

Federal Reserve Staff Presentation
April 6, 2012
New York City

Federal Reserve System Attendees: Tobias Adrian (Federal Reserve Bank of New York); and Sean Campbell, Michael Kiley and Andreas Lehnert (Federal Reserve Board)

Academic Attendees: John Cochrane, Stefano Giglio, Lars Hansen, Bryan Kelly, Harald Uhlig (University of Chicago); Hui Chen, Andrew W. Lo, Robert Merton (MIT); Marcus Brunnermeier, Nobuhiro Kiyotaki, Benjamin Moll, Christopher Sims, Yuliy Sannikov, Hyun Song Shin (Princeton); Mark Gertler, Thomas Sargent (NYU); Giorgio Primiceri (Northwestern); Frank Schorfheide (UPenn)

Summary: The following presentation was delivered to a group of academics who have organized a research group with the goal of “Modeling Financial Sector Linkages to the Macro-Economy”. The research group is organized by the Becker Friedman Institute for Research in Economics at the University of Chicago and is supported by a grant from the Alfred P. Sloan Foundation.

The presentation was made as the result of a request to meet with the group to discuss issues relating to macroeconomic modeling and systemic risk modeling. The presentation was made on April 6, 2012, in New York City.

The presentation discusses staff views on these issues and should not be interpreted as conveying the official views of the Federal Reserve System.

Overview of Near Term Policy Agenda

Focus on Regulatory Reform

Tobias Adrian, Sean Campbell

These slides discuss the near term policy agenda as it relates to regulatory reform efforts. The slides mirror remarks made by Daniel K. Tarullo on 3/22/2012 before the Committee on Banking, Housing and Urban Affairs. The full text of those remarks can be found at: <http://www.federalreserve.gov/newsevents/testimony/tarullo20120322a.htm>

Capital and Liquidity Regulation

- **Capital**

- Basel: market risk amendment, improvement of the quality of regulatory capital, an increase in the quantity of minimum required capital, maintenance of a capital conservation buffer, minimum leverage ratio
- DFA 165: mandate to establish enhanced risk-based capital standards for large BHCs based on the relative systemic importance of those companies

- **Liquidity**

- LCR: designed to ensure a firm's ability to withstand short-term liquidity shocks through adequate holdings of highly liquid assets (2015)
- NSFR: intended to avoid significant maturity mismatches over longer-term horizons (2018)

SIFIs and OTC Derivatives

- **Resolution of SIFIs**
 - BCBS and FSB: standards for national resolution regimes of SIFIs
 - DFA: orderly resolution process to be administered by the FDIC and resolution planning by SIFIs to be overseen by the FDIC and the Federal Reserve
- **OTC Derivatives**
 - DFA: enhancement of the role of central counterparties; improvement of regulation and supervision of dealers and key market participants; introduction of minimum margin requirements for uncleared derivatives
 - IOSCO/CPSS: creation and regulation of central counterparties, swap execution facilities, and swap data repositories; development of margin standards for uncleared derivatives; international standards for systemically important clearing systems including central counterparties that clear derivatives instruments and trade repositories

A Nonsupervisory Framework to Monitor Financial Stability

Tobias Adrian, Dan Covitz, Nellie Liang

These slides present the author's perspective on ongoing research related to stress testing and other supervisory activities. The views expressed herein are solely the author's, and do not reflect those of the Federal Reserve Bank of New York, the Federal Reserve Board or its staff. All information presented here is publicly available.

Dodd-Frank Act

- **Reforms regulatory architecture**
 - Tighter standards: Identify and regulate SIFIs and FMUs
 - Infrastructure: Derivatives reform
 - New entities: FSOC, OFR
 - Places some constraints on the ability of the government to respond to crises
- **New financial stability mandate**
 - Macro prudential approach to supervision
 - Identify and mitigate threats to financial stability
 - Promulgate pre-emptive macroprudential policies
- **Does not control financial flows or innovation**
 - Could push financial activities into the shadows
 - Maturity transformation outside of lender of last resort will continue
- **As a result, we cannot forecast where or in what form systemic risk will arise**

Lessons from the Crisis about Systemic Risk

- 1. Microprudential supervision may not suffice to prevent systemic events, given level of capital**
- 2. Systemic risks can emerge during benign periods**
 - Systemic risk built up during the period of low volatility
 - Accounting and risk measurement problems can obscure risk taking
- 3. Systemic risk externalities have first order, aggregate effects**
 - Fire sales and effects on the real economy
 - Interconnections transmit distress
- 4. Shadow banking system affects core financial institutions**
 - Vulnerability to runs
 - Implicit and explicit guarantees from core institutions to shadow institutions
- 5. Aggregate leverage and maturity transformation matter**
 - While financial innovation can enhance risk sharing, it might increase aggregate risk

Implications of Crisis for Monitoring Financial Stability

- Pre-emptive assessment process:
 - 1. Identify possible shocks from scenarios (with caveats)**
 - 2. Assess amplification mechanisms:**
 - transmission channels and vulnerabilities in the financial system (structural or cyclical) that could transmit and amplify possible shocks
 - 3. Evaluate how these vulnerabilities could amplify shocks, disrupting financial intermediation and impairing real economic activity**

Broad Monitoring Framework

1. SIFIS (bank and nonbank) and FMUs

Firms are considered systemically important because their distress or failure could disrupt the functioning of the broader financial system and inflict harm on the real economy

2. Shadow Banking

Shadow banks (and chains) provide maturity and credit transformation without public sources of backstops and represent systemic risks due to their connections to other financial institutions

3. Real Economy

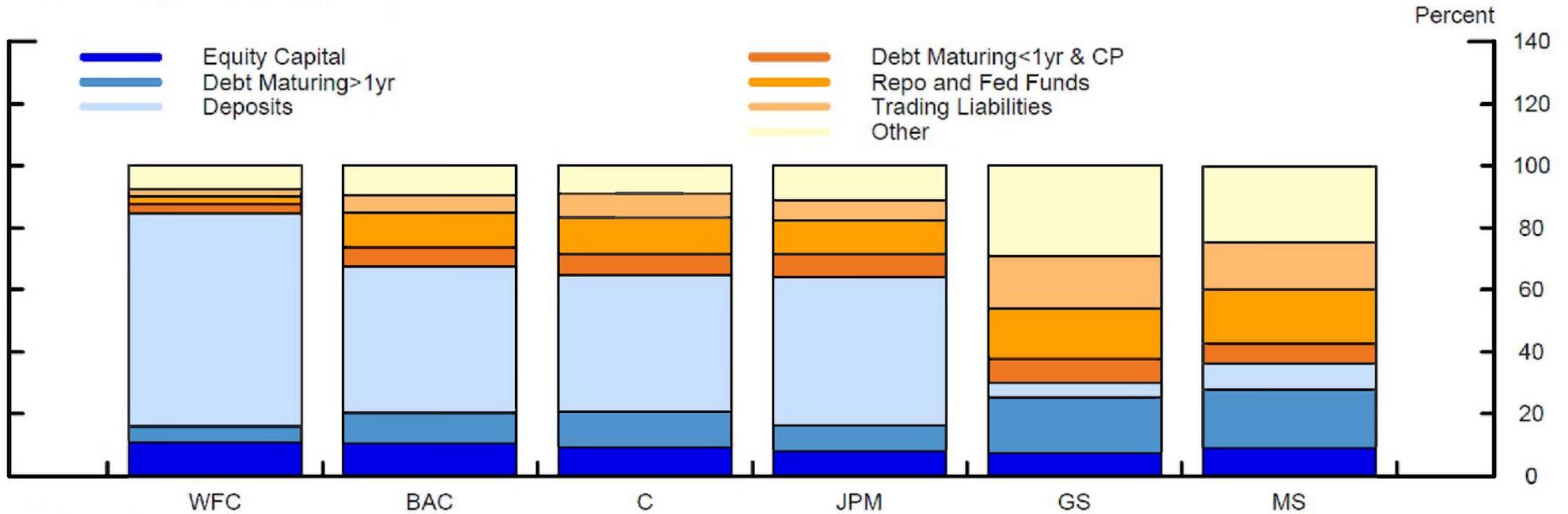
Linkage of financial sector to real economy is via the provision of credit

1. SIFI and FMU Monitoring

- **Measures of default risk**
 - Capital and leverage ratios; off-balance sheet commitments
 - Stress test results (CCAR) – best forward-looking measure
 - Market-based measures
 - CDS, sub-debt bond spreads
 - Stock prices, price to book, market equity capitalization, market betas
- **Measures of liability risk: runs and funding squeezes, cross border**
- **Measures of systemic importance**
 - Size, interconnectedness, complexity, and critical services
 - Interconnectedness: Intra-financial assets and liabilities, counterparty credit exposures
 - Complexity – business lines; number of legal entities; countries of operation
 - Market-based measures of systemic risk – CoVaR, SES, DIP
 - Adrian and Brunnermeier (2008), Huang, Zhou, Zhu (2009), Acharya et al (2010)

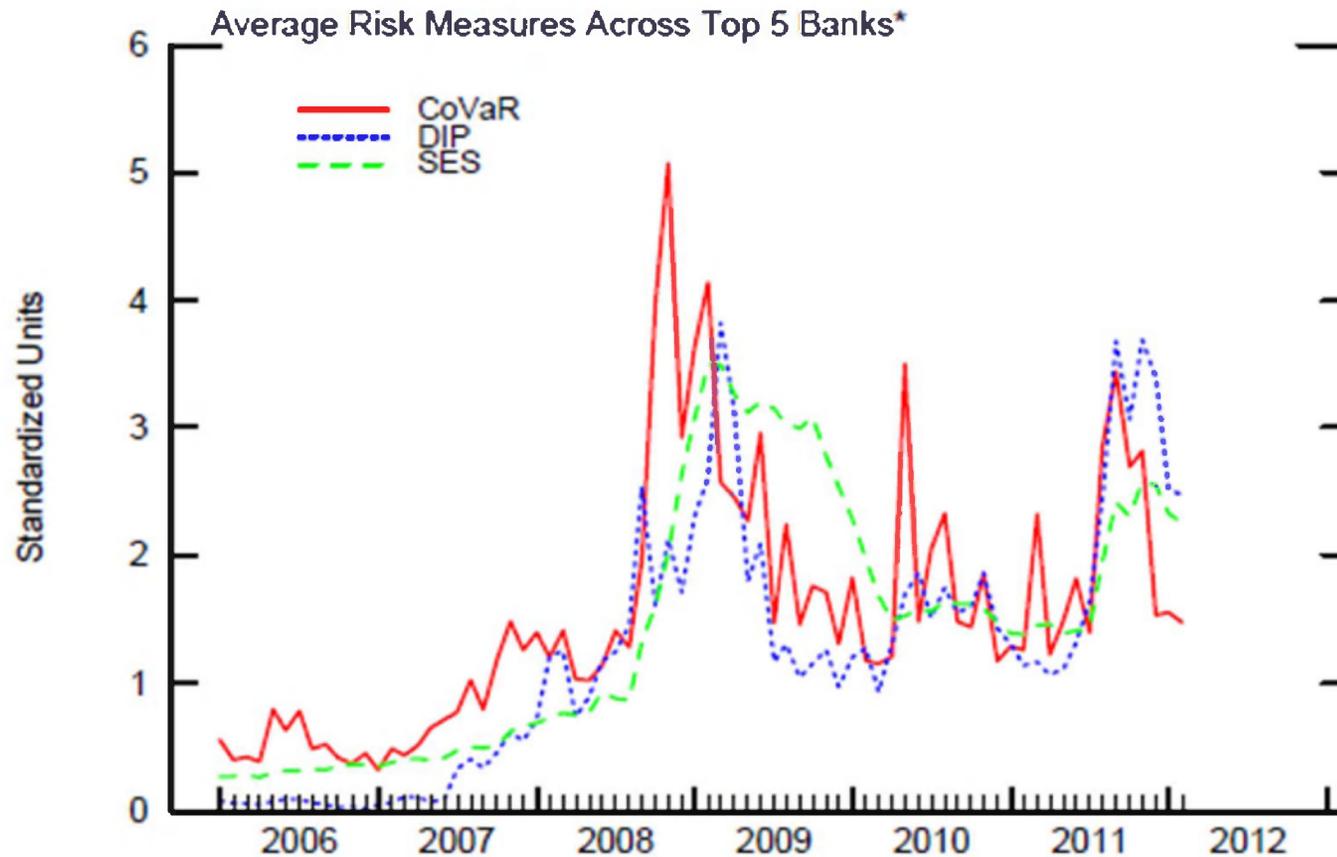
Monitoring SIFIs: Example BHC Liability Structure

BHC Liability Structure (3Q11)



Source: FR Y-9c.

