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REAL ESTATE AND THE GREAT CRISIS: LESSONS FOR MACROPRUDENTIAL POLICY

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Credit conditions have caused real estate booms and busts, owing to an underpricing of credit risk aided by regulatory arbitrage and shadow financing. Across countries, real estate price and credit bubbles have reflected not only inelastic land supply and thin trading, but also the amplification of shocks via backward-looking price expectations and financing based on distorted prices. Macroprudential lessons from the Great Crisis include preventing excess real estate financing and limiting the amplification and correlation of risks. Nonetheless, the costs and benefits of recent regulations require re-evaluation amid an ongoing need to address correlated risks from shadow financing and securitization. (*JEL* G28, E3, R31, R33, R38)

I. INTRODUCTION

The consensus before the financial crisis of 2007–2009 was that monetary authorities should avoid curbing financial excesses and should focus on central bank goals of keeping inflation and unemployment near target in the short run. This view explicitly assumed that monetary policy lacked enough tools to pursue multiple targets and was too blunt to address financial stability—a view largely still intact. Implicit was a belief that Basel II made the financial system resilient enough to survive the unwinding of financial excesses and for fiscal and monetary policy to clean up damage to the macroeconomy and financial system (Bernanke, Gertler, and Gilchrist 1999). Besides this, the precrisis consensus underappreciated how much real estate imbalances could directly contribute to deep recessions and sluggish recoveries.

ABBREVIATIONS

AMLF: Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility
CCB: Countercyclical Capital Buffer
CDO: Credit Default Obligations
CFMA: Commodity Futures Modernization Act
CFPB: Consumer Finance Protection Bureau
CLTV: Combined Loan-to-Value Ratio
CMBS: Commercial Mortgage-Backed Securities
CPFF: Commercial Paper Funding Facility
CRD IV: Capital Requirements Directive
CRE: Commercial Real Estate
CRR: Capital Requirement Regulation
DFA: Dodd-Frank Act
DSGE: Dynamic Stochastic General Equilibrium
DSTI: Debt-Service-to-Income
DTI: Debt-to-Income
EU: European Union
FHA: Federal Housing Administration
GDP: Gross Domestic Product
HQLA: High-Quality Liquid Assets
LCR: Liquidity Coverage Ratio
LTV: Loan-to-Value
MBS: Mortgage-Backed Securities
NAV: Net Asset Value
NSFR: Net Stable Funding Ratio
PMBS: Private-Label Mortgage-Backed Securities
RMBS: Residential Mortgage-Backed Securities
TAF: Term Auction Facility

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The 2007–2009 financial crisis and recession shattered both of these implicit assumptions. By mid-2010 when Basel III was announced and when the Dodd-Frank (financial reform) Act (DFA) was passed in the United States and the Capital Requirements Directive (CRD IV) and Capital Requirement Regulation (CRR) were announced by the European Union (EU) (to implement Basel III), the emerging postcrisis consensus accepted that the financial system was neither resilient enough to survive large financial shocks nor could policy effectively clean up the macroeconomic damage after crises occurred. Systemic risk to the financial system and real economy was seen as so prevalent that new macroprudential policies were needed to address these risks, allowing monetary policy and fiscal policy to focus on broad macroeconomic goals (e.g., Blanchard, Dell'Ariccia, and Mauro 2010). Although both the theoretical and empirical framework of macroprudential policy was still in its infancy—with limited guidance for policy—the United States and European countries, in the wake of the crisis, adopted measures to contain systemic risks. Given the practical challenges of reaching political consensus to pass such reforms in the proverbial heat of the moment, there was not enough time for either Basel III or DFA to be based on a full diagnosis of the financial crisis.

In the United States, DFA took a kitchen-sink approach of passing widespread guidelines aimed at curbing financial practices and factors that may have plausibly contributed to the crisis. The EU, instead, is digesting the regulatory requirements of CRD IV and CRR that introduced harmonized prudential rules under the Basel III accord. And although much care and time was taken to write the rules to implement DFA's guidelines and Basel III regulatory requirements, it was difficult, if not impossible, for the many regulations to benefit from extensive research on the crisis, much of which had yet to appear in print, as well as consider the possible costs of overly broad regulation. For example, small and midsize banks have complained about increases in regulatory burden that particularly disadvantage banks that operate at a lower scale amid challenges unconventional monetary policy poses for lending.[1]

A decade after the crisis, which began in summer 2007, the design and implementation of financial reform is not complete. In the United States, 9 years after the government-sponsored entities, Fannie Mae and Freddie Mac were put into conservatorship, reform of the housing finance system is still in discussion. Over this time, the postcrisis consensus has continued to evolve in at least two major ways. First, real estate busts are now seen as critically contributing to deep downturns and sluggish recoveries by impairing the financial system with losses and households with debt-overhangs (e.g., Bordo and Haubrich 2017; Levitin and Wachter 2012; Mian and Sufi 2009, 2011; Reinhart and Rogoff 2009). There is recognition that across countries and over time, bubbles arising in real estate markets (Abraham and Hendershott 1996) can be acute and cause long-lasting macroeconomic harm, reflecting not only the relatively inelastic supply of land and thin trading of real estate, but also the amplification of shocks via backward-looking price expectations and the funding of real estate loans based on distorted and elevated prices. Second, there is a growing appreciation for the need of macroprudential policy to address externalities that cause buildups of imbalances that lead to crises, directly amplify the effects of shocks during crises, and indirectly amplify these effects by creating correlated risks. More recently, there are widespread concerns about whether the long-term growth rates of U.S. and European gross domestic product (GDP) have slowed. Are these residual effects of the unwinding of the crisis transitional effects from implementing financial reform that will eventually unwind, or alternatively, have financial reforms slowed the underlying dynamism of advanced economies?

Given the depth of the Great Recession and the sluggish recovery, it is appropriate to reassess the macroprudential policy lessons learned, problems solved, and challenges remaining. We begin by reviewing the lessons that can be drawn from the experience surrounding the Great Recession, its aftermath, and what financial reforms have done. We then assess how macroprudential policy could better address critical risks posed by real estate lending and raise questions about whether other regulations pose enough macroprudential

1. Feldman, Heinecke, and Schmidt (2013) show that the additional costs from the new regulations lower the profitability of U.S. community banks, and others find that recent changes in banks' capital requirements (e.g., Auer and Ongena 2016; De Jonghe, Dewachter, and Ongena 2016) reduce banks' supply of credit. Acharya et al. (2017) argue that the ECB's unconventional monetary policies have slowed economic growth because the additional liquidity is not invested productively, while Heider, Saidi, and Schepens (2017) find that high-deposit banks reduce lending after policy rates become negative despite the policy goal of raising loan supply.

benefits to warrant the burdens imposed. In this endeavor, our approach focuses on the nature of key macroprudential externalities—posed by real estate—and how their manifestation in real estate valuation swings can be contained. In this way, macroprudential policy can be better grounded—both theoretically and empirically—and better implemented.

