0585*** (0.0211)	-0.0974** (0.0401)
Interest rates	-0.3402*** (0.0448)	-1.2140*** (0.1278)	-0.7832*** (0.0851)	-0.9130*** (0.1175)	-0.4212*** (0.0416)	-0.4129*** (0.0726)	-0.7064*** (0.0887)	-0.4711*** (0.0571)	-09733*** (0.1220)
Global Growth	-0.2364*** (0.0491)	0.0154 (0.0950)	-0.1153 (0.0751)	-0.3234*** (0.0984)	-0.0455 (0.0449)	-0.0472 (0.00617)	-0.0196 (0.0665)	-0.2423*** (0.0492)	-0.5196*** (0.0928)
Regional contagion	-0.0127 (0.1609)	0.4309 (0.2812)	0.0547 (0.2495)	-0.0180 (0.3448)	0.2743* (0.1411)	0.2103 (0.1977)	0.0141 (0.2234)	0.3293** (0.1620)	0.2764 (0.3274)
GDP growth	0.0396** (0.0180)	0.0047 (0.0391)	-0.0300 (0.0312)	0.0104 (0.0438)	0.0286* (0.0160)	0.0261 (0.0225)	0.0236 (0.0259)	0.0136 (0.0232)	0.0224 (0.0483)
Wald $chi^2(6)$	402.44	284.01	375.85	295.73	284.27	224.52	275.87	538.91	372.32
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log likelihood	-514.7962	-189.7350	-244.1856	-144.3755	-632.4394	-383.8595	-310.2172	-554.5189	-165.2068

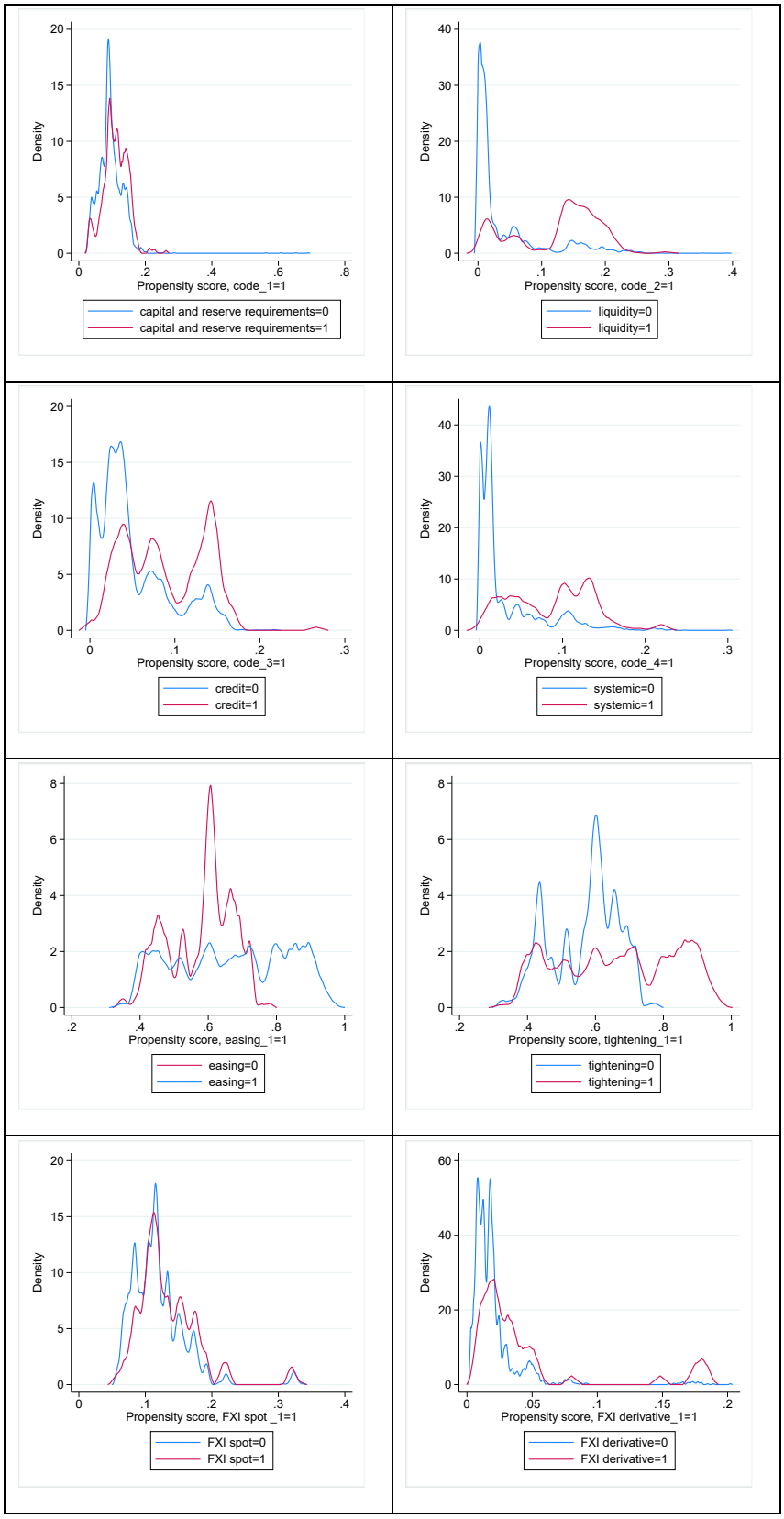
*First Stage logit regressions are used to calculate propensity scores. Observations: 1216 for MaPPs 776 for capital controls. 1492 for FX interventions. '***' denotes significance at the 99% confidence level; '**' denotes significance at the 95% confidence level; '*' denotes significance at the 90% confidence level.*

