CHAPTER 3: KEY MESSAGES

- Higher bank capital contributes to financial stability: it provides a cushion for absorbing losses during a crisis or other bank distress; it may improve screening and monitoring by banks; and it tends to curb risk-taking because shareholders have more skin in the game.
- Regulatory capital requirements set out minimum ratios of capital that banks must maintain relative to their risk-weighted and unweighted assets. However, increasing capital requirements can lead some banks to cut lending in the short run.
- Before the global financial crisis, bank regulation in many countries allowed banks to take excessive risk without holding adequate amounts of high-quality capital, such as common equity. The Basel III framework, proposed in 2009 and currently being implemented, aims to increase the quality and quantity of capital. Basel III has been widely adopted in high-income member countries of the Organisation for Economic Co-operation and Development (OECD), with developing countries taking a more cautious approach. Selective adoption of this complex framework is appropriate in settings with limited supervisory capacity.
- Data suggest that banks in high-income OECD countries are holding more regulatory capital relative to their risk-weighted assets now than before the global financial crisis. However, this change appears to be driven by a decrease in risk-weighted assets relative to total assets; regulatory capital relative to total assets did not increase significantly. It is not clear whether banks are taking fewer risks or instead are adjusting their risk models.
- Data also reveal an increase in Tier 1 capital, but regulators have relaxed the rules of what qualifies as Tier 1 capital. Thus not all of the increase may be high-quality common equity and could instead include instruments such as convertible debt, whose performance has not really been tested in times of crisis.
- Implementation of the Basel III framework seems to have reduced lending, at least in the short run, in adopter countries as well as cross-border lending from high-income OECD banks in developing countries.

3

Bank Capital Regulation

The global financial crisis in 2007–09 revealed significant weaknesses in the regulatory and supervisory system, leading to major reform efforts. Experts agree that the crisis stemmed in part from regulatory and supervisory failures (Calomiris 2012, 2017). These failures extended to different areas of banking regulation, but capital regulation was lacking as well, in the sense that it did not provide banks with enough high-quality equity capital to weather the crisis. It also did not sufficiently curb bank risk-taking before the crisis. There is a consensus as well that regulatory weaknesses stemmed in part from the lack of enforcement of existing regulations and the failure to use supervisory powers (Barth, Caprio, and Levine 2012). Therefore, since the financial crisis, regulators have been revamping regulation by, for example, launching the Basel III framework.

Capital regulation is a major element of this reform effort, so it is the subject of this chapter. The chapter begins by defining bank capital and summarizing its main functions. It then discusses the reasons for regulating bank capital and reviews efforts to standardize capital regulation across countries (Basel I and II). The chapter subsequently turns to the effects of capital regulation on financial access and stability. It reviews the role of capital in the global financial crisis and the regulatory responses that followed (Basel III). It then describes postcrisis trends in the adoption of capital regulation and its effects on capital holdings, stability, and access. The chapter concludes with policy recommendations.

DEFINITIONS AND FUNCTIONS OF BANK CAPITAL

In an economic sense, bank capital consists of the value of equity owned by shareholders. Bank economic capital can be defined as the value of the equity of a bank that can withstand losses. It has the lowest priority if the bank liquidates. Although there are several types of equity instruments (for example, common stock, contributed capital, and retained earnings), equity consists mainly of the profits retained by a bank or obtained from selling shares to investors. However, measuring equity is not simple because its value depends on how all financial instruments and on– and off–balance sheet assets of banks are valued (Berger, Herring, and Szegö 1995). Equity measured by its book value reflects the assets and liabilities that a bank reports on its balance sheet, thereby ignoring most off–balance sheet items and providing a historical accounting value rather than a current one. Equity measured by its market value reflects the value of the bank according to the stock market. For this measure, however, the market may not have the information needed to accurately price all bank assets.

It is important to distinguish bank economic capital from regulatory capital. Regulatory capital is the amount of capital required of banks by their financial regulator to fund their investments, such as extending loans to borrowers or purchasing bonds. It is commonly measured in the form of a ratio, where the numerator corresponds to the amount of regulatory capital and is segmented into layers or tiers. The definition of regulatory capital also allows counting some nonequity financial instruments as capital—such as reserves, hybrid capital instruments, or subordinated term debt—up to some limits (see box 3.1 for details). The denominator of the ratio, or the regulatory measure of risk exposure, corresponds to the assets of the bank, which can be unweighted or weighted by risk. In theory, weighting assets by risk requires banks to hold more capital against portfolio items with higher risk. In practice, however, measuring risk exposure is difficult. Several approaches that have been used only weakly reflect the actual risk of bank operations and

BOX 3.1 Types of Regulatory Capital

As illustrated in table B3.1.1, different types of regulatory capital have different characteristics in terms of liquidity and incentives. To account for these differences, regulatory bank capital is often divided into tiers, which rank instruments according to their subordination (or priority of payment in case of liquidation) and maturity (and thus their capacity to absorb losses). Tier 1 capital broadly consists of the safest types of capital that can absorb losses without disrupting operations, whereas Tier 2 capital consists of instruments considered less safe.

TABLE B3.1.1 Examples of Regulatory Capital Instruments and Key Characteristics

Instrument	Characteristics
Equity capital (common stock, retained earnings)	The instruments constituting the shareholders' equity and considered the core capital of a bank. Equity capital is the most secure and liquid form of capital to absorb losses in the event of a financial emergency.
Disclosed reserves	Published reserves originated by appropriations of retained earnings or other surplus set aside to cover future losses.
Cumulative preferred stock	Securities considered hybrid capital instruments because they share characteristics of debt instruments (that is, they pay fixed dividends). They can be converted into equity when a trigger event occurs. In terms of subordination, these instruments have priority over equity capital.
Revaluation reserves	An accounting term used by banks in revaluating an asset. These instruments are more difficult to liquidate and price because calculating their value is difficult.
Undisclosed reserves	Not a very common instrument, but accepted as capital by some regulators. This type of reserve is created from a profit that has not appeared in the normal retained profits of a bank.
Loan provisions, loan and lease-loss reserves	Money that a bank has set aside on a loan to provide for expected future losses on loans and leases.
Subordinated term debt	Debt that ranks lower than ordinary deposits in the bank. To be considered capital, it must comply with regulatory guidelines on its characteristics, and its initial maturity should be of more than five years. In terms of subordination, these instruments have priority over preferred stock.

may be manipulated by banks (Berger, Herring, and Szegö 1995).

A key function of capital is that it allows banks to sustain unexpected losses, while still honoring deposit withdrawals and other obligations. On a bank's balance sheet, capital is equal to the difference between assets, such as loans and investments, and liabilities, mostly deposits. If the assets of a bank are worth less than its liabilities, capital can thus act as a buffer in absorbing unexpected shocks, allowing the bank to remain solvent and continue operations (Berger, Herring, and Szegö 1995; Diamond and Rajan 2000; Valencia 2016). Higher capitalization should therefore help banks reduce default risk and increase their likelihood of survival during periods of financial turmoil.

A second important function of capital is to provide top management and shareholders of banks with incentives for effective risk management. Moral hazard incentives naturally encourage excessive risk-taking by any entities with debt. These incentives are exacerbated for banking organizations because of their very high leverage and the existence of imperfectly priced deposit insurance that absorbs some of the losses from risk-taking without fully charging for the expected losses. Moral hazard incentives may be even greater for large institutions that believe they are too big to fail and will be bailed out by government. Capital helps offset these incentives because shareholders take the hit when bank losses are absorbed by the core capital of the bank. In principle, the more core capital shareholders contribute, the greater is their skin in the game. By forcing bank owners to put more skin in the game, capital requirements can help curtail excessive risk-taking. Laeven, Ratnovski, and Tong (2016), using data on large banks across 56 countries, empirically analyze the factors associated with systemic risk during the global financial crisis. They find a negative correlation between Tier 1 capital and systemic risk that increases in magnitude with bank size. Berger and Bouwman (2013), studying five financial crises in the United States, including the global crisis, find that higher equity capital ratios improve the likelihood of survival of banks of all size classes during these crises.

CAPITAL REGULATION: WHY AND HOW?

In the absence of regulatory minimum capital requirements, banks may have incentives to maintain insufficient equity capital ratios from a social standpoint. A key reason banks may choose not to raise enough equity is the presence of negative externalities when a bank fails (Aiyar, Calomiris, and Wieladek 2015). Bank failure has large private and social costs in the form of credit supply contraction and loss of economic output, which are not internalized by bank managers or shareholders.

A second reason banks may not hold enough equity stems from the presence of safety nets such as deposit insurance and bailouts. Safety nets protect depositors, but they also indirectly subsidize risk-taking by banks because depositors no longer need to monitor or discipline banks. To the extent that other uninsured creditors are protected, monitoring is further weakened. Thus safety nets weaken the role of the market in encouraging banks to maintain adequate capital (Calomiris 2012).

Banks' corporate governance and compensation schemes can further incentivize banks to hold less equity. Compensation schemes that reward executives for short-term gains in profits encourage them to take more risks. Thus bank managers may have incentives to maintain high default risk at the expense of shareholders. In addition, as Anginer et al. (2016) document using data from a sample of international banks, banks with corporate governance policies that are more shareholder-friendly tend to adopt riskier capitalization strategies. This behavior is consistent with the incentives of shareholders to shift risk toward safety nets.

Capital requirements are therefore an important tool for monitoring banks. When properly implemented, capital requirements incentivize banks to improve their risk

management (Calomiris 2012; World Bank 2012). Moreover, capital can substitute for supervision and oversight in reducing bank risk. Empirical evidence corroborates that in countries where supervision and regulation are costlier, the role of capital in systemic stability is stronger (see box 3.2).