II. MACROPRUDENTIAL LESSONS LEARNED FROM THE GREAT RECESSION

There is a growing consensus that the bursting of real estate bubbles has contributed greatly to prolonged downturns (e.g., Bordo and Haubrich 2017; Crowe et al. 2013; Herring and Wachter 1999, 2003) in being either the impulse for, (e.g., the Great Recession) or an amplifier of, them (e.g., the Great Depression; Green and Wachter 2007). In some countries that experienced severe downturns, such as Ireland and Spain, the demand for real estate was bolstered not only by low mortgage interest rates that underpriced risk, but also by an excessive easing of credit standards via either making too many loans with explicitly high loan-to-value (LTV) ratios (e.g., Ireland–see Kelly, McCann, and O'Toole 2015) or circumventing covered bond caps on the LTVs of mortgages by substituting inflated appraised prices for actual transactions prices (as in Spain) or by avoiding regulatory limits on banks by lending through less-regulated depositories (e.g., cajas in Spain).[2] The resulting high prices enabled a further expansion of lending and triggered building booms that later expanded supply during the house price bust that ultimately worsened loan losses and crippled financial systems.

Weak regulation took a different form, in contributing to the housing bust and the Great Recession in the United States, which can be interpreted as being triggered by the collapse of structured finance—as opposed to direct bank funding—that had earlier spawned credit-fueled bubbles in residential *and* commercial real estate (CRE), the bursting of which ultimately crippled the U.S. financial system and its real economy (Duca, Muellbauer, and Murphy 2010; Levitin and Wachter 2012; Wachter 2015b). An overview of recent evidence on the Great Recession and shadow banking in the United States sheds light not only on why real estate downturns are so severe and long lasting, but also on the tendency for real estate mispricing to give rise to large swings in both residential and commercial real estate prices and valuations. In addition the U.S. experience shows how bubbles can arise from the shadow banking sector, an issue still not fully accounted for by financial reform, as discussed below.

A. How and Why Real Estate Is Vulnerable to Mispricing

In the United States, the residential and commercial ("twin") real estate booms and busts of the mid-2000s were fueled by the rise and fall of structured finance that funded them. While other booms and busts in commercial and residential real estate (e.g., in Japan; Herring and Wachter 1999) had preceded the twin real estate bubbles of the mid-2000s, those had not been funded on their upswings by securitization that later dried up. In contrast, the expansion of structured finance was the key driver of the twin real estate bubbles of the mid-2000s, which coincided with one another. The last decade's structured finance boom arose because the tranching in credit default obligations (CDOs) was made palatable to investors by derivatives enhancements made possible by the Commodity Futures Modernization Act (CFMA) (Cordell, Huang, and Williams 2012; see McCoy, Pavlov, and Wachter 2009; Roe 2011; Stout 2011) and because the easing of capital requirements on commercial mortgage-backed securities (CMBS) and private-label mortgage-backed securities (PMBS) provided regulatory arbitrage incentives to fund an expansion of CRE and nonprime residential lending via securitization. In both cases, the risk in the underlying real estate investments was underpriced in related—but slightly different—ways in commercial and residential real estate markets (Levitin and Wachter 2013a; Levitin, Pavlov, and Wachter 2012).

Using survey data on CRE investors, appraisers, and deal makers, Duca and Ling (2015) found that the risk premium in investors' required rate of return on CRE properties was mainly driven in the short and long run by the combination of a general risk premium (the Baa-10-year Treasury yield spread) and the effective or marginal capital requirement on CRE loans. The latter—which

2. In other countries, higher house prices early in this century owed more to low interest rates fueling upward shifts in the demand for housing against a relatively price inelastic supply of housing (e.g., the Netherlands or France; see Duca, Muellbauer, and Murphy 2010). In others, real house prices were flat in the early 2000s reflecting factors such as declining population (e.g., Germany and Japan) or tax laws favoring rental housing (e.g., Germany).

affects the liquidity of CRE—reflects the lessor of capital requirements on CRE loans or CMBS held in bank portfolios and the risk retention for banks that securitize CRE loans. The lower this capital requirement, the lower is the cost of funding the investment and the lower is the risk premium (see Pennacchi 1988). Duca and Ling (2015) attribute the compression of cap rates (akin to a high price-to-earnings ratio) of the mid-2000s to a decline in the risk premium embedded in investors' required rate of return on CRE properties. Their empirical results indicate that the compression of risk premiums owed to both a reduction in effective capital requirements (the adoption of a 20% risk weight on high-rated CMBS—see Blundell-Wignall and Atkinson 2008) and a narrowing of the corporate bond spread (which has a slightly less than one-for-one impact on the long-run risk premium). The former could be seen as an underpricing of CRE risk by capital regulation. The latter can be interpreted as an underpricing of CRE risk by investors insofar as they treat the risk on CRE as akin to that of Baa-corporate bonds that generally are more liquid than commercial properties. In other words, the implicit use of Baa yields as a benchmark for a required rate of return may be appropriate for some assets whose returns are based more off value added (corporate profits or cash flows) than for CRE whose returns stem from rents and capital gains on land. Levitin and Wachter (2012) show the trajectory of this underpricing of risk, with risk-premium tightening during the boom.

For PMBS, the main funding source for subprime and Alt-A mortgages, the mispricing of risk owed to an underassessment of risk. This in part reflected a lack of stress testing nonprime mortgages through both business and housing cycles. As Duca, Muellbauer, and Murphy (2010) show, while the limited history of the subprime mortgage delinquency rates before 2007 could be largely tracked by job growth, this obscured a key role played by house price appreciation. In the early phases of a financial liberalization, increased credit availability boosts housing demand (see Acolin et al. 2016; Linneman and Wachter 1989; Pavlov and Wachter 2011) and bids up real estate prices. Such gains can delay the appearance of loan defaults because troubled borrowers could pay off mortgages by selling or refinancing an appreciated property or continue making loan payments with funds from home equity loans. This is an acute problem in real estate markets because an underpricing of default risk in lending, which took the form of low teaser interest rates and excessively easy credit standards on nonprime mortgages, ultimately leads to inflated asset prices in markets of fixed supply, as stressed by Pavlov and Wachter (2006, 2009). In addition, at times rising house prices can paradoxically increase the effective demand for housing because if expected appreciation is based on extrapolating recent prices (as is observed empirically—see Case, Shiller, and Thompson 2012), higher prices can raise expected appreciation and lower the perceived real user cost of housing, thereby fueling further increases in house prices and obscuring underlying loan quality problems. Moreover, even with the recognition that lax lending terms and underpriced put options were behind an unsustainable rise in housing prices, selling homes to take advantage of likely future price depreciation is not feasible (Levitin and Wachter 2012; Wachter 2016).

