The Effectiveness of Capital Controls and Macroprudential Measures[†]

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We review the literature on the effectiveness of capital controls and macroprudential measures. First, we explain the purposes and examples of capital controls and macroprudential policies. We then analyze various theoretical models and empirical findings from prior studies that investigate the effectiveness of each instrument. Moreover, we review several studies that directly compare the two instruments and discuss whether policymakers should implement capital controls or macroprudential measures to overcome financial crises. Finally, based on a discussion of the findings of previous studies, we suggest several possible avenues for future research.

I. Introduction

Financial instability provoked by foreign capital has been a major macroeconomic challenge over time. Although international capital flows are considered an important source of investment and growth, they are highly volatile across economies. Large reversals in foreign capital flows have facilitated numerous financial crises, even in countries with seemingly solid fiscal and monetary policies. Governments have struggled to properly employ policy measures to protect their economies from such instability through such means as capital controls and macroprudential measures.

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Capital controls refer to capital account interventions that manage capital inflows and outflows to ensure macroeconomic stability.[1] Capital controls apply exclusively to financial transactions between residents and non-residents. In integrated global capital markets, policymakers in many emerging countries have actively imposed countercyclical capital controls as microprudential policies against financial crises and recessions (Ostry *et al*., 2010). However, the global financial crisis (GFC) reminds us to question whether capital controls are effective policy instruments and thus whether their benefits should be reevaluated (Davis and Devereux, 2019; Zeev, 2017).

Concurrently, the need for macroprudential policies has attracted much attention from policymakers. Macroprudential measures are a set of provisions that calibrate regulatory and supervisory arrangements from a systemic perspective. These measures restrict the financial transactions of domestic agents, regardless of whether capital is provided by domestic agents or their foreign counterparts. Table 1 briefly compares capital controls and macroprudential measures. Indeed, relative to capital controls, the use and development of macroprudential policies have been rising since the GFC (Norring, 2022). Moreover, central banks actively employ both policy instruments in emerging markets to utilize their combined effects in financially distressed situations, such as currency crises (Oh, 2022). Therefore, it is paramount to analyze and compare the effectiveness of capital controls and macroprudential policies.

TABLE 1—CAPITAL CONTROLS VERSUS MACROPRUDENTIAL MEASURES

	Capital Controls	Macroprudential Measures
Definition	Capital account interventions that aim to manage capital inflows and outflows for macroeconomic stability	A set of provisions that calibrate regulatory and supervisory arrangements from a systemic perspective
Restriction	Apply exclusively to financial transactions between domestic and foreign counterparts	Restrict domestic agents' financial transactions regardless of whether the capital is provided by domestic or foreign counterparts
Recent trend	The use and development have been declining since the GFC.	The use and development have been steadily increasing since the GFC.
Emerging vs. Advanced	Emerging countries have implemented both capital controls and macroprudential policies more than advanced economies.	

Source: Galati and Moessner (2013; 2018), Korinek and Sandri (2016).

This study reviews and summarizes research findings on capital controls and macroprudential measures. First, we briefly explain the purposes of capital controls and macroprudential measures while also offering examples. Next, we review theoretical and empirical studies that analyze the effectiveness of capital controls

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[1]Capital account indicates the part of the balance of payments that records financial transactions between domestic and foreign agents. According to the Balance of Payment Manual of the International Monetary Fund (IMF), the official name was changed from "capital account" to "financial account" 20 years ago, and "capital account" means something different. In current literature, nevertheless, many papers still use the term "capital account" with the old meaning.

and macroprudential policies during crises. Furthermore, by exploring recent studies, we discuss whether policymakers should implement capital controls or macroprudential policies to counter crises. Finally, possible avenues for future research on these topics are introduced.

There are other reviews of capital controls and macroprudential measures (Erten *et al*., 2021; Kahou and Lehar, 2017; Rebucci and Ma, 2020). Our study generally refers to recent reviews but differs from them as well. First, we simultaneously consider capital controls and macroprudential measures in a comprehensive framework. Although many countries actively consider implementing both policies to deal with financial crises, they have slightly different characteristics and goals that policymakers should take note of with regard to their country's situation. Comparing which policy is more effective for financial stability is a necessary question for policymakers worldwide, and data is lacking in the literature. We explain the rationale and significance of studying both policies in tandem and introduce several studies that clarify our understanding. Second, we discuss theoretical and empirical studies separately to enable researchers interested in these topics to understand the related literature. We provide clear and understandable explanations of the core ideas of each study. In addition, each section includes a comprehensive summary table of policy effectiveness studies. The summary tables contain information on whether a study is theoretical or empirical, its data, methodology, and results. Third, we review the latest papers, mostly published after 2010, for a better understanding of the latest research trends on our topic. These studies usually focus on more effective capital controls and macroprudential policies to deal with financial crises. We also suggest potential future research directions in line with the current literature. Thus, this study complements the extant literature review on two prominent economic policies against financial crises.

The remainder of the paper is organized as follows: Section 2 presents both the purposes and examples of capital controls and discusses research examining the effectiveness of these strategies. Section 3 considers macroprudential measures and reviews studies that tested their effectiveness. Section 4 discusses recent studies comparing the effectiveness of capital controls and macroprudential policies in overcoming financial crises. Finally, Section 5 concludes the study and suggests possible future research directions.