However, regulating bank capital is not simple, because regulation can distort the risk-taking incentives of banks. Incentives for risk-taking are potentially among the most important sources of financial instability (World Bank 2012). Badly designed regulations or indirect subsidies from safety nets can exacerbate bank risk-taking by, for example, tempting banks to make riskier loans. Banks may also be encouraged to become "too big to fail" by growing larger, "too interconnected to fail" by becoming more connected with large banks, or "too many to fail" by engaging in herding behavior to improve their chances of bailouts (Acharya and Yorulmazer 2007; Berger, Roman, and Sedunov, forthcoming). A challenge for regulators is to identify how banks respond in practice to regulatory changes and to adapt regulation in such a way that banks' risk-taking incentives are best aligned with those of regulators. One suggestion by Čihák, Demirgüç-Kunt, and Johnston (2013) is the use of incentive audits to help regulators identify incentive misalignments in the financial sector. A push for better disclosure of information can also reduce excessive bank risk-taking by making bank operations more transparent. One concrete way would be disclosing information regarding how banks manage risk, which supervisors across various countries already collect via CAMELS ratings.

Basel I was the first international initiative to define and regulate capital. In the early 1980s, U.K. and U.S. regulators pioneered the requirement of minimum capital-to-assets ratios for banks, triggering their adoption in various other countries (Jackson et al. 1999; Rose 2014). In 1988, as a response to an international debt crisis that originated in Latin America, the Basel Committee on Banking and Supervision (BCBS) published the first set of minimum capital requirements for banks, now known as Basel I, with the goal of promoting a sound and stable international banking system. Basel I implemented for the first time higher capital requirements for assets that were perceived to have more credit risk, capital requirements for off–balance sheet activities, and capital requirements that were similar across nations. Although

BOX 3.2 Capital as a Complement to Weak Supervisory Capacity

Analysis of cross-country data reveals a negative and statistically significant relationship between the total regulatory capital ratio of banks and their systemic risk measures. Anginer, Demirgüç-Kunt, and Mare (2018) use data on publicly traded banks across countries to study whether this relationship varies according to the institutional environment, information availability, and monitoring efficiency of bank regulators.

Their study relies on several measures of supervisory capacity and information availability to examine the influence of the institutional environment on the relationship between the systemic risk of individual banks and capital ratios. Overall, this relationship becomes much stronger in countries with weaker institutional environments, where monitoring banks, either via private or public channels, is more challenging and where information about firms and banks is scarcer.

These results suggest that capital exerts a greater impact in banking sectors where the supervisory power of regulators is limited and the institutional environment is weaker. A message emerging from this research is that enhancing the quality and quantity of bank capital can mitigate the adverse effects of a lack of supervisory capacity and information availability. Such a message is particularly relevant for developing countries, where regulating and supervising banks can be prohibitively costly.

the minimum capital requirements agreed to in Basel I originally focused on international banks and were intended for member countries of the Bank for International Settlements (BIS), most banking regulators worldwide ended up adopting them and imposing them on virtually all the banks in their jurisdictions (Goodhart 2011).

Basel I induced banks to maintain higher capital ratios, but its simplicity in measuring risks led to regulatory arbitrage. With the aim of setting a simple risk-weighted asset (RWA) approach, Basel I categorized bank assets and off–balance sheet activities into four credit risk levels that were assigned risk weights of 0 percent, 20 percent, 50 percent, or 100 percent. This broad risk-weighting approach implies that within each risk level there is great variation in the quality of assets. For example, the 100 percent risk category includes all commercial loans irrespective of their credit quality. This ranking of risk also encouraged banks to engage in arbitrage because in a given risk bucket they had no incentives to hold the highest-quality assets with low expected returns, and instead had incentives to hold assets of the lowest quality with high expected returns. Regulatory capital ratios ended up being uninformative about the actual risks that banks were taking (Ferguson 2003). Furthermore, because the Basel standards were calculated using book value accounting measures of capital rather than market values and because accounting practices differ across countries, Basel I was not fully effective in standardizing practices with respect to capital. In addition, its focus on credit risk left key exposures related to liquidity and operational risks unattended, making it almost redundant for the few, yet complex, large international banks.[1]

In 2004 a revised capital framework, Basel II, replaced Basel I. Basel II was set forth with the objectives of better aligning the risk-taking of banks with their required regulatory capital and better reflecting the sophistication and complexity of bank operations. Basel II is built on three pillars: (1) minimum capital requirements; (2) supervisory oversight on behalf of national regulators; and (3) stronger market discipline in the form of information disclosure on capital, risk exposures, and risk assessment processes. Table 3.1 compares Basel I and Basel II. Key features of Basel II were (1) a new definition of regulatory capital, expanding from two to three tiers; (2) two new methodologies to measure credit risk (the denominator of the regulatory capital ratio); and (3) the inclusion of operational risks, defined as risks related to loss from inadequate or failed processes.

Basel II offered a more complex framework for measuring capital requirements and credit risk. It allowed banks to choose one of two approaches to measuring credit risk. The standardized approach (SA) measures credit risk in a manner that resembles the risk buckets used under Basel I. But there are two differences: the number of risk categories increases substantially, and risk weights are determined by assessments from authorized external credit assessment institutions. Subject to the approval of their supervisor, banks can also select the internal ratings–based (IRB) approach, which allows banks to use their internal rating models for credit risk—that is, subject to the approval of regulators, banks develop in-house models for computing the risk parameters of their portfolios.

Even though these new approaches were designed to improve risk sensitivity, the complexity of the calculation of capital requirements increased substantially. Whereas the regulatory capital ratio under Basel I was transparent and easily verifiable by regulators and market participants, the more complex credit risk measures, in particular the IRB approach, made it more challenging for supervisors and investors to monitor financial institutions properly.[2] The imbalance in resources between banks and regulators plays against regulators because they have to understand and evaluate the increasingly sophisticated risk assessment and management tools of banks (Danielsson et al. 2001). Moreover, the use of credit-rating agencies has been shown to be problematic because their ratings do not properly reflect actual risks, and riskier firms are tempted to forgo ratings in order to obtain cheaper loans (Danielsson et al. 2001).

TABLE 3.1 Key Characteristics of Basel I and II

	Basel I	Basel II
Regulatory capital	Regulatory capital consists of Tier 1 + Tier 2 capital.[a] Tier 1 capital consists of disclosed reserves, and noncumulative perpetual preferred stock.[b] Tier 2 capital consists of supplementary capital instruments: undisclosed reserves, revaluation reserves, general provisions or loan loss reserves, hybrid debt capital instruments, and subordinated term debt.	Regulatory capital consists of Tier 1 + Tier 2 + Tier 3 capital. Tier 1 and Tier 2 capital remain unchanged. Tier 3 capital is added to help banks meet the required minimum capital for market risks and is subject to the approval of national regulators. Tier 3 capital consists of short-term subordinated debt (with a maturity of at least two years).
Credit risk measurement	Assets of banks are classified into four groups according to their risk and are weighted according to fixed weights of 0 percent, 20 percent, 50 percent, and 100 percent. Assets with no credit risk such as cash are weighted 0 percent, whereas assets such as commercial loans are weighted 100 percent.	Regulators and banks can select from two methodologies to measure credit risk: 1. Standard approach. Bank assets are bundled in categories and weighted according to fixed risk weights. 2. Internal ratings–based approach. The risk weight of a loan is determined by the internal models of banks.[c]
Regulatory capital ratio	Calculated as the ratio of value of regulatory capital to the sum of credit and market risk-weighted assets (RWA):[d] $\frac{\textit{regulatory capital}}{\textit{credit RWA + market RWA}}$ The minimum required regulatory capital is set at 8 percent, with at least 4 percent in the form of Tier 1 capital and 2 percent in the form of common equity.	Consists of the value of the ratio of regulatory capital to the sum of credit, market, and operational risk-weighted assets (RWA):[e] $\frac{\textit{regulatory capital}}{\textit{credit RWA + market RWA + operational}}$ The minimum required regulatory capital remains unchanged, at 8 percent, with at least 4 percent in the form of Tier 1 capital and 2 percent in the form of common equity.

a. The following limits were imposed on regulatory capital: Tier 2 capital cannot exceed 100 percent of Tier 1 capital; subordinated term debt cannot exceed 50 percent of Tier 1 capital; loan provisions must include only valuations of latent but unidentified losses; and revaluation reserves will face a discount of 55 percent.
b. Under certain restrictions, additional instruments can be counted as Tier 1 but cannot exceed 15 percent of total Tier 1 capital—for example, instruments that have a step-up or minority interest in equity accounts of consolidated subsidiaries.
c. The standard approach resembles the approach under Basel I. The difference is that the number of risk categories grows and weights are assigned by an approved external credit-rating institution. Under the IRB approach, banks determine the risk weight of a loan based on the loan's probability of default, loss given default, exposure at default, and effective maturity.
d. Market risks stemming from movements in interest rates, foreign exchanges, and equity exposures are also subject to a capital charge, with the corresponding methodologies described in BCBS (2004).
e. See BCBS (2004) for the capital requirement methodology for operational risk.

The greater complexity of credit risk measures increased the opacity of the operations and risk management of banks. That situation in turn raised the costs of regulators and market participants to validate the accuracy of reported capital ratios (Haldane 2011), weakening the effectiveness of supervisors (Pillar 2) and market discipline (Pillar III). The global financial crisis revealed that the growth of highly complex, interconnected, nontransparent institutions and instruments was not matched with disclosure of the information needed to monitor them effectively (World Bank 2012).

Although capital requirements are intended to increase the stability of the banking sector, social costs may be associated with them. It is argued that increasing capital requirements can induce changes in the supply of credit of banks, potentially hurting households and firms in need of financing. Social costs may also take the form of reduced bank profitability. The next sections examine the evidence for these social costs and whether capital requirements have succeeded in improving financial stability.

BANK CAPITAL AND CREDIT SUPPLY

Theoretical studies of the role of bank capital in lending reach different conclusions. Some theories predict that greater capital can help banks expand lending. Increasing capital can

improve the capacity of banks to raise funding, compete more effectively for deposits and loans, and better protect them from deposit risk when economic conditions deteriorate (Kishan and Opiela 2000; Calomiris and Mason 2003; Calomiris and Wilson 1998). Other theories point to the fact that lending increases bank risk, whereas capital absorbs risk and therefore expands banks' lending capacity (Bhattacharya and Thakor 1993; Allen and Santomero 1998; Allen and Gale 2004; Repullo 2004; Von Thadden 2004; Coval and Thakor 2005). These theories also generalize beyond banks' lending to their ability to create liquidity for the public (Berger and Bouwman 2009).