Only after the budget constraint effects of higher prices predominated did house prices level off in mid-2006[2] and new subprime borrowers were no longer simply bailed out by price appreciation (Barakova, Calem, and Wachter 2014). Shortly thereafter, subprime delinquencies mounted, inducing investors to flee nonprime mortgage-backed securities (MBS), which induced a reversal of the earlier easing of mortgage credit standards, setting off a house price bust (Duca, Muellbauer, and Murphy 2016; Levitin and Wachter 2012), exacerbated by fire sales as in the theoretical models of Brunnermeier and Sannikov (2016) and Luck and Schempp (2014). Similar interplay between price and default dynamics also delayed and masked the appearance of loan quality problems in CRE and the underpricing of risk during the boom phases of the real estate bubbles.

In addition, the underpricing of risk was transmitted to the pricing of residential and commercial real estate through somewhat different channels. In CRE, the price bubble reflected the transmission of the mispricing of CRE by otherwise savvy investors through an increase in earnings-multiples. Somewhat differently, the subprime boom reflected the transmission of underpriced mortgage interest rates as well as unsustainably easy mortgage credit standards, although both booms were fueled by regulatory shifts (McCoy, Pavlov, and Wachter 2009) in markets whose fundamental incompleteness prevented the short selling of overpriced assets (Wachter 2016).

B. How and Why Real Estate Downturns Can Be Prolonged and Slow to Recover From: The Role of Externalities

Deep and prolonged economic downturns are often linked to real estate busts both across countries and across time within the United States (*inter alia*, Bordo and Haubrich 2017). This relationship between real estate bubbles and subsequent economic crashes has been observed across countries and over time, with the severity and frequency of this connection increasing since housing finance has been integrated into global capital markets (Green and Wachter 2007; Herring and Wachter 1999).

There are three underlying channels through which real estate cycles have a pronounced role in downturns. These are traditional or conventional wealth effects of changes in gross housing wealth, changes in the ability to borrow against housing wealth, and damage to the financial system. These can be thought of as "real estate financial accelerators," akin to the more business-oriented financial accelerator of Bernanke, Gertler, and Gilchrist (1996). And each of these give rise to negative externality effects that lenders do not internalize when making loan decisions, giving rise to more lending than is socially optimal (Herring and Wachter 1999; Turner 2015; Wachter 2014).[3] A financial decelerator effect arises from the overhang of mortgage debt accumulated during housing booms that not only impairs housing activity, but also consumption (Mian and Sufi 2009, 2011). This arises because home values decline, directly lowering household net assets as mortgage payment obligations continue unchanged. This depresses consumption directly due to lower net wealth. Collateral price declines exacerbate the latter effect by limiting the ability to refinance existing debt, which must then be repaid as opposed to refinanced.

A second effect arises from the inability of credit constrained households to access borrowing as lending criteria ratchet up. Access to second liens as well as to refinancing is likely to decline, particularly affecting borrowing constrained households. In recent decades, homeowners have become more able to borrow against accumulated housing equity gains arising from house price appreciation or paying down mortgage principal (Green and Wachter 2007). This phenomenon arose in the United Kingdom during the late 1980s and early 1990s—feeding a consumption boom when house prices rose and a consumption bust when house prices fell (Muellbauer and Murphy 1997)—and has spread to other countries, such as Denmark (Browning, Gørtz, and Leth-Petersen 2013), the United States (Hurst and Stafford 2004), and Ireland. Microevidence indicates this collateral effect, allowing otherwise credit-constrained households to borrow against housing collateral (*inter alia*, Hurst and Stafford 2004).

This effect operates in part through the cyclically changing availability of second liens; while LTVs appeared to be constant through the run-up to 2007, combined loan-to-value ratios (CLTVs, only knowable after the crisis since real-time data were unavailable) increased dramatically (Levitin and Wachter 2015). The time series evidence for the United States indicates that this ability to extract equity increased over the past several decades (e.g., Carroll, Otsuka, and Slacalek 2011), but fell back during and after the Great Recession (Duca, Muellbauer, and Murphy 2013). This up- and then down-swing in the liquidity of housing wealth amplified the positive and then negative effects of swings in gross housing assets of U.S. households, and for countries where home equity extraction is feasible (see Aron et al. 2012, for cross-country evidence). Empirical studies that disaggregate net worth into debt, gross housing assets, liquid financial assets, and illiquid or risky financial assets typically find a larger and similar-sized effect of debt and liquid financial assets on consumption than from the other components of net worth. Indeed, for the United Kingdom, United States, and Australia, the marginal propensity to consume out of liquid assets minus debt is roughly five times the size of that of stock wealth and two to three times that of gross housing assets (see Aron et al. 2012; Duca, Muellbauer, and Murphy 2013). Both of these channels, one operating through the procyclicality of second lien access and the more general procyclicality of mortgage lending standards and the other through conventional wealth effects, reduce consumption in the bust.

The third channel through which a commercial or residential real estate bust has negative externality effects is through the damage it does to the financial system. By destroying bank

3. Particularly vulnerable are credits funded by uninsured securities or shadow bank liabilities (Brunnermeier and Sannikov 2016), especially if accompanied by asset price deflating fire sales (Levitin and Wachter 2013b), which can destabilize a macroeconomy as implied by the theoretical models of Brunnermeier and Sannikov (2012) and Luck and Schempp (2014).

capital and causing banks to fall short of capital requirements, the souring of loans extended during booms induces banks to tighten credit standards (Aron et al. 2012; Bordo, Duca, and Koch 2016) and curtail lending in general (*inter alia*, Bernanke and Lown 1991; Kashyap and Stein 2000; Peek and Rosengren 1995).

The appraisal-based system (Herring and Wachter 1999) that banks need to rely upon for heterogeneous collateral-based lending incorporates the mispricing of real estate and leads to sudden stops when the mispricing is recognized. This can occur in both commercial and residential lending. Indeed, real estate losses—particularly from commercial mortgages (inclusive of residential construction and land development loans) and CMBS holdings were even more tied to U.S. bank failures after the onset of the Great Recession than were home mortgages and PMBS holdings (see Antoniades 2015). In addition to reducing financial intermediation, the uncertainty that real estate busts create about the net wealth of firms and their indirect exposures to counterparties and customers impairs the needed transparency of risk for financial markets to operate. The uncertainty about which firms had losses or indirect (e.g., counterparty risk or off-balance sheet) exposures led to thin trading in which increases in insolvency and liquidity risk reinforced one another, pushing down both asset prices and trading volumes (see Bernanke 2010) and pushing up corporate yield spreads. The resulting negative wealth, user cost of capital, and uncertainty effects of real estate busts on securities markets (direct finance) can thus be viewed as a third, general type of externality that individual lenders do not fully internalize and which can result in an above socially optimal buildup of real estate debt in booms.