II. Capital Controls

A. *Purpose of Capital Controls*

Capital controls are policies that regulate international capital flow movements across borders. They are designed to limit or encourage capital account transactions. In recent studies, capital controls have been suggested as macroeconomic policy tools to address financial stability concerns. Capital controls on cross-border capital flows have received significant attention from academic researchers and policymakers.

Policymakers worldwide consider adopting capital controls for several reasons.

The first two reasons pertain to the "trilemma" hypothesis postulated in international macroeconomics, which indicates that countries have three possible options from which to choose when they manage international monetary policy: fixed exchange rates, independent monetary policy, and the free flow of capital (Farhi and Werning, 2014; Rey, 2015).[2] By hindering free capital flows through capital controls, governments can pursue the other two purposes. First, capital controls are the primary tool for managing a country's exchange rate. For instance, capital inflows can cause the appreciation of real exchange rates (Edwards, 1998),[3] making exported domestic goods less competitive in international markets. Restricting capital inflows (and encouraging capital outflows) therefore decreases the need for monetary expansion efforts and higher domestic inflation that would cause a rapid appreciation of the currency (Neely, 1999).

Second, capital controls contribute to the establishment of a more independent monetary policy. Countries with less developed financial markets are vulnerable to foreign monetary movements. In these countries, capital controls can regulate or change the composition of international capital flows, aggravating distorted incentives in the domestic financial system (Neely, 1999). Therefore, they must actively develop a suitable set of restrictive capital policies to prevent financial destabilization.

Third, capital controls mitigate the volatility of short-term capital flows (Gallagher *et al*., 2011). Capital inflows tend to increase when the economy is booming, and capital outflows tend to decrease during economic depressions (e.g., financial crises). Such short-term fluctuations may intensify economic difficulties, especially in emerging countries, where the vulnerability of foreign capital is severe. To cope with such situations and pursue financial stability, policymakers should consider implementing capital control policies to mitigate the negative effects of short-term capital flows.

B. *Examples of Capital Controls*

The practical implementation of capital controls has a long history in international economic policy (Davis and Devereux, 2019; Edwards, 1999; Magud *et al*., 2018). In actuality, capital controls can be categorized according to several classification standards beyond the direction of flows (i.e., inflows or outflows) and/or the type of asset (e.g., equities, loans, and FDI).

First, capital controls can be classified depending on price or quantity. Price-based capital controls limit asset transactions through pricing mechanisms. These include taxes and subsidiaries on cross-border capital flows. Quantity-based capital controls regulate capital transactions through quantity controls, including outright prohibitions or quotas and encompassing quantitative limits on transactions of specific categories of assets, such as foreign direct investments, portfolio

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[2]Farhi and Werning (2014) and Rey (2015) noted that the global financial cycle transforms the trilemma into a "dilemma," which means that the capital account is managed if and only if independent monetary policies are possible.

[3]Real appreciation refers to an increase in the relative price of domestic goods and services compared to foreign goods and services.

investments into equities or bonds, and bank loans.

Second, the timing of controls can be an important standard for classifying capital controls, specifically as ex-ante and ex-post capital controls. Ex-ante capital controls are designed to suppress excessive risk-taking and decrease the negative shock of a financial crisis. Tightening controls on capital inflows, loosening controls on capital outflows, and the resulting prevention of currency appreciation are examples of ex-ante capital controls that mitigate overheating during boom periods. In contrast, ex-post capital controls are implemented to overcome the negative effects of financial crises. These controls include encouraging new borrowing from foreign countries and tightening capital outflows. Recent studies of capital controls, especially after the GFC, have reached a consensus that it is optimal to adopt a mix of ex-ante and ex-post policies to minimize the welfare costs of financial instability (Benigno *et al.*, 2013; Jeanne and Korinek, 2020).

C. *Effectiveness of Capital Controls*

In this section, we review and discuss the literature on the effectiveness of capital control policies, including theoretical and empirical studies. Table 2 summarizes the studies of capital controls discussed in this section.

TABLE 2—SUMMARY OF STUDIES ON THE EFFECTIVENESS OF CAPITAL CONTROLS

Study	Category	Data	Methodology	Findings
Chamon and Garcia (2016)	Empirics	Data on foreign exchange interventions from the Central Bank of Brazil	Panel regression is used to examine the effects of capital restrictions on the dollar-real bilateral exchange rate.	Brazil's capital inflows restrictions are effective in making domestic assets more expensive, thus insulating the Brazilian financial market from the international market during a crisis.
Costinot *et al.* (2014)	Theory	-	A theory of capital controls as dynamic terms of trade manipulation is developed based on an infinite-horizon endowment economy consisting of two countries.	A country with a rapid growth rate compared to the rest of the world has incentives to tax capital inflows or subsidize capital outflows for intertemporal consumption smoothing.
Dávila and Korinek (2018)	Theory	-	A model with fire sales in an economy with two types of agents is proposed.	Financial friction leads to two distinct types of pecuniary externalities: distributive externalities and collateral externalities.

