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### **ABSTRACT**

Countries are using macroprudential tools more actively with the goal of improving the resilience of their broader financial systems. A growing body of evidence suggests that these tools can accomplish specific domestic goals and should reduce country vulnerability to many domestic and international shocks. The evidence also suggests, however, that these policies are not an elixir. They will not insulate economies from volatility and they generate leakages to the non-bank financial system and spillovers through international borrowing, lending and other cross-border exposures. Some of these unintended consequences can mitigate the effectiveness of macroprudential policies and generate new vulnerabilities and risks. The “Corona Crisis” provides a lens to evaluate the effectiveness of current macroprudential regulations during a period of extreme market volatility and economic stress. Experience to date suggests that macroprudential tools provide some benefits and can help achieve certain macroeconomic goals, but they have limitations and expectations of what they can accomplish must be realistic.

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## **1. INTRODUCTION**

The 2008 Global Financial Crisis was a painful reminder of the importance of macroprudential policy that focuses on the resilience of the broader financial system. Solid economic growth, price stability, and microprudential regulation (of individual financial institutions) were not enough to protect domestic financial systems as problems originating in one sector (US housing) were quickly magnified and spread with devastating global effects. This experience spurred a major rethinking of how to design comprehensive macroprudential frameworks to mitigate these risks and amplification effects in the future. As these tools have been adopted more widely, there is now beginning to be enough experience to critically evaluate their performance<sup>1</sup>. The “Corona Crisis” should also provide a timely lens to evaluate if macroprudential tools are delivering on their goal of increasing the resilience of financial systems during a period of unprecedented market volatility and economic stress.

This paper surveys what has been learned about the use and effectiveness of macroprudential tools, focusing on the international experience and challenges from using regulations primarily aimed at domestic banking systems in a world of cross-border banking flows and other global sources of finance.<sup>2</sup> Although this literature is still in its infancy, and there are a number of challenges to empirical analysis, the evidence suggests that these tools have had some success in attaining certain direct goals (such as reducing domestic credit growth and bank exposure to foreign currency borrowing), but are less effective in other areas (such as limiting international capital flows). The evidence on whether they can accomplish their ultimate goals of strengthening the resilience of financial systems to shocks and mitigating amplification effects is supportive on net, but more tenuous, and likely at the cost of slightly lower short-term growth.

A key theme in this body of research, and factor muting the effects of most macroprudential regulations, are unintended leakages and spillovers. When regulations constrain the behavior of certain entities (usually domestic banks), non-bank financial intermediaries, foreign banks and other institutions outside the regulatory perimeter respond. These leakages and spillovers usually only counteract a small to moderate portion of the direct domestic effects of the regulations, but can still be meaningful and shift risks in ways that generate future vulnerabilities. As a result, although macroprudential regulations should improve the resilience of financial systems and broader economies, they should not be expected

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<sup>1</sup> Kenc (2016) highlights that although many of these issues are not new, the use of macroprudential tools had been fairly limited and idiosyncratic. Bolton et al. (2019) and Metrick and Rhee (2018) discuss the increased attention to macroprudential policy in the broader set of reforms addressing vulnerabilities from the 2008 crisis.

<sup>2</sup> See BIS (2016) for a collection of related research.

to prevent periods of sharp volatility and avert all financial crises. They are a useful and important addition to the macroeconomic policy toolkit, but not an elixir.

The remainder of this paper is in four sections. Section 2 briefly reviews the goals of macroprudential policy and tools to achieve these goals, focusing on tools addressing international exposures and vulnerabilities. This section closes with information on how the use of macroprudential tools has evolved since 1990. Section 3 summarizes the empirical evidence assessing the effectiveness of macroprudential policy. It discusses the econometric challenges and evidence on whether these tools affect: housing markets and credit growth; international borrowing, lending and foreign-currency exposure; and boom-bust cycles, growth and resilience to external shocks. This section closes by tying together the evidence on the importance of international spillovers and leakages from macroprudential policy. Section 4 reports new analysis on whether macroprudential policy buffered countries during the period of heightened market volatility at the start of the Corona Crisis. Countries with tighter macroprudential stances appear to have had more resilience in their equity markets, but not in their credit default swaps, exchanges rates or GDP growth. Section 5 concludes.

## **2. THE GOALS, TOOLS, AND RECENT USE OF MACROPRUDENTIAL POLICY**

This section summarizes the goals of macroprudential policy and tools available to accomplish these goals, highlighting those aimed at mitigating international risks. The section ends by documenting their increased use since 2010.

### **2.a. The Goals and Theory**

Macroprudential regulations encompass a diverse set of tools focused on the stability of the entire financial system. They target the buildup of systemic risk over time, as well as how vulnerabilities in individual institutions can spillover or interact with other policies to affect the entire system and overall economy. In certain situations, there is little distinction between macroprudential regulation and other types of tools—such as microprudential regulation and capital controls. More specifically, microprudential regulation, which focuses on the stability of individual financial institutions, can be similar to macroprudential regulation in countries where the financial system is dominated by a small number of financial institutions.<sup>3</sup> Capital controls, which are taxes or rules based on an investor's

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<sup>3</sup> Forbes (2018) discusses this issue in Iceland.

residency, can be similar to macroprudential regulations that focus on the currency of the investment (IMF, 2015).

After the Global Financial Crisis, international institutions, central banks and other policy forums launched major initiatives on how to mitigate macro-financial vulnerabilities (FSB, 2009; CGFS, 2010; IMF, 2014a). These discussions prioritized three related objectives for macroprudential policy:

- ***Addressing excessive credit expansion and strengthening resilience in the overall financial system.*** This involves containing unsustainable increases in leverage and debt by adjusting the quantity and quality of capital held by financial institutions. This should improve the economy's ability to withstand aggregate shocks and allow the financial system to function effectively during adverse conditions.
- ***Reducing key amplification mechanisms of systemic risk.*** This involves reducing pro-cyclical feedback between asset prices and credit and stocks, including through volatile funding. It can include regulating liquidity, funding, maturity, and any other pricing risks and mismatches, including related to foreign currencies.
- ***Mitigating structural vulnerabilities related to the role of important institutions in key markets:*** This targets vulnerabilities that arise through interlinkages, common exposures, and intermediaries in key markets, including those that can render individual institutions "too-big-to-fail".

As policymakers shifted attention to macroprudential policy to accomplish these goals, academic research developed theoretical models showing why macroprudential tools (usually modeled as a Pigouvian tax) were beneficial even in the presence of sound prudential regulation of individual institutions. This literature is well summarized in Bengui and Bianchi (2018), Bianchi and Mendoza (2018), Brunnermeier et al. (2013), Claessens (2015), Engel (2016), and Galati and Moessner (2018). A common theme is that agents overborrow in good times and do not internalize the cost of their financing choices (which could include duration, liquidity, or currency choice). This overborrowing is generally modelled as some sort of pecuniary externality, combined with incomplete markets and financial constraints that depend on market prices (Bianchi, 2011; Caballero and Krishnamurthy, 2001; Jeanne and Korinek, 2019; and Korinek, 2018). A related strand of literature focuses on how

macroprudential policy can address aggregate demand externalities in the presence of nominal rigidities (Farhi and Werning, 2016).

A few papers modelling the benefits of macroprudential regulation also incorporate the risk of leakages and spillovers. For example, Ahnert et al. (2020) show how macroprudential taxes on foreign-currency bank lending reduce socially costly bank defaults, but cause a partial “snowbank shifting” of risk to less-informed sectors, potentially lowering investment, productivity and growth. Bengui and Bianchi (2018) show how macroprudential taxes on debt can cause “leakages” as unregulated agents respond by taking on more risk, but still improve aggregate welfare by reducing the severity and frequency of financial crises. Agénor and da Silva (2019), Costinot et al. (2011), and Korinek (2018) model how macroprudential policies and capital controls can spillover internationally—with the impact on other countries either positive or negative based on the model’s assumptions.

## **2.b. The Tools**

A range of macroprudential tools have been developed to address these multifaceted goals (Claessens, 2015; BIS, 2012; IMF, 2014a, 2014b). More will undoubtedly be developed over time. They can be divided into five sets of instruments: capital/reserve, liquidity, credit, resolution/structural, and taxation/capital flow measures. Each set includes tools focused on risks related to international exposures (including foreign currency (FX) levels and liquidity, international lending and borrowing, and exchange rate movements), which are in italics below.

