Centre for International
Governance Innovation

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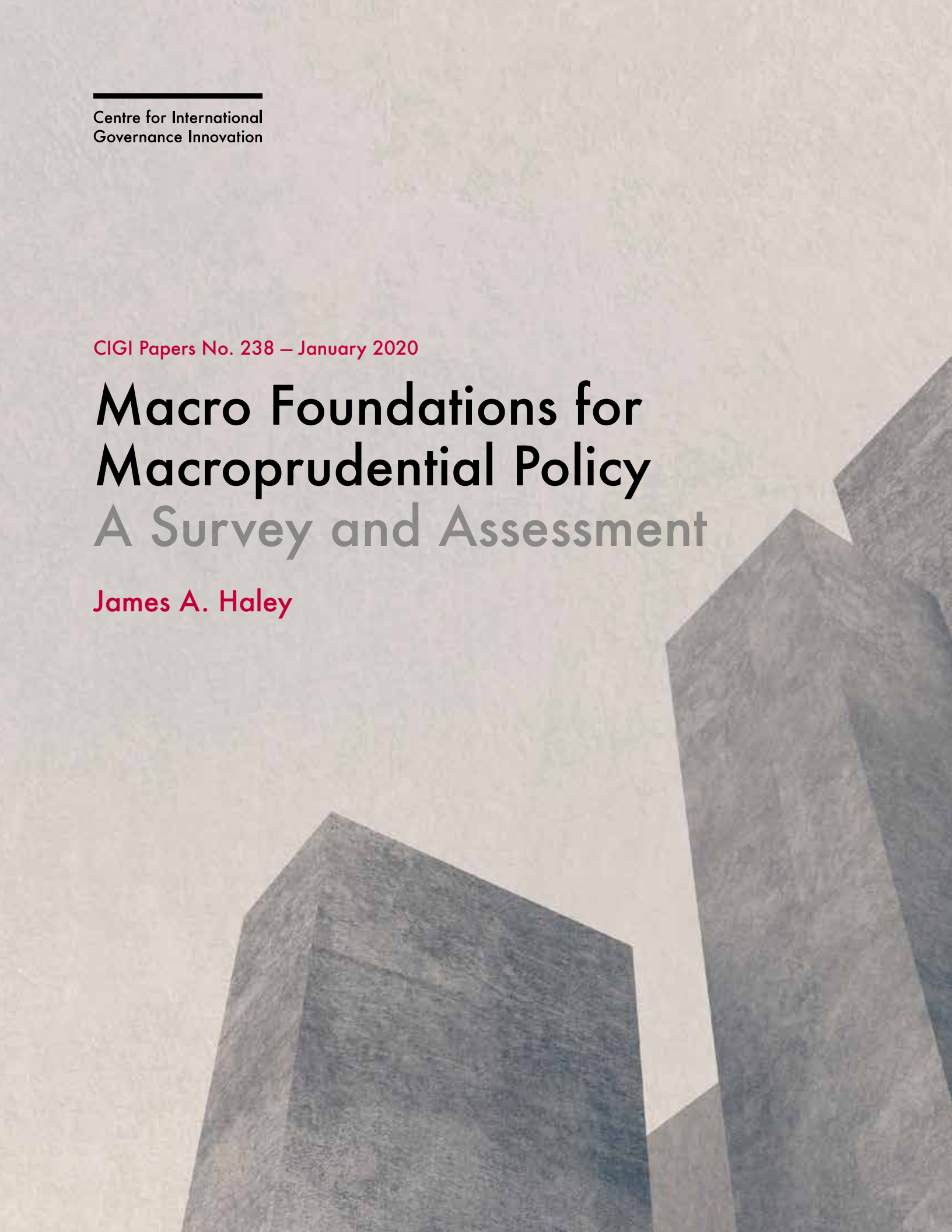
Macro Foundations for Macroprudential Policy

A Survey and Assessment

James A. Haley



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About the Author

James A. Haley is a CIGI senior fellow and former executive director for the Canadian-led constituency at the International Monetary Fund (IMF) in Washington, DC. He served as Canada's executive director to the Inter-American Development Bank in Washington, DC, from 2012 to 2015. Prior to this appointment, he held a number of senior positions in the Canadian Treasury (Department of Finance) and the Bank of Canada. He has represented Canada at meetings of the Working Party 3 and Economic Policy Committee of the Organisation for Economic Co-operation and Development, co-chaired the Group of Twenty working group on rebalancing the global economy, and served as Canadian representative on numerous international working groups. He has lectured on macroeconomics, international finance and international financial institutions at the McCourt School of Public Policy, Georgetown University and the Norman Paterson School of International Affairs, Carleton University. His published work focuses on international financial issues, the IMF and sovereign debt restructuring.

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Executive Summary

This paper examines the theoretical underpinnings of macroprudential policies to contain the buildup of systemic risks in the financial system. It contends that the limited role assigned to financial institutions (and financial factors generally) in the macroeconomic models used by policy makers before the global financial crisis may have led to a sense of complacency regarding such risks and the capacity of monetary policy to return the economy to full employment in the event of a severe financial disruption. The paper notes that macroprudential measures provide policy makers with an additional policy instrument with which to target financial stability. In this respect, an expanded tool kit is justified by the principle that one instrument (monetary policy) cannot simultaneously target both price stability and financial stability. Interactions between macroprudential measures and other elements of the policy framework, especially monetary and fiscal policies, are also discussed. The paper concludes that while macroprudential policies are largely untested, and some skepticism of their purported effects is warranted, it would be both imprudent and irresponsible to ignore the fundamental lesson of the global financial crisis. That lesson, the need to consider financial system stability more broadly and its effects on policy instruments, provides the macroeconomic foundations for macroprudential policy.

Introduction

More than a decade after its peak, the global financial crisis continues to influence the economic conjuncture and current policy debates. This effect is not surprising, given that the crisis disrupted the lives of millions and cast a cloud of uncertainty over the future of millions more. In its wake, the independence of central banks and the inflation-targeting paradigm that characterizes most monetary policy regimes are under attack by populist politicians around the globe. These attacks are one legacy of the crisis.

Macroprudential policies are another legacy. These policies encompass a host of measures, including countercyclical capital and liquidity buffers, loan-to-value (LTV) and debt-to-income (DTI) limits, and stress testing of bank balance sheets, which are designed to curb excessive risk taking and promote the accumulation of buffers to enhance the resiliency of the financial system. Prior to 2008, the prevailing consensus was that regulatory frameworks and banks' risk-management protocols were broadly appropriate in advanced countries. According to this view, financial institutions facing market discipline and exploiting sophisticated risk-management techniques, together with prudential regulation and supervisory frameworks focused on ensuring individual institution capital adequacy, constituted an effective bulwark against instability. The global financial crisis refuted this view.

The crisis also dispelled the notion that financial system stability is assured by simply preserving the soundness of individual institutions populating the economy. Today, there is greater appreciation of the interconnectedness of large, complex financial institutions, both within a particular jurisdiction and across countries, as well as recognition of the feedback effects and spillovers between the financial system and the real economy. In contrast to the microprudential focus on individual institutions, the need is to mitigate risks in the financial system as a whole; the challenge is to address the fact that risks in the financial system are greater than the sum of the risks in its parts.

Macroprudential policies address this challenge. Previous papers published by the Centre for International Governance Innovation (CIGI) have assayed and assessed the full suite of these measures (Lombardi and Siklos 2016;

Siklos 2018; Ademuyiwa, Siklos and St. Amand 2018). Readers are advised to refer to them for more background. This paper complements this work in examining the macroeconomic foundations of macroprudential measures and the connection between them and other policies. The subject is timely and important in the context of not only the current conjuncture and populist criticism of independent central banks, but also the debates about the appropriate role of fiscal policy in a low-interest-rate environment. In this respect, the goal of this paper is to explain how macroprudential measures can support other policy instruments, monetary policy in particular, in promoting financial stability and long-term growth. This objective cannot be achieved without also discussing the impact of financial factors on the real economy and how the financial sector interacts with these other instruments.

Macroeconomics without Finance

The effectiveness of a policy instrument and its impact on welfare cannot be viewed in isolation. Instruments must be analyzed in the context of how the economy is believed to operate and in conjunction with other instruments that constitute the policy framework. Accordingly, this review of the macro foundations for macroprudential measures begins with the evolution of macroeconomic theory and practice before the crisis.[1] It is clear that the prevailing policy paradigm largely ignored the role of the financial sector in providing important functions such as bridging information asymmetries and completing markets in an environment of imperfect information and incomplete markets. And because policy frameworks used by central banks and others were built on general equilibrium models that abstracted from these practical problems, policy makers may have underestimated the growing risks before the crisis and overestimated the capacity of monetary policy to restore growth and close output gaps following a financial shock.

