

# CAPITAL STUDY REPORT: USE OF MARKET DISCIPLINE



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The Committee on Capital Markets Regulation  
125 Mount Auburn Street, 3<sup>rd</sup> floor  
Cambridge, MA 02138  
[www.capmksreg.org](http://www.capmksreg.org)

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**CAPITAL STUDY REPORT:**  
Use of Market Discipline

A Report by the Staff of the  
Committee on Capital Markets Regulation

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## Executive Summary of Policy Recommendations

This study by the Committee on Capital Markets Regulation (the “Committee”) examines a balanced approach to capital regulation that enhances private market discipline while strengthening the complementary role of government-imposed capital requirements. A regulatory approach that recognizes the dual roles of government and the private market in setting appropriate capital levels at financial institutions will result in a stronger and safer financial system than can be achieved through public regulation alone. The Committee believes that the approaches outlined below will achieve the desired goal of a more robust financial system:

- **Capital should primarily consist of “going concern” capital.** The strongest form of capital is common equity, which can absorb losses without disrupting the ongoing operations of the financial institutions (hence, “going concern” capital). Alternative forms of capital that only absorb losses after converting to common equity through a regulatory trigger, such as contingent capital, are much less stable forms of capital. These forms of “gone concern” capital should be disfavored by regulators.
- **Capital adequacy in regulatory stress test scenarios should be based on market assessments.** The appropriate amount of terminal capital under a stressed scenario that is deemed sufficient to “pass” the stress test, should be considered from the perspective of the market. In an economic environment in which a financial institution suffers severe losses, the market’s opinion of capital adequacy may differ substantially from government-imposed minimums. Since the ongoing viability of the financial institution depends crucially on the confidence of the market, a market-driven assessment of adequate capital is necessary for effective stress testing.
- **Regulatory stress tests should have both common designs and bespoke components.** Stress tests allow regulators to evaluate the systemic risk implications of an adverse macroeconomic environment by looking at the aggregate effects across all financial institutions. To this end, regulators should subject each financial institution to common stressed scenarios so that results can be compared and the stability of the financial system as a whole can be evaluated. Stress tests also give regulators insight into specific vulnerabilities at individual financial institutions that may present themselves in different scenarios for different banks. To identify the bank-specific risks, regulators should also conduct stress tests under bespoke stressed scenarios designed for each individual institution.

- **Public disclosure of stress test results should depend on the macroeconomic environment.** During “normal” times in the business cycle, stress tests results should be presented on an aggregate basis without disclosure of bank-specific results. During times of crisis, when market uncertainty heightens the importance of confidence in specific financial institutions, stress test results should be disclosed at the individual bank level in addition to aggregate results.
- **Banks should hold minimum levels of junior debt.** Creditors of financial institutions are incentivized to monitor bank capital levels and therefore impose the best form of market discipline. Regulators can use market signals, such as the yield or the price of a credit default swap (“CDS”) on the junior debt, to gauge the capital adequacy of financial institutions. Banks that breach a maximum yield or CDS price should be subject to immediate stress tests to determine whether the institution should improve its capital position or be wound down.
- **Banks should provide more transparency to the markets.** Increased disclosure requirements will allow the market to make a well-informed determination of bank’s capital adequacy and, consequently, enhance market discipline. Specific areas for improved disclosure include (i) asset composition, (ii) funding liquidity, (iii) interest rate risk, (iv) credit risk, and (v) performance of core business lines.

## I. INTRODUCTION

Imposition of capital requirements is a significant approach to regulating banks and reducing the systemic risk concerns associated with bank failure. Generally, capital requirements refer to mandatory minimum levels of equity and subordinated debt (i.e. “capital”) that banks are required to hold as a percentage of their overall capitalization. Capital requirements can take the form of a simple leverage ratio, which compares the bank’s capital to its total assets, or more complicated measures that include risk-weightings of assets. To date capital requirements have taken a variety of forms that involve multiple measures of capital and indicators of capital adequacy. Capital requirements can be imposed directly through explicit government regulation, such as through domestic implementation of the international Basel accords, or indirectly, such as through market mechanisms that may penalize an undercapitalized bank by increasing its funding costs.

The primary purpose of capital requirements, whether imposed by the government or by the market, is to ensure a minimum level of capital capable of absorbing a bank’s potential losses. Government-imposed requirements are designed to protect taxpayers from having to fund bailouts and to counteract the introduction of moral hazard that arises from implicit public guarantees and deposit insurance. Market-based mechanisms indirectly impose capital requirements by determining a bank’s cost of capital; banks with a higher level of equity are often rewarded with a better credit rating and a lower cost of capital.

While both public and market mechanisms for imposing capital requirements have a place in a sound financial system, an important lesson of the recent financial crisis is that government-imposed capital requirements, in particular the Basel framework, have been inadequate in achieving their objectives.<sup>1</sup> In the run up to the crisis in 2007–2009,

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<sup>1</sup> See *The Global Financial Crisis: A Plan for Regulatory Reform*, Committee on Capital Markets Regulation, May 2009.

the top twenty U.S. banks had average capital ratios of 11.7%, an average ratio that was 50% higher than the 8% minimum imposed by federal regulators.<sup>2</sup> Many banks that appeared to be well capitalized under the prevailing regulatory standards still faced significant challenges.<sup>3</sup> The financial crisis exposed the limitations of these capital requirements. Yet, the regulatory reaction has primarily focused on recalibrating these same government-imposed capital standards. An example of this recalibration can be found in Basel III raising the minimum level of common equity from 2% to 7% of risk-weighted assets.<sup>4</sup>

While there is room for regulators to monitor and refine capital adequacy standards, there are limits to the effectiveness of government standards. Governmental regulators are notoriously inefficient and ineffective at pricing risk, characteristics that undermine their ability to designate appropriate mandatory capital standards. This is borne out by the history of capital regulation via the Basel accord, where some risks have been overcapitalized and others undercapitalized. An optimal financial regulatory regime should instead emphasize the market's role in determining capital adequacy. In general, the private market is much more effective and efficient at pricing risk than regulators, so policymakers should pursue a market-based approach that enhances the market discipline of banks.

This study conducted by the Committee on Capital Markets Regulation examines the effectiveness of both government and market-based capital requirements, with the goal of improving the market-based approach and further incorporating market discipline into a well-balanced regulatory policy. The first stage of this study involved the work of six scholars who authored papers for the Committee that discuss ways to improve market discipline. In *Market Discipline and Capital Regulation*, Arturo Estrella examines the potential for various financial instruments to enhance the role of market discipline in

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<sup>2</sup> Id.

<sup>3</sup> For example, Citi's tier-1 capital ratio never fell below 7% during the crisis and was 11.8% in December 2008.

<sup>4</sup> Press Release, Basel Comm. on Banking Supervision, Group of Governors and Heads of Supervision Announces Higher Global Minimum Capital Standards (Sept. 12, 2010), <http://www.bis.org/press/p100912.pdf>

capital regulation and systemic stability.<sup>5</sup> The instruments discussed include subordinated debt, contingent capital, and capital insurance. In *Measuring Equity Capital for Stress-Testing Large Financial Institutions*, Mark Flannery explores the standard for evaluating a bank's performance during a stress test.<sup>6</sup> The paper argues that capital should be defined narrowly and should include any fair market value adjustments to the bank's balance sheet. In *Stress Testing Banks*, Til Schuermann discusses stress test design issues, including optimal construction of the stress test's adverse economic scenario and the modeling of a bank's balance sheet and income statement under that scenario.<sup>7</sup> In *Should Banks' Stress Test Results be Disclosed? An Analysis of the Costs and Benefits*, Itay Goldstein and Hareesh Sapra consider the potential costs of disclosing stress test results with a focus on the effects of disclosure on bank behavior and market behavior.<sup>8</sup> The paper argues that while some disclosure can enhance market discipline, too much disclosure can exacerbate inefficiencies. Finally, in a presentation on *Improving Public Bank Disclosures*, John Lester outlines the results of an Oliver Wyman survey of bank analysts who provided suggestions for improving bank disclosures.<sup>9</sup> The papers are attached in the Appendix.

This study considers the major results of these commissioned papers as well as outside proposals for enhancing the role of market discipline with the goal of providing specific policy recommendations that the Committee believes can serve as a useful guide for regulators. The rest of the paper proceeds as follows. Section II discusses the role of regulatory capital requirements, including the traditional objectives in setting capital requirements and an analysis of the government's role in achieving those objectives with emphasis on the use of stress testing. Section III discusses the role of the market in determining capital adequacy standards, beginning with an outline of the conditions that

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<sup>5</sup> Arturo Estrella, *Market Discipline and Capital Regulation*, prepared for the Committee on Capital Markets Regulation, March 2012.

<sup>6</sup> Mark J. Flannery, *Measuring Equity Capital for Stress-Testing Large Financial Institutions*, prepared for the Committee on Capital Markets Regulation, April 2012.

<sup>7</sup> Til Schuermann, *Stress Testing Banks*, prepared for the Committee on Capital Markets Regulation, April 2012.

<sup>8</sup> Itay Goldstein and Hareesh Sapra, *Should Banks' Stress Test Results Be Disclosed? An Analysis of the Costs and Benefits*, prepared for the Committee on Capital Markets Regulation, April 2012.

<sup>9</sup> John Lester, *Improving public bank disclosures: Bank analyst survey*, presentation prepared for the Committee on Capital Markets Regulation, April 2012.

are necessary for market discipline to be effective, continuing with an examination of the channels through which market discipline can be imposed, and concluding with a set of proposals. Section IV concludes.

## II. REGULATORY CAPITAL REQUIREMENTS

The role of capital requirements as a feature of bank regulation has varied throughout U.S. financial history. In contrast to the recent practice following the Basel accords, bank regulation and supervision prior to 1980 did not include explicit universal capital requirements. Instead, in evaluating a bank's health, regulators focused on a variety of factors that included the strength of management and the riskiness and overall quality of the loan portfolio.<sup>10</sup> Capital ratios were largely downplayed and strict requirements were not imposed.<sup>11</sup> In the past thirty years, however, bank regulation has coalesced around the setting of specific capital requirements for banks.<sup>12</sup> Unfortunately, the existence of these regulatory capital standards failed to prevent the financial system from nearing the brink of collapse in 2008. Banks that were effectively compliant under the Basel II framework before the crisis proved unable to survive the crisis without financial support.

While the perceived effectiveness of regulatory capital was undermined by the 2008 financial crisis, the post-crisis regulatory strategy has simply been to recalibrate and enhance the existing framework for government-imposed capital requirements rather than to pursue alternative approaches. The leading post-crisis reform proposal on which there is broad international consensus is the Basel III capital regulation framework, developed by the Basel Committee on Banking Supervision of the Bank for International Settlements (BIS) in late 2010. Basel III implements a series of amendments to the capital adequacy standards embodied in the previous capital regulatory architecture under Basel I and Basel II. It thus represents a further augmentation of the government-led

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<sup>10</sup> FDIC, *Basel and the Evolution of Capital Regulation: Moving Forward, Looking Back*, Jan. 14, 2003.

<sup>11</sup> *Id.*

<sup>12</sup> These capital requirements have included, at different points in time, leverage ratios and ratios of capital to risk-weighted assets.

mandatory capital approach. Among other things, Basel III raises the minimum common equity capital ratio requirement, introduces the concept of a “countercyclical” capital buffer, and extends capital regulation to non-bank systemically important financial institutions (SIFIs). It also introduces a minimum leverage ratio of 3%, calculated as total equity capital over total un-weighted consolidated assets, thus requiring the same amount of capital for high-risk and low-risk assets. On July 9, 2013, the Board of Governors of the Federal Reserve System approved a final rule to establish a new regulatory capital framework that brings the U.S. into substantial compliance with the Basel III capital framework.

**a. Traditional objectives for capital requirements**

Assessing the efficacy of capital requirements, both regulator- and market-imposed, requires first considering the traditional objectives of these requirements. It is only after identifying the purpose of capital requirements that an evaluation of various enforcement mechanisms is possible.

- *Objective 1: Mitigate systemic risk by preventing bank failures*

The first objective of capital requirements is to address the systemic risk concerns that arise with bank failures. The underlying premise is that preventing individual bank failure can help stave off a system-wide collapse. This micro-prudential approach to regulating the financial system is straight forward – the more capital a bank has, the less likely it is for the bank to fail, and the more stable the system. However, as will be discussed below, the primary flaw in this approach is that holding capital is costly for financial institutions. Any level of mandatory capital that is reasonable is unlikely to prevent bank failure in times of crisis, which is precisely the time when bank failure becomes relevant to systemic risk concerns.

- Objective 2: Reduce public cost

The second objective of regulatory capital requirements is to reduce the public cost of insuring financial sector liabilities. This cost is incurred through explicit deposit insurance or as the result of implicit government guarantees. Capital serves as an insurance deductible that absorbs banks losses before reaching insured liabilities, thus reducing the potential cost to the government and taxpayers who will be responsible for funding any bailout. Capital only serves this objective if equity holders are wiped out. All capital must be depleted in the event of bank failure for the deductible-like feature of capital to hold true.

- Objective 3: Minimize moral hazard

A third objective of capital requirements is to minimize the moral hazard that is created by the existence of explicit insurance or implicit government guarantees. Similar to an insurance deductible, capital requirements can stem moral hazard by reducing private actors' incentives to incur risks the costs of which they will not ultimately bear.<sup>13</sup> While the public cost objective seeks to minimize the cost of any bailout to the public, the moral hazard objective seeks to prevent a public payout in the first place by aligning public and private interests; the idea being that “capital reduces incentives for incurring risks.”<sup>14</sup> This works in the same way as an insurance deductible. Any insurance provider is concerned about the ex post behavior of the insured party – i.e. moral hazard – so a deductible serves to align the interests of the insured party with the insurer and helps to mitigate the moral hazard concerns. While similar to the cost-minimization objective, the primary justification for capital in this regard is to prevent a public payout in the first place by requiring more “skin-in-the-game.”

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<sup>13</sup> Martin Hellwig, *Capital Regulation after the Crisis: Business as Usual?*, Max Planck Institute for Research on Collective Goods (July 2010).

<sup>14</sup> Id.

- Objective 4: Reduce the cost of debt

A final objective of capital requirements is to reduce the cost of debt issuance to the bank. This objective is the primary determinant of bank capital levels and explains why banks have historically held capital well above regulatory minimums. Creditors' demand for yield on bank debt often varies inversely with the level of capital maintained by the bank; a higher level of equity capital provides a buffer against losses for debt holders and results in a lower cost of debt for the bank. While the first three objectives exist against the backdrop of government regulation, this objective originates entirely from the market and exists independent of government intervention.

#### **b. Assessment of current government-imposed capital requirements**

Given the bold objectives of capital regulation, the ability of the government to achieve these objectives when setting regulatory capital requirements must be examined. Since capital regulation imposes costs on private institutions, the presumptive justificatory premise for government intervention and capital regulation is that it achieves the above objectives, and in particular that of preventing bank failures and minimizing moral hazard – thus pre-empting ex ante the systemic risks that arise from such events. If capital regulation does not achieve these objectives, it would impose costs without achieving its promised benefits; in that case, it would be wiser to shift the regulatory focus towards enhancing market discipline.

There are several reasons to believe that regulators are unlikely to achieve the first objective of preventing bank failures. First, setting an optimal capital requirement for the purposes of preventing failure is notoriously difficult and primarily an exercise in pricing risk. While regulators certainly do have expertise in the area of bank regulation, they are generally less effective and less efficient at pricing risk than the private market. Regulators engage in risk pricing through the assignment of risk weights to various assets classes for capital adequacy purposes; an exercise that involves inherent political constraints. For example, the risk weightings that were placed on mortgage-backed

securities had less to do with the riskiness of the asset and more to do with a social policy of promoting home ownership. Because of these political constraints, the regulators may not be in the best position to price risk for capital requirements that are aimed at preventing failure.

In pursuing these objectives, definitional difficulties have continually posed a challenge to government capital regulation. The tiered approach devised in the Basel I framework classified assets based on categorical classifications. While this had the advantage of simplicity and clarity, it was equally useless as a definition by virtue of its arbitrariness. Basel I also employed an arbitrary system for risk-weighting assets – notably failing to discriminate properly between risks among private borrowers and sovereign debt, a major distortion of economic realities. Basel II attempted to improve on these shortcomings, but as a result made definitions more complex without necessarily improving the system. The Basel II framework relied heavily on rating agencies, whose inaccuracies and structural weaknesses were exposed by the 2008 financial crisis. In particular, allowing banks to use IRB risk weighting led to increased complexity in modeling of risk, but without corresponding accuracy.

The increasing complexity of capital regulation comes with both social and private costs that are not accompanied by any corresponding benefits in accuracy of risk pricing. As Andrew Haldane of the Bank of England argues in his paper, *The Dog and the Frisbee*<sup>15</sup>, the complexity of capital regulation in its modern form actually makes it sub-optimal as compared to a simpler capital regulation formula. Haldane shows that a market-based simple leverage ratio significantly outperforms the complex Basel III capital ratios as an indicator of bank insolvency, thus undermining the project of government capital regulation altogether. However, leverage ratios have their own flaws. The primary problem with a leverage ratio is that it effectively assigns a 100% risk weight to all assets, irrespective of the actual riskiness of the asset. This encourages bank

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<sup>15</sup> Andrew G. Haldane, *The Dog and the Frisbee*, Federal Reserve Bank of Kansas City's economic policy symposium, Jackson Hole, Aug. 31, 2012.

managers to increase exposure to risky assets, thus rendering the bank *more* susceptible to failure, counter to regulators' goals.

Further, it is not clear that regulatory capital aimed at preventing individual bank failure mitigates systemic risk to a significant degree. Underlying the capital regulation approach is a presumption that a financial crisis is triggered by actual failure of individual financial institutions, which would trigger related failures through asset- and liability-side interconnectedness, and that capital requirements therefore help to lower the risk of crisis by reducing the likelihood of such failures taking place. This presumption is severely put in question by this Committee's 2012 paper, *Interconnectedness and Contagion*, which argues that contagion, and not interconnectedness, was the dominant source of systemic risk during the recent crisis.<sup>16</sup>

The Committee's contagion study shows that regulation that achieves the objective of cushioning losses to individual financial institutions still leaves the most serious source of systemic risk – financial contagion through indiscriminate “run” behavior - substantially unaddressed.<sup>17</sup> While providing some degree of loss-absorption buffer for financial institutions, capital requirements are insufficient to deal with tail-risk crisis events – precisely the situation that regulators ought to be concerned with.

The government is also limited in its potential to achieve the third objective of capital regulation, mitigating moral hazard. Relatively small increases in the required level of capital, such as Basel III's requirement of 7% common equity plus a buffer, will not substantially reduce the incentives of bank management to take risky bets in anticipation of a large payoff. Clearly, there are also political reasons to mitigate moral hazard, however, since public perception suggests that moral hazard is a major problem

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<sup>16</sup> For a discussion of the effectiveness of capital requirements as a solution to financial contagion, see *Interconnectedness and Contagion*, Hal Scott and the Staff of the Committee on Capital Markets Regulation, Nov. 2012.

<sup>17</sup> See *Interconnectedness and Contagion*, Hal Scott and the Staff of the Committee on Capital Markets Regulation, Nov. 2012.

with financial institutions. Larry Summers has labeled those with excessive moral hazard concerns as “moral hazard fundamentalists.”<sup>18</sup>

While the government is unlikely to achieve the first and third objectives, regulators potentially have a role to play in achieving the remaining two objectives of capital requirements – reducing public costs and reducing the cost of debt issuance. Reducing public costs is directly achieved through capital requirements since the losses borne by equity and subordinated debt holders will not be imposed on the government. Capital as a deductible is a direct saving to the provider of insurance, whether it is explicit or implicit insurance. In this way, capital requirements reduce the public cost of insuring, explicitly or implicitly, financial sector liabilities. Capital requirements also reduce the cost of debt issuance, since higher capital corresponds with safer, and therefore, cheaper debt.

Despite the potential for the government to achieve two of the objectives of capital requirements, there are problems with relying exclusively on the government to serve these functions. Just as there are doubts about the government’s ability to appropriately price risk, there is also a concern with the ability of regulators to come up with the optimal level of capital to achieve those other objectives. Indeed, given the regulatory complexity and the difficulties for formulating appropriate government capital requirements, there seems to be a strong case for leaving judgment about the appropriate level of bank capital to the markets and private firms. However, problems arise with markets judging capital adequacy if the markets are not at risk of loss. Credit ratings do provide a level of assessment in the face of this problem, but effective market discipline ultimately relies on a private market that fully suffers the consequences of a bank’s failures.

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<sup>18</sup> See Lawrence Summers, *Beware Moral Hazard Fundamentalists*, FIN. TIMES, Sept. 23, 2007.

### **c. Assessment of government-conducted stress tests**

While regulators face challenges in achieving the objectives of capital regulation by setting nominal capital requirements, they also play a crucial role in conducting stress tests. Stress testing is a forward-looking tool that produces valuable information for market participants because it simulates scenarios relevant to evaluating capital adequacy; a stress test is a dynamic analysis of a bank's balance sheet, income statement, and capital adequacy conducted under various scenarios of adverse macroeconomic conditions. The specific details and procedures of a stress-testing program are critical to the stress test's effectiveness as a regulatory tool. In assessing stress tests, a thorough consideration of three areas is necessary: (i) appropriate measures of capital, (ii) stress test design, and (iii) disclosure of stress test results. The first two topics are explored below and a discussion of optimal disclosure policies can be found in Section III.

#### **i. Appropriate Measures of Capital<sup>19</sup>**

Since stress tests are designed to ensure capital adequacy in extremely adverse states of the world, the exact measurement of capital is of vital importance. Two issues arise in determining the appropriate measures of capital in a stress test. The first issue is a question of how much terminal capital (i.e., capital at the end of the stressed simulation period) is adequate for regulatory purposes. Pro forma capital must be sufficient to convince outside investors, namely short-term creditors, that the bank's capital position is strong enough to ensure balance sheet solvency. It is not enough that regulators are satisfied with the bank's capital levels; the market must be convinced as well. Otherwise, short-term creditors will run on the bank and exacerbate any solvency concerns. In this respect, stress tests should ensure that a bank maintains adequate capital from a market perspective at every stage of the stressed simulation.

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<sup>19</sup> Flannery, *supra* note 6.

While the market's opinion of a bank's solvency is critical for preventing runs, the regulators view also plays a role in the stability of the bank. The market may interpret a "pass" as an implicit guarantee of the bank's continued operation. A regulatory determination of solvency is also self-fulfilling in that it allows the bank to access Federal Reserve liquidity, which in turn makes short-term creditors less likely to run, hence reinforcing the bank's solvency.

Regulators may also wish to distinguish between adequate capital *ratios* and an adequate capital *amount*, expressed in dollars rather than as a percentage. In deciding between minimum ratios and minimum amounts, regulators benefit from a stress test design that applies common adverse scenarios to many financial institutions simultaneously. From a systemic risk perspective, aggregate capital amounts dictate the ability of the financial system as a whole to absorb shocks to the macro economy. A bank that is left with an insufficient capital ratio as a result of a negative shock can respond either by increasing capital or by selling risk-weighted assets. While the sale of assets by a small number of banks may be absorbed by the rest of the market without disruption, a mass liquidation by many banks may cause a downward spiral in asset prices (i.e. a fire sale) that threatens the stability of the financial system. Minimum capital levels would force banks to meet ratio requirements by raising capital rather than shrinking their balance sheet, thus mitigating the fire-sale risk. Therefore, if simultaneous stress tests conducted under common adverse scenarios project widespread capital problems across the entire banking system, this might lead supervisors to set a minimum dollar amount of required capital in addition to a specified capital ratio.

A key issue is how to define capital for purposes of passing the stress test. Dodd-Frank leaves it to the regulators to determine the appropriate definition of capital. Basel III defines Tier 1 capital as items that provide "going concern" risk-absorbency, in which losses can be absorbed by the Tier 1 capital without forcing the bank into insolvency proceedings. Conversely, "gone concern" capital may be instruments such as subordinated debt or hybrid securities that are structured to convert to equity "under regulatory control." To the extent that such a conversion feature allows the bank to

continue its operations uninterrupted, these instruments may be considered adequate capital for regulatory purposes. The value of convertible “gone concern” instruments for purposes of the stress test depends critically on the specific conversion features as dictated contractually and/or legislatively. The strongest forms of capital are common equity and retained earnings via the income statement. In addition, certain “gone-concern” capital, such as subordinated debt, preferred shares, and hybrid securities that do not provide “going-concern” loss absorbency, but that have credible bail-in features should also be considered as potentially adequate capital for regulatory purposes.

Since one goal of the stress test is to ensure adequate capital from the perspective of market participants, the stress test design should incorporate all available asset and liability fair market values in calculating capital, as opposed to accounting book values. Short-term creditors will decide whether or not to run on a bank based on the fair market values, rather than accounting book values. In addition, the stress test should include the value of intangible assets to the extent the market assigns a reliable value to them. Simultaneous stress tests should be able to generate information about the fair market value of intangible and off-balance sheet assets.

## ii. Stress Test Design<sup>20</sup>

While several factors influence the optimal design of a stress test, the result of a successful stress testing program should give a reliable assessment of an institution’s capital deficiency and a credible plan for repairing the deficiency if any is found; from a design perspective, achieving a reliable assessment with meaningful results is the more difficult objective. Stress test scenarios are inherently multi-factored, so factors must be considered dynamically: when one factor moves, the other factors do not necessarily remain fixed. This multidimensionality complicates the design of realistic adverse states of the world in which coherent joint outcomes of all relevant risk factors are specified. Since this process can involve mapping thousands of assets to tens of thousands of risk factors, the rigor of this task must be weighed against the resulting credibility of the test.

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<sup>20</sup> Schuermann, *supra* note 7.