Other theories argue that greater capital may reduce bank lending. Diamond and Rajan (2000, 2001) suggest that bank capital may impede bank lending and liquidity creation by making the capital structure of banks less fragile. Fragile capital structures encourage banks to commit to monitoring their borrowers because depositors can run on the bank. Capital may also reduce liquidity creation because it "crowds out" or replaces deposits, which are an important source of liquidity creation (see, for example, Gorton and Winton 2017).

Empirical studies are mixed on the effects of capital on lending, with the results often differing by bank size. Cross-country evidence on major international banks suggests that better-capitalized banks face lower funding costs, allowing them to increase lending (Gambacorta and Shin, forthcoming). Consistent with this evidence, Berger and Bouwman (2009) find that capital has a positive effect on the more general measure of bank output, liquidity creation, for large U.S. banks, primarily driven by off–balance sheet loan commitments. However, the results are reversed for small U.S. banks and for banks in other nations (Lei and Song 2013; Horvath, Seidler, and Weill 2014; Fungacova, Weill, and Zhou 2017). However, measuring the causal effect of capital on lending is difficult because movements in capital are often the response of changing economic conditions, which also affect the demand for loans.[3] Therefore, variation in bank lending may jointly result from changes in the demand for as well as the supply of loans. The empirical studies discussed in the rest of this section have found ways to isolate movements in the supply of credit from responses in the demand for credit and thus have advanced our understanding of the impact that capital has on bank lending and firms' economic outcomes.

Capital can help banks smooth the supply of credit during crisis years. In times of economic turmoil, banks with larger capital buffers are somewhat protected from cuts in lending. Carlson, Shan, and Warusawitharana (2013) find evidence of this by comparing the loan growth of neighboring banks in the United States (that is, banks operating in a same location). By exploiting variation across local banks within a metropolitan area, they control for changes in the demand for credit because neighboring banks are likely to face the same economic conditions, and thus any difference in loan growth can be attributed to the difference in credit supply related to capital ratios. They find that during the global financial crisis years (2008–10) banks with higher capital ratios tended to have stronger loan growth, but not in the years before or after. One question discussed in box 3.3 is whether recapitalization for banks in distress is a plausible policy tool to contain a systemic crisis.

Capital also smooths bank lending in times of monetary policy contractions. Jiménez et al. (2012) exploit the universe of bank loan applications to study how the supply of credit by Spanish banks responds in times of monetary policy contractions. Important in this setting is the fact that the monetary policy in Spain is fairly exogenous because it is set for the euro area as a whole. They find that under tighter monetary and economic conditions, lending to the same firm differs across banks, and those with lower capital are the ones that resort to cutting lending.

The supply of bank lending can be affected by negative shocks to capital. To the extent that firms are dependent on bank finance, a bank credit crunch induced by a shortage of capital can further hinder economic activity (Bernanke and Lown 1991). Capital crunches can result from different factors. One factor is

BOX 3.3 Is Bank Recapitalization an Effective Policy Tool for Banks in Distress?

The design of recapitalization programs is not a trivial matter, because these interventions should protect the interests of taxpayers, reduce the moral hazard incentives of banks, and ensure that only banks in desperate straits—and yet with a real chance of survival—are rescued (Demirgüç-Kunt and Servén 2010). Theory also suggests that saving the financial system is best achieved by rescuing the strong over the weak banks (Choi 2014). To achieve these goals, recapitalization programs must impose tough criteria that guarantee real costs for all the responsible parties and ensure the right incentives for restructured banks going forward. Recapitalization interventions should also rely on the private sector to decide which banks to help—for example, by basing eligibility for the program on securing at least some fraction of capital via private sector funding.

Most studies of the impact of bank recapitalizations have found that these interventions can increase the supply of loans and spur firm growth (Laeven and Valencia 2013; Li 2013; Berger and Roman 2017; Berger, Makaew, and Roman, forthcoming; Chu, Zhang, and Zhao, forthcoming), although some studies find mixed or no effects on credit supply (Black and Hazelwood 2013; Duchin and Sosyura 2014). On an aggregate basis, findings suggest that recapitalizations can improve the real economy (Berger and Roman 2017) and reduce systemic risk in the short term (Berger, Roman, and Sedunov, forthcoming). However, injecting capital into banks appears to help only if banks are sufficiently recapitalized (Giannetti and Simonov 2013). Cross-country empirical evidence further shows that providing distressed banks with timely support during a recession also helps reduce the duration of the recession. According to Homar and van Wijnbergen (2017), recapitalization shortens severe recessions by two years and lighter ones by six months.

One downside of bank recapitalization is that it potentially shifts banks' appetite for risk, as evidence from Indonesia supports. Using data on the universe of commercial banks in Indonesia from 1993 to 2008, Poczter (2016) finds that even though bank recapitalization after the Asian financial crisis of 1997 increased bank lending, it also boosted bank risk in the years that followed. The effect on bank risk was concentrated among banks that were recapitalized, whereas nonrecapitalized banks actually reduced their risk. Recapitalizations in the United States have also been found to increase moral hazard incentives to lend to riskier borrowers (Duchin and Sosyura 2014; Berger, Makaew, and Roman, forthcoming) and may increase systemic risk in the long run (Berger, Roman, and Sedunov, forthcoming).

Some recent research suggests that recapitalizations by the private sector, usually referred to as bail-ins, may have advantages over government recapitalizations. In the United States, bail-ins are the current practice under the Orderly Liquidation Authority (OLA), and in Europe under the Bank Recovery and Resolution Directive (BRRD) and the Single Resolution Mechanism (SRM). Berger et al. (2018) find that bail-ins provide much better incentives than government recapitalizations for banks to hold higher capital ratios during normal times and raise them when they become distressed, although bail-ins may entail other problems.

stricter capital requirements, whereby banks can shrink lending to achieve a higher capital ratio (Thakor 1996; Watanabe 2007; Van Hoose 2008; Calomiris 2012; Aiyar, Calomiris, and Wieladek 2014a). This might happen if it were costly for banks to raise equity. If adverse selection costs due to asymmetric information penalize the stock prices of issuing banks, banks would be discouraged from raising equity in the first place (Aiyar, Calomiris, and Wieladek 2014b). Other factors include increased borrower defaults, the collapse of asset prices (Bernanke 1983; Peek and Rosengren 1995b), or the tightening of monetary policy, whereby an increase in the policy rate can reduce banks' profits and potentially their capital (Van den Heuvel 2002).

Bank and loan-level data confirm that capital shortfalls from capital contractions or increased capital requirements reduce lending. Several studies of the U.S. credit crunch in the early 1990s find that reduced capital from

loan losses and increased capital requirements contributed to a contraction in the supply of credit for banks (Bernanke and Lown 1991; Berger and Udell 1994; Hancock, Laing, and Wilcox 1995; Peek and Rosengren 1995a, 1995b). Similarly, other studies exploiting a series of natural experiments as sources of exogenous capital shocks reach similar findings. Peek and Rosengren (1997) find that a negative capital shock in Japan was transmitted to Japanese bank branches in the United States. In response, those branches significantly reduced their lending to U.S. firms that were not affected by the shock.

Recent empirical evidence further corroborates that banks reduce their lending as capital requirements increase. Aiyar, Calomiris, and Wieladek (2015) argue that because raising equity is costly, banks often opt to reduce their lending when they need to raise their equity-to-asset ratios. Brun, Fraisse, and Thesmar (2013) find that in France, when banks transitioned from Basel I to Basel II, their capital requirements fell by 2 percent, which led to a 10 percent increase in loan size and substantial increases in employment and investment. In the United Kingdom, a 1 percentage point increase in required equity ratios was found to contract lending in the short term by approximately 6 percent (Aiyar, Calomiris, and Wieladek 2015). Gropp et al. (2019) exploit a capital exercise conducted in 2011 by the European Banking Authority (EBA) on a subset of European banks to identify the impact of higher capital requirements on capital ratios and lending. The authors document that the banks subject to this exercise engaged in asset shrinking by reducing their exposures to corporate and retail borrowers.

Some scholars, however, argue that there are ways to increase capital requirements while limiting the effects on loan supply. Admati and Hellwig (2013) claim that the higher cost of equity is not a valid reason for not requiring banks to increase their equity. They argue that better-capitalized banks may not be affected by the costs of raising equity because they have more retained earnings to fund their growth and face proportionally lower costs of issuing equity. Furthermore, they suggest that regulators can help undercapitalized banks reduce the negative stigma of issuing bank equity by, for example, imposing a timetable for equity issuance. To help banks build capital, higher capital requirements should be accompanied by requirements for banks to quickly meet them by restricting dividend and other equity payouts. Although, in the short term, undercapitalized banks may contract lending as a response to increased capital requirements, once banks are better capitalized, they could be able to restore their credit supply.

Increasing capital in the short run is expensive, but having higher capital in the long run does not necessarily hurt bank profitability. Theory suggests that the relations between bank capital ratios may be either negative (Modigliani and Miller 1963) or positive (Allen, Carletti, and Marquez 2011). In reality, higher bank capital can either reduce or increase bank profitability, depending on economic and financial conditions and where a bank is relative to its target capital ratio. Most banks have capital ratios that exceed regulatory capital requirements. Bank capital ratio targets are largely determined by market trade-offs between the tax benefits of lower capital and the lower costs of debt and equity afforded by higher capital (Berger 1995). Because changing capital quickly is costly, actual capital ratios may deviate significantly from targets, altered by earnings shocks and other events, and banks do adjust to these targets over time (Berger et al. 2008). Empirical research on U.S. banks suggests that higher capital enhances the profitability of small banks during both normal times and financial crises and improves the profitability of large banks during financial crises (Berger and Bouwman 2013).

