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Bringing Financial Stability into Monetary Policy

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This paper arms central bank policy makers with ways to think about interactions between financial stability and monetary policy. We frame the issue of whether to integrate financial stability into monetary policy operating rules by appealing to the observation that in actual economies financial markets are incomplete. Incomplete markets create financial market frictions that prevent economic agents from perfectly sharing risk; in the absence of frictions, financial (in)stability would be of no concern. Overcoming these frictions to improve risk sharing across economic agents is, in our view, the intent of policies geared toward ensuring financial stability. There are many definitions of financial stability. Although the definitions share the notion that financial stability becomes an issue for policy makers when a breakdown in risk-sharing arrangements in financial markets has a negative effect on real economic activity, we give several examples that show this notion is too general for thinking about the role that monetary policy might have in smoothing shocks to financial stability. Examples include statistical models that seek to separate "good" from "bad" changes in private-sector debt aggregates, new Keynesian policy prescriptions grounded in neo-Wicksellian natural rate rules, and a historical episode involving the 1920s Federal Reserve. These examples raise a cautionary flag for policy attempts to control both the growth and the composition of debt that financial markets produce. We conclude with some advice for revising central banks' Monetary Policy Reports.

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Financial frictions, incomplete markets, crises, new Keynesian, natural rate, monetary transmission mechanism.

JEL Classification

E3, E4, E5, E6, G2, N12

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Bringing Financial Stability into Monetary Policy*

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This paper arms central bank policy makers with ways to think about interactions between financial stability and monetary policy. We frame the issue of whether to integrate financial stability into monetary policy operating rules by appealing to the observation that in actual economies financial markets are incomplete. Incomplete markets create financial market frictions that prevent economic agents from perfectly sharing risk; in the absence of frictions, financial (in)stability would be of no concern. Overcoming these frictions to improve risk sharing across economic agents is, in our view, the intent of policies geared toward ensuring financial stability. There are many definitions of financial stability. Although the definitions share the notion that financial stability becomes an issue for policy makers when a breakdown in risk-sharing arrangements in financial markets has a negative effect on real economic activity, we give several examples that show this notion is too general for thinking about the role that monetary policy might have in smoothing shocks to financial stability. Examples include statistical models that seek to separate "good" from "bad" changes in private-sector debt aggregates, new Keynesian policy prescriptions grounded in neo-Wicksellian natural rate rules, and a historical episode involving the 1920s Federal Reserve. These examples raise a cautionary flag for policy attempts to control both the growth and the composition of debt that financial markets produce. We conclude with some advice for revising central banks' *Monetary Policy Reports*.

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1 Introduction

The financial crisis of 2007–2009 altered the landscape on which central banks operate. Before the crisis, economists and policy makers seemed to converge on the idea that central banks should concentrate on price stability while also aiming to stabilize employment and resource utilization. And macroeconomic stabilization was the focus of many central bank since the end of the inflation episodes of the 1970s and 1980s. The financial crisis forced central bankers to pivot to thinking about the impact of their decisions on the stability of financial markets.

We discuss what financial stability means for monetary policy. Our organizing principle is that financial stability is about risk sharing, or the lack thereof, among economic agents. Graduate economics textbooks often contain models with a complete set of Arrow-Debreu (AD) securities, which implies complete risk sharing. This relies on trades in AD securities generating prices of risk that are correct in every state of the world so there is no possibility of a financial instability. Complete AD securities also mean there is no role for fiat currency. Since there is no demand for central bank liabilities, monetary policy cannot improve risk sharing by altering the price of fiat currency relative to private securities.

The markets in which central banks actually operate do not offer a complete set of state-contingent securities. We believe that some Arrow-Debreu markets are always missing and which markets are missing can differ across time and across economies. Further, there are moments in time when trading ceases in some financial markets. When such a state of the world occurs, central banks often have to step in to fill the void by providing the missing insurance.

After describing several financial frictions thought to matter for the 2007–2009 financial crisis, we present several definitions of financial stability. The definitions take the view that financial stability becomes a concern for monetary policy when a disruption in the financial markets produces a drop in real economic activity. We argue that, although a useful concept, this notion of financial stability cannot help to decompose observed private-sector credit aggregates and asset prices into "good" and "bad" states of the world. Economists still have too a weak grasp of which of the plethora of financial frictions matter most for aggregate fluctuations and, therefore, are most important to policy makers to identify good and bad fluctuations in a credit aggregates and asset prices in our view.

The paper reviews the experience of the Federal Reserve during the 1920s. The policy framework that motivated the 1920s Fed and its actions teach valuable lessons for economists and policy makers today. Despite the early Fed's mandate of financial stability, the Great Depression happened. While we are *not* suggesting that another Great Depression is in the offing, the 1920s Fed offers insights about what can happen when monetary policy attempts to control both the growth rate and the composition of debt issued by financial markets.

Our organizing principle, discussion of financial stability, and review of statistical methods to separate "good" from "bad" movement in credit is motivated by current attempts to introduce financial frictions into general equilibrium models. These models are missing financial markets in ways that embed financial frictions into steady states. Surprisingly, this is not often the case when financial frictions are added to existing dynamic stochastic general equilibrium (DSGE) models with nominal frictions that are in widespread use to study the impact of monetary policy on real economic activity.

We describe models found in both classes of general equilibrium theories. In recent years, especially in light of the 2007–2009 financial crisis, models built on different financial frictions have received more attention. These frictions serve as a framework for comparing several definitions of financial stability. We complete the circle by engaging these definitions to think about the implications of financial stability and financial crises within DSGE models. We believe that DSGE models constructed on and linearized around a unique steady state have little to say about financial stability. The same is true for DSGE models driven by only a single interest rate or multiple rates that are mechanically connected—that is, linearly dependent. Since financial crises are likely to be associated with multiple steady states, nonlinearities or shifts in the underlying regime of an economy, and disparities in interest rate spreads, DSGE models need to grapple with these features to become useful tools for evaluating monetary policy and financial stability.

We conclude with suggestions and advice for how central banks that wish to integrate financial stability with monetary policy might prepare *Monetary Policy Reports*. We present the advice at a general level by highlighting potential pitfalls that may arise from some approaches and by raising issues that might flow from more explicit communications with the public about financial stability concerns. The section begins by discussing several financial indicators that are thought to provide useful information for monetary policy. Because many of those indicators are produced using statistical models, which estimate the gap between actual and unobserved trend credit growth and have scant connection to theory, we are skeptical that monetary policy will find them to be informative. If policy makers want to understand the connections between monetary policy and financial stability, many of the concepts that are now central to monetary policy making and public communications—concepts like the "natural real interest rate" and degrees of resource utilization—need to be revamped to conform with environments in which financial frictions matter for aggregate fluctuations. Related issues arise in the understanding of the monetary transmission mechanism which, in a world of financial frictions, extends beyond the usual new Keynesian interest-rate and credit channels. Our discussion also touches on several related modeling issues.

Monetary policy makers are also being asked to consider whether financial imbalances have implications for stabilizing inflation and real activity. The distributional implications of financial imbalances and the consequences for redistribution of income and wealth by monetary policy actions aimed at tamping down those imbalances become key issues. This is an especially tricky subject for central bankers, who prefer to focus exclusively on how their decisions affect aggregate outcomes. But financial crises often entail substantial swings in relative prices of assets and securities. Efforts by policy makers to temper those swings will change relative prices and, therefore, reallocate resources. Redistributional impacts bring with them a set of political economy questions that policy makers will need to work through.

The paper ends with a discussion of potential conflicts between financial stability and monetary policies. We are skeptical about arguments that these conflicts can be minimized when monetary policy adopts a longer-term perspective on price stability. Financial stability and monetary policies may be incompatible because "too much" macroeconomic stability can induce risk taking by the financial sector. This provocative possibility turns conventional monetary policy thinking on its head, but we contend that this proposition rests on unresolved issues that carry risk for central banks. Finally, we argue that monetary, fiscal and financial policies are intimately intertwined. The usual model of three distinct policy institutions with three distinct objectives is untenable. Interactions among the three macroeconomic policies raise intriguing questions about the design of policy institutions. Perhaps the answer to these questions will aid monetary policy makers charged with smoothing shocks to financial stability.

We aim to take a dispassionate view, neither advocating nor opposing having central banks expand their objectives to include explicit concerns about financial stability, in addition to the conventional objectives to stabilize inflation and real economic activity. Much of what we write is for the benefit of a central bank that is in the process of deciding or has already decided to bring financial stability into the family of monetary policy concerns.

2 An Organizing Principle

Although it may seem self-evident, the starting point in thinking about financial stability and monetary policy is that in a world of complete AD securities, financial stability is guaranteed and, in fact, there is no need for monetary or macroprudential policies. In this frictionless environment, there is complete risk sharing among economic agents, which ensures financial stability, and money (or fiat currency) plays no role in allocating real resources across economic agents and across time. This leads to the organizing principle for this document: it is the incompleteness of financial markets or the presence of financial frictions that raise the possibility of crises. Our organizing principle also poses a critical question: since this market incompleteness is necessary for monetary non-neutralities to exist, should monetary policy makers attempt to use the tools available to them to stabilize financial markets?

Complete contingent-claims markets carry strong implications. When financial contracts specify outcomes in every possible state of the world, any bankruptcies and defaults that may occur remain contained within the relevant set of actors, so these events cannot become systemic. Indeed, some bankruptcies and defaults *must* occur if financial markets are functioning well.

Incomplete risk sharing and financial frictions constitute a useful organizing principle because they focus analyses on the source of the systemic problem. Only when the source of the financial friction has been identified can economists and policy makers ask whether settings of the monetary policy interest rate—or some other type of policy, like central bank asset purchases, lender-of-last-resort actions, macroprudential policy or fiscal policy—can attenuate the problem. And with an identified source in hand, analysts can explore whether the macroeconomic policies themselves create systemic risks that operate through the frictions in financial markets.

Actual economies exhibit a wide array of departures from complete markets that fall under the rubric of "financial frictions." A partial list of such departures includes: incomplete or asymmetric information; liquidity constraints that may arise from uncertain timing of consumption; moral hazard stemming from expectations of future policy actions like bailouts or elastic liquidity provision; monitoring costs or costly state verification that can create agency problems; missing markets that preclude certain trades; failure of economic players to internalize the effects of their choices on prices and financial stability; imperfect competition that gives certain financial entities out-sized influences on markets and policy reactions; the ability of agents to promise only a fraction of their income streams to creditors; illiquidity of assets backed by durable goods like real estate; search frictions that prevent trades from taking place in centralized markets; regulatory arbitrage that permits financial institutions to innovate around regulatory restrictions; and ubiquitous strategic complementarities. These complementarities include asset prices in which the signaling value of prices strengthens as the number of informed traders rises, bank runs when an individual depositor is better off demanding early withdrawal if other depositors also demand it, or anticipated accommodative monetary policy in response to maturity mismatch that often induces financial institutions to make choices that increase the riskiness of their balance sheets.

As if this partial list isn't sufficiently daunting, a given set of financial frictions can interact in complicated and difficult-to-understand ways with the real economy to produce unexpected results.

2.1 Examples To make the organizing principle more concrete, it is useful to examine several prominent examples of financial stresses and pinpoint the nature of the incompleteness that creates the stresses. There is substantial overlap in the mechanisms at play in these examples, as might be expected in any general equilibrium setting.

1. **Risk-taking channel of monetary policy.** This idea has rapidly gained traction, particularly among central bankers, since the financial crisis.[1] The prominence of this channel in policy discussions, especially in the current environment of prolonged and unusually low policy interest rates, motivates us to explore it in some detail.

   First we give a clear definition of the risk-taking channel. The risk-taking channel highlights the way in which monetary policy, through the level of interest rates and expectations of future policy behavior, affects market perceptions of, tolerance for, and pricing of risk. When real interest rates and/or rate spreads are low for a prolonged period, financial institutions seek out higher returns by leveraging up and purchasing riskier assets than they otherwise would. In this environment, imperfect information creates incentives for banks to expend fewer resources monitoring their loans, which makes credit both easier to obtain and riskier.

   Risk-taking by households and financial institutions, of course, is part and parcel of efficient financial markets. The trick for a policy maker is to determine whether the risk-taking is "excessive," and that question can be answered only relative to *some* economic model (or models).[2] Since general equilibrium models that integrate the risk-taking channel with monetary policy behavior are in their infancy, no consensus view of the appropriate level of risk-taking has emerged.

[1] Borio and Zhu (2012) coined this term; see Dell'Ariccia, Laeven, and Marquez (2014) for a microeconomic model of this channel, Abbate and Thaler (2014) for a macroeconomic take on it, and Apel and Claussen (2012) for a more general discussion.

[2] By way of analogy, Shiller (1981) determined that stock prices were "too volatile" relative to a model in which stock values depend on rational expectations of the discounted present value of future dividend payments. Actual stock prices exhibited excessive volatility according to Shiller when measured against the fundamentals of the present discounted model of stock prices, rational expectations, and a statistical process for dividends.

An essential point about the risk-taking channel, but one often overlooked in current debates, is that it is only one of several channels by which monetary policy affects the economy. And most of the time it is unlikely the dominant channel quantitatively. In environments with complete Arrow-Debreu securities, the risk-taking channel is benign. Since market perceptions of risk are accurate, all risk is priced correctly. Although the risk-taking channel is always operative, its relative importance has likely increased during the current episode of near-zero policy interest rates. The importance of the risk-taking channel may vary with the state of the economy. This suggests that economists will find it challenging to obtain good estimates of the risk-taking channel—simple linear econometric methods are unlikely to produce accurate estimates.

Perhaps the most troubling aspect of the risk-taking channel for policy makers is that it points to a difficult tradeoff facing inflation-targeting central banks. If monetary policy has successfully reduced volatility in the economy—or "good luck" has delivered small exogenous disturbances to the economy—and inflation is low, interest rates will also tend to be low. In this state of affairs, agents may find it easier to obtain financing and at the same time increase their leverage. The result can be a credit boom that creates greater systemic risk.[3]

How central banks should tradeoff macroeconomic stabilization objectives, which typically reduce volatility against "excessive" risk-taking that can arise in low-volatility environments, presents monetary policy makers with a challenge. In starker terms, the tradeoff may be severe enough that macroeconomic stabilization and financial stability are mutually exclusive objectives for a central bank. In a world of increasing financial efficiency, a central bank has to ask both whether smoothing shocks to the real economy will produce a crisis in financial markets and whether smoothing financial fluctuations will harm the real economy.

2. **Household financial imbalances.** Imagine that households' indebtedness is growing at a rate that exceeds their current disposable income, as it has in Norway and Sweden. Policy makers may grow concerned that in the event of a negative shock to household income or a surprise increase in households' liquidity needs, households will be unable to service their debts out of current income. In those two countries, the problem is unlikely to be one of solvency of the households because they own substantial wealth in the form of future pension receipts.[4] Market incompleteness arises because no market exists that permits households to access their pension funds to meet current debt service.[5]

   In this circumstance, a policy that allows households to borrow—temporarily and under specified conditions—against their pensions to meet short-run liquidity needs would add a necessary market to address the market incompleteness. To combat the

[3] Brunnermeier and Sannikov (2014a,b) call this the "volatility paradox." Lower exogenous risk can induce financial institutions to endogenously choose to take on more risk. See section 3.3.3.

[4] Nilsson, Söderberg, and Vredin (2014).

[5] Holmström and Tirole's (2011) notion that some part of an agent's income stream cannot be pledged to lenders, combined with Allen and Gale's (2007) idea that liquidity shocks arise from the uncertain timing of consumer's demand for goods, provide a theoretical framework for understanding systemic problems that household indebtedness may create.

moral hazard problems that might arise from such a policy and the incentives for time inconsistent fiscal policies in the future, the policy must ensure that borrowing against pensions occurs only when specific events are realized. Furthermore, charging a penalty interest rate on those loans, along with an agreed-upon repayment schedule, should be elements of a well-designed policy that reduces potential problems in the future.[6]

3. **Implicit insurance.** During the financial crisis all manner of assumed or implicit insurance arose that induced investors to buy high-return assets whose risk (they assumed) someone else would bear. In the United States, investors believed that government sponsored enterprises—Fannie Mae and Freddie Mac being the primary examples—were backed by the U.S. government, making their liabilities essentially risk-free, and permitting them to borrow at lower rates than other financial institutions. In the event, those bets were rationalized when the U.S. government put the companies into conservatorship, which in essence employed U.S. taxpayers to back any future losses.