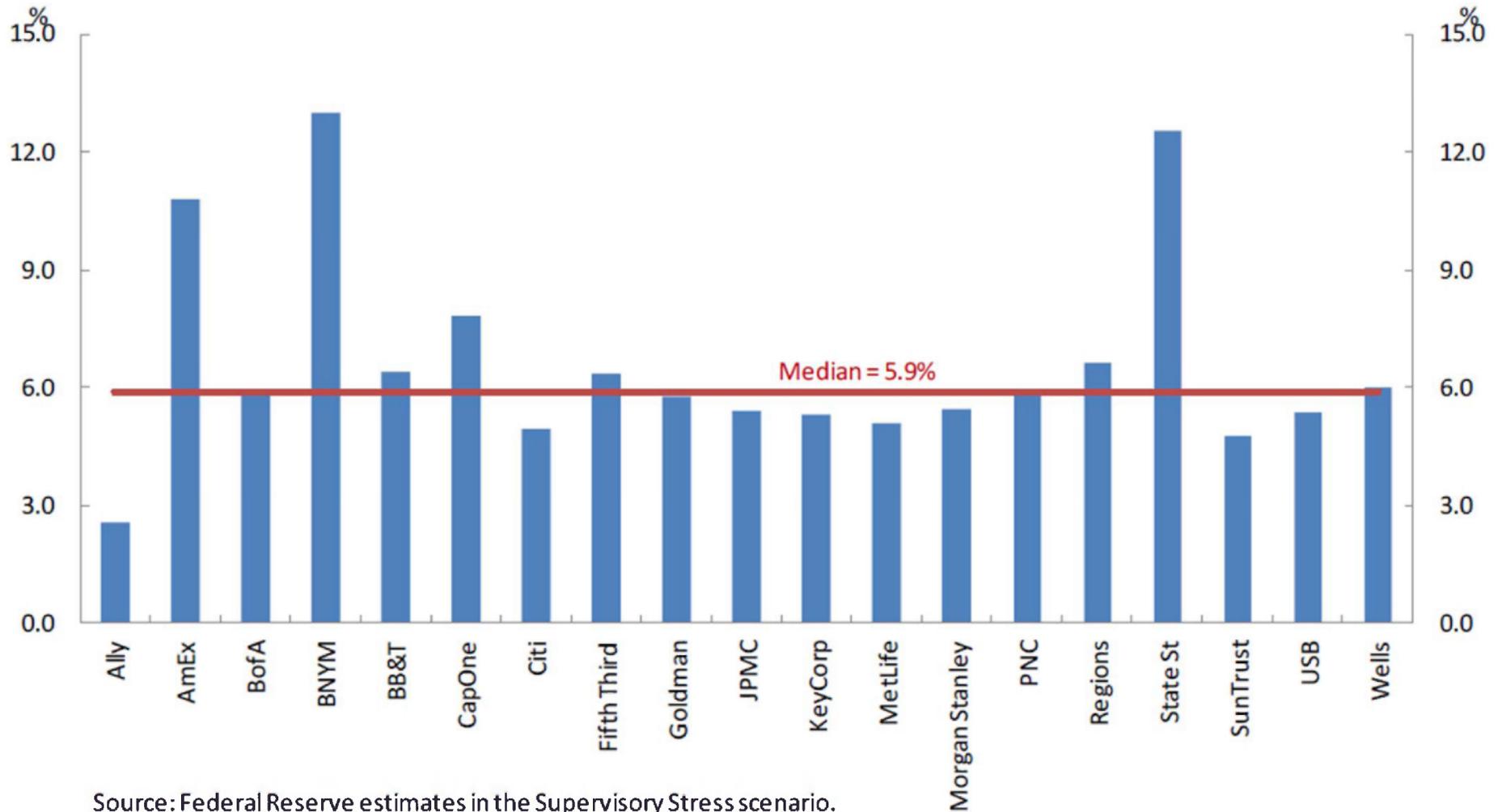
Monitoring SIFIs: Example Market Based Systemic Risk Measures



* Each risk measure (CoVaR, SES, DIP) is averaged across five large banks (BAC, C, JPM, GS, MS). Each resulting time series is then re-scaled by its standard deviation.

Monitoring SIFIs: Example

Minimum Tier 1 Common Ratio in the Supervisory Stress Scenario (%)



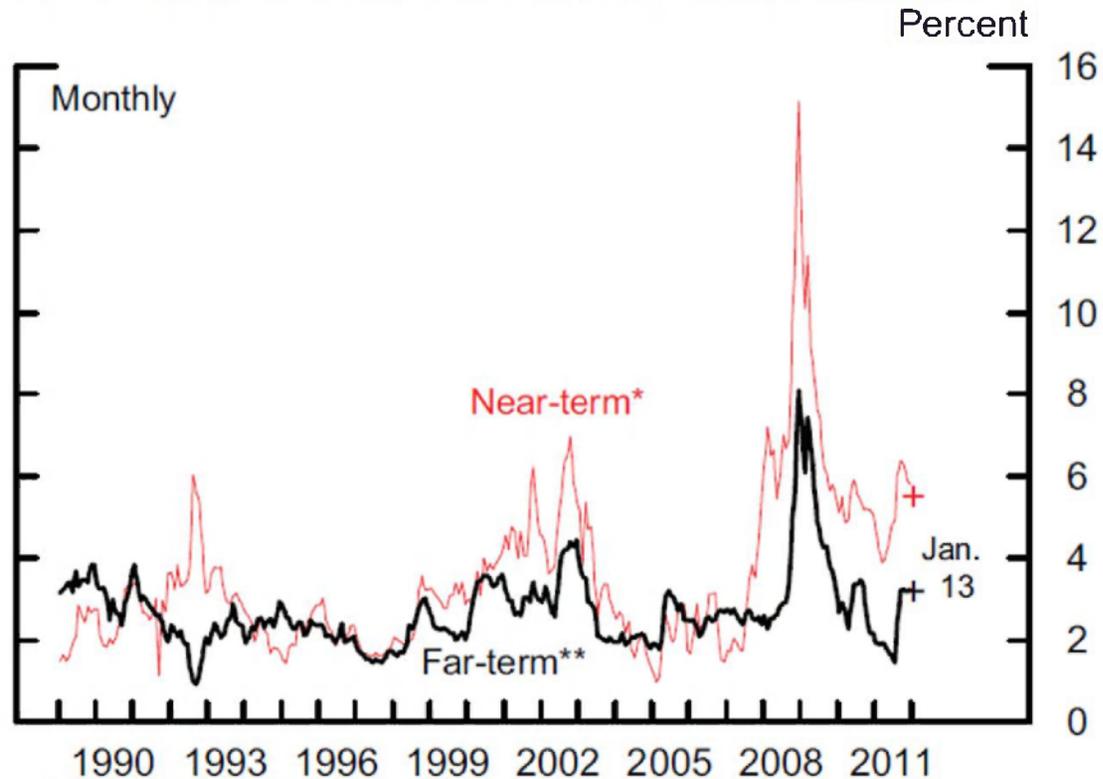
Source: Federal Reserve estimates in the Supervisory Stress scenario.

2. Shadow Bank Monitoring

- **Potential for Destabilizing Drops in Asset Prices**
 - Shadow banking could inflate asset valuations in booms and amplify asset price crashes in busts
 - Price and non-price measures of potential bubbles, extremely low volatility
- **Leverage Cycle, Maturity Mismatch, and Run Risk**
 - Measures of leverage in financial system (including on and off balance sheet exposures)
 - Measures of maturity mismatch and vulnerability
 - Hedge funds, insurers, pension funds, and other financial firms that are not SIFIS
 - Activities not backed by government backstops: MMFs, cash pools, securities lending / repo activities, velocity of collateral, securitization
- **New Products**

Monitoring Shadow Banking: Example Forward Credit Spreads

Near- and Far-Term BB Forward Credit Spreads



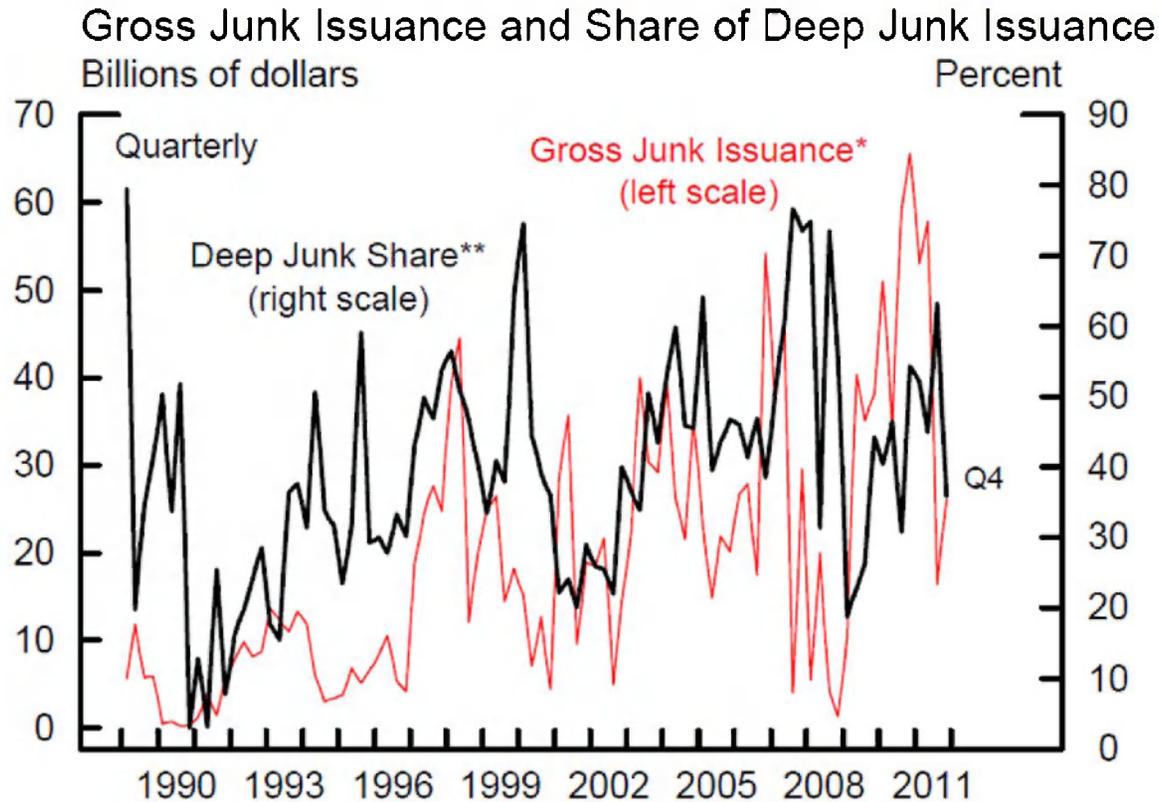
* Forward spread between years two and three.

** Forward spread between years nine and ten.

+ Denotes the latest daily observation.

Source. Staff estimates.