In addition to the daunting dimensionality of optimally-designed stress tests, two central issues should be considered in the stress test design. The first issue concerns the macroeconomic stress scenarios that are modeled. The macro scenario can be a common one that is applied similarly to all tested banks or it can be a bespoke one that directly implicates the particular business mix of an individual bank. Each design offers a particular benefit. A common scenario allows the stress test results to be directly compared across banks. In this manner, the test identifies the weakest banks under a given adverse state of the world (such as a crisis). However, the bespoke design also affords benefits of its own. A test scenario that is bank-specific provides a risk-discovery mechanism to regulators, since this test design reveals a bank's particular sensitivities and vulnerabilities of its specific portfolio of assets. A commonly applied scenario would not necessarily reveal the bank-specific concerns, but a bespoke design makes cross-bank comparison more difficult. Since each of the designs offers valuable information to the regulators, a combination of the two approaches would likely be optimal, similar to the design in the Federal Reserve's 2011 and 2012 Comprehensive Capital Analysis and Review (CCAR), which asked banks to submit results based on their own scenarios in addition to results under the common supervisory stress scenario.<sup>21</sup>

The second important design issue concerns mapping the macro scenarios to micro outcomes. That is, given a particular macro stress scenario (whether common or bespoke), how are the risk factors under that scenario mapped into a corresponding micro outcome for the bank? How is the bank's portfolio of assets affected by the changing macro factors? The process of mapping macro factors to micro effects will involve fundamentally different designs when assessing the banking book versus the trading book.

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<sup>21</sup> Id. at 8.

#### a. Banking book

In modeling banking book losses, geographic heterogeneity comes into play. Regional differences are critical when modeling losses in lending. Therefore, a stress test design that takes into account such geographic heterogeneity is of crucial importance. Furthermore, loss given default (LGD) estimates of the loan portfolios must be coupled with the business cycle, as this coupling is an important feature of a credible stress test. Stressed LGD's do not necessarily increase during a recession. For example, auto loan defaults may have lower LGD's in a recession since the value of the collateral, a used car in the case of an auto loan, may actually increase. On the other hand, LGD's may increase if an entire industry is in distress. For example, aircraft loan defaults have higher loss severity if other firms are not in a good position to purchase the aircrafts. As a result, a credible stress test should consider and provide guidance regarding conditional LGD's and probabilities of default in certain times of stressed economic conditions. Factors that should be considered include loss severity due to the particular stage of the business cycle as well as industry and regional factors. Stress tests will lack credibility if stressed LGD's do not reflect all relevant conditional variables.

#### b. Trading book

In modeling the trading book losses, a key dynamic that should be considered is the counterparty risk of a derivative position. Not only does a negative shock under adverse conditions affect the value of the derivative position, but it also affects the probability of default of the counterparty to that position. Increases in counterparty default put downward pressure on the value of a bank's derivative portfolio. Furthermore, the value of the non-cash collateral held against a derivative position may also have to be revalued under the stressed conditions. While the dynamics of counterparty risk and non-cash collateral have crucial implications for a bank's capital position in a crisis, they have received little attention to date. A credible stress test should address those issues. Finally, the revenue coming out of the trading book must be carefully modeled for an accurate depiction of a bank's capital position. Interest income is a function of the yield curve and

credit spreads under a stressed scenario, while non-interest income must be assessed with extensive discussion of its determinants.

c. Income statement and balance sheet

Finally, post-stress capital adequacy of a bank requires modeling both the income statement and the balance sheet. While the balance sheet provides the snapshot of the bank's capital position for calculation of capital ratios, the interaction of the income statement with the balance cannot be ignored, as retained earnings are a major source of capital. Typically, these financial statements are modeled over a two-year future horizon. In each quarter of such a horizon, the stress test model must consider the nature and amount of new assets that are originated and/or sold during the quarter. An adequate regulatory capital position entails a bank maintaining a capital level above the minimum requirement in each of the modeled quarters.

While regulators have an important role to play in designing and implementing stress tests, a primary objective of stress testing should be the production of information that can then be used by market participants to enforce market discipline. The following section discusses market enforcement mechanisms.

### **III. ROLE OF THE MARKET**

#### **a. Necessary conditions for effective market discipline**

For market discipline to be an effective tool in regulating the financial system, certain features must be present. Maria J. Nieto argues in her paper, *What Role If Any Can Market Discipline Play in Supporting Macroprudential Policy*, that three conditions are necessary for market discipline to be a successful regulatory approach.<sup>22</sup>

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<sup>22</sup> Nieto, Maria J, *What Role, If Any, Can Market Discipline Play in Supporting Macroprudential Policy*, Bank of Spain, Doc. 1202

- Condition 1: Adequate and timely information on financial institutions' risk profiles. Because of high information costs, even markets may not be efficient in practice because private information is not made readily available to all market participants. Financial institutions must be transparent: if markets are to discipline the banks, then it is imperative that the markets have complete and current information regarding a bank's balance sheet and risk profile. Appropriate disclosure standards for accurate and timely information lower information costs and allow the market to effectively discipline banks.
- Condition 2: Financial institutions' creditors consider themselves at risk. Market participants require an incentive to monitor and impose discipline on financial institutions. Financial institutions will only be disciplined by market participants that are at risk of loss. If a financial institution's creditors do not consider themselves at risk, either because of explicit insurance or implicit government guarantees, the market will not have sufficient incentive to conduct costly monitoring activities and appropriate levels of discipline will not be imposed. Shareholders should be first in line to absorb losses, and creditors should know ex ante what the repayment priority will be in the event of an adverse event.
- Condition 3: The reaction to market signals is observable. For a regulator to act on a market signal, the signal must be readily observable to a regulator in a timely fashion. Signals that arrive too late for the regulator to act will not be effective in addressing systemic risk concerns.

A guiding premise in this section is that market discipline is more effectively achieved through debt instruments, rather than equity instruments. Equity holders do not provide appropriate market discipline and stock returns are a poor leading indicator of financial instability because of the limited liability of stockholders and the optionality of large returns that are inherently priced into equity.

## **b. Current Market Discipline**

While the recent financial crisis illustrated a clear need to enhance market discipline, it is important to evaluate the current state of market discipline. Leading up to the crisis, market discipline was primarily imposed upon banks through credit ratings on its debt issuances. Other potential market signals that regulators can use to assess the health of a bank include debt yields and credit default swap (“CDS”) spreads. A primary lesson from the crisis is that all these mechanisms of market discipline have been grossly inadequate.

### **i) Credit Ratings and Market Discipline**

Credit ratings and the resulting cost of debt for firms related to those ratings have been the primary mechanisms to date that impose market discipline on financial institutions. A higher credit rating often leads to a lower required yield on debt issuances and an overall cheaper cost of capital. This effect incentivizes bank management to take actions to maximize the bank’s credit rating. Increasing the bank’s capital level is one such action that can improve a credit rating. A higher level of capital decreases a bank’s probability of defaulting on debt, and therefore, often results in a higher credit rating for the bank.

Although credit ratings have the potential to provide market discipline, there are some serious problems that prevent this mechanism from being effective. A primary factor in the failure of credit ratings is a conflict of interest problem; credit rating agencies are compensated by the issuer. There is an obvious incentive for a rating agency to inflate credit ratings because there are several agencies and an issuer can give business to the one that will award the highest rating. Since the ratings business is a repeated game, even after a debt offering has been issued and rated, the ratings agencies are less likely to downgrade an issuer’s credit rating since doing so would impact any ability to get future business from that issuer. These inherent structural issues compromise the accuracy of the market signals associated with credit ratings: ratings agencies clearly

failed to signal the impending financial distress that many banks, and ultimately the entire financial system, faced prior to 2007.

Notwithstanding those problems, there is some evidence that credit ratings have an effect on the capital decisions of banks and other debt issuing financial institutions – and thus have a useful role to play in enhancing market discipline. Although the literature focuses primarily on the accuracy of credit ratings and the incentive problems of ratings agencies, there is research to indicate that credit ratings have an indirect effect on market discipline by influencing borrowing costs, loan market share, and the value of a firm's equity. In theory, a higher credit rating will increase bank profits by reducing borrowing costs, boosting loan quantity or improving equity return. This creates incentives for higher quality banks to protect their credit ratings, and for lower quality banks to increase their credit ratings.<sup>23</sup>

There is substantial research that also shows credit ratings have an effect on equity and bond valuation. For instance, Hand, Holthausen and Leftwich (1992) find that there are statistically significant effects on bond and stock returns to announcements of downgrades of straight debt. The authors further observe that below-investment-grade bonds are more significantly impacted by downgrades, experiencing 3.82% loss in value on average, when compared with 0.55% for investment grade bonds. This suggests that ratings can have an especially important disciplining effect on banks that are already viewed by agencies as more risky. Similarly, by focusing on equity analyst reactions to ratings changes and the issue of causality, Ederington & Goh (1998) observe that credit ratings downgrades result in negative equity returns, and that equity analysts tend to revise forecasts downwards *because of* the downgrade, and not in reaction to earlier

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<sup>23</sup> See e.g. Matthew T. Billett, Mark J. Flannery and Jon A. Garfinkel, *The Effect of Lender Identity on a Borrowing Firm's Equity Return*, 50(2) THE JOURNAL OF FINANCE 699 (1996). The authors note that, "if a high credit rating raises bank profits (e.g. by reducing borrowing costs or permitting a more extensive derivative business), high quality banks will wish to protect their credit rating". The paper then concludes that "higher rated banks" will have a "stronger *incentive* to monitor effectively". Unfortunately, this paper focuses empirically on the equity performance of corporations who borrow from banks and how that is affected by the banks' ratings – and is thus of not much more use to us.

negative information or contemporaneous earnings numbers.<sup>24</sup> This implies, again, that ratings and ratings agencies have an important role to play in facilitating market discipline; although ratings respond to information that is already in the market, they are “clearly viewed by market participants as providing some new information.”<sup>25</sup>

The importance of ratings and ratings agencies is further evidenced at the level of the individual firm. A study by Graham & Harvey (2002) surveyed 397 Chief Financial Officers (CFOs) and found that credit ratings are the second most important concern for CFOs in determining their firm’s capital structure. Over 57% of the surveyed CFOs reported that credit ratings were “important” or “very important” in how they choose the optimal level of debt in the capital allocation of their firm.<sup>26</sup> Although some effect is visible, the exact nature of the relationship between credit ratings and a firm’s capital decisions is still unclear. There is a scarcity of research in this area, although the available literature makes it clear that there is no simple linear relationship between a firm’s credit rating and its capital decisions: banks do not simply increase their capital level to obtain a better credit rating. In other words, there is no one-directional incentive for all market participants to improve their capital structure in order to obtain an improved rating.

## ii) Market Signals prior to the crisis

The failure of the market to effectively discipline and monitor bank management and shareholders, as experienced in the financial crisis, can occur for a number of reasons. A key reason for failure is that a financial institution’s funding costs may not appropriately reflect the riskiness of the bank’s assets or the fragility of its funding sources.<sup>27</sup> This can result from a lack of transparency on the part of the bank to accurately represent its risk

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<sup>24</sup> Louis H. Ederington and Jeremy C. Goh, *Bond Rating Agencies and Stock Analysts: Who Knows What When?* 33(4) JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS 569, 584 (1998).

<sup>25</sup> *Id.* at 583.

<sup>26</sup> John R. Graham and Campbell R. Harvey, *How do CFOs make Capital Budgeting and Capital Structure Decisions?* 15 THE JOURNAL OF APPLIED CORPORATE FINANCE 1 (2002).

<sup>27</sup> Angkinand, Apanard P., Clas Wihlborg & Thomas D. Willett, *Market Discipline for Financial Institutions and Markets for Information*, Research Handbook on International Banking and Governance, Apr. 2011.

profile or the inclusion of an implicit government subsidy in the pricing of debt. Since funding costs not only discipline a bank's activities but also provide regulators a warning signal about a bank's health, mispricing of funding and incorrect market signaling inhibits managers and regulators from preventing an adverse event. By many accounts, this lack of early warning signal exacerbated the most recent financial crisis. A prime example of this failure occurred during the UK's handling of Northern Rock in 2007.<sup>28</sup> The UK FSA gave this mortgage bank permission to lower its required capital by nearly 30% by adopting the "Advance Internal Measurement Approach" under Basel II. A mere few weeks later, Northern Rock collapsed and was nationalized in early 2008. Not only were any early warning signs absent in this case, but regulators even considered the bank healthy enough to reduce capital by a substantial amount.<sup>29</sup>

CDS spreads can also provide regulators a market signal regarding not only the health of individual financial institutions, but also the stability of the financial sector in aggregate. Empirical research shows that CDS spreads provided a good proxy of bank risk leading up to the financial crisis<sup>30</sup> and CDS spreads indicated an increase of the market perception of systemic risk throughout the financial crisis.<sup>31</sup> However, regulators failed to act on these market driven signals in a timely manner.

### **c. Use of Market Discipline**

Approaches to improving market discipline depend on which aspect of market discipline is being targeted for improvement. Market discipline is provided primarily in two key ways: *direct* market discipline and *indirect* market discipline. Direct market discipline involves the process through which credit markets accurately price a financial institution's risk. As discussed above, the price of risk directly affects the institution's funding costs, which in turn serves to discipline management to the extent that management is incentivized to minimize these funding costs. Indirect market discipline

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<sup>28</sup> Hamalainen, Pop and Howcroft (2008).

<sup>29</sup> Id.

<sup>30</sup> See Laura Chiramonte & Barbara Casu, *Are CDS spreads a good proxy of bank risk? Evidence from the financial crisis*, Working Paper, 2010.

<sup>31</sup> See Stefano Giglio, *Credit Default Swaps and Systemic Financial Risk*, Working Paper, Aug. 2013.

involves the regulators use of market-determined price signals that reflect a financial institution's level of risk. Price signals that exceed a given level may indicate solvency issues and therefore trigger regulatory intervention and prompt corrective action. Bank management may be obligated by regulation to take action that restores the price signal to an acceptable level, which may involve a reduction of funding costs depending on the particular trigger. While many proposals that address market discipline often serve both direct and indirect channels of market discipline, it is important to keep in mind these differences in evaluating the potential effectiveness of a proposed policy.

i) Direct market discipline

Direct market discipline has historically been achieved through the credit ratings on financial institutions. As discussed above, credit ratings have produced questionable results, so additional approaches to direct market discipline must be considered. Regulators can enhance direct market discipline using specific market mechanisms and by accessing improved information. The market mechanisms approach is a direct regulatory requirement that banks issue various financial instruments, such as mandatory levels of subordinated debt. Subordinated debt holders that are subject to losses in the case of default (i.e. with no explicit or implicit government guarantee) will be incentivized to monitor the bank's activities and will impose a level of discipline through the required yield on the debt. A bank will choose a capital level that minimizes the yield and results in market-determined capital adequacy, all achieved through the market mechanism facilitated by regulation. Subordinated debt has been a popular choice of such a market mechanism. The Shadow Financial Regulatory Committee has advocated for a requirement that large depository institutions issue a minimum amount of subordinated debt to enhance the role of the market in disciplining banks and protecting the deposit insurance funds.<sup>32</sup>

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<sup>32</sup> See Statement of the Shadow Financial Regulatory Committee on Requiring Large Banks to Issue Subordinated Debt, Statement No. 168, Feb. 26, 2001.

The effectiveness of market discipline as a complement to capital regulation also relies upon the quality of public information provided by the banks. Regulators can improve direct market discipline through improvement of the transparency of banks, thus reducing the information asymmetry problem that can prevent the markets from accurately pricing the bank's risk in a timely manner. Improving existing bank disclosures therefore becomes a critical component of enhancing the market's role and promoting market-based approaches to capital requirements. There are two main ways that regulators can improve the quality of information that is reflected in market prices. First, regulators can publicly disclose certain official information that is learned through the supervisory process. In particular, regulators can publish the bank-specific results of stress tests. Higher quality information should improve the effectiveness of market instruments in providing discipline on the banks' management. Second, regulators can impose enhanced disclosure requirements on financial institutions and broaden the amount of information that is disclosed to the market.

a. Improved disclosure

A study conducted for the Committee by Oliver Wyman sheds some light on the views of banking industry analysts, credit ratings agency analysts, and senior bank executives on improving the quality of public disclosures.<sup>33</sup> In general, the comparability of disclosure across banking organizations is most important. Heterogeneity of bank disclosures does not allow for adequate comparisons of financial institutions. Such comparison is necessary to ensure efficient allocation of capital and to improve the value of the market signals used by regulators. Definitions should be standardized, line items should be reported consistently, and any inconsistencies between regulatory and GAAP filings should be addressed. Furthermore, additional disclosure should be required of all banks, regardless of size, to ensure that all system-wide material risks are fully understood. The most useful information in this regard is disclosure of downside risks, as opposed to revenue and earnings forecasts. Specific areas for additional disclosure have also been identified. These areas include:

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<sup>33</sup> Lester, *supra* note 9.

- (i) Asset composition. In general, more detailed information is desired on asset breakdown, asset valuation, and asset quality, including any counterparty risk. Specifically, more detailed information is desired on: (i) asset flows, including sales, purchases, and write downs; (ii) banks' internal ratings systems used for asset valuation; (iii) allowances for loans losses (by loan segment), mark downs, and loan-to-value ratios; and (iv) credit ratings, yield duration, and re-pricing time frames.
- (ii) Funding liquidity. In general, there is a recognition that although liquidity risk is difficult to quantify, it directly affects investor confidence. Specifically, more detailed information is desired on: (i) short-term debt, including average, maximum, and period-end borrowings and concentration among the largest creditors; and (ii) well-defined liquidity ratios.
- (iii) Interest Rate Risk. In general, there is a feeling that current models are static and underestimate risk. Specifically, more detailed information is desired for: (i) robust and realistic scenario analyses of interest rate movements; and (ii) an ability to compare across banks the extent to which each is engaging in a carry trade or maturity mismatch.
- (iv) Credit risk. In general, there is a desire for more standardized and consistent reporting on credit risk exposure. Specifically, more detailed information is desired on: (i) net and gross positions; (ii) risk ratings of counterparties; and (iii) the value of risk-mitigating hedges.
- (v) Stress test results. In general, regulator stress test disclosures are viewed as more useful than company-run tests because the Fed test standardizes the stress test process. Specifically, suggested disclosures include: (i) company-run stress tests on trading and loan books; and (ii) company-run stress tests per each segment (commodities, rates, etc.).

(vi) *Performance of core business lines.* In general, detailed segment-by-segment information regarding core business lines is viewed as the best way to assess risks of an institution. Specifically, more information is desired on: (i) market risk statistics (VaR, sensitivity analysis, etc.) for each business line; (ii) granularity on capital markets balance sheets; and (iii) details on quarterly flows onto and off of balance sheets, as well as stock numbers, to understand changes in asset composition.

b. Guiding principles for government policy

There are a number of “informativeness principles” that regulators should consider when implementing new regulation in furtherance of the direct market discipline channel aimed at improved bank transparency.<sup>34</sup> First, it is important that regulators do not negate the incentives for market participants to acquire information privately. Regulation and the disclosure of information that “crowds out” private information will nullify the benefits of market discipline and remove the indirect channel entirely. For example, significant research costs arise in analyzing the mortgage backed securities owned by financial institutions, which can directly affect various market signals including debt yields. If regulators disclose the results of their own analysis of periodic examinations and stress tests that include a review of mortgage backed securities, the market may infer a signal from the regulators that the regulators intend to take action (such as imposing a requirement to increase capital). Any regulatory action will affect debt yields. Therefore, if this regulatory signal dominates the movement of the bank’s debt yields, the markets will be dissuaded from engaging in their own costly analysis of mortgage backed securities, since the private analysis has been crowded out by the regulators. Second, issuers of securities should not be disincentivized to provide information about the characteristics of the securities being issued. Third, regulation should focus on reducing information costs. However, this third principle must be balanced with the first principle. Through their supervisory role, regulators have an

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<sup>34</sup> See Angkinand, et al., *supra* note 27.

advantage over market participants in acquiring certain information more efficiently than the private market. Information that would be prohibitively costly or impractical for market participants to obtain should be made available publicly by regulators. However, information disclosure should not go too far as to sacrifice the first principle of maintaining private incentives for information gathering. The final principle to consider is that regulators should help identify where market failures prevent the acquisition of particular types of information. While the previously discussed third principle is related to the costs involved in information acquisition, this principle focuses on instances where private acquisition of information is not possible at any cost due to an inefficient market friction that prevents discovery of such information entirely. In these instances, optimal mandatory disclosure requirements would address such market friction inefficiencies.

ii) Indirect market discipline

Indirect market discipline involves the monitoring of market signals by regulators. In the case of subordinated debt, higher yields often correspond with higher levels of market-perceived risk, which can warn regulators of impending solvency issues at a bank.

For the market signal to be a credible assessment of the riskiness of the financial institution, the three conditions mentioned above in Section III.a must be satisfied. The market must receive timely and accurate information about a bank's risk profile, creditors must be at risk of loss in the case of default, and the market signals need to be readily observable by regulators. Possible pieces of market information that can serve as an effective signal include CDS prices and subordinated debt yields.

#### **d. Proposals for Enhancing Market Discipline**

##### **i. Market Mechanisms and Instruments**

Enhancing both direct and indirect market discipline in ensuring capital adequacy can be accomplished through particular market mechanisms and instruments.<sup>35</sup> Two ideas must be kept in mind when evaluating the effectiveness of various market-based approaches. First, the availability of information to investors is crucial for any financial instrument to exert market discipline on the issuer. Second, common equity should be seen as the benchmark case when evaluating all other instruments since common equity can unambiguously absorb losses without triggering insolvency. That is, losses imposed on common equity holders never constitute an event of default, which is a key feature of securities that cushion an institution from failure. The instruments considered below include contingent capital and capital insurance. Subordinated debt is then considered with more detailed proposals.

- Contingent Capital

In general, contingent capital is a form of subordinated debt or preferred stock that converts to common equity under a specified regulatory or market-based trigger. Contingent capital, therefore, combines characteristics of debt and equity. The debt-like component retains the tax benefits over common equity and provides protection to senior creditors. However, unlike straight subordinated debt, contingent capital has a conversion mechanism that does reduce the issuing bank's risk of failure. Contingent capital instruments that have been converted to common equity are able to absorb losses without triggering insolvency. This conversion is a convenient mechanism for banks to raise capital without resorting to market issuance, which may take more time and be more costly. The convertibility of contingent capital into equity differs from instruments that are subjected to a regulatory bail-in. Convertibility is an ex-ante feature of contingent capital that is outlined in advance, while bail-in is an ex-post regulatory determination

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<sup>35</sup> Estrella, *supra* note 5.

that converts an instrument into equity that did not have a previously designated convertibility feature.

These benefits, however, are not absolute, since the relative novelty of contingent capital instruments introduces a fair amount of ambiguity. Despite the labeling of contingent capital as debt instruments, there is uncertainty over the tax treatment. The IRS may conclude the conversion feature makes contingent capital sufficiently equity-like and impose similar tax consequences as equity. Furthermore, defining an appropriate trigger for conversion may not be straightforward and could lead to ambiguity about the conditions for conversion. This uncertainty could diminish the credibility of the conversion feature in providing a timely and effective source of equity capital. Finally, contingent capital is much more difficult for analysts to evaluate than straight debt or equity, making it less attractive to investors and potentially much more costly to banks.

- Capital Insurance

Unlike contingent capital that operates on the liability side of a bank's balance sheet, capital insurance provides protection through the asset side, making capital insurance similar to narrow banking proposals that advocate for safer assets. In general, capital insurance is an asset that pays off when either the bank's assets or the assets of the banking system in aggregate fall below a specified value. A bank's capital position is strengthened by the insurance in times of stress, precisely when capital is needed most. In this regard, capital insurance has the benefits of both protecting senior creditors and reducing the bank's risk of failure.

Capital insurance as a viable option relies critically on the willingness of private-sector entities to provide such insurance. Similar to contingent capital, there is uncertainty regarding the pricing of such insurance and whether market participants are willing to make a market in these instruments. Furthermore, efficiency concerns arise with the introduction of capital insurance since it is questionable whether the combination

of safer assets and more equity is consistent with the goals of banking and financial intermediation.

Specific proposals for capital insurance are found in the works of Kashyap, Rajan, and Stein (2009),<sup>36</sup> Caballero and Kurlat (2009),<sup>37</sup> and Admati and Pfleider (2010).<sup>38</sup> Kashyap et al. propose that capital insurance policies be purchased from a private vendor with triggers based on the entire banking industry (as opposed to bank-specific triggers). Caballero and Kurlat suggest insurance contracts sold by the government that can be traded among banks, along with regulations specifying the required amount of insurance a bank must hold at any given time. Admati and Pfleider propose a form of self-insurance in which banks hold extra capital through special purpose vehicles that are structured to protect the senior debt of the bank.

An alternative to capital insurance that utilizes an existing market is the purchase of credit default swaps (“CDS”) on a portfolio of other banks’ credit. The CDS would pay off most when the banking industry is under stress, thus increasing the capital of the bank holding the CDS exactly when it is most vulnerable to failure. This has the advantage of providing a form of capital insurance with financial instruments that are already actively traded. The price of a CDS also serves as a signaling device to market participants; a proposal that uses these prices to signal a bank’s riskiness will be outlined below.

- Subordinated Debt

Subordinated debt lies between equity and senior debt in the pecking order of financial claims on a bank. Senior debt receives payment first, followed by subordinated debt, and then equity. Subordinated debt offers various benefits in advancing the goals of

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<sup>36</sup> Kashyap, Anil K., Raghuram G. Rajan, and Jeremy C. Stein, *Rethinking Capital Regulation*, Federal Reserve Bank of Kansas City Economic Policy Symposium, Mar. 2009.

<sup>37</sup> Caballero, Ricardo J. and Pablo Kurlat, *The ‘Surprising’ Origin and Nature of Financial Crises: A Macroeconomic Policy Proposal*, Working Paper, Aug. 2009.