TABLE 2—SUMMARY OF STUDIES ON THE EFFECTIVENESS OF CAPITAL CONTROLS (CONT'D)

Study	Category	Data	Methodology	Findings
Farhi and Werning (2014)	Theory	-	Nominal rigidity is incorporated into a standard New Keynesian model of a small open economy.	Capital controls are desirable even with flexible exchange rates when monetary policy cannot effectively manage the demand.
Forbes (2007)	Empirics	Data on non-financial Chilean firms obtained from Worldscope	Panel regression is used to examine the effects of Chilean tax restrictions on firm-financing constraints.	Tax controls significantly increase the financing cost of small publicly traded firms during the seven-year period of the *encaje*.
Pasricha *et al.* (2018)	Empirics	High-frequency data on capital control policies in 16 emerging market economies from 2001–2012	Country-level time-variant capital policy action indicators are developed.	Strict capital controls have cross-border spillover effects, which are more prominent in the aftermath of a crisis.
Ma (2020)	Theory	-	An endogenous growth model with a borrowing constraints and pecuniary externalities is proposed.	The model could capture the persistent output loss associated with financial crises and eventually show that the optimal capital control policy generates meaningful welfare gains.
Mendoza (2002)	Theory	-	A model with occasionally binding leverage or collateral constraints is proposed.	The effectiveness of capital controls is related to pecuniary externalities.
Schmitt-Grohé and Uribe (2016)	Theory	-	A model of a small open economy combined with fixed exchange rates and downward nominal wage rigidity is used.	Fixed exchange rates, nominal rigidity, and free capital mobility jointly generate aggregate demand externality.
Zeev (2017)	Empirics	Capital control dataset consisting of 33 emerging countries between 1995 and 2014, based on the de jure annual measures of capital restriction of Fernández *et al.* (2016)	State-dependent impulse responses are estimated based on the local projection method by Jordà (2005).	In countries with stricter capital inflow controls, economic outputs (such as GDP) respond less to global credit supply shocks.

Theoretical studies have mainly developed models based on the concepts of pecuniary externalities, aggregate externality, or terms of trade manipulation. First, many recent theoretical studies that focus on capital controls have introduced pecuniary externalities stemming from balance sheet effects. Mendoza (2002, 2010) proposed a theoretical model that occasionally binds leverage or collateral constraints. Constraints can bind when a negative shock hits the economy under high leverage. Under these constraints, each private agent who does not internalize the effect of borrowing limits generates pecuniary externalities. Dávila and Korinek (2018) also explained that individual decisions can attach pecuniary externalities to the market value of collateral. Specifically, they showed that financial friction can lead to two distinct types of pecuniary externalities. The first of these consists of distributive externalities that come from incomplete insurance markets in which under-insured agents exist. The second is collateral externalities stemming from price-dependent collateral constraints.[4] In another study, Ma (2020) developed an endogenous growth model with borrowing constraints and pecuniary externalities. In the model, private agents' expenditure plans are financially constrained during crisis periods, and the economic growth rate decreases compared to normal times. By incorporating endogenous growth into previous open models of the economy, the model can capture the persistent output loss associated with financial crises and eventually show that the optimal capital control policy will generate meaningful welfare gains. Models with borrowing constraints can also be found in other studies, including those of Bianchi (2011) and Benigno *et al*. (2013).

Other theoretical studies incorporated aggregate demand externalities. These types of externalities occur when aggregate demand differs from aggregate supply. Cross-border capital flows can generate aggregate demand externalities because capital inflows (outflows) are known to lead to an increase (decrease) in domestic aggregate demand. In other words, capital flows reallocate spending between domestic and foreign agents with different marginal propensities to consume (Erten *et al*., 2021). Theoretical studies generally argue that if a policymaker can internalize the effects of demand changes, they can regulate financial market transactions and effectively manage aggregate demand. For example, Farhi and Werning (2014) investigated a standard New Keynesian model of a small open economy with nominal rigidity to study optimal capital controls. They suggested that capital controls are desirable, even with flexible exchange rates, when monetary policy cannot effectively manage demand. In addition, Schmitt-Grohé and Uribe (2016) developed a model of a small open economy combined with fixed exchange rates and downward nominal wage rigidity. Using this model, they showed that fixed exchange rates, nominal rigidity, and free capital mobility jointly generate aggregate demand externalities, arguing therefore that capital controls to manage wage rigidity or unemployment problems can be beneficial during financial crises.

Furthermore, capital controls can arise from a country's willingness to influence its terms of trade (i.e., terms of trade manipulation). Costinot *et al*. (2014) developed

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[4]In other words, Dávila and Korinek (2018) explained that distributive externalities arise when a policymaker can employ changes in prices to allocate wealth to under-insured agents in incomplete insurance markets. Meanwhile, collateral externalities arise when a policymaker can employ price changes to relax binding collateral constraints that rely on market prices.

a theory of capital controls that utilized the dynamic terms of trade manipulation. Specifically, they modeled an infinite-horizon endowment economy consisting of two countries. They assumed that one can choose taxes on international capital flows to maximize welfare, whereas the other country is inactive in terms of control. Solving the model, they showed that a country with a more rapid growth rate than the rest of the world has incentives to tax capital inflows or subsidize capital outflows, as such a country tends to be associated with lower (larger) future trade deficits (surpluses), giving it an incentive to raise future consumption relative to current consumption (i.e., increase current savings).[5] Taxing capital inflows and subsidizing capital outflows helps to smooth intertemporal consumption by distorting prices downward.