- **Capital and reserve instruments:** Capital requirements (equity held by banks against certain positions) and reserve requirements (cash held by banks against certain positions) can be set and/or adjusted to take into account the stage of the economic cycle (such as the countercyclical capital buffer, dynamic provisioning requirements, time-varying leverage ratios, and rules on profit distribution). These can also be applied to certain sectors (such as housing debt), systemically-important institutions, or *risks related to FX exposure (such as on FX deposits or deposits from abroad)*.
- **Liquidity instruments:** Regulations supporting liquidity and containing maturity mismatch include core funding ratios, net stable funding ratios, liquidity coverage ratios, taxes on volatile funding, and caps on loan-to-deposit ratios. *Any of these ratios and requirements can be set more stringently for foreign borrowing, including on net open-currency positions or FX deposits. Deposits may also be*

*required to be repaid in domestic currency (regardless of the deposit currency), to alleviate concerns about withdrawals for which the central bank cannot act as lender-of-last resort.*

- **Credit instruments:** These policies often target potential vulnerabilities to mortgage risk from asset price and income shocks (such as through caps to loan-to-value ratios or debt-service-to-income ratios) or place ceilings on credit growth. *These can also target FX borrowing and lending with stricter ratios if the mortgage is in FX, by limiting FX credit growth, or setting additional limits on FX borrowing by any entity (either at fixed levels or linked to FX earnings).*
- **Resolution Procedures and Mitigating Structural Institution Vulnerabilities:** These tools involve additional cushions and capital surcharges for systemically-important institutions (such as additional loss absorbency requirements, tighter risk weights, and limits on exposures) and regulations for key intermediaries. *These also include regular “stress tests” of major financial institutions to better understand how the financial institutions could withstand various shocks (including foreign and global) and plans for resolution regimes, both nationally and across borders.*
- **Taxation and Capital Flow Measures:** Taxes on certain transactions or holdings can be structured to discourage types of activity through levies, reserve requirements, or quantitative limits. These are often used to target *FX exposure or more volatile capital flows (often debt).* *These could be standard taxes, or unremunerated reserve requirements (when a fee is held in a non-interest bearing account for a fixed period) that make shorter-term investments more expensive.*<sup>4</sup>

### **2.c. Use of Macroprudential Tools**

Cross-country data on macroprudential policy was limited before the 2008 crisis, but several researchers and institutions have begun to fill this void. The most comprehensive early efforts include: data on seven tools from an IMF survey described in Lim et al. (2011); more detailed data on twelve tools from another IMF survey described in Cerutti et al. (2017); survey data on housing-sector tools described in Kuttner and Shim (2016); data focused on foreign-exchange exposures discussed in Ahnert et al. (2020); and information on governance structures for adjusting macroprudential tools in Edge and Liang (2017).

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<sup>4</sup> This paper focuses on the standard definition of macroprudential measures, which excludes capital controls (based on residency), but references studies that use broader definitions as some countries include certain capital controls as part of their macroprudential framework.

To date, the most comprehensive cross-country, time-series data on a broad set of macroprudential regulations is the IMF's integrated Macroprudential Policy (iMaPP) database, described in Alam et al. (2019). This database combines information from a number of pre-existing surveys with a new IMF annual survey and country-specific data to provide detailed information on a range of macroprudential tools for 134 countries from 1990-2016. It groups these tools into 17 different types of policy instruments (with subcategories) and tracks when the tools are tightened or loosened using dummy variables.<sup>5</sup> Some measures incorporate information on international exposures based on the currency of the transaction (such as limits on FX lending and FX positions), but the database does not include capital controls.

Figure 1 uses this iMaPP data to document the general tightening in macroprudential policy over time. The top panel shows net changes in macroprudential policy accumulated each year since 1990 across all 134 countries, or just advanced economies (AEs) or emerging/developing economies (EMDEs).<sup>6</sup> There is a modest net tightening (mainly in EMDEs) from 2000-2007, abrupt loosening in 2008-2009, sharp tightening in 2010, and more gradual tightening since. At the end of the sample in 2016, macroprudential policy had been tightened 96 times on net (54 times in EMDEs and 42 in AEs). Although more net tightening occurred in EMDEs, especially from 2002-2015, this does not reflect more net tightening on average in this group, but instead the larger number of EMDEs. This becomes evident in the middle of Figure 1, which averages the annual net changes in macroprudential policy by the number of countries in each group. AEs have loosened more on net during recessions, and tightened more often on net since 2012. At the end of the sample, AEs were tightening macroprudential policy an average of 1.2 times per country on net, about twice the average for emerging markets.

Next, although the iMaPP data does not measure the overall macroprudential policy stance in each country, it is possible to construct a proxy by aggregating the changes in each country's macroprudential policies since the data starts in 1990—a year when the use of these tools was fairly limited so each country can be assumed to start from a similar, neutral stance. Adopting this approach (also used in Bergant et al., 2020), the bottom of Figure 1 shows average macroprudential stances. There was minimal change in the 1990s, and the modest net tightening over the 2000s implied that on the eve of the 2008 Global Financial Crisis, macroprudential policy had been tightened less than 2 times on net per country on average. Countries began to tighten macroprudential policy more frequently after

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<sup>5</sup> It also includes quantitative LTV ratios.

<sup>6</sup> This measure nets out any tightening and loosening in macroprudential policy and therefore does not capture how actively a policy is used, just any net tightening or loosening. For example if a country simultaneously loosens one tool and but tightens twice (with the same tool or two different tools), this yields +1 for the net policy change.



2010, so that by 2016 the average net macroprudential stance was five tightenings. AEs had a looser macroprudential stance on average than EMDEs, although the gap was closing by the end of the sample, with the looser stance for AEs reflecting their greater tendency to loosen during recessions, rather than a hesitation to tighten during stable times.

To better understand which macroprudential tools are more widely used, Figure 2 calculates average policy stances for the different tools in the iMaPP data. The top panel shows that the macroprudential tool tightened most by 2016 was banks' capital requirements (which includes some microprudential tightening). Other tools with a tighter stance are: limits on LTV ratios, limits on FX positions, liquidity requirements, and loan restrictions. The use of different tools also varies by country group, with advanced economies more likely to have tightened measures aimed at the housing market (LTV and DSTI ratios) and SIFIs, but loosened reserve requirements. In contrast, EMDEs are more likely to have tightened (on net) reserve requirements and set limits on FX restrictions and liquidity.

Finally, while Figure 1 documents that macroprudential policy has become tighter on average, this masks important differences across countries. To better understand this variation, Figure 3 graphs the number of countries with different macroprudential stances at four dates: 2000q1 (before the boom), 2007q1 (before the crisis), 2010q1 (after the crisis), and 2016q4 (the sample end). In 2000, half of the sample had not tightened their macroprudential stances on net over the last decade, and only 5% had tightened three or more times on net. In 2007, the peak of the boom, only 20% of countries had tightened their macroprudential stances more than 3 times (predominantly EMDEs). In contrast, by 2016 almost two-thirds of the sample had tightened their macroprudential stances at least 3 times on net. As the average stance tightened, however, the cross-country variation increased. In 2016 20% of countries had tightened macroprudential policy 10 or more times, while 17% had not tightened at all on net. (AEs and EMDEs had similar average stances, but AEs were over twice as likely to have not tightened at all on net.) This increased variation in macroprudential stances could help identify if these policies improve a country's resilience to global shocks in empirical analysis.

### **3. *EMPIRICAL EVIDENCE: CAN MACROPRUDENTIAL POLICY ACHIEVE ITS GOALS?***

As countries use macroprudential policy more actively, and cross-country, time-series data on these tools has become available, a body of empirical research provides initial evidence of what works—and what does not. This section begins by discussing the empirical challenges in assessing the effects of macroprudential policy (part a). Then it surveys the literature on whether the tools achieve their direct goals in terms of: the housing market and broader credit growth (part b), international borrowing,

lending and FX exposure (part c), and GDP growth, pro-cyclicality, and resilience to shocks (part d). This section concludes by tying together a key theme; many macroprudential tools can influence their immediate objective, but have unintended consequences, especially through non-bank financial intermediaries and international capital flows. These leakages and spillovers can be significant and meaningful, and should be part of any assessment of macroprudential policy, although they are generally smaller than the direct domestic effects. For additional background on the research below, see Bergant et al. (2020), Buch and Goldberg (2016), Cerutti et al. (2017), ECB (2020a) Galati and Moessner (2018), and IMF-FSB-BIS (2016). Particularly noteworthy is Araujo et al. (2020), which performs a meta-analysis of over 66,000 results from 58 empirical studies on macroprudential policy to ascertain which results are consistent across instruments, approaches, time horizons, samples and outcome variables.<sup>7</sup>

### ***3.a. Empirical Challenges***

Empirical assessments of macroprudential policy face five challenges: measuring intensity, reverse causality, omitted variable bias, limited time series, and spillovers/leakages. Some papers have addressed these challenges through unique micro-level data, natural experiments, or creative econometric strategies, but each approach has advantages and disadvantages.

A first challenge is measuring the intensity of macroprudential measures—including both the relative intensity of the same tool applied across countries as well as of different tools within a specific country. Countries have adopted different macroprudential tools, with different thresholds, different levels of enforcement, different goals, and in different financial settings, so that imposing the assumption that a tightening has the same effect across countries would bias coefficient estimates toward zero (i.e., suggesting no effect). For example, even something as specific as a limit on FX lending could be a modest cap relative to a bank’s overall loan portfolio (or FX assets), or limits on just FX mortgage lending, or a complete prohibition on all FX lending. Even more complicated is comparing the magnitudes of changes in different types of tools—even within the same country. For example, how can a change in the CCyB be compared to changes in rules on FX borrowing or tighter regulations on SIFIs? Given these challenges, most empirical studies do not incorporate the intensity of changes in macroprudential policy and instead simply code any tightening in any tool as a +1 (and any easing -1). This amalgamation of very different macroprudential actions into dummy variables biases studies against finding any effect of macroprudential regulation.