<sup>38</sup> Admati, Anat R. and Paul Pfleiderer, *Increased-Liability Equity: A Proposal to Improve Capital Regulation of Large Financial Institutions*, Stanford University Graduate School of Business Research Paper No. 2043, Jun. 2010.

capital adequacy. As with any form of debt, subordinated debt offers tax advantages over common equity, making it a more attractive form of funding for the bank. A layer of subordinated debt is also useful in protecting senior creditors, since subordinated debt holders will absorb losses before senior debt holders. Since subordinated debt holders are the first to incur losses in the event of a bank failure, the yields on this debt should be the most correlated with a bank's riskiness. A bank's ability to issue subordinated debt and the price of the issued debt can provide regulators indications of financial strength. The market information included in subordinated debt instruments can be formally built into regulatory rules. Given the valuable information embedded in the market price of subordinated debt issuances, many economists support a proposal that not only *permits* banks to issue subordinated debt to satisfy capital requirements, but also *requires* banks to issue a minimum amount.<sup>39</sup> Regulators can then monitor market signals arising from the issuance of subordinated debt, including the yields demanded by the market. A recent study of UK banks has found that subordinated debt yields do reflect the riskiness of a bank and therefore can be effective as a market disciplining tool.<sup>40</sup> In addition, if there is no market demand for a bank's subordinated debt and the bank is unable to issue any, this signals to the regulators that the market views the banks to be unstable and potentially in need of more capital.

Despite the attractive signaling features of subordinated debt, it does have a limitation. Subordinated debt does not directly reduce the likelihood of a bank's failure. Losses that exceed a bank's equity capital cannot be absorbed by subordinated debt without triggering insolvency proceedings (absent a credible conversion feature). Furthermore, subordinated debt is only triggered when the value of the equity reaches zero.

All of the above market mechanisms for complementing capital regulation involve a weighing of costs and benefits. This exercise is complicated by the overall

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<sup>39</sup> See Shadow Financial Regulatory Committee, *Reforming Bank Capital Regulation*, Shadow Statement No. 160, Mar. 2000.

<sup>40</sup> See Zhang, Zhichao, Wei Song, Xin Sun & Nan Shi, *Subordinated Debt as Instrument of Market Discipline: Risk sensitivity of sub-debt yield spreads in UK banking*, *Journal of Economics and Business* (2013).

untested nature of many of these instruments and the ambiguity over the market's willingness to provide such instruments in sufficient volume to have the desired effects. Despite these challenges, market-based solutions are potentially significant complements to capital regulation. Given the already established markets for subordinated debt, the Committee believes that a subordinated debt requirement is the preferred approach to enhancing market discipline and providing market-based signals to regulators.

The Committee does not recommend that contingent capital instruments or capital insurance be used in a market-based approach. The Committee does find that subordinated debt requirements are a promising approach. Various schemes that use subordinated debt in regulating bank capital have been proposed by leading academics. Two of the most promising proposals are reviewed below.

- *Proposal 1: Credit Default Swap prices as a signal*

A proposal by Oliver Hart and Luigi Zingales uses CDS prices as the primary signal for regulatory action.<sup>41</sup> Under this approach, financial institutions are required to maintain a minimum ratio of junior long-term debt to assets as stipulated in the Basel III proposal.<sup>42</sup> Financial institutions would then be required to hold sufficient equity capital to serve as a loss-absorbing buffer that protects the junior long-term debt. A determination must be made as to how much equity capital the institution should hold. Regulators would not explicitly specify the mandatory level of equity capital, but instead would rely on the CDS price of the required junior long-term debt to serve as a signal of the health of the firm. A CDS is essentially an insurance product: it derives its price based in part on the market's view of the adequacy of a bank's level of capital. The CDS price will fluctuate with the level of capital and with the risk profile of the bank's assets. The market may consider a given level of capital to be adequate under one risk profile, but inadequate if risk increases. As the risk level of the portfolio changes, the market's view of capital adequacy will change, which will be reflected in the prices. Higher CDS

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<sup>41</sup> Hart, Oliver and Luigi Zingales, *A New Capital Regulation for Large Financial Institutions*, Aug. 2010.

<sup>42</sup> Id.

prices correspond with a market view that the bank is not adequately capitalized given its risk profile. Regulators can monitor the price to gauge capital adequacy and rely upon the market to assess the financial condition of the bank. Under this approach, regulators can refrain from engaging in the complex and error-prone process of determining strict minimum capital requirements.

The requirement that financial institutions have enough capital to keep CDS prices at a sufficiently low level is essential to this proposal. Regulators can use these prices as the signal of a bank's financial health. If the price exceeds a given predetermined threshold, the bank has the choice of raising capital in an amount sufficient enough to return the CDS price to an acceptable level or reducing the risk profile of its portfolio. This process can be triggered automatically, with regulatory intervention required only if the CDS price remains too high for an extended period of time. Upon intervention, the regulator would first conduct a stress test to gauge the true financial health of the bank. If it turns out that the bank is healthy, despite its high CDS prices, the regulator would assure the market that the long-term debt is not at risk. On the other hand, if the stress test reveals that the bank is facing distress, a regulatory takeover ensues and the bank is resolved in an orderly fashion.

The Hart and Zingales proposal has a number of benefits. The requirement of a junior level of long-term debt protects other debt holders that pose a systemic risk, such as short-term creditors. Subordinated debt also serves as the primary reference security for CDSs, creating visible signals that regulators can use to evaluate the necessity of direct market intervention. Furthermore, the CDS price itself is transparent signal that regulators can readily monitor on a daily basis. As pointed out by Hart and Zingales, "the CDS is a better indicator than equity because equity prices capture also the upside and thus might disguise the probability of default when the assets are very volatile."<sup>43</sup> Finally, by mandating the use of stress testing, this approach also addresses the problem of healthy financial institutions potentially facing distress despite being solvent.

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<sup>43</sup> Id.

While this approach relies heavily on market mechanism, there are several key points that require regulator involvement, namely the establishment of both the required level of junior long-term debt that must be issued and the CDS price that would trigger regulator intervention. Finally, regulators must establish which particular institutions would be governed by these new regulatory mechanisms.<sup>44</sup>

- *Proposal 2: Subordinated debt yields as a signal*

Evanoff and Wall (2001) propose a mandatory subordinated debt requirement to be used both as a direct market discipline mechanism and as an informative tool for supervisors.<sup>45</sup> This proposal is representative of a family of plans that require financial institutions to issue minimum amounts of subordinated debt, subjecting any institution that fails to issue subordinated debt to regulatory examination. Since subordinated debt holders would be the first to incur losses in the event of a bank failure, the yields on this debt should be the most correlated with the bank's riskiness. The requirement would also have a direct market discipline effect by increasing funding costs for riskier banks. Through the subordinated debt requirements, regulators can extract timely and accurate information from the market. Regulators can then use this information as a signal for potential intervention. In this regard, the Evanoff and Wall proposal is similar in approach to the Hart and Zingales proposal, but uses the yield on the subordinated debt as the regulatory trigger rather than CDS prices.

Evanoff and Wall propose a requirement that the largest banks hold 3% of risk-weighted assets as subordinated debt with five-year maturities. Regulators would monitor the subordinated debt yields, using yield levels and volatility as signals of a bank's riskiness. For instance, subordinated debt that trades at junk-level yields for an extended period of time would inform regulators that a bank may be undercapitalized. Regulatory intervention may follow if the bank's capital position is not strengthened and yields restored to investment-grade level. Another important feature of the proposal is that

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<sup>44</sup> Hart and Zingales suggest a \$200 billion threshold.

<sup>45</sup> Douglas Evanoff and Larry Wall, *Subordinated debt as bank capital: A proposal for regulatory reform*, FED. RESERVE BANK OF CHICAGO ECON. PERSPECTIVES, 24, 2 (2000).

banks would be required to issue subordinated debt at least twice a year, ensuring that they enter the market at regular intervals. Frequent subordinated debt issues would require ongoing monitoring by the market, thus improving the quality of the signals. Furthermore, if a bank fails to meet its issuance requirement, the regulator can infer that the bank is undercapitalized. Other similar subordinated debt plans differ based on the percentage of risk-weighted assets the banks must hold (2-3%), the initial duration of the bonds (2 to 5 years), and how often the banks must enter the market (monthly to biannually).<sup>46</sup>

Evanoff, Jagtiani & Nakata (2007) contend that subordinated debt requirements will produce a deeper, more liquid market for subordinated debt that will improve the signaling quality of yield spreads.<sup>47</sup> The potential downside to using subordinated debt yields as signals is that the instruments are too differentiated and thinly traded, thus creating noisy signals. However, a mandatory subordinated debt requirement with frequent issuances would produce a deeper, more liquid market that demands bank transparency.

Additional proposals suggest variations on the general subordinated debt requirements. Chen and Hasan (2011) propose a regulator-imposed ceiling on subordinated debt coupon rates to prevent banks from gaming the system by bribing investors not to monitor bank activities.<sup>48</sup> Furthermore, their proposal envisions subordinated debt that is convertible, converting into the issuing bank's equity at a pre-determined price. The conversion trigger would be any public support given to the bank, such as a capital injection, liquidity assistance, or direct takeover. Conversion would occur at a penalty price so that subordinated debt investors suffer losses. The risk of loss would incentivize the market to engage in thorough ex ante monitoring to prevent conversion.

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<sup>46</sup> BASEL COMM. ON BANKING SUPERVISION, MARKETS FOR BANK SUBORDINATED DEBT AND EQUITY IN BASEL COMMITTEE MEMBER COUNTRIES, Working Paper No. 12, Aug. 2003.

<sup>47</sup> Evanoff, Douglas D., Jagtiani, Julapa A., and Nakata, Taisuke, The Potential Role of Subordinated Debt Programs in Enhancing Market Discipline in Banking, Fed. Reserve Bank of Kansas City Econ. Research Dept. Working Paper, RWP 07-07, Sept. 2007.

<sup>48</sup> Yehning Chen and Iftekhar Hasan, *Subordinated debt, market discipline and bank risk*, Bank of Finland Research Discussion Papers 20.2011.

## 1. Comparison of the Proposals

The proposal using CDS prices and the subordinated debt proposals are very similar in that they seek to supplement existing bank examinations with market-based assessments. The fundamental difference between them is the signal used to trigger regulatory action. Under both sets of proposals, once the market trigger has been reached, the regulator can conduct stress tests, mandate capital injections, or begin to liquidate the firm in an orderly manner, if necessary. However, the use of CDS prices is preferable to the subordinated debt proposals because of superior information value and increased feasibility.

Multiple studies have found that CDS prices offer a clearer picture of a bank's default risk versus yield levels. Although CDS prices and bond yields are positively correlated, CDS prices vary more due to default risk factors than do yields.<sup>49</sup> As pointed out by Hart and Zingales, the CDS market is superior to bond markets in terms of information discovery.<sup>50</sup> Furthermore, bond yields typically only provide regulators with relative riskiness of banks (i.e. as compared to its peers) rather than absolute default risk.<sup>51</sup> Since regulators are concerned with absolute default risk, bond yields are less informative.

The use of CDS prices as a market signal is also more feasible than subordinated debt yields. In particular, subordinated bond issuances can differ in many respects including the coupon rate and term, making the market for these bonds illiquid and therefore less reliable as indicators of stress. Credit default swaps, on the other hand, are much more standardized contracts that lead to a more liquid market. As a result, CDS prices are a more feasible market signal than subordinated debt yields.

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<sup>49</sup> See Blanco, Roberto, Brennan, Simon, and Marsh, Ian W., *An Empirical Analysis of the Dynamic Relationship Between Investment-Grade Bonds and Credit Default Swaps*, Journal of Fin.60, Oct. 2005. See Lars Norden and Martin Weber, *The comovement of credit default swap, bond, and stock markets: an empirical analysis*, European Fin. Mgmt. 15, 3, June 2009

<sup>50</sup> See Hart and Zingales at 23.

<sup>51</sup> *The Feasibility and Desirability of Mandatory Subordinated Debt*, Report by the Bd. of Govs. Of the Fed. Reserve System and Sec. of the U.S. Dep't. of the Treasury, Dec. 2000

## ii. Stress Test Results and Market Discipline

The information provided by the market instruments in the above proposals can be used by regulators in assessing the health of banks; the market is informative for regulators. However, regulators can also be informative for the market through stress tests. As discussed previously, production of information that the market can use to enforce market discipline is a key objective in implementing a stress test. Therefore, regulators must carefully consider the appropriate level of information disclosure that should accompany stress testing to enhance market discipline.

### a. Disclosure of stress test results<sup>52</sup>

A critical complement to the design of the stress test is the potential effect on market discipline that results from the public disclosure of stress test results. Regulators must consider two questions when determining an appropriate disclosure policy. First, what are the actual effects on market discipline of stress test disclosure? Based on the answer to the first question, the second question is how much and what level of detail should be publicly disclosed? There is a wide range of possible optimal disclosure policies from disclosing nothing to offering complete transparency. The optimal policy may fall between these extremes.

#### i. Effects of Disclosure

Disclosing the results of stress tests can be beneficial in a number of ways, but disclosure also comes with a number of costs. Proper evaluation of a disclosure policy must weigh the benefits against any of the associated costs.

Stress test disclosure produces three primary potential benefits: market discipline, investor confidence, and information precision. Disclosure enhances market discipline by allowing investors and other counterparties to better understand the risk profiles of each

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<sup>52</sup> Goldstein and Sapra, *supra* note 8.

bank. Short-term creditors are less likely to run if there is more clarity about the strength of the bank's balance sheet. Furthermore, given the disclosure of the risk profile, a bank may be less inclined to engage in excessive ex ante risk-taking behavior if the details of such behavior are subject to public dissemination. Disclosure also boosts investor confidence. Not only will investors have better information to assess the stability of the bank, but disclosure of the stress test results also make the stress test procedure more transparent, which increases confidence in the credibility of the regulatory supervision. Improving investor confidence in the banking sector in general has overall positive effects on the macro economy. Finally, disclosure of the stress test results improves the precision of information that capital market participants receive about the economic fundamentals of a bank. More precise information helps ensure that capital is transferred to banks that can make best use of it.

There are also potential costs associated with public disclosure of stress test results. Disclosure may lead to inefficient ex ante behavior by the banks, ex post overreaction by market participants, and counterbalancing negative effects on investor confidence and market discipline. First, if a bank is aware that its stress test results will be released publicly, it has an ex ante incentive to position itself to appear as favorably as possible. As a result, a bank may engage in "window dressing" in which it improves its stress test result even if that improvement entails sub-optimal portfolio allocation or inefficient asset sales. Second, the "beauty contest" nature of public disclosure, in which each bank's results can be compared by the market, may cause market participants to overreact to the public information. The market may put more weight on the disclosed information than is justified by the precision and quality of the information. As a result, capital may be allocated less efficiently than is optimal. Third, investor confidence may swing in a negative direction if stress test results are poor. The market may take a "failing" result as a signal to run on the bank, thus exacerbating any problems the bank may have already had. In this manner, a negative result could be a self-fulfilling determination. On the other hand, the market may react positively to negative information if it is not as bad as the market's worst fears. Finally, public disclosure of stress test results could negatively impact market discipline. Releasing detailed bank information

could chill private acquisition of such information. An analyst will not invest time and resources evaluating a bank if regulators release similar information publicly.

*ii. Level of Disclosure*

As discussed above, even though there are substantial benefits to disclosing stress test results, there are also significant costs involved. It is certainly not clear that more disclosure is always better. In determining the optimal level of disclosure, a distinction could be made between disclosure during crises and disclosure during normal times. Stress tests can have different objectives given the overall macroeconomic context, so a disclosure policy could be flexible in that regard.

During times of crisis there is general uncertainty about the health of the banking system, as was seen in the most recent financial crisis. Given this uncertainty, the market may be unable to distinguish a good bank from a bad bank. In these circumstances, detailed bank-specific stress test disclosure may be useful in instilling market confidence in the healthy banks. If stress test results are released on an individual bank level, it would be important that they are accompanied by detailed descriptions of the exposure of banks to provide the market with enough information to properly assess the relevance of the results.

Conversely, during normal times, or more generally when trust in the banking system has been re-established, stress test disclosure could tip away from individual bank-level disclosure towards a more aggregated disclosure of results. Stress tests results would be released for the banking system in total, without separately identifying those banks that passed or did not pass. Aggregated disclosure would provide the market with the new information that regulators obtained from the stress test, but would not disincentivize market participants from privately producing individual bank-level information. Market discipline would not be compromised under this disclosure policy.

#### IV. CONCLUSION

The Committee's study on capital regulation has examined the complementary roles of the government and the private market in regulating the capital adequacy of financial institutions. Given the traditional goals of capital regulation, private markets can be more effectively positioned to impose discipline and ensure financial institutions maintain an adequate level of capital. A combination of increased information disclosure and targeted use of financial instruments as market signaling devices can lead to more effective market discipline. Successful implementation of these proposals requires cooperation between both regulators and the private sector.

In making its recommendations, the Committee incorporates the findings of six scholars whose work is included in the attached Appendix. Based on the results of these studies, the Committee has prepared specific recommendations for regulators, which address (i) appropriate definitions of capital and regulatory capital levels, (ii) effective stress test design, (iii) optimal disclosure policies for stress test results, (iv) use of market-based signals for regulators, and (v) specific areas for improved bank transparency. The following are a summary of the Committee's specific policy recommendations:

- **Capital should primarily consist of “going concern” capital.**
- **Capital adequacy in regulatory stress test scenarios should be based on market assessments.**
- **Regulatory stress tests should have both common designs and bespoke components.**
- **Public disclosure of stress test results should depend on the macroeconomic environment.**
- **Banks should hold minimum levels of junior debt.**
- **Banks should provide more transparency to the markets**

The Committee's ultimate goal in commencing this study and preparing these recommendations is to increase the stability of the U.S. financial system through enhancement of private market discipline. A more thorough analysis of these issues and the basis for the recommendations can be explored through the papers found in the attached Appendix, which include: *Market Discipline and Capital Regulation* by Arturo Estrella; *Measuring Equity Capital for Stress-Testing Large Financial Institutions* by Mark Flannery; *Stress Testing Banks* by Til Schuermann; *Should Banks' Stress Test Results be Disclosed? An Analysis of the Costs and Benefits* by Itay Goldstein and Haresh Sapra; and *Improving Public Bank Disclosures* by John Lester.



# Improving public bank disclosures Bank analyst survey

April 17, 2012



## Surveyed bank analysts suggested a variety of ways to improve existing bank disclosures

- Oliver Wyman elicited views from ~10 individuals including buy- and sell-side analysts, credit ratings agency analysts, and senior executives from large banking/securities firms on ways to improve public bank disclosures
- Buy- and sell-side analysts overwhelmingly agreed that **comparability** across disclosures is most important
  - Disclosures across banking organizations demand standardized definitions and consistently reported line items
  - Additionally, inconsistencies between bank regulatory and GAAP filings should be addressed
- Interviewees also suggested **additional disclosures** across a number of dimensions
  - Some analysts pointed out that additional disclosures should be required of all banks, regardless of size, so that all material risks in the system are fully understood
  - Most found that information on downside risks is ultimately more useful (and comparable) than revenue / earnings dynamics
  - A number of constructive suggestions included disclosures that banks already have the capacity to make (and may have already begun reporting in some instances, e.g. stress test results)

### Suggested topics of additional disclosure

Asset composition

Funding / liquidity

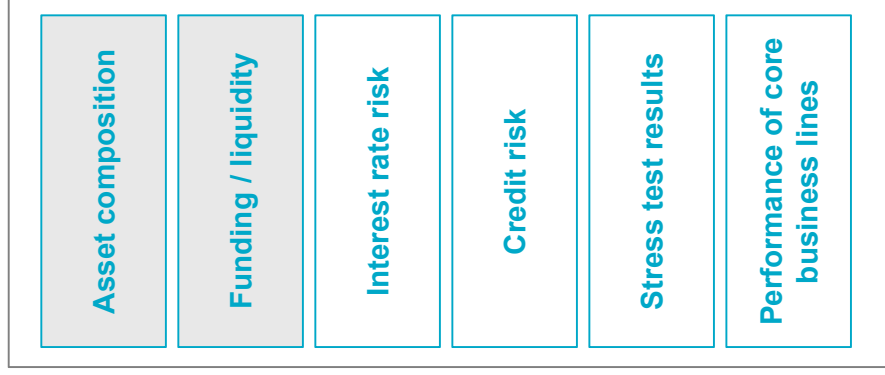
Interest rate risk

Credit risk

Stress test results

Performance of core business lines

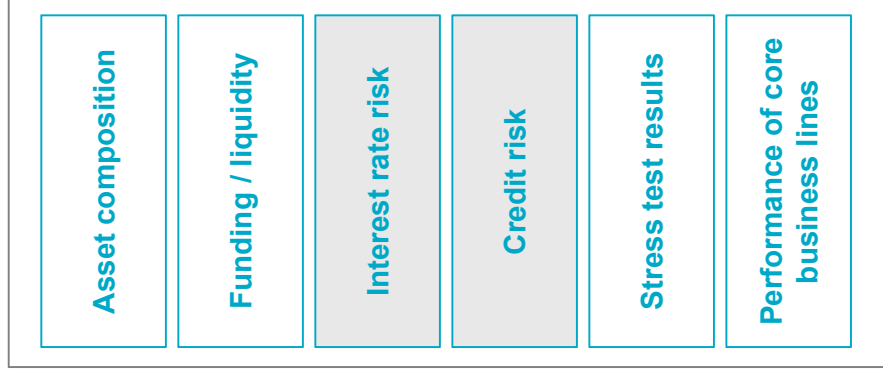
# Suggested topics of additional disclosure (1)



- **Asset composition**
  - Generally, analysts want more detail on asset breakdown, valuation and quality  
*“If you have this information on assets, then you can assess where the capital is sitting within an institution and you can do a calculation of earnings that is free from manipulation.”*
  - Comprehensive asset valuation and quality information should include counterparty credit risk
  - Specifically, analysts requested more information on:<sup>1</sup>
    - Asset flows including sales, purchases, and write-downs
    - Banks’ internal ratings systems used for asset valuation
    - Allowances for loan losses (by loan segment), mark-downs, loan-to-value ratios, etc.
    - Credit ratings, yield, duration, and repricing time frames
- **Funding / liquidity**
  - Interviewees recognize that liquidity risk is difficult to quantify; moreover this is a sensitive topic because it directly affects investor confidence
  - Analysts requested more information on:
    - Short term debt, including average, maximum, and period-end borrowings and concentration amongst largest creditors<sup>2</sup>
    - Well-defined liquidity ratios

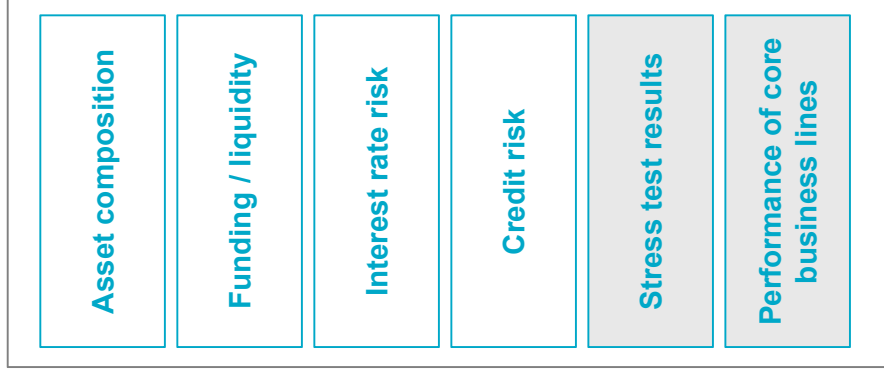
1. A proposal by FASB in January 2010 requiring more flow information as well as valuation techniques and inputs for Level 2 and 3 assets addresses some of these concerns  
2. A proposal by the SEC in September 2010 to increase qualitative and quantitative disclosures for short term debt addresses some of these concerns

## Suggested topics of additional disclosure (2)



- **Interest rate risk**
  - Most analysts felt that current models are static and underestimate risk  
*“Most banks report one stress scenario – rates up or down – but instantaneous changes are just a small part of rates movements.”*
  - *“There is a risk that rates will rise in the near future; meanwhile banks are duration extending with a potentially huge downside to come.”*
  - Specifically, analysts requested:
    - More robust / realistic scenarios analyses of rates movements
    - Ultimately, the ability to compare how much of a carry trade or maturity mismatch a bank is taking relative to peers
- **Credit risk**
  - Interviewees recognized the need for standardized, consistent reporting on credit exposure  
*“When credit blows up, e.g. the current situation with EU sovereigns, disclosures become very detailed; when credit is good, these unfortunately go away.”*
  - Analysts requested significantly more information on credit risk including:
    - Net and gross positions
    - Risk ratings of counterparties
    - Value of risk mitigating hedges

## Suggested topics of additional disclosure (3)



- **Stress test results**
  - Fed stress test disclosures are generally viewed as more useful than company-run tests because they standardize the process
  - Analysts noted that the Fed is (understandably) still struggling with right level of disclosure, but in general these have the potential to be immensely useful
  - European stress test scenarios are viewed by some as not meaningfully constructed, but are nonetheless useful for the sake of comparability
  - However, analysts also suggested that firms should share:
    - Company-run stress tests on trading and loan books
    - Company-run stress tests per each segment (commodities, rates, etc.)
- **Performance of core business lines**
  - One analyst pointed out that performance across business lines is not a useful benchmarking metric without standardized definitions of what constitutes each business line
  - However, the majority of analysts felt that detailed segment-by-segment information is the best way to assess risks of an institution, including:
    - Market risk statistics (VaR, sensitivity analysis, etc.) for each business line

*“Risk statistics are clearly shown to the Board of Directors because they understand business risks – investors need to see this level of granularity too.”*
  - More granularity on capital markets balance sheets (currently only breakdown is equity versus FICC – need breakdown of fixed income, currency, commodities)
  - Details on quarterly flows onto and off of balance sheets, in addition to stock numbers, to understand changes in asset composition

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## Market discipline and capital regulation

Arturo Estrella\*

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JEL Codes: G21, G18, G13

Keywords: bank regulation, contingent claims, CoCo bonds

Abstract: Market monitoring and discipline have traditionally played a useful complementary role to capital regulation in promoting the safety and soundness of the financial system. This article examines the conceptual benefits and drawbacks of several recently proposed financial instruments that enhance market discipline, and looks at the potential importance of these instruments for capital regulation and systemic stability. Among the proposals reviewed are various forms of mandatory subordinated debt, contingent capital, and capital insurance. The analysis provides a critical review of existing proposals and related research, which may be helpful to practitioners, regulators, and other participants in discussions concerning financial regulatory reform.