Policy Frameworks before the Crisis

The confidence placed in the effectiveness of monetary policy to maintain full employment was mirrored by a clear assignment of policy instruments. A broad consensus prevailed among practitioners and academics alike on the objectives of monetary, fiscal and financial sector policies: monetary policy must provide a nominal anchor for the economy; fiscal policy should smooth tax burdens associated with the provision of public goods and services, consistent with a target for public debt; and effective financial sector policies (embodied in microprudential regulation) were needed to safeguard financial stability. The deliberate pursuit of all three objectives, most policy makers agreed, would foster long-term growth.

The period of macroeconomic stability preceding the crisis, labelled the "Great Moderation," seemed to confirm this consensus. Michael Woodford (2003, 2) clearly articulated the prevailing thinking: "This period of improved macroeconomic stability has coincided with a *reduction,* in certain senses, in the ambition of central banks' efforts at macroeconomic stabilization. Banks around the world have committed themselves more explicitly to relatively straightforward objectives with regard to the control of inflation, and have found when they do so that not only is it easier to control inflation than previous experience might have suggested, but that price stability creates a sound basis for real economic performance as well."

Monetary policy and fiscal policy were seen as complementary, with good economic performance (stable growth, low inflation) dependent on the effective coordination of the two. This need for cooperation between the monetary and fiscal authorities derives from the fact that the Nash non-cooperative equilibrium resulting from independent plays of separate authorities need not be efficient.

This framework embodied a clear separation or decoupling of policy instruments. And while sound monetary and fiscal policies were both viewed as necessary for good economic performance, there was a clear hierarchy. Consistent with the evolution of macroeconomic theory, monetary policy bore the burden of stabilizing output around

1 Pierre Siklos (2018) explores the nexus between macroprudential policies and the monetary transmission mechanism, or the linkages between monetary policy instruments and growth and inflation, and the difficulties of integrating macroprudential policy with monetary policy.

its potential level.[2] For inflation-targeting central banks, this objective was best promoted through transparency of the inflation target and clarity of communications. Over time, this approach would result in a steady accretion of credibility that would reduce the output costs of returning inflation to target in the face of shocks such that achieving the inflation target would be synonymous with full employment.[3] The importance attached to credibility led policy makers to focus on the need for effective institutions and policy rules: independent, accountable central banks to stabilize long-term inflation expectations, and fiscal rules to avoid excessive debt burdens and potential "fiscal dominance" that, if left unchecked, might constrain monetary policy.[4]

Financial sector policies were assigned the task of safeguarding stability in this policy framework. Most policy makers agreed that this goal could be achieved through the prudent regulation of individual institutions; if the institutions populating the financial system had adequate capital and sound management, the system would be stable.[5] Of course, individual institutions could be expected to fail, given the nature of banking — characterized by the issuance of liquid, short-term liabilities and the holding of illiquid, long-term assets. Nevertheless, it is fair to say that policy makers believed that deposit insurance, coupled with adequate supervision, would remove the threat of destructive bank runs, protect the payments system and safeguard the stability of the system in the event of individual failures.[6] Moreover, the macroeconomic spillover effects of such failures could be neutralized by timely action by the central bank acting as lender of last resort: a bank failure that triggered a panicked withdrawal of deposits from other institutions into short-term government securities could be offset by central bank liquidity injections that would be reversed once calm was restored and deposits returned to the banking system.

In short, the framework used by policy makers before the crisis assumed the financial system largely operated independently from the rest of the economy and that the failure of individual financial institutions would not pose a systemic threat to the macro economy. As Franklin Allen (2001) observed, theory ignored financial intermediaries because they were widely viewed as a "veil" that passively accommodates developments in the real economy. The pre-crisis framework was thus consistent with the proposition that, in the long run, real output is independent of money and nominal magnitudes. It contributed to the view that credit responded passively to factors in the real economy — real consumption and real investment. In turn, this unidirectional view (the real economy causes credit growth; credit growth does not cause changes in the real economy) led to the parsimonious treatment of the financial sector in the macro models used for policy analysis.[7]

The crisis revealed significant weaknesses in the theoretical and empirical foundations of the prevailing consensus. Financial disruptions were shown to radiate through the financial system, amplifying the size of the shock, and generating severe adverse effects on output and employment against which monetary policy alone had limited capacity to offset. In turn, these real-side effects fed back to the financial system through a range

2 John B. Taylor (2000) clearly articulated this proposition. And as Alan Blinder (2016, 5) notes, "These were not idiosyncratic views. There really was such a consensus." Nevertheless, as subsequent events demonstrated, policy makers recognized the possible need to mobilize fiscal policy in response to severe shocks, albeit for too short a time. That said, the notion that fiscal policy should eschew stabilization objectives was deeply embedded in the policy framework before the crisis; adherence to it may have led to the International Monetary Fund's (IMF's) call for consolidation in 2010.

3 Olivier Blanchard and Jordi Galí (2005, 2) referred to this felicitous property as "divine coincidence." In practice, central bankers recognized that temporary deviations from the inflation target may be periodically required to close output gaps.

4 A rich literature on policy games building on these insights grew from the unsatisfactory economic performance of many countries in the 1970s. This experience was marked by high inflation and high unemployment, a combination attributed, in part, to the lack of effective coordination between monetary and fiscal instruments.

5 This view was not universally shared. The Bank for International Settlements (BIS) under the leadership of Andrew Crockett, William White and Claudio Borio raised the alarm and identified the need for a broader perspective on systemic risks. See, in particular, Borio and White (2004), who were prescient in their analysis of the growing risks. See also Rajan (2005).

6 Not only were failures accepted as inevitable, they were viewed as necessary to discipline management and avoid the moral hazard that deposit insurance could introduce into the system. While such failures could result from a common regional real-side shock, the potential interconnections between financial institutions across regions not exposed to common shocks, which could lead to a system-wide withdrawal of liquidity that drives down asset prices, may have been underappreciated.

7 As discussed below, this approach ignored a growing body of work on the role of financial institutions in bridging information asymmetries and "completing financial contracts" through the monitoring of investment projects and enforcement of loan covenants or the role of credit constraints in propagating shocks to the real economy. For the most part, the neglect is probably best attributed to pragmatic trade-offs in modelling and lags in the incorporation of theoretical insights rather than to willful disregard.

of effects, including falling asset prices and declining net worth, increased delinquency rates and higher loan losses, and a loss of confidence.

The crisis also highlighted interactions between policies that had not been fully appreciated before. In particular, the real economy is tied to financial sector stability, and vice versa.[8] One implication is that price stability is not a sufficient condition for financial stability, so the question of how monetary and macroprudential policies interact is of prime importance. The Bank of England (Hammond 2012, 16-17) acknowledged this fact in its *State of the Art of Inflation Targeting* report:[9] "A key issue for central banks has been how to combine the goal of financial stability with the goal of price stability. It is clear that low and stable inflation does not guarantee financial stability.... While inflation targeting generally resulted in low and stable consumer prices in the 1990s and early part of the 2000s, asset prices were more volatile, and there were long-standing concerns about the build-up of money and credit in some economies."

Moreover, it is now recognized that the presence of externalities in the financial sector implies that regulating individual institutions is insufficient; sound institutions are not synonymous with a sound, stable financial system.[10] As a result, there is greater appreciation that the policy assignment is more complex than that embodied in the pre-crisis framework.

Because of these weaknesses in policy frameworks, potential risks posed by financial market developments and possible interactions between financial markets and the real economy were underappreciated. In hindsight, it is also clear that policy makers underestimated the hurdles to central bank efforts to restore the economy to a stable growth path in the wake of a crisis that a severe financial disruption would raise. In some respects, Japan's ongoing battle with deflation following a collapse in real estate prices was an object lesson. Timely, aggressive monetary ease pursued with the necessary resolve would, it was believed, be sufficient to end deflation (see Bernanke 1999). A decade after the global financial crisis and following a slow recovery in economies at the centre of the crisis, during which monetary policy struggled to raise inflation to its target and close output gaps, there is a growing recognition that monetary policy alone is insufficient to get the job done.

Macroeconomic Theory and Models

In his masterly survey of financial/real-side linkages, Mark Gertler (1988) noted that Depression-era economists believed that the financial system was largely responsible for the severity of the economic collapse.[11] In the United States, the trauma of the Great Depression led to the introduction of federal deposit insurance and a complementary strengthening of regulation and supervision of institutions and markets to promote financial stability and protect consumers. Other countries also strengthened their regulatory frameworks. And while individual institutions periodically failed, sometimes with serious repercussions across financial markets, the risk of systemic financial crises had largely been eliminated in industrialized countries — at least until the financial liberalization of the late 1970s and 1980s. Barry Eichengreen and Michael Bordo (2003) document that banking crises all but disappeared in the quarter-century after World War II, with only one crisis recorded in their 1945–1971 sample.[12]

Over time, however, the role of financial factors faded from macroeconomic theory.[13] This process can be attributed to three factors. The first was the publication of an influential monograph by Milton Friedman and Anna Jacobson Schwartz (1963) advancing a purely monetary interpretation

8 See Shleifer and Vishny (2010) for a model with such interactions.

9 As noted later in this paper, this was one of five principles identified by Crockett (2000) that collectively define a macroprudential approach to financial stability.