   The so-called "Greenspan put"—the perception that whenever the stock market fell dramatically or the financial system showed signs of stress, the Federal Reserve would provide virtually unlimited liquidity—was another prominent example of implicit insurance. In the United States, that perception spread well beyond traditional commercial banking to include investment banks, money market mutual funds, and even insurance companies. The 2012 declaration by the European Central Bank's President Draghi that the ECB would "do whatever it takes to preserve the euro," a pledge that the Governing Council soon ratified when it announced the Outright Monetary Transactions program, may be regarded as a type of insurance against sovereign default in the euro area. It clearly was designed to shape market expectations of future policy to preempt speculative attacks.

   These and other examples arose because of moral hazard created by either anticipated or actual policy actions.

4. **Securitization.** Securitization is a relatively recent financial innovation, and one that is still largely unregulated in many countries. A financial intermediary—investment and/or commercial banks—originates loans and then creates pools of loans to be sold in capital markets by selling asset-backed (or mortgage-backed) securities with repurchase agreements. Those securities are, in turn, linked to pools of loans held by legally distinct corporations called Special Purpose Vehicles (SPVs). In this regulatory arbitrage, banks move the risky assets off their balance sheets, against which they would otherwise have to bear the costs of holding capital, shifting the risky assets to non-bank entities that do not face capital requirements.

   Initially, the bank receives deposits from investors in exchange for collateral from the bank in the form of repurchase agreements. The bank agrees to repurchase the same asset at a later date for an agreed-upon amount. In brief, the bank securitizes the mortgages that it originates by selling them to outside investors, the Special Purpose Vehicles, which combine lower rated tranches into new asset-backed securities (ABSs)

[6] This is one component of Bagehot's (1873) prescription for the appropriate response to a financial crisis.

with higher ratings. This process can continue, with other SPVs acquiring a pool of ABSs, creating from them AAA and AA-rated securities, and selling them to investors or still other SPVs. The expansion of high-grade securities in the lead-up to the financial crisis was driven by demand for AAA-rated collateral by the repo markets.[7]

In principle, securitization can serve to *complete* financial markets by extending risk sharing. Pooling risk and splitting the risk into tranches can lead to more accurate pricing of risk. And, in the absence of financial frictions, securitization can improve the efficiency of financial markets. Of course, enhanced efficiency *requires* that the securitized assets are accurately priced. Evidence from the financial crisis suggests that asymmetric information delivered significant mispricing of risk. In addition, with each level of securitization, the new financial instrument grows more removed from the underlying asset from which it derives its value, further confounding the problem of pricing risk.

5. **Credit chains and repurchase agreements.** "Rehypothecation" occurs when an investor receives collateral in exchange for cash and then re-pledges that collateral in a new trade with a third party. There are at least two frictions generated by rehypothecation. Rehypothecation imposes costs on the financial system when there are runs on repo. One cost is tied to problems for the chain of custody of collateral if a trade fails in the chain repo contracts. In this instance, there are legal costs generated to recover the collateral by its owner. Even if the chain of repo trades implies a zero net supply of these securities, the financial friction is that the gross position is what concerns traders in the repo market at the moment that there is a failure in a repo trade or a default by a firm involved in the repo markets. Netting these gross position impose pecuniary and non-pecuniary costs on those settling these positions subsequent to financial crisis.[8]

   Another issue is that rehypothecation produces credit chains that have money multiplier-like implications. For example in the repo market, if the haircut is x, say 10 percent, then the process of rehypothecation implies that the initial collateral can support a $1/x$- (10-) fold increase in leverage.[9]

   Of course, like all multipliers, the collateral multiplier also works in reverse: a SEK 1000 withdrawal of repo generates a multiple contraction in collateral. Several authors have pointed to this phenomenon—a run on repo—as central to the 2007 financial crisis.[10]

[7]As Gorton and Metrick (2012b, p. 431) put it: "...essentially, there is not enough AAA debt in the world to satisfy demand, so the banking system set out to manufacture supply."

[8]See Duffie (2010), Gorton (2010), Gorton and Metrick (2012a,b), and Fleming and Sarkar (2014).

[9]Suppose an asset used as collateral is worth SEK 1000 and a bank sells it for SEK 900, promising to repurchase the asset at a specified date for SEK 945. Then the repo rate is $(945 - 900)/900 = 5$ percent and the haircut is $(1000 - 900)/1000 = 10$ percent. The collateral multiplier, analogous to the textbook money multiplier, implies the following multiple expansion in credit

$$1000(.9^0 + .9^1 + .9^2 + \ldots) = 1000/.10 = 10000$$

Monnet (2011) contains a useful discussion of rehypothecation.

[10]For example, Gorton (2010).

> Rehypothecation creates credit chains in which all subsequent credit creation is backed by the initial collateral. This makes credit chains potentially fragile. With incomplete information, trades that are more distant from the initial collateralized trade may require verification of the value of the collateral. In the event of a breakdown of the chain due to withdrawal of some repos in the chain, the time it takes to verify the value may trigger a run on repos.[11]
>
> Through interest-rate settings, the central bank can influence rates in the repo market to temper the effects of rehypothecation. But changes in the policy rate may have unintended consequences for the structure of interest rates throughout the economy, with undesirable impacts on macroeconomic stabilization.
>
> Examples of more targeted policies include minimum haircut requirements or more extensive use of tri-party repo markets. Because the asymmetric information embedded in credit chains is amplified by the length of the chains, a policy of setting minimum haircuts would effectively shorten the chains and reduce the systemic impacts of a run. Tri-party repo markets rely on a trustworthy third party to hold both the collateral and the initial cash. This stabilizes the collateral multiplier by reducing the risk that the repo will not ultimately be reversed.
>
> Both the repo market and securitization are financial innovations that affect the supply of private credit and, therefore, inside money. In the typical formal models that central banks employ, inflation, output and employment are insulated from fluctuations in inside money. It is important to recognize, however, that the insulation is *hard-wired* into the models. Common financial frictions imposed on new Keynesian models are consistently found to have quantitatively small effects on the business cycle features of, and therefore on monetary policy impacts in, those models. More importantly, conventional financial frictions do not permit medium-scale new Keynesian models to explain the financial crisis.[12] This is an indication that the macroeconomic amplification effects that arise from credit booms or busts are absent from that class of models.

As even this brief and incomplete discussion reveals, departures from complete Arrow-Debreu securities markets are abundant and complex.[13] A goal of integrating the "important" financial frictions into a general equilibrium model with monetary policy is a fool's errand. Which set of financial frictions is "important" varies over time and with the state of the economy. How important a given friction might be depends on the other frictions that are present and these interactions have only begun to be explored. Financial markets will continue to innovate in ways that may diminish the importance of some frictions, enhance other frictions, and create new, yet-to-be-discovered frictions.

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[11] Gorton and Metrick (2012a) recount several instances of runs on short-term debt markets—primarily repo and commercial paper—in 2007 and 2008.

[12] Suh and Walker (2013) combine the new Keynesian model of Smets and Wouters (2007) with four financial frictions—Bernanke, Gertler and Gilchrist's (1999) financial accelerator, Kiyotaki and Moore's (1997) borrowing constraint, Iacoviello's (2005) collateral constraint, and Zhang's (2009) limited ability of financial intermediaries to intermediate credit due to default risk—to find that the frictions contribute little to the model's ability to interpret the crisis. See also Brzoza-Brzezina, Kolasa, and Makarski (2013).

[13] Brunnermeier, Eisenbach and Sannikov's (2013) survey of macroeconomics and financial frictions is 91 pages long and covers only the literature existing at the end of 2011. See also Quadrini (2011).

Nonetheless, as a point of departure for analyzing what role, if any, monetary policy can or should play in financial stability, efforts to isolate the sources of financial frictions are essential.

3 Defining, Measuring and Modeling Financial Stability

What is "financial stability?" This fundamental question is surprisingly difficult to answer, largely because there appear to be a plethora of definitions. As a frame of reference, it is useful to contrast concepts of financial stability with the now widely-accepted notion of macroeconomic stability. In the current genre of new Keynesian models, macroeconomic stability has come to mean minimizing weighted deviations of inflation from target and some measure of real economic activity from potential—either an output gap or an employment gap. A critical underlying aspect of this definition of macroeconomic stability is that monetary policy has no long-run impacts. At most, according to this view, monetary policy can affect the cyclical behavior of real variables, but not their long-run behavior.

Long-run neutrality of money stems from several deeper assumptions. Primary among these is that nominal rigidities are the main impediments that prevent the economy from reaching an efficient equilibrium in a finite span of time.[14] There are good reasons to presume that wage- and price-setting behavior, even if sluggish in the short run, does eventually adjust to the economy's fundamentals. When all wage and price adjustments are complete, as they are in a long-run steady state, there is no tradeoff between inflation and real activity.[15] Essential to this long-run adjustment, though, is that economic players form expectations rationally.[16]

A vertical long-run Phillips curve can be an assumption of convenience. Still, for many economists and policy makers, long-run neutrality reflects a prior belief about how the economy and expectations work. Central banks, though, often treat the trend and cycle in DSGE models as unrelated to each other both theoretically and statistically. One reason for this treatment is that there is no single theory that successfully predicts movements in longer run growth and fluctuations in business cycles simultaneously. There is also a tradition in DSGE modeling that assumes that aggregate fluctuations in the growth frequencies impose no restrictions on changes in output, employment, inflation, and interest rates at the business cycle horizons. Whether this assumption is supported by sample data remains an open research question. But the assumption is consistent with new Keynesian models that often show monetary policy shocks have powerful effects on output over the business cycle, even though the shocks are restricted from having any affect on real activity in the long run. This dichotomy is ironic in light of the oft-repeated claim that price stability enhances long-run growth. The claims seems to rest on an inconsistent analysis that assumes long-run growth

[14]New Keynesian DSGE models often include habit formation and investment cost of adjustments, which are real frictions. These frictions affect the steady state of new Keynesian DSGE models.

[15]Faust and Henderson (2004) identify the vertical long-run Phillips curve as a linchpin in the development of inflation-targeting regimes.

[16]Akerlof and Yellen (1985) and Akerlof, Dickens, and Perry (2000) introduce "near-rational" expectations that permit permanent deviations of expected inflation from actual inflation, so long as inflation does not deviate too much from zero. Under near-rational expectations, the long-run Phillips curve is not vertical within a range of inflation rates around zero. Svensson (2013) employs this departure from rational expectations to interpret Swedish monetary policy.

and the business cycle are unconnected.

Until the recent financial crisis, an analogous assumption of convenience was applied to financial markets: they are a veil from which the study of business cycles can safely abstract. That sanguine view has now been shattered and central bankers currently worry about financial stability as much as they once worried about targeting inflation or stabilizing the real economy. With this concern has come a variety of proposals for policy to use monetary and macroprudential tools to dampen "financial cycles." So far, the research on financial cycles and the associated "gaps" has been either empirically based, with little explicit connection to theory, or theoretically based, with scant attention to the theory's detailed empirical implications.

Many economists believe that financial-market disturbances differ from business-cycle disturbances along two dimensions. First, among economists who regard the "financial cycle" as a robust and well-documented feature, that cycle is thought to operate at lower frequencies and have much greater amplitude than the business cycle. That is, problems in the financial sector are believed to take much longer to buildup and to unwind, with larger economic consequences, than the typical business cycle. Second, when a financial cycle ends in a bust, its impacts on real economic activity are anticipated to last much longer than the typical recovery from a nonfinancial recession.

One illustration of the long-lasting impacts comes from the Swedish financial crisis in the 1990s. Cumulative employment losses from 1990–1994 have been estimated at 16.6 percentage points relative to trend, the worst in recorded Swedish history.[17] Estimated output losses appear in figure 1, suggesting that the crisis may have permanently reduced the level of real GDP in Sweden.

Estimates of the harm the recent financial crisis inflicted on the United States are consistent with large and likely long-lasting effects. Over the period 2007–2013, the cumulative shortfall in total U.S. output was 13.3 percent, of which the major contributors were productivity (3.5 percent), capital stock (3.9 percent), unemployment (2.2 percent), and labor force participation rates (2.4 percent).[18] Of these contributors, one study conjectures that the declines in total factor productivity and participation rates may not reverse themselves, or may do so only very slowly.[19]

Permanent or very long-lived effects on the real economy from financial collapses present a formidable modeling challenge. The usual methods for separating cycle from trend in order to focus on the cyclical aspects of data, run the risk of discarding many of the long-run effects of financial imbalances. Widely used estimation techniques *require* that data be transformed to be stationary, which can discard long-run features of the time series.

Lasting effects from financial developments pose equally formidable challenges to policy makers. The solution is not merely to extend central bank forecasts of the economy beyond the usual two-to-three-year horizon, as some economists propose.[20] Policy makers need to understand how changes in the policy rate transmit into the entire structure of interest rates in the economy and how changes in that structure affect activity in the financial markets and the real economy because those effects can alter the probability of a financial crisis. Although

[17]Jonung and Hagberg (2005).
[18]Hall (2014).
[19]See also Reinhart and Rogoff (2009, 2013) for further evidence of the lasting impacts of financial crises.
[20]For example, Caruana and Cohen (2014), Woodford (2012) or Sveriges Riksbank (2013, pp. 42–48).

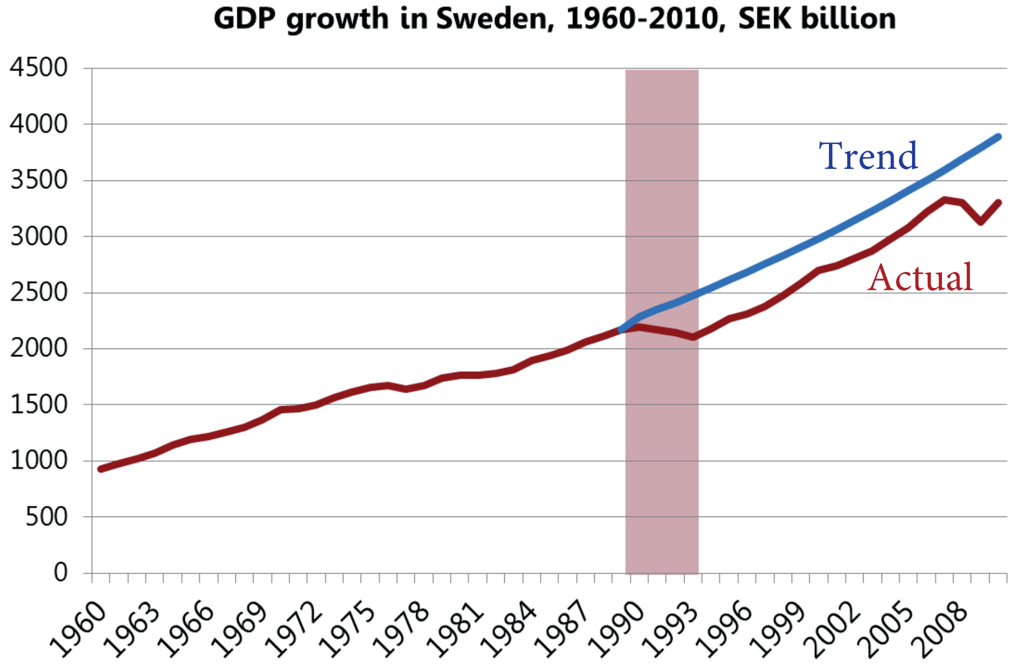


Figure 1: Source: Ingves (2012)

several pure statistical techniques have been proposed to produce forecasts of financial crises, the historical record of forecasting without theory to offer policy analysis does not suggest pure statistical methods hold great promise.

3.1 Conceptual Approaches Some early work on financial stability sought to develop broad definitions of financial stability (or instability). One definition of financial stability is:

> "A financial system is in a range of stability whenever it is capable of facilitating (rather than impeding) the performance of an economy, and of dissipating financial imbalances that arise endogenously or as a result of significant adverse and unanticipated events."[21]

A compatible definition of financial *in*stability is:

> "...I'll define financial instability as a situation characterized by these three criteria: (1) some important set of financial asset prices seem to have diverged sharply from fundamentals; and/or (2) market functioning and credit availability, domestically and perhaps internationally, have been significantly distorted; with the result that (3) aggregate spending deviates (or is likely to deviate) significantly, either above or below, from the economy's ability to produce."[22]

Another definition brings in the role of relative price movements:

[21] Schinasi (2004, p. 8).
[22] Ferguson (2002, p. 2).

"...we have financial stability where there is:

a) monetary stability (defined as stability of the value of money)
b) employment levels close to the economy's natural rate
c) confidence in the operation of the generality of key financial institutions and markets in the economy
d) and where there are no *relative* price movements of either real or financial assets within the economy that undermine (a) or (b)."[23]

The aspect of this definition that involves relative price movements also appears in the second definition and will be a theme in discussions below.

Central to all definitions is the notion that the financial sector becomes a concern when there is the prospect that financial difficulties might spill over into the real economy. These definitions are sufficiently general to encompass any number of specific aspects of problems arising from financial instability, such as gradual buildups of financial imbalances that threaten the stability of the system or unanticipated shocks that can cause the complete shutdown of certain critical markets.