\* Rensselaer Polytechnic Institute, Russell Sage Laboratory 3rd Fl., 110 8th St., Troy, NY 12180. Tel. 1-518-276-2049. Fax 1-518-276-2235. E-mail: [estrea@rpi.edu](mailto:estrea@rpi.edu).

## 1. Introduction

Monitoring and discipline from investors in publicly-traded securities issued by banks and other financial firms have traditionally played a useful complementary role to capital regulation in promoting the safety and soundness of the financial system. Even the most complex structures of formula-based capital requirements are blunt and inaccurate when applied in practice to the existing broad diversity of financial institutions. Monitoring is essential to ensure compliance and to interpret capital levels in context, but government resources to perform such monitoring are limited even in the best of cases. It thus seems very sensible to enlist the services of investors and other interested parties to enhance the overall effectiveness of monitoring of financial institutions through market forces.

For some time now, there has been a growing conviction among both academic researchers and regulators that the role of market discipline in capital regulation may be further enhanced through the issuance, perhaps mandatory, of new near-capital or contingent-capital instruments. Among the proposed instruments are various forms of subordinated debt, contingent capital, and capital insurance. These approaches are based on the market issuance of financial instruments whose holders have clear incentives to monitor the issuing institutions and to price the instruments efficiently. By pursuing their individual goals, investors also contribute to the attainment of social goals associated with capital regulation. Externalities may still remain, but their effects could be reduced by the alignment of public and private goals induced by these market instruments.

Although the individual instruments vary in many respects, they have two important features in common: they help accomplish goals that are fundamental to financial regulation and supervision, and they provide a clear role for financial market participants to collaborate. With

regard to regulatory goals, the instruments protect senior debt holders of financial institutions, help contain the costs of deposit insurance, and mitigate both the risk of failure of individual institutions and systemic risk. In terms of market involvement, the instruments engage various financial market participants in their issuance and pricing, and investors may also play an important role as monitors of the issuing institutions.

This article examines the conceptual benefits and drawbacks of several recent proposals for the issuance of market instruments that induce desirable monitoring and market discipline. Many of these proposals have appeared in the form of academic articles, and we take a critical look at some of those articles here. In addition, we consider how these proposals would be applied in practice and how the relevant instruments have performed if they already exist in the market. The article attempts to gauge the potential importance of these instruments for capital regulation and more generally for systemic stability. In the end, the goal is to provide a review of existing proposals and related research that may be helpful to practitioners, regulators, and other participants in discussions concerning financial regulatory reform.

## 2. Background and motivation

For many decades, bank capital regulation has been a key component of activities by financial authorities to maintain order and stability in the financial markets, particularly in the event of crises of various scopes and dimensions. Explicit capital regulations were not common until the 1980s, but bank supervisors and financial regulatory agencies had been applying internal capital benchmarks long before that time. The combination of compliance with these benchmarks and supervisory examination of the primary activities of the financial institutions were deemed largely sufficient to maintain a reasonable level of financial soundness in the

system from the 1950s to around 1980. The boom in financial innovation that began in the 1980s made it much harder for regulators to cope with the increasing volume of information and suggested that enlisting market forces to accomplish regulatory goals would be beneficial.

In the context of banking and allied fields, supervisors and regulators are interested in various interconnected goals, such as the protection of deposits and other senior debt, the prevention of bank failure, and the minimization of systemic risk. Minimum regulatory capital requirements are clearly helpful in accomplishing all of these goals.

Financial institutions themselves share at least some of the regulatory goals as they endeavor to preserve and enhance their reputations and to assure their continued success. However, higher capital levels in practice involve tradeoffs such as constraints on expected profits and limitations on the pursuit of traditional roles of financial intermediation, so that there are limits to the extent to which the regulatory goals will be aligned with those of individual financial institutions.

Traditionally, banks and other financial institutions have employed market instruments to achieve their own goals with regard to safety and soundness, as well as those of regulators. The principal form of regulatory capital is equity, and institutions of sufficient size have tended to issue publicly-traded equity that serves both their own purposes and those of the financial authorities. Other market instruments such as preferred stock and subordinated debt also have a long history, and have been recognized internationally as forms of capital at least since the 1988 Basel Accord.

Another standard approach to safety and soundness has been the holding of safe assets by financial institutions. These instruments, such as publicly issued short-term government bonds,

reduce the potential for asset losses and hence for institutional failure and losses to creditors, including depositors and senior debt holders.

Building on these ideas, academics, financial regulators, and financial analysts have proposed in recent years that financial firms employ various market instruments that have the potential to improve individual safety and soundness and to lessen systemic risk. Subordinated debt proposals date back to at least the 1980s. More recently, much attention has been devoted to contingent capital, that is, debt instruments that convert to equity if the financial condition of the institution deteriorates beyond a certain trigger point. In the banking sector, these proposals date from around 2005 and have recently led to some actual issuance by banks. Contingent capital has gained much theoretical and some regulatory momentum, though at a practical level it is still at an early stage of development. More recently, capital insurance has been actively discussed in the banking literature.

Availability of information to investors is crucial for any of these instruments to exert market discipline on the issuer. This information may be public, such as in accounting reports or periodic regulatory disclosures, or it may be channeled through institutions such as credit rating agencies. International banking regulators have recognized the importance of information disclosure for market discipline in their formulation of Pillar 3 of the Basel 2 regulations.

However, earlier research such as Battacharya, Boot, and Thakor (1998) and Estrella (2004) suggests that public disclosure is generally not sufficient by itself to achieve regulatory goals because of incentive structures, organizational complexity, and competitive pressures. Informed market discipline is potentially a powerful complement to the direct supervision and regulation of banks and other financial institutions.

### 3. Analytical framework

For each of the instruments considered, several natural questions arise. What makes the instrument attractive to the issuer and to investors? How is the instrument priced? How does the instrument affect the value of the firm and the value of senior debt, including deposits? How does the instrument affect the incentives of the various stakeholders? What possible externalities and systemic issues does the instrument mitigate or exacerbate?

Consider in general terms how the balance sheet of a financial institution can be modified to address regulatory goals such as protection of deposits and other senior debt, prevention of bank failure, and minimization of systemic risk. At a very basic level, the likelihood of failure of an institution is determined by two main factors: the riskiness of assets and the size of the equity cushion. Thus, failure can be made less likely by substituting safe for risky assets or by increasing equity in proportion to bank liabilities or total assets.

Similarly, senior debt may be protected by making assets safer and by increasing the equity cushion. Moreover, the security of senior debt may also be enhanced by adding junior debt. Unlike equity, junior debt does not reduce the probability of failure, but even if failure does occur, the introduction of subordinated debt affords senior debt additional protection.

Systemic risk is more difficult to define and to model than the risk of individual failure. It seems evident, however, that measures that enhance the safety and soundness of individual institutions will at a minimum also tend to contribute to a reduction in systemic risk.

Three forms of financial instruments are examined in the next three sections. Section 4 focuses on subordinated debt, which stands between equity and senior debt, thus accomplishing the goal of protecting the latter. It does not directly reduce the likelihood of firm failure, although

it may indirectly address that goal by stimulating the monitoring of the financial institution by investors.

Section 5 examines contingent capital, which starts out as debt, much like subordinated debt, but converts into equity if a specific trigger point is reached in terms of the financial deterioration of the firm or the industry. Thus, unlike straight subordinated debt, contingent capital has the potential to reduce directly the likelihood of firm failure as a result of the conversion feature.

Finally, Section 6 looks at various forms of capital insurance. In effect, these proposals act by directly reducing the riskiness of firm assets, by increasing the effective level of capitalization, or both. The insurance instruments may be provided by the government, by private issuers, or by the firm itself.

To examine the incentives of the various stakeholders and to value the instruments, the analysis employs a contingent claims pricing framework that extends Merton (1974) and Geske (1979) to accommodate equity conversion. The basic model has three time periods 0, 1, and 2, and possible conversion of contingent capital takes place in period 1. Absent this intermediate date, contingent capital would be indistinguishable from subordinated debt in the model.

The values of the instruments, whose payoffs may be related nonlinearly to asset value, are obtained by risk-neutral pricing as in Merton (1974) and are functions of current asset value, asset volatility, and the risk-free interest rate. As in Geske (1979), payoffs at time 2 are dependent on the realization of a random event at time 1. However, whereas the event in the Geske framework is the possible exercise of an option, the event here is the involuntary triggering of the conversion feature as result of financial deterioration. Quantitative illustrations of instrument valuations are provided by numerical integration.

The analytical framework abstracts from too-big-to-fail policies and from the possibility of ad hoc bailouts during crises, which could have important implications for the pricing of the market instruments considered. For instance, the Basel Committee (2011a) commented on the inability of subordinated debt to perform its role as capital in the recent financial crisis as a result of government intervention before debt holders incurred any losses. In consequence, the recent Basel 3 rules were formulated to include stricter requirements for subordinated instruments to be considered as capital. The analysis below implicitly assumes that market instruments are designed with provisions that contain such safeguards.

#### 4. Subordinated debt as a near-capital instrument

Simply stated, subordinated debt instruments have a lower-priority claim on bank assets than deposits or senior debt. For that reason, subordinated debt acts as a loss buffer and may be very helpful in addressing the goal of protecting more senior bank liabilities. By itself, the existence of subordinated debt has little direct influence in reducing the likelihood of failure for a banking institution or for systemic risk more broadly. However, the monitoring activity subordinated debt generates from investors imposes a certain amount of market discipline on the bank that may contribute to a lessening of the likelihood of failure and systemic risk.

Subordinated debt has received extensive coverage in the banking literature, as well as in large-scale studies by staff of the Federal Reserve (1999) and of the Basel Committee (2003). Thus, discussion here will be more limited than for the other instruments, and the reader is referred to the foregoing studies and to the papers cited below for more detail.

The study by staff of the Federal Reserve (1999) identifies three generations of proposals for the use of subordinated debt in bank capital regulation. The first generation focused on the

discipline imposed by the pricing of subordinated debt on banks, especially when the banks are required to issue and maintain certain levels of subordinated debt. Proposals of this generation include Benston et al. (1986) and Litan and Rausch (1997). Kupiec (2005), though more recent than the Federal Reserve study, shares some features with these earlier proposals.

The second generation envisioned a role for subordinated debt pricing as providing a trigger for supervisory discipline. In addition to the direct costs imposed by the market in pricing new and existing issues, the supervisor could use rate spreads on subordinated debt as indicative of bank risk and could impose penalties or restrictions based on specific triggers. Examples of this approach are Cooper and Fraser (1988), Wall (1989), and Evanoff (1993), as well as the more recent Hart and Zingales (2010).

The third generation expanded on the regulatory use of subordinated debt pricing to propose a system of progressive supervisory discipline based on market pricing and on the ability to issue new debt. This approach was suggested by Calomiris (1999) and by the Federal Reserve (1999) study itself.

Current regulation shows a distinct preference for longer-term subordinated debt for capital purposes. The Federal Reserve (1999) notes that a standard initial maturity for subordinated debt is ten years and that Basel regulation provides for linear amortization of the value of the debt over its last five years. For example, only 20% of the value of an issue is applicable toward capital when remaining maturity is one year.

In contrast, several of the more recent proposals advocate for the use of short-term subordinated debt and for relaxing amortization rules for long-term debt when it approaches maturity. In fact, some proposals argue that short-term debt is helpful in that banks may be

forced to roll over the debt by bringing new issues to market. New issues provide both a test of the ability of the firm to attract investors and new pricing information.

Recent proposals for enhanced use of subordinated debt in capital regulation are based on a “stick” approach to regulation, in that banks would be required to issue and to hold specific levels of subordinated debt outstanding at all times, and would face possible penalties even if the issuance requirements were met.

The 1988 Basel Accord already provided a “carrot” type incentive for banks to issue subordinated debt in that these instruments were included in the list deemed acceptable as regulatory capital. Subordinated debt was recognized as tier 2 capital under the original 1988 Basel guidelines and as both tier 2 and tier 3 capital in the more recent Basel 2 rules. The latest Basel 3 guidelines, however, eliminate tier 3 altogether and impose stricter conditions for subordinated instruments to be recognized as tier 2. Thus, the carrot is still there but it has gotten smaller.

Is the carrot approach sufficient to achieve regulatory goals or should requirements be imposed on banks? There are tradeoffs between the beneficial effects of subordinated debt issuance in terms of bank and system safety and the possible distortions that either a stick or carrot approach would introduce in the financial sector.

Consider the use of subordinated debt by banks under the Basel Accord, which includes the carrot but not the stick. The Federal Reserve (1999) study indicates that U.S. banks that issued subordinated debt in 1998 had average outstanding levels corresponding to 2.00% of total assets (average weighted by total assets). Results for top-tier bank holding companies and for the top 50 holding companies were 2.19% and 2.26%, respectively. Data for 2001 from the FDIC are roughly consistent, with 1.5% for all commercial banks and 1.9% for banks with assets more

than \$10 billion. In recent times, the volume outstanding of subordinated debt is somewhat lower than at the time of the large-scale studies. As of March 31, 2011, the average ratio to total assets as reported by the FDIC was 1.1% for all banks and 1.4% for banks with assets more than \$10 billion.

The Basel Committee (2003) study focuses on large banks in nine industrial countries and provides an international cross-section with data as of 2001. For the United States, the ratio of subordinated debt to total assets is 2.3%, which is consistent with the Federal Reserve (1999) result for the top 50 holding companies and not too different from the 2001 FDIC figure for large banks. For other countries, the ratio of subordinated debt to total assets varied from a low of 1.1% for Japan to a high of 4.0% for France, with an average of 2.1%.

Inclusive of the incentives provided by the Basel guidelines, banks seem willing to hold levels of subordinated debt that are substantial, though not comparable to the levels of equity. For example, FDIC data for March 2011 show equity capital of 11.4% of total assets for all commercial banks and 11.5% for large banks, or about 8 to 10 times the amount of subordinated debt.

Even at the 1 to 1.5% level, the financial system is likely to reap some of the benefits that subordinated debt has to offer with regard to bank and systemic safety. However, a real test of the full benefits associated with the proposals in the literature would require significant changes to current regulations.

Information about subordinated debt outstanding is available from regulatory reports. Banks in particular are generally required to disclose subordinated debt amounts in regulatory reports associated with capital regulation. For example, U.S. bank holding companies report their qualifying subordinated debt in Schedule HC-R of the quarterly FR Y-9C report. In this report,

subordinated debt is combined with other instruments, whereas it could be helpful for regulators and market participants if subordinated debt were separately reported. Even in the absence of more detailed regulatory reporting, however, market information regarding issuance and pricing of the instruments is generally available and may be of significant value to investors and regulators.

## 5. Contingent capital

### 5.1 General features of contingent capital

Contingent capital instruments start out as junior debt, and as such share some of the helpful characteristics of subordinated debt. For instance, they serve as a buffer between equity and senior debt, providing additional protection for the latter. In addition, investors in contingent capital have many of the same pricing and monitoring incentives as investors in subordinated debt. Contingent capital may also share with debt the tax deductibility of interest payments in at least some jurisdictions, making it attractive for issuers. In practice, claims to this benefit are not altogether clear, particularly in the United States where tax treatment as debt seems questionable. See for example Ernst & Young (2010).

The main feature that distinguishes contingent capital from subordinated debt is that it converts involuntarily to equity if a prescribed trigger event associated with financial deterioration occurs. For instance, the trigger could alternatively be that regulatory capital falls below a certain level, that the firm's stock price falls below a given threshold, or that the firm's regulator determines that the firm is in financial distress. If the relevant trigger is reached, the firm converts the contingent capital debt instrument into a contractually specified number of shares of equity. The number of shares is frequently determined by dividing the face value of

debt held by an investor by a given stock price per share. One important consequence of the conversion feature is that the bank is recapitalized when the condition is triggered and the probability of failure is therefore reduced.

Various forms of contingent capital have been discussed for more than a decade, with some of the earlier products intended for use in the insurance industry. Early instruments such as contingent surplus notes were typically structured as put options allowing the firm to issue equity in the future at a predetermined price. See, for example, Elliott (2000, 2001). In contrast, the current crop of contingent capital instruments is generally based on bond conversion into equity rather than new capital issuance. Perhaps closer in spirit to the recent instruments is a contingent surplus note trust, in which investors contribute to a trust fund that may be used to purchase equity in the future. Culp (2002) discusses various types of contingent capital contracts as tools for the financial management of firms.

## 5.2 Contingent capital proposals

Various specific forms of contingent capital have been described in the financial literature. Flannery (2005) proposes “Reverse Convertible Debentures” or RCDs, which convert to equity if the capital ratio based on the market values of equity and assets falls below a prescribed level, such as 8%. Conversion occurs at the then-current values of RCD debt and equity so as to effect an even dollar-for-dollar swap. The amount converted is not necessarily the full issue of the RCD, but only an amount sufficient to bring the market capital ratio back to the prescribed level. On conversion, the firm must “promptly” issue new RCDs to replace the converted ones, which implicitly would require further action on the part of the firm to maintain

the capital ratio at the appropriate level. RCDs are assumed to be treated as debt for tax purposes, though such treatment is uncertain, as mentioned above.

Flannery (2009) proposes “Contingent Capital Certificates” or CCCs, which are very similar to RCDs, but the later paper offers more details about the operation of the instruments. For example, the 2009 paper gives a list of “essential CCC features,” which require inter alia that the trigger and target capital amounts be chosen by the regulator, that conversion occur rapidly, and that CCCs may not be owned by “systemically important firms for their own account.” In the Squam Lake Working Group (2010) report, various prominent economists endorse a generic form of contingent capital with features similar to the Flannery proposals.

Raviv (2005) discusses “Debt-for-Equity Swaps” or DESs, which are similar to the Flannery proposals, at least at some level of generality. While the Flannery papers provide ample discussion of operational details, the focus in Raviv (2005) is on the valuation of DESs and other items on the issuer’s balance sheet. Value is calculated by analyzing cash flows and applying closed-form expressions for down-and-in and down-and-out option values.

Sundaresan and Wang (2010) consider a contingent capital instrument in which the trigger is based on the stock price, rather than the capital ratio as in Flannery (2005, 2009). A key element in their analysis is a technical issue regarding the calibration of the terms for conversion from debt to equity. Specifically, they argue that if the conversion ratio is set to an arbitrary value, the potential conversion event may affect the value of equity, producing price indeterminacy and possible distortions in the distribution of value among classes of investors.

To deal with these problems, Sundaresan and Wang (2010) suggest that the initial bond issued under the contingent capital instrument have a floating rate coupon so that the bond is always valued at par and the terms of conversion do not depend on bond valuation. In addition,

the conversion ratio is set at issuance to the unique value that avoids any transfer of value between contingent capital investors and equity holders. The terms of conversion are thus known in advance and are set so as to avoid price indeterminacy and incentives for price manipulation.

McDonald (2010) raises a concern that the typical contingent capital contract protects every issuer from failure, whereas he argues that banks that are poorly managed in ordinary conditions should not receive protection from failure in case of a systemic event. The proposed solution is the use of a dual trigger, with one component related to the stock price of the firm and another related to a broader index of financial institution stock prices. Conversion takes place when all firms face financial adversity, not when an individual firm is in danger of failing by itself, presumably because of poor management. The dual trigger also helps avoid potential problems of stock price manipulation.

Pennacchi, Vermaelen, and Wolff (2010) are also concerned that standard contingent capital may induce price manipulation, as well as transfers of wealth from stockholders to bondholders, stock price indeterminacy, and excessive risk for investors. They propose adding two features to standard contracts in order to avoid these problems, and they dub the resulting instrument “Call Option Enhanced Reverse Convertibles” or COERCs. As in some of the other proposals, the trigger is based on the firm’s stock price and conversion occurs at a predefined price level. However, in the case of COERCs, the conversion price is set “significantly below” the trigger price and the shareholders have an option to buy back the converted shares from the bondholders at the conversion price. The argument is that the combination of the option and the low conversion and strike price protects shareholders from an involuntary transfer of wealth and COERC-holders from losing market value at the time of conversion.

Contingent capital proposals have focused much less on the initial maturity of the debt instrument than subordinated debt proposals. Flannery (2005) suggests that the original maturity should substantially exceed the conversion interval, though most discussions simply assume that that maturity is longer than the interval. In practice, actual issues have had initial maturities of at least 10 years (see Section 5.4), which is consistent with market practice for subordinated debt.

### 5.3 Analysis of contingent capital

This section provides a simple model of contingent capital with some numerical illustrations of the pricing and execution of these instruments. The model contains three time periods. At least three periods are required so that contingent capital has the minimum essential properties of equity after conversion, including time value.

At time 0, a bank with risky assets has three types of funding instruments outstanding: senior debt (or deposits), equity, and contingent capital. Contingent capital is initially treated as zero-coupon debt and its face value, like the face value of senior debt, is payable at time 2.

The senior debt contract is standard in that creditors receive the full face value  $D_2$  at time 2 if assets are sufficient to cover the payment, and they otherwise take possession of time 2 assets. Conditional payoffs to these investors are not affected by the structuring of the contingent capital contract.

At time 1, the price per share of equity is compared with the trigger value for contingent capital and, if the conversion condition is triggered, all contingent debt is converted into shares of equity at a rate prescribed in advance. In that case, only senior debt remains at time 2 and equity in this final period is distributed between the initial shareholders and the contingent capital investors in the proportions determined at conversion in period 1.

The value of bank assets is assumed to follow a Brownian motion process. For valuation purposes, the trend term in the process has a form consistent with the risk-neutral distribution as defined, for instance, in Merton (1974). This assumption for asset growth is similar to those of Raviv (2005) and Pennacchi (2010). The equation for assets is

$$dA/A = \left(r - \frac{1}{2}\sigma^2\right)dt + \sigma dz \quad (1)$$

where  $r$  is the riskless interest rate,  $\sigma$  is the volatility of assets, and  $z$  is standard Brownian motion.

Under this assumption, the ratio of the value of assets at time  $t$  to the value at time 0,  $A_t/A_0$ , follows a lognormal distribution with mean  $\left(r - \frac{1}{2}\sigma^2\right)t$  and variance  $\sigma^2 t$ . Asset values at times 1 and 2 are thus lognormally distributed with means and variances as above with  $t = 1, 2$  and correlation  $1/\sqrt{2}$ . More details with regard to these and other calculations are given in the appendix.

Let  $\bar{S}_T$  be the price level that triggers conversion, that is, contingent capital converts to equity at time 1 if and only if the price per share of equity falls to a level  $\bar{S}_T$  or below. Note that equivalent triggers may be formulated in terms of a corresponding asset value  $T$  or a capital ratio  $\rho_T$ , as shown in the appendix.

If conversion is triggered, contingent capital investors receive  $h$  shares of equity and it is customary to define  $h$  implicitly in terms of the face value of the debt component as  $B_2 = h\bar{S}_C$ , where  $B_2$  is the face value of contingent capital debt and  $\bar{S}_C$  is the conversion price. See, for example, Flannery (2009) or De Spiegeleer and Schoutens (2011).

In general, the trigger price and the conversion price may be different, and there is no standard choice for either one in theory or in practice. Flannery (2005, 2009) proposes a trigger

in terms of the capital ratio while setting  $\bar{S}_C = \bar{S}_1$ , the current price per share at time 1.

Pennacchi, Vermaelen, and Wolff (2010) similarly consider a trigger based on the capital ratio, but suggest that the conversion price be significantly below  $\bar{S}_1$  and that a buy-back option be offered to the original shareholders.

There is considerable flexibility with regard to the specification of a conversion trigger, which may correspond to some sensible level of the capital ratio but whose precise level is not clearly pinned down by theory. Investors in the instrument would probably tolerate a range of conversion levels, with pricing adjusting accordingly.

With regard to the conversion price, we may consider as a convenient benchmark the level at which there is no transfer of value between the convertible instrument holders and the original equity holders. Before conversion, market values at time 1 are subject to the identity  $A_1 = D_1 + B_1 + S_1$ , where the left hand side is the market value of assets and the terms on the right hand side correspond to the market values of senior debt, contingent capital, and standard equity, respectively. If contingent capital converts to equity, the total value of equity is then

$$A_1 - D_1 = B_1 + S_1.$$

If  $H$  represents the shares of equity held by the original stockholders and  $h$  is the number of shares allotted to the holders of contingent capital, the proportion of equity held by the latter after conversion is  $\phi = h/(H + h)$  and its value is  $\phi(B_1 + S_1)$ . Thus, a “fair” conversion with no transfer of wealth occurs if  $B_1 = \phi(B_1 + S_1)$  or  $\phi = B_1/(B_1 + S_1)$ . An equivalent condition is given by  $B_1 = h\bar{S}_1$ , which has the same form as the standard conversion condition, but with the current market price as the conversion price and the pre-conversion market value of contingent capital on the left hand side instead of the face value.

The analysis below considers three possible alternative conversion price relationships, each of which may be expressed formally in terms of the conventional conversion condition  $B_2 = h\bar{S}_C$ . First, we consider the benchmark condition itself, maintaining parity between the pre- and post-conversion values of contingent capital. Note that  $B_1 = h\bar{S}_1$  may be rewritten as  $B_2 = h(B_2/B_1)\bar{S}_1$ , so that the conventional equation  $B_2 = h\bar{S}_C$  holds with  $\bar{S}_C = (B_2/B_1)\bar{S}_1$ .

Second, we use the current stock price directly in the standard conversion condition in which the face value of contingent debt appears on the left hand side. However, to make the timing of the equation consistent with pricing of equity at time 1, it seems reasonable to use the present value of the bond rather than its face value, obtaining  $\exp(-r)B_2 = h\bar{S}_1$ . Technically, the conversion price using the standard formula would then be  $\bar{S}_C = \exp(r)\bar{S}_1$ .

Third, a similar argument suggests that if conversion is defined in terms of the original stock price, the conversion condition could be expressed as  $\exp(-2r)B_2 = h\bar{S}_0$ , with a formal conversion price defined as  $\bar{S}_C = \exp(2r)\bar{S}_0$ .