For empirical studies that test the effectiveness of capital controls, the most important task is to "quantitatively measure" the level of capital controls. Most empirical work measuring capital controls is based on the International Monetary Fund's (IMF) *Annual Report on Exchange Arrangements and Exchange Restrictions* (AREAER). AREAER contains a set of de jure restrictions on a wide range of international transactions for each IMF member country. A representative capital control measure is the capital restriction index developed by Fernández *et al*. (2016). This index considers broader information on the existence of capital inflow and outflow restrictions on ten asset categories, including equity, bonds, direct investment, derivatives, and commercial credits. It stems from dummy variables that classify whether restrictions on a particular category of cross-border transactions are in place in any given country year. The index covers 100 countries from 1995–2017, and a higher (lower) value indicates that a country has a tight (less) regulation of capital inflow and outflow.[6]

In light of capital openness, Chinn and Ito's (2006) *de jure* index of capital account liberalization is a prominent country-level measure in international finance literature. The Chinn–Ito index measures a country's level of financial openness and reflects information on the country's actual regulatory controls on cross-border capital flows. It is based on the dummy indicators related to restrictions on cross-border financial transactions described in the IMF's AREAER. Specifically, the index is the first principal component of four dummy variables regarding restrictions on capital account transactions, restrictions on current account transactions, requirements for the surrender of export proceeds, and the existence of multiple exchange rates, (Chinn and Ito, 2008). Its value ranges from -1.92 to 2.33, where a higher (lower) value means that a country exhibits a higher (lower) level of capital account openness.[7] According to these definitions, the Fernandez index and the Chinn–Ito index are negatively correlated.

Previous empirical studies have found a range of country-specific or cross-country evidence of the effectiveness of capital control policies during financial crises. Forbes (2007) investigated the Chilean tax on short-term capital flows (i.e., *encaje*)

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[5]Costinot *et al*. (2014) explained that a country has a stronger incentive to distort prices downward by decreasing domestic consumption during periods of larger trade deficits. In contrast, it has a stronger incentive to distort prices upward by increasing domestic consumption during periods of larger trade surpluses.

[6]The capital control indexes of Fernández *et al*. (2016) can be found at http://www.columbia.edu/~mu2166/fkrsu/.

[7]The Chinn and Ito (2006) capital account openness index is available on the research page for Menzie Chinn and Hiro Ito: http://web.pdx.edu/~ito/Chinn-Ito_website.htm.

between 1991 and 1998. The goals of the *encaje* were to mitigate the appreciation of the Chilean peso for competitive export prices, to regulate short-term capital inflows, and to increase the central bank's ability to implement effective monetary policy, with a wedge between foreign and domestic interest rates. Using data on non-financial Chilean firms obtained from Worldscope, she found evidence that tax controls significantly increased the financing cost of small publicly traded firms during the seven years of the *encaje*. Chamon and Garcia (2016) focused on capital controls, this time in Brazil, one of the leading countries in the effort to actively manage capital inflows in response to the GFC. Brazil adopted taxes on portfolio inflows in October of 2009 and implemented several other policies to discourage inflows from late 2009 to mid-2011. They found evidence that such efforts did not yield significant changes in the exchange rate, implying limited success in alleviating exchange rate appreciation when using them. However, a tax on the notional amount of derivatives in 2011, the last restriction during the study period, strongly depreciated the exchange rate. Overall, their results indicate that Brazil's capital inflow restrictions effectively made domestic assets more expensive, thus separating the Brazilian financial market from the international market. Other country-specific studies discussed the effects of capital controls during crises: Dornbusch (2002) for Malaysia (on the Asian financial crisis) and Keller (2019) for Peru (on the 2008 GFC).

In cross-country studies, Pasricha *et al*. (2018) used high-frequency data on capital control policies in 16 emerging market economies around the time of the GFC (i.e., 2001–2012) to investigate the domestic and multilateral effects of capital controls. Specifically, they developed country-level time-variant capital policy action indicators, including easing and tightening restrictions. They showed that increases in capital account openness reduce exchange rate stability and monetary policy autonomy, a finding consistent with the monetary policy trilemma. In addition, strict capital controls caused cross-border spillover effects that are more prominent in the aftermath of the crisis. They explained that these spillovers imply the existence of a coordination problem between countries that use capital controls as an economic policy. Zeev (2017) studied the shock-absorbing capacity of capital controls by investigating whether capital controls moderate the influence of an international credit shock. The study used a capital control dataset consisting of 33 emerging countries between 1995 and 2014 based on the de jure annual measures of capital restriction of Fernández *et al*. (2016). Jordà (2005) estimated state-dependent impulse responses using the local projection method. Their main results indicated that capital inflow controls showed significant shock-absorbing capacity, whereas outflow controls had no significant effects. In countries with stricter capital inflow controls, economic outputs (e.g., GDP) respond less to global credit supply shocks. This result suggests that governments in emerging countries should consider capital inflow controls as an effective tool to improve macroeconomic stability against economic shocks.

Several studies point out the advantages of implementing capital controls, enabling countries to alter the maturity composition of financial flows. In addition, capital controls can be utilized to discourage short-term capital flows, which may cause balance-of-payment crises owing to their volatility. Ultimately, capital controls contribute to broader national goals. They allow countries to be more selective

regarding the types of investments they want and to divert flows to prioritized sectors. Specifically, Cordero and Montecino (2010) presented case studies of four countries (Malaysia, Chile, Colombia, and Brazil) regarding their use of capital controls and policy implications on economic growth.