10 In addition to this "fallacy of composition" effect, Borio (2003) argued that a microprudential approach takes risk as exogenous in the sense that shocks triggering a financial crisis originate outside the financial system; a macroprudential approach recognizes that risks can arise endogenously.

11 For example, Irving Fisher's debt-deflation theory (1933) drew attention to the destructive effects of deflation in raising debt burdens.

12 In contrast, Ash Demirgüç-Kunt, Enrica Detragiache and Poonam Gupta (2000) noted that 35 countries had banking crises between 1980 and 1995. In most countries, domestic prudential regulation was supported by capital controls on the international movement of capital. Michael D. Bordo and Christopher M. Meissner (2016) survey the costs associated with banking crises.

13 This is not to suggest that financial factors were wholly ignored: John G. Gurley and E. S. Shaw (1955) integrated financial institutions into macroeconomics through their notion of "financial capacity," or the debt-carrying capacity of borrowers; Don Patinkin (1961) examined how intermediaries facilitate borrowing and lending; James Tobin and William C. Brainard (1963) expanded the financial sectors of macroeconomic models; and Hyman Minsky (1977) and Charles Kindleberger (1978) explored the effects of financial crises.

of the Great Depression. Their work attributed the economic collapse of the 1930s to the failure of the US Federal Reserve to offset the contraction in the money supply that resulted from widespread bank failures.[14] But if money, which constitutes the liability side of commercial bank balance sheets, is all that is needed to explain real output (assuming price stickiness), the role of financial institutions and markets more broadly can be ignored.

The second factor accounting for the decline of financial factors in theory was the formal demonstration by Franco Modigliani and Merton H. Miller (1958) that real economic decisions are independent of financial structure. Their result was influential, Gertler (1988, 565) argued, "because it provided researchers with a rigorous justification for abstracting from the complications induced by financial considerations." The fact that the Modigliani and Miller irrelevance theorem rests on a number of stringent assumptions that are unlikely to hold in practice (and which explain the existence of financial institutions) did not prevent its application to a wide range of economic issues, including the development of neoclassical investment theory.

The third factor accounting for the parsimonious treatment of the financial sector in macroeconomic theory was the methodological revolution of the 1970s featuring models of a representative agent's optimizing decisions in which macroeconomic outcomes are assumed to result from the decision making of a single "representative" individual. This approach is immune to the critique that estimated coefficients of structural equations not based on such explicit optimization will not be invariant to shifts in policy regimes (Lucas 1976). Yet, as some have pointed out, this strategy abstracts from the complexities of the real world, limiting its value to policy analysis.[15] This criticism of the representative agent paradigm is particularly trenchant with respect to the initial "real business-cycle" models of this genre, which assumed price flexibility and continuous market clearing, consistent with key assumptions underlying classical economics.

To address these shortcomings, new classical models were soon followed by variations marrying stochastic general equilibrium models (derived from explicit optimization decisions in the presence of stochastic shocks) with Keynesian assumptions regarding imperfections and frictions in product and labour markets. The resulting "New Keynesian" models could be used for policy analysis; prior to the global financial crisis, these dynamic stochastic general equilibrium (DSGE) models were the workhorse of choice in key central banks.[16] But, as the crisis revealed, the typical DSGE model used for policy analysis suffered from two fundamental weaknesses. First, the model is linear, whereas financial markets and asset prices display non-linear responses: non-financial firms with access to credit on favourable terms one day may be denied working capital the next; asset prices may make an instantaneous discrete jump to a new level.[17] Understanding these effects has been an important objective in its own right in the post-crisis period and, as discussed below, they provide a justification for macroprudential policies.

The second shortcoming of the state-of-the-art DSGE model circa 2006 is methodological. Models had extremely parsimonious representations of the financial structure of the economy. This modelling economy was facilitated by the assumption of perfect capital markets. For example, in their survey of models in use on the eve of the crisis, Galí and Gertler (2007, 30) observed: "In the baseline model, both capital and insurance markets are perfect. Within this frictionless setting, the household satisfies exactly its optimizing condition for consumption/saving decisions. It thus adjusts its expected consumption growth positively to movements in the expected real interest rate. Similarly, with perfect capital markets, the representative firm satisfies exactly its optimizing condition for investment: it varies investment proportionally

14 Friedman and Schwartz's (1963) empirical evidence fits neatly with John Hicks's (1937) interpretation of Keynesian analysis as captured in his justly famous and highly influential IS-LM framework (which shows how the market for economic goods [investment-savings or IS] interacts with the demand for money, or liquidity in the money market [LM]).

15 See the exchange between Robert Solow, on the one hand, and V. V. Chari and Patrick J. Kehoe, on the other hand, in the *Journal of Economic Perspectives* (2008).

16 DSGE models are not the only empirical tool used by central banks, most of which maintain a pragmatic mix of models. That said, they likely aligned most closely with policy makers' views of the underlying structure of the economy. Winston Dou et al. (2017) discuss models used for policy analysis in four major central banks – the Federal Reserve Board, the European Central Bank, the Bank of England and the Bank of Canada.

17 See Krishnamurthy, Nagel and Orlov (2014) on the nonlinearity of financial crises. A related problem is the potential for multiple equilibria inherent in models with debt. In addition, the potential for sudden sharp jumps in asset prices has long been recognized in macroeconomics. Rudiger Dornbusch (1976) introduced such dynamics in his celebrated exchange rate "overshooting" model.

with Tobin's *q*, the ratio of the shadow value of installed capital to the replacement value."

In such a set-up, financial institutions are superfluous and financial markets matter only to the extent that interest rates affect the representative agent's inter-temporal optimization decisions. With the central bank controlling the overnight rate and influencing the entire spectrum of interest rates through term-structure relationships, the policy challenge is to set a path of interest rates that achieves its inflation target objective. In effect, the absence of financial frictions arising from agency costs implies that the central bank has the capacity to stabilize output by adjusting the policy rate. In the period of the Great Moderation, this assumption seemed to be validated by actual practice. That being said, the limitations of this approach were recognized before the global crisis; Galí and Gertler (ibid.) approvingly noted efforts to incorporate financial market frictions to understand the real effects of financial disruptions.[18]

Models of Financial Intermediation and Markets

This work incorporating financial factors builds on two distinct streams in the earlier literature.[19] The first is the analysis of financial intermediaries pioneered by Dwight M. Jaffee and Thomas Russell (1976), Robert M. Townsend (1979), and Joseph E. Stiglitz and Andrew Weiss (1981), which explored credit rationing, costly state-verification and excess demand for loans as an *equilibrium* phenomenon. In contrast to the artificial economies inhabited by representative agents or homogeneous populations in stochastic general equilibrium environments, these models introduce heterogeneity and unobserved differences in borrower quality to demonstrate the important roles financial institutions play in providing real services to the economy. These functions include the provision of liquidity insurance to individuals facing idiosyncratic liquidity shocks modelled by Douglas W. Diamond and Phillip Dybvig (1983), enlarging the set of investment projects that receive financing as a result of specialized monitoring of investment projects and the pooling of risks, which Townsend (1979), Diamond (1984) and Stephen Williamson (1987) examined, and consumption smoothing as formally modelled by Allen and Gale (1997).

A key result of Stiglitz and Weiss (1981) is that limited liability provides an incentive for firms' owners (managers) to shift risk to their creditors by substituting higher risk projects once a loan is negotiated. If the high-risk project succeeds, the firm reaps the bulk of the returns since the return to the creditor is fixed by the interest rate on the loan. If the project fails, the firm's losses are bounded from below by limited liability. Of course, in a world of perfect information and zero transaction costs, creditors would observe risk-shifting behaviour and write the appropriate state-contingent contract. Under asymmetric information, however, there is an agency problem in which lenders are not indifferent to the degree of the borrowers' leverage.

The second stream of literature on financial/real linkages builds on this result in considering the effects on the economy resulting from the relaxation of the strong assumptions invoked by Modigliani and Miller (1958). For example, Bernanke and Gertler (1989) examine the effects on investment of a decline in net worth of non-financial firms in an economy characterized by a "lemons" problem.[20] High net worth reduces the borrower's cost of external funds by increasing the amount of collateral to support its borrowing and thereby lowering informational risks (agency costs) faced by outside lenders.

They demonstrate that *endogenous* procyclical movements in net worth magnify investment and output fluctuations. And because output changes generate positively correlated changes in borrowers' balance sheets, the wedge between the cost of external versus internal funds moves countercyclically, further amplifying swings in investment and output.

18 The works they cited included Bernanke, Gertler and Gilchrist (1999), Christiano, Motto and Rostagno (2010), Monacelli (2009) and Iacoviello (2005). Borio and Haibin Zhu (2008) explored the link between monetary policy and the perception of risk by economic agents – what they referred to as the "risk-taking channel" of monetary policy.

19 There are a number of excellent surveys extant: Gertler (1988) reviews efforts to integrate financial and real factors up to the mid-1980s; Gary Gorton and Andrew Winton (2003) provide a comprehensive survey of the literature on financial intermediation, covering both theoretical and empirical work; and Franklin Allen and Douglas Gale (2008) examine theoretical advances in modelling financial intermediation and financial crises to the eve of the global financial crisis.