The rules of thumb using present values rather than the face value of debt are adopted in the numerical illustrations below for use with conversion prices  $\bar{S}_1$  and  $\bar{S}_0$  in conjunction with the face value  $B_2$ . Note that if the Sundaresan-Wang (2010) approach is adopted,  $B_1 = B_2$  and  $\bar{S}_C = \bar{S}_1$ , and the present value adjustment is unnecessary. In that case, the benchmark relationship results, with no transfer of wealth between investors.

Just before conversion, the price per share of equity is  $\bar{S}_1 = S_1/H$ , where  $H$  is the original number of shares outstanding. After conversion, the price per share becomes  $\bar{S}_1^* = (S_1 + B_1)/(H + h)$  and the proportions of total equity held by contingent capital investors

and original shareholders, respectively, are  $\phi = h/(H + h)$  and  $1 - \phi$ . In terms of the formal conversion price, the contingent capital investor share is  $\phi = B_2/(\bar{S}_C + B_2)$ .

Payoffs to the three types of stakeholders are given in Table 1. If conversion is not triggered at time 1, the payoffs in the last column of the table are the same as if contingent capital were treated as subordinated debt. If conversion is triggered at time 1 ( $0 \leq A_1 \leq T$  in terms of a trigger value of assets), original and contingent shareholders share any excess of period 2 asset value over the face value of senior debt according to the proportion  $\phi$ .

We now examine numerical results that illustrate how the values of the various instruments (senior debt, equity, subordinated debt, contingent capital) relate to one another and how they are affected by underlying settings such as the market value of assets and asset volatility. For these purposes, we define a base case set of assumptions in Table 2. Unless otherwise indicated, the illustrations in the figures are based on those assumptions. The conversion trigger is equivalent to a market-value capital ratio of 5%. Note also that the base case conversion price for contingent capital is based on the rule of thumb conversion rate given by  $\exp(-r)B_2 = h\bar{S}_1$ . If the “fair” conversion rate  $B_1 = h\bar{S}_1$  is used, the time 0 valuation of contingent capital is the same as for subordinated debt.

In the base case, the bank in the illustrations starts out at time 0 with a market equity capital ratio of 12%. This ratio is obtained by dividing the initial value of equity computed under the foregoing assumptions by the stated level of initial assets. As initial assets move from 90 to 110, the market-value capital ratio goes from 5.5 to 19%.

Figure 1 shows the values of contingent capital, senior debt, and equity as the time 0 asset value is allowed to change from 90 to 110. For comparison, the figure also displays the value of subordinated debt and the corresponding value of equity under the assumption that contingent

capital is replaced by subordinated debt of the same face value. The value of senior debt is the same in either case. In Figure 1 we see that the value of each of these instruments is positively related to the initial value of assets, with equity being far more sensitive to asset value than the others.

Figure 2 presents the delta for each instrument, that is, the derivative of its value with respect to initial asset value. Thus, the delta characterizes the sensitivity of the instrument's value with respect to a small change in asset value for a range of initial asset levels shown in the horizontal axis. Equity is more sensitive to assets when bank assets and capital are high, while the opposite holds for debt and contingent capital. Senior debt is quite sensitive for banks with less capital, but its sensitivity is very similar to subordinated debt and contingent capital when assets are high.

The values of these instruments are also sensitive to changes in asset volatility, which together with leverage is a major determinant of the riskiness of a bank. Figure 3 explores the influence of asset volatility by letting it vary between 0.05 and 0.3. Recall that the base case value of volatility is 0.1. The value of equity is positively related to volatility, a standard result in these types of models. The main reason is the limited liability of equity, which emphasizes the right tail of the probability distribution relative to the left tail, which has less of a relative impact on shareholders. As volatility rises, the probabilities in both tails increase, but the right tail has greater significance for equity valuation. Conversely, debt and contingent capital are negatively related to volatility because of the more limited upside potential.

Figure 4 shows the vegas of the instruments, that is the derivatives with respect to volatility, or the sensitivity to small changes in volatility at different levels. As expected, the vegas are positive for equity and negative for debt and contingent capital. It is interesting to note

that the vegas of contingent capital and subordinated debt move closer to zero beyond a certain point, whereas the senior debt vega continues to fall to more negative levels.

It was noted earlier that various conversion prices may be used with contingent capital. To illustrate the effects of using the different prices, Figure 5 shows the value of contingent capital under the rules of thumb based on the stock price at time 1 or time 0, as well as the “fair” rule based on the value of pre-conversion contingent capital at time 1.

When conversion is based on the time 1 pre-conversion value of contingent capital, its time 0 value matches that of subordinated debt, as earlier noted. We can use this case as a benchmark for comparisons. The rule of thumb based on the stock price at time 1, with simple discounting, tends to favor the contingent capital investor, as shown in Figure 5. Simple discounting ignores risk in valuing risky debt, so the conversion price tends to be lower and the proportion of equity allocated to the investor is higher than with an even swap.

In contrast, using the rule of thumb based on the stock price at time 0 overstates the conversion price because conversions only occur when the price has declined sufficiently so as to activate the trigger. The higher conversion price in turn leads to a lower conversion ratio and a lower value of contingent capital, as shown in Figure 5.

Finally, the model may be used to illustrate the effectiveness of contingent capital in reducing the likelihood of failure. The previously defined lognormal distribution may be used to calculate the probability of bankruptcy with either subordinated debt or contingent capital, as well as the difference between the two probabilities. Looking at the possible outcomes in Table 1, there is only one case in which failure occurs with subordinated debt but not with contingent capital, namely the joint event that  $D_2 < A_2 \leq D_2 + B_2$  and  $0 \leq A_1 \leq T$ .

Figure 6 shows the two probabilities of failure and their difference under the base case assumptions in Table 2, but allowing volatility to vary from 0.05 to 0.15. One caveat regarding these calculations is that they are based on the risk-neutral distribution, which is intended for valuation purposes and is not based on the physical distribution of asset returns. Nevertheless, the results in the figure should be at least qualitatively informative.

The figure shows that both probabilities rise with volatility, whereas their difference first rises and then declines. Intuitively, higher asset volatility is not necessarily worse for the value of contingent capital, as compared with subordinated debt. We saw in Figures 3 and 4 that volatility tends to favor equity and impair the value of debt. Since contingent capital is a hybrid instrument, the effect of a change in volatility on the differential probability of failure is ambiguous and the positive equity effect may dominate.

#### 5.4 From theory to practice: CoCo bonds

Two recent major issues of contingent capital instruments have been offered to investors in global public markets. The instruments are generally known in market jargon as contingent convertible or CoCo bonds.

On December 1, 2009, Lloyd's Banking Group PLC issued £7 billion of enhanced capital notes in 32 series. The largest of these series, number 21 (ISIN XS0459089255), has a total outstanding value of £775,158 million, 10-year maturity, 15% coupon, and converts to equity at a price per share of 59.2093 if Lloyd's tier 1 capital ratio falls below 5%. The issue seemed to be well-received by the market and its price trend was generally positive until a significant decline occurred in the second half of 2011, as shown in Figure 7 (left-hand scale). The current price is slightly above the price at issue.

The Lloyd's bonds received ratings of BB in December 2009 from both S&P and Fitch, whereas Moody's assigned a Ba2 rating in February 2010. S&P upgraded its rating to BB+ on March 9, 2011 (first vertical line in Figure 7), where it has remained. On November 9, 2011 (second vertical line in Figure 7), Moody's placed the bonds' rating on watch for downgrade after the bond price had dropped significantly, but the price has recovered since then and no change in rating has been announced.

The second major issue was for \$2 billion of buffer capital notes from Credit Suisse Group AG on February 24, 2011 (ISIN XS0595225318). The debt component of this issue has a 7.875% coupon until August 24, 2016, when it becomes variable, and has initial maturity of 30 years. Conversion to equity is triggered by a tier 1 capital ratio below 7% and the conversion price is an average of the share price over the 30 days before conversion with dual floors of \$20 and CHF20.

As with the Lloyd's bonds, the price of the Credit Suisse issue fell sharply during the second half of 2011 and has recovered somewhat since then, as seen in Figure 8 (left-hand scale). The bond is currently trading around par. It is rated only by Fitch, from which it received a BBB+ rating on February 24, 2011, but was subsequently downgraded to BBB- on December 15, 2011.

In addition to CoCo bond prices, Figures 7 and 8 also show stock prices for Lloyd's and Credit Suisse, respectively, over the same time periods (right-hand scale). These share prices provide additional information relevant to the pricing and conversion of the CoCo bonds. For example, note in Figure 8 that the Credit Suisse share price (dotted line) pierced the CHF20 conversion price floor (horizontal line) on a few days in September and November 2011.

However, the lagging 30-day average of share prices has remained above the floor throughout and the conversion condition based on the capital ratio has not been triggered.

An interesting feature of Figure 7 is that Lloyd's CoCo bond and share prices seem to move together most of the time, with the exception of a period roughly from December 2010 to April 2011, indicated by shading in the figure. The visual impression is confirmed by a striking difference in the correlation between stock and bond prices, which was -77% during the shaded period as compared with 75% before the period, and 86% after.

It is difficult at this level of information to ascertain the exact reasons for the change in correlation, but the theoretical analysis of section 5.3 suggests a possible reason. Figure 2 shows that the asset deltas of contingent capital and equity are both positive, so that CoCo bond and share prices should tend to move in the same direction in response to a change in asset value. The strongly positive correlation observed for Lloyd's over most of the sample period is thus consistent with the relationship being driven primarily by changes in asset value or asset returns. Both increases and decreases in stock and CoCo bond prices are observed during the periods of positive correlation.

In contrast, Figure 4 shows that the volatility vegas of contingent capital and equity have opposite signs, with positive vegas for equity. The implication is that CoCo bond and share prices would tend to move in opposite directions in response to changes in asset volatility. Thus, the strong negative correlation observed in the shaded period in Figure 7 is consistent with the relationship being driven primarily by asset volatility or risk. More precisely, the stock price trends down during the shaded period while the CoCo price goes up, suggesting a reduction in risk.

The foregoing interpretation in terms of risk is consistent with the upgrade in the S&P rating from BB to BB+ in March 2011 and also with a statement on corporate strategy issued by Lloyds in June 2011 (Lloyds Banking Group 2011). The statement said in part that “We will focus on attractive UK customer segments, reduce our international presence, and continue our disciplined reduction of non-core assets, to ensure sustainable, predictable returns on equity above our cost of equity.” Although this assertion was intended to be forward-looking, the data suggest that it may reflect a strategic view that was phased in during the early part of 2011.

The correlation between CoCo bond and share prices for Credit Suisse in Figure 8 also shows evidence of a change in correlation, in this case roughly at the beginning of June 2011. Before that time, the correlation is -46%, matching Lloyd’s in sign though not in magnitude over a similar period. Again the suggestion is that asset volatility or risk was generally declining over this initial period. However, the correlation since June 2011 has been 76%, consistent with changes being driven by changes in asset value over that period.

Overall, issues of contingent capital instruments by banks have been few, but they seem to have been well received by markets. Regulators have also been willing to consider official recognition of these instruments for capital purposes and, at least in the case of Switzerland, the support has been fairly enthusiastic. The Basel Committee has opened the door for the use of contingent capital, but has not yet sanctioned the instruments explicitly. A recent Committee document (Basel Committee 2011b) describing “Basel III” indicates that “the Committee continues to review the role that contingent capital should play in the regulatory capital framework.”

A few other CoCo or similar bonds have been issued or are close to issue. For example, Credit Suisse placed privately CHF6 billion of CoCo-type notes with their previously-existing

investors shortly before the public issue in 2009. The banking group has received encouragement to issue contingent capital instruments from Swiss regulators, who have called for higher levels of capital and have spoken favorably about contingent capital as a means of raising capital. See Bart (2010).

Netherlands-based Rabobank issued in March 2010 senior contingent notes that have some features in common with contingent capital. However, Rabobank is mutually owned and the senior contingent notes feature a 75% write-down and 25% cash recovery in lieu of conversion into equity. These write-down instruments are perceived by analysts as generally unattractive for investors, except in cases of conservative and very highly-rated banks such as Rabobank. See Zähres (2011).

A few other financial institutions are planning to issue or are in the process of issuing CoCo bonds in 2012. Among these is a new issue from Credit Suisse on the order of at least CHF250,000. Also planning to enter the market is Unicaja, a large Spanish savings bank that is absorbing Caja España-Duero in a merger. Unicaja is expected to issue up to €1 billion in CoCo bonds. Similarly, the Bank of Cyprus has plans to issue €1.34 billion.

### 6.3 Comments

Additional experience with contingent capital, if positive, may increase the comfort level of issuers, regulators, supervisors, and investors, and thus lead to growth in the market. An important question is whether national tax authorities will confer deductibility to interest payments on the debt component of contingent capital. If so, they would share with subordinated debt this advantage over straight equity issuance, which would add to their attractiveness for issuers.

From a policy point of view, the market discipline associated with contingent capital combines several of the benefits that equity and subordinated debt provide and which are aligned with regulatory goals. Contingent capital issuers must meet investor requirements in order to be able to bring an issue to market. Moreover, the issuers of these instruments are subject to ongoing monitoring by investors and rating agencies in order for the marketable instruments to remain viable. Moreover, pricing of the instruments reflects this ongoing scrutiny by the market and hence contains useful information that is generally available to market participants and regulators. Financial regulation could make use of these benefits by encouraging or requiring the issuance of contingent capital, and supervisors could use pricing and issuance information formally or informally in monitoring the issuing institutions.

As with subordinated debt, it would be helpful for regulators and market participants if the amounts outstanding of contingent capital instruments were separately disclosed in regulatory capital reports. Given the early stage of the market, it is understandable that such information is not currently reported. However, even in the absence of detailed regulatory reporting, market information regarding issuance and pricing of the instruments is already available and can be of significant value to investors and regulators, as it is for subordinated debt.

## 6. Capital insurance

### 6.1 General features

Like contingent capital, capital insurance has as goals both the protection of senior debt and a reduction in the risk of failure. Unlike contingent capital, which resides on the liabilities side of the balance sheet, capital insurance operates through the introduction of safe or super-safe

assets on the other side of the balance sheet. In this sense, capital insurance is akin to the motivation behind narrow banking proposals, which have argued that banks should invest in safe assets to avoid loss of deposits and reliance on the safety net. See, for instance, Litan (1987).

In its simplest form, capital insurance involves the purchase of an insurance policy that pays off when the firm's assets – or more generally the assets of firms in the banking industry – are under stress. Specifics vary, but the general principle is that a premium of some form is used to purchase an insurance policy that pays off in periods of stress and whose value increases as the financial condition of the firm and the industry deteriorate.

Existing proposals vary with regard to the provider of capital insurance. For example, insurance may be offered by private sector entities, by the government, or by the bank itself through a special purpose vehicle financed with outside equity. We look at one example in each of these three categories.

## 6.2 Specific proposals

The proposal in Kashyap, Rajan, and Stein (2009) is a capital insurance policy purchased from a private vendor such as a pension fund or sovereign wealth fund. The policy has a specific finite term (for example, five years) and pays off when the overall banking sector deteriorates to a certain level or suffers a systemic event. The triggering event occurs at the aggregate level, not at the individual institution level, and could be determined by the total losses of banks in a given country or by a national bank stock price index.

Since the payoff is triggered during adverse aggregate conditions, the proposal suggests that the face amount of the insurance should be covered by a custodial or “lock box” account to ensure that funding is available. Thus, the insurance policy is a super-safe asset for the firm,

defined as an asset that gains value as the market declines, and is backed in the background by the holding of safe assets, somewhat in the spirit of narrow banking. Conceptually, the insurance premium includes implicit compensation for the insurer to hold safe assets.

Beyond making these policies available, Kashyap, Rajan, and Stein would have regulation that requires banks to hold capital insurance. Each country or region would have an insurance system and each internationally active bank would need to satisfy its regulator that at least 90% of its activities are covered worldwide.

Tradable insurance contracts or TICs, as proposed by Caballero and Kurlat (2009), are offered by the government and provide insurance coverage in a format that is tradable. TICs are government guarantees that may be attached to debt instruments in periods of stress, after some industry-wide triggering condition is met. The condition is based on aggregate financial stress, which is assumed to be measurable by means of an aggregate risk indicator.

In normal times, there would be a market for the trading of TICs and the contracts would also be available from the government through open market operations. The price of a TIC may be defined up front, in analogy to a single-premium insurance policy, or may be structured as a flow over the life of the instrument. Regulators would require highly leveraged and systemically important institutions to maintain a certain amount of TICs at all times in proportion to their risk-weighted assets.

In the analysis by Caballero and Kurlat, the government is assumed to be a safe guarantor and plays the standard role of the safe assets found in other proposals. In practice, this assumption may be too sanguine, particularly if the expectation is that this approach would be adopted by a broad spectrum of countries. Governments in emerging economies may be too risky to be reliable insurers, and the same may even apply in advanced industrial economies in light of

recent experience. For instance, Estrella and Schich (2011) examine the valuation of government guarantees on bank debt when the sovereign is risky and, using data for Europe, find that the impact of guarantees from a range of countries may be very modest.

Admati and Pfleider (2010) propose a way for the bank to self-insure through a special purpose vehicle called an “equity liability carrier” or ELC. Table 3 shows in a very simple stylized setting how an ELC may be structured to protect the debt of a conventional bank. The strategy is to have the ELC raise standard external capital in excess of the level of capital in the bank itself. The ELC then holds as assets the conventional bank equity and safe assets, the latter representing the difference between ELC equity and conventional bank equity.

The minimum amount of external equity is the level of conventional bank equity and the maximum equals the amount of risky assets held by the bank. The latter case is dubbed “unlimited-liability equity” (ULE) because the bank’s debt is fully protected. Lower levels of external equity constitute “increased-liability equity” (ILE). The general strategy is to raise additional equity and to invest each marginal unit of equity in safe assets. Thus, increased-liability equity combines the conventional strategy of reducing risk by raising more equity with the narrow-banking strategy of investing in safe assets.

The functioning of increased-liability equity is best illustrated by considering the effects of an asset loss  $\Delta A_R = -\lambda A_R$ , where  $A_R$  represents the risky assets of the bank and  $0 \leq \lambda \leq 1$  is the proportional loss. The impact of such a loss on bank debt may be derived from the last two columns of Table 3, which represent the combined balance sheet of the bank and the ELC. Note that conventional bank equity is netted out in the combined balance sheet.

Let  $\kappa = (A_R - D)/A_R$  be the initial capital ratio under the conventional structure,  $0 < \kappa < 1$ , and let  $\alpha$  represent the ratio of ELC equity to bank assets, so that  $E_L = \alpha A_R$ . The

conventional equity case corresponds to  $\alpha = \kappa$ , the partial coverage ILE case is  $\kappa < \alpha < 1$ , and the full coverage ULE case corresponds to  $\alpha = 1$ . Assume that there is no loss of safe assets,  $\Delta A_S = 0$ , and consider the proportional loss for creditors  $\delta = -\Delta D/D$  in each of the three cases.

First note that if  $\lambda \leq \alpha$  in any of the three cases, there is sufficient equity to absorb the loss and therefore there is no loss to creditors, that is  $\Delta D = 0$ . For larger asset losses such that  $\lambda > \alpha$ , the proportional loss to creditors is  $\delta = -\Delta D/D = (\lambda - \alpha)/(1 - \kappa)$ . Thus, the value of  $\alpha$  influences the size of the loss in two ways: as a threshold for a non-zero loss and as a parameter in the proportional loss formula.

In the conventional case, the loss to creditors is  $\delta_C = (\lambda - \kappa)/(1 - \kappa)$  for  $\lambda > \kappa$ . With partial coverage (ILE) the loss is  $\delta_{ILE} = (\lambda - \alpha)/(1 - \kappa)$  for  $\kappa < \alpha < 1$  and  $\lambda > \alpha$ . With full coverage (ULE) the loss is zero, since the condition  $\lambda \leq 1 = \alpha$  always holds. It is easily shown that  $\lambda > \delta_C > \delta_{ILE} > \delta_{ULE}$ , so that progressively increasing protection is provided by conventional capital, ILE, and ULE, respectively.

### 6.3 Comments

Each of the three proposals for capital insurance is conceptually sound and its application would tend to reduce risks to bank debt and deposits. However, it is clear from the analysis that, as usually happens, there is no free lunch here. Capital insurance and increased-liability equity rely on the holding of safe assets. In both cases, these assets are held by a different entity, but the bank will bear the associated opportunity costs in one way or another, through insurance premiums or through the cost of equity financing of a special purpose vehicle. TICs are seemingly unencumbered by the need to hold safe assets, but rely on government guarantees that

may or may not provide the level of safety necessary for them to be fully effective in adverse conditions.

Another key question is how distortionary the use of these instruments will be for the banks they are intended to protect? Will it turn the institutions into narrow banks, or at least narrower banks than market forces would generally imply? There is a tradeoff between these possible distortions and the additional safety that these instruments can provide.

Moreover, will the private sector be ready to provide capital insurance, and at what price? Any insurer, public or private, would have to be comfortable with underwriting a capital policy for a bank whose financial position or business strategy is less than transparent. Would the insurer have better information than investors or credit rating agencies? There is also the issue of risk concentration and the potential that no insurer may be able to sustain the losses associated with a systemic crisis. Insurance could help reduce individual losses in most circumstances, but private insurance may not be able to cope with systemic problems.

If these issues are addressed, capital insurance techniques and instruments have the potential to engage financial market participants in providing a measure of market discipline consistent with regulatory goals. Each of the instruments considered above has at least one important market-based component that promotes market discipline through issuance or pricing. Capital insurance may be provided directly in an insurance market, insurance instruments (TICs) may be tradable, and a technique such as ILE may involve the issuance of equity into the marketplace.

## 7. General review

As the analysis has shown, all the market-based instruments discussed in this article have the potential to engage market discipline in addressing the objectives of financial regulation, such as the safety and soundness of individual institutions and the reduction of systemic risk. While no single instrument provides a perfect way to accomplish all these goals, it is likely that any of the instruments could play a role in a consolidated overall approach to individual and systemic risk mitigation. The breadth of practical experience varies substantially across instruments in terms of market development, tax treatment, and capital regulation. Each of the instruments considered has its pros and cons, which have been discussed in the foregoing sections. This section reviews some of the salient points and provides a summary of the pros and cons of individual instruments in Table 4.

Standard equity may be seen as a benchmark for all the instruments, since it has been the cornerstone of capital regulation from the start and should continue to play a major part in the capitalization and risk management of banks and other financial institutions. In fact, equity is an important component of at least two of the new instruments discussed, namely contingent capital and increased-liability equity. Equity is helpful in protecting senior debt and in reducing both individual and systemic risk. On the other hand, finance theory and practical experience suggest that equity may be more costly than other forms of capital, for instance, with regard to tax treatment.

Subordinated debt has a relatively long history in most industrial economies and has been recognized internationally as a lower-tier form of capital since the 1988 Basel Accord. Debt financing also has tax benefits over equity in many countries, and large international banks tend to use subordinated debt actively in their financial and risk management. In the United States, for

example, the banking industry has subordinated debt outstanding equal to about one tenth of equity, with the ratio a bit higher for large banks. Subordinated debt is useful in protecting senior creditors, but does not directly reduce the likelihood of failure. Indirect safety benefits may accrue, however, from increased monitoring by investors.

Subordinated debt provides several ways of accessing market discipline for regulatory purposes. The ability to issue debt and the pricing of that debt by the market provide indications of the financial strength of financial firms. Supervisors can monitor issuance and pricing, and issuance of subordinated debt may be formally built into regulatory rules with either carrot or stick approaches. Ongoing monitoring by investors in subordinated debt is also generally aligned with regulatory goals.

Contingent capital combines characteristics of debt and equity, albeit subject to a conversion process that introduces another layer of uncertainty. Like equity, contingent capital has the potential to protect senior creditors and to reduce the risk of failure and systemic risk. Unlike equity, it has a debt component that may receive favorable tax treatment in some jurisdictions, though significant uncertainty remains concerning this point. Contingent capital is convenient for issuers, since it may provide equity capital when it is most needed without the need to resort to market issuance. For investors, contingent capital is harder to evaluate than straight debt or equity and may be less attractive for that reason. Early issues seem to have been successful, but more experience is needed to assess the future of the instrument.

There is less practical experience in banking with capital insurance that with the other instruments discussed. The basic underlying concept is hard to dispute. Less reliance on risky assets and greater emphasis on assets whose returns are negatively correlated with others on the balance sheet reduce the risk of failure and protect senior creditors. Nevertheless, several

important questions remain. Will private-sector entities be willing to make a market in capital insurance? If capital insurance is provided by the government, will guarantees be effective in a world in which sovereigns are increasingly risky? Is a combination of safer assets and more equity consistent with the goals of banking and financial intermediation?

For each of the instruments, it is unclear whether the market can deliver sufficient volume to make a meaningful contribution to complement capital regulation. Subordinated debt has a relatively long history and volumes have been steady, if not substantial, but only for the larger banking institutions. It is unclear how the market will react to the stricter recognition requirements in Basel 3 as they are phased in. Contingent capital is relatively new and the experience in banking is too limited to support any strong conclusions. Pricing and market reaction so far are fairly positive.

Banking and financial regulators face an interesting set of questions with regard to instruments that engage market discipline in the regulatory process. Regulators are likely to have their preferences for choice of instrument, particularly a strong preference for equity financing, but how should the other instruments be treated? Should regulators be neutral and let market forces determine the fate of the various instruments? Should they use the carrot approach and encourage the use of contingent capital and capital insurance, as they have with subordinated debt? Should they use the stick approach and require banks to issue subordinated debt or contingent capital, or to hold capital insurance?

Regulators face various tradeoffs as they ponder these decisions. Nudging the market in the direction of increasing safety at the margin may be an effective way to deal with systemic issues and externalities. However, imposing severe requirements or providing excessive incentives may hinder financial institutions from providing services necessary for economic

growth and development. Regulatory decisions should not be made in a vacuum, and they should not rely on one-size-fits-all mechanical formulas that can destroy the markets they are intended to protect. A prudent level of encouragement to use all the instruments is likely beneficial. A similarly prudent use of requirements may also be beneficial, but carries greater risks with regard to market distortions.