Table A1c: Logit regressions for the implementation of capital flow management techniques: Advanced economies

	Capital and reserve requirements	Liquidity	Credit	Systemic	Proliferation	Easing	Tightening	FX spot interventions	FX derivative interventions
Risk	0.0140**	0.0147	0.0110	0.0097	0.0073	0.0197	0.0074	0.0043	0.0338
	(0.0067)	(0.0121)	(0.0094)	(0.0127)	(0.0053)	(0.0219)	(0.0233)	(0.0095)	(0.0205)
Liquidity	-0.0647***	0.0034	-0.0516***	0.0154	0.0111	-0.0641	-0.0236	0.0084	0.1199**
	(0.0133)	(0.0239)	(0.0187)	(0.0255)	(0.0109)	(0.0560)	(0.0570)	(0.0262)	(0.0538)
Interest rates	-0.4352***	-1.2750***	-0.8141***	-1.3394***	-0.4817***	-0.9842***	-1.1489***	-0.4196***	-0.8332***
	(0.0328)	(0.0872)	(0.0537)	(0.0960)	(0.0278)	(0.1398)	(0.1618)	(0.0644)	(0.1342)
Global Growth	-0.2503***	-0.0996	-0.2198***	-0.1097*	-0.0815***	-0.4460***	-0.2256*	-0.4200***	-0.6934***
	(0.0350)	(0.0623)	(0.0461)	(0.0665)	(0.0297)	(0.1255)	(0.1358)	(0.0651)	(0.1230)
Regional contagion	-0.1820	-0.1204	-0.0415	-0.2769	0.0505	0.3501	-0.2964	0.3506*	0.6935
	(0.1255)	(0.1875)	(0.1629)	(0.1989)	(0.0996)	(0.4481)	(0.4721)	(0.2103)	(0.4351)
GDP growth	0.0346***	0.0467**	0.0473***	0.0489**	0.0314***	0.0670*	-0.0009	0.0653**	0.0420
	(0.0091)	(0.0214)	(0.0109)	(0.0235)	(0.0084)	(0.0396)	(0.0561)	(0.0311)	(0.0602)
Wald $chi^2(6)$	1270.79	735.33	1018.23	689.56	1109.05	282.87	257.39	365.02	249.52
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log likelihood	-1014.2351	-455.0957	-634.813	-407.0266	-1477.0009	-129.3489	-109.8309	-395.9956	-120.0251