3.2 Statistical Approaches Like financial stability itself, the "financial cycle" is also subject to a multitude of definitions and measures. One approach to financial cycle measurement employs statistical models and observations on credit aggregates and house prices.[24] For example, in a BIS analysis across a broad set of advanced economies, a decomposition of an observed credit aggregate yields a financial cycle that lasts between 8 and 30 years, which stands in contrast to the business cycle horizons of 1 to 8 years. This analysis also estimates that the duration of the financial cycle is 16 years when averaged across the sample economies since 1960, but only 11 years on pre-1998 data and nearly 20 years using post-1998 data. The BIS concludes "The financial cycle is visibly longer and has a larger amplitude," as depicted in figure 2.[25]

The BIS argues that peaks in the financial cycle, as they measure it, are associated with systemic banking crises. For policy purposes, the BIS advocates employing "gaps"—deviations of credit-to-GDP and house prices from trends—as real-time leading indicators of buildup of the risk of financial crises. The credit gap is interpreted as a measure of leverage in the economy, while the property-price gap is taken to reflect the probability and magnitude of the ultimate price reversal.[26] This review of financial market fluctuations also implies that the nature of the financial cycles is connected to and influenced by the degree of financial liberalization, monetary policy behavior, and developments in the real economy like globalization.

Similar analysis is found in work by staff at the Bank of England. They define the credit cycle with respect to bank loans and bank assets, employing data from 1880–2008

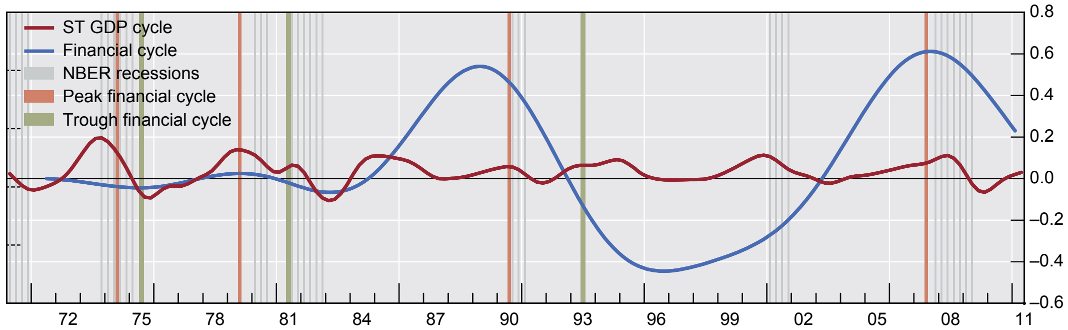
[23]Foot (2003).

[24]The BIS has produced several papers representative of this framework to develop empirical characterizations of the financial cycle. This exposition draws on Borio and Drehmann (2009), Drehmann, Borio, and Tsatsaronis (2012) and Borio (2014).

[25]Drehmann, Borio, and Tsatsaronis (2012, p. 18).

[26]Borio (2014).

The financial and business cycles in the United States



Note: Orange and green bars indicate peaks and troughs of the combined cycle using the turning-point (TP) method. The frequency-based cycle (blue line) is the average of the medium-term cycle in credit, the credit to GDP ratio and house prices (frequency based filters). The short term GDP cycle (red line) is the cycle identified by the short-term frequency filter.

Figure 2: Source: Drehmann, Borio, and Tsatsaronis (2012)

for the UK and the US.[27] Real loan growth exhibits cycles with two distinct durations—13 years and 3.5 years. Although somewhat more of the variance of loan growth occurs at the longer duration, the differences are small, suggesting that medium-term and business-cycle frequencies are important for loan growth. Since a substantial fraction of the variance in loan growth occurs at the business cycle frequencies, at issue is whether this methodology has isolated the financial cycle *per se*, rather than confounding the financial cycle with the business cycles.

The Bank of England staff report credit cycle measures for the United Kingdom and the United States that have far greater amplitude than the associated estimates of the business cycle. This closely replicates the behavior of the U.S. financial and business cycle plots displayed in figure 2. The amplitude of the credit cycle is larger by a factor of five at the business cycle frequencies. The U.K. and U.S. data also predict that the chances of a banking crisis rises when credit grows faster than GDP, according to the Bank of England staff. Their regression analysis indicates a significant relationship between credit-to-GDP growth and distress in the banking sector. The point estimates suggest a rule of thumb that a 1 percentage point increase in the growth rate of credit-to-GDP for one year raises the probability of a banking crisis two years into the future by 0.18 percentage points, on average over the sample period.[28]

Not all empirical work supports the view that financial cycles have far longer duration than business cycles. Work at the International Monetary Fund estimates cycles for 21 OECD countries using data on credit, house prices, and equity prices from 1960–2007, a sample with substantial overlap with the BIS data set.[29] The IMF finds that equity price

[27] Aikman, Haldane, and Nelson (2010, 2014).

[28] This unconditional statement is of limited value for policy because it does not account for the many years during which credit growth did not produce a financial crisis. Similar to models that describe the way in which monetary shocks are transmitted into the real economy, theory is required to understand the mechanisms that create channels for financial shocks to drive fluctuations in real activity. More is required of monetary policy analysis than just to identify "healthy" and "dangerous" credit growth when evaluating the effects of shocks to the stability of financial markets.

[29] Claessens, Kose, and Terrones (2011).

cycles are more frequent than business cycles, while the frequencies of credit and house prices are comparable to that of the business cycle. Financial cycles have downturns that last 5–8 quarters, while upturns in equity prices last 22 quarters, in house prices last 14 quarters, and in credit last 8 quarters. Credit and house price cycles are strongly correlated, but equity cycles are less synchronized with other financial markets. Financial cycles appear to be synchronized across countries: about 75 percent of the time for credit cycles, 70 percent for equity-price cycles, and 59 percent for house-price cycles.[30]

The upshot is that there could be a "financial cycle." Results from the BIS, Bank of England, and the IMF suggest that sharply distinguishing the financial from the business cycle is a difficult and subtle task that likely requires economic theory and models to identify shocks to real, monetary, and financial trends and cycles. The current state of research has yet to establish the exact empirical features of the financial cycle and its temporal stability.[31]

3.3 Theoretical Approaches This section discusses three theoretical frameworks that integrate monetary policy with financial stability. These frameworks should be taken as illustrative of some channels through which interest-rate policy might aid stability in financial markets. Each model employs some subset of the financial frictions discussed in section 2 to generate the possibility of a financial crisis.

Financial transactions inherently take place between economic agents that differ in some important way. One agent may want to consume more than his current income, the other may want to consume less than her current income. One may want to remain liquid, while the other may anticipate that long-term investments are a better choice. These examples show that differences in preferences are important for motivating trading, an idea that economists have long studied. More generally, heterogeneity across economic players is critical to any model that aims to understand financial stability. Each framework below combines some kind of heterogeneity with some set of financial frictions to generate a need for policy to pay attention to financial conditions in the economy.

3.3.1 Illustration 1 The first framework introduces financial frictions in a way that is designed to depart from the canonical new Keynesian model with nominal rigidities only minimally.[32] The economy is populated by two types of households that differ in their personal rates of time preference and their willingness to substitute intertemporally. Households randomly switch between being savers and borrowers, according to an exogenous process. Incomplete risk sharing arises because in some states of the world, designated borrowers would like to save and savers would like to borrow, but the friction prevents these trades from happening. With shocks to the economy, this friction creates variations in the credit spread, the difference between the interest rate that borrowing households pay on loans from

[30] Helbling, Huidrom, Kose, and Otrok (2014), Eickmeier, Gambacorta, and Hofmann (2014) and Eickmeier and Ng (2011) obtain similar results. The second and third papers show that identifying global liquidity supply, demand, and policy shocks matters for estimates of the duration of financial cycles.

[31] As discussed by Cogley and Nason (1995), employing atheoretic statistical decompositions of aggregate data to study business cycles is problematic. Evaluating these reduced-form statistical exercises is difficult because there is no economic model and there is no explicit accounting of the underlying processes generating aggregate data.

[32] Cúrdia and Woodford (2009, 2010).

a financial intermediary and the interest rate that savers receive on their deposits with the intermediary. Credit spread fluctuations distort resource allocations.

The credit spread arises because the marginal utility of income for borrowers generally exceeds that for savers. An increase in the spread means that the marginal utility of borrowers exceeds that of savers by a larger degree and consumption by borrowers is inefficiently low. A larger marginal-utility wedge, which depends on the expected sequence of interest-rate spreads discounted by the probability that agents will not change type, reflects the extent to which credit frictions have increased. To eliminate the inefficiencies that the friction creates, policy wants to achieve complete risk sharing by equating the marginal utilities of income of both types of agents; doing so reduces the model to the canonical new Keynesian model with only a pricing friction.[33]

By retaining the essential features of the basic new Keynesian model, this framework permits exogenous disturbances to the financial sector—intermediaries' markups or interest rate spreads—to be treated symmetrically with other exogenous sources of variation—"demand" or "supply" shocks, such as technology, preferences or wage markups.[34] In fact, in this case optimal monetary policy continues to take the usual form of a target criterion involving only inflation and the output gap, which emerges from simple new Keynesian models.[35] Policy runs off of natural-rate-of-interest and natural-rate-of-output assumptions. Since the evolution of inflation and the output gap depend on financial disturbances, monetary policy must pay attention to financial market developments, particularly credit spreads, but the model does not elevate the status of financial stability to a level that exceeds macroeconomic stability. By emphasizing interest-rate spreads, the model does not ascribe to credit or monetary aggregates any special role as indicators of financial imbalances.

A major limitation of the Cúrdia-Woodford setup is that it leaves no room for the possibility of a financial crisis.[36] Defaults and bankruptcies cannot occur. The policy problem, as in linear new Keynesian models, is one of minimizing fluctuations of variables around their steady state values. Linear methods necessarily require that the shocks be sufficiently small to ensure that the equilibrium remains within a small neighborhood of the unique steady state.

Woodford takes a step toward addressing that limitation by including an *ex post* two-state Markov chain for the credit spread.[37] There is a low or "normal" state and a high or "crisis" state. The probability of moving from the normal to the crisis state rises with

[33]Shi (2012) constructs a counterexample. Although his model is purely real, the lack of risk sharing between borrowers and lenders is tied to exogenous shocks to collateral constraints and endogenously to the price of equity. Complete risk sharing occurs only if the price of capital equals one, so that the replacement cost of capital and the price of new capital are equal. This suggests that the sources and causes of incomplete risk sharing in financial markets involve frictions deeper than just the timing of consumption of different agents.

[34]Importantly, although the model includes credit frictions, it nonetheless maintains the usual assumption in new Keynesian models of complete contingent-claims markets.

[35]For example, in Woodford (2003). When there is endogenous variation in credit spreads, the loss function also includes the marginal utility wedge and the level of real lending.

[36]In fact, Cúrdia and Woodford (2009, p. 43) write, "We have nothing to say about the issue of how monetary policy decisions should take into account financial stability concerns... since we simply abstract from such concerns in our reduced-form model of the financial sector."

[37]Woodford (2012).

the extent of aggregate leverage in the economy, but the Markov chain is introduced into the model subsequent to borrowers and savers making their consumption and labor supply decisions. Leverage is procyclical, rising when output is above its natural rate. When financial intermediaries are highly leveraged, only a small surprise drop in asset values can trigger insolvency or raise the expectation of insolvency.[38] This feature figures prominently in discussions of crises, as many observers argue that financial crises are often set off by relatively small shocks that would cause no serious difficulties if financial intermediaries were not highly leveraged.

Optimal monetary policy now follows a modified target criterion that depends on the output gap, the price level, the implicit price-level target, and what Woodford calls the "marginal crisis risk," which measures the rate at which welfare losses due to a crisis increase with leverage. More precisely, the target criterion involves current inflation, the change in the current output gap and the expected present value of the marginal credit risk over the infinite future. Optimal policy reacts to an increase in crisis risk by contracting monetary policy, which buys a lower probability of crisis with a lower price level and smaller output gap. Woodford's optimal targeting criterion retains the general form that appears in new Keynesian models without financial frictions and at the same time seems to hark back to Foot's definition of financial stability in section 3.1. Foot defines financial stability in a way that suggests there must be substantial deviations of asset prices from fundamentals and aggregate demand from supply to create a non-negligible probability of a crisis.

This approach to thinking about financial crises underscores the importance of understanding what a "crisis" in the Woodford-Cúrdia model is—and is not. High credit spreads reduce welfare and further distort resource allocation. Policy concerns about the wedge between the marginal utilities of borrowers and lenders do create tradeoffs for an optimal policy that also seeks to stabilize inflation and the output gap. To be sure, reduced welfare and additional policy tradeoffs do arise in crises.

Of course, actual financial crises have many more implications for the macro economy than this model captures. Linear analysis prevents the model from producing the wide swings in credit, interest rates, and real activity that empirically are associated with crises. To some extent, both of these models sidestep what many policy makers think of as financial instability—the possibility that in some states of the world, the value of real or financial assets drops dramatically, precipitating fire sales of assets, potential runs on some parts of the financial sector, and outright defaults by borrowers. By construction, this cannot happen in a linear analysis that requires the economy to remain near its steady state.

3.3.2 Illustration 2

The second illustration comes not from a formal economic model, but from several insightful essays about the linkages between financial stability and monetary policy. By arguing that the new Keynesian framework, as commonly employed, abstracts from the economic mechanisms that are essential for understanding the nexus between financial stability and monetary policy, the essays provide a useful segue to the third illustration, which is not at all in the new Keynesian tradition.

These essays criticize the new Keynesian approach to monetary policy for adopting the

[38] In the model, the function mapping leverage into the probability of a crisis is increasing and convex in leverage. Convexity implies that the crisis probability increases at an increasing rate and mimics the consequences of a gradual build up in aggregate indebtedness.

"neo-Wicksellian" appellation, while overlooking a central theme of Wicksell's work—credit creation, capital formation, and the consequences of the interactions of these factors for the macro economy beyond price stability.[39] The authors argue that price stability does not guarantee financial stability. It is even possible that through an excessive focus on achieving inflation targeting, central banks could unwittingly undermine the stability of the financial system.

A credit cycle develops when the market rate of interest—the rate paid by borrowers—falls below the "natural" or "neutral" rate—determined by long-term investments, such as physical capital. Financial frictions or persistent information problems prevent arbitrage from rapidly restoring equality of these interest rates. Economic agents are encouraged to borrow from financial intermediaries at the market rate and that borrowing is channeled into long-term investment that eventually raises the economy's productive capacity and the supply of consumption goods.[40] Financial intermediaries generate credit—or inside money—to support the maturity transformation that converts saving into investment.

But it is also possible that newly created credit will be used, not to buy new capital goods, but instead to finance purchases of *existing* capital goods—real estate, for example—on the belief that the value of the durable goods used to collateralize the loans will rise in value over a long horizon. If many investors coordinate on such a belief and the belief does not become reality, this coordination failure can cause a sharp drop in asset values that produce solvency problems for borrowers. The fundamental danger in excessive credit creation is not, as many commentators claim, that it endangers price stability; the danger comes from distorting intertemporal relative prices, which generate an excess demand for putting off consumption even as resources are allocated to low-return or unproductive investment projects.[41]

Laidler argues that the job of monetary policy extends well beyond ensuring low and stable inflation, to include preventing the excess saving of agents from being used to purchase assets for speculative purposes. Doing so requires the central bank to pay attention to the effects of monetary policy on relative prices and on saving and investment. He warns, however, that because over-investment tends to occur only in specific sectors at any given time, to preempt financial instability, monetary policy may require tools that can target sector-specific problems without undermining the aggregate goal of price stability.[42]

Whether the established inflation-targeting framework can be usefully extended, as Woodford argues, or must be wholly reworked, as Leijonhufvud contends, remains to be deter-

[39] This discussion distills some of the arguments in Leijonhufvud (1981, 2007), Laidler (2009) and Turner (2013). Wicksell (1898), similar to new Keynesian models, focused primarily on the ways in which stable prices emerge when the market interest rate closely tracks the "natural rate of interest." However, Wicksell identified the natural rate of interest with the marginal product of capital. This was the way Wicksell causally linked credit, real activity, and price-level stability. The new Keynesians define the market interest rate as the monetary policy rate in their models. And they define the "natural rate of interest" as the real rate of interest that would prevail in the absence of all frictions, especially frictions on the nominal and financial side of the economy. Broader implications of credit cycles for the macro economy were developed by von Hayek (1931), Sraffa (1932), Fisher (1933) and Minsky (1986).

[40] This leads to a concept that von Hayek (1932) dubbed "forced saving."