Capital requirements that increase in bad times are more likely to affect lending and economic output. When economic conditions are good, firms are better able to overcome tightening of bank credit induced by increased capital requirements. In turmoil years, replacing bank credit with other sources is more challenging. Thus countercyclical capital requirements may help reduce the negative effects on lending. Conversely, approaches such

as risk-sensitive capital regulation that link capital requirements with the risk of different assets more directly can exacerbate lending procyclicality because measures of asset risk change with economic conditions. Under these approaches, capital requirements may further prompt lending to drop during a downturn and rise during periods of economic growth (Danielsson et al. 2001; Kashyap and Stein 2004; Repullo and Suarez 2012).

Indeed, empirical evidence shows that risk-sensitive capital regulation deters bank lending in bad times. When implementing Basel II, German banks were allowed to choose between two methodologies to calculate their regulatory capital: the standard approach and the internal ratings-based approach.[4] Whereas capital requirements under the standard approach are determined the moment loans are issued and are fixed thereafter, the required capital under IRB changes over time as banks update the default probabilities of their loans. Because banks that opted for the IRB approach phased it in over time, Behn, Haselmann, and Wachtel (2016) exploit the failure of Lehman Brothers to examine how the credit conditions of a given firm in the IRB pool of one bank and the SA pool of another IRB bank changed. After the shock, banks reduced loans to the same firm by 2.1–3.9 percentage points more when capital requirements for the loan were based on internal ratings (IRB) than when they were based on fixed risk weights (SA).

Overall, a large body of evidence has advanced understanding of how capital requirements can affect access to finance; yet several other questions remain unanswered. What is the longer-term impact of adjustments to capital requirements on loan supply, and how long does it take banks to weather the increased requirements? What effect would a large change in capital requirements have on lending supply? Because most empirical studies rely on local and relatively small changes in capital requirements, extrapolating their findings may not be very informative (Aiyar, Calomiris, and Wieladek 2015). Admati and Hellwig (2013) find that substantially higher equity capital requirements in the long term can help banks improve their lending decisions and reduce excessively risky investments.

CAPITAL AND FINANCIAL STABILITY

Theory predicts that higher bank capital can lower bank risk-taking in at least two ways. First, banks will improve their screening and monitoring of borrowers (Holmstrom and Tirole 1997; Coval and Thakor 2005; Allen, Carletti, and Marquez 2011; Mehran and Thakor 2011). Second, greater capitalization can give banks incentives to choose less risky asset portfolios (Furlong and Keeley 1989; Calomiris and Kahn 1991; Rochet 1992; Freixas and Rochet 2008).

Some argue, however, that higher bank capital may also lead to more risk-taking through two potential channels. First, if higher capital implies a greater number of shareholders, owners may exert less effort as their ownership becomes diluted (Besanko and Kanatas 1996). Second, because increasing equity lowers the return on equity (ROE), banks may invest in riskier projects as capital increases to seek higher returns and to bring ROE back up (Koehn and Santomero 1980; Dell'Ariccia, Laeven, and Marquez 2014). These incentives may increase because of greater expectations of a bailout. For large banks, additional capital may thus increase risk-taking because they want to benefit from the upside and perceive little downside (Calem and Rob 1999).

Empirical evidence supports the view that higher bank capital leads to less bank risk. In a sample of almost all U.S. banks for 1984–2010, higher capital, measured as the ratio of equity to total assets, was associated with a greater probability of survival during noncrisis times (Berger and Bouwman 2013). This result reflects a correlation and is not necessarily causal. However, a study comparing Belgian banks with other European banks between 2003 and 2007 provides causal evidence of the effects of a bank capital increase that was caused by a 2006 tax reform (Schepens 2016). Banks increased

their retained earnings in response to the tax reform, and the resulting increase in capital, again measured as the ratio of equity to total assets, led to reduced risk-taking both in terms of a lower ratio of nonperforming loans to total loans and in terms of lower volatility of returns on assets.

However, higher capital during normal times appears to lower risk-taking mostly for small banks, not large ones. Both Berger and Bouwman (2013) and Schepens (2016) find that the risk-mitigating effects of higher capital are mostly concentrated among smaller banks. These findings are in line with the argument that larger banks may be willing to take more risks because they are likely to be saved by a bailout when in distress.

In times of crisis, greater capital is associated with better performance by banks of all sizes. In crisis years, both small and large U.S. banks are more likely to survive if they have more capital (Berger and Bouwman 2013). Beltratti and Stulz (2012), after assessing a sample of 164 large banks in 32 countries with more than US$50 billion in assets, learned that those with more Tier 1 capital to risk-weighted assets had significantly higher stock market returns during the global financial crisis. These findings may reflect the following two channels. First, capital can act as a "cushion" for absorbing losses in a crisis. Second, banks with more capital (as opposed to debt) suffer less from the debt overhang problem, in which existing debt is so great that a bank cannot easily borrow more money (Myers 1977).

CAPITAL AND THE GLOBAL FINANCIAL CRISIS: CAUSES AND REGULATORY RESPONSES

Although higher capital helped banks weather the 2007–09 financial crisis, capital requirements in many countries were not sufficient to avert the crisis. For 164 large banks in 32 countries, stricter capital regulation did not come with higher stock market returns during the crisis (Beltratti and Stulz 2012). Similarly, a study of over 3,000 banks in 86 countries finds no relationship between Basel Core Principle compliance and bank risk over the period 1999–2006 (Demirgüç-Kunt and Detragiache 2011). Data on all publicly traded European and U.S. banks over the period 1991–2014 also reveal that banks in countries with more stringent capital requirements contributed less to systemic risk only after, but not before, the financial crisis (Bostandzic and Weiß, forthcoming). On the other hand, in a sample of almost 400 banks in 70 developing countries, stricter capital regulation was associated with lower bank risk over the period 2002–08 (Klomp and De Haan 2014, 2015). In the same way, stricter capital requirements were associated with lower bank risk in 13 Central and Eastern European countries over the period 1998–2005 (Agoraki et al. 2011). A possible explanation for these different findings is that regulation may have been more effective in developing countries than in high-income countries because it was simpler.

Capital regulation before the global financial crisis was often too complex and discretionary to be effective. According to data from the fourth round of the Bank Regulation and Supervision Survey (BRSS) covering 143 countries, countries directly affected by the crisis had less stringent and more complex definitions of capital, giving banks greater discretion in how they satisfied capital requirements. Banks in crisis countries also exhibited lower Tier 1 capital ratios than those in noncrisis countries (Čihák et al. 2013). Further evidence from 381 banks in 12 countries suggests that risk-weighted capital ratios lacked credibility during the crisis (see box 3.4). For these 381 banks, capital was associated with higher stock market returns during the financial crisis, but this relationship is stronger when capital is measured by a simple leverage ratio (regulatory capital divided by total assets) rather than a risk-adjusted regulatory capital ratio, particularly for larger banks, which tend to have the most discretion in Basel II risk calibrations (Demirgüç-Kunt, Detragiache, and Merrouche 2013).

Regulations in place before the financial crisis diluted the quality of capital. All countries directly hit by the crisis allowed Tier 2 capital

BOX 3.4 Bank Capital: Lessons from the Global Financial Crisis

Demirgüç-Kunt, Detragiache, and Merrouche (2013), using Bankscope data, have examined the relationship between bank capital and stock market returns around the time of the global financial crisis. Their sample consists of 381 banks in 12 countries covering the period 2005:Q1–2009:Q1. The authors also present estimation results for a subsample that consists of only 91 banks with assets above US$50 billion in eight countries.

The empirical analysis relates stock market returns in quarter t to bank capital in quarter $t - 1$, controlling for other bank characteristics. The authors estimate this relationship separately for the precrisis period (up to 2007:Q2) and the crisis period (2007:Q3–2009:Q1).

The paper examines different measures of capital to determine which measure showed the strongest correlation with stock returns—that is, the authors look at a Basel II measure of regulatory capital, defined as Tier 1 + Tier 2 capital to risk-weighted assets, as well as a nonrisk-based leverage ratio, defined as Tier 1 + Tier 2 capital to total assets. They also disaggregate capital into various levels of quality, looking separately at Tier 1, common equity, and Tier 2 capital.

The results show that higher capital was linked with higher stock returns during the financial crisis. This relationship is stronger for large banks. It is also much stronger when capital is measured as a simple leverage ratio than a risk-weighted ratio. This finding may reflect the fact that market participants viewed the risk adjustment under the Basel rules as subject to manipulation or at least not reflective of true risk for large banks.

Another finding is that higher-quality capital—Tier 1 capital and common equity—displayed a stronger correlation with subsequent stock market returns than Tier 2 capital, especially for larger banks.

The results have several policy implications. First, they support the view that a stronger capital position is an important asset during a crisis, suggesting that an emphasis on strengthening capital requirements is appropriate. Second, introduction of a minimum leverage ratio to supplement minimum risk-weighted capital requirements is important because properly measuring risk exposure is very difficult, especially for large and complex financial organizations. Finally, a greater emphasis on "higher quality capital," in the form of Tier 1 capital or common equity, is justified.

in regulatory capital, and 81 percent allowed Tier 3 capital, compared with 86 percent and 27 percent of noncrisis countries, respectively (Čihák et al. 2013). However, these types of capital appeared to be less relevant for mitigating the crisis. As described in box 3.4, Tier 1 capital, particularly common equity, showed the strongest link with banks' stock market returns during the crisis.

The global financial crisis also highlighted that banks' assets were riskier than risk measurement suggested, pointing to issues with the existing risk models. Several studies have provided evidence that banks use accounting discretion to underreport their risk positions, and approaches such as the IRB may give banks more opportunity to manipulate their credit risk measures. Huizinga and Laeven (2012) find that during the U.S. mortgage crisis, banks overstated the value of their distressed assets and their regulatory capital. They further point out that banks select valuation techniques that yield relatively high asset values. Mariathasan and Merrouche (2014) use cross-sectional data on 115 banks from OECD member countries to document that banks, particularly undercapitalized ones, lower their reported riskiness after their IRB approval. This decline in risk is more modest when supervisory capacity is high.