*First Stage logit regressions are used to calculate propensity scores. Observations: 3573 for MaPPs 1020 for capital controls. 1015 for FX interventions. '***' denotes significance at the 99% confidence level; '**' denotes significance at the 95% confidence level; '*' denotes significance at the 90% confidence level.*

Table A2: Overlap identification assumption



The overlap identification ensures that there are comparison cases in the untreated group for each treated case, and comparison cases in the treated group for each untreated

case. In Table A2, plots densities of propensity scores by treatment case. These plot: (i) the estimated density of the predicted probabilities that a country not experiencing a surge imposed a CFM, and (ii) the estimated density of the predicted probabilities that a country experiencing a surge imposed as CFM.

In each Figure, neither plot indicates too much probability mass near 0 or 1, and the two estimated densities have most of their respective masses in regions in which they overlap. Thus, there is no evidence that the overlap assumption is violated for each CFM.

Table A3: Balancing test

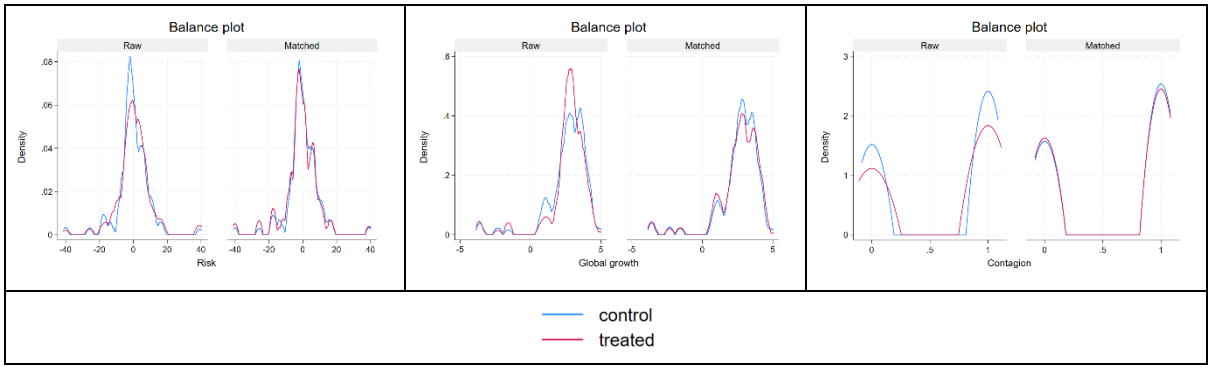
The balancing test verifies whether the matching was able to remove significant differences between the treated and control groups that existed in the unmatched samples. After matching our treated countries, baseline covariates should be similarly distributed between treated and untreated groups. This assesses the standard mean difference between group means across all baseline covariances. Ideally, following matching, standardised differences should be zero and variance ratios close to one.[56] The test results in Table A2 confirm that the model balances all of our covariates, besides risk, global growth and the contagion variables. We therefore look at the respective kernel density plots in Table A3, which indicated that the matched data appear to be balanced. Using the propensity scores we restrict our estimations to the regions where the treatment and control overlap. i.e. we drop outliers as suggested by Visconti and Zubizarreta (2018: 221).

Table A2: Covariate balance summary

	Standardised differences		Variance ratio	
	Raw	Matched	Raw	Matched
Risk	0.0845	-0.0953	1.2480	1.2754
Liquidity	-0.0264	0.0041	0.6879	0.9113
Interest rates	-0.5946	-0.0022	0.7889	0.9469
Global Growth	-0.0104	-0.0450	1.0075	1.1413
Surge contagion	0.0159	-0.0330	0.9932	1.0149
GDP growth	0.1159	0.0404	0.6117	0.7212

*Notes: Reports difference in means between treated and control groups, with control group created based on regression results reported in Table 3 and matching performed using algorithms listed at top. Estimation is based off the proliferation of macroprudential policy. * indicates significant at the 10% level, ** at the 5% level, and *** at the 1% level*

Table A3: Balance Plots



Notes: Graphical illustration of balancing test. Figures present the density functions of our problematic variable before and after matching.