[41] New Keynesian DSGE models, like all modern growth models, rely on a transversality condition for equilibrium existence and sometimes uniqueness. Transverality conditions restrict agents from trying to improve their lifetime welfare by postponing consumption indefinitely. See the discussion in Brock (1982).

[42] Targeting specific sectors will have distributional consequences, a topic to which we return in section 5.3.

mined.[43] One point is clear: buildups of financial imbalances and the subsequent crises, if they occur, cannot be adequately modeled as small fluctuations around the economy's steady state growth path. They come from extended departures from steady state followed by sharp deviations in the opposite direction. This basic observation strongly suggests that progress in modeling monetary policy and financial stability will have to come from nonlinear models.

The next illustration picks up on the need for nonlinear modeling and on Laidler's point that successful financial stabilization policies are likely to alter relative prices and, by extension, redistribute wealth across economic agents.

3.3.3 Illustration 3 The final illustration comes from a line of work that is motivated more by a banking and finance perspective than from DSGE models of monetary policy. The models embed a variety of financial frictions, but no nominal rigidities of the kind that are central to new Keynesian models. While monetary versions of these models can highlight particular channels through which monetary policy can dampen financial cycles, they are not yet ready to offer practical policy advice about the tradeoffs between macroeconomic and financial stabilization that actual monetary policy may face. Nonetheless, this work delivers valuable insights into the genesis and dynamics of financial crises.

These models include fairly rich heterogeneity across economic players and, by emphasizing gradually building financial imbalances and excess investment over the cycle, followed by sharp drops in asset prices and fire sales of capital, they recall the earlier work by Wicksell and Fisher.

The first model abstracts from monetary policy and nominal considerations to highlight the roles played by financial frictions in creating a crisis.[44] Two types of agents live in the economy—productive "experts" and less productive "households." Experts also are less patient than households and their physical capital depreciates less rapidly. Households may freely accumulate debt, but experts face borrowing constraints. Experts finance investment projects by issuing risk-free debt that households purchase. The economy is subjected to a common aggregate shock that hits both types of agents and either augments (if positive) or diminishes (if negative) capital accumulation. Although the agents can hedge against idiosyncratic shocks, they cannot hedge against aggregate shocks.

If markets were complete and there were no financial frictions, funds would flow to their most productive uses—all capital would be owned by experts—and the distribution of wealth between experts and households would be irrelevant. Financial frictions mean that the two agent types have different wealth levels so that aggregate shocks affect the two types differently. By extension, policy actions will also affect the two kinds of agents differentially, a theme to which we return in section 5.3 below.

The economy experiences "normal" times and "crisis" periods. In normal times, experts accumulate capital by borrowing from households and the economy approaches its steady state. When experts are well capitalized, they can withstand small exogenous disturbances by liquidating some capital and then gradually rebuilding their capital before the next shock arrives. Well capitalized experts hold all the capital stock and resources are efficiently allocated.

[43] See Woodford (2012) and Leijonhufvud (2007).

[44] We discuss Brunnermeier and Sannikov (2014b), which builds on the mechanisms developed in Kiyotaki and Moore (1997) and Bernanke, Gertler, and Gilchrist (1999).

A sequence of adverse shocks, or an unusually large negative shock, can move the economy substantially away from the normal-times steady state. Far away from the steady state, even a small bad shock can trigger a crisis: it reduces capital and the net worth of experts, which reduces the experts' share of the value of the aggregate capital stock and the price of capital. But the lower price of capital feeds back to reduce the value of aggregate capital, reducing the experts' net worth as a share of the value of capital. This feedback mechanism—called the "liquidity spiral"—amplifies the effects of the initial shock to increase the volatility of asset prices. The more leveraged are the experts at the time of the shock, the larger is the amplification. In the crisis state, capital is misallocated and the extent of misallocation increases the farther the current economic state is from the steady state.[45]

The model captures several features of financial crises:

- Positive and negative shocks can generate dynamics that are not merely mirror images of each other; small shocks affect the economy very differently from large shocks; and a given shock may have very different impacts when investors are highly leveraged. These features arise from nonlinearities in the model.
- A crisis period can persist for an extended period, as experts gradually rebalance their portfolios, which requires them to replenish their net worth enough to weather the next bad shock.
- During a crisis, small shocks get amplified and can trigger drastic movements in asset prices, along with fire sales of capital. In the model, experts can hit up against their borrowing constraints and have no choice but to sell capital to households at fire sale prices. Households buy the capital, speculating that they can resell it in the future at higher prices.
- Although the initial shock was exogenous, the portfolio adjustments that the shock induces from experts raise the level of *endogenous risk* in the economy. The increase in endogenous risk is larger the more highly leveraged are the experts.
- Equilibrium generates a bimodel distribution of the experts' share of aggregate wealth. The two modes of the distribution—where the economy resides most of the time—correspond to normal times, when experts' share of wealth is high, and crisis periods, when experts hold relatively less of the wealth. This implies the kind of tail risk that is foremost in the minds of many policy makers.
- Financial innovations can be destabilizing, even though they may improve risk sharing by helping to hedge against idiosyncratic shocks. New financial tools such as securitization can induce investors to maintain smaller net worth buffers and to take on more leverage. Innovations that might improve efficiency at the *micro* level can increase endogenous risk at the *macro* level, especially when the new financial tool is a response to a regulatory arbitrage.

[45]The model is reminiscent of developments in the U.S. housing market. For about 15 years, house prices didn't decline and Americans accumulated a lot of housing. Beginning in 2006, house prices began to sag and eventually declined enough so that when a bad shock hit the U.S. economy, there were fire sales on mortgage-backed securities. Also see Brunnermeier (2009).

A provocative feature of this model is that endogenous risk does not disappear, and may even rise, as exogenous risk declines toward zero.[46] The most important determinant of the level of endogenous risk is liquidity. When agents see a drop in the price of capital, they believe it is possible that the price will continue to fall, further tightening the financial constraints. When liquidity is scarce, those constraints become more binding, which increases endogenous risk. This implies that liquidity provision by the central bank may help to reduce the level of risk in and the severity of crises.

This feature suggests another element that may be important for understanding crises:

- Subsequent to an adverse shock, agents' expectations may not be anchored on a rapid recovery, but instead on a belief that the economy may remain mired in a low growth state for a prolonged period. In that state, resources are misallocated and welfare is low. This phenomenon cannot arise in linear models with a unique, stable steady state.[47]

This model highlights some important mechanisms at play in the lead-up to financial crises. Because it abstracts from nominal variables and monetary policy, its policy implications focus primarily on macroprudential, rather than monetary, policies. While the model makes the critical, and general, policy point that if regulations to ensure financial stability are too restrictive, they can retard economic growth, to address monetary policies, we need to turn to an extension of the model.

The next papers introduce financial intermediaries and money to produce formal models that get at some of the issues that section 3.3.2 raises.[48] The economy consists of three types of economic agents: two kinds of households—end-borrowers and savers, with the end-borrowers being more productive using capital—and financial intermediaries. Savers can rent capital to end-borrowers, but they can also channel their saving through *nominal* deposits at intermediaries, which use the deposits to extend loans that finance the end-borrowers' investment projects. A monetary authority controls the supply of outside money.

Intermediaries perform three distinct functions: they have the ability to monitor end-borrowers; they make commercial and real estate loans to businesses and households; they transform maturity by issuing short-term money—inside money—to invest in long-term assets. To align incentives correctly, intermediaries are required to take on risk—have "skin in the game"—so that if an adverse shock hits borrowers, the shock also affects the leveraged balance sheets of intermediaries. Such a shock induces intermediaries to reduce loans and limit deposits. This contracts the supply of inside money, raises the value of the imperfect substitute, outside money, and generates deflation. In some circumstances, the sequence of effects can trigger Fisher-like debt-deflation dynamics.

Capital constitutes a risky real asset and the two kinds of money represent safe nominal assets. Money serves as a store of value and, in contrast to the new Keynesian approach

[46] With the financial crisis of 2007 following immediately on the heels of the Great Moderation, this feature might help to capture the lead-up to the 2007 crisis.

[47] The steady state in a stable linear model is a powerful attractor: after a shock moves the economy away from steady state, agents' expectations are anchored on a return to steady state, so capital prices do not need to fall much to induce households to buy capital. Technically, after the shock, the economy jumps to the stable manifold and monotonically returns to steady state.

[48] Brunnermeier and Sannikov (2014a) develop the formal theory and Brunnermeier and Sannikov (2013) provide a nontechnical discussion of the theory, with special emphasis on the policy implications.

where the interest rate transmits monetary policy, policy's impacts are transmitted through capital gains and losses on money holdings and other forms of wealth.

Two interesting extreme cases of this economy provide useful intuition. One extreme finds the intermediation sector severely undercapitalized. Financial intermediaries create no inside money, which makes the supply of money low, the value of money high, and the price level low. Savers can hold only outside money and risky (direct) loans to end-borrowers. Loans are risky because savers—unlike intermediaries—have no special ability to monitor loans and, because intermediaries are not accepting deposits, savers cannot diversify by depositing funds with the intermediaries.

The other extreme has a well-capitalized financial sector with a large risk-bearing capacity. Intermediaries perform their functions well: they reduce financial frictions, take in deposits, which they then use to extend loans to end-borrowers. Intermediaries hold well-diversified and effectively-monitored portfolios and channel funds to high-productivity projects, which improves resource allocations in the economy. In the process, intermediation creates inside money and the money multiplier is high. With the economy flush with money, the value of money is low and the price level is high.

Suppose that this economy is subjected to an adverse aggregate shock that moves the system from the second case toward the first case. As in the real version of this model, the price of capital and the net worth of the financial sector fall, with the decline in price feeding back to amplify the impact of the initial shock; this creates the liquidity spiral. At the same time, financial intermediaries seek to reduce their exposure in order to satisfy the "skin-in-the-game" constraint. Intermediaries issue less inside money at the same time that the most productive agents must sell some of their capital to less-productive households (or savers), further driving down the price of capital. As the money multiplier falls, the supply of inside money drops, which reduces the price level. However, a lower price level raises the real value of the intermediaries' liabilities, further reducing the financial sector's net worth. This triggers a debt-deflation spiral, especially if the drop in the price level generates realized inflation that is persistently lower than inflationary expectations. As a safe store of value, inside and outside money permit holders to hedge against financial risks because in a deflation, the value of money rises. The imperfect substitutability of inside and outside money explains the value of monetary policy for mitigating the debt-deflation spiral. Accommodative monetary policy places a floor underneath asset prices, which creates a space for intermediaries to replenish their balance sheets.

The two amplification mechanisms, which operate through the price of capital and the general price level, conspire to destroy wealth and to redistribute wealth across economic agents. Some wealth in the financial sector is destroyed without benefitting other agents. Wealth is also transferred from holders of capital to holders of money at the same time that higher endogenous risk shifts wealth from productive to less-productive sectors of the economy. Since wealth redistribution lies at the heart of a crisis in this model, it will also play an essential role in the model's policy prescriptions.

The centrality of wealth redistributions from financial crises leads to policy implications that many central bankers may find unsettling. Of course, as a general principle, since economies are populated by agents whose asset holdings and levels of wealth differ across agents, interest rate changes or asset purchases engineered by monetary policy *always have redistributive effects*. The representative-agent models that typically lie at the core of central bank modeling efforts obscure this general principle and allow policy makers to imagine that their adjustments to "the interest rate" have only aggregate impacts on inflation, output and employment. Sargent (2011) argues that one way to distinguish complete from incomplete markets models is that in the latter economies heterogeneous agents obtain different return-risk payoffs from holding the same asset. This feature is missing from most new Keynesian models employed to conduct policy analysis by central banks.

But financial stability concerns *necessarily* arise from environments with heterogenous agents who are differentially affected by *any* action that policy takes.[49] Brunnermeier and Sannikov drive home this point in their 2012 Jackson Hole paper entitled "Redistributive Monetary Policy." They conclude that monetary policy can temper the redistributive effects of the two spirals and help to move the wealth distribution back to its noncrisis state. Those conclusions include:

- By lowering the short-term policy interest rate and raising the term spread, the central bank increases the net worth of intermediaries by affecting both sides of their balance sheets. Intermediaries' funding costs—the interest rate of deposits—fall and the value of their assets—longer-term bonds—rises. With higher net worth, intermediaries can gradually recapitalize and move toward a state where they can perform their basic functions. This raises inside money and reinflates the economy. At the same time, this policy reallocates wealth to the distressed financial sector. It is possible, though, that the policy is not a zero-sum game; by avoiding a financial crisis, all agents in the economy can be better off.

- Forward guidance—a commitment to keep the policy rate low in the future—has different distributional effects than a cut in the policy rate. Whereas a typical interest-rate cut raises the term spread and benefits banks that borrow at short-term interest rates, a credible commitment to maintain low short rates in the future reduces the term spread, which reduces the cost to end-borrowers of loans to finance investment projects. But forward guidance, when it is a credible commitment to keep short rates low for a considerably extended period, also aims to lower the entire yield curve. Pushing down the height of the yield curve aids firms with weak balance sheets by placing a floor under the value of poorly performing assets. Either way, forward guidance has implications for redistributing income and wealth, especially after bad shocks to financial markets. This appears to endow forward guidance with the flavor of a policy aimed at enhancing financial stability.

- Central bank asset purchases or lending programs directly redistribute wealth to the recipients of the policies. By buying risky assets, the central bank takes on upside and downside risk, whereas by lending against collateral, the original asset holders retains the upside risk, while the central bank assumes the downside (tail) risk. To the extent that the borrower goes bankrupt and the collateral is worth less than the loan, the central bank can cover the shortfall by printing outside money. Because the higher money stock raises the price level, the risk shifts from the central bank to nominal

[49]Heterogeneity was a theme of early dynamic general equilibrium models of monetary policy, as in Wallace (1981, 1989) and Sargent and Wallace (1982).

asset holders. Of course, printing money could conflict with the price-stability goals of monetary policy.

- If the central bank implements these policy actions through a well-understood and credible policy rule, private agents' expectations will adjust to accord with that rule, and the policy actions morph into a type of insurance. Like all insurance, a policy rule that redistributes wealth in response to an adverse aggregate shock is likely to carry with it the potential for moral hazard as agents adjust their behavior given their expectations of these policies.[50]

In addition to combining monetary policy with financial stability policy, the work by Brunnermeier and Sannikov shows that fiscal policy has a critical role to play. Their theory makes particular assumptions about fiscal behavior and those assumptions are essential for some of the policy conclusions that they reach. We return in section 5.4.3 to the general topic of fiscal backing.

3.4 A Cautious Assessment The IMF offers a conservative assessment of the state of knowledge about financial stability and monetary policy.[51] Although they see, in principle, a role for monetary policy in preserving financial stability when macroprudential policies are not perfectly implemented, they are circumspect in proposing specific monetary policy actions. Their caution stems from acknowledging that the large number of financial frictions in an economy interact in ways that economists understand only poorly and that the nature of these frictions changes over time. In sum, "It is therefore not yet possible to operationalize financial stability to the same degree as price stability [p. 6]."

4 Monetary Policy and Financial Stability: The 1920s Fed

The reaction of policy makers to the 2007–2009 crisis is not the first time financial stability has been at the top of the policy agenda of central banks. The Federal Reserve was given a financial stability mandate in its founding legislation in 1913, a remit that was not unusual for the era. However, the decentralized structure that has characterized the Federal Reserve since its founding in 1914 was and remains unique among central banks in developed economies. This structure, which consists of 12 district Federal Reserve Banks (FRBs) and the Board of Governors (BofG), has contributed to the evolution of U.S. monetary policy. Despite this organizational difference, the Fed conducts monetary policy in ways with more similarities to than differences with central banks in other developed economies during the early years of the 21st century.

This is not true when comparing the monetary policy of the current Fed with the way the Fed conducted monetary policy during the 1920s. For example, price stability was not part of the Fed's legislative mandate from the Fed's inception until well after the Great Depression. Nonetheless, the 1920s Fed had to confront the issue of whether it could or should be responsible for providing the U.S. economy's nominal anchor along with smoothing shocks to the business cycle. This would represent an important policy conflict for the 1920s

[50] Brunnermeier and Sannikov (2013, pp. 371–373) discuss the interactions of such a monetary policy rule with macroprudential regulations.

[51] Claessens, Habermeier, Nier, Kang, Mancini-Griffoli, and Valencia (2013).

Fed. It had a mandate to provide an elastic currency, but it was not instructed to smooth shocks to the price level and/or the business cycle. The elastic currency mandate, which aimed to smooth shocks to the U.S. banking system, dominated Fed policy by the late 1920s.