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<sup>7</sup> The “FRAME” online repository from the BIS ([https://www.bis.org/publ/qtrpdf/r\\_qt1903f.htm](https://www.bis.org/publ/qtrpdf/r_qt1903f.htm)) provides updated evidence on the impact of a subset of bank regulations.

Only a few studies have attempted to address this challenge of measuring the intensity of regulations. Forbes et al. (2015) analyse reports by investors and international financial institutions to classify a subset as “major”. Vandebussche et al. (2015) and Ahnert et al. (2020) use detailed data on four similar tools in Eastern Europe to incorporate the magnitudes of adjustments. Cerutti et al. (2017) cumulate the number of changes in reserve requirements over time to create an index of intensity, and Alam et al. (2019), Richter et al. (2019), and Friedrich et al. (2020) use changes in either the LTV ratio or CCyB (which are more comparable across countries). Each of these studies finds evidence that more “major” or larger adjustments have larger effects—although sample sizes are generally small and error bands are wide. The studies which incorporate precise magnitudes (such as for the LTV or CCyB), however, have the important advantage of providing information on how to calibrate adjustments to achieve a certain result—a calibration critically important for policy.

A second challenge in assessing the impact of macroprudential policy is reverse causality. When the dependent variable (such as credit growth or FX borrowing) starts to increase, policymakers are more likely to tighten tools related to those variables. This would downward bias estimates of the impact of the tools—or even find correlations suggesting the opposite of expected. To address this challenge, most papers take the easy approach of lagging their measures of macroprudential policy. This is unlikely to fully address issues around endogeneity and selection bias. Several papers go further by instrumenting for the policy changes and/or creating some type of exogenous macroprudential policy shock (Cizel et al., 2019; Ahnert et al., 2020). This is more likely to lead to unbiased estimates, but the first-stage is often imprecisely estimated because it is difficult to predict when tools are adjusted. Another solution is to use micro data or event studies (often combined with some type of binding constraint), such as Aiyar et al. (2014b) and Jiménez et al. (2017). This can provide better identification, but the specific examples may not generalize and the narrower tests can miss important leakages and spillovers. One of the best approaches is propensity score matching, which compares the dependent variables in countries that have adjusted policy with the “nearest neighbor” or a synthetic construct of similar countries that do not adjust policy. This approach was first used in Forbes et al. (2015) and Forbes and Klein (2014, 2015), with more recent applications in Cizel et al. (2019) and Frost et al. (2020). The two main challenges with this approach are finding good “matches” and large standard errors over longer horizons.

A third and closely related challenge in estimating the impact of macroprudential tools is omitted variable bias. This occurs if factors correlated with regulations, but not included in the empirical specification, affect the dependent variable. This is an issue because countries which use

macroprudential policy more actively have significantly different institutions and macroeconomic characteristics than countries which do not (Forbes and Klein, 2015; Forbes et al., 2015), and because countries often adjust macroprudential policy in conjunction with other policies (Akinci and Olmstead-Rumsey, 2018). The obvious solution is to control for any country characteristics and policy changes that are correlated with changes in macroprudential policy, but many of these studies already have limited degrees of freedom and it can be difficult to control for such a broad array of other hard-to-measure characteristics and policies. Some studies reduce these concerns, however, with careful attention to their econometric specification and/or by using difference-in-difference methodologies.<sup>8</sup>

A fourth challenge in this literature is the relatively limited use of macroprudential tools to date (Forbes, 2019 and 2020). Many tools have only been adjusted by small increments and to levels well below what models suggest are optimal (see Hanson et al., 2011 for the CCyB). As a result, some tools may not have been tightened to levels that meaningfully improve resilience to certain shocks. Also, the majority of macroprudential adjustments have been tightenings (Figure 1), so there is limited evidence on whether the effects of tightening and loosening are symmetric. Perhaps most problematic, macroprudential tools have only become more widely used during the recovery after the Global Financial Crisis, so there has been little opportunity to analyze their effectiveness during downturns and over the full business cycle (Forbes and Klein, 2014). The financial market stress and sharp recession in 2020 from Covid-19, however, will provide an opportunity to assess if current stances can provide the hoped-for resilience to a large external shock (Section 4), as well as if loosening macroprudential tools (such as for the CCyB, in Friedrich et al., 2020) can cushion the impact of the crisis.

A final challenge in this literature is that any analysis should assess not only the direct impact of macroprudential tools, but also any leakages or spillovers. Leakages are generally defined as lending or credit shifting to other domestic institutions that are not subject to the same regulations (often non-bank entities), while spillovers are when lending or credit shifts to other countries. The evidence suggests that these leakages and spillages often occur, can be significant, and can meaningfully mitigate the impact of macroprudential policies on their specific targets—as well as impact other variables and countries. Agénor and da Silva (2018) survey the evidence on international spillovers, especially through cross-border banking flows. Incorporating these leakages and spillovers in any empirical analysis can be challenging, however, as it often involves incorporating additional data (such as from non-bank entities

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<sup>8</sup> For example, Forbes et al. (2016) look at portfolio shares (instead of total portfolio flows) to control for any omitted variables affecting capital flows, and Ahnert et al. (2020) compare changes in banks' and corporates' borrowing and debt issuance to control for any omitted variables that affect each type of entity or borrowing.

and non-resident banks). Studies that achieve better identification by using detailed micro data are often unable to capture these types of unintended consequences. More recent macroeconomic work, however, is paying closer attention to these leakages and spillovers when possible given the evidence on the importance of the regulatory perimeter (Ahnert et al., 2020; Cerutti and Zhou, 2018).

### ***3.b. Empirical Effects: Housing and Domestic Credit Growth***

Despite these empirical challenges, a rapidly growing literature assesses the effects of macroprudential policies. A focus of this literature is the housing market and broader credit growth—two key targets of macroprudential policy given the evidence that housing booms, growth in mortgage lending, and rapid credit growth are correlated with financial stability risks, sharper recessions and slower recoveries (Mian et al. 2017; Jordá et al., 2016).

Beginning with the housing market, most studies find that tightening a range of macroprudential tools meaningfully dampens housing activity.<sup>9</sup> The tools appear to be more effective in terms of slowing the growth of mortgages and household credit, with weaker effects on house prices (Araujo et al., 2020). There is also some evidence that macroprudential tools can increase the resilience of borrowers and the financial system to shocks to house prices or income, including by reducing the pro-cyclical feedback between credit and house prices. Studies also suggest that there are benefits from using multiple housing-related tools at the same time—such as some targeting lenders and others borrowers—in order to reinforce their effectiveness and mitigate the shortcomings of individual tools. For example, although LTV limits are one of the more popular and easy-to-implement regulations, other tools become more important when house prices increase rapidly (making LTV limits less effective).

A closely related focus of empirical work is how macroprudential policy affects overall credit growth. Tighter macroprudential policy is generally significantly correlated with slower aggregate credit growth, with some evidence this is where macroprudential policy is most effective (Araujo et al., 2020).<sup>10</sup> Much, but not all, of the impact on aggregate credit growth occurs through household credit, and there is mixed evidence on which tools are most effective. For example, Claessens et al. (2014) show that caps on borrowers (such as LTV and DTI ratios) have a stronger impact than general capital buffers, while Araujo et al. (2020) find stronger effects from liquidity tools.

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<sup>9</sup> Key studies include: Crowe et al. (2013); Vandenbussche et al. (2015); He et al. (2016); Kuttner and Shim (2016); Cerutti et al. (2017); Akinci and Olmstead-Rumsey (2018); Alam et al. (2019); Richter et al. (2019); and Acharya et al. (2020).

<sup>10</sup> See Lim et al. (2011); Aiyar et al. (2016); Cerutti et al. (2017); Jiménez et al. (2017); and Akinci and Olmstead-Rumsey (2018).

This literature examining the impact on housing measures and broader credit growth also provides some evidence on when macroprudential policy is more effective. There is stronger evidence when regulations are tightened (instead of loosened), although this may reflect the limited observations for the later. Macroprudential policy appears to have larger effects: in less financially developed and less open economies (Cerutti et al., 2017; Cizel et al., 2019); when targeted narrowly at specific sectors (Crowe et al. 2013; Basten and Koch, 2015); and in emerging markets, for shorter windows, or when using micro-level data (Araujo et al., 2020). One factor that can influence the size of the estimated effects is if the analysis incorporates leakages through non-bank credit and spillovers through international banks (section 3e). When tighter regulations slow the growth in domestic bank credit, there is often a corresponding increase in credit from other sources. These other sources are generally more responsive in countries with more developed non-bank financial markets (usually advanced economies), in countries more integrated with international financial markets, and over longer periods. These unintended consequences are also less likely to be captured in research using micro data.

### ***3.c. Empirical Effects: International Lending, Borrowing and FX Exposure***

Another focus of the empirical literature on macroprudential regulations is the effects on lending abroad by domestic banks, domestic borrowing from foreign sources, and domestic exposure to foreign currency (which includes borrowing from domestic or foreign entities). Much of this work focuses on international banks, building on a long literature on regulatory arbitrage and banks' internal capital markets (Cetorelli and Goldberg, 2012), although some incorporates other sources of cross-border credit. Understanding these international exposures and capital flows is important as they can generate macrofinancial vulnerabilities and amplification effects that are a key concern of macroprudential policy.<sup>11</sup> They can also be an important part of the leakages and spillovers that undermine the effectiveness of macroprudential tools aimed at bolstering the domestic economy.