[56] There are no standard errors on these statistics, so inference is informal. See Austin (2009) and Rosenbaum and Rubin (1985) for further discussion on these diagnostics.

Table A4a: PSM estimations for average treatment effects of MaPPs and restricted CFMs, and FXI on extreme capital flow episodes

	Surge	Stop	Flight	Retrenchment
Capital	-0.0458 (0.3076)	0.0161 (0.0737)	0.0944 (0.0938)	-0.0098 (0.0750)
CCB	-0.0801 (0.0738)†	-0.0958** (0.0475)†	0.0008 (0.0877)†	-0.0784 (0.0989)†
Conservation	-0.0833*** (0.0266)†	-0.0568* (0.0340)†	-0.0702*** (0.0233)†	-0.0614* (0.0362)†
RR	-0.0501* (0.0296)	-0.0309 (0.0235)	-0.0433* (0.0235)	-0.0436** (0.0219)
Liquidity	-0.0416 (0.0304)	0.0077 (0.0582)	0.0414 (0.0827)	0.00221 (0.0934)
LTD	0.0205 (0.1408)†	-0.0844 (0.0604)†	-0.0334 (0.1203)†	-0.1318*** (0.0051)†
LFX	-0.1082*** (0.0143)	-0.0917*** (0.0343)	-0.0282 (0.0318)	0.0230 (0.0555)
LTV	-0.0586** (0.0252)	0.0320 (0.0485)	-0.0265 (0.0324)	-0.0125 (0.0184)
DSTI	-0.0139 (0.0332)	0.2398 (0.1529)	-0.0066 (0.0387)	-0.2764** (0.1379)
LCG	0.1196 (0.1760)‡	-0.1150*** (0.0285)‡	0.2520* (0.1382)‡	-0.0779*** (0.0118)‡
LFC	0.0185 (0.0838)	-0.0756*** (0.0166)	-0.0123 (0.0373)	-0.1116*** (0.0275)
LLP	-0.0184 (0.0467)	0.0082 (0.0703)	0.0071 (0.0549)	-0.0080 (0.0782)
LOANR	-0.0509 (0.0512)	0.1056 (0.0727)	0.0202 (0.0902)	0.0195 (0.0558)
LVR	-0.1360*** (0.0052)†	0.0296 (0.0623)†	-0.1397*** (0.0064)†	-0.0214 (0.0979)†

TAX	-0.1124*** (0.0195)†	-0.1195*** (0.01442)‡	-0.1152*** (0.0174)†	-0.0972*** (0.0200)‡
SIFI	-0.0639** (0.0322)	-0.0044 (0.0333)†	-0.0863*** (0.0324)	-0.0548 (0.0358)
OT	-0.1089*** (0.0162)‡	0.0455 (0.0661)†	-0.0785 (0.0588)‡	0.0085 (0.0637)‡
Easing capital controls[57]	0.0187 (0.0118)	0.0071 (0.0108)	-0.1491 (0.1377)	-0.0037 (0.0115)
Tightening capital controls	0.0267** (0.0106)	0.0099 (0.0117)	-0.1536 (0.1436)	-0.0938 (0.1053)

*Notes: Each number represents the average treatment effect on the treated for a tool (left hand column) on an extreme capital flow episode (top row). Full sample (1990Q1-2020Q3). 4437 observations for all estimates. AI robust standard errors in parentheses. '***' denotes significance at the 99% confidence level; '**' denotes significance at the 95% confidence level; '*' denotes significance at the 90% confidence level. Logit treatment model estimated using 2 nearest neighbours". The following represent if an independent variable is dropped: '†' - interest rates (US, UK, Japan, Eurozone); '¥' - liquidity (change in global M2); '‡' - domestic GDP growth; '♪' - global growth (IMF estimate); '♫' - contagion; and '♯ - global risk (VIX).*

[57] Restricting to just capital controls on inflows in surges and stops, and just capital controls on outflows for flight and retrenchments. However, inflows and outflows in the Pasricha et al (2018) dataset only accounts for direction not residency, hence why every combination is evaluated here.