As a result, the question of where the U.S. would find its nominal anchor was left open. The Fed's answer to this question would be driven by the theory of the monetary transmission mechanism that dominated Fed thinking during the 1920s. Nonetheless, the global economy left the pre-World War I gold standard in 1914 and never really returned to this policy regime, which meant that price stability was not addressed by the Fed while it pursued a financial stability policy geared to supplying an elastic currency.[52] In contrast, the goal of price (or inflation) stability is ubiquitous for central banks of developed economies in the 21st century. Today, financial stability goals are once again an important factor driving monetary policy actions at the Fed and at other central banks, just as it was for the 1920s Fed. A theme of this section is that the 1920s Fed provides lessons about how conflicts over policy goals can result in poor decision making by a central bank and lead to bad outcomes.

We also review the theory on which the 1920s Fed grounded its monetary policy goals. This theory was closely related to the Fed's views of the sources and causes of financial instability. This discussion frames the way in which the 1920s Fed responded to the shocks that produced the Great Depression. The section ends by asking whether the policies of the 1920s Fed are useful for understanding the role of monetary policy in responding to shocks to financial stability.

4.1 The Fed at Its Founding The Federal Reserve Act of 1913 created a central bank whose duty, among others, was to ensure an elastic currency. This responsibility dovetailed with assigning the Fed the role of lender of last resort (LLR) for the U.S. financial system.[53] Congress did not give the Fed an explicit price stability mandate, though, because the U.S. had committed to a price level target with the Gold Standard Act of 1900.

Provision of an "elastic currency" had several meanings for the early Fed. First, the Fed was charged with supplying liquidity to the financial markets. Besides giving the Fed responsibilities for managing the U.S. payments system, Congress wanted the Fed to supply an elastic currency to smooth seasonal interest rate fluctuations across the 12 Federal Reserve districts, both intratemporally and intertemporally. Before the Fed, there were regional differences in interest rates operating at the seasonal frequencies. The disparity in rates arose from an absence of risk sharing across the U.S. between banks, businesses, farmers, and households.[54] The Fed was created, in part, to complete these missing financial markets

[52] Congress held hearings on whether to pass legislation that would have given the Fed should have a price stability mandate several times in the 1920s. All Fed officials and staff testified against these initiatives except Governor Strong of the FRB-New York in 1928. See Wicker (1966, p. 62), Hetzel (1985) and Meltzer (2003, pp. 182–192).

[53] The U.S. lacked a LLR during the Free Banking Era (1837–1862) and the National Banking Era (1863–1913) by Congressional intent. During these years when the U.S. had no central bank, bank runs were stopped by private sector agents acting in concert with the U.S. Treasury or allowed to run their course; Calomiris and Gorton (1991) and Wicker (2000).

[54] For example, banks on the Great Plains would have an excess demand for liquidity during the autumn when winter wheat is planted while there was an abundance of liquidity in the Midwest during the fall harvest season.

across the U.S. by pooling bank reserves and gold.[55]

The Fed was also given the task of acting as America's LLR for reasons that are well known since Bagehot (1873). The reasons are that with a regulated banking system, there has to be a credible "big player" that the public expects will satisfy its LLR obligations when there is the need to internalize the social costs of a bank run. The Panic of 1907, in which the New York Clearing House (NYCH) banks and J.P. Morgan organized the LLR efforts to end a bank run, contributed to a consensus in the U.S. that ad hoc private sector answers to this problem had to be replaced with an institution backed by a government mandate.[56] Although serving as the LLR was part of the Fed's responsibility for providing an elastic currency, it was a responsibility that was expected to be fulfilled only on occasion.

The Federal Reserve Act of 1913 also anticipated that the Fed would run a hands-off monetary policy. Since the gold standard committed the U.S. to a price level target in which a persistent inflation had to be followed by a deflation, providing a nominal anchor was not deemed to be the Fed's job. Instead, the Fed's founders believed that the gold standard set a permanent monetary policy regime, while financial stability policy required more frequent policy interventions.

Financial stability policy, although including the LLR function and supplying an elastic currency, had another aspect that the founders of the Fed thought was just as important. Under the Federal Reserve Act of 1913, the district FRBs ran discount windows with perfectly elastic demand schedules at the posted discount rate. Given these conditions, private banks expected that the commercial paper and/or bankers' acceptances brought to a discount window would be taken by the FRBs, but discounted at the posted rate.[57] This commitment rested on the assumption that a FRB setting its discount rate above market rates (specifically, the commercial paper rate) would give banks an incentive to minimize the securities brought to the discount window.[58] This incentive would serve as a brake on loan creation by banks, especially on credit that the founders of the Fed viewed was extended for speculative investments.

The founders of the Fed believed that financial stability would be achieved by imposing costs on banks. A bank would generate these costs when it created assets for its balance sheet far in excess of its deposit base—a bank with high leverage. This belief stemmed from the assumption that these assets forced banks to go into debt to the Fed by borrowing reserves. Borrowed reserves were considered a signal of speculative activity in financial

[55] See Wicker (1966, p. 50) and Meltzer (2003, pp. 68–71).

[56] See Wicker (2000), Moen and Tallman (2008, 2014) and Tallman (2012). The NYCH was established as the payments center for banks in New York City in 1853. When bank runs occurred during the Free and National Banking Eras, a NYCH member bank could borrow from the association in the form of a clearing house loan certificate. Although this made a clearing house loan certificate a liability of the borrowing bank, these loan certificates became a kind of currency that was not state contingent because a claim against any member bank that failed would be honored by NYCH. Thus, clearing house loan certificates diversified the risk of a member bank's default across the entire NYCH network. This gave clearing house loan certificates credibility as a means to clear payments within the NYCH, which stymied bank runs.

[57] A bankers' acceptance is a time deposit that helped to finance international trade during the 1920s.

[58] The question of whether the district FRBs had discretion over their discount rates independent of the BofG was settled by a decision of the U.S. Justice Department in December 1919; see Meltzer (2003, p. 102). Still, the FRBs struggled to maintain their independence throughout the 1920s, as Wheelock (1991, pp. 74–80) states.

markets by the Fed, especially after 1920. When a positive news shock induced banks to issue credit for speculation by going into debt to the FRBs, raising the discount rate relative to market rates would impose costs on these banks.[59] Since these loans are not self-liquidating, prices must increase for borrowers to roll over their debts, in the view of many Fed economists in the 1920s. This argument was used as an instruction for the Fed to target the composition of credit and tie changes in credit to fluctuations in production and prices.[60] Forestalling financial speculation, therefore, required the Fed to control both the growth and the composition of credit.

4.2 The 1920s Fed and the Real Bills Doctrine

The notion that a central bank can maintain financial stability by controlling the production and composition of credit aggregates comes under the rubric of the real bills doctrine.[61] The classical real bills doctrine got its name from the idea that when

1. banks issue short-term assets to finance only productive activities,
2. money is created only to support trade in goods and services, and
3. aggregate real demand equals aggregate real supply, which
4. restricts the money stock to vary with movements in aggregate output at current prices.

There is no inflation in asset, goods, or services prices, according to the real bills doctrine, because banks withdraw cash from circulation when short-term productive loans to firms are repaid.[62] The real bills doctrine also predicts that aggregate output and the aggregate price level are strictly exogenous in the short, medium, and long run with respect to changes in credit.

The 1920–1921 recession revealed problems with the policy regime set up by the Federal Reserve Act. Before that recession, which the NBER dates from the expansion's peak in January 1920 to the recession trough of July 1921, the U.S. experienced double-digit inflation in 1918 and 1919. The inflation was attributed to the increase in defense spending and to the collapse of the gold standard during World War I. The Fed responded by raising discount rates to satisfy the financial stability goals of inhibiting gold outflows and warding off perceived speculation in the New York equity markets.[63] A signal of the extent of the contractionary policy was that the FRB-New York's discount rate increased from 4.5 percent at the end of World War I to a maximum of 7.0 percent in April 1921. Since spring 1921 was well past the NBER dated peak of January 1920 and 7.0 percent was the highest level this discount rate reached in the 1920s, the result was a substantial deflation. The wholesale

[59] The Federal Reserve Act of 1913 required member banks to hold reserves against demand deposits. Required reserves were the financial friction anticipated to make the discount rate an effective margin on which to manage policy. Changes in the discount rate were expected to alter the relative price of borrowed to required reserves.

[60] See Yohe (1990), Humphrey (2001) and Meltzer (2003, p. 263).

[61] The real bills doctrine is often associated with the Banking School economists of the nineteenth century; see Meltzer (2003, p. 21). Bagehot (1873) was perhaps the Banking School's most insightful advocate.

[62] Humphrey (1982) and Yohe (1990).

[63] Wicker (1966, pp. 37–45), Wheelock (1991, pp. 14–15) and Meltzer (2003, pp. 90–109).

Price Index (WPI) dropped nearly 20 percent (23 percent) from December 1919 (1920) to December 1920 (1921). Real activity also collapsed as seen in the BofG's industrial production (IP) index, which fell about 18 percent between December 1919 and December 1920 and more than 27 percent from July 1920 to July 1921.

The 1920–1921 recession proved to the Fed that its initial version of the real bills doctrine was insufficient to achieve its mandated policy goals. The BofG responded by building its own version of the real bills doctrine.[64] These modifications to the real bills doctrine relied on measuring

1. real activity, the aggregate price level, and a non-speculative credit aggregate,
2. to generate an estimate of demand at the FRBs' discount windows, which
3. drives open market operations (OMOs) that employ Treasury debt to manage reserves.

Since this policy regime eschewed the passivity of the classical real bills doctrine and because of the experience of the 1920–1921 recession, the BofG needed data on real activity, the aggregate price level, and productive credit issued by banks in order to pursue an activist policy using OMOs. The IP index was constructed by the BofG to gauge real activity in the U.S. economy. The 1920s Fed equated the aggregate price level with the WPI, which reflected the cost of raw materials paid by productive firms. Relative price shocks were assumed to dominate movements in the WPI in the view of the BofG, which implies real shocks dominate fluctuations in the price level. Non-speculative bank credit was identified with loans to commercial, industrial, and agribusiness establishments to finance production and selling of goods to other firms and households.[65]

There were alternative approaches to the modified real bills doctrine within both the Fed and academia during the 1920s. Although conflicts among Fed policy makers dated at least to the recession of 1920–1921, the modified real bills doctrine came to dominate Fed policymaking by the late 1920s.[66] The modified real bills doctrine operated by forecasting the IP index and WPI to estimate the volume of non-speculative bank credit that banks would bring to the FRBs discount windows. Given these estimates, the Fed conducted OMOs to restrict (expand) credit creation by selling (buying) Treasury securities to stabilize financial markets. In this way, OMOs were viewed by the 1920s Fed as a tool to control the asset side of the FRBs' balance sheets. The liability side of these balance sheets, that is the monetary base, was paid next to no attention by the 1920s Fed.

The discovery of OMOs is often pointed to as the Fed's important policy innovation of the 1920s. Although true, the BofG justified OMOs as a way to assess whether banks were engaged in excessive borrowing from the Fed or in productive or speculative lending.

[64]Meltzer (2003, pp. 161–165) refers to the Riefler-Burgess doctrine. W. Randolph Burgess and Winfield Riefler wrote books detailing their views of Fed policy in the 1920s and 1930s; see also Yohe (1990) and Humphrey (2001). Riefler spent most of his career at the BofG and was Chairman Martin's main economic advisor. Burgess worked as an economist at the FRB-New York in the 1920s and became U.S. Ambassador to NATO from 1957 to 1961.

[65]Humphrey (2001).

[66]Wheelock (1991, pp. 68–74), Humphrey (2001) and Meltzer (2003, pp. 192–252). As early as 1922, Governor Strong of the FRB-New York argued that the Fed could not control the ways in which borrowed reserves where used by member banks; see Humphrey (2001, p. 80) and Meltzer (2003, pp. 133–135).

The BofG argued that OMOs were a tool to manage reserves by controlling the growth of credit and/or the composition of credit. In doing so, OMOs replaced the discount rate as the discretionary policy instrument to smooth shocks to the financial stability of the U.S. banking system under the BofG's modified real bills doctrine.[67]

4.3 Fed Policy from 1927 to 1929 These innovations to the real bills doctrine failed to create a policy regime that staved off the Great Depression. By the late 1920s, the Fed judged the state of the economy using the IP index, the WPI, market interest rates, and the composition and growth of bank credit. The first three indicators signaled a recession was imminent. IP growth was −5.6 percent from November 1926, an NBER dated recession trough, to November 1927 and equaled 14.4 percent between these months in 1927 and 1928. However, IP growth fell to 0.4 percent from the latter month to November 1929. Inflation was −2.2 percent, −0.4 percent, and −2.7 percent as measured by the WPI on these year-over-year dates. Market rates report similar information because yields on short- (long-) term Treasury securities were 3.0 percent (3.2 percent) in November 1927, 4.3 percent (3.4 percent) in November 1928, and 3.5 percent (3.3 percent) a year later. In sum, Treasury yields appears to invert by 1928, there was deflation according to the WPI in the late 1920s, and, although there was strong recovery from the 1926–1927 recession, between November 1928 and November 1929 real activity in the U.S. was slowing. From the viewpoint of modern macro and finance economics, the U.S. economy was signaling a recession, rather than the boom that had the Fed worried in the late 1920s.

The Fed became increasingly concerned about the composition and growth of credit produced by the banking system from 1927 to 1929. For example, credit growth was 8 percent in 1927 and 1928.[68] At the same time, Fed policy makers aimed to stem the flow of credit into the New York call money market, which supported the purchase of stocks on margin. Growth in the volume of trading on the New York Stock Exchange (NYSE) leveled off in mid-1928 at about the same time that the Fed raised discount rates to increase the cost to banks of lending into the call money market, but NYSE trading volume resumed growing in autumn 1928. Given the failure of discount rate policy to check activity on the NYSE, that OMOs had lost favor as useful policy tool, and a fear that rising market rates were affecting real activity, the BofG adopted a policy of controlling of what it considered to be speculative activity with a policy of persuading the FRBs to curtail lending to the banking system in early 1929.[69] Resistance by the FRBs during 1929 limited the Fed's capacity to arrive at any decision before the fall of the year.[70] Nonetheless, the BofG's policy of pressuring the FRBs to limit speculative credit creation by the banks had little likelihood of success. Note that the BofG seemed unaware that the balance sheets of the FRBs were shrinking as policy aimed to limit private sector credit activity. On the other hand, this policy is not completely out of the ordinary: when faced with tradeoffs across conflicting objectives, policy makers may have no good choices.

The policy failures of the 1920s Fed can be traced to ideas in economics well known to 21st century macroeconomists. Among these ideas are that *ex post* real rates, which differ

[67] See Wheelock (1991, pp. 12–13), Humphrey (2001, p. 75) and Meltzer (2003, p. 73 and pp. 161–165).
[68] Meltzer (2003, p. 228 and p. 236).
[69] Wicker (1966, pp. 131–137).
[70] See Wicker (1966, pp. 137–143) and Meltzer (2003, pp. 237–245).

from nominal rates, are important for quantifying the state of financial markets and the real economy. These measures are also useful for constructing inflationary expectations and *ex ante* real rates. The 1920s Fed seemed unaware of or unconcerned by these building blocks of modern macro and financial economics.

A coherent story of the monetary transmission mechanism was another gap in the 1920s theory that the Fed used to implement policy. This theory assumes that credit creation is driven by fluctuations in output and prices, but the converse is not true in the short or long run, according to any of the Fed's versions of the real bills doctrine. The Fed's understanding lacked an appreciation for the way the monetary transmission mechanism links together nominal rates, real rates, inflation inflationary expectations, monetary aggregates, and real activity at all horizons. These elements contributed to the bad economics practiced by the 1920s Fed.

The 1920s Fed is an object lesson for economists and policy makers because of the calamity of the Great Depression. This section sought to glean lessons from this episode that teach economists and policy makers to be skeptical about their models and the uses to which these models are put. For example, the real bills doctrine in one form or another was almost never questioned by Fed economists and policy makers during the 1920s. This unquestioned authority of the real bills doctrine is equivalent to holding a dogmatic prior about a model, which Bayesian decision theory teaches leads to poor outcomes. Perhaps the 1920s Fed is instructive that the beliefs one generation of economists and policy makers holds about theories and models may not transfer well to the next.

Another lesson is that a central bank with conflicting objectives will eventually run afoul of those goals. The 1920s Fed tried to balance financial stability against price stability when the nominal anchor of pre-1914 gold standard no longer existed. When these goals clashed in the late 1920s, the Fed acted as if it placed great weight on financial stability and almost no weight on price stability. These policy preferences would have dire consequences because it lead the Fed to dismiss information that the U.S. economy was deflating in the late 1920s. This deflation should have raised concerns that the expectations the Fed was creating about its reaction function. It should have alerted the Fed that there was increasing risk the U.S. economy could enter a deep recession. The Fed's experience suggests that a central bank facing policy tradeoffs would benefit by asking if the problem is its institutional design or legislative mandate, rather than which tools should be engaged to conduct policy.