20 Their result harkens back to Fisher (1933) and the Gurley and Shaw (1955) notion of "financial capacity." Debt-deflation that raises the real burden of debt reduces borrower net worth and thus the financial capacity of the economy.

This work spawned a range of papers in which collateral plays a critical role. Among them, Nobuhiro Kiyotaki and John Moore's work (1997) is a key contribution. Their analysis starts with the observation that a firm's physical assets play a dual role as factors of production and as collateral that can be used to align incentives in the presence of agency problems. In their model, credit-constrained firms facing a temporary shock cut back on investment expenditures, reducing revenues and net worth in subsequent periods. For the market in the durable asset (land, for example) to clear, unconstrained firms' demand must increase. But for this to happen, the price must fall. This further depresses the net worth of constrained firms in an inter-temporal multiplier process, generating mutually reinforcing *persistence and amplification effects*.

Bengt Holmstrom and Jean Tirole (1997) focused on the role of net worth in assuaging moral hazard problems, observing that firms that take on too much debt in relation to equity and that do not have sufficient stake in the financial outcome may engage in risk shifting. For investments of a given size, firms with high net worth will be able to finance the project internally; firms with low net worth must borrow. Banks can reduce the demand for collateral by increasing the intensity of their monitoring. Monitoring is costly, however, and not all firms can be monitored in equilibrium because intermediaries, like firms, must invest capital in order to be credible monitors (banks can also engage in risk shifting by not monitoring). The implication is stark: better capitalized banks can monitor more intensively and support more lending.[21]

This analysis led others to examine a range of financial market frictions, including collateral constraints, information-based frictions, moral hazard and limited commitment. Bernanke, Gertler and Gilchrist (1999), for example, incorporated a Kiyotaki-Moore countercyclical credit market friction generated from first principles (that is, using agent optimization) into a standard New Keynesian DSGE model to examine the nexus between credit market imperfections and the transmission of monetary policy. They demonstrated that this friction amplifies and propagates productivity shocks. More recent work by Christiano, Motto and Rostagno (2010) extends the simple model in Bernanke, Gertler and Gilchrist (1999), including financially constrained intermediations. That said, the key financial and credit market imperfections are similar to the financial accelerator mechanism in Bernanke, Gertler and Gilchrist (ibid.).

Since the crisis, efforts to model the effects of financial disruptions consistent with amplification channels of Bernanke and Gertler (1989), in which small shocks to net worth are amplified through a financial feedback loop, have met with some success.[22] The incorporation of financial accelerator effects in DSGE models improves their ability to fit macroeconomic data.[23] But, as Narayana R. Kocherlakota (2000) noted, the results are mixed, in part because the amplification channel of these models is through corporate net worth, while the great leveraging of the second half of the twentieth century primarily took place through the household, and not the corporate, sector.[24] More fundamentally, Blanchard (2016a, 1) identifies a number of methodological issues that, in his judgment, render DSGE models "seriously flawed."[25] Yet, despite his criticism, he believes that they are "eminently improvable and central to the future of macroeconomics" (ibid.). This process of improvement will take time. For the foreseeable future, therefore, policy will likely be guided by two polar approaches — at one

21 This result provides a justification for countercyclical banking norms that are loosened in recessions and tightened in expansion — a key instrument in the macroprudential tool kit.

22 A partial list includes: Kiley and Sim (2011), Brunnermeier and Pedersen (2009), Gertler and Kiyotaki (2010), He and Krishnamurthy (2013), Christiano, Motto and Rostagno (2010), Adrian and Shin (2009; 2010), Adrian, Estrella and Shin (2010), and Gertler, Kiyotaki and Prestipino (2016a; 2016b; 2017). He and Krishnamurthy (2013) model the impact of capital constraints binding on financial intermediaries and replicate the nonlinearity of premia during crises.

23 See, for example, Christiano, Motto and Rostagno (2010; 2014), De Graeve (2008), Christensen and Dib (2008), Queijo von Heideken (2008) and Merola (2013). Empirical work has largely focused the relationship between credit spreads, which reflect the costs of external capital, and the economy (Gilchrist, Ortiz and Zakrajšek 2009; Gilchrist and Zakrajšek 2012).

24 Atif Mian and Amir Sufi (2011; 2014) provide microeconomic evidence on the role of housing leverage in the recent financial crisis.

25 Blanchard identifies four problems associated with DSGE models. First, they are based on "unappealing assumptions" that are "profoundly at odds with what we know about consumers and firms" (2016a, 1). Second, the estimation technique, employing a mix of calibration and Bayesian estimation, is "unconvincing" (ibid., 2), as are, third, the normative implications coming from the models. Fourth, Blanchard contends that DSGE models are "bad communications devices" (ibid., 3). Paul Romer (2016) provides a devastating — and readily accessible — critique of the theoretical underpinnings of the current state of macroeconomics represented by DSGE modelling.

pole, static, partial equilibrium microeconomic models of financial frictions; at the other pole, DSGE models incorporating a wide array of financial frictions. As Xavier Freixas, Luc Laeven and José-Luis Peydró (2015, 48) noted, these modelling strategies sit uncomfortably together:

> Static, partial equilibrium models typically do not predict the real impact of any shock, since they lack the general equilibrium dimension. Yet they give us sound understanding of the financial frictions and their immediate effects. The macro-based models provide us with a clear perspective of the intertemporal and spillover effects of an exogenous shock to the economy, but finance, in general, and systemic risk, in particular, do not matter much, since financial frictions have a limited role in these models. We could say, in a simplistic, provocative way that static asymmetric information models provide us with the understanding of phenomena we cannot measure, while DSGE models provide us with the measure of phenomena we cannot understand.

This juxtaposition is the analytical foundation for macroprudential policies. In this respect, while the extreme financial turbulence of the panicked stage of the crisis was comparatively brief, owing to the extraordinary policy interventions of central banks, the crisis was long-lived, as measured by the time to recover pre-crisis output and close output gaps. The economic and fiscal costs of this "long" crisis clearly warrant a careful analysis of its origins and the policy frameworks in place at the time.

Policy Frameworks for Financial Stability

The origins of the global financial crisis lie in the remarkably benign period of strong global growth and low interest rates in the pre-crisis years that encouraged excessive credit growth, weakened risk assessments and led to domestic imbalances, most notably asset price bubbles in housing markets. But macroeconomic policy frameworks also played a role. Fixed or heavily managed exchange-rate regimes likely contributed to the crisis, as growing reserve holdings by foreign central banks financed large US current account deficits.[26] And, in the wake of the crisis, some argue that excessive reliance on inflation targeting before the crisis may have created a sense of complacency with respect to growing risks in the economy.[27] With the benefit of hindsight, it is now clear that monetary policy focused primarily on goods' price inflation failed to adequately incorporate the consequences of latent deflationary pressures "imported" through growing trade imbalances. In retrospect, goods prices may have been well contained, but that apparent stability masked underlying asset price inflation and the buildup of dangerously overleveraged positions. In this respect, monetary policy that was judged to be broadly appropriate on the basis of goods' price inflation provided fertile ground for growing systemic risks.

Of course, the risk of asset bubbles was hotly debated before the crisis.[28] US Federal Reserve chair Greenspan (2005) famously acknowledged the possibility of asset price bubbles but rejected calls to act on that risk. He noted that it was difficult to distinguish, a priori, whether a particular run-up in asset prices reflected a bubble or the rational discounting of future profits. The danger of acting pre-emptively to "prick" potential bubbles, he argued, would be in curtailing access to capital for firms that might raise long-term growth through the innovative application of emerging technologies. His preferred approach was to act after the fact, "cleaning up" or mitigating the effects of collapsing bubbles. Greenspan believed that such costs would be contained *ex ante* by effective regulation and the growing sophistication of financial institutions and markets, in which competitive pressures would create incentives for

26 Reserve accumulation may have been a prudent response to the risks associated with sudden stops and reversals of capital flows following the Asian financial crisis (1997-1998). However, as observed by Bernanke (2005), the resulting savings "glut" dampened the rise of US long-term bond yields (which former Fed chairman Alan Greenspan referred to as a "conundrum"), providing a fertile environment for rising asset prices. With the US dollar-renminbi exchange rate effectively fixed, meanwhile, another key channel of adjustment was suppressed, while the massive expansion of the Chinese export sector imparted downward pressure on US inflation.

27 See Beckworth (2014) for a clear statement of this perspective.

28 Analysis of the minutes of the Federal Open Market Committee shows that concerns over risks to financial stability were growing prior to the crisis (Peek, Rosengren and Tootell 2015).

prudent risk taking, and market discipline would enforce effective risk management frameworks.[29]

In retrospect, the post-crisis deleveraging that followed the crisis impaired the ability of central banks to return the economy to full employment in a timely fashion. In an environment of historically low interest rates, persistent weak inflation (below most inflation-targeting central banks' targets) and anemic growth, fiscal policy could have been used to stimulate demand and close output gaps. In key economies, however, fiscal policy was tightened, resulting in a procyclical impulse. As a result, fiscal austerity had the perverse effect of keeping output gaps open, prolonging labour market adjustment, supressing wage growth and exacerbating inequality. Populist politicians around the globe have exploited these conditions to attack existing policy frameworks and undermine the independence of central banks.