The global financial crisis thus exposed the weaknesses of existing capital regulation, so the Basel III norms were proposed in 2009 to improve the quantity and quality of capital and address these weaknesses. As further described in box 3.5, major features of the capital requirements under Basel III relative to Basel II are that Basel III (1) requires a higher share of common equity and Tier 1 capital; (2) introduces two new capital buffers—the

BOX 3.5 Basel III

The Basel III norms were proposed in 2009. Most of the regulatory changes have been phased in gradually, for completion by 2019. What follows are summaries of some of the key features of Basel III aimed at improving both the quality and quantity of capital.

More common equity
Basel III increases the common equity ratio from 2 percent to 4.5 percent of risk-weighted assets, with an additional "capital conservation" buffer of 2.5 percent of common equity, bringing the total to 7 percent. The capital conservation buffer implies that regulators will impose constraints on a bank's discretionary distributions when common equity falls into the buffer range. This step prevents the kind of market failure that occurred during the global financial crisis. Some banks continued to make large distributions even though their financial condition and the outlook for the sector were deteriorating. Much of this activity was driven by a collective action problem, in which reductions in distributions were perceived as a signal of weakness; and in fact the distributions ended up weakening banks and the sector (BCBS 2010). Basel III also introduces a "countercyclical buffer" of 0–2.5 percent of common equity, to be applied at the discretion of country supervisors when credit growth is judged to result in an unacceptable buildup of systematic risk. This buffer of capital ensures that the banking system is protected against future potential losses.

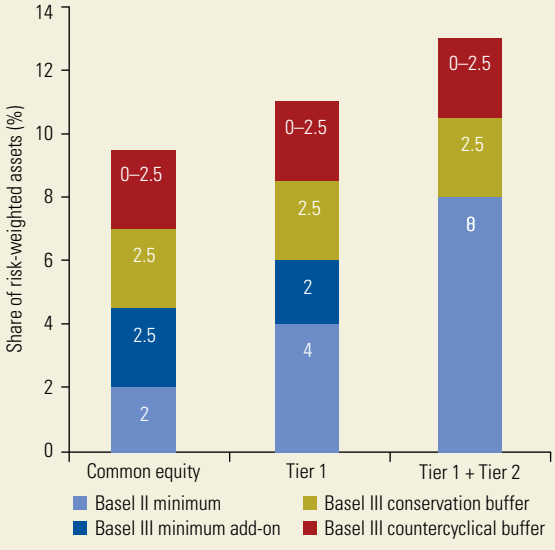
Same overall capital requirement, but more Tier 1
Basel III increases the Tier 1 capital requirement from 4 percent to 6 percent. The total risk-adjusted capital requirement remains unchanged, at 8 percent.

Stricter definition of capital—no more Tier 3
Banks can meet the difference between the total capital requirement and the Tier 1 requirement with Tier 2 capital—that is, Basel III eliminates Tier 3 capital.

Leverage ratio
Basel III imposes a supplemental minimum 3 percent leverage ratio to serve as a backstop to the risk-based capital requirement. This leverage ratio is calculated as Tier 1 capital to total assets and thus is not based on risk-weighted assets.

Liquidity requirements
Basel III introduces a liquidity coverage ratio that requires banks to have enough high-quality liquid assets to withstand a 30-day stressed funding scenario specified by supervisors. It also defines a longer-term structural net stable funding ratio that is designed to address liquidity mismatches. This ratio covers the entire balance sheet and provides incentives for banks to use stable sources of funding.

FIGURE B3.5.1 A Comparison of the Capital Requirements for Basel II and III



Source: World Bank staff calculations.

capital conversion buffer and the countercyclical capital buffer—that increase overall capital requirements; and (3) contains a stricter definition of capital—that is, it limits what can be considered as regulatory capital. Basel III also adds a nonrisk-based leverage ratio, and it includes liquidity requirements, for example, to ensure that enough high-quality liquid resources are available for survival for one month in the face of a stress scenario.

Chapter 1 discusses these liquidity requirements, as well as stress tests, in more detail.

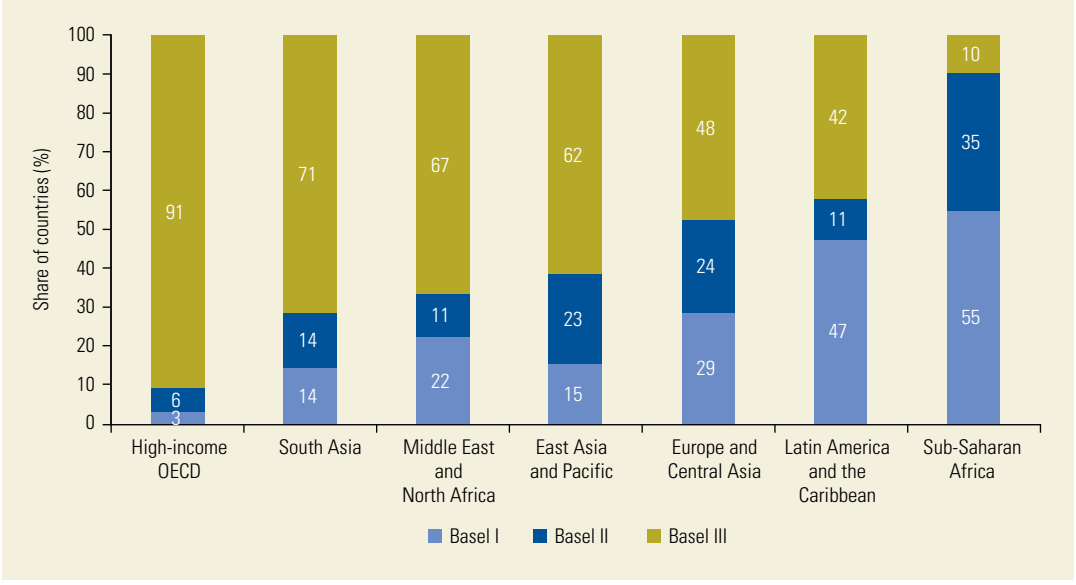
ADOPTION OF POST–GLOBAL FINANCIAL CRISIS CAPITAL REGULATION

In BRSS 2019, all countries reported using one of the Basel regimes, but many were still using Basel I or Basel II. High-income countries have adopted Basel III more quickly than middle- and low-income countries. In 2016, 85 percent of high-income countries were using Basel III, followed by about half of upper-middle-income countries and a third of lower-middle-income countries. Only one low-income country, Nepal, reported using Basel III.

Basel III's adoption varies greatly across regions. In 2016 more than two-thirds of countries in the South Asia and the Middle East and North Africa (MENA) regions reported using Basel III. By contrast, adoption of Basel standards has been slow in the Latin America and the Caribbean (LAC) and Sub-Saharan Africa (SSA) regions, where close to half of countries continued to use Basel I in 2016 (figure 3.1).[5] Overall, countries in the same region tend to follow the same Basel regime. This pattern is in line with evidence from 102 countries indicating that a country is more likely to implement reforms in financial sector supervision if nearby countries also undertake such reforms (Masciandaro and Romelli 2018).

Both Basel II and III were designed to fit the needs of the more sophisticated banking sectors of Basel Committee members. Thus the rules proposed under these agreements may be overly complex for banking sectors in many developing countries. The reliance of Basel II and III on market discipline and strong supervisory capacity can even have an adverse effect on banking sectors of countries with weaker institutional environments and where market discipline and supervisory capacity are thin (Barth, Caprio, and Levine 2008). With poor oversight of banks, regulators may become lax, and banks may be tempted to take on more risk. Box 3.6 discusses in greater detail the approach that developing countries are taking when moving beyond Basel I.

FIGURE 3.1 Percentage of Countries Following Each Basel Regime, by Region



Source: Bank Regulation and Supervision Survey (BRSS), wave 5, https://www.worldbank.org/en/research/brief/BRSS.
Note: This figure is based on 2016 data from 133 countries. Not all high-income OECD countries use Basel III. Chile follows Basel I, and Austria and Latvia follow Basel II. OECD = Organisation for Economic Co-operation and Development.

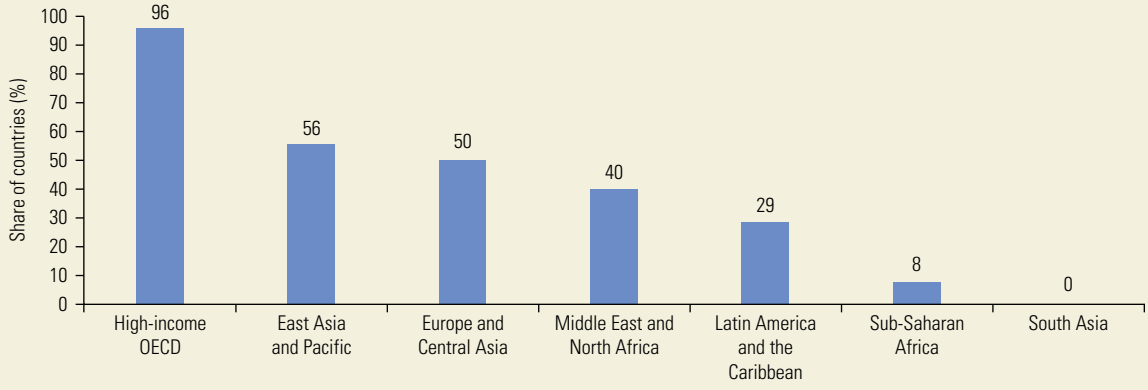
BOX 3.6 Adoption of Basel II and III in Developing Countries: Why and How?