The tale of Fed policy in the 1920s raises the issue of the map that economists and policy makers use to move from policy goals through economic theory to policy decisions. For example, real bills proponents often claim that their theory avoids price level indeterminacy if fiat currency is convertible, say, into gold and national economies that are price takers in international goods markets. The question of whether the real bills doctrine is consistent with price level determinacy is, perhaps, better understood as asking whether the economy offers a complete set of AD securities.[71] Advocates of real bills-like polices contend that the policies increase financial market efficiency by eliminating interest rate differentials across credit and money markets. This arbitrage depends on borrowers and lenders having access to the same return available to the central bank so that returns on securities with the same

[71] See Sargent (2011). He also points out that a central bank paying interest on reserves can have a similar impact on market completeness as does a policy built on the real bills doctrine.

risk are the same no matter the owner.

For a central bank, the problem is whether these arrangements result in price level indeterminacy. Sargent argues that this aspect of the real bills doctrine illustrates a tradeoff facing policy makers.[72] When policy makers strive for financial stability by improving efficiency, a central bank may lose control of the price level because credit or inside money and outside money become closer substitutes. The Great Depression occurred, in part, because the 1920s Fed failed to understand that this tradeoff required being aware of changes to the assets and liabilities on its balance sheet. By not doing so, the Fed failed to see the policy implications of a large drop in inside money and other monetary aggregates.

5 Reworking Monetary Policy Reports

Sweden's banking and sovereign debt crisis in the 1990s shook Swedish society to its core. Policy makers reacted to the crisis with wholesale reforms that took the economy in a new direction. Sweden adopted a flexible exchange rate regime, undertook fundamental fiscal reforms to create a leaner central government and eventually embrace "The Swedish Fiscal Policy Framework," and granted independence to its central bank, which soon joined the vanguard of inflation-targeting nations. While we are not advocating reforms of that magnitude, we are asking for members of the policy community to be open to raising questions about existing monetary policy frameworks. A serious integration of financial stability concerns with monetary policy making requires shedding or overhauling some theoretical frameworks, communication devices, and designs of institutions that seemed to work well when macroeconomic stabilization was a central bank's sole focus. This section offers advice about the direction that central banks may want to take their *Monetary Policy Reports* in the future, should they decide to give financial stability considerations prominence.

5.1 Financial Indicators. At the moment, there is a strong desire at some central banks to develop "financial indicators," which are statistical measures designed to reflect developing financial stress in the economy. This class of financial indicators is motivated by the strong prior that "...it is possible to measure the build-up of risk of financial crises in real time with fairly good accuracy."[73] As section 3.2 discusses, the BIS advocates using deviations of credit-GDP ratios and house prices from trend as indicators of future financial crises. In other work, those two variables are employed "to capture the information content that financial factors have for the cyclical, potentially highly persistent, variations in output and filter such movements out to obtain estimates of sustainable output."[74] The idea is that financial frictions and the supply of credit play important roles in determining the level of sustainable output. Financial conditions can lead to higher or lower output: rapid economic growth might be fueled by credit creation, but weak growth may be due to "financial headwinds." By including financial information in estimates of relatively low-frequency movements in output, this work aims to arrive at a "finance-neutral" measure of potential output.

[72] Sargent (2011).
[73] Borio (2014, p. 5).
[74] Borio (2014, p. 7).

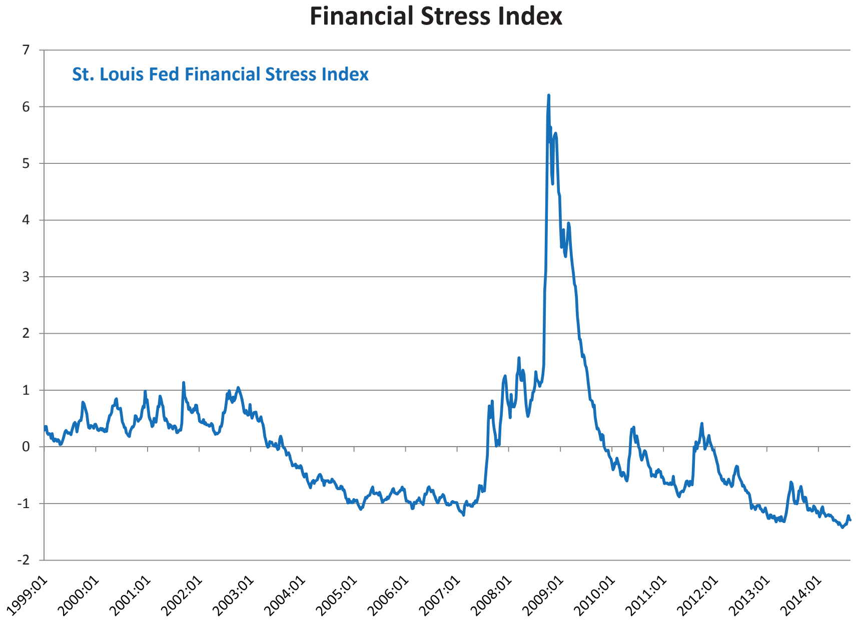


Figure 3: Source: Federal Reserve Bank of St. Louis

Several Federal Reserve Banks (FRBs) have developed indicators of financial stress.[75] These financial indicators are averages of credit spreads, interest rates and other financial variables Figure 3 and 4 plot the weekly stress series produced by the FRB-St. Louis and the FRB-Cleveland. The FRB-St Louis index reaches its maximum in mid-October 2008, but it does not suggest any unusually high financial stress until the middle of 2008. Figure 4 graphs the Cleveland Fed's daily financial stress index. This series shows signs of financial stress in the United States far earlier than does the FRB-St. Louis index in figure 3. The FRB-Cleveland index begins to rise in August and September 2007. Nonetheless, this index appears benign from October 2005 through July 2007, predicting no looming problems.

This pursuit of financial measures that indicate future stress reminds us of past efforts by central banks to reduce complex economic phenomena to simple summaries. Following the "missing money" in the 1970s, monetarists worked hard—but futilely—to find a definition of *some* money supply for which *some* single-equation specification of demand was stable over time.[76] This monumental failure, which coincided with the empirical discovery that much of the variation in the money stock can be explained by current and past interest rates,[77] lies behind the new Keynesian claim that monetary policy and inflation determination can be understood without reference to monetary aggregates. This bring us full circle. But for some policy analysts, the search now concentrates on credit aggregates that indicate future financial conditions, rather than the definition of a money stock that predicts future

[75]FRBs that publish financial stress indicators include Cleveland, Kansas City and St. Louis. European Systemic Risk Board and European Central Bank (2014) publishes a Composite Indicator of Systemic Stress, which is intended to reflect the *current* condition of the euro zone's financial system.

[76]See Goldfeld (1976) and the discussion in Sims (2011).

[77]Sims (1980).

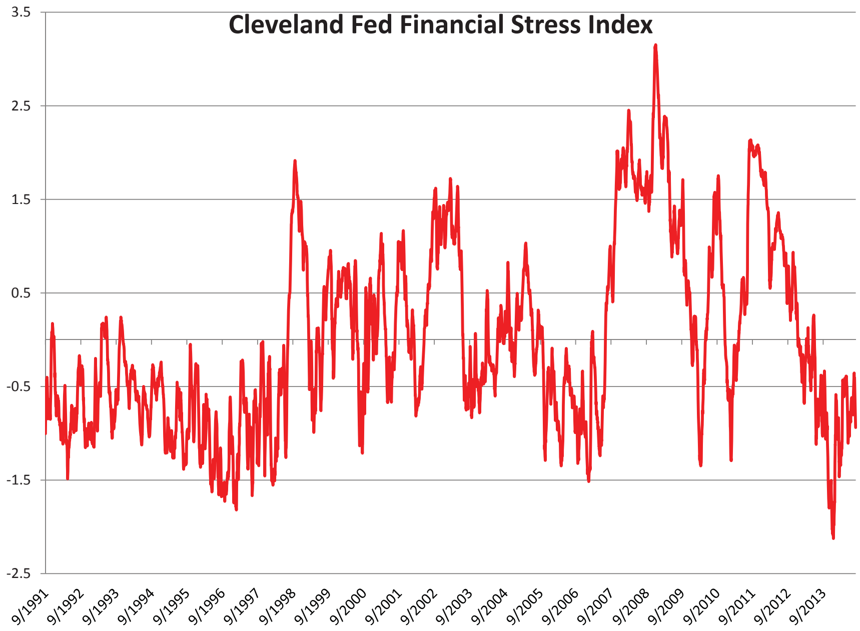


Figure 4: Source: Federal Reserve Bank of Cleveland

macroeconomic conditions.

The financial indicator indices in figures 3 and 4 draw heavily on various interest rates and interest-rate spreads. This emphasis echoes the implication of Cúrdia and Woodford's model.[78] They find that a Taylor rule, augmented to include a negative response of the policy interest rate to credit spreads, can come close to delivering the optimal monetary policy in response to some kinds of shocks. And that analysis identifies credit *spreads*, more so than *aggregates*, as the important variable for policy to monitor.

We are not as sanguine about the prospects of having interest-rate policy react to interest-rate spreads. Figures 5 and 6 reports two distinct sets of interest-rate spreads—for U.S. rates and for European sovereign bond spreads. In both cases, spreads did not move significantly until the financial crisis or the sovereign debt crisis were full-on. Whether the rates did not move until the crisis was underway because of problems with credit-rating agencies or for some other reason, it is hard to see how a policy reaction to these movements in spreads could have forestalled or minimized the costs of either crisis.

An additional reason for caution in taking the finding of Cúrdia and Woodford into actual policy decisions comes from a proposal by Stein.[79] He works from the premise that macroprudential regulations cannot completely eliminate the risks that arise from financial markets, leaving a potential role for interest-rate policies to play. He argues that when risk premia—both term premia on Treasury securities and credit spreads—are low, markets perceive that there is little risk to investments, so they accumulate leverage. As in Brunnermeier and Sannikov's analyses, highly leveraged financial institutions are particularly vulnerable to bad shocks. Stein then builds a case that when risk premia are low, monetary policy

[78] Cúrdia and Woodford (2009).
[79] Stein (2014).

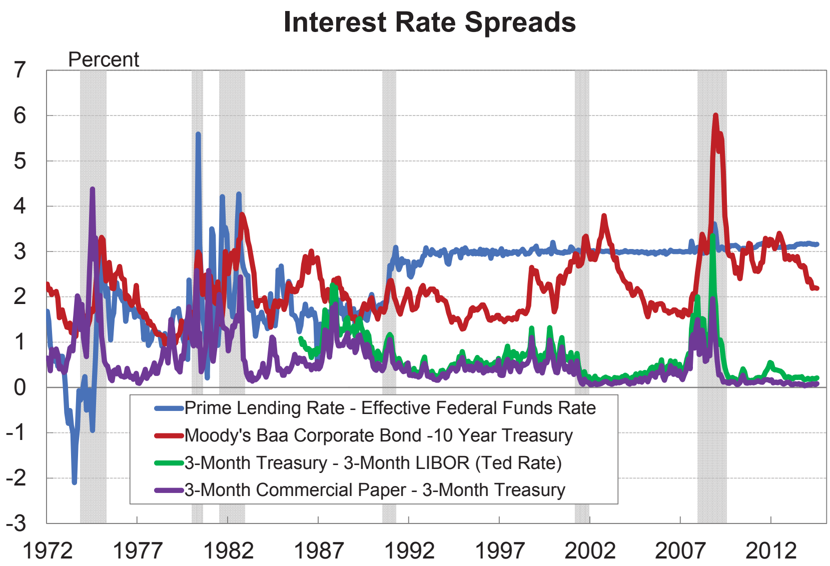


Figure 5: NBER recession dates are shaded areas. Sources: Federal Reserve Board (H.15 and G.13 Releases) and Federal Reserve Bank of St. Louis

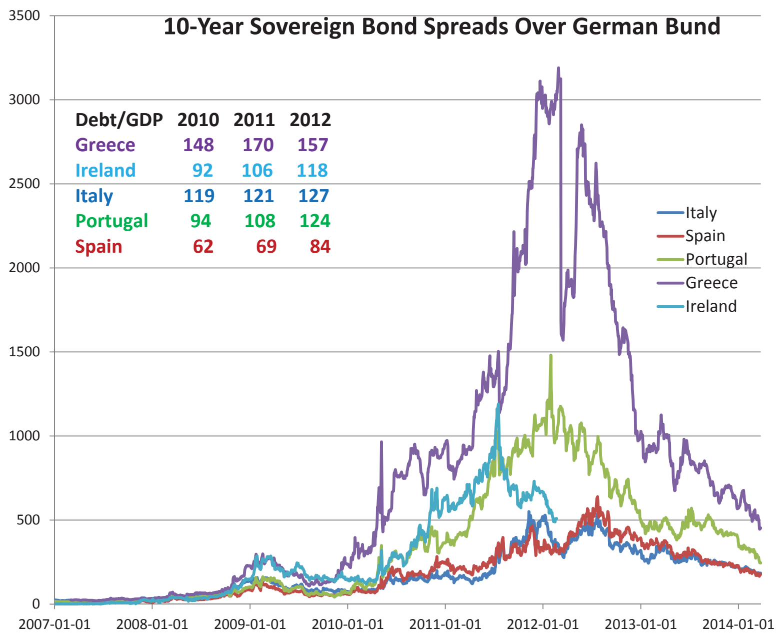


Figure 6: In basis points. Source: Bloomberg

should be tighter in the sense that it is willing to accept a larger shortfall in unemployment from its full-employment level or inflation from its target in exchange for a lower probability of future financial instability. So Stein looks at data like those in figure 5 and argues that the time for monetary policy to tighten would have been between 2002 and 2005, when the TED spread and the 3-month commercial paper-Treasury bill spread were low, or between 2005 and 2007, when the Baa corporate bond-Treasury bond spread was low.[80]

A common theme that runs through discussions of how monetary policy might respond to credit spreads or to above-trend credit growth is that policy makers can distinguish "good" credit from "bad" credit, just as the 1920s Fed claimed it could. This notion is analogous to the new Keynesian idea that there can be "good" economic growth—when output grows in line with potential—and "bad" economic growth—whenever output differs from potential. Good and bad economic growth are determined relative to a welfare criterion from some theoretical model. Whether fluctuations in some financial indicator are a problem to which monetary policy needs to respond, can be addressed only within the context of an economic model. In Woodford's setup, for example, an increase in interest-rate spreads is associated with a larger gap in the marginal utilities of income of the two types of agents. This signals that the financial friction is reducing welfare, so there is a rationale for the central bank to react.

Similar reasoning does not apply to reduced-form analyses of financial indicators that might, for example, focus on forecasting. Some analysts, in what may seem to them are small steps, go from reduced-form models to treating these measures as causal or structural. There are temptations to think that movements in these reduced-form indicators are informative about the underlying state of financial markets on which policy decisions might be based. Although we do not deny that reduced-form financial indicators may contain useful information for monetary policy, without economic theory to interpret this information—the exogenous shocks that caused the indicators to move or how changes in the components of the indicators transmit into the macro economy—we are left with little more than to attach a subjective "good" label to credit that grows at trend and an equally subjective "bad" label to credit that deviates from trend by more than an *ad hoc* trigger.

But what makes credit that grows at trend "good?" Figure 7 plots household debt as a percentage of disposable income for several OECD countries. A given time series can exhibit trend-like behavior that changes over time. For Sweden, for example, is the trend from 2003–2010 "good," while the recent flattening out is "bad" or is the recent trend "good" and growth in the preceding period "bad?" We cannot address these questions without some model that helps us to interpret the time series in terms of economic fundamentals.

Reliance on reduced-form correlations raises another, subtler, issue. Empirical patterns of comovement in credit-GDP ratios and housing prices might seem to suggest that central banks can exploit the information in the financial cycle to adjust policy instruments in order to attenuate the cycle and reduce the probability of subsequent financial crises. But this comovement emerges over time periods in which monetary policy either did or did not react to that information. Implicit in this approach is that monetary policy did not

[80] Although Cúrdia-Woodford and Stein arrive at similar policy prescriptions, they base their recommendations on very different economic environments with very different transmission mechanisms for monetary policy.