Relationship with Stabilization Policy Instruments

These interactions between monetary and fiscal policies and financial stability and economic growth suggest that macroprudential measures must be evaluated in the context in which they are deployed and of how they interact with other stabilization policies — fiscal and monetary policy instruments — to form a macro-financial framework that anchors leverage, promotes financial stability and delivers long-term growth.[30] The goal is to buttress the effectiveness of each element of the framework and limit possible risks that would arise from excessive reliance on any one instrument.

Monetary Policy

Pre-crisis debates on the possible use of monetary policy to limit asset price increases were heavily influenced by the Tinbergen principle, which states that the number of objectives (targets) is determined by the number of independent instruments available to the policy maker (Tinbergen 1952). If the condition is not satisfied — if there are two targets, say, but only one instrument — attempts to achieve one objective may move you further away from the other. In this regard, defining financial stability as a separate goal alongside price stability provides a compelling justification for the design and deployment of macroprudential measures. Andrew G. Haldane (2014) and David Aikman, Haldane and Benjamin D. Nelson (2013) make the case based on the fact that the credit cycle is distinct from the business cycle, with longer cycles and more pronounced peaks and troughs. If the two cycles coincided, one instrument would suffice: monetary policy that smoothed the business cycle would also contain the buildup of risks that could undermine financial stability. In the absence of this felicitous outcome, macroprudential measures can complement monetary policy, freeing the monetary authorities to focus on their price stability objective while the macroprudential regulator targets financial stability.

When viewed through the lens of the Tinbergen principle, the case for macroprudential measures seems straightforward. The question is whether monetary policy can or should also be used proactively in pursuit of financial stability. As discussed above, the consensus on the goals of monetary, fiscal and financial sector policies that prevailed prior to the crisis included a clear assignment of policy instruments. Monetary authorities were admonished to use their policy rate to achieve the inflation target, while prudential regulators focused on the soundness of individual institutions, rather than worry about asset prices generally, or about how their policies might affect the macro economy, or how their policies with respect to one institution might have interaction effects with other institutions. In the wake of the crisis, there is less certainty that a one-to-one mapping between policy instruments and targets is possible.

While this uncertainty is not necessarily a repudiation of the Tinbergen principle, it does suggest that the need to integrate the interactions and feedback effects between the macro economy, asset prices and financial institutions increases the complexity of the policy framework. Absent this integration, the pre-crisis dilemma — that monetary policy could not simultaneously target

29 The unintended consequence of this was the moral hazard introduced by expectations that Fed policy would put a "safety net" under institutions taking reckless gambles.

30 Interactions between microprudential policies and macroprudential policies should also be considered, given the potential for the two policies to diverge over their respective cycles and the fact that microprudential regulation can be procyclical: capital requirements that become binding following an asset price shock, forcing financial institutions to sell assets, can amplify and spread the shock. Microprudential regulations narrowly focused on individual institutions may conflict with macroprudential measures targeted on systemic concerns and overall financial stability (Osiński, Seal and Hoogduin 2013). The anomalous result may be cases in which microprudential regulations are tightened as macroprudential constraints are relaxed.

CPI inflation *and* prick bubbles — remains. In some respects, however, this dilemma is a polar case constructed more for pedagogical purposes than policy guidance. As Stanley Fischer (2010) put it, "In that case [more targets than instruments] we have to find marginal conditions for a maximum, and to talk about trade-offs in explaining the optimum. So it is *not* generally true that because the central banks has only one instrument, it can take into account only one target — unless the instrument has no effect on any variable other than the target."

More generally, the presumption that the monetary authorities can target price stability independently of the regulator's pursuit of financial stability need not apply. As Adam Cagliarini, Christopher Kent and Glenn Stevens (2010) argued, the problem should not be posed as "Should the central bank try to prick bubbles?" but rather as whether the central bank should take asset prices and the state of asset markets into account in setting monetary policy. Their answer to the latter question is "yes." As they put it, the challenges associated with incorporating information on asset prices in decision making "are not that different from the difficulties monetary policy routinely faces in judging the risks to inflation and output" (ibid., 26).

These interactions between macroprudential measures and monetary policy are critical, given that both are inherently dynamic — monetary policy smoothing the business cycle; macroprudential policy dampening the credit cycle. But the interlinkages between the two can be masked by the fact that the effects of various macroprudential measures are subject to uncertainty (Lombardi and Siklos 2016). Under perfect certainty, macroprudential regulators would be able to finely calibrate instruments to effectively dampen the effects of leverage and other sources of externalities. Of course, in the world in which regulators operate, decisions are made under uncertainty. As a result, macroprudential policy makers must consider the possibility that policy is too activist — that they take action against what seem to be growing systemic risks that threaten crisis, but in fact reflect speculative growth (Caballero, Farhi and Hammour 2006).[31] Conversely, there is a risk that macroprudential regulators might ignore systemic risks that could trigger a crisis.

Beyond the effects of uncertainty (Box 1), there are two key issues to address in considering the use of monetary policy to target financial stability. The first is the role of monetary policy in avoiding the buildup of systemic risk, *ex ante*, by having monetary policy "lean against the wind," that is, to increase interest rates to contain speculative pressures or limit excessive risk taking.[32] The second issue is the role of central banks as lenders of last resort and monetary policy *ex post*, in the wake of a financial crisis. These roles are not independent, as the lender-of-last-resort regime will affect behaviour, risk taking in particular. Moreover, there are concerns that low interest rates associated with the extraordinary response of central banks to the global financial crisis may fuel imprudent risk taking or the formation of asset price bubbles.

Leaning against the Wind

The argument for proactive monetary policy to reduce the risk of crises thus reflects, in part, the repudiation of the pre-crisis notion that monetary policy alone can return an economy to full employment after a large financial disruption. Central banks therefore have an interest in pre-emptive measures to preserve financial stability. Well-targeted macroprudential measures can assist by curbing excessive risk taking and promoting the accumulation of buffers. And those who support leaning against the wind also believe that monetary policy must encompass some responsibility for financial stability.[33]

This is the policy prescription of the Committee on International Economic Policy and Reform (2011), which argued that central banks should go beyond traditional emphasis on low inflation and adopt an explicit goal of financial stability using macroprudential tools together with monetary policy. The Committee acknowledged the Tinbergen principle, but noted that "ultimately, political reality will thrust responsibility for financial stability on the central bank....As lender of last resort, it will be charged with cleaning up the mess. It follows that it would be better off devoting more of its

31 Giovanni Dell'Ariccia et al. (2012) note, for example, that one-third of boom cases end up in crisis; others do not lead to busts but to extended periods of below-trend economic growth.

32 See Borio and Lowe (2002; 2004), Borio and White (2004), White (2009). Taylor (2010) presents an alternative perspective.

33 As discussed below, greater harmonization between monetary authorities and prudential regulators may be required for joint maximization of their respective objectives.

Box 1: The Effects of Uncertainty

Monetary theory has long incorporated the effects of uncertainty. The starting point is the *certainty equivalence theorem*, which states that if the only source of uncertainty is an additive error term in the relationship between the policy objective and the instrument, the policy maker should ignore it (Tinbergen 1952). The intuition behind this result is that, with an additive term with zero mean and fixed variance, the expected values of positive and negative shocks cancel each other so that the central banker can proceed as if operating in a world of certainty. This is clearly a limiting case, as central banks also face uncertainty regarding how their policy instruments affect the economy. In the face of uncertainty regarding monetary transmission mechanisms, William Brainard's (1967) *uncertainty principle* maintains that central bankers should exercise caution in deploying their policy instruments. This result stems from the fact that parameter uncertainty is multiplicative rather than additive; the more a policy is used, therefore, the greater the uncertainty that is introduced into the system.

Brainard uncertainty could be expected to militate for the conservative use of macroprudential measures since their effectiveness is uncertain. In fact, Saleem Bahaj and Angus Foulis (2016) assert that the nature of the uncertainty associated with the buildup of systemic risks and the deployment of macroprudential policies reverses the Brainard result. Given the nature of systemic risks, they argue, macroprudential policy makers must make judgments that cannot be readily supported by statistical analysis. The problem policy makers confront is rare events whose likelihood is difficult to judge. In the face of such Knightian uncertainty, policy makers may wish to act in a robust fashion to limit the risk of a worst-case scenario. Moreover, policy makers may have asymmetric objectives: attaching more weight to avoiding an unstable, highly fragile financial system than to achieving a system that is somehow "too stable." Bahaj and Foulis (ibid.) suggest that if the cost of downside risk that is overlooked is significantly greater than the benefits of erring on the side of looser policy, policy makers should buy insurance against the system being less stable by tightening policy. Similarly, if uncertainty about the effectiveness of policy instruments increases, policy makers should insure themselves against the possibility of their tools being ineffective by setting tighter policy.

resources and attention to attempting to prevent the crisis, the elegance and analytical appeal of the Tinbergen principle notwithstanding" (ibid., 7).