Each of these effects is specific to real estate. One implication of the special role played by real estate in financial and economic crises is that the rush to enact financial reform may have had unintended consequences of overregulating types of lending that pose little systemic risk. For example, banks report making fewer small business loans for which the lack of hard information makes them subject to higher capital assessments in stress tests. Indeed, some measures show much higher bank regulatory burden (see Bordo, Duca, and Koch 2016, 26) and small business lending has grown slowly in the current U.S. economic recovery, which has been characterized by unusually slow business formation.

III. ADDRESSING MACROPRUDENTIAL REAL ESTATE RISKS

Since the financial crisis began, much has been done to detect and address macroprudential risks in advanced countries, such as the implementation of Basel III at the national level in Europe and the implementation and rule-writing specific regulations for the DFA in the United States. The choice of early warning indicators of systemic risk and macroprudential instruments across these countries reflect similarities and differences in mortgage funding models (see Wachter 2015, for comparisons). These can be classified as policies or tools aimed at (a) preventing financial excesses that directly result in crises and bolstering resiliency to the financial crises that do occur and (b) addressing correlated risks that amplify the broad effects of financial crises. Some of the tools address more than one of these goals. In addition, each of these goals entails regulations or policies that are or could be imposed on lenders (“lender-based”), financial markets (“market-based”), and borrowers/investors (“borrower-based”), and which address the risks posed by innovations that either circumvent or make obsolete existing regulations, as well as risks posed by networks or interconnectedness.

A. Macroprudential Tools to Prevent and Limit Financial and Real Estate Crises

Several major steps have been taken or are being implemented to prevent credit-booms that can fuel real estate bubbles. These include increased capital requirements and buffers for lenders, stress tests, limits on risk taking in securities markets, limits on borrowers, and new liquidity requirements on banks and money market funds. Some of these steps also limit the intensity of crises. These include increases in regular and countercyclical buffer capital requirements and the adoption of forward-looking stress tests. In this regard, the countercyclical buffer is particularly useful in reducing the severity of credit crunches. In addition, the new liquidity requirements on banks and money funds would limit the intensity of runs and of fire sales when they occur.

Increased Capital Requirements and Buffers for Lenders. First, under Basel III capital requirements were raised on commercial banks in terms of overall and risk-based leverage ratios, along with the planned implementation of countercyclical capital buffers (CCBs) and

additional capital requirements on large and globally systemically important institutions.[4] The specific implementation of these lender-based restrictions has much commonality across Europe and the United States, such as imposing an overall leverage ratio and tightening up the definition of bank equity capital. In particular, CRD IV in the EU applies generalized CCB, which is conditional on aggregate credit growth, and which is also expected from all member states to limit regulatory arbitrage.

Nevertheless, there are some differences in implementation. For example, in Europe, the countercyclical buffer and provisions requiring banks to build buffers are specified in terms of whether the credit-to-GDP ratio or gap exceeds a certain threshold chosen by individual member states. Some studies find that such thresholds have empirical evidence favoring their imposition (e.g., Borio 2014; Drehmann and Juselius 2014; Drehmann and Tsatsaronis 2014) or are effective in dynamic stochastic general equilibrium (DSGE) models (e.g., Alpanda, Cateau, and Meh 2014) or in agent-based models (e.g., Popoyan, Napoletano, and Roventini 2017). In contrast, the United States has not (to date) adopted thresholds for adjusting the countercyclical buffer based on an explicit credit-to-GDP ratio. One argument against using such ratios is that data revisions make them suboptimal on a real-time basis (Edge and Meisenzahl 2011) and another is that credit outstanding tends to lag business and credit cycles.

Another difference across countries reflects the constrained latitude that Basel III provides countries with options to impose higher risk weights to some loan categories or capital surcharges on certain types of riskier loans. For example, in Ireland, Spain, and the United Kingdom banks are required to hold additional capital if the share of real estate loans that have high LTVs or debt-service-to-income (DSTI) ratios exceeds certain thresholds, whereas higher risk weights or capital surcharges are levied on all high LTV or high DSTI mortgages in Belgium and Switzerland.[5] Indirect sectoral capital requirements that work on variables that affect capital requirements—such as risk weights and loss given default parameters—are more flexibly used under EU jurisdiction (since the countercyclical buffers are generalized and work only on aggregate credit side) due to their targeted nature. In particular, in Sweden and Norway regulatory authorities imposed a floor on risk weight calculated by banks on residential exposures to limit regulatory arbitrage opportunities if a bank uses the internal rating-based model. The United States has generally avoided imposing additional capital surcharges on riskier portfolio-held mortgages for purchasing existing homes. However, the United States did impose a 50% capital surcharge on construction and land development loans, partly given the historical tendency for default rates on these loans to rise more in real estate busts.

Stress Tests. Another major type of bubble-prevention tool aims at buttressing increased capital requirements with the imposition of stress tests on banks and systemically important nonbank financial firms. These tests limit incentives to make riskier loans within broad loan categories and prevent banks from delaying the write-off of bad loans as a means of complying with capital and safety requirements. Another advantage of stress tests is that the scenarios incorporated in them can be used to address forward-looking risks, tail risks, and correlated risks across lenders and the economy. And stress tests can address the unknown risks of financial innovations by levying extra capital buffers on the new and "untested" exposures they create. The implementation of stress tests differs by country, reflecting heterogeneity in the types of shocks or scenarios they may encounter, which encompasses different judgments about the probability of defaults and the rates of loss given default for different loans and borrowers operating in different goods or real estate markets. For example, except for annual EU-wide stress tests conducted by the European Banking Authority, Norway and Sweden augment their baseline scenarios in their national stress tests with adverse scenarios for mortgage and real estate markets. As a result, both countries have tightened the risk weights and default parameters applied to mortgages in their stress tests.[6]

4. In the 2000s, large U.S. banks did not build up capital ratios as risks in the financial system rose. And while large U.S. banks built up capital during the 1920s as financial risks mounted in the absence of a large federal safety net, they needed liquidity and capital support in the Great Depression (see Koch, Richardson, and Van Horn 2016).

5. Since January 2014, Switzerland—which is under EU jurisdiction—has imposed a sector-specific CCB equal to 2% of risk-weighted positions secured by residential real estate.

6. Norway tightened assessments of residential mortgage risk, imposing a loss given default floor of 20% since January 2014, while Sweden raised the risk weight floor on residential mortgages from 15% to 25% since November 2014.

From a broader perspective, the widespread adoption of stress tests can be interpreted as promulgating a lending culture of prudence, where the spirit of the law or regulations—not just the letter of the law—is followed. In a sense the prudential bank regulation approach of traditionally more prudent regulators (e.g., Canada and Australia) is now being applied more broadly, albeit perhaps in a form of more quantitative rather than qualitative judgment from the perspective of regulators. Nonetheless, the efficacy of stress tests will be limited if potentially large "shadow" providers of capital escape such tests while they remain in the shadow.