#### Appendix. Valuation of financial instruments in 3-period model

Asset returns at times 1 and 2 are lognormally distributed with means  $r - \frac{1}{2}\sigma^2$  and  $2r - \sigma^2$  and variances  $\sigma^2$  and  $2\sigma^2$ , respectively, and their correlation is  $1/\sqrt{2}$ . Let  $f(x, y)$  represent the corresponding bivariate lognormal density, with the values of  $A_1$  and  $A_2$  represented by  $x$  and  $y$ . If  $\pi(x, y)$  is the net piecewise-continuous payoff from the instrument at time 2, conditional on  $A_1 = x$  and  $A_2 = y$ , the value of the instrument at time 0 is

$\int_0^\infty \int_0^\infty \exp(-2r) \pi(x, y) f(x, y) dy dx$ . For the numerical illustrations in the article, integrals were evaluated by numerical integration.

If the trigger point for conversion of contingent capital debt into equity at time 1 is expressed in terms of equity valuation, it is frequently stated as a level of the price per share, as in the text. However, equivalent conditions may be expressed in terms of total value of equity or of the capital ratio. Let  $C(A)$  be the Black-Scholes (1973) price of a one-period call option on the assets  $A$  of the bank with strike price  $D_2 + B_2$  and with values of the strike price, volatility, and the riskless rate as given in Table 2. Moreover, let  $\bar{S}_1 = S_1/H$  be the price per share of equity at time 1, where  $H$  is the original number of shares outstanding. Since  $S_1 = C(A_1)$  before

conversion, the trigger condition  $\bar{S}_1 \leq \bar{S}_T$  may be alternatively expressed in terms of assets as  $A_1 \leq T$ , where  $T$  is such that  $\bar{S}_T = C(T)/H$ , or as  $S_1/A_1 \leq \rho_T = H\bar{S}_T/T$  in terms of the capital ratio.

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Table 1. Conditional payoffs at time  $t = 2$  for senior debt, contingent capital debt, and equity  
Payoffs in each cell appear vertically in the above order

	$0 \leq A_1 \leq T$	$A_1 > T$
$D_2 + B_2 < A_2$	$D_2$ $\phi(A_2 - D_2)$ $(1 - \phi)(A_2 - D_2)$	$D_2$ $B_2$ $A_2 - D_2 - B_2$
$D_2 < A_2 \leq D_2 + B_2$	$D_2$ $\phi(A_2 - D_2)$ $(1 - \phi)(A_2 - D_2)$	$D_2$ $A_2 - D_2$ 0
$0 \leq A_2 \leq D_2$	$A_2$ 0 0	$A_2$ 0 0

where

$A_i$  = market value of assets at time  $t = i$

$D_2$  = face value of senior debt

$B_2$  = face value of contingent capital debt

$T$  = conversion trigger in terms of assets

$\phi$  = proportion of equity held by contingent capital investors post conversion

Table 2. Base case scenario for numerical illustrations

Parameter	Symbol	Value
Initial asset value	$A_0$	100
Risk-free rate	$\exp(r) - 1$	3%
Asset volatility	$\sigma$	0.1
Senior debt face value	$D_2$	90
Contingent capital face value	$B_2$	5
Capital ratio trigger	$\rho_T$	5%
Asset level trigger	$T$	94.07
Stock value trigger	$S_T$	4.70
Conversion value	$\exp(r)S_1$	Determined by $A_1$

Table 3. Balance sheet structures under “increased liability equity”

Conventional structure		Equity liability carrier		Combined balance sheet	
$A_R$	$E_C$	$E_C$	$E_L$	$A_R$	$E_L$
	$D$	$A_S$		$A_S$	$D$

where

$A_R$  = risky assets

$E_C$  = conventional limited-liability equity

$D$  = debt

$A_S$  = safe assets

$E_L$  = limited-liability equity financing the equity liability carrier

Table 4. Market discipline and regulatory goals: Comparison of financial instruments

Instrument	Pros	Cons
All	Protects senior debt holders Reduces deposit insurance costs Mitigates risk of failure Mitigates systemic risk Market involvement in issuance and pricing of instrument	Regulatory benefits generally less than with straight equity issuance More experience required in all cases
Subordinated debt	Market pricing Monitoring by investors Test of firm's ability to issue Tax advantages	No increase in equity cushion Increases likelihood of failure, all else equal May distort capital structure of firm if there is binding regulation Demand may be limited Ability to issue may be limited Volume of issuance may be small for regulatory purposes
First generation	Required issuance imposes discipline	No explicit regulatory reactions
Second generation	Pricing provides regulatory triggers	Regulatory reaction based on price only
Third generation	Pricing and ability to issue used in progressive supervisory discipline	
Contingent capital	Potential increase in equity cushion Automatic equity boost at critical time Functions as debt before conversion Possible tax advantages Few issues so far but well-received by market Some experience in corporate risk management	Calibration of triggering and conversion may be difficult Use of market conversion values may have unclear effects Demand may be limited Practical experience is limited Tax advantage not altogether clear
Capital insurance	Operates on asset side, not directly on capital structure	Untested
Private insurance	Relies of market provision of insurance	Unclear who would underwrite Credit quality of underwriters
TICs (government)	Insurance instrument traded in market Pricing and ability to hold may impose market discipline	Relies on government guarantees Assumes government is safe
ILE (self)	Special purpose vehicle (ELC) controlled by firm Ability of ELC to issue equity imposes market discipline	Requires holding of safe assets Requires additional equity (in ELC) Demand for ELC equity may be limited

Figure 1. Instrument values for different levels of initial bank assets

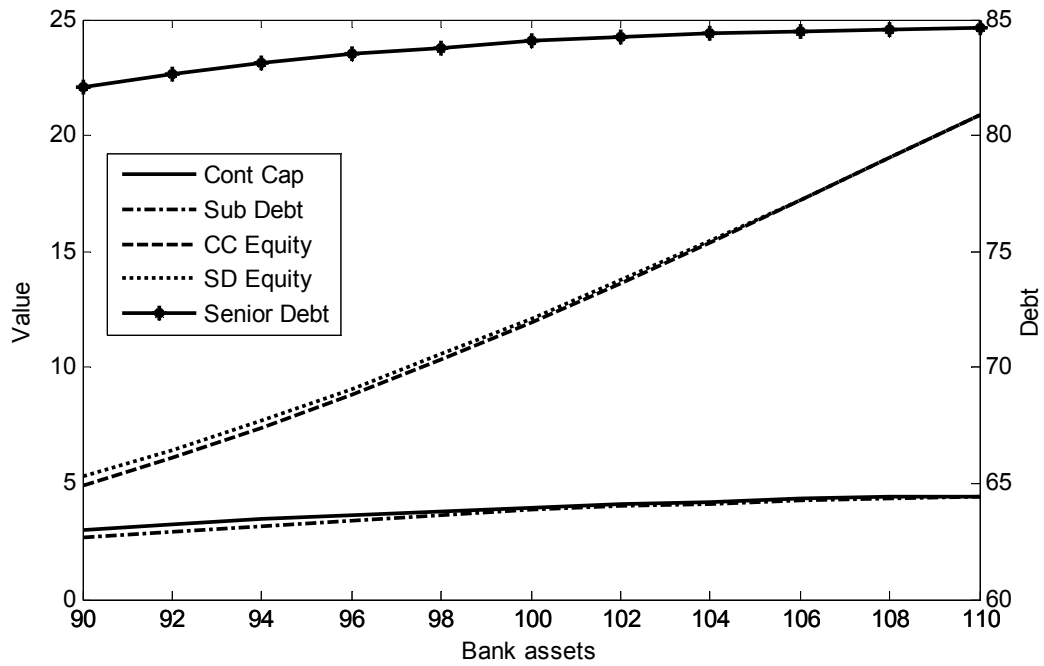


Figure 2. Instrument value sensitivity to a small change in asset value

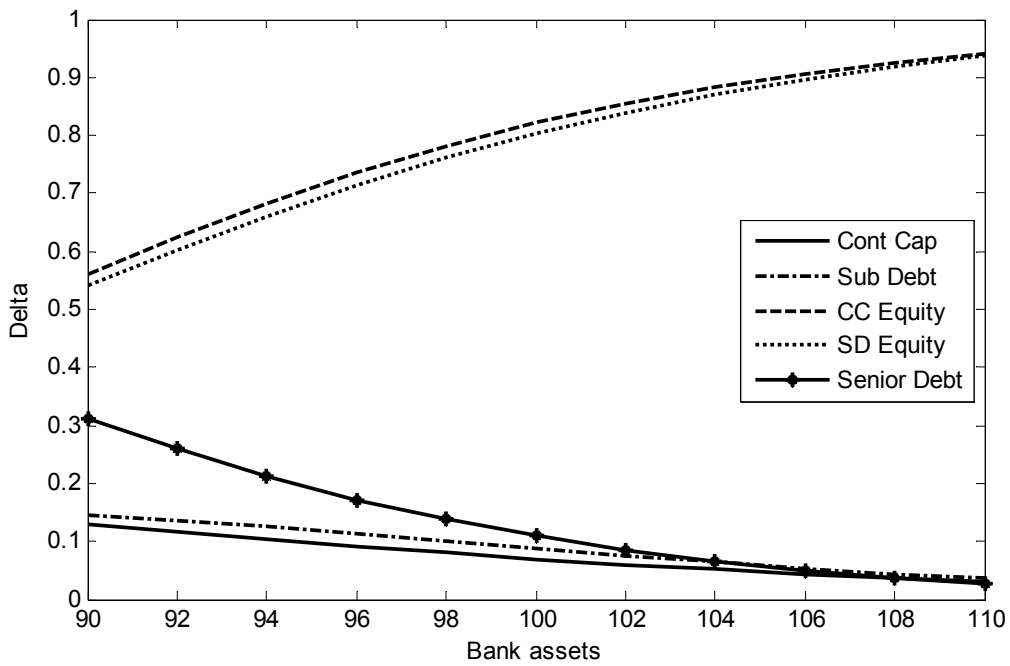


Figure 3. Instrument values for different levels of asset volatility

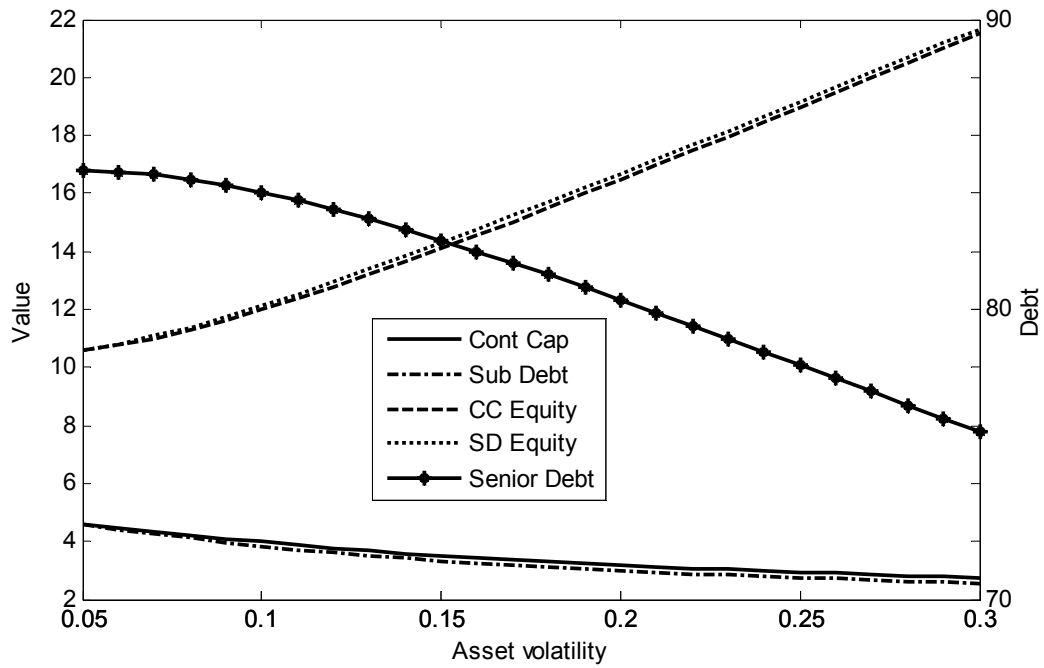


Figure 4. Instrument value sensitivity to a small change in asset volatility

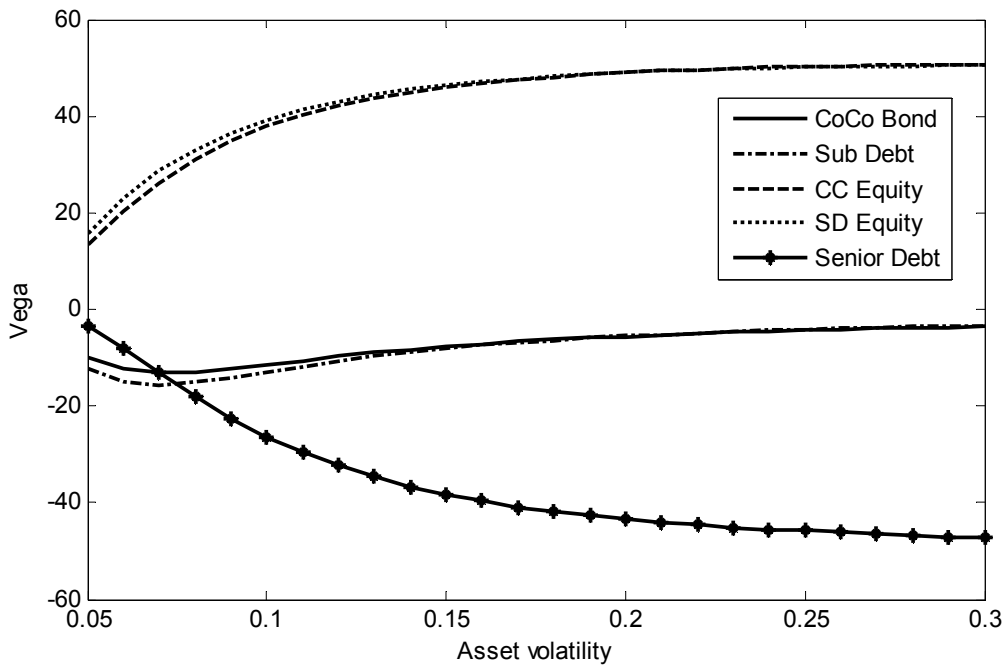


Figure 5. Contingent capital values with different conversion prices

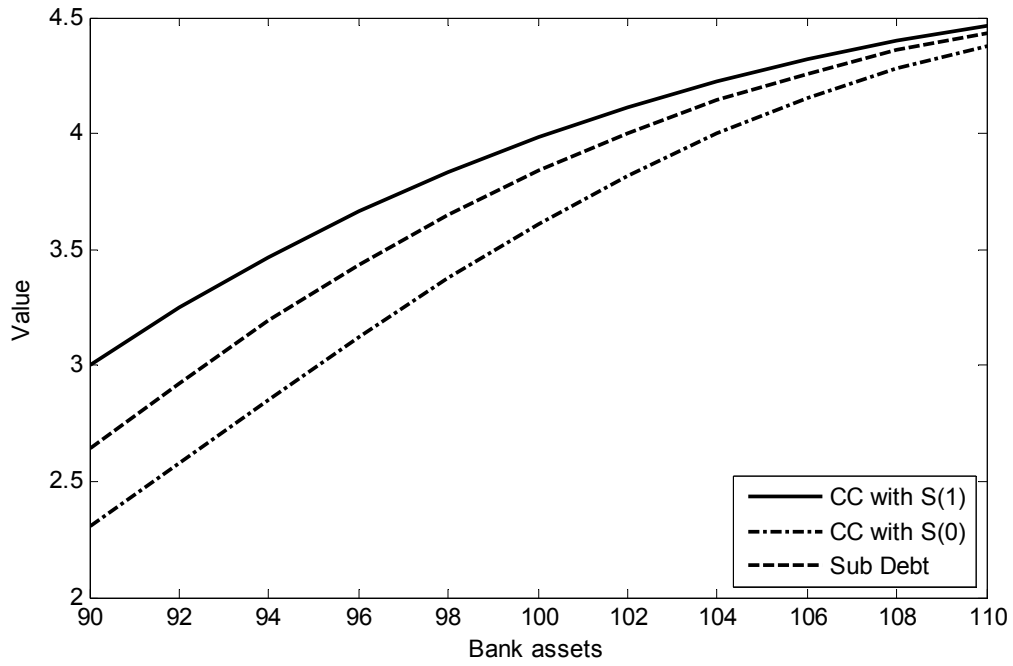


Figure 6. Probability of failure with contingent capital or subordinated debt

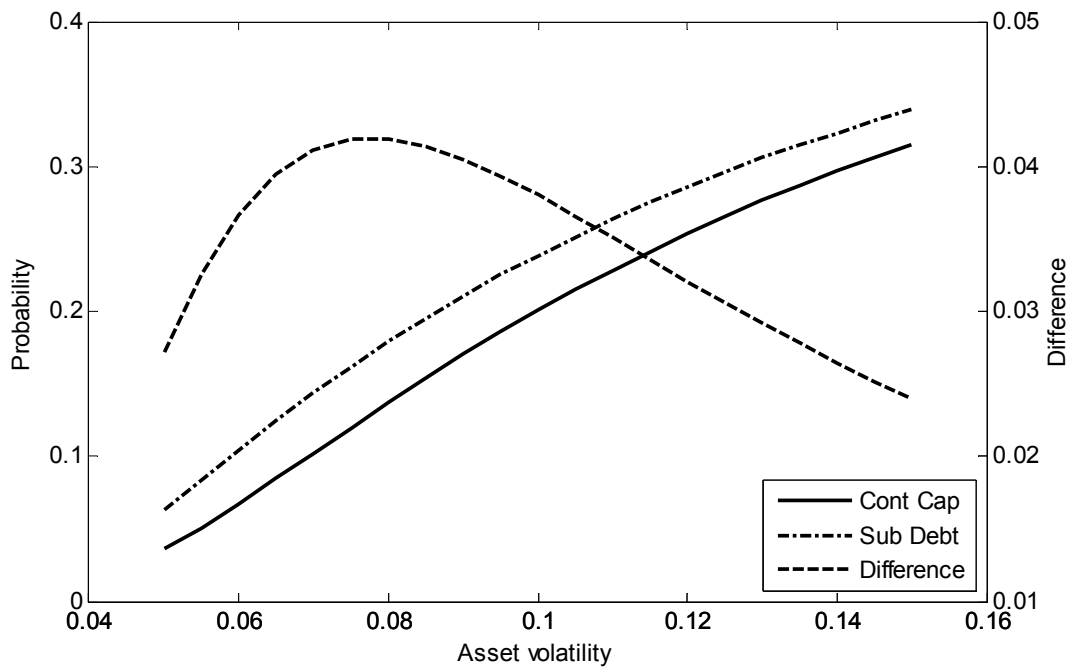
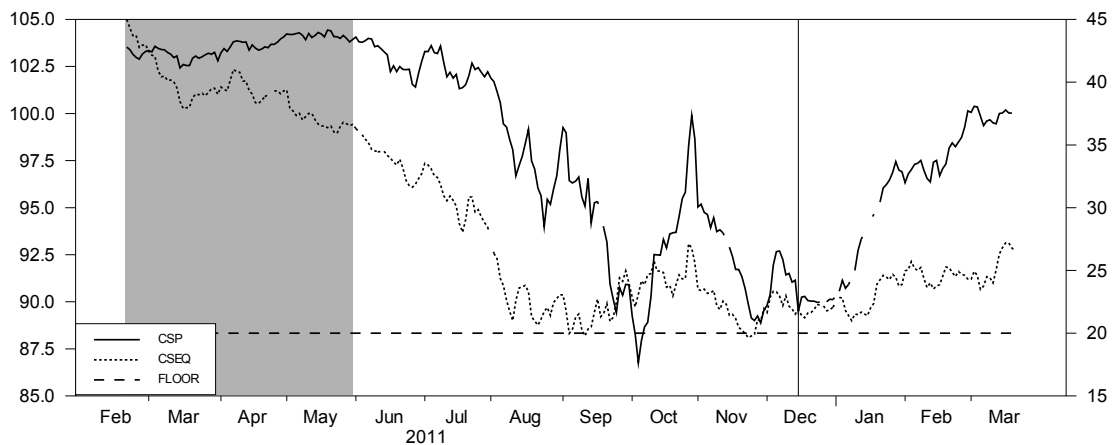


Figure 7. CoCo bond and stock prices for Lloyd's Banking Group PLC (£)  
 Daily data from Nov. 23, 2009 to March 21, 2012. Stock price scale is on the right.



Note: Vertical lines represent an upgrade in the S&P rating BB to BB+ on March 9, 2011 and the announcement of a negative outlook for the bond by Moody's on November 9, 2011. Shading indicates period of negative correlation between stock and bond prices. Data source: Bloomberg.

Figure 8. CoCo bond (\$) and stock (CHF) prices for Credit Suisse Group AG  
 Daily data from Feb. 18, 2011 to March 21, 2012. Stock price scale is on the right.



Note: Vertical line represents a downgrade in the Fitch rating from BBB+ to BBB- on December 15, 2011. The horizontal line is a conversion price floor (right-hand scale). Shading indicates period of negative correlation between stock and bond prices. Data source: Bloomberg.

# Measuring Equity Capital for Stress-Testing Large Financial Institutions

Mark J. Flannery  
[flannery@ufl.edu](mailto:flannery@ufl.edu)

## ABSTRACT

The Dodd-Frank Act seeks to assure financial stability in part by mandating periodic stress tests for large and systemically important financial institutions. Appropriately, the legislation leaves implementation issues to regulatory staff, including choice of the standard for assessing whether individual institutions “pass” the stress tests. This paper recommends that stress test results be evaluated in terms of a narrow definition of equity capital that includes all available fair value adjustments. Simultaneous stress tests for important financial institutions can help supervisors determine the fair value of intangible and off-balance-sheet assets and liabilities, which are typically excluded from capital measures.

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“The traditional role of capital, especially common equity, is to absorb unexpected losses and thus to protect depositors and other creditors.” (Federal Reserve Board of Governors (2009a), pp. 2-3)

## **I. Introduction**

The Dodd-Frank Act (DFA) requires the Federal Reserve to conduct annual stress tests for systemically important financial institutions.<sup>1</sup> These tests should evaluate “whether such companies have the capital, on a total consolidated basis, necessary to absorb losses as a result of adverse economic conditions.” (DFA, section 1115(a)) The Act further mandates that important financial firms administer their own internal stress tests: systemically important firms quarterly and other firms (with assets exceeding \$10 billion) semi-annually (DFA, sections 1115(a), 1115(b)). The standard by which an institution will “pass” its stress test is not specified in legislation. Somewhat surprisingly, such a definition is conceptually ambiguous. Surviving a stress test requires that a firm emerge from the stress period not only solvent – with asset values exceeding the present value of promised liability payments – but obviously strong enough to prevent runs by short-term claimants. The the relevant assessment of asset values is the fair value attributed by market investors, who must roll over their short-term liabilities if a banking firm is to continue operating. Unfortunately, the market’s assessment of fair value need not coincide with any accounting measure of solvency. These disparities reflect both accounting rules and managerial judgmental flexibility that permits slow recognition of a firm’s deteriorating economic condition.

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<sup>1</sup> Formally, the “Dodd–Frank Wall Street Reform and Consumer Protection Act”, Pub. L. No. 111-203, H.R. 4173.

A stress test can be viewed as a formal mechanism for marking a financial institution's entire book to something like market or fair values. The inspiration for DFA's stress tests comes from the Supervisory Capital Assessment Program (SCAP) undertaken by Federal regulators in spring 2009. Stress tests were simultaneously applied to all 19 U.S. financial institutions with consolidated assets exceeding \$100 billion. Supervisors and bankers simulated asset and liability values, loan performance, revenues and costs over a two-year period. "Passing" the test required that an institution "remain sufficiently capitalized over the next two years and able to lend to creditworthy borrowers should such losses materialize." (Federal Reserve Board (2009a), page 1). Specifically, an institution was required to project at least 6% (of RWA) Tier I capital and 4% Tier 1 common equity.<sup>2</sup> If a firm's estimated capital position at the end of the two-year stress period fell short of either standard, it was required to raise additional funds promptly, so that its pro forma statements would satisfy the test's capital requirements.

Congress left it for the regulatory agencies to specify stress test details. The open questions include: What shocks should be simulated? How should the effects of macro-level shocks on bank accounting variables be estimated? To what extent should results be publicly announced? How much terminal capital (at the end of the stressed simulation period) is adequate? What definition of "capital" should be applied? This paper primarily considers the last two questions: the appropriate definition of capital for supervisory stress tests, and the determination of a "passing" stressed performance. Section II discusses the conceptual role of stress test results in judging a regulated firm's ability to continue normal operations. Clearly, a healthy financial firm must convince market observers – including short-term liability holders – that their asset values are sufficient to repay outstanding liabilities in full. Yet, at least to date,

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<sup>2</sup> Note that the SCAP's Tier I capital requirement exceeded the applicable regulatory minimum, which was 4% of risk-weighted assets.

assessments of bank condition in stress tests have relied on regulatory (accounting) measures of capital adequacy, which need not correspond to the notion that adequately capitalized banks must have sufficient market value to discourage runs. Regulatory capital definitions also exclude recently-conceived contingent capital or bail-in instruments, which are discussed in the last part of Section II. The next section explains how various accounting measures of “equity capital” differ from market (fair) valuations, and Section IV presents data about the composition of U.S. bank holding companies’ equity accounts. Section V concludes the paper by recommending a capital definition to use in assessing stress test performances.

## **II. Conceptual Issues Regarding Stress Test Results**

Stress tests are designed to determine whether a financial institution can survive a large but plausible shock (e.g. Schuermann (2011)). Basically, the test estimates a pro forma balance sheet for an institution subject to the assumed stress. The test simulates how an institution’s balance sheet under specified economic conditions over a specified horizon (e.g. two years). Ideally, a stress test produces a plausible *pro forma* balance sheet with assets, liabilities and hedge positions marked to the fair values implied by the stress event. In addition, the impact of assumed economic conditions on a bank’s revenues and expenses (and hence the effect on retained earnings) are included in the projection. “Passing” the stress test requires that an institution have sufficient equity capital that it can survive on its own resources, going forward. However, the impact of supervisory support on bank solvency makes it difficult to separate the public’s assessment of financial condition from the supervisors’.