Paul Tucker (2014) makes a similar point in arguing that, in the wake of the crisis, central banks are not free to carry on as before, whether they are endowed with formal prudential regulatory responsibilities or not. Central banks have been "forcibly returned to their roots," he suggests, since financial stability matters and, as lenders of last resort, they will inevitably "be at the scene of the disaster."[34]

The starting point for evaluating the interaction between monetary policy and macroprudential measures is to recognize their respective strengths and limitations.[35] Borio (2014) notes, for example, that there are two ways in which macroprudential policy can be used to promote financial system stability: increasing the resilience of the system and constraining financial booms.[36] The second is more challenging, he contends, because empirical evidence shows that the effectiveness of macroprudential tools is limited, especially for "the typical range of variation in the instruments" (Borio 2014, 33). While some measures work better than others, such as DTI

34 Charles A. E. Goodhart (2014) likewise notes that financial stability was the key objective of monetary policy under the gold standard. With the price level anchored by the commitment to gold, financial stability was critical, because crises could lead to a run on gold reserves as individuals sought to convert currency into gold. The view that inflation-targeting central banks cannot evade responsibility for financial stability is thus consistent with the observation that inflation targeting is akin to the gold standard in its reliance on prescribed "rules of the game."

35 Dell'Ariccia, Laeven and Suarez (2017) contend that the effects of monetary policy on risks are theoretically ambiguous. Monetary policy trades off risk shifting with portfolio rebalancing and will depend on bank leverage.

36 As Borio (2014, 32) puts it, "protecting the banks from the financial cycle and protecting the financial cycle from the banks."

and LTV ratios, the effectiveness is limited by ongoing regulatory arbitrage.[37] His conclusion is that macroprudential policy alone cannot bear the full burden of safeguarding financial stability.

Monetary policy can provide a supporting role through its effect on risk perceptions and risk appetite — the so-called risk-taking channel — by its influence on the incentive and ability to borrow, setting the price of leverage in a given currency. Jeremy C. Stein (2013), who attributes the severity of the global financial crisis to "put-writing" on tail risks, argues in this vein that monetary policy has a role to play in promoting financial stability, notwithstanding the "decoupling" view consistent with Tinbergen. While he acknowledges that monetary policy may not be the most appropriate tool for the job, it has the advantage — relative to supervisory and regulatory policies — that it "gets in all of the cracks" (ibid.). As Stein put it, "To the extent that market rates exert an influence on risk appetite, or on the incentives to engage in maturity transformation, changes in rates may reach into corners of the market that supervision and regulation cannot" (ibid.).

This approach runs counter to the pre-crisis paradigm, which was clearly articulated by Bernanke and Gertler (1999) and succinctly summarized by an IMF working paper: "Monetary policy was to react to movements in asset prices and credit aggregates only to the extent that they affected inflation (and output)."[38] In this framework, the link between the price stability objective and short-term policy instruments was captured by the Taylor rule. But this policy paradigm largely reflected DSGE models in which financial frictions figured, if they did at all, only on the borrower side of credit markets. Such models do not account for the role of financial institutions in providing liquidity, expanding the supply of credit through contract monitoring, or facilitating better risk diversification. In this respect, more recent work incorporating frictions in financial intermediation shows that policy reaction functions augmented with asset prices and credit spreads can improve on a standard Taylor rule (Cúrdia and Woodford [2010, 2015] and Gambacorta and Signoretti [2014]). However, these results depend critically on the source of the shock and are not robust to alternative assumptions about the nature and persistence of disturbances.[39]

At the same time, the proposition that monetary policy should proactively promote financial stability has not gone unchallenged. Laureys, Meeks and Wanengkirtyo (2015) show that the trade-off between the stabilization of output and inflation is degraded when the central bank's mandate expands to include responsibility for financial stability through a policy of leaning against the wind. They find that the incorporation of financial objectives makes inflation stabilization increasingly costly in terms of output stabilization; in effect, increased output and inflation volatility is the trade-off for reduced financial volatility. But these results are dependent on the nature of the underlying disturbance, and on the precise variable that policy aims to stabilize.

Leaning against the wind is supported in terms of reducing the probability and severity of financial crises. As Lars E. O. Svensson (2016) notes, however, there is no guarantee that crises will be avoided even with proactive policy.[40] And since the timing of a crisis is uncertain, a policy of leaning against the wind that reduces employment may result in a crisis coinciding with a weaker economy. In this respect, unemployment during the crisis will be higher, which increases the costs of the crisis. The proactive policy thus entails costs in terms of employment and output if no crisis occurs, and even higher costs in the event of a crisis. Svensson (ibid., 8) shows that the costs of the policy exceed the benefits by a substantial margin: "If a less effective macroprudential policy, for instance by resulting in a credit boom, leads to a higher probability of a crisis or a deeper crisis, the less effective macroprudential policy actually

37 This point underscores the importance of a system-wide perspective and the careful definition of the perimeter of regulation.

38 See IMF (2015) for a comprehensive review of the issue and model-based results of the welfare effects of a proactive monetary policy.

39 Agur and Demertzis (2015) used a general-form, axiomatic framework to show that a central bank with financial stability objectives leans against the wind by cutting interest rates deeper, but for a shorter period, to avoid the buildup of risks. Douglas W. Diamond and Raghuram G. Rajan (2012) argue that the expectation of lower rates in the event of a liquidity shortage may require the central bank to raise rates above equilibrium in states where liquidity needs are low to avoid distorting incentives. This recommendation is made in the context of a central bank that has achieved its price stability objective; it would not apply in current circumstances, in which inflation-targeting central banks are struggling to raise inflation to target levels.

40 Monetary tightening is unlikely to deter speculative bubbles in which asset prices are increasing by many multiples of feasible interest-rate tightening. However, Frederick S. Mishkin (2013) cites evidence that raising interest rates can restrain lending growth and excessive risk taking, in particular if the central bank commits to keep raising rates with increased risk taking.

strengthens the case *against* leaning against the wind, counter to the common view that less effective macroprudential policy strengthens the case *for* leaning against the wind."

The issue of whether "to lean, or not to lean" remains an area of active research, and a definitive policy with respect to leaning into the wind lies in the future. Nevertheless, there is a broad consensus that well-designed macroprudential policies that contain systemic risks are a useful addition to the policy framework. Going forward, policy makers are likely to follow Janet Yellen (2014) in adopting a synthesis that combines macroprudential policies with a willingness to consider the use of monetary policy to attenuate risk taking, if circumstances warrant:

> Such an approach should focus on "through the cycle" standards that increase the resilience of the financial system to adverse shocks and on efforts to ensure that the regulatory umbrella will cover previously uncovered systemically important institutions and activities. These efforts should be complemented by the use of countercyclical macroprudential tools....But experience with such tools remains limited, and we have much to learn to use these measures effectively.
>
> I am also mindful of the potential for low interest rates to heighten the incentives of financial market participants to reach for yield and take on risk, and of the limits of macroprudential measures to address these and other financial stability concerns. Accordingly, there may be times when an adjustment in monetary policy may be appropriate to ameliorate emerging risks to financial stability.

Lender-of-last-resort Facilities

The second issue regarding the interplay of monetary and macroprudential policies concerns the response of the central bank as lender of last resort once in a financial crisis. The potential need for a lender of last resort stems from the inherent fragility of banking.[41] Ricardo J. Caballero and Arvind Krishnamurthy (2008) show, for example, how a lender of last resort that commits to adding liquidity can induce private agents to free up private liquidity and help "thaw" credit freezes. However, Diamond and Rajan (2012) demonstrate that a general policy of recapitalizing banks facing insolvency because of panicked runs can undermine the disciplining role of demandable debt and lead to a strictly worse outcome. In contrast, a policy of undirected interest-rate intervention, under which the central bank lends to any solvent bank that needs funds, preserves the commitment induced by private contracts, even while restoring flexibility to the system by bringing down rates in a way that private contracts cannot achieve.

At first glance, the issue of lender of last resort is independent from the central tenet of macroprudential policy — the containment of behaviours that amplify and transmit shocks, creating systemic risks to the economy. But further inspection would reveal that the response of the lender of last resort, *ex post*, to financial disruption can influence *ex ante* risk taking. Bianchi (2016) argues that the anticipation of bailouts leads to an increase in risk taking, increasing vulnerabilities to a financial crisis (Chari and Kehoe 2013). Such moral hazard effects are limited if bailouts are broadly based and systemic. The problem is that too-frequent interventions can exacerbate private sector mistakes and reduce the value of intervention over time.[42] This is a key result from Diamond and Rajan (2012, 553): The central bank's willingness to intervene when liquidity needs are high by pushing down interest rates *ex post* does not just affect expectations of the real interest rate but also encourages banks to make commitments that increase the need for intervention — because banks and depositors do not internalize the costs of interest rate intervention. Expectations of low real interest rates (colloquially the belief that the central bank will stay "low for long") can increase the future need for low rates. To mitigate this, the central bank may have to commit to push the interest rate above the natural equilibrium rate in states where liquidity needs are low to offset the incentives created by its lowering them when needs are high.