Limits on Risk Taking in Securities Markets. In addition to adopting tougher capital requirements and stress tests, a third set of bubble-prevention measures entailed imposing market restrictions on risk taking in securities markets. This has not been done so much in Europe, where there are more bank centric financial systems and where efforts have been made to encourage an expanded role of securities markets in providing finance. Nevertheless, several EU member states have imposed LTV caps on mortgages eligible to be funded by covered bonds (see ESRB 2014). For example, Austria and Germany have a 60% LTV limit for residential and commercial mortgages, while Italy, Denmark, and Spain have caps of 80% for residential and 60% for commercial mortgages. In Spain, there is a limit of 80%, which can be relaxed to 95% if the remaining exposure of the issuing bank is covered by a guarantee from another bank. In the United States, LTV caps have not been placed on residential mortgage-backed securities (RMBS), and more generally private-label residential securitization is moribund with RMBS securitized by the GSEs, Fannie Mae and Freddie Mac, and/or by Ginnie Mae for the Federal Housing Administration (FHA) and the U.S. Department of Veterans Affairs (VA) government guaranteed loans, each of which has LTV limits, thus imposing *de facto* limits on LTVs in RMBS, in the absence of private-label securities.

In Europe, there are also some changes in appraisal rules that affect securitization. Prior to the crisis, the LTV on a home purchase mortgage could be based on the higher "appraised" property value rather than the actual transaction price, and LTVs were artificially depressed to make some mortgages eligible for being financed with covered bonds. Actual sales prices are now required to calculate LTVs in some countries (e.g., Spain), with national authorities having the option of imposing larger collateral haircuts to determine eligibility.

In the United States where more commercial as well as residential mortgage lending is funded in securities markets, a major step was taken to impose market restrictions on risk taking in securities markets. Specifically, to limit regulatory arbitrage, the DFA requires originators of CMBS and of private-label RMBSs that did not meet certain credit standards to retain a first loss position of 5% in such securities originated. This effectively imposes a 5% capital requirements on originators, thereby limiting—but not eliminating—regulatory arbitrage incentives of issuing CMBS and PMBS as a means of funding mortgages. Nevertheless, as Pavlov and Wachter (2006) show, even with modest skin in the game, today's fees on mortgage lending will still be attractive if the "put option" is in the money.

Another step taken in the United States concerns new limits on which kinds of home mortgages can be securitized as "qualified mortgage" without imposing additional legal risk on investors or lenders. Now such mortgages are limited to either government guaranteed mortgages (the FHA and the U.S. Department of VA loans), mortgages meeting the underwriting criteria of Fannie Mae or Freddie Mac, or mortgages that have DSTI ratios below 43% with other restrictions on borrower attributes. However, this remains an open issue as the resolution of GSE reform is uncertain. The CMBS market has had a limited resurgence amid these requirements, although as noted, PMBS has not.

Limits on Borrowers. Another set of initiatives to limit the buildup of systemic risk involves direct restrictions on borrowers' ability to borrow (these differ from greater bank capital requirements on risky loans mentioned above). These have differed across countries, in part reflecting a lack of theoretical consensus about their efficacy. For example in DSGE models with endogenous distortions, reducing maximum limits on individual borrowing (e.g., lowering LTV caps) in periods of rapid credit growth or high debt-to-GDP ratios can improve financial stability (Brunnermeier and Sannikov 2012; Lambertini, Mendicino, and Punzi 2013; Rubio and Carrasco-Gallego 2014). Other DSGE models point to the need for macroprudential tools only with endogenous distortions; without such distortions, these models imply monetary policy should be used to quell credit bubbles rather than macroprudential tools

(e.g., Cecchetti and Kohler 2012). In agent-based models, such restrictions promote both financial and macroeconomic stability (e.g., Popoyan, Napoletano, and Roventini 2017).

The empirical evidence generally indicates a financial stability role for tools limiting or discouraging lending to high-risk borrowers, but less about which specific tools are most efficacious. Cross-country studies generally find that limits on borrowers such as caps on LTVs, DSTI, or debt-to-income (DTI) ratios are all effective in limiting large buildups in debt relative to income (e.g., Borio and Shim 2007; Ciani, Cornacchia, and Garofalo 2014; Dell'Ariccia et al. 2012; Lim et al. 2011). Kuttner and Shim (2013) and Gross and Población García (2017), however, find evidence that limits on borrower DSTI ratios tend to be more effective than LTV or DTI caps in stabilizing housing credit growth and house price appreciation.

The United States has eschewed imposing LTV caps on mortgages not insured by federal agencies,[7] in favor of shielding lenders from borrower lawsuits on mortgages meeting DSTI caps and other non-LTV criteria, as well as by banning outright the use of certain mortgage products such as teaser adjustable rate loans which were widely securitized in the run-up to the crisis. In contrast to the United States, Asian and European countries have been more open to imposing LTV caps across borrowers and to varying them countercyclically. For example, Hong Kong has imposed LTV caps, which it has adjusted to counter overvaluation in real estate. In the wake of the financial crisis, several European countries have imposed general LTV caps (e.g. Sweden, Belgium, and the Netherlands) or more stringent ones on loans for high-priced homes to first-time homebuyers or on investors ("buy-to-let"). While Canada does not have explicit LTV caps in general, its government insurer of mortgages has varied its LTV and DSTI limits on the mortgages it insures, while the regulatory authority reduced the maximum maturity of mortgages from 30 to 25 years to counter rising house price pressures from low interest rates (see Crawford 2015).

New Liquidity Requirements on Banks and Money Market Funds. A final set of actions to help prevent financial crises and limit their severity are several new liquidity requirements. The two most prominent of these are aimed at ensuring banks have sufficient liquidity to withstand stressful situations. One is the liquidity coverage ratio (LCR), which requires banks to hold enough high-quality liquid assets (HQLA) that could be sold to offset withdrawals of short-term funds over a 30-day period. The second is the net stable funding ratio (NSFR), which requires banks to have enough stable liabilities to fund assets over the next year under different stress scenarios. The above new liquidity requirements were generally applied and implemented similarly across the United States and European countries with some minor exceptions.[8]

However, reflecting the prevalence of floating net asset value (NAV) money market mutual funds in Europe and the former prevalence of fixed-NAV money funds in the United States, several steps were taken in the United States (but not Europe) to improve the liquidity of money funds to limit the risk of runs and the fire sales of commercial paper. Most notable of these is the requirement that institutional money funds investing in non-Treasury paper use floating NAVs to price accounts. Earlier, U.S. money funds had a "don't break the buck" policy of not pricing money fund accounts below par when the assets the funds invested in fell in price. When large losses on commercial paper emerged around Lehman Brothers' failure in September 2008, many account holders withdrew at par rather than risk capital losses if their fund failed. Investors in one major fund that did fail suffered capital losses, which though small in absolute size, were large relative to the narrow returns typically earned on short-run paper. This helps account for the 1/2 trillion dollar run on U.S. institutional money funds in a 3-week period following Lehman's collapse.