Relying on case studies and cross-country data, Beck, Jones, and Knaack (2018) explore why developing countries outside Basel Committee membership decide to adopt Basel II or III. In many cases, countries wish to move beyond Basel I to signal sophistication and strong domestic regulatory standards. Upgrading from Basel I may also ease coordination between home and host country supervisors. Peer countries also may play a role in the form of either peer pressure or peer learning. And international organizations such as the World Bank and the International Monetary Fund tend to recommend to countries that they adopt Basel II or Basel III.

That said, regulators in developing countries seem to have followed the principle of proportionality in their adoption of elements of Basel II and III. Beck, Jones, and Knaack (2018), Hohl et al. (2018), and Jones and Zeitz (2017) document that although many nonmember countries of the Bank for International Settlements are taking steps to implement Basel II, regulators cautiously decide which components to adopt. Because of the complexity of the Basel standards, nonmember countries may not have the infrastructure or supervisory capacity needed to effectively monitor compliance. Moreover, the benefits of Basel II may not offset the implementation costs in countries with only a few large international banks.

Data from BRSS 2019 shows consistent patterns, in that the more complex additions of Basel II and III were adopted only by countries with more sophisticated banking sectors (Anginer et al. 2019). Although all countries that moved beyond Basel I reported relying on the standard approach to measure credit risk (which is quite similar to the simple risk-weighted assets approach used in Basel I), adoption of the more complex internal ratings–based (IRB) approach is highly correlated with income, with very low to zero adoption rates among countries in the Latin America and the Caribbean, Sub-Saharan Africa, and South Asia regions (see figure B3.6.1).

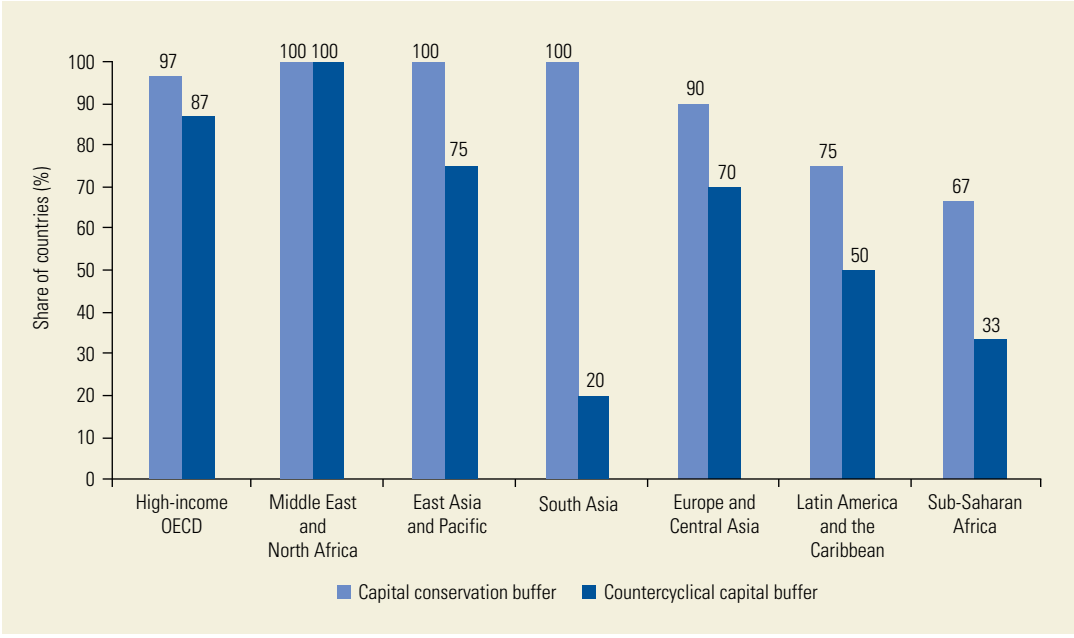
FIGURE B3.6.1 Percentage of Countries Adopting the Internal Ratings–Based (IRB) Approach, by Region



Source: Bank Regulation and Supervision Survey (BRSS), wave 5, https://www.worldbank.org/en/research/brief/BRSS.
Note: Information for 2016 from supervisors of 77 countries that adopted Basel II or III. OECD = Organisation for Economic Co-operation and Development.

Most Basel III countries have a capital conservation buffer, but only about 70 percent introduced a countercyclical capital buffer. In most regions, virtually all Basel III countries reported having a capital conservation buffer in 2016. The two exceptions are the LAC and SSA regions, where only three-fourths and two-thirds, respectively, of Basel III countries put in place a capital conversion buffer. Adoption rates of the countercyclical capital buffer are lower in all regions, except MENA. MENA is the only region in which all Basel III countries reported using both buffers in 2016 (figure 3.2). Although 70 percent of Basel

FIGURE 3.2 **Percentage of Countries with Capital Buffers, by Region**



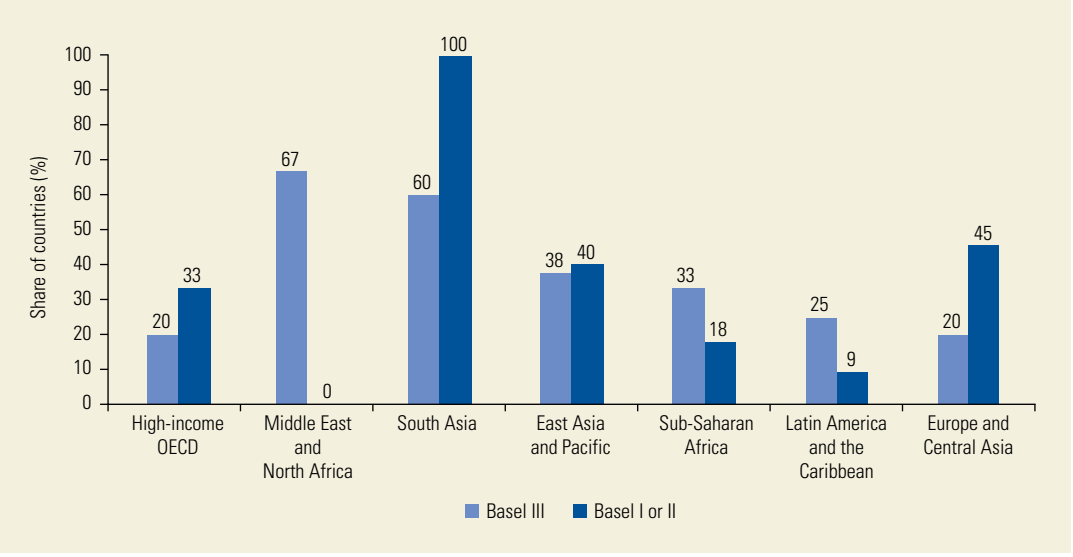
Source: Bank Regulation and Supervision Survey (BRSS), wave 5, https://www.worldbank.org/en/research/brief/BRSS.
Note: This figure is based on 2016 data from 70 countries that reported using Basel III. Data on the countercyclical capital buffer refer to having this buffer in place, even if it is currently not "turned on." OECD = Organisation for Economic Co-operation and Development.

III countries report having a countercyclical capital buffer in place, this buffer was "turned off" for most countries at the end of 2016. Only 15 percent of countries with the buffer report that it had a nonzero value at that time.

Apart from countries in the MENA region and South Asia, relatively few Basel III countries had implemented a leverage ratio requirement in 2016. In the MENA and South Asia regions, 67 and 60 percent of Basel III countries, respectively, reported having a leverage ratio requirement. However, across other regions the percentage of Basel III countries with such a requirement was lower, varying between 20 and 38 percent. Interestingly, some countries following Basel I or II also have in place leverage ratio requirements, most notably in South Asia. In the East Asia and Pacific (EAP) and Europe and Central Asia (ECA) regions, as well as high-income OECD countries, the percentage of countries with a leverage ratio requirement is greater among Basel I and II countries than among Basel III countries (figure 3.3). The size of the required minimum leverage ratio is typically 3 percent for Basel III countries, with some using higher ratios, up to 5 percent, and it is 5 or 6 percent for non-Basel III countries, up to a maximum of 10 percent (Tajikistan).

Basel III has arguably increased countries' compliance and reporting costs, leading some to adopt proportional frameworks for bank regulation. Some elements of Basel III, such as the introduction of liquidity requirements, may contribute significantly to increasing the regulatory burden for banks because supervisors need more data to monitor and verify the elements. Some countries are thus using or contemplating proportional regimes that exempt certain banks from some of the standard (Basel) regulatory requirements and specify alternative rules for qualifying banks. For example, Brazil, the European Union, Japan, Switzerland, the United States, and Hong Kong SAR, China, apply the standard Basel framework only to banks bigger than a certain size; and of those, Brazil and the United States apply the framework only to

FIGURE 3.3 Percentage of Countries with a Leverage Ratio Requirement, by Region and Basel Regime



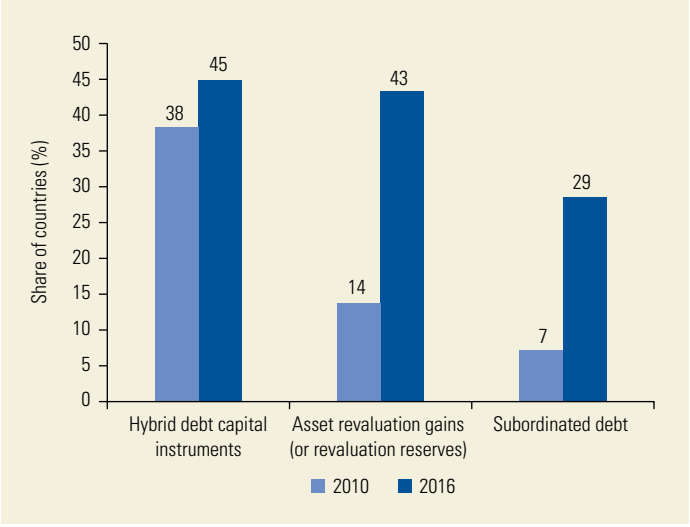
Source: Bank Regulation and Supervision Survey (BRSS), wave 5, https://www.worldbank.org/en/research/brief/BRSS.
Note: This figure is based on 2016 data from 70 countries that reported using Basel III, and 63 countries that reported using Basel I or II. OECD = Organisation for Economic Co-operation and Development.

banks with sufficiently large foreign operations (Castro Carvalho et al. 2017).