The nexus between monetary policy and financial stability concerns is of especial importance in the context of historically low, and in some cases

41 See Gorton and Winton (2003) for a review of the pre-crisis literature on this issue.

42 The role of various safety nets in propagating financial crises is explored in White (2009), Haldane and Alessandri (2009), and Haldane (2010); such interventions could account for the increased virulence of crises documented in Jordà, Schularick and Taylor (2016).

negative, nominal interest rates. If, as Diamond and Rajan (2012) contend, lower interest rates excite risk taking, with financial intermediaries assuming leveraged positions in risky assets that increase the severity and/or likelihood of crises, prudence is clearly warranted. In the tepid recovery following the global financial crisis, with short-term interest rates in most major advanced economies at the effective zero lower bound, central banks resorted to large-scale purchases of long-term bonds to lower the yield curve and provide stimulus to the economy. Some argued that this *quantitative easing* (QE) could fuel the buildup of financial stability risks. Such risks reflect feedback effects through asset prices and leverage and exposure to interest-rate shocks, in particular in financial systems in which variable-rate financing is prevalent. Meanwhile, the use of QE by central banks could reduce risk *premia* on longer-term bonds, likewise leading to excessive risk taking.[43]

In this context, the critical question is whether stimulus is better delivered through a relaxation of macroprudential policies or through some combination of policies. This question is addressed by Woodford (2015) using a model in which financial institutions can generate excessive leverage through the issuance of collateralized short-term debt.[44] He examines the effects of three policy rules — interest-rate policy; QE; and macroprudential policy effected through reserve requirements, which represent an effective tax rate on short-term debt issuance by banks — on aggregate demand, financial conditions, and the likelihood and severity of a banking sector funding crisis. All three can be used independently to influence aggregate demand, and all increase financial stability risk. They are not equivalent, however. QE increases financial risks, but by less than a relaxation of macroprudential policies or a reduction in interest rates.[45] Woodford (ibid.) concludes that it is possible to use QE to raise aggregate demand at the zero lower bound without adverse effects on financial stability by combining it with macroprudential tightening.

This result underscores the importance of integrating financial intermediaries into macroeconomic models to better understand the relationship between price stability and financial stability. Brunnermeier and Sannikov (2016) is an important contribution. Financial intermediaries diversify risks (among other functions) and create "inside" money. But because they engage in liquidity and maturity transformation, intermediaries are exposed to risk. When banks suffer losses, they shrink their balance sheets, reducing inside money and financing fewer projects. Given these effects, equilibrium in the economy is determined by the degree of capitalization. With undercapitalized intermediaries, the money multiplier is low, as is the supply of inside money, while the demand for money is high, because it is not subject to the idiosyncratic risks in contrast to inside money. In contrast, well-capitalized intermediaries assuage financial frictions and exploit the diversification benefits of investing across many different projects while creating inside money. At the same time, the demand for money is low because households can diversify idiosyncratic risks through the financial system.

The importance of this distinction is that the former case is associated with disinflation or a Fisher (1933) debt-deflation process. Moreover, a negative shock that imposes losses on an undercapitalized financial system could push the economy from a high-level of output and price stability into a period of stagnation and persistent disinflation. Markus K. Brunnermeier and Yuliy Sannikov (2016) contend that a monetary policy response that affects the prices of assets can help maintain the capacity of financial intermediaries to diversify idiosyncratic risk (lower interest rates increase the price of bonds held by intermediaries, resulting in a "stealth" recapitalization). While moral hazard is a potential problem, they note, it is less severe than direct bailouts because it

43 The IMF (2016) identifies risks associated with a reach for yield on the part of pension funds and insurance companies, whose discounted future liabilities move counter to interest-rate levels, and stresses to bank business models. At the time of writing (December 2019), there are growing concerns of increasingly fragile debt structures in some economies, characterized by the spread of collateralized debt instruments reminiscent of practices before the crisis. Michael Brei, Borio and Leonardo Gambacorta (2019) present evidence of a shift in large international bank activities from interest-generating to fee-generating and trading activities. Such a shift was also a feature of the pre-crisis environment.

44 See Gertler, Kiyotaki and Prestipino (2016a) for a discussion of the problem.

45 The degree of price flexibility is key. When prices are flexible, an expansion of QE is not equivalent to a relaxation of macroprudential policy; in fact, the result is equivalent to a tightening of macroprudential policy, because the increased supply of safe assets reduces incentives for bank issuance of short-term debt, like macroprudential policy.

disproportionately benefits prudent institutions that held bonds as a hedge against idiosyncratic risks, rather than reckless institutions that took on leverage to take more risk. *Ex post* bailouts of failing institutions, in contrast, create strong risk-taking incentives *ex ante*. That being said, monetary policy cannot control risk separately from risk taking and risk *premia*. However, combined with macroprudential policies, such a response can result in a significantly higher level of welfare.

This result underscores the importance of macroprudential measures in avoiding the buildup of leverage and risks that propagate crises and undermine confidence in financial systems and lead to system-wide dysfunction. An effective and credible lender-of-last-resort facility that limits moral hazard effects is one mechanism to support confidence and sustain a high-level equilibrium. But in the heat of the crisis, some jurisdictions greatly expanded public deposit insurance coverage and were obliged to inject capital in failing banks and other financial institutions to contain panic and restore stability. The resulting public debt "overhang" led to concerns of long-term fiscal sustainability that subsequently influenced decision making.

Fiscal

The transfer of private sector liabilities onto public sector balance sheets in the global financial crisis underscores the need to understand the interaction between public safety nets, the incentives for risk taking and fiscal crises. This is not a new phenomenon, as Bordo and Meissner (2016, 46-47) document:

> The connection between financial crises and fiscal crises is primarily a more recent event, at least since the 1930s, although there were a number of such events in emerging market countries going back to the late nineteenth century. The key link between the two types of crises has been the increased use of government guarantees of financial institutions. These have surged in incidence and magnitude greatly since the Great Depression and especially since the 1980s. Governments after the Great Slump realized that banking panics were very costly events both in economic and political terms, and they have gone to great lengths to avoid the classic banking panics of the nineteenth and early twentieth centuries and to avoid the perception of inaction. The consequence has been both more virulent modern banking crises with an increasingly strong likelihood of fiscal resolution and the accompanying fiscal resolution costs.

The conclusion seems clear: However important safety nets to safeguard financial stability may be, they create moral hazard risk and incentives for institutions to pursue strategies to grow to sufficient size and/or complexity that their failure would impose unacceptable costs on society.[46] The managers of these institutions do not incorporate social costs when making investment decisions, introducing an externality in the pricing of risk. Ideally, private agents responsible for these costs would bear them. But governments face a time inconsistency problem in that *ex ante* commitments to enforce market discipline may lack credibility *ex post* if the cost is judged too high; meanwhile, failure to penalize excessive risk taking exacerbates the incentive to engage in the practice. These considerations have important implications for the design of the regulatory environment.[47]

At the same time, the pre-crisis policy orthodoxy that precluded the use of fiscal policy to achieve short-term stabilization objectives is under review. Blinder (2016, 22) contends that the proposition that "fiscal policy is superfluous because monetary policy can always do the job" is "demonstrably false." The uneven, uncertain and anemic performance of the global economy following the crisis has focused attention on the limitations of monetary policy to restore full employment and

46 The global financial crisis revealed the extent to which underlying legal and structural arrangements in the financial system can facilitate excessive risk taking in the financial system. White (2004) provided a prescient discussion of the issue on the eve of a catastrophic financial crisis in which the US authorities would eventually extend guarantees exceeding $30 trillion. Bordo and Meissner (2016) note that safety nets based on deposit insurance and other guarantees have led to regulatory forbearance and moral hazard and increased leverage by the protected financial institutions. The need to limit the exploitation of safety nets to engage in imprudent risk taking is thus a key lesson from the global financial crisis.

47 Of special importance are legal and structural issues that can form a critical element of the overall policy framework. A key lesson of the global financial crisis is the need to contain excessive risk taking animated by access to deposit insurance regimes and credible orderly resolution frameworks. Stress testing of large systemically important banks and bespoke capital requirements tailored to the specific risk taking of individual institutions constitute a bulwark against the buildup of systemic risks and are critical components of the overall policy framework (Haley 2019). That said, a comprehensive review of all relevant instruments is beyond the scope of this paper.

the importance of better coordination of the two key tools of stabilization policy (Furman 2016).

More generally, the crisis demonstrated that fiscal policy should support monetary policy in an environment in which the financial sector is engaged in a protracted process of deleveraging. In this regard, the premature withdrawal of fiscal stimulus in key advanced countries meant that monetary policy single-handedly shouldered responsibility for supporting growth, leading to the concerns about the protracted use of extraordinary monetary policies as discussed below. A robust fiscal response that closed output gaps sooner might have allowed monetary policy to "renormalize" sooner, reducing the threats to financial stability posed by protracted low interest rates. Blanchard and Lawrence Summers (2017, 3) put it bluntly: "Fiscal policy must be reintroduced as a major stabilization tool."