Monitoring Shadow Banking: Example Junk Bond Issuance

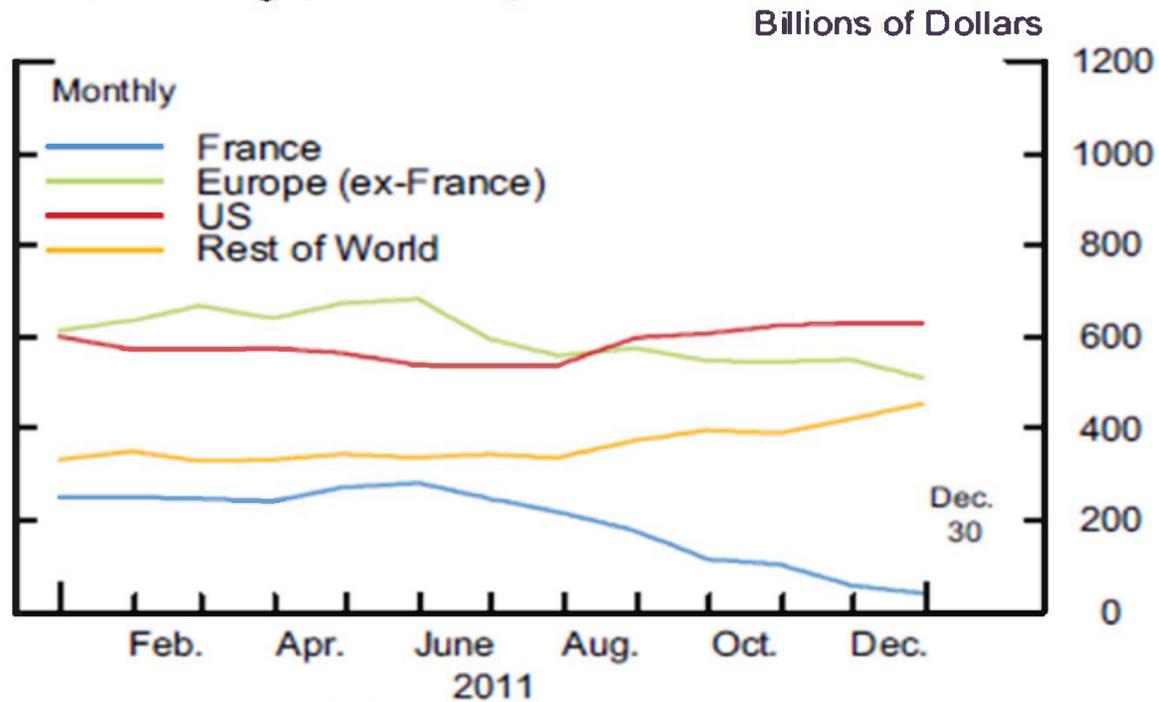


* Includes public, 144a, euro, and MTN issues.
** Fraction of bonds rated B- or lower over total nonfinancial junk issuance.

Source: Thomson-Reuters

Monitoring Shadow Banking: Example Prime Money Market Fund Exposures

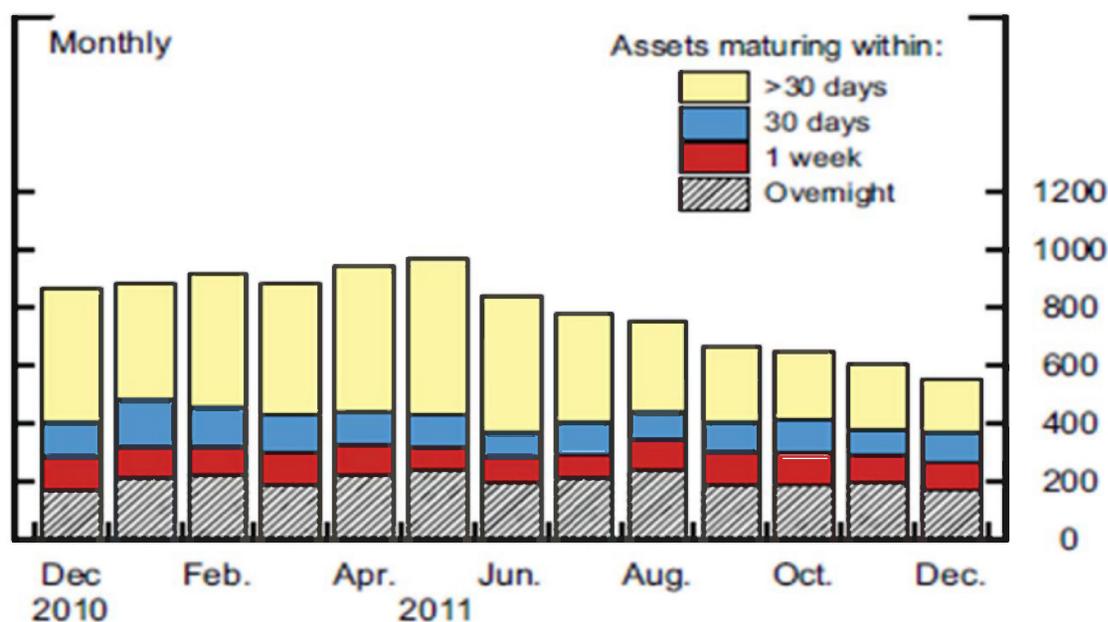
MMF Holdings, Prime Exposure



Source: SEC form N-MFP.

Monitoring Shadow Banking: Example Prime Money Market Fund Maturity Exposures

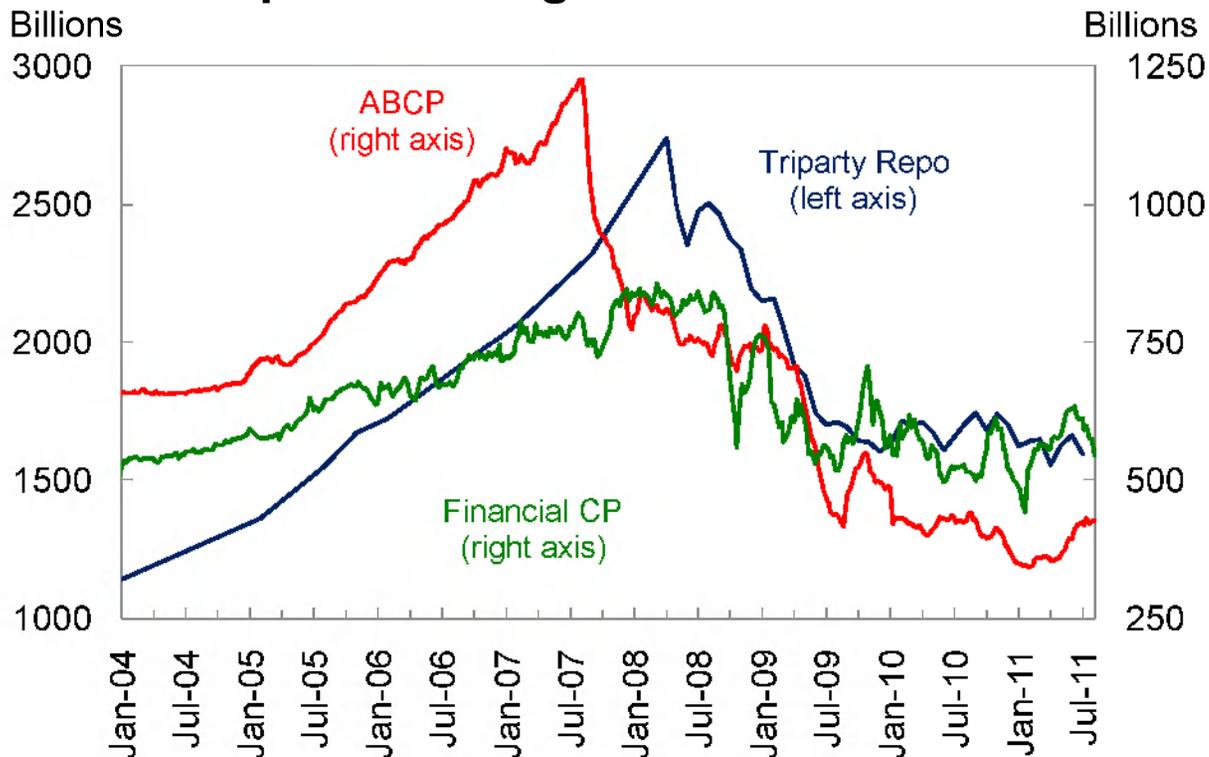
Maturity Distribution of Prime MMF European Holdings
Billions of dollars



Source: SEC form N-MFP filings.