Although the new liquidity requirements limit the incentives of banks and money funds to use short-term funds to finance investments in longer duration risky assets ("carry trade" behavior)—such as CMBS or PMBS—or to invest in the short-run debt of other financial institutions used to finance risky investments, challenges remain. One is whether the new rules on money funds go far enough. For example, retail money funds are not required to adopt floating NAV pricing, which not only continues

7. Although, as discussed below, LTVs are effectively limited in securitized MBS since the GSEs and Ginnie Mae do set limits and the private-label market is moribund at this time.

8. For example, new Congressional legislation mandates that U.S. municipal bonds be treated as high-quality liquid assets despite the recent bankruptcies of Detroit and Puerto Rico.

posing a risk of runs on retail funds, but also encourages some institutional funds to convert to retail status by limiting the size of individual money fund accounts. The second challenge, noted by Allen and Gale (2016), is that the new Basel III liquidity regulations have already induced regulatory arbitrage in the form of innovations involving "evergreen funding" such as "extendable repos" to circumvent the LCR ratio (see Alloway 2015).

Market-Based Backstop Facilities. Another set of macroprudential tools that reduce the intensity of crises and aide recovery from them are the market-based backstop facilities created by the Federal Reserve and Treasury, referred to as lender-of-last-resort or credit-easing tools. Although these tools may be seen as preserving the functionality of particular markets, there are sizable macroeconomic externalities from possible market dysfunction that impart a macroprudential dimension to these tools.

In response to the financial crisis, there was concern that Federal Reserve support of particular institutions under earlier "13-3(c)" powers encouraged too much moral hazard by large institutions. DFA enables circumscribed lender of last resort actions through orderly liquidation authority (Bernanke 2017) as the central bank can set up backstop facilities for a broad array of market participants to use with the approval of the U.S. Treasury provided that such facilities are not designed to save any one or handful of institutions.

During the financial crisis of 2007–2009, five major actions[9] (among more that space prescribes mentioning) were taken by the Fed to backstop markets, which continue to be options allowed under DFA. One such facility was the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF), under which the Federal Reserve made nonrecourse loans to money funds investing in private commercial paper. This too had the effect of cushioning the negative impact of the financial and money market crisis on commercial paper issuance (see Duygan-Bump et al. 2013). Another facility was the Commercial Paper Funding Facility, under which the Federal Reserve bought A1/P1 rated commercial paper at interest rates that were 100 basis points above the option-indexed swap rate. At one point, the Federal Reserve held about 20% of U.S. commercial paper outstanding and its actions prevented commercial paper from collapsing as much as it did during the Great Depression (Duca 2013a, 2013b). Both of these actions were augmented by the U.S. Treasury's action to extend deposit insurance to money fund accounts and to insure many large-time deposits issued by banks.

In addition to buttressing commercial paper and money funds, the Federal Reserve created three other noteworthy facilities (among many) to prevent liquidity problems from worsening the crisis. These included creating the term auction facility (TAF) to provide banks with longer term discount loans and through a new facility with less stigma, the primary dealer facility to provide liquidity backstop to dealers who make markets in initially offered debt and equity, and creating facilities to fund eligible consumer, small business, and high-grade CMBS. Of these, the TAF helped make banks more liquid, allowing them to continue lending to and servicing real estate markets, while the last facility helped the top quality portion of the secondary CMBS market to continue operating—setting the stage for the later re-emergence of limited CMBS issuance.

B. Tools to Address Risks Posed by Externalities

Aside from the macroeconomic effects that crises create by directly impairing lenders and the functioning of securities markets,[10] there are important network risks that macroprudential tools should address. For real estate assets whose collateral role can obscure correlated risks, it is critical to monitor lending from all sources that might unsustainably elevate collateral prices. LTV caps and tougher capital requirements are ineffective if values are elevated by other sources of capital. Overleveraging from all sources, including shadow financing which, as discussed below, creates monitoring difficulties, creates correlated risks (Levitin and Wachter 2012).

One prominent remaining correlated risk concerns the impact on consumption of mortgage equity withdrawals, which tend to boost consumption in liberalized economies during booms and restrain it when debt overhang effects prevail in their aftermath (see Aron et al. 2012; Muellbauer and Murphy 1997). Most of the

9. Also of course quantitative easing was implemented in part in the United States by the purchase of agency MBS which directly supported mortgage prices as well as serving the expansionary goals of monetary policy.

10. These include credit crunches, higher debt costs, and stock or bond wealth effects on consumer spending and on the ability of firms and consumers to raise funding.

active mortgage equity withdrawal during the subprime housing boom took the form of cash-out mortgage refinancing or borrowing via home equity lines of credit. Starting in late 2007, the incidence of the former has been curtailed by Fannie Mae and Freddie Mac, which have imposed sizable surcharge fees withdrawing equity when refinancing mortgages. And new regulatory and enforcement scrutiny by the Consumer Finance Protection Bureau (CFPB) coupled with stress tests by other bank regulators have likely deterred riskier forms of mortgage equity withdrawal. Nonetheless lenders of first lien loans have no way of discouraging second lien loans despite the increased risk they impose (Levitin and Wachter 2015).

Unlike other assets, holders of first liens are not required to be notified or give their permission for granting second liens; in part due to this, the capacity to track property level CLTVs is limited (Levitin and Wachter 2015). Thus, this important source of risk remains. Indeed, as documented by Kumar (2018), the 80% cap that Texas imposed on CLTVs for loans extracting home equity significantly limited the rise of home equity mortgage delinquencies compared to that of other U.S. states during the recent housing bust. Furthermore, without an explicit macroprudential goal of limiting mortgage equity withdrawal effects, there is no guarantee that the new cash-out surcharges by Fannie Mae and Freddie Mac will continue or might be offset by more liberal policies by PMBS securitizers or by banks holding home equity loans in portfolio.

More generally, unless new econometric techniques are employed (Duca, Muellbauer, and Murphy 2013, being an exception), it is difficult to track how much the liquidity of housing wealth has been affected by new regulatory actions, thereby limiting the impact of house prices on consumer spending. Nor is it possible going forward to identify risks deriving from easing of lending conditions through shadow market activity (Wachter 2014, 2015). Other correlated risks concern how problems in one market can cascade into others, particularly if there are complex interactions and exposures. Aside from the fire sale issue, derivatives pose serious network risk exposures as was revealed in the financial crisis when credit default swap contracts suddenly became suspect as the contracts were not transparent and uniform, creating uncertainty about the exposures of private firms and impairing securities markets in general (Bernanke 2008). Reforms to address this include creating industry standards and a clearinghouse for many derivatives contracts, spurred in part by the experience in 2008 surrounding the real estate exposures of Bear Stearns and Lehman.[11] Nevertheless, there are concerns that these may be insufficient to adequately prevent crises, such as that of 2008 (Duffie and Zhu 2011).