To begin, consider how macroprudential regulations that increase the cost of lending domestically and reduce domestic credit growth (Section 3b) affect a bank's decision to lend abroad. Some papers find that banks respond by reducing lending both at home and abroad by similar amounts (Aiyar et al., 2014a), or that the reduction in lending abroad is substantially larger when the regulations interact with other policies that make domestic lending more attractive (Forbes et al., 2017). This evidence, however, largely comes from detailed UK bank data, which allows cleaner identification of

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<sup>11</sup> See Eichengreen et al. (2003), Bordo and Meissner (2005), and Ahnert et al. (2020).

country-specific loan demand and supply effects than most work, but may not generalize to other experiences. Other work focusing on a cross-section of countries generally finds that tighter macroprudential regulations cause banks to increase lending abroad, primarily through affiliates (Cerutti and Zhou, 2018). Banks also appear to respond by increasing foreign lending more in countries with fewer regulations and weaker standards, leading to weaker overall lending standards (Ongena et al., 2013; McCann and O’Toole, 2019; Houston et al., 2012).<sup>12</sup> These international spillovers suggest that macroprudential tools that only regulate domestic lending may be less effective at bolstering overall bank resilience.

Why do tighter regulations at home contribute to a large contraction in foreign lending in some cases, but not others? Buch and Goldberg (2016) help reconcile these findings using detailed micro-data for fifteen countries. They document different effects across countries, partially reflecting different bank characteristics and macroprudential tools. For example, they find greater international spillovers from tools targeting liquidity or specific sectors, and weaker effects from capital tools. In most cases, they find that the spillovers through international lending are small in magnitude, albeit with the important caveat that few countries tightened macroprudential policy over their sample.

While the evidence on how macroprudential regulations impact banks’ lending abroad is mixed, there is stronger evidence of the impact on international exposures and borrowing (from banks and other entities). A large literature shows that “surges” of borrowing from abroad are significantly correlated with unsustainable credit growth and asset price bubbles, as well as with “sudden stops” that correspond to sharp recessions and currency and banking crisis (Forbes and Warnock, 2012). The theoretical literature shows how borrowers do not fully account for the externalities from international debt (section 2a), justifying macroprudential tools restricting international borrowing and foreign currency exposures (section 2b). This literature often lumps together macroprudential measures related to foreign currency exposures with capital controls on international borrowing—jointly referred to as “capital flow management measures”.<sup>13</sup>

This literature generally finds that macroprudential limits on borrowing in foreign currency (including limits on FX exposure, FX liquidity and currency mismatch) can be highly effective. For example, De Crescenzo et al. (2017) show that currency-based restrictions on banks reduce short-term cross-border banking flows, and Aguirre and Repetto (2017) find that limits on banks’ FX positions

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<sup>12</sup> Danisewicz et al. (2017) find that multinational banks respond to changes in capital regulations by adjusting lending through branches more than through subsidiaries.

<sup>13</sup> See Forbes (2007), Cline (2010), Ostry et al. (2010), Magud et al. (2011), and Klein (2012) for surveys on controls.

meaningfully reduce credit growth in Argentina. In the most detailed study of FX-related macroprudential tools to date, Ahnert et al. (2020) find significant and large reductions in bank borrowing and lending in foreign currency, albeit with a side-of effect that companies react by increasing their FX bond issuance. The overall FX borrowing of the economy declines (as the increase in FX bond issuance is significantly less than the reduction in FX bank borrowing), but FX exposure shifts from regulated banks to unregulated sectors.<sup>14</sup> Bank sensitivity to the exchange rate declines, which could reduce bank failures after large currency depreciations, but the sensitivity of the broader economy to exchange rate movements does not appear to improve as much due to these leakages.

Given these leakages from regulations focused on FX exposure by banks, another approach for limiting a country's exposure to foreign borrowing is to limit capital inflows directly, such as through moderate taxes on capital inflows. The evidence on whether these types of measures work, however, is less compelling than for measures targeting FX exposures directly. A few studies focusing on an individual country or small group of countries find some impact,<sup>15</sup> but cross-country studies generally find no significant or lasting effect on the volume of inflows. On a more positive note, many studies of the impact of moderate taxes on capital inflows find that they can shift the composition of flows in ways that should reduce country vulnerability, such as to a longer duration or away from debt towards equity (De Gregorio et al., 2000; Ostry et al., 2010; Ostry et al., 2012; Klein, 2012; and Magud et al., 2011). The issue of selection bias (section 3a) is a major challenge in these studies, as countries with larger capital inflows are more likely to enact policies limiting these flows, therefore biasing estimates of their effects towards zero. Studies that address this with propensity-score matching, however, also find that capital-flow measures do not significantly affect the volume or volatility of aggregate portfolio flows, but can reduce other measures of financial vulnerability (Forbes et al., 2015 and Frost et al., 2020).<sup>16</sup>

Taxes on capital inflows also appear to generate meaningful leakages and spillovers. For example, Alfaro et al. (2017) find that Brazil's capital controls had no impact on large, export-oriented firms, as they could more easily shift to other sources of finance. Forbes et al. (2016) use portfolio-level data to show that investors responded to Brazil's taxes on capital inflows by shifting exposure to countries that are "similar" to Brazil, while decreasing exposure to other countries viewed as more likely to adjust their capital controls. Giordani et al. (2017) find similar evidence of capital controls shifting

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<sup>14</sup> Bacchetta et al. (2019) also find that macroprudential FX regulations correspond to increased FX bond issuance of non-financial corporates.

<sup>15</sup> See Bruno et al. (2015) for 12 Asia-Pacific countries and Forbes et al. (2016) for Brazil.

<sup>16</sup> Frost et al. (2020) also finds that some FX-based macroprudential policies are more effective at shifting the composition of flows in ways that correspond to a lower probability of banking crises and inflow surges.



flows into other countries with similar economic characteristics (measured using risk levels). Both papers find that the magnitude of this capital flow “deflection” from controls can be important in magnitude, and that there is no comparable deflection from macroprudential regulations. Forbes et al. (2016) suggest that the larger spillovers from capital controls may reflect a greater “salience” as they receive more attention from international investors than macroprudential policies.

### ***3.d. Empirical Effects: Pro-cyclicality, Boom-Bust Cycles, Resilience to Shocks and GDP Growth***

While most of the empirical literature on macroprudential regulations assesses their direct impact on specific variables that correspond to financial risks (such as housing, credit growth, FX exposure, and international lending and borrowing), several papers are more ambitious and test if macroprudential regulations achieve their broader goals of stabilizing growth, dampening boom-bust cycles, and reducing vulnerability to shocks. In other words, instead of assessing intermediary targets that should make the financial system less likely to amplify shocks, these papers directly assess if the regulations make the financial sector less pro-cyclical and more resilient. The evidence from these more ambitious tests is even more tentative, however, because omitted variable bias is a greater concern and macroprudential tools have not been in widespread use for long enough to assess these effects across the full business cycle. The sharp volatility and recession in 2020 from the “Covid shock”, however, should provide an initial test during a sharp “bust” (section 4).

Studies using a variety of approaches find some evidence that tighter macroprudential tools can reduce pro-cyclicality and boom-bust cycles. For example, Nier and Zicchino (2008) show that better-capitalized banks lend more during downturns and crises, and Jiménez et al. (2017) find that dynamic provisioning can smooth post-crisis credit supply. Buchholz (2015) reports faster credit growth after the 2008 crisis in countries with caps on banks’ leverage, and Dell’Ariccia et al. (2012) find that macroprudential tools reduce the frequency of credit booms and the severity of the following busts. Several studies find evidence that tighter regulations reduce the negative tail risk of output growth by tempering booms and cushioning the economy during recessions (Boar et al., 2017; Neanidis, 2019).

A branch of this literature focuses on whether macroprudential tools can reduce vulnerability to shocks. Brandao-Marques et al. (2020) show that macroprudential regulations dampen downside risks from external financial shocks, with some evidence this occurs by dampening capital flow volatility (Neanidis, 2019; Gelos et al., 2019). In contrast, capital controls appear to be less effective at dampening capital flow volatility (Forbes and Warnock, 2012; Bergant et al., 2020), and can even be counterproductive by prompting greater capital outflows after foreign shocks (Gelos et al., 2019).

International spillovers and leakages are important in assessing these tools. For example, Forbes (2020) shows that tighter macroprudential regulations reduce surges of capital inflows, but have less impact (and may even increase) sudden stops. These seemingly contradictory results occur because the regulations decrease cross-border bank lending (which becomes less prone to surges), but increase cross-border debt issuance (which is more prone to sudden stops). Bergant et al. (2020) show that macroprudential regulations (but not capital controls) reduce the impact of global financial shocks on GDP growth in emerging markets, but have decreasing marginal returns as tighter regulations push some financial activities outside the regulatory perimeter.