In addition, capital controls have spillover effects on neighboring countries (Gallagher *et al*., 2011). Lambert *et al*. (2011) analyzed how portfolio inflows responded to capital controls based on evidence from Latin American countries. They used a detailed balance of payments and higher frequency data on portfolio equity and bond flows. They found evidence that the increase in the Brazilian tax on portfolio bond inflows affected other Latin American countries with significant surges in portfolio funds. This effect may explain almost all of the surges in bond inflows to Mexico in 2010. Forbes *et al*. (2011) also studied the changes in the Brazilian tax on foreign investors from 2006–2011 and tested their multilateral and direct effects on portfolio flows. They found that when capital controls are strengthened, foreign investors decrease their portfolio allocation to Brazil and increase their allocations to other Latin American countries. Overall, these studies emphasize that when we evaluate the effectiveness of capital controls, we should consider the spillover effects on investments in other countries.

Moreover, the widespread implementation of capital controls can create additional macroeconomic problems. Ostry *et al*. (2010) pointed out that the extensive use of capital controls has detrimental effects on the efficient allocation of investments across countries. They argue that the greater use of capital controls in one country compels countries whose economic circumstances do not justify using controls to impose superfluous restrictions on capital inflows. Their main perspective is that when policymakers decide on capital controls, they should carefully compare the benefits of removing financial instability and implementation costs. Furthermore, the widespread use of capital controls inevitably hinders some of the beneficial capital flows necessary for a country, thus creating distortions in balance sheets.

III. Macroprudential Measures

A. *Purpose of Macroprudential Measures*

Macroprudential measures can be defined as a set of provisions that calibrate regulatory and supervisory arrangements from a system-wide or systemic perspective. After the 2008 GFC, policymakers and scholars noted that macroprudential policy can play an important role in mitigating the negative effects of systemic risk on the overall economy (Claessens, 2015; Galati and Moessner, 2013; Kahou and Lehar, 2017). Countries have actively used macroprudential policies in tandem with capital controls and monetary policies (Akinci and Olmstead-Rumsey, 2018; Cerutti *et al*., 2017; Forbes, 2021). Consequently, there is growing policy debate about implementing macroprudential measures and their effects on economic outcomes (Tavman, 2015).

The main objective of macroprudential measures is to complement microprudential policies. Traditionally, microprudential policies assume that financial stability can be achieved through the regulations of individual institutions. However, the 2008 GFC

highlighted the shortcomings and deficiencies of a microprudential orientation. Although 99% of U.S. financially insured institutions met or exceeded the requirements of regulatory capital standards, they are widely considered the epicenter of the crisis (Kahou and Lehar, 2017). As argued by Borio (2011), the bottom-up approach to microprudential policies potentially includes fallacies of composition in that financial institutions can be stable at the individual level but fragile at the macro level. The underlying logic behind this argument is the characterization of risk. The microprudential orientation focuses on the exogenous risk because it considers the behavior and soundness of institutions on a stand-alone basis. In contrast, a macroprudential orientation emphasizes endogenous risk induced by the collective behavior of institutions. Macroprudential measures take a top-down approach to ensure the safety of the financial system as a whole.

Specifically, macroprudential tools try to ensure financial stability by reducing systemic risks. However, there is no clear consensus on how systemic risk can be defined and measured explicitly. Lehar (2005) defined a systemic crisis as "an event in which a considerable number of financial institutions default simultaneously." Acharya (2009) provided a model of systemic risk, referring to the failures of banks as a systemic crisis "if many banks fail together, or if one bank's failure propagates as a contagion causing the failure of banks." Although the literature proposes several measures of systemic risk based on these definitions, the question of which method better captures the concept of systemic risk remains open (Bisias *et al*., 2012; Brownlees and Engle, 2017; Engle, 2018). Therefore, the explicit and practical goals of macroprudential policies remain poorly defined.

B. *Examples of Macroprudential Measures*

The actual use of macroprudential tools can be classified according to two usage scenarios: time and cross-sectional.[8] First, an important objective of macroprudential measures is to mitigate the procyclical behavior of the financial system. Examples include loan-to-value (LTV) ratio restrictions, countercyclical capital requirements, and dynamic provisioning. Caps on LTV ratios reduce bank losses by limiting excessive loans during booms. This strategy is the most common macroprudential policy and aims to prevent financial crises caused by bad loans (Lim *et al*., 2011; Morgan *et al*., 2019). Countercyclical capital requirements require financial institutions to hold more capital during an economic boom and less during an economic downturn. Dynamic provisioning requires banks to predict credit losses during bad times and to build capital buffers during good times. Combined with countercyclical capital requirements, it is widely believed that the dynamic provisioning introduced in Spain in 2000 bolstered the stability of the Spanish financial system by smoothing credit supply cycles (Balla and McKenna, 2009; Jiménez *et al*., 2017). Overall, these measures are designed to reduce the procyclicality of the financial system.

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[8] Claessens (2015) provided information on the frequency at which each macroprudential policy was implemented in 42 countries.

Macroprudential measures can also allocate risk at a given point in time. Based on the risk management literature (Huang *et al*., 2012; Tarashev *et al*., 2010), these measures focus on shocks amplified through the interconnections among financial institutions. One such example is capital surcharges on systemically important financial institutions. For example, Huang *et al*. (2012) found that the marginal effect of each bank on systemic risk is mainly driven by its size, suggesting that "too-big-to-fail" is an important issue from a macroprudential perspective. Thus, the distinction between banks according to size effectively reduces systemic risk (Braouezec and Wagalath, 2018; Laeven *et al*., 2016).