A macroprudential tool for gauging both network effects and markets where imbalances are building are heat or radar maps designed to summarize and provide an overview of risks in the financial system—the development of which was recommended by Geanakoplos (2009, 2010). One example is the "heat map" of Aikman et al. (2015), which highlights that CRE valuations are a major outlying risk, consistent with the cap rate analysis of Duca and Ling (2015). Another type maps out networks such as that of Gai, Haldane, and Kapadia (2011).

Nevertheless, these are tools for identifying systemic risks, not necessarily for preventing or addressing them, which requires additional action. The development of such tools has enabled regulators to identify and act upon areas of risk, such as CRE as noted by Federal Reserve Chair Yellen and the Board of Governors of the Federal Reserve System (2015).

One particular issue for such tools is the danger of rapid growth in new products not on regulators' radar maps. A poignant example is how in the lead up to the subprime crisis, the only widely available measures of residential LTV ratios were based on conventional loans and for all home buyers and indicated no problem, whereas gauges on LTVs for first-time homebuyers who had access to nonprime mortgages showed a sharp deterioration in credit standards (Duca, Muellbauer, and Murphy 2011). More broadly, radar or heat maps will need to be capable of tracking a rapid expansion of less-regulated financial sectors (Wachter 2015a, 2016).

Indeed, the empirical evidence indicates that the shadow banking system's provision of short-term business credit (Duca 2016) and of CRE finance (Duca and Ling 2015; Levitin and Wachter 2013a) is prone to expanding rapidly

11. As Duffie and Zhu (2011, 74–75) note, "Effective clearing mitigates systemic risk by lowering the likelihood that defaults propagate from counterparty to counterparty. Clearing could also reduce the degree to which the solvency problems of a market participant are suddenly compounded by a flight of its OTC derivative counterparties such as when the solvency of Bear Stearns and Lehman Brothers was in question. Central clearing reduces the risk of disruptions to financial markets through fire sales of derivatives positions or of collateral held against derivatives positions."

when general risk aversion recedes or when regulatory arbitrage increases because of either financial innovation or regulatory laxity. And since shadow or security market financed lending depends on uninsured funding, these credit sources have been very vulnerable to runs and credit crunches during periods of distress. Owing to the volatility and potential size of shadow funding, the thin trading of real estate, and the lagging adjustment of construction, swings in shadow bank funding of real estate can induce real estate cycles that can undermine financial and macroeconomic stability even if banks are well-regulated. For this reason, tightening regulations on banks needs to be matched by tougher regulations on other sources of funding (such as toughening risk retention requirements on loan securitizers) to address the externalities those sources pose.[12]

C. Some Limits on the Usefulness of Macroprudential Tools to Supplement Monetary Policy

For all of their potential helpfulness in providing policymakers with an extra tool to address financial stability, macroprudential tools are not a substitute for systematic monetary policy strategies aimed at stabilizing output and inflation. For example, the unusually low interest rates of the early and mid-2000s—which departed from the Taylor Rule—helped push up real estate prices and construction (Taylor 2007). Building off theories of monetary overinvestment, Schnabl (2017) shows that since the early 2000s, ultra-loose monetary policy in the periphery of the European Monetary Union raised the likelihood of overinvestment booms that could spawn financial and economic imbalances. Nevertheless, interest rates alone are insufficient to directly explain the vast bulk of the subprime boom and bust of the 2000s. For example, Taylor's (2007) simulations of post-1999 real estate prices and housing starts under actual and more Taylor-Rule consistent interest rates reveal that actual prices and construction rose by more than what short-term interest rates could explain during 2004–2006. The timing of these underpredictions lines up with the 2004 easing of capital requirements on investment-grade MBS that securitized nonprime home mortgages and CMBS, which Duca, Muellbauer, and Murphy (2016) estimate contributed to the easing of mortgage credit standards and which Duca and Ling (2015) find contributed to higher CRE prices.

Moreover, with a risk-taking channel at work, an accommodative monetary policy can alter the perception of risk or risk tolerance of financial institutions (empirical evidence is in Borio and Zhu 2012; Adrian and Liang 2016; Jiménez et al. 2014). For instance, low interest rates can create a stimulus to expand balance sheets, reduce screening efforts (Borio and Zhu 2012; Maddaloni and Peydro 2011), and, consequently, induce lenders to seek more risk associated with higher returns (Challe, Mojon, and Ragot 2013). Consequently, an accommodative monetary policy can lead to excessive procyclical risk taking in financial markets, which works against the countercyclical intentions of macroprudential policy. As noted by Rajan (2006), low-interest rate environments increase the incentives for investors to reach-for-yield, encouraging financial institutions to take on more risk (frequently, tail risk) on both the asset and the liability side of their balance sheets. This enhances the sensitivity of the shadow banking system to tail events, particularly because much shadow banking activity is often tailored to exploit tail risk that is mispriced by regulation. In the mid-2000s environment of easier capital requirements, accommodative monetary policy plausibly induced a greater use of risky financial practices by inducing investors to finance riskier shadow banking products when safe short-term yields were low (Dell'Ariccia et al. 2012; Duca 2016; and Maddaloni and Peydro 2011).[13]

These considerations challenge an extreme Tinbergen-like view of a perfectly clean separation of policy targets, in which monetary policy can solely focus on macroeconomic goals such as inflation and output stabilization, while disregarding macroprudential policy, which should solely focus on financial stability (see

12. For example, following the stock market crash of 1987, the Federal Reserve was able to prevent a full-blown financial and economic crisis partly because the crash reflected an equity bubble that was not financed by debt and also because by providing liquidity to banks and indirectly to securities dealers, the Fed could stabilize a financial system in which only one-third of household and nonfinancial business debt was funded by securities markets. In contrast, the financial imbalances leading up to the Great Recession were debt-financed and about two-thirds of household and nonfinancial business debt was funded by securities markets when the subprime crisis hit. As a result, only regulating bank balance sheets and providing liquidity to just banks were inadequate to address the recent crisis.

13. Such reach-for-yield or risk-taking channel effects, coupled with the high interest sensitivity of long-duration real estate assets, imply that accommodative monetary policy can be conducive to the buildup of real estate imbalances depending on the regulatory environment.

Popoyan 2016, for a discussion between monetary and macroprudential policies). In a review of financial booms and busts over the past 400 years, Brunnermeier and Schnabel (2016) argue that such a separation may work if excesses are limited to particular institutions or specific market segments, while more widespread bubbles may call for a more complementary response of monetary and macroprudential policy to prevent the buildup of financial excesses.