Bergant et al. (2020) also explore one channel through which macroprudential regulations could increase a country's resilience to external shocks—providing more freedom to adjust monetary policy to support domestic growth. Financial systems with stronger capital and liquidity buffers, and that are better hedged against currency movements, should be better able to withstand any reduction in capital inflows or currency depreciations that often correspond to negative external shocks. This would give a country more flexibility to respond to negative shocks by reducing interest rates to stabilize growth, rather than tightening monetary policy to support capital inflows or stabilize the currency. Takáts and Temesváry (2019a), Aizenman et al. (2020), Friedrich et al. (2020), and Mano and Sgherri (2020) also find that macroprudential policy helps emerging economies gain some monetary policy independence to respond more counter-cyclically to global financial shocks. Aizenman et al. (2020) highlight, however, that peripheral economies are less likely to have this independence if they have current account deficits, low reserve levels, relatively closed financial markets, and/or recent sharp increases in net portfolio inflows and credit growth.

While these studies find tentative evidence that macroprudential regulations can reduce a country's vulnerability to negative shocks, moderate boom-bust cycles, and support long-term growth, there is some evidence that this comes at a cost in terms of short-term growth. When tighter macroprudential policy achieves its goals of slowing credit growth and reducing international exposures (sections 3b and 3c), this reduced access to credit can slow economic activity and GDP growth (Belkhir et al., 2020; Sanchez and Rohn, 2016; Richter et al., 2019). The meta-analysis in Araujo et al. (2020) provides evidence of these contrasting effects over different time horizons. Most evidence of significant negative effects of macroprudential policy on economic activity occur in the short term, with more muted and often positive effects over longer horizons. This could generate political challenges to tightening macroprudential policies, as the costs accrue today while the benefits accrue over a longer period than the political cycle.

### **3.e: Summary: Weighing the Direct Effects against the Indirect Leakages and Spillovers**

The evidence on the effectiveness of macroprudential regulations suggests that they have had some success in terms of their direct targets—primarily in terms of credit growth (including mortgages) and certain types of riskier exposures (such as to FX bank borrowing). There is also tentative evidence that they can moderate boom-bust cycles over time, albeit possibly at a cost of slower short-term growth. There is less evidence, however, that these regulations (including capital-flow management measures) can meaningfully affect other variables, such as the exchange rate or volume of capital flows. One emerging theme is how regulations can also have unintended consequences that dampen their effectiveness and shift risks outside the regulatory perimeter.

More specifically, although tighter macroprudential regulations restrain lending by domestic banks, the impact on broader credit growth is more muted as lending increases through non-banks (Akinci and Olmstead-Rumsey, 2018; Cizel et al., 2019; Ahnert et al., 2020) and foreign banks (Aiyar et al., 2014a, 2014b; Reinhardt and Sowerbutts, 2015; Avdjiev et al., 2016). Banks can even dodge certain regulations by adjusting the type of loan.<sup>17</sup> The size of these leakages and spillovers depends on the characteristics of the banking system, with larger effects in countries that have more developed non-bank financial systems and that are more open to international banks (Beirne and Friedrich, 2017). Most important, however, although these leakages and spillovers can be large, the increased lending by international banks and non-bank institutions appears to only partially compensate for the reduction in credit from domestic banks, so that macroprudential regulations still accomplish their direct goals.<sup>18</sup>

While these leakages and spillovers appear to only mute, but not undermine, the effectiveness of macroprudential regulations, they could also introduce other hard-to-measure risks. For example, if macroprudential regulations cause banks to have safer lending portfolios at home, but increase lending to riskier entities abroad—what are the implications for the resilience of domestic banks? Or if regulations reduce banks' exposure to currency movements, but FX exposure shifts to other domestic entities that are less sophisticated and less hedged against currency rate movements—is the country as a whole more vulnerable (Ahnert et al., 2020)? Or if regulations cause banks to reduce lending to leveraged households but increase lending to the corporate sector, are they less resilient to some

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<sup>17</sup> For example, banks responded to LTV limits on secured lending in Sweden by increasing unsecured loans (Sveriges Riksbank, 2012).

<sup>18</sup> For example, Aiyar et al. (2014b) estimate that resident foreign branches fill in about one-third of the initial contraction in domestic lending from tighter regulations in the UK, while Ahnert et al. (2020) estimate that corporate debt issuance fills in for about 10% of the contraction in domestic lending from tighter FX requirements.

shocks in the future (Acharya et al., 2020)? Finally, many of these scenarios involve shifting risks outside the regulated sector, implying government authorities could be less cognizant of risks building in the broader economy, and possibly less able to effectively respond to a major shock.

This growing evidence that macroprudential regulations can shift risks outside the regulatory perimeter and across borders raises important questions about the coordination of macroprudential regulations across countries. Agénor and da Silva (2018), ECB (2020a), and Engel (2016) are comprehensive surveys of the arguments and evidence; all conclude that there is a strong case for international coordination in order to improve effectiveness at the national level, especially in a world of global capital markets. ECB (2020b) provides framework for assessing and moderating these spillovers within Europe, and BIS (2010) for use of the CCyB. Theoretical models, however, show that while there can be sizable gains from coordination, especially for more financially integrated economies, the gains can be asymmetric and small for the world as a whole (Agénor and da Silva, 2019). This can create political economy challenges, in addition to concerns that many macroprudential authorities (including central banks) have a purely domestic mandate. Bergant et al. (2020) makes the important point, however, that even if macroprudential policies in one country lead to regulatory arbitrage that shifts risks to others, this could still be optimal for the receiving country if it improves the resilience of an important trading and financial partner. Therefore, even if practical and political hurdles limit the international coordination of macroprudential policies, there are still net benefits for each country in bolstering its own financial resilience, despite widespread regulatory arbitrage.

#### **4. DID MACROPRUDENTIAL POLICY REDUCE VULNERABILITY DURING THE CORONA CRISIS?**

The spike in risk aversion, increase in market volatility and sharp economic contraction in early 2020 due to the “Corona Crisis” provide a unique natural experiment to fill in one of the gaps in the literature on macroprudential policy: whether countries that tightened policy have meaningfully improved the resilience of their financial systems and broader economies to external shocks. This assessment was previously constrained by the limited number of recessions and “busts” over the window that these tools have gained prominence (section 3d). Moreover, even though the tentative evidence to date suggests that tighter macroprudential policy can moderate financial cycles, it is unclear if policy has been tightened enough to provide meaningful support during a severe shock. The sharp impact of the Corona Crisis, however, provides a test under extreme stress. The unexpected global spread of the virus in early 2020 also provides an econometric setting that avoids the endogeneity issues plaguing earlier empirical work (section 3a), as the initial impact was independent of country adjustments to

macroprudential policy. Data is not yet available for a full assessment, but this section performs a first look at whether macroprudential stances mitigated the immediate negative impact on market variables and growth forecasts.

This analysis is most closely related to Takats and Temesvary (2019b), which finds that macroprudential measures helped stabilize cross-border capital flows during the 2013 taper tantrum, but that the effects were stronger in advanced economies than emerging markets (the opposite of expected). This analysis is also related to Ostry et al. (2012), which shows that emerging markets with FX-related regulations and/or capital controls experienced smaller declines in GDP growth during the 2008 Crisis. One challenge for both of these papers, however, was the more limited use of macroprudential policy during these earlier episodes (Figure 1).

This section assesses if a country's pre-existing macroprudential policy stance affected key variables during the first quarter of 2020—what I will refer to as the “Covid shock”. This window captures the period of market stress when the world shifted from expecting Covid-19 would likely be contained to one region to realizing its global contagion and virulence. Although the health and economic effects were still largely unknown at the start of 2020, strong policy responses began to stabilize financial markets by early April, so that most market measures (such as the VIX and credit spreads) began to improve just after 2020Q1. This timing is propitious as it allows the use of quarterly data.

More specifically, to assess the impact of a country's macroprudential policy stance during this period of heightened stress, I estimate:

$$(Y_{i,C} - Y_{i,BC}) = \alpha + \beta * MP_{i,BC} + \delta * X_{i,C} + \gamma * Z_{i,BC} + \varepsilon_{i,C} \quad ,$$

where  $Y_{i,C}$  and  $Y_{i,BC}$  are measures of the resilience of each country  $i$  during the Covid shock ( $C$ ) and before Covid ( $BC$ );  $MP_{i,BC}$  is the country's macroprudential policy stance before the Covid shock;  $X_{i,C}$  are variables to control for the immediate impact of the coronavirus; and  $Z_{i,BC}$  are variables to control for key characteristics of the economy before the Covid shock. The  $\alpha$  captures the average impact of the Covid shock across countries.