Another approach to classify macroprudential measures is to categorize them into foreign exchange (FX)-related regulations and others. FX-related macroprudential tools aim to reduce the foreign currency exposure of banks. These policies are examples of capital flow management measures that are also classified as macroprudential measures (CFM/MPM), as they limit not only capital flows but also systemic risks (IMF, 2014). Indeed, the Korean government introduced such policies after the GFC because Korea has characteristics of both an advanced and an emerging economy. For example, Bruno and Shin (2014) reported lower sensitivity of Korea's capital flows compared to other Asian countries after several FX-related measures (e.g., a leverage cap on the notional value of FX derivatives contracts, and a levy on non-core FX denominated liabilities of the banking sector) were implemented. Ahn *et al*. (2022) and Yun (2022) also argued that such measures could contribute to an increase in the debt maturity levels of foreign bank branches. Overall, compared to capital controls, there is a great variety of macroprudential measures in terms of policy goals, leading to a lack of an underpinning for a unified framework.

C. *Effectiveness of Macroprudential Measures*

In this section, we discuss the literature on the effectiveness of macroprudential measures. In contrast to the capital controls literature, studies of macroprudential measures have been conducted only in recent years and thus have not provided clear policy guidance. Nevertheless, we briefly review recent progress in theoretical and empirical studies on the rationale behind the use of macroprudential policies.[9] Table 3 summarizes studies that focused on the effectiveness of macroprudential measures.

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[9]Lim *et al*. (2011), Galati and Moessner (2013, 2018), and Forbes (2021) provided comprehensive reviews of macroprudential instruments.

TABLE 3—SUMMARY OF STUDIES ON THE EFFECTIVENESS OF MACROPRUDENTIAL MEASURES

Study	Category	Data	Methodology	Findings
Acharya *et al*. (2017)	Empirics	U.S. financial firms with equity market capitalization exceeding $5 billion as of the end of June of 2007	Systemic risk is estimated using the expected shortfall.	The measure of systemic risk is useful for predicting the systemic crisis of 2007–2009.
Bekiros *et al*. (2020)	Theory	-	The non-fundamental house price expectation is incorporated into a DSGE model.	Monetary policy can more effectively mitigate the impact of non-fundamental shocks than macroprudential policy.
Braouezec and Wagalath (2018)	Theory	-	A bank's response to an exogenous shock on its balance sheet is analyzed under the constraint of a risk-based capital ratio.	The capital surcharge of BNP Paribas should be higher to mitigate systemic risk.
Cerutti *et al*. (2017)	Empirics	Macroprudential measures for 119 countries during 2000–2013 from the IMF survey, Global Macroprudential Policy Instruments	Panel regression is used to examine the effects of macroprudential instruments on credit growth.	Macroprudential policies negatively affect credit growth, in particular for emerging markets.
Gertler and Kiyotaki (2015)	Theory	-	Liquidity mismatch and bank runs are incorporated into a DSGE model.	The existence of a bank-run equilibrium depends on bank balance sheets and liquidation prices for bank assets.
Girardi and Ergün (2013)	Empirics	74 U.S. financial institutions with equity market capitalization above $5 billion	Systemic risk is estimated using the conditional value-at-risk concept.	The systemic risk measure captures information differently in the time series of institutions' value-at-risk.
Horváth and Wagner (2017)	Theory	-	Bankers' investment decisions are examined when they anticipate countercyclical capital requirements.	Countercyclical capital requirements provide an incentive for banks to invest in more correlated projects.
Jiménez *et al*. (2017)	Empirics	Bank loans, bank balance sheets, and firm balance sheets in Spain	The impacts of dynamic provisioning on credit supply and firm-level real effects are examined.	Dynamic provisioning plays an important role in smoothing credit supply cycles.

TABLE 3—SUMMARY OF STUDIES ON THE EFFECTIVENESS OF MACROPRUDENTIAL MEASURES (CONT'D)

Study	Category	Data	Methodology	Findings
Morgan *et al*. (2019)	Empirics	Data on LTV policies and mortgage loans of 4000 banks from 46 countries	The relationship between residential mortgage loans and LTV policies is analyzed using the generalized method of moments.	Although LTV policies reduce mortgage loans for the average bank, their effects are smaller for large banks and banks with bad loans.
Ono *et al*. (2021)	Empirics	Business loan ratios of Japanese firms from 1975–2009	The pattern of LTV ratios and their effects on borrowers are examined.	LTV ratios exhibit counter-cyclicality and have a negative impact on firm growth.
Punzi and Rabitsch (2018)	Theory	-	Welfare gains and losses are estimated using a DSGE model considering the ability to borrow of different households.	The LTV policy that only targets highly leveraged borrowers improves welfare.
Wong *et al*. (2011)	Empirics	Panel data for 13 countries, including information about whether each country adopts an LTV policy	The effects of LTV policies on mortgage delinquency rates and property markets are estimated.	LTV policy can effectively mitigate systematic risk.
Gambacorta and Murcia (2020)	Empirics	Bank-loan data from five Latin American countries (Argentina, Brazil, Colombia, Mexico, and Peru)	The impact of macroprudential policies on credit growth is investigated using meta-analysis techniques.	The macroprudential policies dampen credit cycles.