Table A4b: PSM estimations for average treatment effects of MaPPs and CFMs on extreme capital flow episodes, pre-great financial crisis

	Surge	Stop	Flight	Retrenchment
Capital	0.0429 (0.0286)	0.0598 (0.1447)	0.0581 (0.0887)	-0.1089*** (0.0347)
CCB	-0.0165 (0.0604)†	…	…	…
Conservation	0.0111 (0.0292)†	…	…	…
RR	-0.0499*** (0.0085)	-0.0324 (0.0278)	-0.0737*** (0.0275)	-0.0637*** (0.0244)
Liquidity	-0.0184 (0.0206)	0.0473 (0.0933)	0.0793 (0.1240)	-0.0182 (0.1513)
LTD	0.0385 (0.0604)	…	…	…
LFX	-0.0534*** (0.0057)	-0.1574*** (0.0204)†	0.0403 (0.0591)†	0.2741 (0.3182)†
LTV	-0.0207 (0.0149)	0.0010 (0.0600)	-0.0126 (0.0431)	-0.0611*** (0.0235)
DSTI	0.0000 (0.0353)	-0.0333*** (0.0101)†	0.2662*** (0.0862)	-0.0094 (0.0340)†
LCG	-0.0653*** (0.0057)‡	-0.1709*** (0.0064)‡	0.4470** (0.2102)†♪‡	-0.1623*** (0.0064)‡
LFC	-0.0534*** (0.0057)	0.0183 (0.1377)†	0.2538 (0.2498)†♫	-0.0768 (0.0802)†
LLP	-0.0407** (0.01986)	-0.0808** (0.0373)	0.1292 (0.1268)†	-0.1276*** (0.0210)†
LOANR	-0.0089 (0.0340)	0.0645 (0.1364)	0.0257 (0.1690)	0.0084 (0.0485)‡
LVR	-0.0531*** (0.0057)†	…	…	…

TAX	-0.0534*** (0.0057)†	-0.1709*** (0.0064)†♪‡	0.7879** (0.3536)†¥♪♫♯	-0.1623*** (0.0064)†♪♯‡
SIFI	0.0111 (0.0335)	…	…	…
OT	0.0124 (0.0341)‡	0.0006 (0.0883)‡	-0.1605*** (0.0188)†‡	0.0456 (0.1143)‡
Proliferation of MaPP instruments	-0.0778*** (0.0232)	-0.0239 (0.0289)	0.0061 (0.0348)	-0.0309 (0.0306)
Easing capital controls	-0.0306 (0.0784)	-0.0511 (0.0372)	0.0187 (0.0596)	-0.0289 (0.0415)
Tightening capital controls	-0.0704 (0.0946)	-0.0874*** (0.0092)	0.1606 (0.1731)	-0.0318 (0.0574)
FX spot interventions	0.1230* (0.0712)	0.0226 (0.0409)	0.0553 (0.0544)	-0.0505** (0.0229)
FX derivative interventions	-0.0473 (0.0943)	-0.0854*** (0.0093)	0.0048 (0.0530)	0.0977 (0.2072)

*Notes: Each number represents the average treatment effect on the treated for a tool (left hand column) on an extreme capital flow episode (top row). Full sample (1990Q1-2006Q4). 1573 or 1872 observations for all estimates. AI robust standard errors in parentheses (2300 for proliferations; 881 for capital controls, 931 for FXI; sample spans 2001Q-2006Q4 for capital controls and FXI). '***' denotes significance at the 99% confidence level; '**' denotes significance at the 95% confidence level; '*' denotes significance at the 90% confidence level. Logit treatment model estimated using 2 nearest neighbours. '…' denotes "in-estimate-ability". The following represent if an independent variable is dropped: '†' - interest rates (US, UK, Japan, Eurozone); '¥' - liquidity (change in global M2); '‡' - domestic GDP growth; '♪' - global growth (IMF estimate); '♫' - contagion; and '♯' - global risk (VIX).*

Table A4c: PSM estimations for average treatment effects of MaPPs and CFMs on extreme capital flow episodes, Post-great financial crisis