Capital regulation involves a variety of capital definitions by which supervisors have agreed to assess a financial firm’s condition. Unfortunately, not all these regulatory capital definitions measure a firm’s ability to continue operations without government support. In order

to focus first on the basic concept of solvency, assume that banks have only one sort of equity -- common equity, which is fully loss-absorbing. This section discusses the economic goals of a stress test in terms of this simple “equity” account. How large a pro forma equity position is required to “pass” the stress test? Even with such a simplified definition of equity, specifying the answer to this question is problematic.

### A. Assessing “Solvency”

A financial institution can continue normal operations so long as it is “solvent” – that is, so long as it can meet its financial obligations as they come due. The literature identifies two sorts of solvency. First, a firm is solvent on a *balance sheet basis* if the value of its assets exceeds the value of its liabilities. If the firm were wound up in an orderly fashion, shareholders would receive positive value. Second, a firm may be balance sheet *insolvent* but *cash flow* solvent. (It’s not dead yet, and might get lucky with the passage of time.) Such a firm can continue funding itself if sufficient assets mature before each liability comes due. Eventually, however, the assets become insufficient to pay off maturing liabilities.<sup>3</sup>

Cash flow solvency can be relevant for a firm financed with large amounts of equity and long-term debt, which includes many nonfinancial firms. However, banks specialize in funding long-term, illiquid assets with shorter-term liabilities.<sup>4</sup> Banking theory (going back to Diamond and Dybvig (1983)) points out that maturity transformation makes a bank unstable (“fragile”). If opaque assets cannot be sold for their fair value, thinly capitalized banks may be subject to two rational expectations equilibria. If all short-term depositors roll over their claims, the bank need

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<sup>3</sup> A balance sheet insolvent firm that is cash flow solvent has underwater shareholders running the institution. Their incentives are to raise risk – to gamble for resurrection. History from the savings and loan crisis strongly suggests that the expected return to risk-taking in such circumstances is negative.

<sup>4</sup> For simplicity, I refer to all short-term liability holders as “depositors.” Note that some BHC finance themselves with substantial amounts of insured, retail deposits, which are less likely to run even if the bank appears to be solvent. These firms are less fragile than ones that rely heavily on short-term, uninsured liabilities. For example, see Brunnermeier et al. (2009).

not liquidate and is solvent. But if short-term depositors refuse to roll over their claims, the bank must liquidate its asset portfolio, at a cost that may exhaust its equity.<sup>5</sup>

Uncertainty about asset/liability valuations complicates outsiders' (depositors') assessment of a bank's balance sheet solvency. If banks are not very transparent (particularly in times of crisis), high bank leverage means that even small errors in asset or liability valuation can imply large errors in valuing equity. In addition, banks with large trading books can substantially change their portfolios daily, further complicating an outsider's assessment of solvency. Even the *possibility* of insolvency creates uncertainty about how losses might be assigned in a (lengthy) bankruptcy process, and depositors might rationally run.<sup>6</sup> The threat of bankruptcy can thus cause insolvency.<sup>7</sup> In other words, the reported equity value required to avoid runs might change with market uncertainty about true asset values.

Stress test results can be separated into three possible ranges. First, a bank's pro forma equity may be substantially positive. If there is no question about its solvency, there is no danger of a run. This situation is easy to classify: because this bank has demonstrated its ability to absorb unusual losses without becoming undercapitalized, it passes the stress test. At the other extreme, a bank's simulated losses might result in negative pro forma equity following the stress event. That is, the stress is expected to render this bank insolvent. Supervisors must close such a bank or re-capitalize it. If re-capitalization requires government contributions (either in cash or in the form of liability guarantees), the firm has clearly failed its stress test.

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<sup>5</sup> If depositors can estimate bank asset values only with error, they may rationally, but mistakenly, run against a truly-solvent bank. Hence central banks' "discount window" facilities (Goodhart (1990)), which protect banks against "irrational" runs or simple liquidity problems.

<sup>6</sup> Runs can be motivated by an individual investor's fear that her funds will not be repaid, or by her fear that other short-term investors will have that fear (Morris and Shin (global games??)).

<sup>7</sup> Recent reforms have included arrangements designed to resolve insolvent banks quickly while insulating depositors from loss.

The final case is most complex: a bank's projected equity is positive, but not large enough to dispel the perception that it might be insolvent or to satisfy regulatory capital standards. Such a bank might have enough equity to finance the issuance of sufficient new shares to make itself obviously (to depositors) solvent. Issuing shares requires transactions costs, which must be borne by the existing shareholders. If the pro forma equity value can cover these costs, the bank can be re-capitalized privately and pass the stress test.<sup>8</sup> If the projected equity is too small to cover the issuance costs required to make it obviously solvent, it fails the test. Government can let this institution fail, or re-capitalize it with public funds (including guarantees).

### ***B. A Role for Contingent Capital Instruments***

A bank whose stressed common equity is inadequate might still pass its stress test if it has sufficient "going concern" contingent capital instruments outstanding to make it obviously well capitalized. Regulators have considered several types of "going concern" contingent capital instruments in recent years. For example, Lloyd's issued Enhanced Capital Notes ("cocos") in late 2009 that convert to shares (at a pre-determined price) if its book capital ratio falls below 5%. The following year, Rabobank issued bonds whose value is reduced by 75% if its capital ratio falls too low. And Swiss regulatory authorities imposed a 19% capital ratio on their large, international banks in 2011, of which up to 9% could take the form of contingently convertible bonds.<sup>9</sup> Others have proposed that long-term bank debt be subject to "bail in" if the issuer fails (Calello and Ervin (2010)). At the point of non-viability, such debt would be converted to equity, permitting the bank to continue operations without public assistance.

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<sup>8</sup> A debt overhang means that shareholders will not voluntarily sell equity when they are in this condition.

<sup>9</sup> Credit Suisse issued about \$6.2 billion of these contingent bonds in February 2011, which constituted about half of their required coco issue.

Both cocos and bail-in bonds provide something like a pre-packaged bankruptcy process that comes into force when the issuing firm weakens sufficiently. With enough of these instruments on the balance sheet, even a bank that has insufficient common equity in the stress scenario might be rendered sufficiently capitalized by the conversion of contingent capital instruments. Details would depend on the terms of the contingent instrument. But if their conversion were feasible and sufficiently large, the bank's pro forma condition should permit it to continue normal operations.

### *C. Regulatory Influences*

The supervisors' own opinion about a bank's solvency carries important implications for its survival in three ways. First, market participants may perceive an implicit guarantee for firms that pass the stress test. Despite Fed intentions, its announcement that a firm is sufficiently well capitalized to withstand an extreme economic event may be taken as a guarantee of continued operations – or even a guarantee that no new shares will need to be issued.

Second, the lender of last resort can help banks to offset deposit runs by lending on the basis of good collateral. But the Federal Reserve may lend only to a solvent bank, so its definition of solvency (how large is the bank's equity account, and by which definition?) affects the bank's survival, at least temporarily. The supervisory definition of passing a stress test thus involves an element of self-fulfillment. If the supervisor stands ready to provide liquidity to "passing" banks, depositors are less likely to run and fire sale losses are less likely to render the bank insolvent.

Third, supervisors may wish to distinguish between adequate capital ratios and an adequate dollar amount of capital. A bank can comply with a ratio requirement either by accumulating capital or by shedding risk-weighted assets. In 2009, supervisors feared that large

banks' efforts to liquidate assets would combine with cash-in-the-market pricing (Allen and Carletti (2008), Plantin et al. (2008)) destabilize financial markets via a downward price spiral ("fire sale"), as in Kashyap Rajan and Stein (2008) or French et al. (2010). A similar concern applied for European banks in 2011. In order to prevent banks from planning to shrink their balance sheets, the SCAP required a minimum amount of capital (not a capital ratio) for each tested bank.<sup>10</sup> In deciding between minimum ratios and minimum amounts, supervisors benefit from applying similar stress tests to many institutions simultaneously (Hirtle et al. (2009)) The tests will indicate whether many, a few, or no institutions have deficient equity. If the financial sector were sound overall, asset sales by a few institutions might not disrupt markets and should be permitted. Supervisors can assess whether asset sales are likely to have untoward social effects, and set the passage levels of equity in terms of ratios, amounts, or (as in the SCAP) both.

The most important conclusion from this section is that post-stress solvency must be judged on the basis of equity capital's economic value as viewed by market investors. This conclusion applies most clearly when banks have a single type of loss-absorbing equity. Actual capital accounts for U.S. BHC include more types of securities, not all of which protect short-term liability holders from potential loss to the same extent.

### **III. Valuing Assets and Liabilities**

SCAP and CCAR criteria for passing the stress test involved the pro forma values of Basel book (accounting) measures of capital. But the prior section's discussion of a simplified equity account indicates that solvency depends on the economic value of equity – its "market" or

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<sup>10</sup> This concern about potentially destabilizing asset sales emphasizes that a stress test must include assumptions about how institutions may respond to the stress (Pew (2011)). Does the bank close down lines of business with growing losses? Does it sell assets to book accounting profits and/or to reduce the capital ratios' denominator.

“fair” value. Book-valued capital does not necessarily protect liability-holders from asset value declines, and hence provides no assurance that liability holders will be repaid as promised. Moreover, the reporting options permitted by GAAP accounting enable managers to raise book values above market values, and the incentive to do this is particularly strong when the firm is encountering trouble (Flannery (2005)). Book values are most suspect when the true value of equity is most relevant to a firm’s stability.

The distinction between book and market valuation is clearly illustrated by recent history. Five large U.S. financial firms that failed or were acquired in 2008 (Bear Stearns, Lehman Brothers, Washington Mutual, Wachovia and Merrill Lynch) reported Tier 1 book capital ratios between 12.3% and 16.1% in their final quarterly financial reports (Kuritzkes and Scott (2009)). Despite these impressive book equity ratios, short-term liability-holders soon refused to roll over their claims. Depositors require that the market value of a banking firm’s assets exceed its promised payments on liabilities. If this condition does not hold – regardless of what book values may say -- short-term liability holders will run and bring down the bank.

How closely will a post-stress test measure of bank capital correspond to its fair market value? Bank capital accounting is one of the most arcane areas of financial regulation, and Basel’s bank capital definition does not correspond directly to the single equity account assumed above. Regulatory “capital” accounts include several types of equity (e.g. common shares, preferred shares, mandatory convertible bonds) and debt (e.g. trust preferred securities, subordinated notes). Moreover, the Basel definitions do not uniformly identify deviations between bank and market values, and exclude some asset values when computing capital.

This section surveys the extent to which unrealized gains/losses on securities and hedge positions are included in measures of bank equity, and then discusses the conditions under which

intangible assets (such as goodwill, deferred tax assets, or mortgage servicing rights) add value to a banking firm.

#### ***A. The Trading Book***

A bank's trading book contains assets and liabilities for which the bank makes a market, as well as positions invested for the bank's own benefit. Trading account securities are carried at current market values. Realized and unrealized capital gains/losses flow to the income statement and enter the bank's equity account through retained earnings. Some security valuations (and hence reported gains/losses) may be subject to managerial discretion, particularly "Level 3" securities that have no close substitutes trading in a liquid market. Banks value Level 3 assets using internal models based on bespoke assumptions. Nissim (2003) concludes that banks under greater capital pressure from regulators tend to mark their Level 3 assets more optimistically. The financial crisis included prominent instances – most notably Lehman Brothers before its failure – where investors believed that the internal values (marks) assigned to real estate or mortgage assets were unrealistically high. Yet these valuations had not yet been contradicted by auditors or regulators.

#### ***B. The Banking Book***

At the opposite extreme lies the "banking book," composed primarily of illiquid loans. These loans are generally valued at their historic cost, with initial premia or discounts amortized over the loan's life.<sup>11</sup> The most prominent effects on loan values reflect changes in the borrowers' credit-worthiness, which is a type of "other than temporary impairment" (OTTI). To account for higher expected defaults, banks maintain a general loan loss reserve (the "allowance for loan and lease losses" or ALLL) that is meant to estimate likely credit losses from the

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<sup>11</sup> Since 2007, SFAS No. 159 permits banks to fair value their loans in order to recognize the full effect of hedging (beyond the hedges that qualify for cash-basis treatment). A loan's fair-value changes if interest rates or the borrower's credit condition changes.

existing portfolio. Loan charge-offs and recoveries are charged to a bank's ALLL, which is restored through an accrual expense ("provision for loan loss") charged to current earnings. Under-stating the ALLL overstates earnings and regulatory capital ratios.

The discretionary components of ALLL make it difficult for outsiders to value a bank. For example, Thomas (2011) asserts that

Although bankers will disagree, ALLL methodologies, which differ greatly in both quantitative and qualitative risk factors, can often deliver any desired level. This is because bankers can argue they understand their loan risk better than anyone else.

The challenge is particularly severe for troubled banks, whose loan books are notoriously slow to reflect value losses. Many banks have exhibited rapid deterioration in earnings and equity when an on-site examination leads to large loan write-downs. Gunther and Moore (2003) report that large increases in the ALLL hardly ever result from voluntary managerial actions, but nearly always follow an on-site examination. Stress tests should avoid such precipitous changes by linking anticipated loan loss estimates to assumed economic conditions in a timely manner.

### ***C. The Investment Portfolio***

The investment portfolio's reporting of asset value changes lies between that of the trading book and that of the banking book. Before the early 1990s, investment securities were valued at historic cost, adjusted (as time passed) for premia or discounts included in the acquisition price. Unrealized investment gains/losses were ignored unless they reflected credit quality deterioration. But such OTTI were rare because investment portfolios included large shares of relatively riskless treasury and agency debt. "Cherry picking" the investment portfolio to realize gains provided a means of manipulating reported earnings.

FAS 115 changed this situation in 1993 when it made the accounting valuation of investments depend on their expected holding period. Banks were required to specify each investment asset as either a

- “Held to Maturity” (HTM) security that the bank does not plan to sell before maturity; or
- “Available for sale” (AFS) security that might be sold before maturity.

HTM securities are valued at amortized historic cost. Although the Y-9C collects information on unrealized gains/losses on HTM securities (Schedule HC-B), these magnitudes do not affect income or retained earnings. AFS securities are marked at their current fair value, as defined in SFAS No. 115. In order to reduce income fluctuations, the unrealized gains or losses on AFS securities are excluded from reported income. Instead, SFAS No. 130 in 1998 required that AFS unrealized gains/losses flow to “other comprehensive income” (OCI), which becomes a component of the firm’s retained earnings and hence reported in equity capital. Similarly, accumulated net gains/losses on cash flow hedges affect OCI (and hence common equity but not net income).

The concept of OCI may require some explanation for non-accountants.<sup>12</sup> As accounting standards have moved toward recognizing fair value changes for assets and liabilities, accountants wish to maintain a distinction between value changes that are realized – and which therefore affect the income statement -- and those that are not realized. The accumulation of unrealized value changes is entered to an equity account called OCI, which is posted to retained earnings. As reported in the Y-9C forms, OCI includes<sup>13</sup>

1. net unrealized holding gains (losses) on available-for-sale securities,

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<sup>12</sup> See <http://www.principlesofaccounting.com/chapter%209.htm> for an introduction to the concept of OCI.

<sup>13</sup> BHCs’ OCI also includes cumulative foreign currency translation adjustments and minimum pension liability adjustments.

2. accumulated net gains (losses) on cash flow hedges.

Fair value changes are thus captured selectively on investment securities and according to the definition of hedge accounting. (Gains/losses on non-cash flow hedges flow directly to the institution's income statement and hence get carried into retained earnings.) Incorporating all available asset and liability fair values into equity accounts is important to using those accounts to assess stress test results.

Yet they are not all measured, and even the ones that are measured are not fully included in regulatory capital definitions.

#### **IV. The Composition of BHC Capital**

This section begins by explaining alternative definitions of regulatory capital, and evaluating the loss-absorbing capability of each component. I then use U.S. bank holding company data to illustrate the importance of each capital element in total BHC capital, as of mid-year 2011.

##### ***A. Capital Definitions***

The rows in Table 1 indicate the components of alternative capital measures. All of these capital concepts include the value of common shares outstanding and (cumulative) retained earnings. The first capital definition, tangible common equity (TCE), is also the simplest; it emerged from the confusion of 2008-9 as the market's preferred measure of ability to withstand losses. TCE includes only the value of common shares and accumulated retained earnings. The U.S. definition of Tier 1 "common equity" in row 2 of Table 1 closely corresponds to TCE. Basel's Tier I capital, the erstwhile definition of high-quality capital, begins with book equity (see Table A-2) and

- 1) Adds the liquidation value of perpetual preferred shares,
- 2) Adds trust preferred securities (TRuPS),
- 3) Removes some intangible assets, and
- 4) Removes unrealized investment and cash flow hedge gains/losses, and adds some minority stakes in subsidiary firms.

The trouble with Tier 1 capital as a standard for passing stress tests is that it includes some elements that do not protect liability-holders (e.g. TRuPs) and omits some elements that arguably do (some intangibles).

In response to the financial crisis, the Basel Committee has taken steps to “improve the quality” of bank capital. They began by introducing a distinction between capital instruments with “going concern” vs. “gone concern” loss absorbency. The former permits a firm to absorb losses without becoming insolvent. The latter provides a mechanism for absorbing losses among a bank’s fixed claimants after equity is exhausted, without forcing the BHC into a lengthy and uncertain bankruptcy procedure.<sup>14</sup> Instead, regulators oversee a process in which short term liability holders are protected from losses and some longer-term debt is converted to new equity.

The Basel 3 definition of primary (Tier 1) capital includes only items that provide “going concern” risk-absorbency:

“Total regulatory capital will consist of the sum of the following elements:

1. Tier 1 Capital (going-concern capital)
  - a. Common Equity Tier 1
  - b. Additional Tier 1
2. Tier 2 Capital (gone-concern capital)” (BCBS (2010), page 12)

Common Equity Tier 1 includes only fully paid-in common shares (par value plus surplus), retained earnings, and OCI. If an “Additional Tier 1” capital instrument is accounted for as a liability, it

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<sup>14</sup> It thereby resembles Covello and Ervin’s (2010) “bail in” concept.

must have principal loss absorption through either (i) conversion to common shares at an objective pre-specified trigger point or (ii) a write-down mechanism which allocates losses to the instrument at a pre-specified trigger point. (BCBS (2010, page 17)

The notion that Tier I instruments will provide going-concern loss-absorbency simplifies regulatory capital definitions, and brings them closer to the simplified equity concept in Section II above.<sup>15</sup>

“Gone concern” capital might take the form of subordinated debt or hybrid securities, designed to convert to equity under regulatory control. If these securities in fact enable supervisors to re-capitalize a firm with negative common equity, it would be appropriate to include them in the definition of capital related to passing the stress test. Indeed, implementing gone concern capital conversion in connection with a stress test could be a good precedent for subsequent re-organizations the supervisor might need to implement under market pressure. However, the process for converting gone concern securities to equity is untested and the tranche of gone-concern capital must be thick enough to leave the institution adequately capitalized. Ultimately, the value of gone-concern capital in “passing” a stress test will depend on its contractual and legislated features.

The components of regulatory capital in Table 1 vary in their ability to provide going-concern loss absorption.

#### 1. Unrealized Gains / Losses

Solvency is affected by the fair value of a bank’s assets and liabilities, which are incompletely recorded on bank balance sheets. All realized capital gains/losses in the trading book flow through reported income to equity value. AFS investments’ unrealized gain/losses

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<sup>15</sup> Starting Jan 1 2015, all internationally active financial institutions must “at all times” have at least 4.5% of RWA as Tier 1 Common Equity, 6% Tier 1 Capital and 8% Tiers 1 + 2 capital. Refinements of the new capital definitions and requirements will be phased in between January 1, 2016 and 2019 on a schedule illustrated by Annex 4 of BCBS (2010).

flow through OCI to equity, but unrealized HTM gains/losses do not. Still most of the investment portfolio's unrealized value changes are incorporated into equity because the vast majority of investments are classified as available for sale (AFS).<sup>16</sup>

Even though we see fair values for the trading book and for most of the investment portfolio, fair valuation is applied incompletely elsewhere in the bank balance sheets. Banking firms acquired the option to fair value other assets and liabilities (outside the investment portfolio) in 2007, but the extent of such valuations is not uniform across institutions. Moreover, managers have discretion about how much of the balance sheet they fair value, probably leading to an upward bias in reported equity values. Second, hedges that do not satisfy GAAP requirements for cash accounting can distort equity unless the associated assets or liabilities are fair valued. Accordingly, the extent to which a bank's equity account reflects fairly valued assets and liabilities cannot be known with certainty and doubtless varies across reporting BHC. Although we would like to have completely fair-valued balance sheets for judging bank solvency, this goal is presently unattainable. We should include fair valuations to the extent possible in bank stress test results.<sup>17</sup>

## 2. Preferred Stock

Some measures of regulatory capital sum common and perpetual preferred stock, implying that they can equally well absorb portfolio losses to maintain bank solvency. Unlike interest payments on debt, failing to pay a preferred dividend is not an event of default. In this sense, preferred shares provide more loss absorption capacity than a similarly-sized tranche of

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<sup>16</sup> As of mid-year 2011, 97% of the top 25 BHCs' investment assets were characterized as AFS, as were 87% of other BHCs' investment securities. The largest BHC classified the vast majority of their investment securities as AFS for at least the past decade. (Not plotted.) The proportion of AFS investments at smaller BHC has risen to 87% from about 75% in 2001.

<sup>17</sup> Plantin et al. (2008) and others argue that fair value is not perfect. Still, it seems important to recognize unrealized valuation changes in a balance sheet to be judged for solvency by depositors.

junior debt would provide. Troubled institutions may be able to negotiate a conversion of preferred into common shares, as was done in several cases during the crisis.

However, preferred stock also has some disadvantages compared to common, which make a comparison with subordinated debt more appropriate. Preferred shares' liquidating value constitutes a fixed claim in bankruptcy, just as debt does. Both preferred stock and subordinated debt shelter short-term claimants from losses. Both securities can therefore preserve cash flow solvency even when a firm is balance sheet insolvent. This is not necessarily a good thing. If asset values have fallen enough to impair the preferred stock's liquidating value, preferred shareholders have become the marginal claimants on firm cash flows, while common shareholders continue to control the firm. In this situation, common shareholders can increase their expected payoff by raising asset volatilities. Hedging or otherwise moderating risks is strictly inferior to "gambling for resurrection."<sup>18</sup>

In summary, preferred and common stock claims do not substitute perfectly for one another; preferred shares provide less "going concern" loss absorbency than common shares, and may enable situations in which common shareholders have dysfunctional incentives.

### 3. Debt and Hybrid Capital Instruments

Not all components of bank equity and regulatory capital can absorb losses on a going-concern basis as I assumed in Section II above for simple, stylized equity. Indeed, the financial system's reliance on "capital" that could not absorb losses without bankruptcy added substantially to the government's cost of supporting troubled financial institutions in 2008-9. This section describes the prominence of various components of regulatory capital measures and

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<sup>18</sup> Preferred shares have been used as the device for government solvency support to weakened financial institutions. The resulting corporate control effects constitute one drawback of this policy.

then discusses several capital aggregates that could be used to assess solvency following a stress test.

Since the 1980s, U.S. banks and bank holding companies have fulfilled their capital requirements in part by issuing junior debt claims (subordinated to insured liabilities). Subordinated debentures were considered protection for the deposit insurance fund. However, subordinated debentures cannot absorb losses on a going concern value, but only after the issuer has failed and losses are being apportioned in bankruptcy. As we saw during the financial crisis, though, supervisors were unwilling to put large institutions into bankruptcy, and so debentures absorbed few losses during the crisis.

The first two Basel Accords included debt and hybrid securities in Tier 2 capital, despite the fact that their loss-absorption capacity required that the issuer fail and enter bankruptcy.<sup>19</sup> The U.S. implementation of Basel 2 includes in Tier 1 capital a specific type of subordinated debt: “trust-preferred” obligations. These are deeply discounted debentures issued to a special purpose entity that finances them by issuing preferred shares to the public (FDIC (2010)). Interest payments on trust preferred debentures can be postponed for up to 19 quarters if the bank becomes troubled. In 1996, the Federal Reserve Board ruled that trust preferred securities could comprise up to (roughly) 25% of Tier 1 capital.<sup>20</sup>

No element of debt contributes to a firm’s book value solvency. Although a sufficient volume of credibly subordinated debt might forestall bank runs, this was not the case recently,

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<sup>19</sup> The introduction of required capital for trading account volatility in 1996 gave rise to “Tier 3” capital instruments which are subordinated debt with at least a two-year maturity. See Appendix E to CFR 225 Capital Adequacy Guidelines for Bank Holding Companies: Market Risk Measure.) The Tier 3 category of capital has been eliminated in Basel 3.

<sup>20</sup> See <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=7e2c11c5db686600654d880e46da4d8f&rgn=div9&view=text&node=12:3.0.1.1.6.12.8.2.10&idno=12>

and should not be the bet following stress tests. As Basel 3 has recognized, if a security is straight debt, it's not equity and not loss-absorbing.

“Hybrid” debt instruments were issued by many European banks before the crisis. These bonds were meant to incur principal write-downs if book equity fell below zero (and subsequently to recover their value if the bank made profits). Yet they functioned poorly, primarily because their ability to absorb losses was tied to negative accounting equity. Managerial options in constructing book values simply provide too much flexibility for a troubled firm to be forced to report negative equity. Hence the hybrid securities functioned like straight debt.

#### 4. Intangibles and Growth Options

Accounting rules limit the extent to which intangible assets are reflected on bank balance sheets. The most conservative measures of bank equity (tangible common equity) completely exclude intangible assets, and regulatory capital measures recognize the value of some intangibles but not all.<sup>21</sup> Basel 3 will progressively tighten up (exclude) more intangibles from the definition of regulatory capital during the 2014-2017 period. As with any other asset, intangibles' valuation has a dollar-for-dollar effect on a firm's reported equity.