Theoretical studies of macroprudential policies can be divided into those that discuss partial and general equilibrium models. Partial equilibrium models generally consist of banking and finance. They analyze the interaction between lenders and borrowers with many realistic assumptions, such as information asymmetry, incentive problems, and strategic interactions (Braouezec and Wagalath, 2018; Horváth and Wagner, 2017). Although these models generate fruitful insights into the effectiveness of macroprudential policies, they are mostly one- or two-period models that do not capture the role of business cycles. In contrast, general equilibrium models mainly employ dynamic stochastic general equilibrium (DSGE) models. This approach incorporates the time dimension into the analysis by solving infinite-horizon models. Thus, DSGE models are particularly attractive for deriving practical policy guidance because they have the advantage of being able to include simulations (Bekiros *et al*., 2020; Gertler and Kiyotaki, 2015; Punzi and Rabitsch, 2018). However, the financial institutions in these models are stylized due to their technical complexity. Overall, existing theoretical studies face tractability issues when evaluating the effects of macroprudential measures on the financial system as a whole.

Next, we review the empirical studies that focus on the effectiveness of macroprudential measures. The empirical analysis in this field is complicated owing to the absence of a comprehensive framework for examining the impacts of macroprudential policies. Furthermore, the lack of discussion pertaining to which variables are suitable for capturing macroprudential purposes leads to different interpretations of the results of macroprudential measures. The main issue is how to quantify systemic risk. Although the literature employs various methods, such as the conditional value at risk, vector autoregression, and expected shortfall approaches (Acharya *et al*., 2017; Girardi and Ergün, 2013), there is no commonly shared measure of systemic risk.

Several studies have argued that macroprudential measures improve financial stability (Hahm *et al*., 2013). Cerutti *et al*. (2017) examined the effectiveness of macroprudential measures implemented during 2000–2013 in 119 countries. They found that macroprudential policies are negatively associated with credit growth. Moreover, macroprudential tools are used more frequently, and their effects are stronger, in emerging markets. Jiménez *et al*. (2017) analyzed the role of dynamic provisioning by employing the case of Spain. They showed that dynamic provisioning provides capital buffers to mitigate credit crunches during bad times. Wong *et al*. (2011) observed that caps on LTV ratios reduce the systemic risk stemming from property markets. Gambacorta and Murcia (2020) evaluated the effectiveness of macroprudential policies for five Latin American countries. Using information on bank loan data, they concluded that macroprudential tools stabilize credit cycles. Moreover, the effects of macroprudential policies on credit growth are reinforced when a monetary policy is implemented simultaneously.

However, empirical evidence of the effects of macroprudence is inconclusive. Other studies used different methods and obtained different results. For example, Morgan *et al*. (2019) argued that LTV is less effective with regard to reducing mortgage loans for large banks and banks with loans, suggesting the need for other macroprudential policies rather than LTV policies. Ono *et al*. (2021) examined the effects of the LTV business ratio on firm growth. They found that LTV ratios exhibit counter-cyclicality, which is inconsistent with the underlying assumption of LTV caps. Moreover, they documented that firms obtaining high LTV ratios are more likely to grow more rapidly in terms of employment, sales, and return on assets. Their results suggest an unintended consequence of LTV caps: while LTV caps cannot effectively reduce loans during booms due to the counter-cyclicality of LTV ratios, such a policy may negatively affect firm growth. Overall, these studies highlight the importance of specifying the objectives of macroprudential measures and their effects on the overall system.

IV. Capital Controls versus Macroprudential Measures

Finally, we discuss whether policymakers should implement capital controls or macroprudential policies to prevent or overcome crises. Few studies have directly compared the effectiveness of capital controls and macroprudential measures because the literature on macroprudential tools is still in its infancy. While the

concept of capital controls could be incorporated into a theoretical model using taxation on capital flows, macroprudential regulations have various goals and measures. This situation has led to a lack of a comprehensive framework considering both policies. Nevertheless, we review the underlying idea behind the use of capital controls or macroprudential measures through theoretical and empirical arguments. Table 4 summarizes studies that consider both capital controls and macroprudential measures.

TABLE 4—SUMMARY OF STUDIES COMPARING THE EFFECTIVENESS OF CAPITAL CONTROLS AND MACROPRUDENTIAL MEASURES

Study	Category	Data	Methodology	Findings
Bacchetta *et al.* (2023)	Empirics	Corporate bond issuances in 17 emerging countries	The likelihood of issuing foreign currency bonds is estimated.	Capital controls have a stronger effect on financial stability than macroprudential measures.
Blundell-Wignall and Roulet (2014)	Empirics	Data on nine international commercial banks and 29 emerging countries	The effects of macroprudential policies and capital controls are estimated separately.	Capital controls in emerging countries negatively affect economic growth.
Forbes *et al.* (2015)	Empirics	Data on capital flows and macroprudential measures for 60 countries	The effectiveness of capital controls and macroprudential policies is examined using the propensity score matching method.	Most capital flow management measures do not achieve their goals, whereas macroprudential policies contribute to financial stability.
Frost *et al.* (2020)	Empirics	Data on capital flows and macroprudential measures for 83 countries	The effectiveness of capital controls and macroprudential policies is examined using the propensity score matching method.	Most capital flow management measures do not achieve their goals, whereas macroprudential policies contribute to financial stability.
Korinek and Sandri (2016)	Theory	-	The effectiveness of capital controls and macroprudential policies is analyzed considering a small open economy.	Both capital controls and macroprudential policies are important to avoid financial crises.
Ostry *et al.* (2012)	Empirics	Capital controls and macroprudential measures of 51 emerging countries during 1995–2008	The effects of capital controls and macroprudential measures on crisis resilience are estimated.	Both capital controls and macroprudential measures can help improve financial stability.