Monitoring Shadow Banking: Example Commercial Paper and Repo Financing

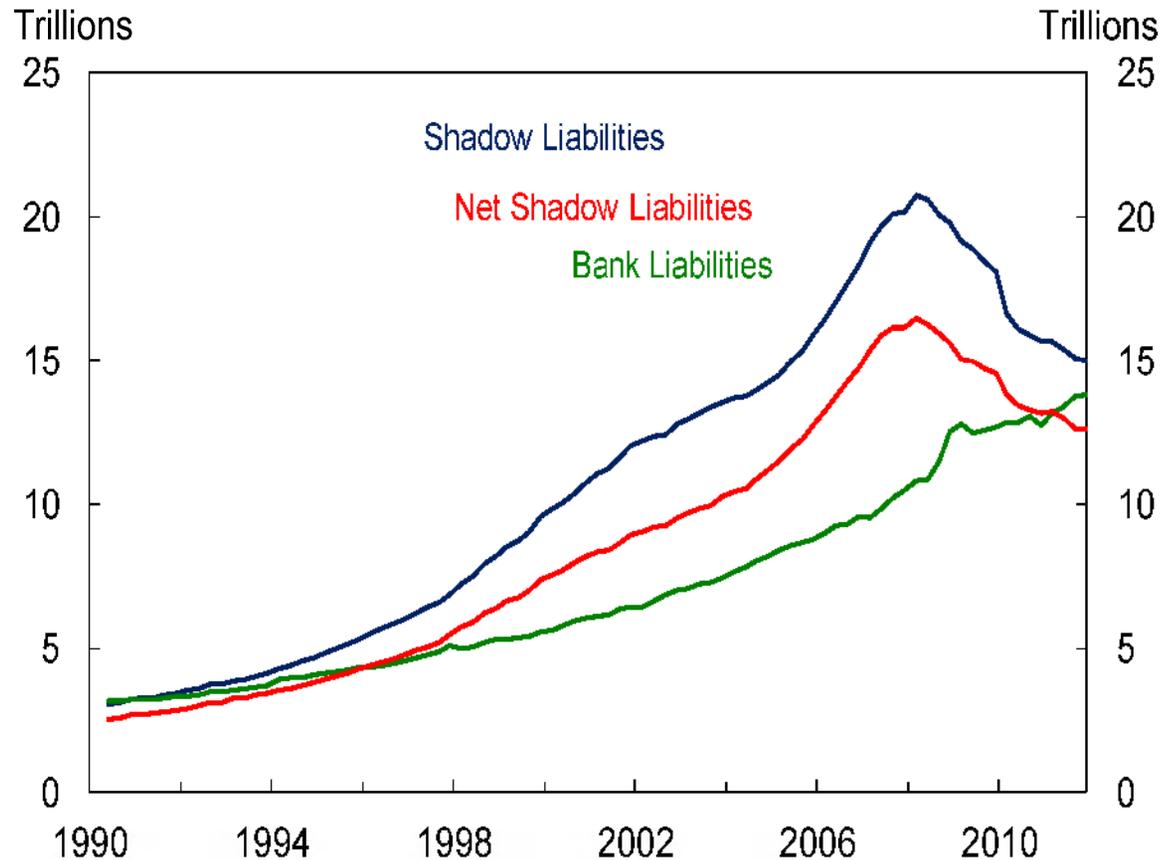
CP and Repo Financing



Source: FRBNY and Federal Reserve Board

Monitoring Shadow Banking: Example Shadow Banking Liabilities

Shadow Liabilities



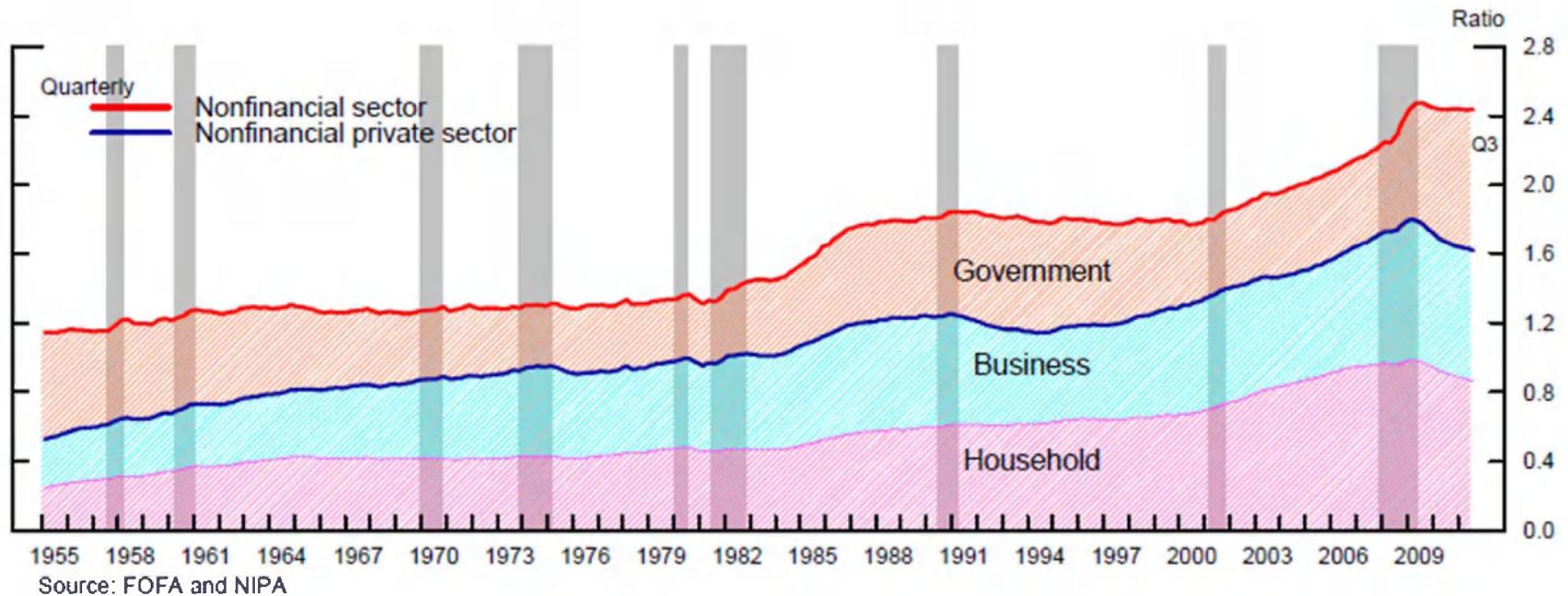
Source: Flow of Funds

3. Real Economy Monitoring

- **Nonfinancial sector risk**
 - Leverage of nonfinancial sector—households, businesses, governments
 - Nonfinancial credit that is ultimately funded with short-term debt
- **Effect of financial sector on economic activity**
 - Underwriting standards, risk appetite, and balance sheet capacity of financial institutions
 - Indicators of macro-economy vulnerability to financial risks

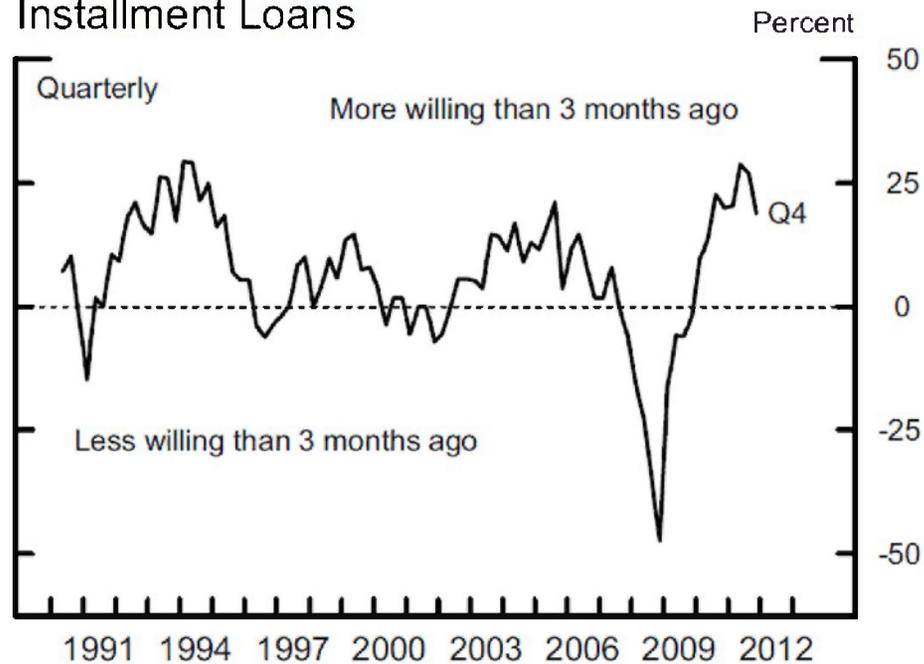
Real Economy Monitoring: Example Nonfinancial Sector Credit-to-GDP Ratio

Nonfinancial sector credit-to-GDP ratio



Real Economy Monitoring: Example Senior Loan Officer Survey

Willingness to Make Consumer
Installment Loans



Note: Net percent of banks reporting willingness to make loans.
Source: Senior Loan Officer Opinion Survey on Bank Lending Practices.

Conceptual Framework for Policy Response to Systemic Risk

- **Monitoring indicates the extent to which shocks might trigger systemic events**
 - Monitoring informs us about exposures to changes in the pricing of risk
 - Sharp increases in the pricing of risk can generate systemic risk
- **Tradeoff between systemic risk and the price of risk**
 - Regulation is trading off the price of risk with the level of systemic risk
 - Higher price of risk today may reduce buildup of systemic risk
- **Tougher regulation, higher price of risk, less systemic risk**

Ex ante Policies to Promote Financial Stability

1. SIFIs

- Size of macroprudential surcharge
- Stringency of capital requirements, and liquidity requirements

2. Shadow Banking

- Margins , more centralized clearing
- MMMF and repo reforms
- Greater disclosure and transparency, better accounting

3. Nonfinancial sector

- Lender restrictions
- Borrower requirements

Research Agenda for Measuring Interconnectedness

Sean Campbell

These slides present the author's perspective on ongoing research related to the measurement of interconnectedness. The views expressed herein are solely the author's, and do not reflect those of the Federal Reserve Board or its staff. All information presented here is publicly available.

Outline

- Brief overview of near term policy initiatives that call for concrete measures of interconnectedness
- Research perspective on interconnectedness measures
- Discussion of how interconnectedness relates to other important research/policy initiatives
- Directions for future research

Near Term Policy Initiatives

- A number of specific policy initiatives require concrete measures of interconnectedness
1. FSOC determination of non-bank SIFI's
 - Proposed rule issued by FSOC 10/2011
 - Proposal states that “The Council intends to evaluate a broad group of nonbank financial companies by applying uniform quantitative thresholds representing the framework categories that are more readily quantified, namely size, **interconnectedness** ... A nonbank financial company would be subject to additional review if it meets both the size threshold and any one of the other quantitative thresholds.”
 2. Evaluation of systemic risk consequences of significant bank mergers
 - Evaluations are currently underway (CapOne and ING)
 - Evaluation will consider “a variety of metrics. These would include measures of the size of the resulting firm;.... interconnectedness of the resulting firm with the banking or financial system”

Near Term Policy Initiatives

- Interconnectedness is not simply one of many small dimensions of the problem that must be assessed. Rather it is seen as being critical to these near term initiatives.
- Consider the FSOC proposed rule on identifying non-bank SIFI's
 1. Interconnectedness is identified as one of six key elements defining a non-bank SIFI
 2. Commenters view this element as being, perhaps, the most important of the six complementary elements

“Many commenters expressed the view that interconnectedness with the broader financial system is the most important indicator of a nonbank financial company’s potential to pose a threat to U.S. financial stability.” – FSOC proposed rule

Research Perspective on IC Measures

- How should “interconnectedness” be **defined**? What is a useful working definition?
- The FSOC proposed rule provides one candidate definition

“[interconnectedness is an assessment of] the potential impact of a [non-bank financial] company’s financial distress on the broader economy”

- How does financial distress translate into a real effect (i.e. lost output) on the broader economy (i.e. both inside and outside the financial sector)
- The key issue is to think about trying to measure how financial distress leads to real negative effects on other firms, industries and sectors
- Measured against this working definition of interconnectedness how well do existing measures quantify the important elements of interconnectedness???

Research Perspectives on IC Measures

- Many extant measures of IC focus heavily on measuring the potential size of financial distress that a given firm might experience

e.g. Systemic Expected Shortfall (SES) Acharya et. al. (2010) – “each financial institution's contribution to systemic risk can be measured as its systemic expected shortfall (SES), i.e., its propensity to be undercapitalized when the system as a whole is undercapitalized. **SES increases with the institution's leverage and with its expected loss in the tail of the system's loss distribution.**”

- These types of measures are useful for measuring the size and significance of financial distress but it is **not clear how such financial distress can be mapped into outcomes for the broader economy**
 - Could the failure (near failure) of the firm be absorbed by the rest of the economy?
 - Could other competitors fill the void for the period of time that the firm is under financial stress?
 - How important are the services of the firm to the rest of the economy?

Research Perspectives on IC Measures

- Understanding how financial distress in one firm/industry/sector feeds forward through the rest of the economy is a significant research challenge
- The inter-relationships between different aspects of the financial sector and the broader economy is complex and multi-faceted.
- Consider all of the following sub-sectors of the financial sector that play a role in the broader economy
 - prime brokerage, underwriting, securities lending, clearing services, SME lending, insurance, reinsurance, asset management,...
- The linkages between these sectors and the rest of the financial sector as well as the broader economy are not well understood in a systematic and quantifiable manner
- Measures that focus on characterizing the size and significance of financial distress in these (and other) industries fall short of the mark. Ultimately, IC measures need to make a systematic and quantifiable connection to the unavoidable fallout from such financial dis-location.

Research Perspectives on IC Measures

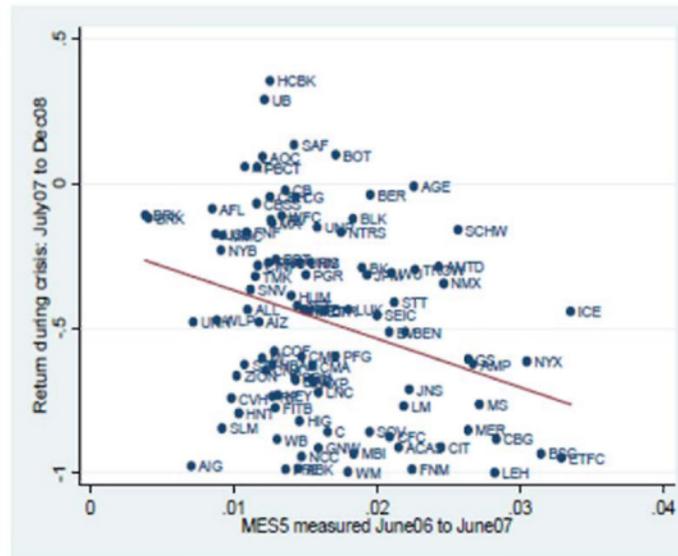
- Understanding and quantifying the degree of uncertainty around IC measures is important for having the appropriate perspective on the signal strength of any particular measure. It may also tell us which components of IC may hold more promise for measurement

MES Predicts Realized Equity Returns During the Crisis

Research Perspectives on IC Measures

- Understanding and quantifying the degree of uncertainty around such IC measures is important for having the appropriate perspective on the signal strength of any particular measure. It may also tell us which components of IC may hold more promise for measurement

MES Predicts Realized Equity Returns During the Crisis



- Tail events are notoriously hard for anyone/thing to forecast. Other aspects of IC may be more amenable to stable and systematic quantification

Relation of Interconnectedness to Other Initiatives

- Interconnectedness is an important concept for broadening our understanding of how different aspects/sectors of the economy function together
- Understanding how different financial activities relate to the broader economy is a key part of understanding the economics of financial stability
 - How does the financial sector play a role in our understanding of the near-term evolution of the macroeconomy? (Macro Modeling - Kiley)
 - What are the feedback effects to other banks and FI's in the event that one particular financial institution is impaired? (Macroprudential Stress Tests- Lehnert)

Directions for Future Research

Modeling and measurement of interconnectedness is in its infancy. Lots of promising avenues for future research. A few that come to mind include:

- Thinking through how to quantify the real effects of financial distress across the broader economy
- What are the best measures/indicators of “connection” to other firms and sectors?
 - Credit or other services provided?
 - Number of counterparties?
 - Ease of substitution?
- Network models – a number of “first generation” network models (e.g Gai et. al. (2011)) are promising but lack realism in network dynamics.
 - What are the determinant of network formation?
 - How do networks change in the event of information or stress events?
 - What are the conditions that lead to the formation of fragile/robust networks?