	Surge	Stop	Flight	Retrenchment
Capital	0.0429 (0.0286)	0.0388 (0.0604)	0.0140 (0.0299)	-0.0299 (0.0703)
CCB	-0.0165 (0.0604)	-0.0032 (0.0363)	0.1491 (0.1064)	-0.0720*** (0.0067)
Conservation	0.0111 (0.0292)†	-0.0184 (0.0389)†	0.0051 (0.0252)†	0.0207 (0.0488)†
RR	-0.0499*** (0.0085)	-0.0779*** (0.0069)	0.0613 (0.1036)	-0.0741*** (0.0069)
Liquidity	-0.0184 (0.0206)	-0.0021 (0.0335)	-0.0159 (0.0599)	0.0083 (0.0253)
LTD	0.0079 (0.0342)	0.0063 (0.0398)	-0.0540*** (0.0057)	0.0706*** (0.0065)
LFX	-0.0534*** (0.0057)	-0.0178 (0.0136)	-0.0540*** (0.0057)	-0.0401 (0.0254)
LTV	-0.0207 (0.0149)	0.0057 (0.0329)	-0.0286 (0.0206)	-0.0089 (0.0226)
DSTI	0.0309 (0.0232)‡	0.0343 (0.0530)	-0.0375*** (0.0102)	0.0413 (0.0375)
LCG	-0.0653*** (0.005937)‡	-0.0488** (0.0233)‡	-0.0540*** (0.0057)†	-0.0183 (0.0376)‡
LFC	-0.0534*** (0.0057)†	-0.0769*** (0.0067)	-0.0553*** (0.0059)†	-0.0712*** (0.0065)
LLP	-0.0407** (0.0199)	0.0909* (0.0551)	-0.0461*** (0.0071)	0.0305 (0.0485)
LOANR	-0.0089 (0.0340)	-0.0133 (0.0344)	-0.0464*** (0.0087)	0.0048 (0.0298)
LVR	-0.0531*** (0.0057)†	-0.0337 (0.0424)	-0.0178 (0.0385)†	-0.0337 (0.0695)

TAX	-0.0531*** (0.0057)	0.0089 (0.0157)‡	-0.0544*** (0.0057)	-0.0111 (0.0280)
SIFI	-0.0232 (0.0157)	0.0264 (0.0371)†	0.0251 (0.0894)	0.0242 (0.0236)
OT	0.0124 (0.0341)‡	-0.0447** (0.0221)†	-0.0381*** (0.0120)†	-0.0523*** (0.0172)‡
Proliferation of MaPP instruments	-0.0314** (0.0127)	-0.0014 (0.0165)	-0.0392*** (0.0124)	-0.0207 (0.0172)
Easing capital controls	-0.0102 (0.0213)	-0.0295 (0.0236)	0.0114 (0.0265)	-0.0341* (0.0185)
Tightening capital controls	-0.0296* (0.0154) ‡	-0.0034 (0.0273)	-0.0136 (0.0249)	-0.0614*** (0.0093)
FX spot interventions	0.0215 (0.0244)	-0.0485** (0.0212)	-0.0173 (0.0205)	-0.0257 (0.0194)
FX derivative interventions	-0.0448*** (0.0082)	-0.0316 (0.0319)	-0.0510*** (0.0155)‡	-0.0713*** (0.0079)

*Notes: Each number represents the average treatment effect on the treated for a tool (left hand column) on an extreme capital flow episode (top row). Full sample (2010Q1-2020Q3). 1573 (1385 in flight) observations for all estimates. AI robust standard errors in parentheses. 1072 observations in FXI. '***' denotes significance at the 99% confidence level; '**' denotes significance at the 95% confidence level; '*' denotes significance at the 90% confidence level. Logit treatment model estimated using 2 nearest neighbours. '…' denotes "in-estimate-ability". The following represent if an independent variable is dropped: '†' - interest rates (US, UK, Japan, Eurozone); '¥' - liquidity (change in global M2); '‡' - domestic GDP growth; '♪' - global growth (IMF estimate); '♫' - contagion; and '♯' - global risk (VIX).*