Korinek and Sandri (2016) presented a theoretical framework to compare the effectiveness of capital controls and macroprudential measures on financial stability. They focused on the fact that capital controls segment domestic and foreign agents,

whereas macroprudential regulations restrict domestic borrowing, regardless of who provides the capital. They then analyzed the feedback loop of capital flows, exchange rate depreciation, and financial crises. While capital controls and macroprudential tools share the common purpose of preventing a financial crisis, the authors found that it is optimal to implement both policies because they affect different agents. A government planner uses macroprudential regulations to discourage risk-taking by borrowers. Capital controls further strengthen financial stability by inducing domestic agents to hold more insurance in that their portfolios yield higher payoffs when the economy experiences adverse shocks, such as exchange rate depreciation. Thus, the importance of capital controls decreases as exchange rates become more stable because the effects of capital controls are mainly driven by changes in capital outflows. In this framework, macroprudential measures play more of a role in advanced countries and less of a role in emerging countries than capital controls.

However, empirical evidence for Korinek and Sandri's (2016) model is mixed. Ostry *et al*. (2012) found that both macroprudential policies and capital controls helped to enhance economic resilience during crises in 51 emerging economies from 1995 to 2008. They also documented that the effects of capital controls dominate those of foreign currency-related macroprudential measures. By examining 17 emerging markets between 2013 and 2015, Bacchetta *et al*. (2023) also noted that the effects of macroprudential policies on the issuance of foreign corporate bonds are substantially reduced when capital controls are used. These studies are in line with the argument that capital controls complement macroprudential policies when currency risk significantly affects financial instability. In contrast, Forbes *et al*. (2015) observed that while macroprudential measures in 60 countries reduce financial instability from 2009 to 2011, capital flow management measures do not. Frost *et al*. (2020) reported similar results for 83 countries from 2007 to 2017, also finding that capital controls can affect volatile capital inflows for emerging economies. Blundell-Wignall and Roulet (2014) showed that capital controls harmed the economic growth of 29 emerging economies between 2005 and 2012. They argued that capital controls during crises reduce the funding ability of firms because countries with high capital controls are not attractive to foreign investors. Because the sample periods of these studies are around the GFC, they raise the possibility that macroprudential policies are more effective during periods of global crises rather than during a crisis period in a specific country. In sum, although the theoretical argument suggests that capital controls benefit emerging countries more than advanced countries, related evidence is less conclusive.

V. Conclusion

This study summarizes the literature on capital controls and macroprudential measures and discusses their effectiveness. First, we briefly review previous studies of capital controls and macroprudential measures. Capital controls have been a part of economic theory and have been employed in many countries for a long time. In contrast, macroprudential policy is a relatively new field of research and, thus, has yet to provide clear guidance for policy decisions. We then compare the effectiveness

of the two instruments.

In the remainder of this section, we propose some avenues for future research.

The first issue is that theoretical analysis considering both capital controls and macroprudential measures still needs to be improved. Although Korinek and Sandri (2016) suggested a helpful framework to distinguish between them, it does not fully capture the role of business cycles. Extending their model to include more macroeconomic dynamics potentially generates interesting policy implications.

Another critical question centers on the conditions under which capital controls or macroprudential measures effectively mitigate the negative effects of financial crises. For example, because a series of currency devaluations caused the East Asian crisis, many emerging countries relied on capital controls (Asiedu and Lien, 2004; Edwards, 1999). In contrast, the 2008 GFC began in advanced countries and raised the need to implement macroprudential measures. A fundamental understanding of the characteristics of countries and crises will provide policymakers with valuable guidance when responding to crises. The recent coronavirus disease 2019 (COVID-19 crisis) is an interesting test bed because it differs from previous crises in that both global consumption and production were affected by the pandemic. Igan *et al*. (2023) evaluated the resilience of banks in 52 countries during the COVID-19 crisis, finding that macroprudential measures significantly reduced banks' systemic risk. Comparing the effectiveness of macroprudential instruments and capital controls during these three crises in advanced and emerging economies sheds light on how the characteristics of crises and countries determine the effectiveness of capital controls and macroprudential measures.

Finally, from a practical point of view, the overall effects of capital controls and macroprudential measures on the economy as a whole must be discussed. Although the literature suggests that while these policies could contribute to financial stability, they could also have unintended consequences. For example, Ahn *et al*. (2022) documented that a levy on banks' short-term external borrowing can induce price distortions in foreign bank branches over domestic banks in that the marginal cost of funding increases more for domestic banks. Indeed, the IMF consults with member countries on various issues pertaining to the use of CFM, MPM, or CFM/MPM. While the effectiveness of these measures in reducing the volatility of capital flows or systemic risks is an important factor to those making policy decisions, other impacts on the real economy should be considered as well. Indeed, the IMF always emphasizes that CFM, MPM, or CFM/MPM cannot replace necessary macroeconomic adjustments. In this regard, studying how to coordinate these measures with other monetary or fiscal policies is one important avenue of future research.

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