Research Agenda for Stress Testing

Andreas Lehnert

These slides present the author's perspective on ongoing research related to stress testing and other supervisory activities. The views expressed herein are solely the author's, and do not reflect those of the Federal Reserve Board or its staff. All information presented here is publicly available.

Outline

- Overview of generic stress testing process
- Research perspective on the 2012 exercise
- Directions for future research
 - Information collections

Process overview

Design elements

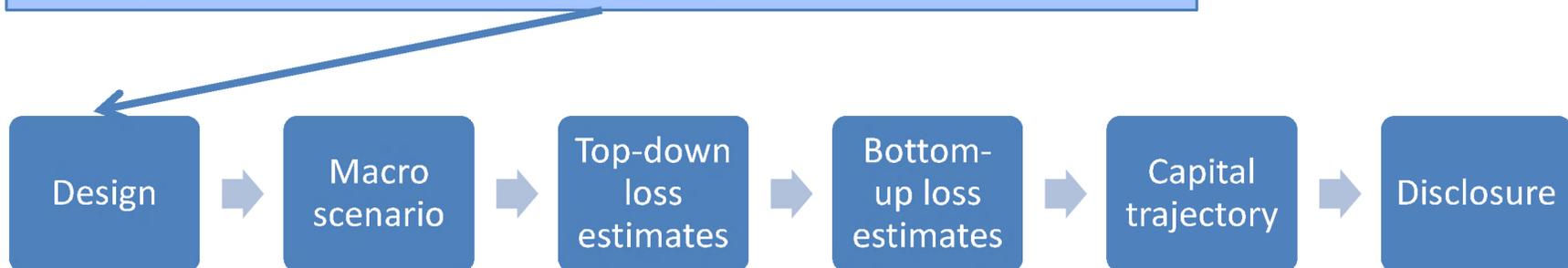
What data to collect

Standard for pass/fail; actions tied to results

Evolution of balances/RWA

Other assumptions (e.g. riskiness of newly originated loans)

Macroprudential elements?



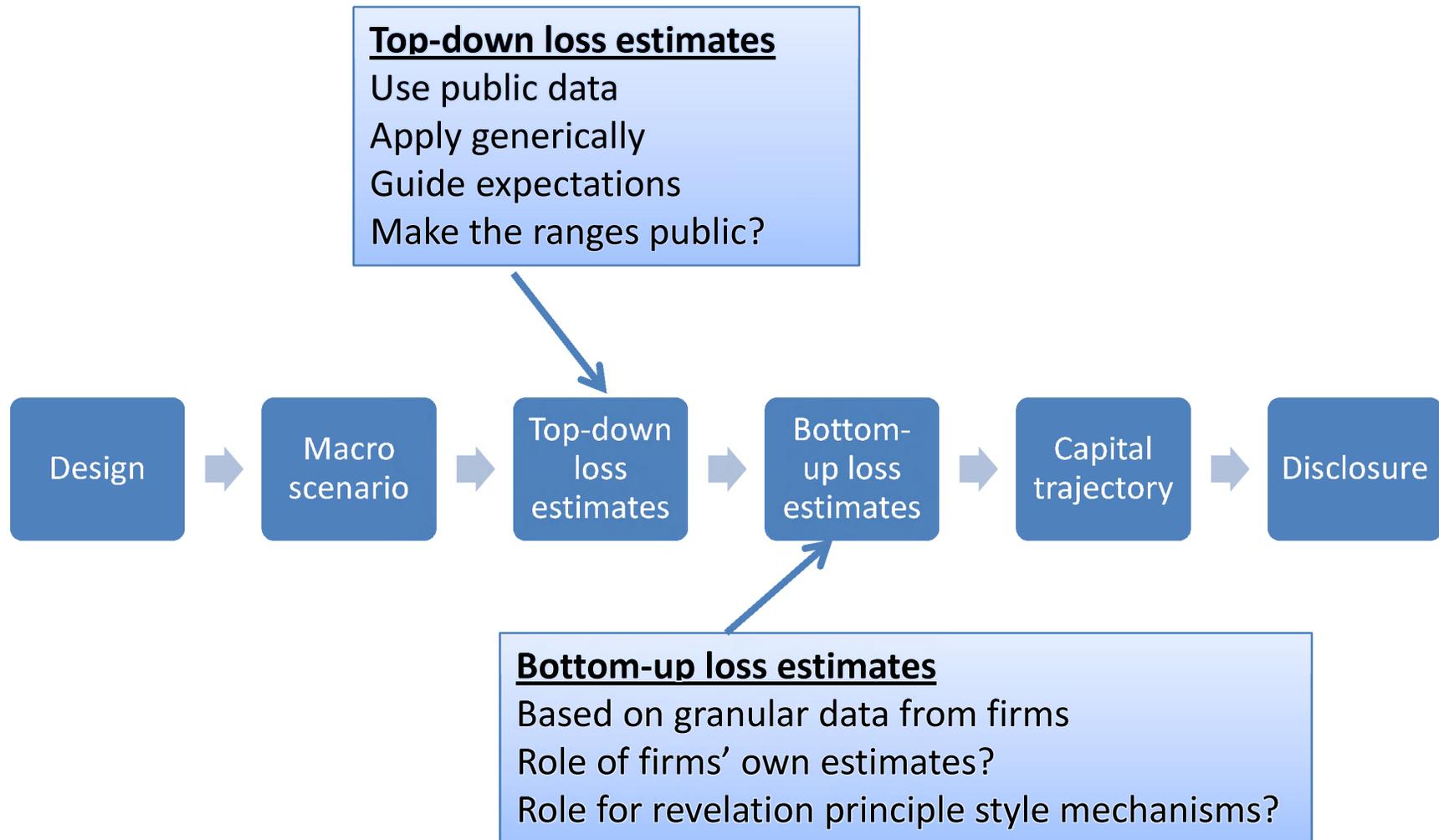
Scenario design

Variables to include?

Severity?

Separate trading shock

Process overview



Process overview

Capital trajectory

Forecast of income & losses → quarterly path of capital
Pass/fail per quarter?
Include “below the line” adjustments?



Disclosure

By asset class?
By firm?
Time series or just ending?
Supervisory actions?

RESEARCH PERSPECTIVE ON THE 2012 EXERCISE

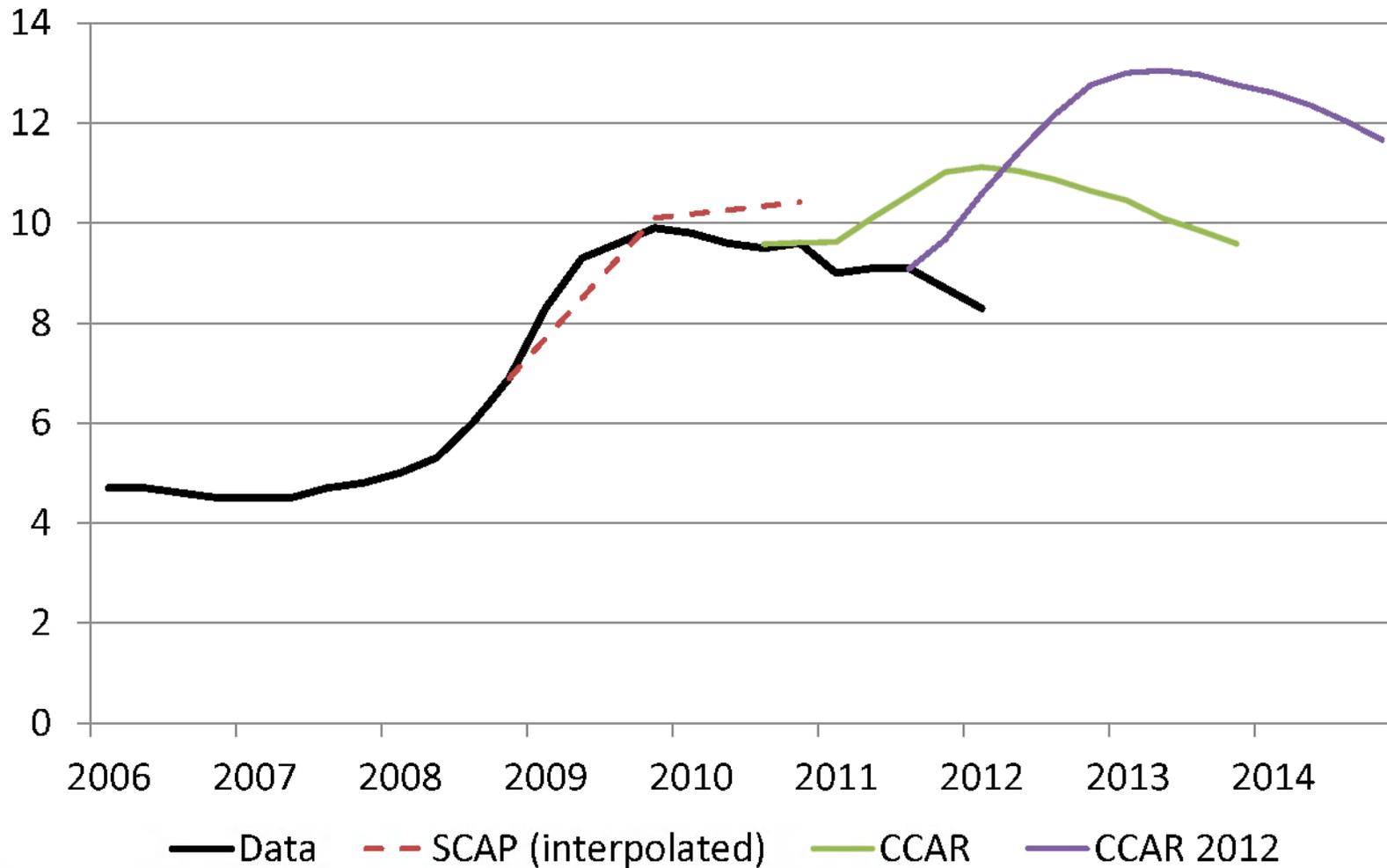
Summary of 2012 Exercise: Timeline and Design

- Timeline
 - Scenario published in November 2011
 - Used firm positions as of Sep. 30, 2011 and in Nov. 2011 for trading book
 - Firms submitted capital plans, including loss forecasts, in early January 2012
 - Federal Reserve published independent loss estimates & capital ratios on March 13, 2012
- Design
 - Held proposed capital distributions constant in the stress scenario
 - Three regulatory ratios, 5% tier 1 common
 - Qualitative assessment of firms' capital planning processes
 - Supporting processes such as risk measurement and risk management
 - Dynamic balance sheets specified by firms
 - Six large trading firms subject to market shock using Nov. 2011 positions
 - Losses & earnings forecast for nine quarters: 2011:Q4—2013:Q4
 - Losses in 2014 used to size end-of-period ALLL and for other purposes