This questioning of the pre-crisis orthodoxy reflects the fact that the crisis was a sobering experience. And in the wake of the crisis, a reconsideration of the role of fiscal policy is clearly warranted. There is scope for reanimating the use of countercyclical fiscal policy, even if that is limited to developing more robust automatic stabilizers (Blanchard 2016b). In the first instance, this may be limited to ensuring that fiscal policy is *not* procyclical.[48] In this respect, the failure to contain the size and severity of the crisis *ex ante* ultimately contributed a debt overhang in the global economy, which is still rising, despite ultra-low rates — a trend that is detrimental to long-term growth — and limits more aggressive policy responses.

48 Consideration could also be given to the proactive use of tax policy to limit, *ex ante*, the buildup of excessive leverage that subsequently impairs the effectiveness of other policy instruments in a crisis.

Assessment: Implications for Policy Frameworks

A careful evaluation of a policy instrument cannot be conducted in isolation of the broader policy framework in which it operates. It follows that the effectiveness of macroprudential policy can only be assessed in the context of monetary and other policies. If too much burden is placed on one instrument, the effectiveness of that instrument may degrade, or there may be other, unexpected or unintended consequences.

In the pre-crisis policy paradigm that guided most advanced economies, financial institutions, markets and the financial system, generally, were considered only in the context of the role of banks in creating money through the money multiplier. Unfortunately, this parsimony was mirrored by the models used by most inflation-targeting central banks to frame decision making (but not necessarily for the preparation of economic forecasts) prior to the crisis. This state of affairs can be accounted for by the prevailing view that focusing on the liability side of financial intermediaries, the "money side," is sufficient — that consideration of other financial variables would not add to the analysis of short-run fluctuations.

Neglect of wider financial stability concerns may have also reflected the hegemony of the Tinbergen principle: if the central bank is targeting inflation, it cannot be distracted by other objectives, including financial stability. And in the halcyon days of the Great Moderation, it was believed that central banks could always step in to restore calm should it be necessary. This perception likely contributed to a problem of time inconsistency — commitments to allow market discipline to work were widely viewed as dynamically inconsistent by "too big to fail" banks that engaged in imprudent risk taking. At the same time, the view that central banks must focus strictly on the price stability objective aligned with central bankers' desire to establish and then defend their independence. Monetary policy that is expected to achieve multiple policy objectives is at risk of political interference.

With the benefit of hindsight, it is now widely recognized that the pre-crisis policy framework ignored a large literature that explained the

important real services that financial institutions provide in terms of liquidity insurance, risk sharing and expanding the volume of financing for real investment. Potential risks (financial and to the real economy) were underestimated, as were the lasting impacts of a major financial disturbance. And too much reliance was placed on the role of financial innovations in facilitating better risk management. Rather than spreading risks, these instruments contributed to the concentration of exposures in low probability, but also to costly "tail" risks through the use of "shadow" banks, which facilitated regulatory arbitrage and enabled a large increase in leverage. A key lesson of the crisis is that more complete markets do not necessarily enhance welfare; partial movement to completeness may be harmful to welfare.[49]

Even as the crisis was still unfolding, Axel Leijonhufvud (2009) provided a concise and remarkably robust narrative of its origins, based on three simple propositions: first, in contrast to product markets, imperfect and asymmetric information in financial intermediation entails externalities that lead to systemic risks; second, macroeconomic policy frameworks adopted by central banks before the crisis failed to provide a foundation for financial stability; and third, left on their own, private markets will not generate a unique level of leverage in the economy consistent with full employment and financial stability. The policy conclusion: just as a central bank is needed to provide a nominal anchor in an economy with fractional-reserve banking, regulation is needed to anchor the degree of aggregate leverage.

In this regard, a major weakness in the regulatory environment prior to the crisis was a preoccupation with a microprudential perspective — the notion that if each individual institution held sufficient capital to withstand a given shock, the system itself would be safe. This view largely ignored externalities that combined to create systemic risks. The recognition of these risks, and the role they played in amplifying and transmitting financial disruption throughout the financial system and around the globe, accounts for the widespread acceptance of the need for a macroprudential approach to macro-financial stability.

Given the nascent state of most macroprudential regimes, it is too early to pronounce on the effectiveness of such measures. Nevertheless, the available evidence suggests that, while some measures are more effective than others, it would be imprudent to conclude that macroprudential policies alone can preserve financial stability. There is a need for supporting policies (monetary, fiscal, microprudential) and structural measures to anchor leverage in the economy and to address the underlying root causes of the externalities that breed systemic risks.

In the wake of the crisis, the pre-crisis assignment of policy instruments is therefore also under review. It is clear that, while the Tinbergen rule still applies, central banks can ill afford to be oblivious to financial stability. As Paul A. Volcker (1990, 15) warned in his Per Jacobsson lecture, "neither monetary policy nor the financial system will be well-served if a central bank loses interest in, or influence over, the structure and performance of the financial system."

Conclusions

Three broad conclusions follow from this review of the macroeconomic foundations for macroprudential policies. The first is that macroprudential policy can be an important addition to the stabilization policy tool kit. By limiting the accumulation of systemic risks and promoting financial sector resiliency, macroprudential measures can support the capacity of monetary policy to respond effectively to real and financial shocks. In practice, uncertainty with respect to the effects of macroprudential measures abounds and care should be taken in not ascribing too much power to them. It is clear, however, that the pre-crisis paradigm was woefully inadequate in terms of containing systemic risks, and the post-crisis attention to them is warranted.

The second conclusion, consistent with Volcker's admonition above, is that monetary authorities can ill afford to ignore threats to financial stability. Single-minded pursuit of an inflation target could entail the pitfall of Goodhart's Law: a situation

49 Adair Turner et al. (2010) note that the presumption that new securities (such as credit default swaps) help to complete markets and thus improve societal welfare ignores the insights of the theory of the second best, which demonstrates that in the presence of multiple market failures, reducing the scope of one could lead to a decrease in societal welfare. Introducing these new instruments for betting may have increased economic volatility and lowered output permanently.

in which, on the one hand, goods price inflation may be well contained, but, on the other, that condition becomes disconnected from the fundamental objective that inflation-targeting regimes were introduced to promote. In this respect, the past decade amply demonstrates that price stability is not synonymous with overall financial and macroeconomic stability. This assertion would likely not be surprising to central bankers of an earlier era; it merely reflects the fact that central banks were created to promote financial stability by providing liquidity insurance to the private banking system.

A return to this earlier perspective is fully consistent with the fundamental mandate of central banks, as is the "rediscovery" of macroprudential policy (Elliot, Feldberg and Lehnert 2013). The global financial crisis revealed a key distinction between price stability and financial stability: while inflation targeting is intended to promote stability of the value of a central bank money, financial stability more broadly concerns the stability of private banking system money-like liabilities in terms of central bank money. Most of the time, in periods of financial tranquility, the exchange rate between the two is at unity. But in periods of severe financial distress, such as the panic of October 2008, this is not the case; the financial system freezes up as agents hoard central bank money and eschew private monies, with devastating consequences for the real economy.

Avoiding this dysfunction requires confidence that the rate of exchange will remain at unity and that that equilibrium is robust or is "information-insensitive" to (most) new information (Holmstrom 2015, 7). As Tucker (2019) argues, that condition may entail formal backing of private monies through deposit insurance, coupled with assurances that the state is capable of, and can be trusted in, backing up and paying out on those guarantees. Getting the right governance arrangements for such arrangements requires well-articulated money-credit constitutions (Tucker 2018).

The policy implications of incorporating financial intermediaries in policy decisions, in contrast to the pre-crisis practice, are straightforward. To start, governments should clearly limit contingent fiscal liabilities associated with potential financial sector guarantees by promoting *ex ante* resiliency (that is, ensuring the system is resilient to possible shocks). Macroprudential policies help in this regard. But there is also a need *ex post* for policy to calm fears, restore credit flows and prevent a further deterioration in asset values. A timely return to full employment can promote these goals. Yet, as the Great Recession demonstrated, the absence of crisis does not imply growth. In these circumstances, fiscal policy may need to shoulder part of the burden for restoring growth and returning the economy to full employment.

The third conclusion of this review of the macroeconomic foundations for macroprudential policy is thus the need to revisit the role of fiscal policy in the stabilization policy frameworks. This was the case prior to the development of the New Keynesian policy consensus that prevailed prior to the crisis. As Summers and Anna Stansbury (2019) put it, "Instead of more old New Keynesian economics," the need is for "a new Old Keynesian economics." Returning to an earlier policy assignment would likewise ease some of the burdens on monetary policy. That being said, to avoid politically motivated fiscal measures, and to limit the moral hazard that accompanies government commitments to preserve stability, which can foster the next crisis, policy makers and governments may need to develop clear money, credit *and* fiscal constitutions.

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