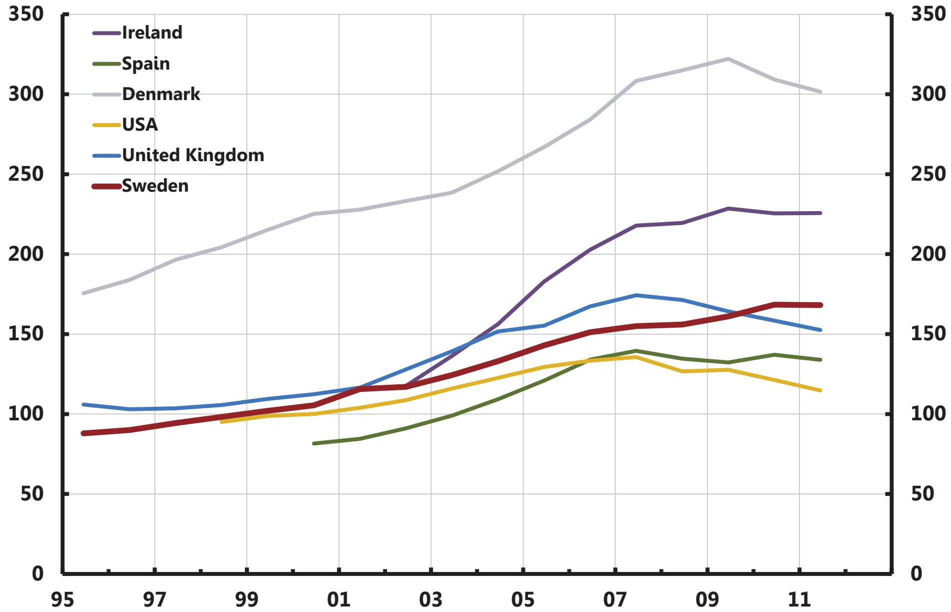


Figure 7: Household debt as a percentage of disposable income. Source: OECD

systematically use the information to set policy rates in the past, but that policy going forward should employ information about the comovement of credit-GDP ratios and housing prices. This approach would have central banks adopt new interest rate rules that entail a systematic response of policy to financial conditions. Those new rules would eventually shift private-sector expectations. Whether those expectational shifts will destabilize the historical patterns of correlation is a question that requires economic theory to answer.

At one level, this is an obvious application of the Lucas critique. The question left unanswered is how to use historical data generated under the current and/or previous policy regime to evaluate a new proposed regime. This topic cuts on an old and largely unresolved debate about policy evaluation.[81] At a minimum, this discussion counsels that the information embedded in financial variables needs to be interpreted cautiously and, ideally, through the lenses that only structural models provide.

5.2 New Keynesian Models and Neo-Natural Rate Policy.

5.2.1 Gaps and Natural Rates. Models that come with the "new Keynesian" label have a real business cycle (RBC) model at their core—under certain parameter settings, the new Keynesian model collapses to that purely real view of the world. The canonical RBC model has two features pertinent to our discussion: (1) complete Arrow-Debreu contingent-claim markets, so financial imbalances and their associated problems cannot arise; (2) competitive equilibria are Pareto optimal, meaning that any fluctuations in real or nominal variables that might arise are optimal and attempts by policy to smooth fluctuations lead to worse outcomes for economic agents. Since RBC theory offers no role for policy to

[81] Lucas (1976), Sargent (1984) and Sims (1982, 1987).

improve real allocations, frictions of various sorts must be superimposed on the core of RBC models to generate interesting policy implications.

One example of a new Keynesian policy model comes from the Riksbank: Ramses II is a large-scale small, open economy model.[82] The frictions superimposed to create Ramses II include: asymmetric information and monitoring costs between borrowers and lenders; search and matching frictions in the labor market; monopolistic competition; sticky price-setting behavior for intermediate, imported and exported goods; investment adjustment costs; capital utilization costs; vacancy posting costs; working capital requirements for firms to meet wage bills; habit formation in consumption. The model includes 23 exogenous shock processes, several of which enter asset pricing equations or optimality conditions as "wedges" that force the equilibrium to deviate still further from the core.

Like all new Keynesian models, Ramses II contains "gaps" that reflect degrees of resource utilization—an hours gap and an output gap. One aim of monetary policy is to try to make those gaps small and stable. The hope is that one can move seamlessly from conventional new Keynesian models, such as the original Ramses,[83] to a model like Ramses II, with financial frictions, without any significant modification to the analytical tools, the understanding of the monetary policy transmission mechanism, or the communication about policy decisions.

Woodford's model of a "crisis" sharply illustrates this approach.[84] In that model, Woodford defines the natural rate of interest in the conventional new Keynesian way: the real interest rate that would prevail in the absence of *all* frictions—nominal and financial. This definition is coherent *in this model* because the financial friction is not embedded in the steady state. Monetary policy can, in principle, unwind the friction completely by using interest-rate policy to drive the credit spread to zero.[85] This draws an exact analogy to the way that interest rate rules can neutralize nominal price rigidities in new Keynesian models.

A problem is that in a world with many interest rates, which reflect the variety of risk, maturity and liquidity characteristics embedded in the underlying assets, and multiple interacting financial frictions, theory does not necessarily define "the natural rate of interest." Within a given model, there might be a unique natural rate, but still many definitions of the natural rate are arbitrary and ad hoc. Only if interest rates are linearly dependent in the steady state will the natural rate be well posed within a new Keynesian DSGE model. Furthermore, if some of the existing financial frictions are impervious to interest-rate policies, so that monetary policy cannot unravel the frictions, economic theory may yield no obvious definition of the natural rate and the role it ought to play in policy analyses and decisions. Since economic theory offers little guidance on the appropriate definition of the natural interest rate at the moment, we question whether a complete markets, frictionless environment is a useful benchmark for monetary policy. The question is whether the principles of monetary policy can be usefully grounded on concepts that lack a generic theory, are unobservable in actual data, and are unattainable for policy makers in practice.

Defining natural rates as arising in the absence of financial frictions is logically different from defining those rates as occurring without nominal rigidities. There is reason to believe

[82] Adolfson, Laséen, Christiano, Trabandt, and Walentin (2013).

[83] Adolfson, Laséen, Lindé, and Villani (2007).

[84] Woodford (2012).

[85] This is not to say that completely unwinding the financial friction is the optimal policy because the central bank must also be concerned with the distortions created by sticky prices.

that "in the long run" all wages and prices will adjust completely. This is not true of financial frictions. We see no reasons to believe that monitoring costs, borrowing constraints, information discrepancies, or incomplete risk sharing will disappear merely through the passage of sufficient time. And if those frictions—or other yet-to-be-discovered frictions—are likely to persist indefinitely, then aiming policy toward a frictionless ideal may have unintended negative consequences for financial and macroeconomic stability. This is especially true for economic welfare because of the impact of financial frictions on the ability of economic agents to share risk. Since financial frictions can change over time, imperfections in risk sharing will as well. Recent episodes of low interest rates have raised questions of whether this policy regime induces greater financial innovations, possibly through the risk-taking channel that section 2.1 discusses. Since these innovations can alter risk-sharing arrangements in actual economies, which induce nonstationarities in data, DSGE modeling faces substantial challenges. Our view is not to abandon this approach, but instead to recognize that DSGE models need to be revised along several dimensions to be useful to policy makers charged with a financial stability brief. One straightforward example would be for DSGE models to integrate financial frictions with monetary policy to motivate that inside and outside are imperfect substitutes, as Brunnermeier and Sannikov suggest.

This reasoning extends. New Keynesian models imply a tight connection between the natural rate of interest and the natural, or efficient, level of output. Ambiguity about how to define the natural interest rate flows directly into ambiguity about how to define potential output or full employment and their associated gap concepts. Purely statistical methods exacerbate problems of gap measurement. Central bank economists know these difficulties well because they employ statistical and economic models to measure output gaps, resource utilization, and the natural rate of unemployment. The search for such measures is plagued by estimation and conceptual problems. Estimates of, for example, the natural rate of unemployment are extraordinarily imprecise, to the point that their value for monetary policy can be questioned.[86] Most central banks grapple with this imprecision by examining several gap measures obtained using different empirical techniques in the hope that a robust story will emerge that can guide monetary policy to its mandated goals. But if no robust story emerges, central bank communications with the public can be hampered.

There is also a chasm between empirical and theoretical notions of "potential" GDP or "natural" employment rate. Is it the trend from a Hodrick and Prescott (1997) filter or a latent factor or a production function at full employment or the flexible-price equilibrium from a DSGE model? Each method delivers its own concept of the output gap or cyclical employment rate, along with different estimates of these objects. Part of the problem is that the statistical measures have no obvious theoretical counterparts, so it is only the apparent empirical regularities that connect statistical measures to the objects that are meaningful to policy makers.

Ambiguity about measures of resource utilization or the financial indicators discussed in section 5.1 and the role that the various measures should play in monetary policy choices are specific examples of the fact that policy makers never know the true model of the economy.

[86] Staiger, Stock, and Watson (1997a,b) estimate that the 95 percent confidence intervals around the natural rate estimates can vary from about 2 to 5 percentage points, depending on the data series used. These ranges imply dramatically different tradeoffs between inflation and unemployment.

That is, "all models are false." We believe that when it comes to the ways that monetary policy interacts with financial stability, the level of model uncertainty is unusually high. Rather than continue to expend time and energy on the task of robustifying gap stories, central banks could conduct an alternative robustness exercise that explicitly acknowledges the prevailing level of model uncertainty.[87] If financial stability is an important priority, policy analysis can first focus on appraising the effects of shocks that have the potential to generate financial crises over the relevant horizon. Next, policy makers can seek to understand the impact of their decision rules when their favored model is misspecified. Their favored model might be a particular DSGE model or an identified VAR or a model that integrates monetary policy with a detailed financial sector. The goal is to assess how robust the policy makers' preferred model is relative to all the other models in use at the central bank.[88]

5.2.2 Monetary transmission mechanism. The monetary transmission mechanism in basic new Keynesian models is straightforward: when prices are sticky, the central bank achieves some control over the short-term real interest rate; through variation in that rate, monetary policy can affect intertemporal consumption and labor supply choices. With the forward-looking nature of optimal behavior, both the current *ex-ante* real rate and all expected future values of that rate affect household and firm choices. Richer models generate more elaborate responses to policy, but the effect of monetary policy on the path of the real interest rate remains the linchpin in policy impacts. With the addition of certain kinds of financial frictions, this interest-rate channel may be complemented by the credit channel.[89] This expanded transmission mechanism amplifies monetary policy impacts somewhat and it permits the model to predict how policy actions will affect credit creation and capital accumulation in the economy.

In models outside the new Keynesian tradition, the presence of credit frictions can easily generate more than one steady state equilibrium, yielding ambiguous implications for monetary policy.[90] Borrowers make investments with a random return and can finance investment either with external—borrowed—funds or with internal financing. While borrowers know the return on their own projects, lenders must incur a cost to verify the return. Internal financing makes the costly state verification problem less severe. The central bank controls the real interest rate and borrowers are forced to pay that rate on funds that they acquire. There are typically two ways this can happen. First, the capital stock and output can be low, making both the marginal product of capital and the interest rate on loans to investors high. Because this amplifies the costly state verification problem, the return on loans will be low. In this case, there will be little internal financing. Alternatively, the steady state capital stock and output can be high, with a low marginal product of capital, but a heavy reliance on internal financing. This reduces the costly state verification problem and leads to more efficient financial markets.

The two steady state equilibria carry diametric implications for monetary policy. In the low-capital steady state, a monetary expansion—increase in the growth rate of outside money—raises the capital stock, output and credit creation. These effects are exactly oppo-

[87] See Hansen and Sargent (2007) or Geweke (2010) for different attacks on this fundamental issue.
[88] See Brock, Durlauf, Nason, and Rondina (2007).
[89] This is a key distinction between Ramses I and Ramses II.
[90] This discussion follows Boyd and Smith (1998).

site in the high-capital steady state. To the extent that this kind of indeterminacy, and its associated ambiguity about the monetary transmission mechanism, is intrinsic to environments with financial market imperfections, it creates uncertainty about how a central bank concerned with financial stability should expect its actions to feed into the macro economy. No such uncertainty appears in typical new Keynesian models, which in most cases are designed to deliver only one equilibrium.

Missing from the two new Keynesian transmission channels are the wealth effects—both changes in aggregate wealth and redistributions of wealth—that monetary policy induce. These wealth changes arise from the impacts of the policy interest rate on the entire spectrum of interest rates and asset prices—term, risk and liquidity structures—as Brunnermeier and Sannikov emphasize.[91] To the extent that assets and liabilities in the economy are denominated in nominal terms, policy effects on the price level trigger additional wealth effects by revaluing both sides of the balance sheets of financial institutions, households, and firms.

Of course, the term "the transmission mechanism" is a bit of a misnomer. The three channels mentioned—interest rate, credit and wealth—are not invariant across time and states of the economy. During a crisis, when some financial markets are either shut down or not functioning efficiently, transmission that relies on interest rates may not be operating at all. This is analogous to having the policy rate hit the zero lower bound, where monetary policy turns to asset purchases to continue to influence the economy. Or when the economy is operating far from steady state, as in Brunnermeier and Sannikov's models, a given change in the policy rate may have dramatically different impacts than the same change has in normal times. How large wealth effects are will depend on that aggregate level of wealth, as well as the composition. Finally, on-going financial innovation will also affect how monetary policy is transmitted: growth in shadow banking relative to commercial banking makes the conventional channels of policy, which operate through bank reserves, only a small part of the story about policy impacts.

As remarkable as it sounds, our understanding of the broadly defined transmission mechanism of monetary policy remains quite limited. By stressing the interest-rate channel to the exclusion of other ways that monetary policy affects portfolio choices and risk taking, the new Keynesian research program has provided few insights into the broader effects of policy on financial markets. The state of knowledge about the transmission mechanism of monetary policy exemplifies the "uncertainty outside and inside economic models" that Hansen explores in his Nobel Lecture.[92] His concluding remarks contain useful advice for central bankers: "Uncertainty, generally conceived, is not often embraced in public discussions of economic policy. When uncertainty includes incomplete knowledge of dynamic responses, we might well be led away from arguments that 'complicated problems require complicated solutions.' When complexity, even formulated probabilistically, is not fully understood by policy makers, perhaps it is the simpler policies that are more prudent [p. 41]."

5.2.3 Modeling issues. Central banks that wish to integrate financial stability with more conventional macroeconomic stabilization policy confront a fundamental modeling issue. Ramses II is a typical illustrative case. That is a new Keynesian model extended to

[91] These capital gains and losses from monetary policy are central to Tobin's (1969) and Brunner and Meltzer's (1972) views of monetary policy.

[92] Hansen (2014).

include some financial frictions. To solve, calibrate and estimate the model, it is linearized around the unique deterministic steady state. For the sake of clarity, let's suppose that this DSGE model is used mechanically to produce the forecasts that the Sveriges Riksbank *Monetary Policy Report* presents.[93]

This linear model exhibits strong mean reversion so that forecasts inevitably converge back to the steady state in which output is at potential and inflation is on target. Ramses, therefore, provides no indication that there are troubling financial imbalances—in the sense that they are preventing the economy from behaving over the forecast horizon exactly as it usually behaves. Nonetheless, the July 2013 *Monetary Policy Report* proposes a way "how monetary policy can take household indebtedness into account within the framework of flexible inflation targeting."[94] The proposal adopts a longer-term perspective beyond the usual three-year forecast horizon. It suggests that out past the forecast horizon the economy will be in one of two possible situations: either in the steady state or in a crisis state with rapidly rising unemployment. It further assumes that a lower policy interest rate raises the likelihood that the crisis state will be realized.

The difficulty with this proposal as a communication device to explain to the public the Riksbank's concerns about financial stability are apparent. The forecasts out three years look perfectly benign. A lower repo rate would, as always, simply allow inflation and resource utilization to rise to target more rapidly. The looming financial crisis is an extra-model feature, a *deus ex machina* in reverse, that takes a benign outlook and turns it into something sinister.

The logic of the new Keynesian structure of Ramses makes the problems with this proposal clear. In simplified form, two central equations in Ramses, the consumption Euler equation and the Phillips curve, imply that

$$\pi_t = E_t \sum_{j=0}^{\infty} \beta^j (\kappa x_{t+j} + v_{t+j})$$

$$x_t = -\sigma^{-1} E_t \sum_{j=0}^{\infty} (i_{t+j} - \pi_{t+j+1} - r^n_{t+j})$$

The first equation says that current inflation depends on the expected present value of all future output gaps and markup shocks and the second connects the current output gap to the sum of the gap between all expected future real interest rates and the natural real rate of interest. In the baseline three-year forecast, both the output gap and inflation's deviations from target are zero after three years.

If a lower policy rate raises the probability of a financial crisis and substantially lower resource utilization beyond the forecast horizon, then it must reduce expected future output gaps—creating negative values of x after three years—which then must cause current inflation to fall farther from target. A lower path for inflation would, without a further reduction in the policy rate, tend to increase the interest-rate gap, reducing the current output gap.[95]

[93]Without loss of generality, we ignore the judgement and the other models that are vital to any central bank's forecasting process. This assumption allows us to focus on the issues of communicating to the public.