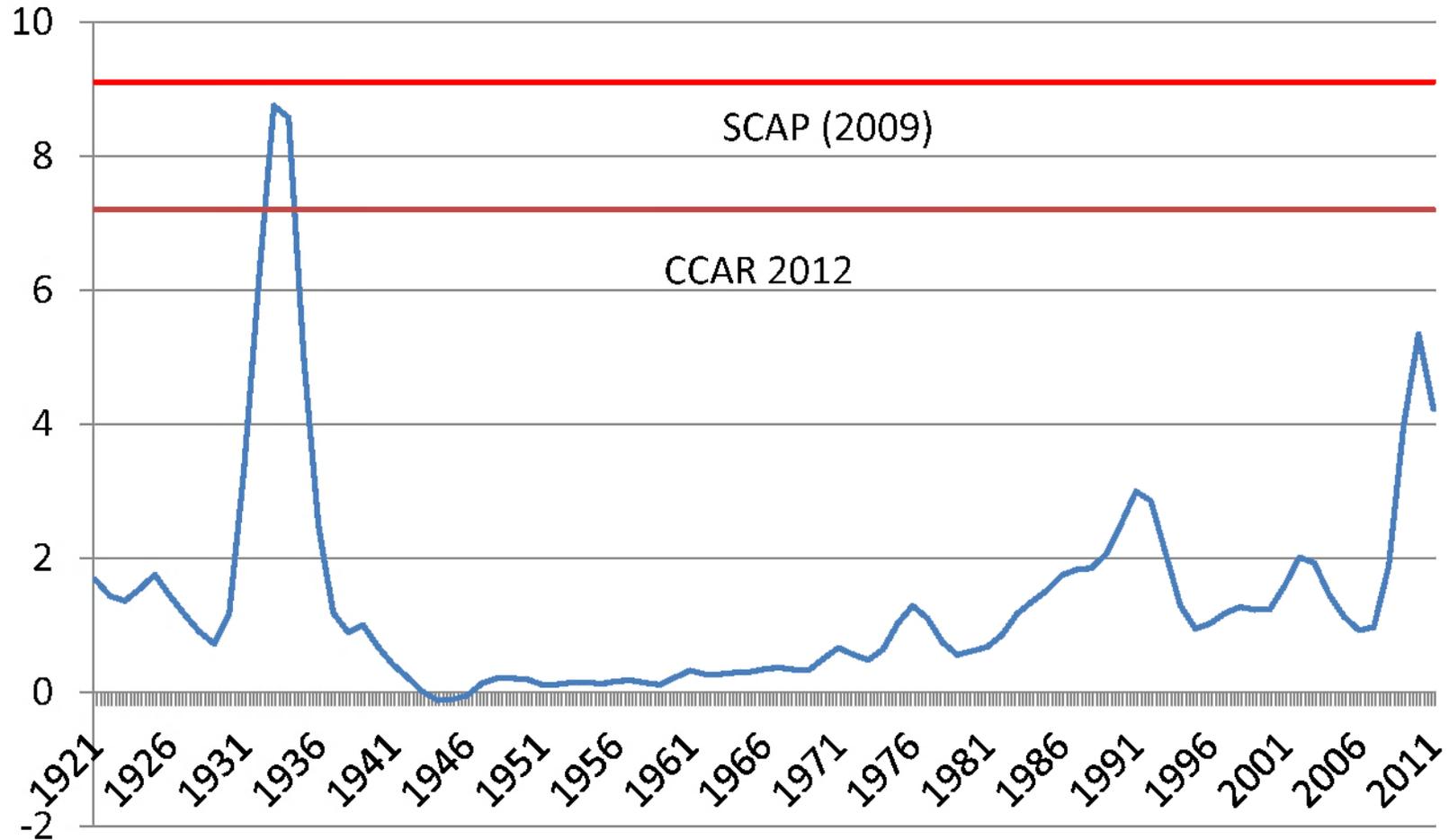
Summary of 2012 Exercise: Scenario, Loss Estimates & Disclosure

- Scenario
 - U.S. enters a severe recession
 - Unemployment rate 13%, house prices -21%
 - GDP and exchange rates for country/country blocks
 - Trading shock reflected widening in sovereign spreads
- Loss estimates
 - No top-down loss estimates distributed
 - Wholesale, retail, AFS-HTM
 - Trading book & PPNR
 - Bottom-up independent loss estimates published
- Disclosure
 - Firm-specific results
 - Minimum and period-end capital ratios

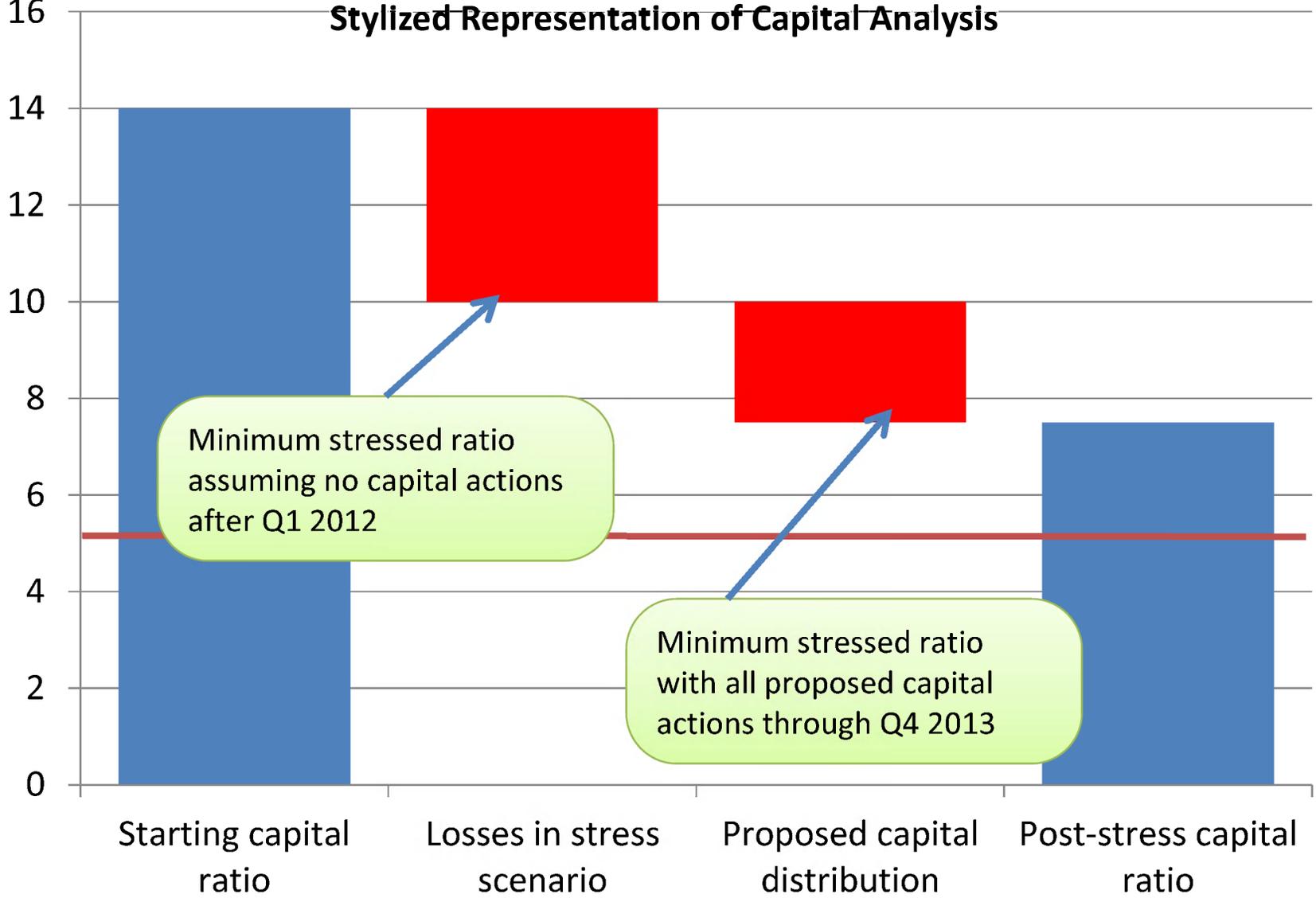
Scenario Unemployment Rates



Two-year Loan Loss Rates Commercial Banks 1920-2011

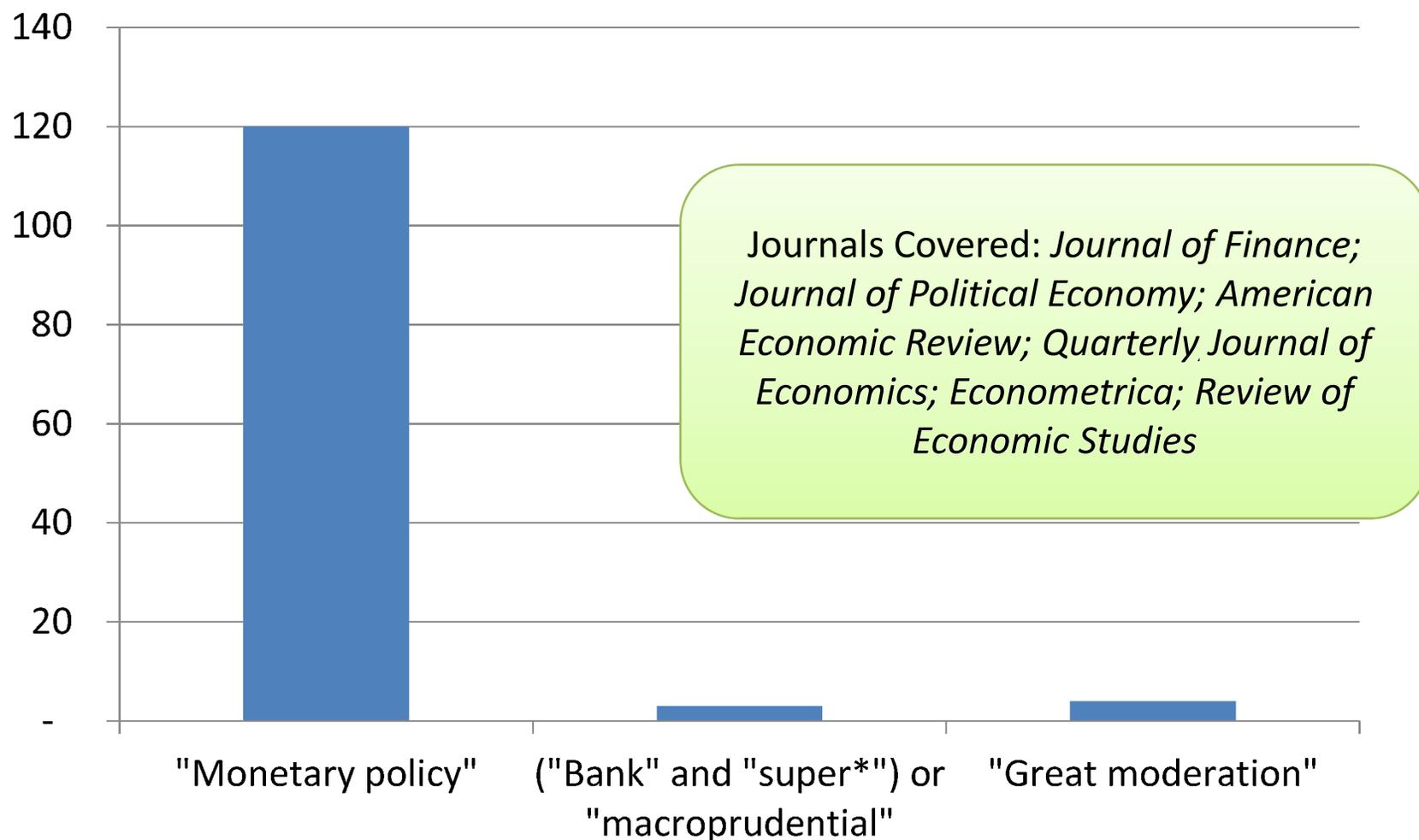


Stylized Representation of Capital Analysis



DIRECTIONS FOR FUTURE RESEARCH

Number of journal articles containing the search term in their *abstracts* (1980 to 2011)



Information Collections

- Understand what information supervisors are collecting
 - And what might be feasible alternatives
- Information collected (generally) using public regulatory reports
- Changes to reports typically associated with public notice and comment

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Recent Developments

- Agencies clarify effective date for Section 716 of the Dodd-Frank Act
- Testimony by Sandra F. Braunstein, Director, Division of Consumer and Community Affairs, on mobile payments
- Speech by Governor Duke on building sustainable communities
- Federal Reserve Board issues enforcement action, and terminates enforcement action

Does the Fed get audited? YES

[Learn more >](#)

INDEPENDENT AUDITORS' REPORT
To the Board of Governors of the Federal Reserve System
We have audited the accompanying balance sheet as of December 31, 2010 and 2009, and the results of operations, and cash flows for the Board's management. Our responsibility is to express an opinion on these financial statements based on our audit.