To measure a country's macroprudential policy stance ( $MP_{i,BC}$ ), I begin by aggregating all changes in macroprudential policy since 1990 from the iMaPP data in Alam et al. (2020), as discussed in Section 2c and graphed in Figures 1-3. The resulting policy stances range from -5 to 54 across 134

countries, with a higher value indicating a tighter stance.<sup>19</sup> The distribution is asymmetric with a long right tail (Figure 3), reflecting a few countries that have tightened macroprudential policy frequently, while the majority have made more limited net changes.<sup>20</sup> Since this measure may not accurately capture the intensity of macroprudential policy,<sup>21</sup> and since the effect of policy on resilience may be non-linear, I construct several proxies for the policy stance. First,  $MP_{i,BC}$  is a dummy variable equal to 1 if the country has tightened macroprudential policy on net since 1990 (83% of the sample). I also define the dummy with tighter thresholds—such as if the country tightened policy at the median (four times) or more. Next,  $MP_{i,BC}$  is a continuous measure (the net changes in macroprudential tools since 1990, in Figure 3) to roughly measure intensity. Finally, I create different “bins” capturing rough groups of countries that have tighter or looser stances. For example, I create one bin for countries with a modestly tight stance (from 1 to 6 tightenings, 51 % of sample) and another for countries with more aggressive tightening (over 6, 32% of sample). I also create narrower sets of bins.<sup>22</sup> In each case, the omitted bin is countries that have made no change or loosened macroprudential policy since 1990 (17% of the sample).

Country resilience ( $Y_i$ ), is assessed using four measures: a broad equity index (in local currency); the 5-year credit default swap rate (in US\$); the US\$ exchange rate; and the IMF’s forecast for 2020 GDP growth.<sup>23</sup> For the regressions predicting exchange rate movements, I exclude countries with a fixed exchange rate (based on Ilzetki et al., 2019). For the baseline analysis, the control variables for the immediate impact of the Covid shock are: the confirmed cases of Covid-19 as percent of the population and the stringency of the containment and closure measures as of March 31.<sup>24</sup> The controls for characteristics before the Covid shock are: the Chinn-Ito measure of financial openness; the current account balance as a percent of GDP; and country risk<sup>25</sup>. All estimation uses robust regression in order

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<sup>19</sup> The data ends in 2016 and therefore does not capture recent changes in macroprudential policy, including tighter CCyB ratios in several countries (see Friedrich et al., 2020).

<sup>20</sup> China has the tightest stance (54), followed by Peru and South Korea (23).

<sup>21</sup> See section 3a. Also, countries which tighten often in small increments will appear to have a tighter stance than countries which tighten less frequently in large increments.

<sup>22</sup> For example, I use three narrower bins (tightening 1-4 times, 5-10 times, or >10 times). The results do not change.

<sup>23</sup> Equity indices and exchange rates are from Datastream and the IMF’s IFS. CDS are from Bloomberg. IMF growth forecasts for the before-covid period were released in October 2019, and for the Covid period in April 2020. All dependent variables are percent changes, except the growth forecasts which are in changes.

<sup>24</sup> The case and stringency variables are for March 31 from the Oxford Covid-19 Government Response Tracker available at: <https://github.com/OxCGRT/covid-policy-tracker/>.

<sup>25</sup> See [http://web.pdx.edu/~ito/Chinn-Ito\\_website.htm](http://web.pdx.edu/~ito/Chinn-Ito_website.htm) for the Chinn-Ito index. Current account data for 2019 is from the IMF’s WEO Database, April 2020. Country risk is an index compiled by Fitch Solutions that incorporates

to reduce the influence of outliers (which is important given the skewness of the variable measuring the intensity of macroprudential policy). A series of sensitivity tests includes additional explanatory variables, none of which changes the main results.

Table 1 shows a sample of resulting estimates. Countries that had a tighter macroprudential stance (and were more financially open) had significantly better equity market performance during the Covid shock using each measure of the macroprudential stance. More specifically, column 1 shows that equity markets fell by an average of 22% for countries that had not tightened macroprudential policy at all, but about 16% (5.6pp less) for countries that had tightened policy at least once. Moreover, there appears to be no additional benefit to equity markets from tightening macroprudential policy more aggressively (relative to tightening only modestly). For example, column 3 shows no significant difference in equity market resilience for countries that did some tightening (1 to 6 times) relative to those that tightened more than 7 times. Results are similar using tighter bin cutoffs. Equity market performance is also similar when the criteria for a “tight” macroprudential policy uses stricter thresholds than just tightening once or more.<sup>26</sup> Moreover, although the coefficient on the continuous measure of the macroprudential stance is significant in column 2, which could indicate a linear relationship between tighter policy and equity market resilience, this coefficient becomes insignificant when China (which had the tightest stance and a relatively resilient equity market) is dropped.

Although a tighter macroprudential stance appears to have supported equity markets during the Covid shock, it provided no significant support for CDS rates, exchange rates, or expected growth. More specifically, a tighter macroprudential stance is correlated with a smaller rise in CDS spreads, but the effect is insignificant. The relationship between tighter macroprudential policy and the exchange rate or expected growth appears to be even weaker, with positive coefficients in some cases and negative in others. The results at the right of the table also suggest that far more important than macroprudential policy for growth revisions during the Covid shock was the spread of the virus and stringency of the government response.

To further explore if tighter macroprudential policy boosted equity market resilience during the initial phase of the Corona crisis, but provided no significant support for CDS rates, exchange rates, or expected growth, I perform a number of sensitivity tests. I add squared and/or cubed terms for the macroprudential stance (using the measure of intensity) to test for different non-linear relationships,

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operational, short-term and long-term political and economic risk, with a higher value indicating less risk, [https://www.fitchsolutions.com/sites/default/files/downloads/Product\\_Guide\\_Country\\_Risk\\_Apr19.pdf](https://www.fitchsolutions.com/sites/default/files/downloads/Product_Guide_Country_Risk_Apr19.pdf).

<sup>26</sup> For example, when the macroprudential dummy is based on the tighter threshold of the sample median, the coefficient falls slightly to 0.041 (and remains significant).

but these additional terms are not significant (even for equity markets). I also add eight variables (one at a time) to capture country characteristics in 2019: an emerging market/developing economy dummy, growth in GDP per capita, the fiscal balance to GDP, gross government debt to GDP, volatility in the commodity terms-of-trade index (to capture reliance on commodity exports or imports, from Gruss and Kebhaj, 2019), a rule of law index (from World Governance Indicators), restrictions on the capital account (from Fernandez et al., 2016) and a business risk index (from Fitch Solutions).<sup>27</sup> In each case, the key results are unchanged. A tighter macroprudential stance is correlated with significantly stronger equity performance in every case (at least at the 10% level), but no significant difference in CDS, exchange rates, or growth revisions. The additional variables are almost never significant.

Although it is still early in the Corona crisis, these results are consistent with the empirical evidence assessing the impact of macroprudential tools (Section 3). One of the strongest effects of tighter macroprudential policy is restraining credit growth, which is likely to restrain equity market booms before 2020, and therefore make these markets less vulnerable to sharp declines during the Covid shock. Given the more limited effects of macroprudential policy on capital flows and exchange rates, it is not surprising these tools provided less support for CDS and exchange rates. Finally, although macroprudential tools may mitigate downside risks and amplification effects, any benefits for short- and medium-term growth are likely to be overwhelmed by the effects of the virus on health, the stringency of the corresponding shutdowns, and other policy responses.

## **5. CONCLUSIONS**

Many countries have substantially improved their macroprudential frameworks since the 2008 crisis, providing a set of experiences to evaluate what works—and what does not. Although the literature analyzing macroprudential policy is still in its infancy, and the number of observations and period for analysis is still limited, a compelling body of evidence is beginning to emerge. This accumulating evidence suggests that many of these tools can influence their immediate objective (such as slowing credit growth and reducing exposure to FX borrowing) and some may provide benefits in terms of achieving their longer-term goals of building financial resilience and reducing procyclicality. There is more mixed evidence, however, on whether these tools can accomplish other goals (such as restricting capital flows or stabilizing exchange rates), and on how effective they would be during sharp downturns. Certain tools appear to be more effective than others, and many can create significant leakages and

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<sup>27</sup> All variables are from the IMF's World Economic Outlook unless otherwise noted.



spillovers, side-effects that can partially undermine the effectiveness of the macroprudential policies by reducing resilience in unregulated sectors.

Several caveats to this evaluation of macroprudential tools are of critical importance. Many of these regulations are fairly new and untested, and there is only limited understanding of the appropriate levels at which to set them in order to sufficiently reduce systemic financial risk during the next major shock. Even if they are set at optimal levels and work as intended to improve resilience and reduce the chances of another financial crisis, they should not be expected to reduce all volatility, tame the business cycle, or reduce the probability of another financial crisis to zero. The unexpected spillovers and leakages are also shifting some vulnerabilities from the regulated banking sector to other unregulated sectors, thereby generating a new set of risks that are less closely monitored and less understood. As macroprudential tools remain tighter for longer periods, regulatory arbitrage will only increase, making it important to continually adapt the regulations and possibly adjust the regulatory perimeter.

The experience from the early stages of the Corona Crisis largely support the empirical evidence on the effectiveness of macroprudential regulations. In 2020 Q1, as markets experienced unprecedented volatility and it became clear there would be a sharp global recession, bank resilience was not a prominent concern. Tighter macroprudential regulations over the previous decade appeared to mitigate issues around banks amplifying the initial shock (as occurred in 2008). Countries with tighter macroprudential policy stances also appear to have suffered less of a decline in equity markets—possibly because the regulations had previously mitigated credit growth. At the same time, however, liquidity dried up, markets became dislocated, and other sectors experienced significant stress (such as money market funds and many bond markets). These sectors were outside the purview of many of the macroprudential tools discussed in this paper, but also where some of the risks may have shifted through spillovers and leakages as banks responded to earlier macroprudential regulations.