On the other hand, monetary policy is generally too blunt an instrument to address financial stability in addition to standard macroeconomic goals (Svensson 2016). Kohn (2016) takes a more nuanced view, advocating the approach of the Bank of England where a monetary policy committee focuses on conventional macro goals and a financial policy committee focuses on financial stability, with some overlap of committee members. Overcoming coordination difficulties arising from how each affect the environment and the risks that each operates is a work in progress.[14] In the United States, the Treasury Report, "A Financial System That Creates Economic Opportunities: Banks and Credit Unions," suggests a strengthened role for the systemic risk coordinating function for the Financial Stability Oversight Council (U.S. Department of Treasury 2017).

Other concerns about macroprudential policy relate to whether postcrisis reforms have slowed long-run growth in advanced economies, as some have contended (e.g., Wallison 2015) and others have dismissed (e.g., Bailey, Klein, and Schardin 2017). Still others find that there are noticeable, but not large effects of the reforms on economic growth (e.g., Elliott, Salloy, and Santos 2012), consistent with more balanced views on the need to adjust particular postcrisis reforms from a cost-benefit point of view (e.g., Greenwood et al. 2017). From a broader perspective, an evaluation of potential policy stabilization gains of business cycles versus the costs of the downside from slower long-run growth could be beneficial.

IV. CONCLUDING COMMENTS

From a broad macrofinancial structure perspective, an underpricing of risk made possible by regulatory flaws contributed greatly to the housing and financial crises of the late-2000s in several advanced economies. In the United States, regulatory arbitrage and shadow financing fueled the credit and twin real estate bubbles of the mid-2000s that led to the Great Recession. Insufficient macroprudential policy also contributed to large real estate booms and busts in Ireland and Spain, whose economies were among the hardest hit in Europe before the sovereign debt crisis began in the spring of 2010. The effects of regulatory failure and mispricing of risk were most acute in real estate markets reflecting not only the relatively inelastic supply of land and thin trading of real estate, but also the amplification of shocks via backward-looking price expectations and the funding of consumption and loans off distorted and elevated prices. The reversal of these excesses triggered downturns amplified by correlated shocks to financial intermediation and—in the cases of the United States, Spain and Ireland—to consumption. The resulting debt and residential real estate overhangs both deepened the Great Recession and prolonged the subsequent sluggish recovery from all three of these countries.

On the surface, this pattern of macroeconomic and financial behavior lends itself to interpreting the Great Recession as the outcome of a largely endogenous leverage or debt-super cycle. That interpretation, however, does not really account for the 80-year hiatus between the real estate busts of the Great Depression and Great Recession in the United States nor does it account for why twin booms and busts emerged in both commercial and residential real estate prices in the United States or for the rise and fall of structured finance and shadow banking that accompanied them during the past two decades. Moreover, with housing finance integrated into global capital markets, an earlier lack of macroprudential regulation contributed to booms and busts across many of the advanced economies, implicating the banking sector (as in the Scandinavian real estate boom and bust of the 1990s), while in countries such as Canada, macroprudential regulation has been more successful in avoiding severe banking busts (see Crawford 2015; Wachter 2015; Pavlov and Wachter 2017).

More detailed analysis indicates that changes in regulation amplified financial innovation in the form of structured finance largely as part of the shadow bank system. This, in turn, spawned collateralized credit bubbles and fueled twin real estate bubbles and debt overhangs that ultimately

14. For example, under a "separate-but-coordinated" approach, stress tests could benefit from the financial policy authority having a more accurate view of future interest rate and macroeconomic conditions, while the monetary policy committee could benefit from having a better understanding of how evolving regulation and innovations may affect the transmission channels of monetary policy.

crippled the U.S. financial system and its real economy. From this perspective, the leverage cycle of this century's first decade was not simply an endogenous development (e.g., Minsky 1982a, 1982b). Rather regulatory actions undermined the restraining influence of capital requirements on credit creation, thereby spiking the proverbial punch bowl instead of taking it away. Hence, better regulatory steps can help tame or temper the leverage cycle (Geanakoplos 2009, 2010). Furthermore, systematic and sensible regulatory policy could be viewed as a supplement to systematic monetary policy strategies—such as the Taylor Rule—by allowing macroeconomic policy to not only focus more on achieving inflation and output stabilization goals, but also to better achieve such goals by making real estate behavior more predictable.

The macroprudential lessons from the Great Crisis highlight the need to prevent the buildup of excess real estate financing via both interest rate and nonprice terms of credit, limit the amplification and correlation of real estate risks, and enhance the ability to cleanup real estate busts. Progress has been made in addressing these challenges. In the United States, this has mainly taken the form of instituting stress tests and tougher capital requirements on banks and "systemically important financial institutions," limiting debt-service burdens on households, implementing limited skin-in-the-game risk retention on originators of MBS, and imposing liquidity limits on commercial banks and money funds. Similar steps have been taken in Europe, where more emphasis has been placed on limiting LTVs. Nevertheless, in the United States more progress has been made to reduce the risk of fire sale actions by banks and money funds than by investors in CMBS.

There, however, remain other major challenges. For one, some of the increased regulation of small business lending and community banks may have had the unintended consequence of stifling business formation and the economic recovery while doing little to address systemic risks that can arise from real estate and high-leverage lending. Here, some well-targeted and narrow deregulatory steps may be warranted, but not a weakening of capital buffers or risk retention rules for securitization (see Greenwood et al. 2017). Second, restricting the extent of home equity borrowing via LTV caps could limit the buildup of mortgage debt overhangs and their negative consequences as illustrated by recent experience in Texas (see Kumar 2018); even tracking the extent to which home equity lending is increasing a property's CLTV remains difficult (see Levitin and Wachter 2015). Third, the relatively less-increased regulation of lending to the CRE sector relative to home real estate sector may help account for why recent CRE valuations are notably more elevated than house price valuations, induced in large part by low long-term real interest rates. Fourth, because finance is integral to the pricing of long-duration real estate assets, macroprudential policies can limit but not eliminate the buildup of upward pressures on real estate prices stemming from factors such as low interest rates. Fifth, there are uncertainties about the future structure of RMBS (e.g., GSE reform in the United States), what entities would be responsible for maintaining underwriting standards, and how postcrisis financial reforms could be revised. Finally, the effectiveness of the Federal Reserve's imposition of higher capital requirements on systemically important financial institutions in curbing real estate risks could be undermined by regulatory capital arbitrage unless there is a strengthening (not a weakening) of "skin-in-the-game" risk-retention rules on mortgage securitizers or of capital requirements on all holders of nonqualified mortgages. This may also be an issue for European nations that increase capital requirements on their systemically important institutions. For these reasons, monitoring home equity borrowing to deter homeowners from stepping under debt-overhangs, while strengthening effective capital requirements and other regulations on securitized CRE and home mortgages (especially private-label RMBS) could help keep real estate markets from re-entering the shadows of structured finance.

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