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Information collections under review

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FR Y-14A
FR Y-14M
FR Y-14Q

Information Collections Out for Public Comment (* End of Comment Period)						
Reporting Form Number	OMB Supporting Statement (PDF)	Draft Reporting Form (PDF)	Draft Reporting Instructions (PDF)	Other Attachments (PDF)	Initial Federal Register Notice (PDF)	Final Federal Register Notice (PDF)
FR 2018	36 KB	not applicable	not applicable	not applicable	156 KB *04/06/2012	not available
FR 2023	28 KB	not applicable	not applicable	not applicable	156 KB *04/06/2012	not available
FR 2064	25 KB	not applicable	not applicable	not applicable	200 KB *05/14/2012	not available
FR 3051	32 KB	not applicable	not applicable	not applicable	162 KB *04/02/2012	not available
FR 3059	26 KB	not applicable	not applicable	not applicable	162 KB *04/02/2012	not available
FR 4203	not available	not applicable	not applicable	link	231 KB *06/08/2012	not available
FR H-4	29 KB	not applicable	not applicable	not applicable	162 KB *04/02/2012	not available
FR Y-14A FR Y-14M FR Y-14Q	124 KB	525 KB 575 KB	not available	not applicable	163 KB *04/23/2012	not available
Reg W	26 KB	not applicable	not applicable	not applicable	200 KB *05/14/2012	not available
Reg YY R-1438	not available	not applicable	not applicable	link 1 link 2	451 KB 190 KB *04/30/2012	not available
RFP RFPQ	29 KB	not applicable	not applicable	not applicable	162 KB *04/02/2012	not available

Current information collection

FR Y-14Q & FR Y-14M

- PPNR
 - Actual balances & rates earned on assets by category (first-lien, C&I,...)
 - Non-interest income/expenses
 - Weighted average life of assets/liabilities
 - Retail repricing “beta” (sensitivity of cost of funds to rate shocks)
- Retail (mortgages, cards, auto, ...)
- Wholesale (C&I, CRE loans, ...)
- Securities (financial assets held in AFS/HTM portfolio)
- Trading
 - Sensitivities of assets to shocks (DV01, CS01, vega)
 - Counterparty credit risk exposures (CVA, IDR, top 10 lists)
- Basel III
- Regulatory capital instruments

Scenario Information Collection

FR Y14-A

- Five scenarios: BHC baseline & stress, Federal Reserve baseline & stress, separate trading shock (potential for additional scenarios)
- Project nine quarters (under each scenario)
 - Flows to income/hits to capital
 - PPNR
 - Loan losses
 - ALLL
 - OTTI
 - Trading mark-to-market losses
 - Asset balances (loans outstanding, RWA)
 - New originations by loan category
 - Special topics (e.g. repurchases, fair value, etc)
- Additional trading/CCR collections
 - Top counterparties

Research Directions

- Micro/product-specific analysis
 - Loss forecasting
 - Elasticity of demand
 - Behavior in tail events
 - Better information to collect
- Trading and counterparty credit risk
 - Designing scenarios
 - Counterparty behavior in stress episodes
- Macro topics
 - Designing scenarios
 - Role of bank capital in macro outcomes (e.g. countercyclical capital buffers)
- Banking
 - Cost of bank liabilities
 - Determinants of bank risk appetites
- Research on supervision
 - Connection to program evaluation literature
 - Study of forecast errors
 - Alternative approaches (including information collection)
 - Alternative targets
 - Disclosure policy
 - New form of supervision (public, quantitative, ...)

Macroeconomic Modeling of Financial Intermediation: A Review of Tools Used at the Federal Reserve Board and Their Relation to Ongoing Research

Michael Kiley

These slides present the author's perspective on ongoing research related to macroeconomic modeling.
The views expressed herein are solely the author's, and do not reflect those of the Federal Reserve Board or its staff

Macroeconomic Models at the Federal Reserve Board

- Staff at the Federal Reserve use many “models”
- “Models” are used in a wide variety of contexts
- Perhaps most importantly, “models” are tools that are widely used, but no single model “rules the day”, and model results are just one input into forecasting and policy analysis
- In the remainder of this presentation, I will mainly focus on “structural” macroeconomic models used for forecasting and policy analysis, with a tilt toward models that address issues related to financial intermediation
 - I will focus (almost) exclusively on models used at the Federal Reserve or other central banks, either systematically or on certain projects (including research projects)
 - As a result, this review of models leaves out many important academic contributions that have helped shape the approaches taken by researchers at central banks

Macroeconomic Models at the Federal Reserve Board

- Staff at the Federal Reserve use many “models”
 - Simple-to-complex time series models
 - Small, “semi-structural” models capturing key relationships that can bring out the intuition behind results (e.g., Fuhrer-Moore (1995), Rudebusch-Svensson (1999) models)
 - A mix of calibrated/estimated dynamic general equilibrium models (e.g., like EDO (Edge, Kiley, Laforte (2008), Chung, Kiley, Laforte (2010) and SIGMA (Erceg, Guerrieri, and Gust (2006))
 - Larger “structural” models (FRB/US (Brayton and Tinsley (1997))

Macroeconomic Models at the Federal Reserve Board

- “Models” are used in a wide variety of contexts
 - To assist staff analyses and research of monetary policy issues, including
 - The production of forecasts
 - The estimation of latent variables (e.g., “the output gap”, “the state of the business cycle”)
 - The assessment of the effects of monetary policy strategies
 - To analyze the implications of other policies (e.g., fiscal policies). Such analyses
 - Aid monetary policy analyses, contribute to public discussions of the effect of such actions, and engage related research
 - Examples: Elmendorf and Reifschneider (2002), Coenen et al (2012)
 - To analyze issues related to financial stability
 - The use of “macroeconomic” models to consider issues related to financial stability is increasing, and basic research is a significant part of these analyses
 - Example: Macroeconomic Assessment Group reports (BIS (2010))

Structural Macroeconomic Models: A Review of Common Approaches

- A variety of “structural” models are used for forecasting and policy analysis
- Financial conditions in a large number of central bank models share a Neoclassical view of financial conditions (as discussed in Boivin, Kiley, and Mishkin (2011))

Small, Semistructural (many examples, e.g., Fuhrer and Moore (1995))	FRB/US (Brayton and Tinsley (1997))	EDO (Edge, Kiley, Laforge (2008), Chung, Kiley, Laforge (2010))	SIGMA (Erceg, Guerrieri, Gust (2006))
Loosely motivated equations	Equations reflect explicit dynamic adjustment problem	DSGE model, firm/household optimization (specific functional forms)	DSGE model, firm/household optimization (specific functional forms)
Perhaps an IS curve, Phillips curve, and interest rate rule	Very large (hundreds of equations)	Medium-sized (less than 100 equations)	Multicountry versions can be very large -- medium/small per country
Rational expectations	Reduced-form or Rational expectations	Rational expectations	Rational expectations
Neoclassical view of financial conditions (EH)	Largely Neoclassical view of financial conditions	Largely Neoclassical view of financial conditions	Largely Neoclassical view of financial conditions
Frictionless financial intermediation	Largely frictionless financial intermediation, exog. risk premiums	Largely frictionless financial intermediation, exog. risk premiums	Largely frictionless financial intermediation, exog. and endog. risk premiums

Incorporating Financial Frictions into Macroeconomic Models – Exogenous Shocks

- Fluctuations in financial frictions play a key role in how policy models are used
 - In EDO, exogenous fluctuations in a risk premium account for the lion's share of macroeconomic fluctuations
 - In SIGMA, key risks from international conditions often are modeled as exogenous fluctuations in a risk premium (for example, on dollar assets (e.g., flight-to-safety movements) or foreign private-sector borrowing rates)
- Emphasis on exogenous movements in risk premiums reflects both the simplicity of the models and the fact that amplification of other shocks through fluctuations in risk premiums is often moderate (or less) in such models (e.g., Boivin, Kiley, and Mishkin (2011))
- Modeling of exogenous risk premiums – some exogenous factor ($X(t)$) that drives a wedge between the return on a risk-free asset and the return to investors in a private asset (e.g., physical capital, residences, consumer durables).
 - Example: Smets Wouters (2007) risk-premium shock (e.g., most important shock in EDO)
$$1 = E_t M(t+1)R(t+1)X(t+1)$$
 - Increase in risk premium leads to lower consumption and investment

Incorporating Financial Frictions into Macroeconomic Models – Endogenous Frictions

- Frameworks popular for modeling behavior of households or nonfinancial firms
 - Collateral Constraints (e.g., loan-to-value constraints for housing, Iacoviello (2005)). Debt must be less than some fraction of the market value of an asset.

$$B(t) \leq \mu Q(t)K(t)$$

- A tighter collateral constraint – reflecting, for example, a decline in asset values ($Q(t)$) or exogenous shocks to collateral constraint (μ) (i.e., change in loan-to-value required, etc.)
 - depresses investment and consumption by the constrained household
- Financial Accelerator (e.g., Bernanke-Gertler-Gilchrist (1999)). Debt financing limited by net worth of borrower

$$1 = E_t (M(t+1)R(t+1))$$

$$Q(t) = E_t \left(\frac{M(t+1)}{X(t+1)} (MPK(t+1) + Q(t+1)) \right)$$

$$E_t X(t+1) = F \left(\frac{N(t+1)}{Q(t)K(t+1)} \right)$$

- A decline in asset values boosts spread (X), lowers investment; similar implications for some exogenous shocks, such as an increase in idiosyncratic risk of investment projects

Incorporating Financial Frictions into Macroeconomic Models – Intermediation

- Extensions to models of intermediation
 - Use models of frictions for nonfinancial firms to think about intermediaries
 - Example: Impose a capital/leverage constraint on intermediaries, much in the same way an exogenous collateral constraint might be imposed, to think about influence of balance sheet conditions for macroeconomic outcomes
- Such extensions need to think about special features of intermediaries. For example, intermediaries
 - Finance investment and provide liquidity services
 - Have access to cheap debt-like financing because of liquidity services associated with deposits/short-term liabilities, taxes, or other features – creating high leverage
 - Engage in maturity transformation – financing long-term investment (lending) using short-term liabilities

Incorporating Financial Frictions into Macroeconomic Models – A Model of Intermediation