As the Corona Crisis is still in its early stages, these results are only preliminary. Over time, however, future work should be able to use this experience to fill in gaps in the existing literature on macroprudential policy. Top priorities should be better understanding which macroprudential tools meaningfully improve resilience during a severe negative shock, if the tools are being calibrated appropriately, and whether regulations need to be adjusted to account for the leakages, spillovers, and other forms of regulatory arbitrage that may be generating new risks in the future.

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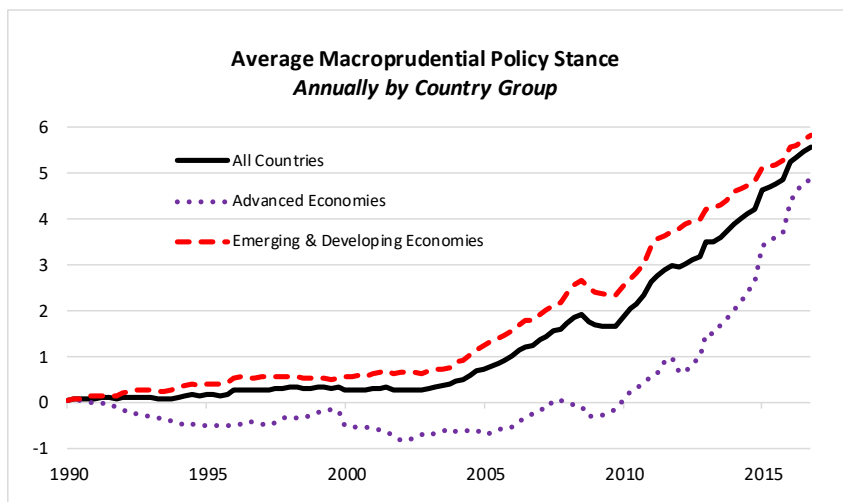
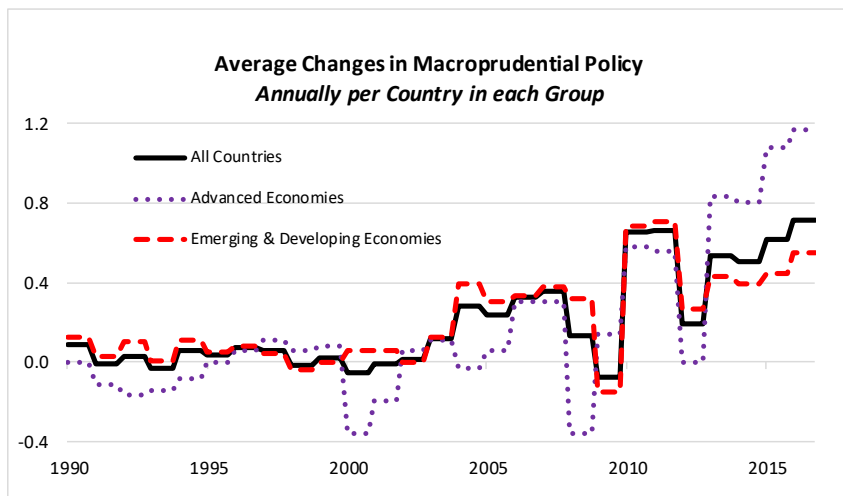
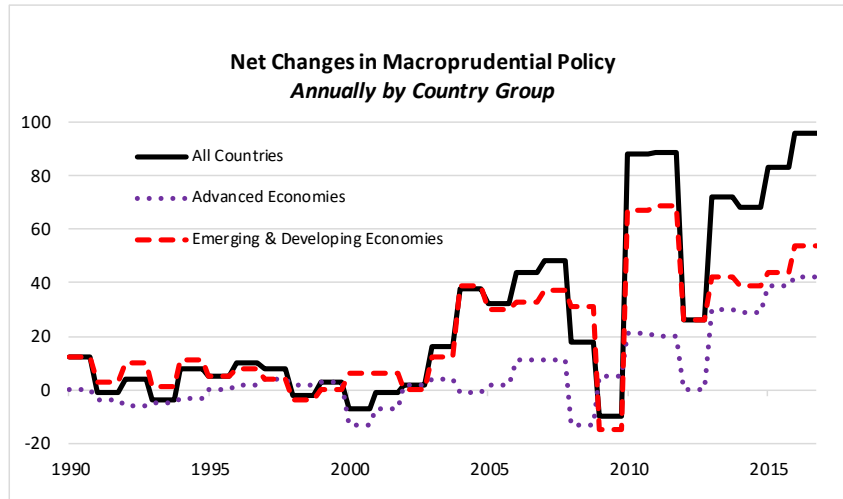
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**Table 1**  
**Impact of Macroprudential Stance on Equities, CDS, Exchange Rates and Expected Growth during the Covid Shock**

MP Measure	Equity Market			Credit Default Swap Rate			Exchange Rate			GDP Growth Forecast for 2020		
	Dummy	Intensity	Bins	Dummy	Intensity	Bins	Dummy	Intensity	Bins	Dummy	Intensity	Bins
Macroprudential Stance	0.056** (0.025)	0.003** (0.001)		-0.206 (0.255)	-0.016 (0.011)		0.028 (0.057)	0.003 (0.003)		-0.622 (0.522)	0.005 (0.026)	
Moderate MP Tightening			0.059** (0.027)			-0.204 (0.277)			-0.001 (0.064)			-0.495 (0.545)
Aggressive MP Tightening			0.055* (0.028)			-0.209 (0.282)			0.037 (0.064)			-0.840 (0.576)
Covid Cases / Population	-0.217 (0.252)	-0.180 (0.246)	-0.210 (0.258)	-1.992 (2.121)	-2.186 (2.022)	-1.993 (2.147)	0.295 (0.346)	0.355 (0.336)	0.301 (0.364)	-11.325** (4.726)	-9.158* (4.807)	-11.633** (4.701)
Stringency of Response	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	0.001 (0.007)	0.001 (0.007)	0.001 (0.008)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.033** (0.012)	-0.033** (0.012)	-0.032** (0.012)
Capital account openness	0.120** (0.040)	0.105** (0.039)	0.117** (0.041)	-0.698* (0.362)	-0.768** (0.353)	-0.698* (0.366)	-0.126 (0.075)	-0.161* (0.078)	-0.122 (0.080)	-1.409** (0.694)	-1.263* (0.711)	-1.397** (0.690)
Current account / GDP	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.007 (0.024)	0.012 (0.023)	0.008 (0.024)	-0.008 (0.005)	-0.010* (0.005)	-0.009 (0.005)	0.078** (0.031)	0.066** (0.032)	0.079** (0.031)
Country risk index	-0.002 (0.001)	-0.001 (0.001)	-0.002 (0.001)	-0.013 (0.013)	-0.012 (0.013)	-0.013 (0.014)	0.001 (0.003)	0.002 (0.003)	0.001 (0.003)	-0.073** (0.024)	-0.075** (0.025)	-0.071** (0.024)
Constant	-0.220* (0.112)	-0.226** (0.106)	-0.216* (0.114)	2.611** (1.008)	2.576** (0.946)	2.609** (1.020)	0.175 (0.201)	0.138 (0.199)	0.159 (0.211)	2.010 (1.712)	1.397 (1.689)	1.835 (1.722)
<b>Observations</b>	<b>65</b>	<b>65</b>	<b>65</b>	<b>72</b>	<b>72</b>	<b>72</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>106</b>	<b>106</b>	<b>106</b>
<b>R-squared</b>	<b>0.260</b>	<b>0.259</b>	<b>0.253</b>	<b>0.218</b>	<b>0.250</b>	<b>0.217</b>	<b>0.230</b>	<b>0.269</b>	<b>0.208</b>	<b>0.375</b>	<b>0.352</b>	<b>0.387</b>