Table A6: Capital flow management measures: Variable meanings

Variable	Descriptions of policy changes by country for each instrument	category
Capital	Capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements. Countercyclical capital buffers and capital conservation buffers are captured in their balance sheets respectively and thus not included here.	i
CCB	A requirement for banks to maintain a countercyclical capital buffer. Implementations at 0% are not considered as a tightening in dummy-type indicators.	i
Conservation	Requirements for banks to maintain a capital conservation buffer, including the one established under Basel III.	i
RR	Reserve requirements (domestic or foreign currency) for macroprudential purposes. This category may currently include those for monetary policy as distinguishing those for macroprudential or monetary policy purposes is often not clear-cut.	i
Liquidity	Measures taken to mitigate systemic liquidity and funding risks, including minimum requirements for liquidity coverage ratios, liquid asset ratios, net stable funding ratios, core funding ratios and external debt restrictions that do not distinguish currencies.	ii
LTD	Limits to the loan-to-deposit (LTD) ratio and penalties for high LTD ratios.	ii
LFX	Limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mismatch regulations.	ii
LTV	Limits to the loan-to-value ratios, applied to residential and commercial mortgages but also applicable to other secured loans, such as for automobiles. Other aspects of the LTV regulation are also covered, such as speed limits (i.e., a regulation on the percent of new loans that can go above certain LTV limits).	iii
DSTI	Limits to the debt-service-to-income ratio and the loan-to-income ratio, which restrict the size of debt service payments or the size of a loan relative to income (e.g., household income, net operating income of a company).	iii
LCG	Limits on growth or the volume of aggregate credit, the household-sector credit, or the corporate-sector credit, and penalties for high credit growth.	iii

LFC	Limits on foreign currency (FC) lending, and rules or recommendations on FC loans.	iii
LLP	Loan loss provision requirements for macroprudential purposes, which include dynamic provisioning and sectoral provisions (e.g., housing loans).	iii
LOANR	Loan restrictions that are more tailored than those captured in "LCG". They include loan limits and prohibitions which may be conditioned on loan characteristics (e.g., the maturity, the size, the LTV ratio and the type of interest rate of loans), lender characteristics (e.g., mortgage banks), and other factors.	iii
Tax	Taxes and levies applied to specified transactions, assets, or liabilities, which include stamp duties, and capital gains taxes.	iv
SIFI	Measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFIs), which include capital and liquidity surcharges.	iv
OT	Macroprudential measures not captured in the above categories e.g., stress testing, restrictions on profit distribution, and structural measures (e.g., limits on exposures between financial institutions).	iv
Easing capital controls	The unweighted dataset that assigns an equal weight to each measure is used. Measures are classified according to their international investment position category (portfolio flows, FDI, financial derivatives, other investment); type of instrument; whether they discriminate based on residency or currency; the type of instrument; the direction of flows that the measure regulates; and the policy stance of the measure. For a full description, see Pasricha et al (2019).	
Tightening capital controls		
FX spot interventions	FXI proxy variables are estimated relying on the change in (net) foreign asset position of the central bank. A Hodrick-Prescott filter is used to remove endogeneity arising from movements in the U.S. dollar value of nominal GDP.	
FX derivative interventions		