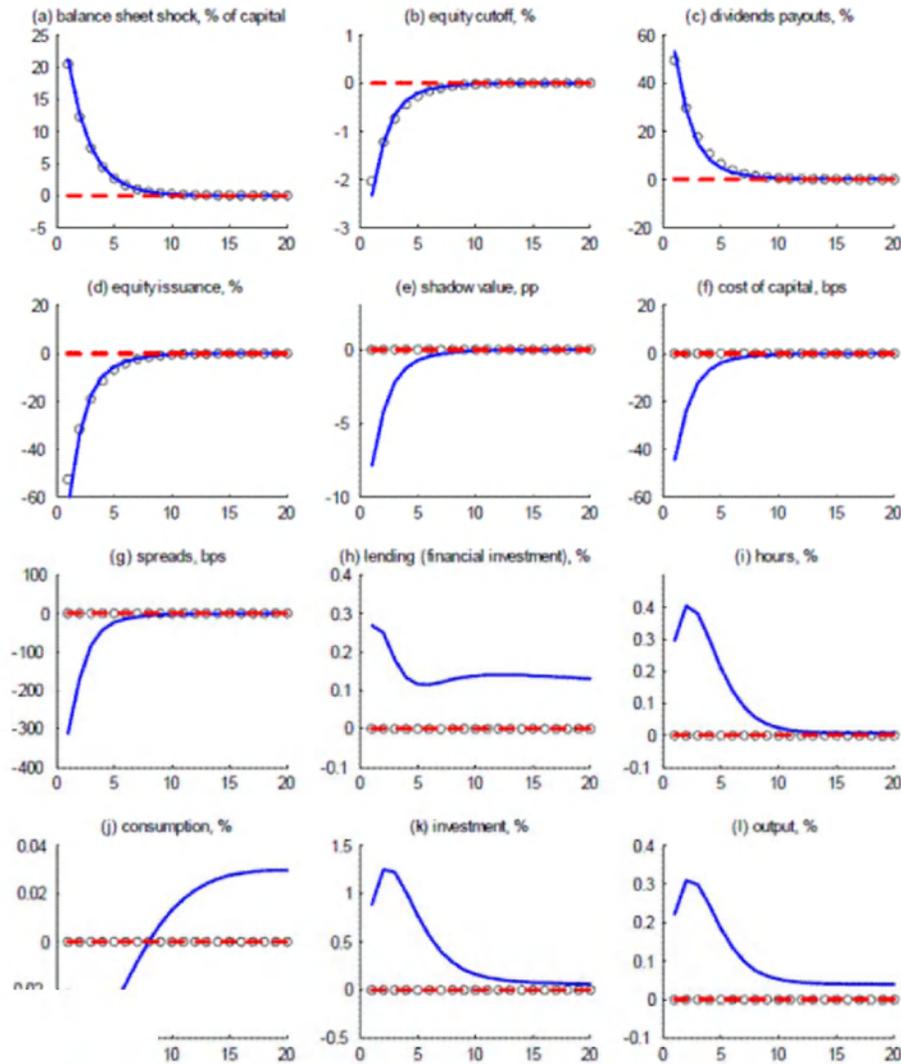
- A model of intermediaries in the presence of financial frictions (Kiley and Sim (2011), (2012))
 - **Intermediaries are essential** – households direct investment activities through intermediaries
 - **Debt financing is cheap** (liquidity services, tax preference), but bankruptcy is costly (limited recovery)
 - Internal funds cheaper than external funds (e.g., **costly to issue equity**)
 - **Maturity mismatch** – timing of returns creates funding risk, yielding time-variation in the value of cash on the balance sheet and hence willingness to lend (precautionary behavior)
 - Implications: **Capital policy** that trades off benefits of debt financing and the risk of having to raise external funds
- Key equation and implications: Pricing equation for lending rate
 - $M(t+1)X(t+1)$ is the stochastic discount factor of the intermediaries, which prices assets throughout the economy as household savings are channeled through intermediaries

$$1 = E_t M(t+1)R(t+1)X(t+1)$$

- Similar to He and Krishnamurthy (2010), who assume risk-averse intermediaries
- Precautionary behavior of intermediaries reflects mis-match between assets and liabilities – lending commitments that cannot be unwound in response to changes in value of assets
- Key role for “willingness to lending” (e.g., Lown and Morgan (2006))

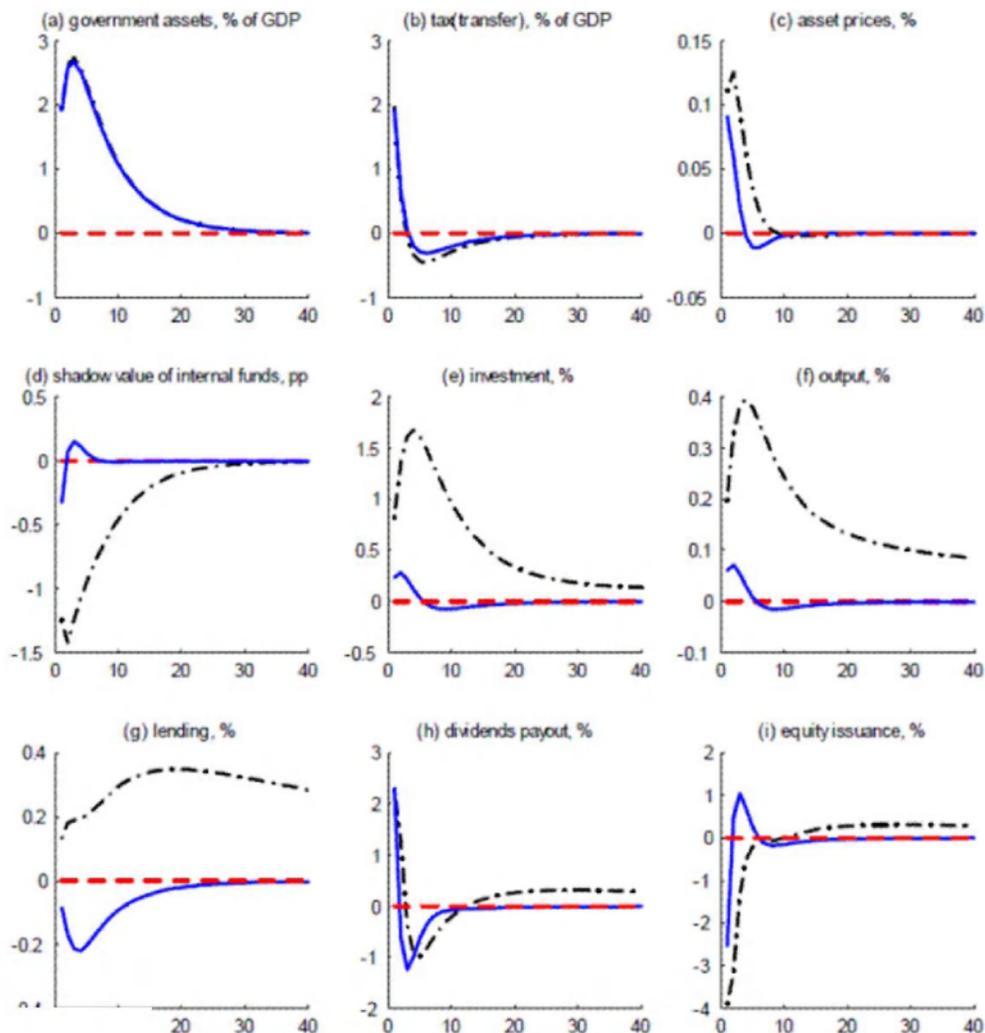
Incorporating Financial Frictions into Macroeconomic Models – Some Model Implications

- **Willingness to lend** is adversely affected by any adverse shift in balance sheet condition/risk



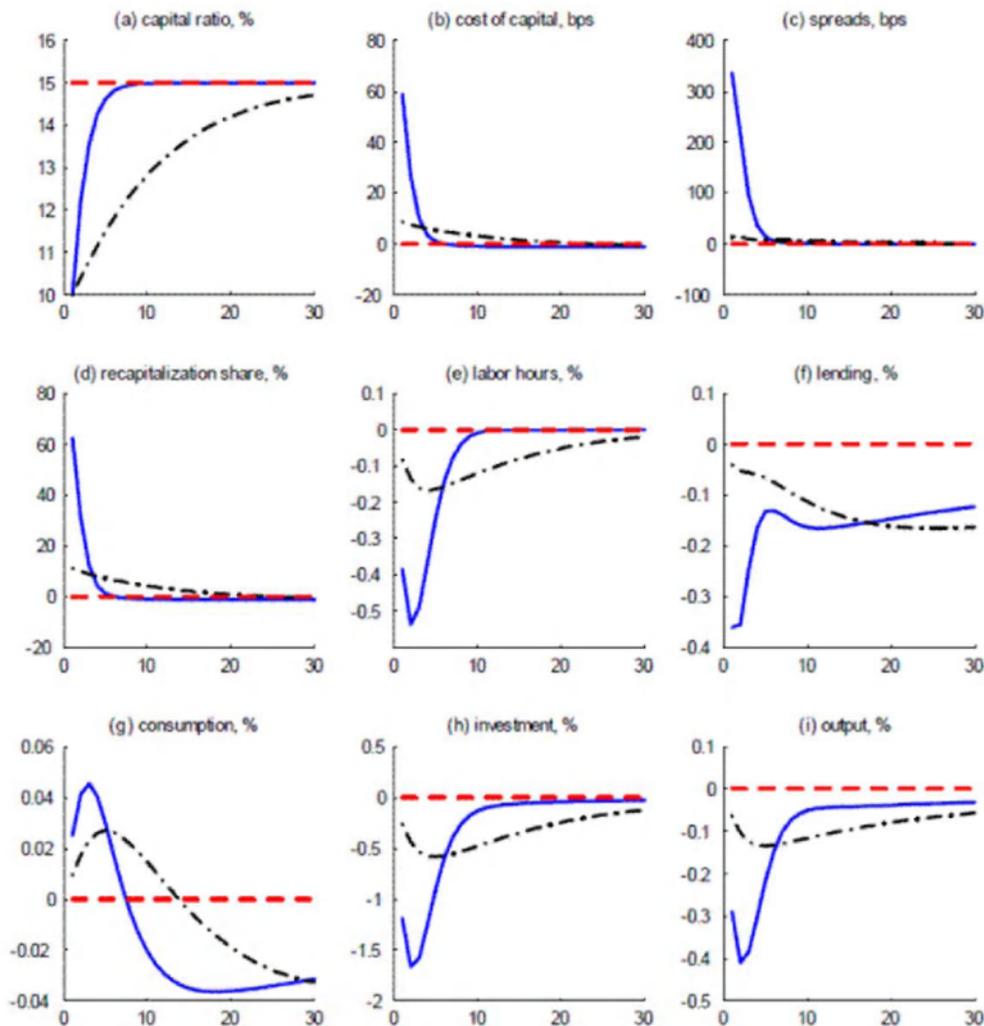
Incorporating Financial Frictions into Macroeconomic Models – Some Model Implications (2)

- **Crisis policies** – capital injections differ from asset purchases because of *crowding out*



Incorporating Financial Frictions into Macroeconomic Models – Some Model Implications (3)

- **Transition to Basel 3** – slow transition may lower transition effects by facilitating capital accretion using internal funds



Incorporating Financial Frictions into Macroeconomic Models – Further Examples

- Crisis policies such as
 - Capital injections vs. asset purchases (Kiley and Sim (2011, 2012))
 - Government-financed intermediation (Gertler and Karadi (2011,2012))
- Implementation of Basel 3 (BIS (2010), Kiley and Sim (2011))
- Research questions relating to macroprudential regulation
 - Stabilization properties of policies that adjust capital requirements in response to credit indicators (e.g., Christensen, Meh, and Moran (2011))
 - This research investigates questions raised by, for example, the Basel 3 countercyclical capital buffer proposals from the BIS (for a discussion and references, see Edge and Meisenzahl (2011))
 - Examine alternative macroprudential approaches – e.g., leaning against financing spreads (Kiley and Sim (2012))
 - Cyclical adjustment of loan-to-value ratios
 - Leaning against the wind through LTV adjustments may ameliorate housing cycles (Lambertini et al (2011))

Incorporating Financial Frictions into Macroeconomic Models – Some Important Challenges

- Asset prices don't move a great deal in response to many shocks in dynamic general equilibrium models
 - Amplification of shocks through financial frictions requires significant asset price movements
 - Therefore, models rely on large, exogenous fluctuations
 - As a result, macro models may not provide a lot of insight into emerging fragility – that is, how seemingly small shocks may lead to significant fluctuations
- Models typically only model a small degree of heterogeneity and of financial flows
 - Example: Models in which intermediation is essential often ignore or have trivial treatments of equity and debt financing by nonfinancial firms
- Macro models typically ignore interconnectedness and importance of large institutions
 - Network approaches are not intertwined with dynamic macro model agenda to date
- Models are importantly shaped by issues related to tractability
 - Models are typically small
 - Models are most often solved via perturbation methods – highly nonlinear aspects (e.g., an occasionally binding constraint, or dynamics not easily captured by a local approximation) are therefore not considered

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