Over time, the definition of Tier 1 capital seems to have become laxer in some countries, highlighting that the Basel frameworks leave room for discretion. Basel III sought to increase the quality of capital by eliminating Tier 3 capital and by raising the percentage of Tier 1 versus Tier 2 capital (see box 3.5). However, like Basel II the Basel III guidelines allow some financial instruments that are not common equity to count as Tier 1 capital. Interestingly, over time supervisors seem to have changed the way in which these guidelines are applied. In 2016 a higher percentage of countries allowed hybrid debt capital instruments, asset revaluation gains, and subordinated debt to count as Tier 1 capital than in 2010 (figure 3.4). The change here is greatest for asset revaluation gains. The percentage of countries allowing this item to count as Tier 1 increased from 14 in 2010 to 43 in 2016.

In practice, however, most of the Tier 1 capital that banks hold appears to be common equity. Systematic and comprehensive information on which types of instruments go into banks' Tier 1 capital holdings is lacking. Bankscope, which compiles data from banks' balance sheets, includes information on hybrid capital and subordinated debt, but the data on the over 90 percent of

FIGURE 3.4 Percentage of Countries Allowing Items as Part of Tier 1 Capital, 2010 and 2016



Source: Bank Regulation and Supervision Survey (BRSS), wave 5, https://www.worldbank.org/en/research/brief/BRSS.
Note: This figure is based on 2010 data from 115 countries and 2016 data from 133 countries.

banks reporting Tier 1 capital in Bankscope are missing. By contrast, data on common equity are available for most banks. The values of common equity reported in Bankscope are close to the total value of Tier 1 capital reported, suggesting that most Tier 1 capital is common equity. This finding is the same in countries that allow other types of instruments to count as Tier 1 capital.

Contingent convertible bonds (CoCos) are being used as part of Tier 1 capital in some countries, but it is not clear how well they work in practice. CoCos or bailable bonds are debt instruments that can be converted to equity after a triggering event, such as a fall in stock prices below a prespecified threshold or a decline in regulatory capital to below a threshold. These bonds can thus provide additional capital to absorb losses in times of crisis (see also chapter 2). CoCos may be easier and less costly to issue than equity, and, compared with equity, they can provide similar or even stronger incentives for sound risk management (Calomiris and Herring 2011).[6] However, it is unclear how well CoCos work in practice. For example, Fiordelisi, Pennacchi, and Ricci (forthcoming) describe a Spanish bank that failed before reaching any of the triggers for its CoCos. This scenario could be avoided by designing CoCos differently, as suggested by Calomiris and Herring (2011), but it illustrates how theory may differ from practice when such adverse events occur. CoCos are also not a viable option for countries lacking an appropriate financial market for issuing contingent debt instruments.

EFFECTS OF POSTCRISIS CAPITAL REGULATION

In high- and middle-income countries, the ratio of Tier 1 capital to total regulatory capital has increased since the global financial crisis. From 2005 to 2017, the ratio of Tier 1 capital to total regulatory capital increased from 75 to about 90 percent in high-income countries and from 75 to about 85 percent in middle-income countries (figure 3.5). In low-income countries, the ratio of Tier 1 capital to total regulatory capital has not changed much since 2005, but it started out at an elevated level (over 90 percent). These data from the International Monetary Fund's Financial Soundness Indicators do not include a breakdown of Tier 1 capital, so it is not clear whether the increase in Tier 1 capital comes from common equity or from other types of capital. However, according to the bank balance sheet data from Bankscope for 2009–12, for 101 large banks in 23 jurisdictions that are mostly OECD countries, common equity increased. About two-thirds of the rise in common equity stemmed from higher retained earnings, with the other third from other sources, including new share issues (Cohen and Scatigna 2016).

In high-income countries, the ratio of capital to risk-weighted assets has caught up with middle-income countries since the global financial crisis. In high-income countries, the ratio of regulatory capital to risk-weighted assets was lower than that in middle- and low-income countries before the crisis—about 12 percent, compared with 16–18 percent (figure 3.6). Since the crisis, high-income countries have caught up with middle-income countries: both high- and middle-income countries now have a ratio of regulatory capital to risk-weighted assets of about 18 percent. Low-income countries have increased their ratio of regulatory capital to risk-weighted assets up to 22 percent.

However, the ratio of capital to total assets has increased by much less. High-income countries also started out with a lower leverage ratio (defined as the ratio of regulatory capital to total assets), at about 7 percent, compared with 11–14 percent in middle- and low-income countries (figure 3.7). The leverage ratio has increased slightly in high-income countries, standing at 9 percent in 2017, but it is still lower than those of middle- and low-income countries. Upper-middle-income and low-income countries also both saw a slight increase in their leverage ratio, while lower-middle-income countries experienced a slight decline.

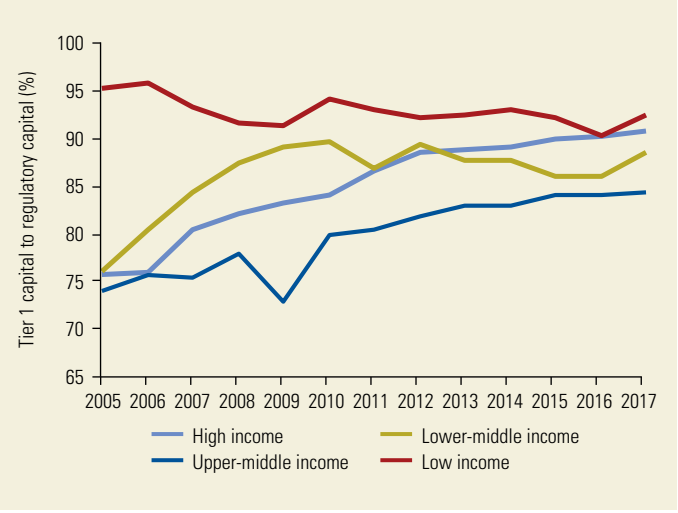
In high-income countries, the ratio of risk-weighted assets to total assets has steadily decreased, from 61 percent in 2005 to 50 percent in 2017. In middle- and low-income

countries, this ratio has remained higher: in 2017 it was about 65 percent (figure 3.8). In line with these numbers, Cohen and Scatigna (2016) find that large banks increased their total assets from 2009 to 2012, but risk-weighted assets increased less than total assets. The decline in risk-weighted assets relative to total assets could be driven by a shift toward safer assets. However, only patchy data on banks' asset holdings are available from Bankscope and the Financial Soundness Indicators; thus we are not able to verify whether such a shift toward safer assets took place. An alternative explanation for the decrease in risk-weighted assets relative to total assets is that banks have adjusted their internal risk models to lower risk weights.

Although Basel III was mainly adopted in high-income countries, it has implications for lending in developing countries as banks adjust their assets and cross-border operations. For example, Berrospide et al. (2017) find that tighter U.S. capital regulation reduced lending by large U.S. global banks in other countries. At the same time, high capital requirements seem to change to whom banks lend in other countries. Ongena, Popov, and Udell (2013) analyze business lending by 155 banks to firms in 16 countries in the ECA region, where bank subsidiaries have tended to rely more on parent funding than in other regions, such as LAC. They find that higher minimum capital requirements in domestic markets are associated with lower bank lending standards abroad (more lending to opaque firms but not other firms). This finding may imply that banks take advantage of laxer host country regulation to try to make up abroad for the inability to engage in high-risk, high-return lending at home.

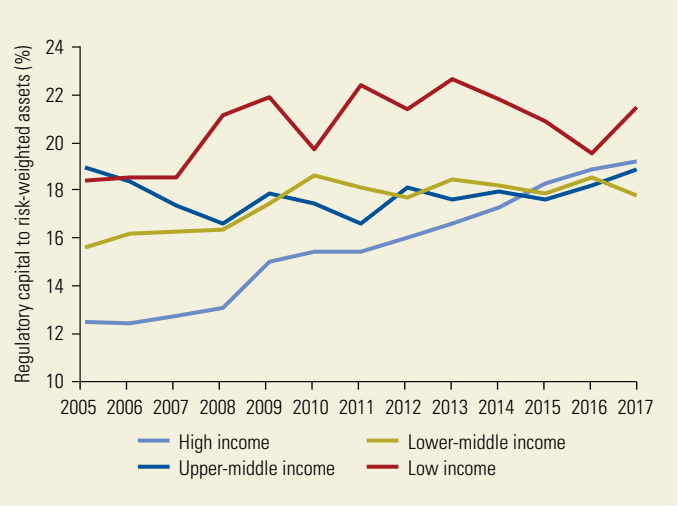
Evidence suggests that Basel III also slowed down bank lending in adopting countries, at least in the short run. Several studies have used economic models and empirical results from pre-Basel III times to extrapolate the effect of Basel III on lending (see Cosimano and Hakura 2011; Gambacorta 2011; BCBS 2016). These studies find that Basel III would have a negative effect on bank lending, although this effect would vary across

FIGURE 3.5 Tier 1 Capital to Total Regulatory Capital, by Country Income Group



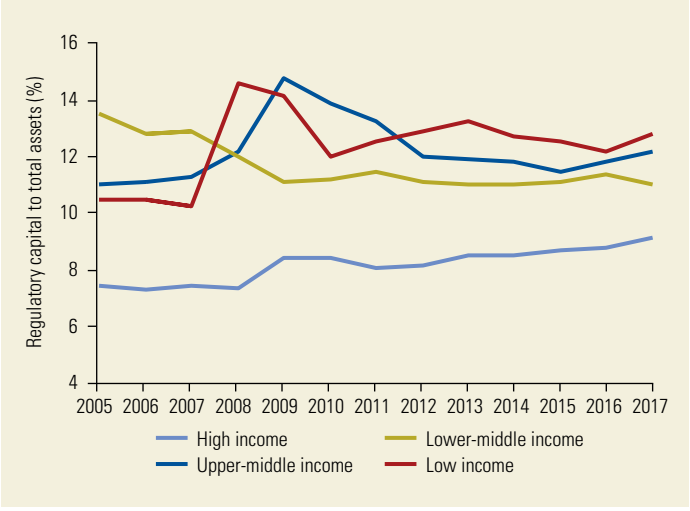
Source: World Bank staff calculations based on data from Financial Soundness Indicators (database, International Monetary Fund).
Note: The Financial Soundness Indicators (FSI) provide country-level data on total capital and assets holdings of the banking sector, as reported by participating countries to the IMF. Tier 1 capital to regulatory capital is calculated as total Tier 1 capital divided by regulatory capital of the banking sector. Country-level ratios are then averaged by country income group using a simple average. Country coverage increases over time, moving from 28 countries in 2005, to 70 in 2008, and to 114 in 2016.