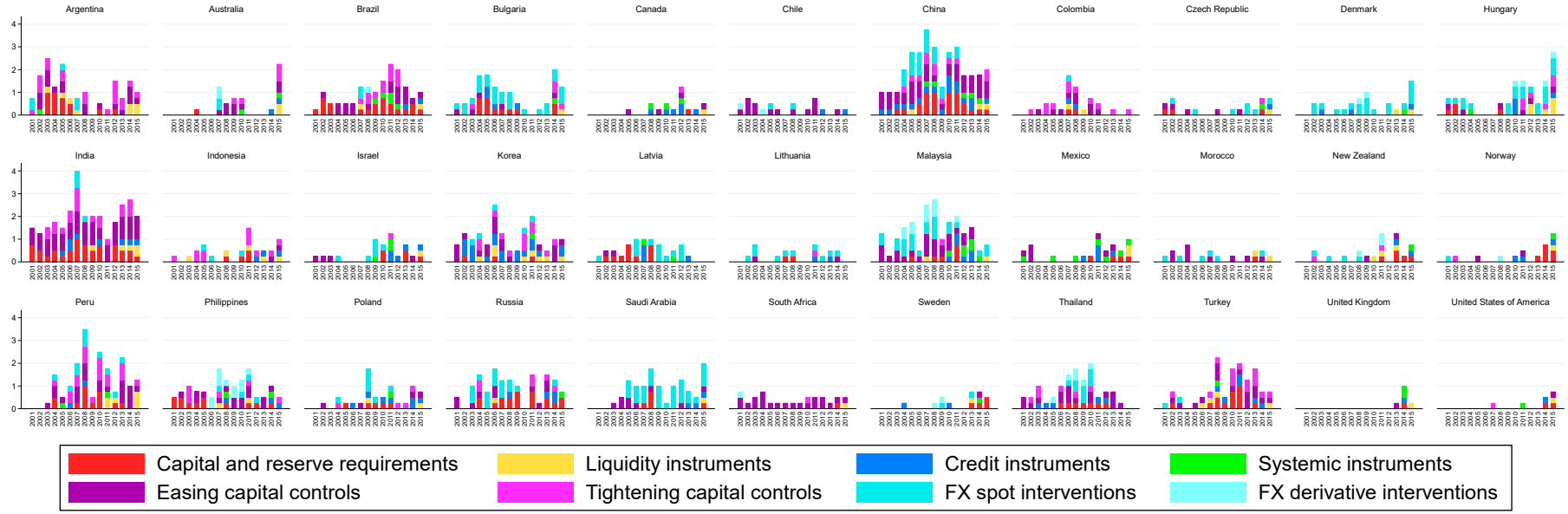
Notes: category corresponds to (i) 'capital and reserve instruments'; (ii) liquidity instruments; (iii) credit instruments; and (iv) systemically important institutions. All categorised variables come from Alam et al (2019). Capital controls come from Pasricha et al (2019). Foreign exchange interventions are from Adler et al (2021).

Table A7: Independent variable symbols when omitted

†	interest rates (US, UK, Japan, Eurozone)
¥	liquidity (change in global M2)
‡	domestic GDP growth
♪	global growth (IMF estimate)
♫	contagion
♯	global risk (VIX)

Control variables are only dropped when/if estimation fails. For instance, if the contagion variable is a perfect predictor on the limits on foreign currency lending (LTC) estimation for flight episodes, then the flight contagion variable is dropped.

Figure A1: Capital flow management techniques graphical summary, full sample, 2001Q1-2015Q4



Sources: Authors calculations (2023); Pasricha, Falagiarda, Bijsterbosch, and Aizenman (2018); and IMF iMaPP database (2022); Adler, Chang, Mano, and Shao (2021).
Notes: This spans 2001Q1-2015Q4 and this represents only for countries for which data for all three of MaPPs, CCs, and FXI is concurrently available. See Table A8a (emerging market economies) and A8b (advanced economies) for full graphical summary. The y-axis represents the number of policies activated, and the x-axis represents the year.

Figure A2a: Capital flow management techniques graphical summary: Emerging market economies

Sources: Authors calculations (2023); Pasricha, Falagiarda, Bijsterbosch, and Aizenman (2018); and IMF iMaPP database (2022); Adler, Chang, Mano, and Shao (2021). Notes: This spans 2000Q1-2020Q3 and this represents only for countries for which there is data for either MaPPs, CCs, and FXI. CCs do not extend past 2015. The y-axis represents the number of policies activated, and the x-axis represents the year.

Figure A2b: Capital flow management techniques graphical summary: Advanced economies

Sources: Authors calculations (2023); Pasricha, Falagiarda, Bijsterbosch, and Aizenman (2018); and IMF iMaPP database (2022); Adler,6 Chang, Mano, and Shao (2021). Notes: This spans 2000Q1-2020Q3 and this represents only for countries for which there is data for either MaPPs, CCs, and FXI. CCs do not extend past 2015. The y-axis represents the number of policies activated, and the x-axis represents the year.