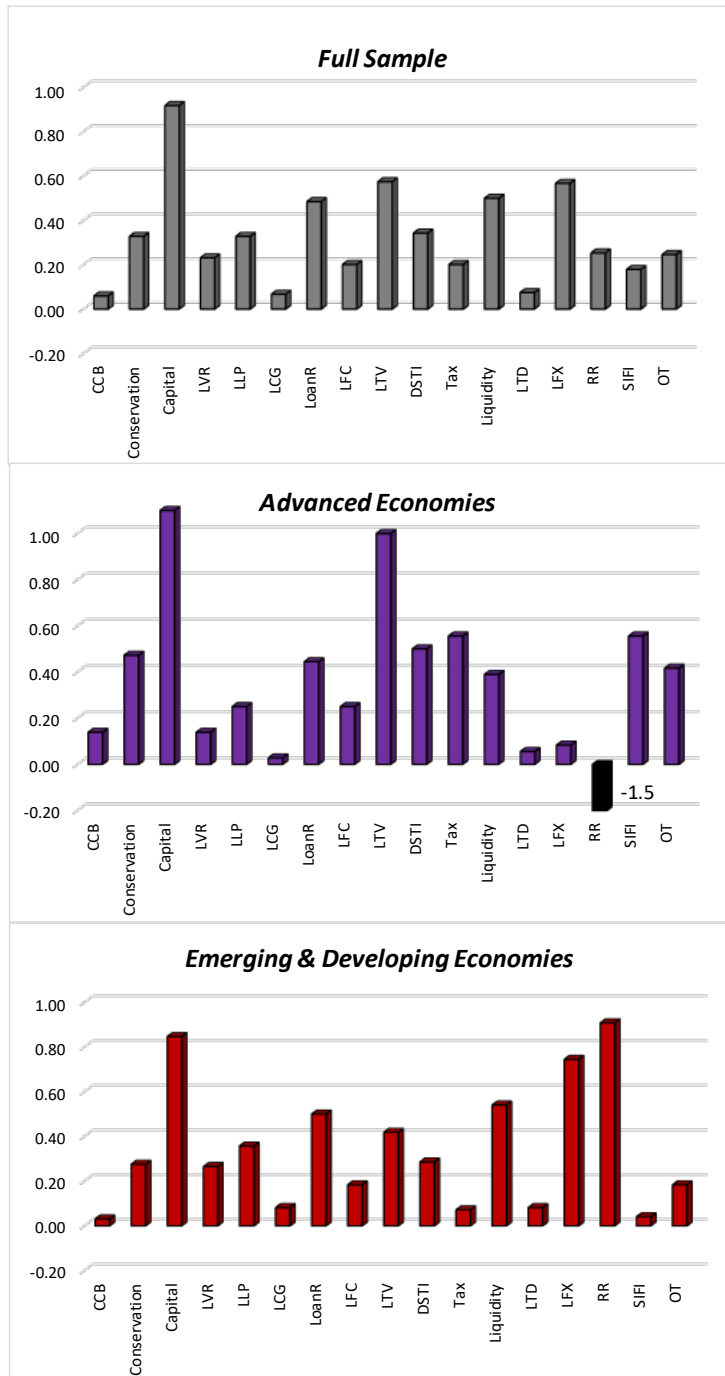
**Notes:** Equity market, credit default swap rate and exchange rate are the percent change in the broad equity index (in local currency), five-year credit-default swap (in US\$), and exchange rate (versus the US\$) from end-2019 to 2020Q1. GDP growth forecast for 2020 is the change in the IMF's forecast for 2020 GDP growth between its October 2019 forecast and April 2020 forecast. Countries with a fixed exchange rate are excluded from the exchange rate regressions. The MP (Macroprudential Policy) is either: a "Dummy" equal to 1 if macroprudential policy has been tightened 1 or more times on net; "Intensity" which is a continuous measure of the aggregate tightening since 1990; or "Bins" with a dummy equal to one for "Moderate MP Tightening" (from 1 to 6 times) or "Aggressive MP Tightening" (more than 6 times). See text for other variable definitions. All estimates are robust regressions. \*\* and \* indicate significance at the 5% and 10% level, respectively.

**Figure 1**  
**Changes in Macroprudential Policy over Time**



**Notes:** Macroprudential data based on data from Alam et al. (2019). Country classification based on IMF, World Economic Outlook database (2018). See text for additional details on calculation of macroprudential measures.

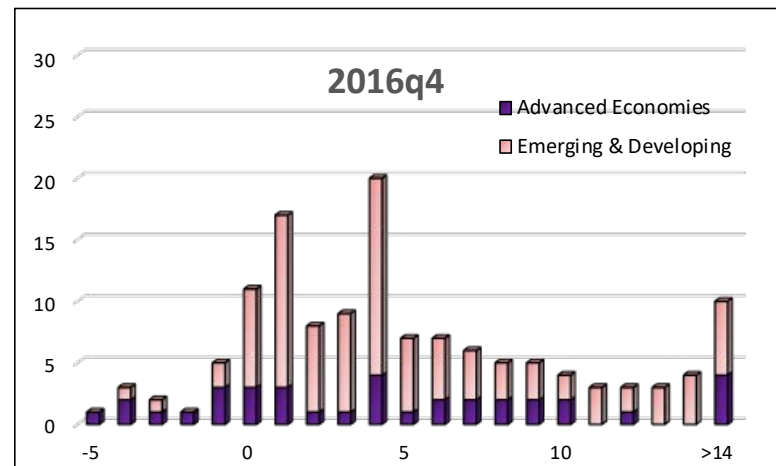
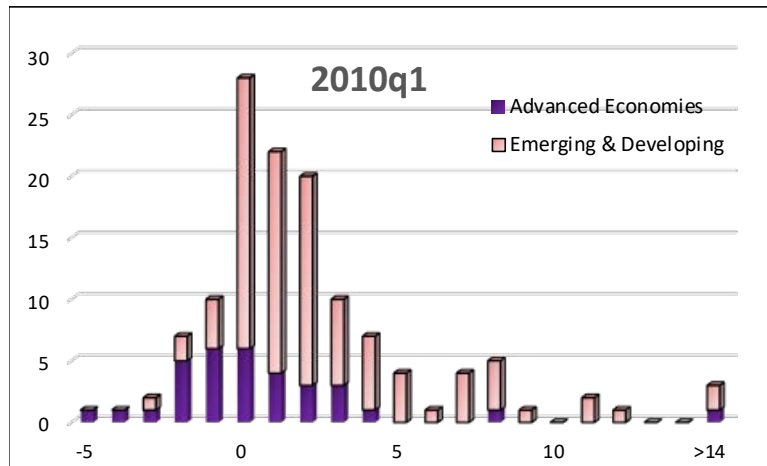
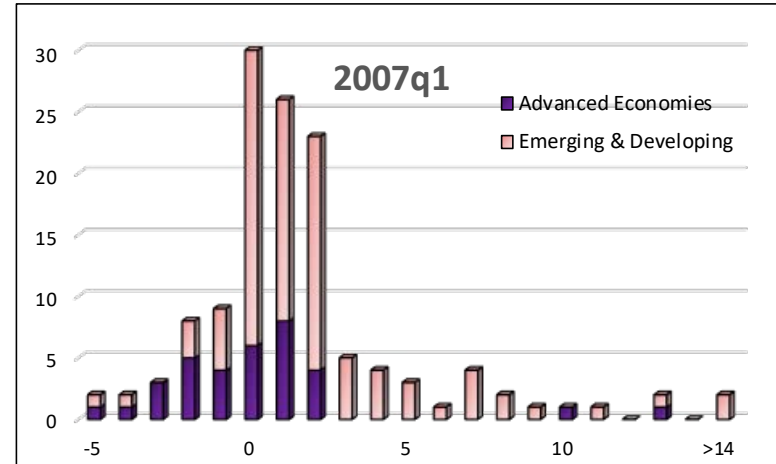
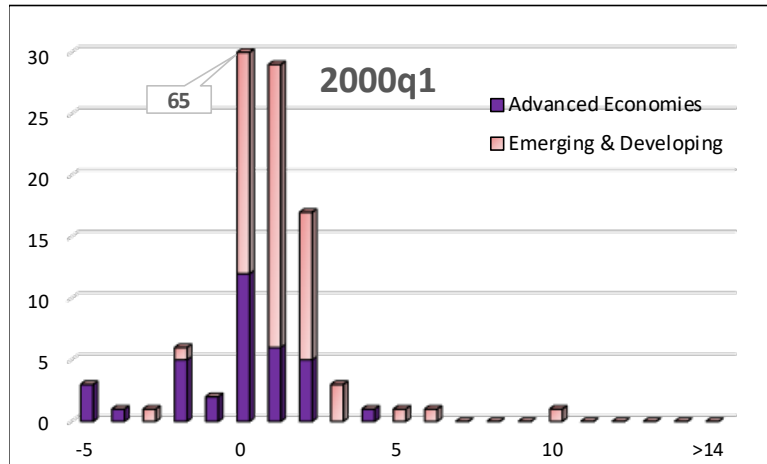
**Figure 2: Average Country Stance by Macroprudential Tool (2016q4)**



**Notes:** The macroprudential tools are: the counter-cyclical capital buffer (CCB), capital conservation buffer (Conservation), capital requirements (Capital), leverage limits (LVR), loan loss provisions (LLP), Limits on credit growth (LCG), loan restrictions (LoanR), limits on foreign currency lending (LFC), limits on loan-to-value ratios (LTV), limits on the debt-service-to-income ratio (DSTI), taxes and levies applied to certain transactions, assets or liabilities (Tax), liquidity requirements (Liquidity), limits on the loan-to-deposit ratio (LTD), limits on foreign exchange positions (LFX), reserve requirements for macroprudential reasons (RR), measures to mitigate risks from global and domestic systemically important institutions (SIFI) and macroprudential measures not captured in the above list (OT).

**Source:** Based on data from Alam et al. (2019).

**Figure 3**  
**Distribution of Macprudential Policy Stances**



**Notes:** Macprudential policy stance is cumulative changes in 17 different macroprudential policies since 1990q1. Sample includes 36 advanced economies and 98 emerging and developing economies, based on IMF, WEO 2018 classification.

**Source:** Based on quarterly data from Alam et al. (2019), version 2019-03-05.