FIGURE 3.6 Total Regulatory Capital to Risk-Weighted Assets, by Country Income Group



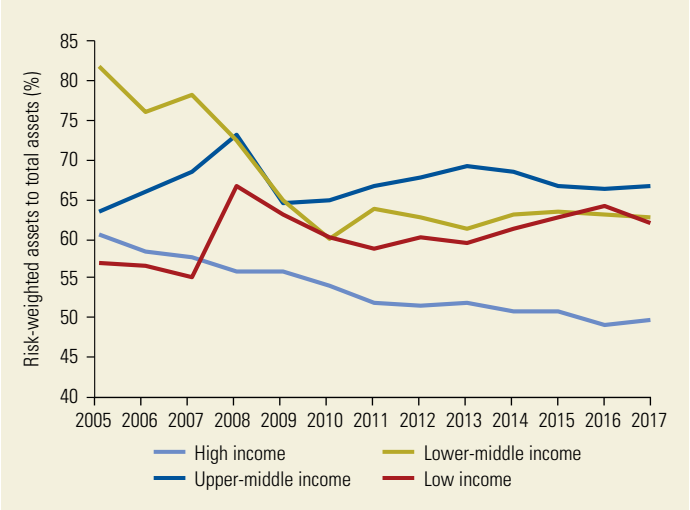
Source: World Bank staff calculations based on data from Financial Soundness Indicators (database, International Monetary Fund).
Note: The Financial Soundness Indicators (FSI) provide country-level data on total capital and assets holdings of the banking sector, as reported by participating countries to the IMF. Regulatory capital to risk-weighted assets is calculated as total regulatory capital divided by risk-weighted assets of the banking sector. Country-level ratios are then averaged by country income group using a simple average. Country coverage increases over time, moving from 28 countries in 2005, to 74 in 2008, and to 116 in 2016.

FIGURE 3.7 Total Regulatory Capital to Total Assets (Leverage Ratio), by Country Income Group



Source: World Bank staff calculations based on data from the Financial Soundness Indicators (database, International Monetary Fund).
Note: The Financial Soundness Indicators (FSI) provide country-level data on total capital and assets holdings of the banking sector, as reported by participating countries to the IMF. Regulatory capital to total assets is calculated as total regulatory capital divided by total assets of the banking sector. Country-level ratios are then averaged by country income group using a simple average. Country coverage increases over time, moving from 25 countries in 2005, to 65 in 2008, and to 107 in 2016.

FIGURE 3.8 Risk-Weighted Assets to Total Assets, by Country Income Group



Source: World Bank staff calculations based on data from Financial Soundness Indicators (database, International Monetary Fund).
Note: The Financial Soundness Indicators (FSI) provide country-level data on total capital and assets holdings of the banking sector, as reported by participating countries to the IMF. Risk-weighted assets to total assets is calculated as risk-weighted assets divided by total assets of the banking sector. Country-level ratios are then averaged by country income group using a simple average. Country coverage increases over time, going from 25 countries in 2005, to 65 in 2008, and to 107 in 2016.

countries. For example, countries with higher costs of raising equity would be more affected. Direct evidence on the effects of Basel III is still scarce. An exception is a paper on Peru, which introduced bank-specific capital buffers when it adopted Basel III. Fang et al. (2018) use this bank-level variation in capital requirements to measure the effect on lending. In line with other studies, their results show that higher capital requirements had a negative impact on bank lending, but this effect was short-lived, lasting about six months. In the Peruvian case, banks seem to have been able to raise additional capital, in part thanks to the early announcement of reforms, the relatively slow speed of implementation, and the high profitability of banks.

Countercyclical capital buffers appear to smooth credit for firms across the business cycle, increasing firm growth and survival. Jiménez et al. (2017) use data from Spain to analyze the impact that capital buffers have on credit supply and firm outcomes. They exploit the introduction of and changes in dynamic provisioning over time. They find that banks use the stored buffers in bad times to continue lending, and that tightening capital in good times has little impact on firms because they switch to other credit sources. Such a switch may be entirely appropriate because these other sources would not carry government guarantees, and thus they may be well positioned to absorb risk. The effects measured in this study are substantial: increasing capital buffers by 1 percentage point expands firms' credit by 9 percentage points, employment by 6 percentage points, and survival by 1 percentage point. A caveat is that countercyclical capital buffers can undermine monetary policy (Calomiris 2012).

Liquidity requirements can enhance the role of bank capital in sustaining lending by large banks during a crisis. In their study of U.S. commercial banks over the period 1993–2010, Kim and Sohn (2017) find no evidence that bank liquidity mattered for the relationship between bank capital and lending in small and medium-sized banks. For large banks, however, greater liquidity was associated with a stronger positive correlation

between bank capital and lending, particularly during the global financial crisis. These findings suggest that Basel III liquidity requirements complement capital requirements and can help smooth lending by large banks during times of crisis.

POLICY RECOMMENDATIONS

Proportionality. One set of regulations may not fit all countries. Regulations tailored to the needs of developed countries—with their more sophisticated banks, more complex operations, and stronger supervisory power—may not be appropriate for the banking sectors of developing countries. The observed selective and gradual adoption of Basel II and III is thus appropriate. Rather than adopting overly complex capital requirement approaches, regulators in developing countries should focus on simpler capital ratios and give priority to building up supervisory capacity that improves enforcement and better monitoring of their local financial systems.

Simple is better. A simple capital ratio appears to be more reliable than a risk-weighted ratio. In the global financial crisis, the market relied primarily on a simple measure of leverage for valuing bank stocks—capital to total assets—instead of relying on capital to risk-weighted assets (see, for example, box 3.4). Risk-weighted models tend to be less informative because measuring risk exposure is very difficult, especially for large and complex financial organizations. Although a simple leverage ratio may make it possible for banks to hold overly risky assets, it also avoids manipulation of risk weights and is relatively transparent and verifiable (Haldane 2011; Calomiris 2012). Overall, then, the leverage ratio introduced under Basel III seems appropriate as a complement to the risk-weighted ratio. Setting the minimum value at 3 percent is a topic for more research because some analysts advocate much higher levels (Admati 2016).

Quality matters. The low quality of regulatory capital contributed to the global financial crisis, implying that the focus of Basel III on common equity is warranted. Under Basel II, part of regulatory capital (Tiers 2 and 3) had a low loss absorptive capacity, contributing to risk-taking before the crisis and leaving banks in trouble during the crisis. Basel III sought to improve the quality of equity by eliminating Tier 3 capital and increasing the minimum common equity requirement. These changes appear to have indeed led to an increase in Tier 1 capital, but there is also evidence that some regulators have relaxed the definition of Tier 1 capital. It is thus important to carefully monitor exactly what banks are holding as part of Tier 1.

Increases in the quantity and quality of capital since the global financial crisis can foster financial stability, but the increases appear to have reduced access to credit, at least in the short run. There is, however, little direct evidence on the effect of Basel III regulation on credit access in high-income OECD countries, which are the main adopters of Basel III. According to a study of Peru by Fang et al. (2018), Basel III reduced bank lending, but only in the short run. Moreover, several studies suggest that tightening of regulation in high-income OECD countries has led banks from these countries to lend less in developing countries. The effects on lending may be mitigated by allowing banks to increase capital with contingent convertible bonds, but experience with these instruments remains limited. It is not clear how well they will perform in practice, and they are not an option for countries without developed capital markets.

Greater transparency, information disclosure, and monitoring are needed to ensure that banks are not tempted to circumvent regulation. Based on the data available through BankScope and public sources, it is not possible to determine what exactly banks are holding as Tier 1 capital. It would thus be useful for market participants to have more information about the types of instruments that banks hold and how they are meeting their Tier 1 requirements. Information is also lacking on the types of assets that banks have, making it difficult to know why their risk-weighted assets relative to total assets have fallen over time. Thus,

although on the surface it looks as though banks may now be holding more equity and safer assets than before the global financial crisis, the numbers may be providing a false sense of security.

NOTES

1. See Jackson et al. (1999) for a thorough discussion of the impact of Basel I regulation.
2. As Haldane (2011) notes, the number of risk categories under Basel II exploded for the larger, more complex banks, moving from fewer than 10 to over 200,000. This change implies that the number of calculations needed to determine the regulatory capital ratio of this size bank rose to over 200 million.
3. Further evidence also finds that the composition of borrowers among banks of varying degrees of capital is not random. "Bank-dependent" firms are more likely to seek financing from banks with greater capital (Schwert 2018).
4. Under the standard approach, the capital required for a loan is similar to that of Basel I because it is determined by fixed risk weights. By contrast, under the IRB approach banks use their own estimates of four risk parameters to determine the risk weight of a loan. The four parameters are probability of default, loss given default, exposure at default, and effective maturity of the loan.
5. These percentages are driven in part by small countries because most larger countries within each region have adopted Basel III.
6. However, Berg and Kaserer (2015) show that in some cases CoCo bonds can magnify equity holders' incentives to increase the riskiness of assets and decrease incentives to raise new equity in a crisis.