[94]Sveriges Riksbank (2013, pp. 42–48).

[95]We assume that the crisis is not associated with markup shocks and that, by definition, it cannot affect the natural real interest rate.

A reader of the *Monetary Policy Report* can be forgiven for being confused by this communication. The model that produced the forecasts of inflation tending to target and resource utilization returning to normal after three years would not produce those forecasts if there were a nonnegligible probability of a crisis beyond the forecast horizon. A higher probability will generally shift down the expected present value of output gaps. Two possibilities suggest themselves: either there is a tangible threat of a crisis and the economy will not return to steady state within three years or the economy really will return to steady state because there is not a worrisome probability of a crisis that raises unemployment significantly in the out years.

Essentially, the problems with the proposal in the *Monetary Policy Report* stem from using two disjoint models to try to tell a single, coherent story. The first model is a fully articulated DSGE model, which is used to produce the short-term forecast, and the second is an intuitive, empirically driven crisis model. Because the models are disjoint, there is no feedback from the crisis to the forecasting model.

5.2.4 Nonlinearities. Financial crises are inherently nonlinear events. The economy and financial sector gradually move to a state where a relatively uneventful disturbance, which in other states would raise no special policy concerns, can trigger a cascade of reactions that in their totality constitute a crisis. Along the path to a crisis-susceptible state, the impacts of both exogenous shocks and monetary policy actions will change with the ever-evolving economic state. Linear analysis—whether it is econometric or a linearized DSGE model—averages across these state-dependent responses to shocks. Because on average the economy is not in crisis or likely imminently to fall into crisis, linear methods cannot describe crisis dynamics.

5.3 Distributional Impacts. Thoughtful central bankers are aware that when the policy rate is changed income and wealth are redistributed. This redistribution benefits some agents and harms others. This fundamental point is a prediction of some earlier general equilibrium monetary models in which a financial friction arises because contracts cannot be written across overlapping generations. These models emphasize that central bank OMOs affect interest rates "only if policy is conducted in a way which is intentionally redistributive."[96] One appeal of inflation targeting is that this policy seems to allow central bankers to avoid confronting the distributional impacts of policy by focusing attention on aggregates—the inflation rate and total economic activity. Moreover, widespread use of representative agent models to study inflation targeting has swept under the rug any potential distributional effects of monetary policy.

Policy actions designed to combat excessive credit growth, in contrast, aim directly at reallocating resources in an economy. When the goal is to dampen fluctuations in response to shocks to financial stability, a central bank no longer simply "removes the punch bowl" from the economy's party. The central bank is explicit in its intent to deny the "kool-aid" only

[96] Smith (1995, p. 78). The theme of redistributive monetary policy impacts ran through a number of overlapping generations monetary models, which are necessarily inhabited by heterogeneous agents, in which Modigliani-Miller irrelevance propositions can hold. Wallace (1981) is the key reference, but Boyd and Smith (1998) explores the issue in an environment with credit frictions, anticipating much of the recent theoretical work on financial crises.

to those deemed overly indulgent at the party. In this case, policy aims to thwart the plans of those perceived to be accumulating inordinate stocks of debt or becoming unreasonably leveraged. The question is, as it was for the 1920s Fed, whether a central bank can control the composition or uses of a growing credit aggregate. If monetary policy is tasked with managing the stability of financial markets and a central bank chooses its policy rate to achieve this goal, new approaches to central bank communication are necessary to make clear to the public the motivations, transmission mechanisms, and objectives of this redistributive policy policy.

Redistributive aspects of monetary policy become of central importance in environments like the ones that Brunnermeier and Sannikov study, where monetary policys effects come from redistributing wealth.[97] During the buildup toward a financial crisis, the amplification effects that section 3.3.3 describes, shift wealth from one group of agents to another. Monetary policy's task, according to Brunnermeier and Sannikovs prescription, is to intervene to affect asset prices and income flows in order to reverse the redistributions caused by the amplification effects. Since moral hazard is a natural byproduct of the monetary policy actions, the design of the redistributional policies is essential.

Because monetary policy is transmitted entirely through wealth effects in Brunnermeier and Sannikov's models, the redistributive implications of policy actions take center stage. But it is clear that during the financial crisis many lender-of-last-resort actions and unconventional policies that central banks pursued created the perception among the public that monetary policy disproportionately benefitted some parties at the expense of others.[98] This perception raises two issues. First, how should a central bank conduct financial stabilization policy in light of the constraints that political economy dynamics impose on that conduct? Second, how would the imposition of political economy constraints alter the policy prescriptions from an environment like Brunnermeier and Sannikov's theory?

A central bank policy to use the policy rate to maintain financial stability by altering private allocations can have unintended consequences. A policy rate is just the relative price of a private short-term security to the central bank's liability. A central bank can only imperfectly affect short-term activity in financial markets by changing its policy rate. In no way does a central bank exert sufficient control on private agents to guide which assets and securities land on their balance sheets. In attempting to inhibit growth in one part of the financial market, however, a central bank can distort risk-sharing arrangements elsewhere in the economy by altering the relative prices of large classes of securities. For instance, private agents respond to a policy rate that is held low for an extended period by altering the securities on the asset and liability sides of their balance sheets. These changes in financial balance sheets can induce a greater risk of crisis, rather than alleviate the imbalances in the financial markets. The message is *not* that a central bank should not engage its policy rate for the purposes of financial stability, but that a central bank needs to understand the general equilibrium consequences of this course of action.

When monetary policy actions are geared toward repairing risk sharing arrangements, the communications problem is deepened. Individual agents often do not regard their actions

[97] Brunnermeier and Sannikov (2013).

[98] The Occupy Movement, which organized protests in dozens of countries, partly grew from this perception. Occupy Wall St., with the motto "We kick the ass of the ruling class," was spawned specifically out of frustration with the bailouts of financial institutions in the United States.

as detrimental to the macro economy. They see themselves as responding to the incentives presented to them. This places a central bank in a difficult position as it tries to explain to specific members, sectors, or segments of the public that their actions are increasingly putting the aggregate economy at risk for a financial crisis. Given the dearth of knowledge about which financial frictions matter most in an economy, caution maybe the most advice the economist-advisor can offer.

5.4 Conflicts Between Financial Stability and Monetary Policies.

5.4.1 A BIS view.

A paper by the BIS paints an optimistic picture of how financial stability and monetary policies can coexist.[99] That view takes as a premise that financial cycles are longer than business cycles, so monetary policy must maintain a long-term perspective on price stability in order to avoid conflict with financial stability objectives. As Caruana and Cohen state,

> "This longer-term perspective, in fact, relieves some of the possible tensions between monetary policy and macroprudential decisions. Imagine a situation in which a leveraged asset price boom occurs when inflationary pressures are falling. The apparent tension between a desire to cut interest rates and to tighten macroprudential standards disappears once a longer-run perspective on price stability is taken. Since financial crises can generate huge disinflationary pressure, a tightening of monetary policy will promote longer-run price stability.
>
> "Moreover, if macroprudential considerations do call for a different calibration of a policy instrument (such as the policy rate) than would be derived solely from monetary policy considerations, the size of this deviation need not be large. As noted, the financial cycle tends to have a longer duration than the business cycle. For example, this may mean that, if a build-up of credit pressures calls for macroprudential policy measures, the appropriate response could be to 'lean against the wind' through a small but persistent increase in the policy rate as long as these pressures continue. This is unlikely to impose much of a burden on price stability which would continue to be the main driver of movements in the policy rate.' Caruana and Cohen (2014, p. 20).

In the absence of a model that predicts "a small but persistent increase in the policy rate" will moderate a buildup of credit without harming monetary policy's macroeconomic objectives, we have difficulties assessing these claims. Nonetheless, an interpretation of this view of monetary policy is that the welfare losses associated with lower inflation and output are outweighed by the gains from preventing a crisis.

A deeper concern is that this approach contends that the tradeoffs between financial stability and macroeconomic stability are tilted in favor of the latter. It is unclear to us whether such assertions are defensible. Surely the nature of the source of the credit boom matters for this tradeoff. It must also matter what asset or activity the credit is financing—is it productive or speculative investment projects? To put this differently, we argue that examining both sides of the balance sheets of the financial sector and the central bank is

[99] Caruana and Cohen (2014).

important for studying the tradeoffs between financial stability and macroeconomic stability. Many financial stability policies operate largely on the asset side of the central bank's balance sheet, whereas monetary policy actions operate primarily on the liabilities side.[100] But, of course, a balance sheet is a *balance sheet*, so operations on one side must have implications for the other side. Without specifying what those implications are, it is difficult to evaluate the tradeoffs that the previous quotation claims.

5.4.2 "Too much" stability. "Too much" macroeconomic stability can create perverse incentives for financial market participants and lead to higher systemic risk in the economy. Brunnermeier and Sannikov show that even as exogenous risk becomes very small, endogenous risk does not disappear, and might even rise. Exogenous risk comes from the variance of fundamental shocks to technologies, preferences, and potentially policy. Endogenous risk stems from the the portfolio and investment decisions of households, firms, and financial institutions. When exogenous risk is low, as it was during the Great Moderation, investors have an incentive to leverage up because it is relatively cheap to do so and financing is easy to obtain. When investors accumulate capital by financing it with debt, the level of endogenous risk increases. If the market is illiquid, so that capital can be sold only at a significantly lower price, the constraints on the financial sector become tighter, further increasing endogenous risk and moving aggregate net worth farther from the steady state.

Although in their formal model, Brunnermeier and Sannikov's notion of exogenous risk is, literally, exogenous, their results raise the question of whether a similar phenomenon could arise if volatility were low because of deliberate efforts by monetary policy to smooth inflation and real activity. If so, then successful macroeconomic stabilization might encourage the buildup of leverage and plant the seeds for subsequent financial instability.

This outcome illustrates two points touched on above. First, as section 5.2.3 argues, it is essential that short-term forecasts of inflation and resource utilization be integrated with longer-term concerns about financial imbalances. When those two analyses are conducted in disjoint models, there is no way to make clear to policy makers how their achievement of short-run goals may entail tradeoffs that are realized only over longer horizons. Second, this idea is an example of a potential conflict between traditional monetary policy objectives and financial stability objectives.

Brunnermeier and Sannikov is but one example where enhanced macroeconomic stability may lead to higher systemic risk. It is too early to know whether this phenomenon is sufficiently general or large enough to be a central concern to monetary policy makers. But the phenomenon is unsettling enough, and clashes strongly enough with conventional monetary policy wisdom, that it deserves further analysis and scrutiny.

5.4.3 "Walling off" monetary policy and policy interactions. There is a widespread tendency for policy makers to try to separate monetary, fiscal and financial policies by creating three distinct policy institutions, each assigned to focus on its own objective—price and real economic stability, government debt sustainability, or financial stability. This tendency stems partly from a belief that the spillovers among policies are

[100]Basic new Keynesian models are an exception to this general principle. By exploiting "cashless" economies, those models envision monetary policy as consisting of a sequence of repurchase agreements that move the policy interest rate as desired, with no impact on the central bank's liabilities.

small. Real-world developments since 2007 belie that belief: financial instability has had profound impacts on inflation and economic activity and fiscal positions in many countries; fiscal stresses have forced the hands of monetary authorities—particularly the ECB—and fiscal austerity measures have prolonged the impacts of the recession; efforts to pull economies out of recession have prompted central banks to purchase risky private assets, an action that amounts to fiscal policy. Although the urge to treat these policies independently is understandable from a political viewpoint, economic reality and economic theory teach that the conditions under which independence is possible are quite severe and unlikely to hold in actual economies. We probably cannot avoid thinking hard about redesigning the institutions responsible for monetary, financial stability, and fiscal policy. At least part of this redesign has to respond to the fact that are going to be moments in time when the policy goals and the actions of these institutions overlap.

Up to this point, we have refrained from bringing fiscal policy into the picture. But any discussion of the monetary-financial stability nexus is incomplete without explicit consideration of the role of fiscal policy. This threesome of macro policies must be internally consistent for any one of the policies to operate effectively.[101] Any effort to "wall off" monetary policy with an independent central bank that is given a specific remit will place restrictions on the behavior of fiscal and financial stability policies. Exactly what those restrictions are and what the restrictions might imply for the design of policy institutions is only beginning to be researched.

Early work on monetary and fiscal policy interactions, which did not bring in financial stability considerations, established that monetary policy can control inflation—"monetary dominance"—only if fiscal behavior is compatible.[102] Compatibility requires that increases in government debt be backed by higher future primary budget surpluses. When such fiscal backing is not assured—"fiscal dominance"—then monetary policy actions can have perverse effects on inflation and real economic activity. Brunnermeier and Sannikov have added to the macro policy lexicon the term "financial dominance," which arises when the financial sector is unwilling or unable to absorb losses or raise equity and failures of financial institutions may threaten contagion if the institutions are not bailed out. In this case, the policy question is which policy institution in a democracy is best equipped to respond to the financial crisis. Or perhaps the best *ex ante* response to a crisis may be to redesign policy institutions to act in concert in certain states of the world.

Interactions among the three policy can be illustrated with two examples: sovereign-debt issues and fiscal backing for financial stability operations. The euro zone has become the poster child for how a financial crisis can evolve into a sovereign-debt crisis.[103] A combination of a serious recession, which raised government deficits both because of cyclical declines in revenues and increases in spending and because of fiscal stimulus packages, and banking crises in certain countries, quickly drove some European government debt-GDP ratios to unsustainable levels. With monetary policy determined centrally by the ECB, countries could not rely on inflation to revalue their debt. At the same time, the monetary union

[101]Several economist have raised the need to develop a framework for understanding monetary, fiscal and financial stability policies, including Sims (2012, 2013), Brunnermeier and Sannikov (2013) and Leeper (2014).

[102]Sargent and Wallace (1981), Leeper (1991) or Woodford (1995).

[103]This is not an uncommon sequence of events, as the Swedish experience in the 1990s attests.

insisted that exits from the unions would not be permitted. It was only through extraordinary efforts by European and international policy institutions that the union held together with only relatively small outright defaults on sovereign debt.

Despite the respite following the ECB's announcement of Outright Monetary Transactions, current and prospective inflation developments in the euro zone could portend further difficulties. Already euro inflation rates are well below the ECB's target of "below, but close to, 2 percent," generating capital gains to holders of sovereign bonds—including the ECB—that were priced under the expectation that inflation would be near target. Should the euro area experience deflation, as some analysts now worry, the real value of outstanding government liabilities will rise, which may trigger markets to grow concerned once again about fiscal sustainability in some countries.[104]

By extension, when the central bank is assured fiscal backing, so the treasury automatically recapitalizes the bank should balance sheet troubles arise, the central bank is freed to pursue its objectives.[105] Fiscal backing of the central bank has become all the more pressing now that central banks hold far riskier assets than they have in the past. Although the central bank can always recapitalize itself by creating reserves, massive reserve creation may jeopardize the bank's inflation goals. Paying interest on reserves can induce banks to hold them, rather than lend them out, but the interest payments must be financed. This brings us full circle to the need for assured fiscal backing on the central bank.

For countries like Sweden, fiscal backing of the Riksbank may not be a concern. But it has become a critical issue in the euro area. To date, the ECB's promise to conduct unlimited purchases of sovereign debt has not had to be realized. But if it were realized, the ECB's balance sheet would become substantially riskier and in the face of additional sovereign debt troubles—not at all a remote possibility—the probability could increase that the bank may have negative new worth. Given the political economy in the euro area, it is not at all clear that the euro system's "capital key" provisions will be fulfilled. Perhaps more likely than the negative net worth scenario is that the ECB may behave in a constrained manner and refrain from undertaking actions that could put its balance sheet in a tenuous position. How would a constrained central bank carry out lender-of-last-resort functions?

6 Concluding Remarks

Bringing financial stability into monetary policy is a difficult task. It requires understanding which financial frictions matter most for financial stability, defining financial stability, constructing empirical measures of financial stability, building macro models with financial frictions that can provide useful guidance to policy analysis, and communicating to the public about policy actions that necessarily have distributional consequences. At the moment, these difficulties prompt us to suggest that monetary policy makers exercise caution when there are calls for monetary policy to smooth shocks to financial stability. The knowledge that policy makers need to respond effectively to these shocks is only beginning to be accumulated, but the state of knowledge is rapidly improving.

[104]This is a further implication of Fisher's (1933) debt-deflation theory.

[105]Park (2012) shows that if the fiscal authority refuses to recapitalize the central bank, the bank can lose its ability to control inflation. Del Negro and Sims (2014) examines the issue of fiscal support for the central bank's balance sheet in a general equilibrium model calibrated to U.S. data.

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