By contrast, investors fully value intangible assets when pricing shares, and that valuation can vary with market conditions or the firm's condition. Despite their accounting treatment, valuable intangible assets enhance a bank's solvency because investors should be willing to contribute new equity in order to preserve access to valuable future investment opportunities. In general, market valuations of BHC common equity exceed book valuations: over the period 1986-2009, the mean (median) ratio of common stock's market to book value was 174% (161%)

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<sup>21</sup> Even when GAAP permits inclusion of an intangible asset, regulators sometimes curtail its valuation. For example, DTA cannot exceed 10% of Tier I capital and must be likely to offset taxable income within the next twelve months.

for a sample of large U.S. bank holding companies. Part of this market premium reflects intangible assets that are imperfectly captured on (or excluded from) the balance sheet. For example, expected future rents from an exceptionally profitable branch network are fully incorporated into stocks' market values, but may be absent from accounting statements. Growth opportunities also influence market values, but are excluded from book equity values.

A major justification for excluding some intangibles from accounting statements is that their true value can be difficult to establish. For example, the goodwill associated with an acquisition might be worth either more or less than the amount initially booked, according to whether the combination turns out better or worse than expected. Accountants have also struggled with the value of deferred tax assets (DTA). DTA can shelter a firm's future income from taxation, provided the firm earns taxable income before the tax deferral period ends. But even if a firm has no profits in its immediate future, its DTA might raise the price an acquirer would pay for it. The value of mortgage servicing rights (MSR) also depends on economic conditions, specifically the number of firms with servicing expertise that also have sufficient cash to acquire them (Shleifer and Vishny (1992)). In sum, intangible assets are relatively difficult to value, and the realizable value depends on both a firm's own condition and that of the industry.

Although estimating the value of intangible assets is tricky, it seems appropriate to include in the stress test criterion assets and liabilities to which the market assigns a reliable value. This probably requires factoring the financial markets' overall condition into valuation of intangible assets, which may be worth much less if many financial firms are simultaneously weakened. (See Hirtle et al. (2009).)

The discussion in this Section indicates that regulatory capital definitions are both too inclusive and too narrow. How empirically important are these deviations from going-concern loss absorbency?

### ***B. Relative Magnitudes***

The importance of various capital components to U.S. bank holding companies can suggest the magnitude of the gap between book capital measures and the idealized concept of loss-absorbing equity. Accordingly, I assembled a sample of all top-tier U.S. bank holding companies that submitted quarterly Y-9C reports over the period 1986-Q2 through 2011-Q2. The dataset includes 151,867 firm-year observations for both publicly-traded and non-traded holding companies.

Because the largest BHC are qualitatively different from their smaller counterparts in many ways, I summarize capital components separately for the largest 25 BHC in each quarter, and for all the other BHC. Figure 1 plots the ratio of the largest 25 BHCs' total assets to those of all reporting BHCs. From an initial level of 50%, the largest 25 BHCs' share of total BHC assets rises to 83.4% at the end of 2011-Q2. The top 25 institutions thus comprise a large majority of all BHC assets. They also have the most varied business models, and the most complex accounting issues related to their capital accounts.

Figures 2 - 9 plot the mean ratios of the major equity components of Basel 2's "equity capital" for all top-tier U. S. BHCs, as of June 30, 2011. Figures 2 and 3 plot capital components' proportional contributions to equity book value (row 2 of Table 1), as of June 30, 2011. Common shares (paid-in capital plus surplus) and retained earnings (through the income statement) constitute by far the greatest proportion of all capital aggregates, and its loss-absorbing capacity is absolute. The next five columns of Table 1 represent regulatory capital categories whose loss-absorbency is less complete.<sup>22 23</sup>

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<sup>22</sup> The text does not discuss one capital component: the allowance for loan and lease losses (ALLL). This allowance constitutes a component of Tier 2 capital (up to a maximum 1.25% of a BHC's risk-weighted assets). It should approximately equal expected losses on the existing loan portfolio and therefore

Because Tier I capital both augments and diminishes GAAP equity, it might be either larger or smaller than the accounting measure of bank equity. For the top 25 BHCs, Figure 4 shows that the equal-weighted mean and median values of equity are 10 – 35% lower than Tier I capital. The difference most likely reflects the large share of intangible assets at large banks (see Figure 6): although the reported intangibles are included in equity, many are excluded from Tier I. This is not the case for smaller BHCs. Figure 5 shows that their equity and Tier I capital measures are approximately equal. The value-weighted mean is somewhat lower, consistent with the finding in Figure 4 that larger BHC tend to have more Tier I capital per dollar of equity.

Figure 6 plots the mean and median accounting value of all intangible assets as a proportion of large BHCs' equity. Before adjustments, intangibles average 40% - 50% of common equity. After the exclusions specified in Basel 2, intangibles account for less than 10% of the top 25 BHC's common equity (Figure 8). For smaller BHCs, Figures 7 and 9 indicate that intangibles are less than half as large.

This brief data analysis indicates that changing the accepted definition of regulatory (stress-test-related) capital may have nontrivial implications for at least some BHC. The issues raised in this section are probably too large to ignore as stress testing methodologies progress in the future.

## **V. Conclusion: A Recommended Equity Definition for Stress Test Assessments**

The conceptual condition for passing a stress test is that the firm will retain its ability to function normally – providing credit to legitimate borrowers – after enduring the assumed shock. But identifying

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provides BHC liability holders with no protection against unanticipated losses. Accordingly, the ALLL should be excluded from the capital aggregate(s) used to assess stress test results.

<sup>23</sup> The thin tranche of preferred equity at large BHCs in 2011-Q2 may reflect conversions to common shares negotiated during the crisis.

the amount of pro forma equity capital a “passing” bank should have at the end of a stress test is conceptually challenging. The ability to continue normal operations depends in good measure on market estimates of the institution’s resources and in some measure on the regulator’s attitude toward the institution. Pro forma capital must be sufficient to convince outside investors of its balance sheet solvency. If a bank’s projected balance-sheet is not obviously solvent, it should not pass. Yet accounting conventions complicate this assessment because balance sheets incorporate asset and liability fair values incompletely. Although stress tests are intended to incorporate fair values into pro form accounting statements, there will inevitably be errors in the process.

The bottom row in Table 1 indicates my recommended capital definition for assessing an acceptable stress test performance. My preferred definition naturally includes common equity. All available fair value adjustments (unrealized gains/losses) should be included, even though banks need not value all their cash and hedge positions at fair value. (100% fair value reporting is a goal worth considering.) As presently constructed, preferred shares provide no formal loss absorption on a going-concern basis. They could be transformed into an acceptable source of “going concern” capital if reliable provisions were estimated for converting preferred into common shares when the firm encounters funding difficulties. Likewise, hybrid securities with credible conversion features should be included in the capital definition considered in stress test results.

Finally, the simultaneous application of stress test simulations to multiple financial institutions provides two sorts of valuable information about the financial sector’s overall condition. First, unlike “micro-prudential” examination practices, simultaneous stress tests generate information about the fair values of intangible and off-balance sheet assets. Although their valuation uncertainty makes it advisable to limit the contribution of intangibles to common equity, if the market would value these things, so should supervisors in assessing stress test results. Second, a test that projects widespread capital problems might lead supervisors to set a minimum dollar amount of required capital for each institution, as in the SCAP, rather than encouraging firms to meet a specified capital ratio by liquidating assets.

**Appendix:****Calculation of Basel 2 Capital Aggregates for  
U.S. Bank Holding Companies****Table A-1: FRB Y-9C calculation of Bank Holding Company Equity Capital**  
(line numbers refer to the Y-9C's Schedule HC—Consolidated Balance Sheet)

- 23. Perpetual preferred stock and related surplus
- 24. Common stock (par value)
- 25. Surplus (exclude all surplus related to preferred stock)
- 26. a. Retained earnings
  - b. Accumulated other comprehensive income<sup>a</sup>
  - c. Other equity capital components<sup>b</sup>
- 27. a. Total bank holding company equity capital (sum of items 23 through 26.c)
  - b. Noncontrolling (minority) interests in consolidated subsidiaries
- 28. Total equity capital (sum of items 27.a and 27.b).

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<sup>a</sup> Includes net unrealized holding gains (losses) on available-for-sale securities accumulated net gains (losses) on cash flow hedges, cumulative foreign currency translation adjustments, and minimum pension liability adjustments.

<sup>b</sup> Includes treasury stock and unearned Employee Stock Ownership Plan shares.

**Table A-2: FRB Y-9C Calculation of Tier 1 Regulatory Capital**  
(line numbers refer to Y-9C's Schedule HC-R—Regulatory Capital)

1. Total bank holding company equity capital (from Schedule HC, item 27.a).
2. LESS: Net unrealized gains (losses) on available-for-sale securities (if a gain, report as a positive value; if a loss, report as a negative value).
3. LESS: Net unrealized loss on available-for-sale equity securities<sup>1</sup> (report loss as a positive value).
4. LESS: Accumulated net gains (losses) on cash flow hedges<sup>1</sup> (if a gain, report as a positive value; if a loss, report as a negative value)
5. LESS: Nonqualifying perpetual preferred stock
6. a. Qualifying Class A noncontrolling (minority) interests in consolidated subsidiaries
  - b. Qualifying restricted core capital elements (other than cumulative perpetual preferred stock)<sup>2</sup>
  - c. Qualifying mandatory convertible preferred securities of internationally active bank holding companies.
7. a. LESS: Disallowed goodwill and other disallowed intangible assets
  - b. LESS: Cumulative change in fair value of all financial liabilities accounted for under a fair value option that is included in retained earnings and is attributable to changes in the bank holding company's own creditworthiness (if a net gain, report as a positive value; if a net loss, report as a negative value)
8. Subtotal (sum of items 1, 6.a., 6.b., and 6.c., less items 2, 3, 4, 5, 7.a, and 7.b)
9. a. LESS: Disallowed servicing assets and purchased credit card relationships.
  - b. LESS: Disallowed deferred tax assets
10. Other additions to (deductions from) Tier 1 capital
11. Tier 1 capital (sum of items 8 and 10, less items 9.a and 9.b)

<sup>1</sup> Report amount included in Schedule HC, item 26.b, "Accumulated other comprehensive income."

<sup>2</sup> Includes subordinated notes payable to unconsolidated trusts issuing trust preferred securities net of the bank holding company's investment in the trust, trust preferred securities issued by consolidated special purpose entities, and Class B and Class C noncontrolling (minority) interests that qualify as Tier 1 capital.

**Table A-3: FRB Y-9C Calculation of Tier 2 Regulatory Capital**

(line numbers refer to Y-9's Schedule HC-R—Regulatory Capital, continued from Table A-2 here)

11. Tier 1 Capital
12. Qualifying subordinated debt, redeemable preferred stock, and restricted core capital elements (except Class B noncontrolling (minority) interest) not includible in items 6.b. or 6.c.
13. Cumulative perpetual preferred stock included in item 5 and Class B noncontrolling (minority) interest not included in 6.b., but includible in Tier 2 capital.
14. Allowance for loan and lease losses includible in Tier 2 capital.
15. Unrealized gains on available-for-sale equity securities includible in Tier 2 capital.
16. Other Tier 2 capital components.
17. Tier 2 capital (sum of items 12 through 16).
18. Allowable Tier 2 capital (lesser of item 11 or 17).

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**Table 1: Summary of Capital Components (not an exhaustive list)**

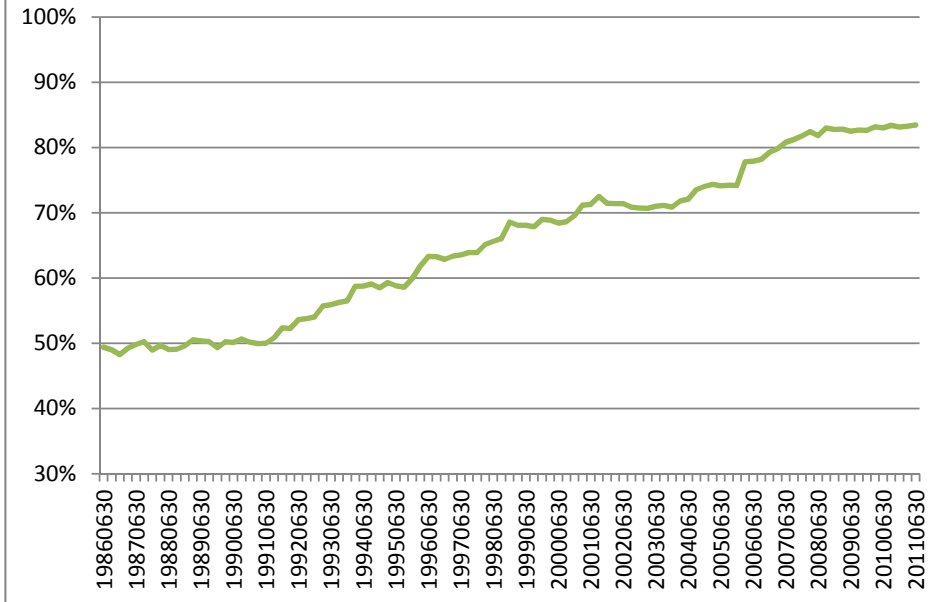
		Common Shares	Retained Earnings		Perpetual Preferred Shares	Liabilities			Intangibles
			Via the Income Stmt.	Unrealized FV Gains/Losses <sup>a</sup>		TRUPS	Hybrids <sup>b</sup>	Other <sup>c</sup>	
1.	Tangible Common Equity	+	+	Some					
2.	Basel 2 "Equity capital"	+	+	Some					Some
3.	Basel 2 Tier 1	+	+	Some	+			?	Some
4.	Basel 2 Tier 2	+	+	Some	+			+	Some
5.	Basel 3 Common Equity Tier 1	+	+	Some			+		
6.	Basel 3 Tier 1	+	+	Some	+				
7.	Recommended	+	+	All	?				Some

<sup>a</sup> Unrealized value changes and gains/losses on cash flow hedges affect retained earnings through the Other Comprehensive Income account.

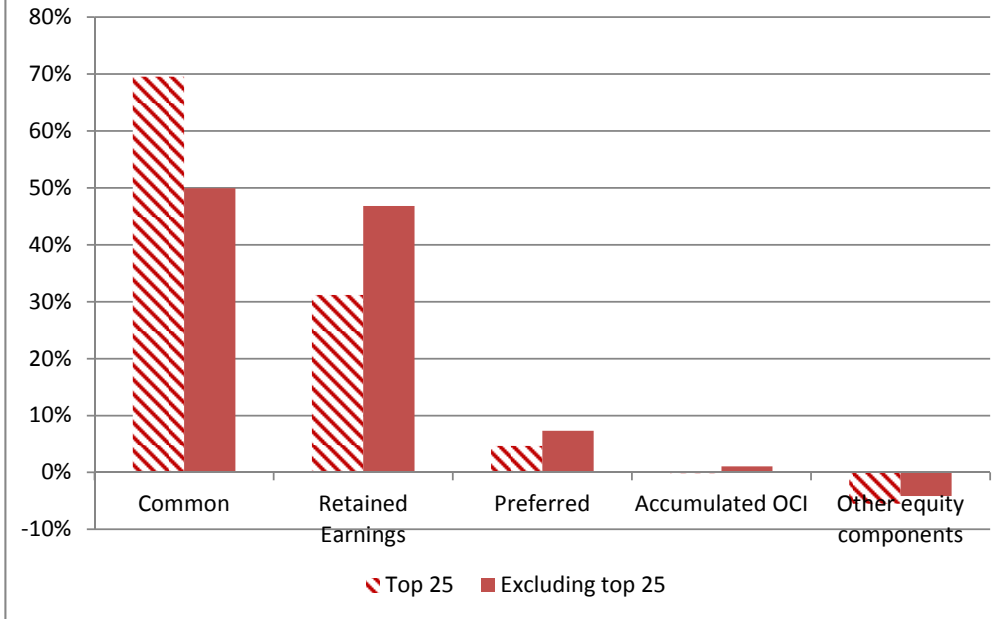
<sup>b</sup> Hybrids include such instruments as limited-life preferred shares and subordinated debentures. Securities booked as liabilities count as Basel 3 Tier 1 capital only if they can absorb losses on a "going concern" basis.

<sup>c</sup> Includes subordinate notes and debentures, limited-life preferred shares.

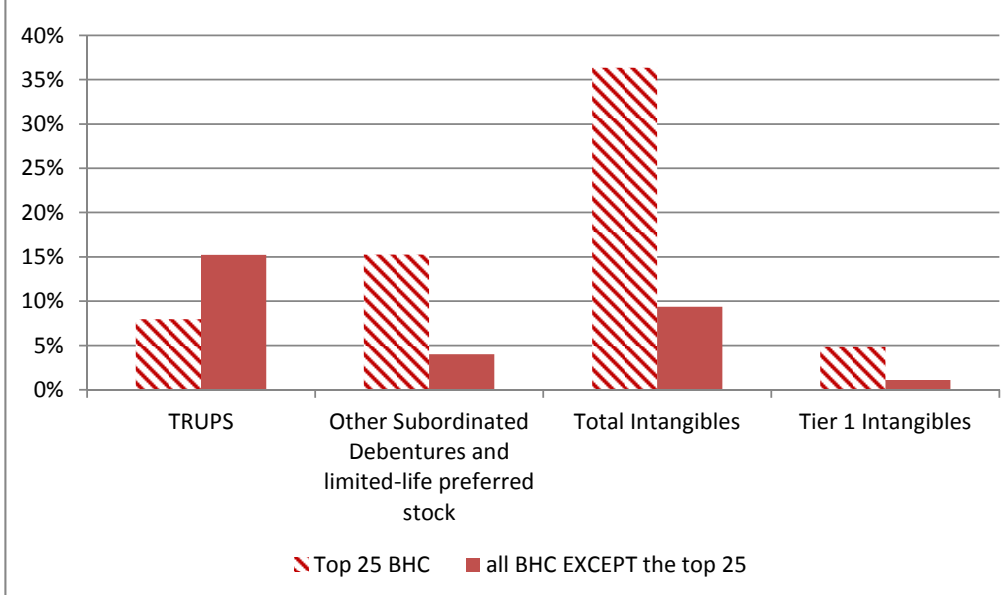
**Figure 1: Ratio of Total Assets of Largest 25 BHC to All BHC**

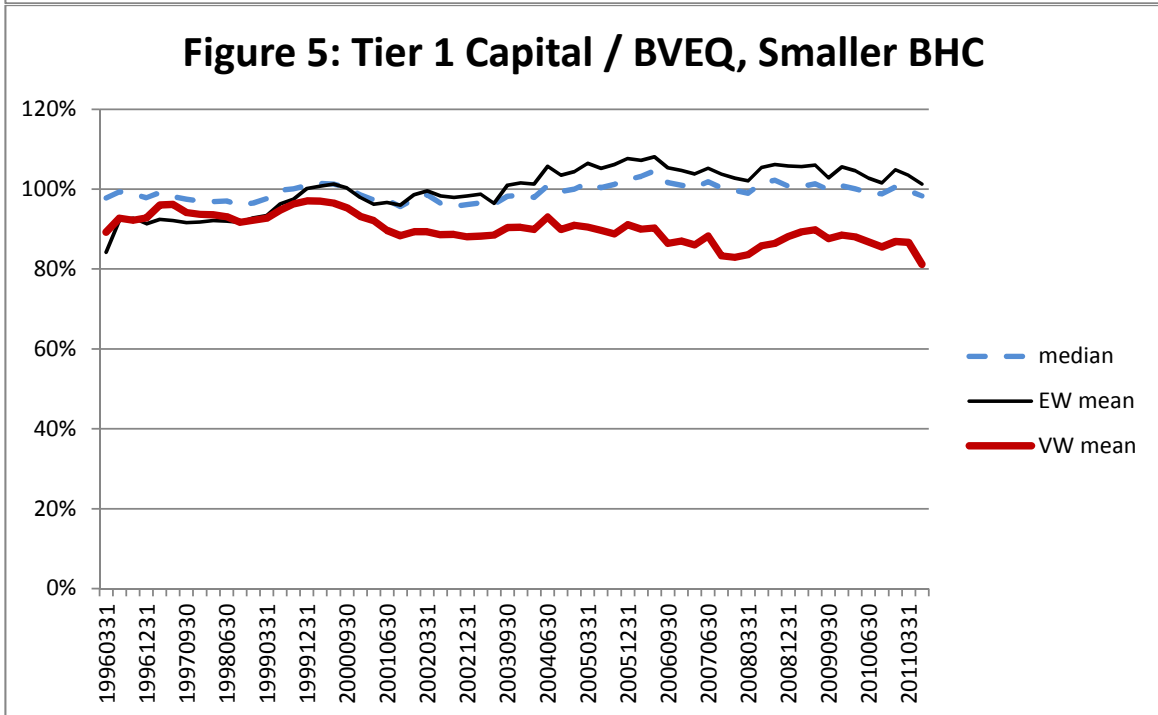
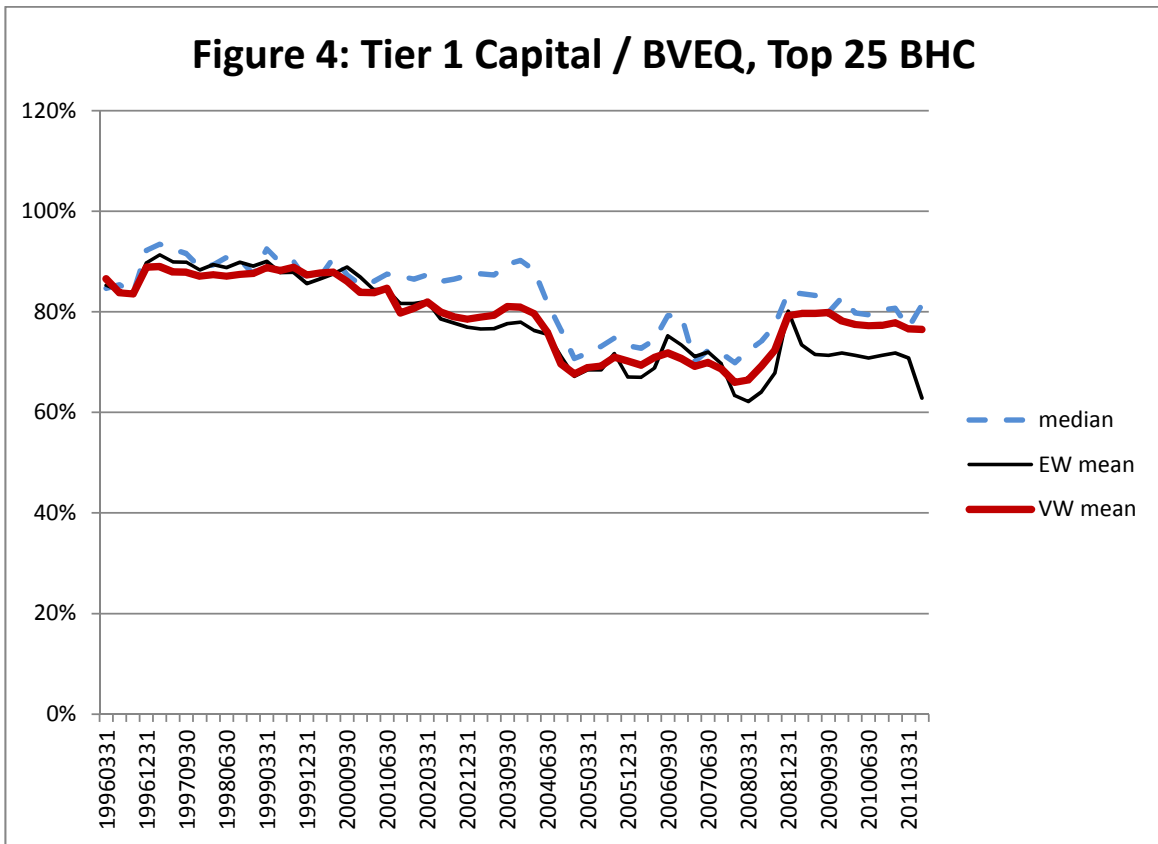


**Figure 2: Mean Components of BVEQ (in %), 2011-Q2**

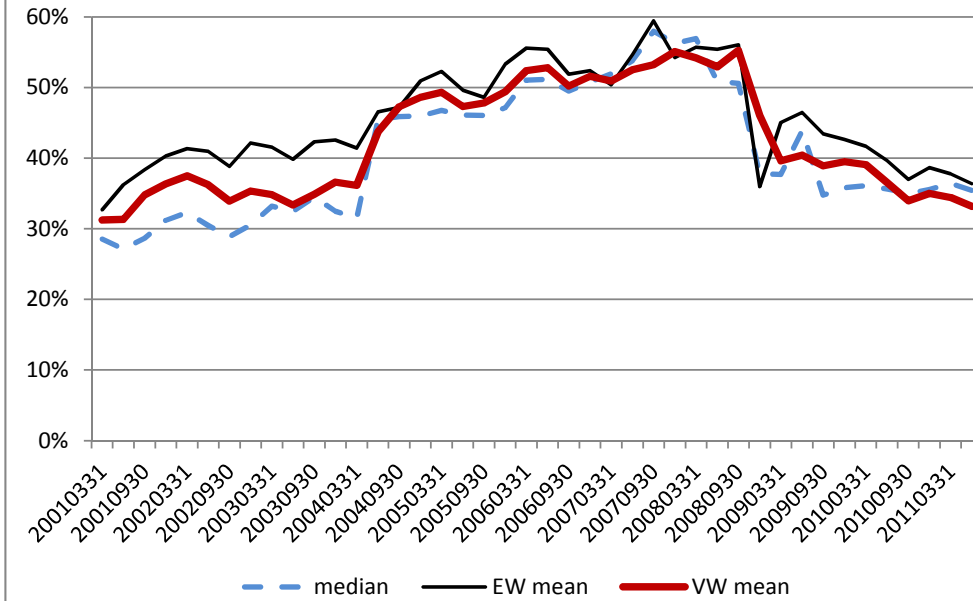


**Figure 3: Mean Components of BVEQ (in %), 2011-Q2**

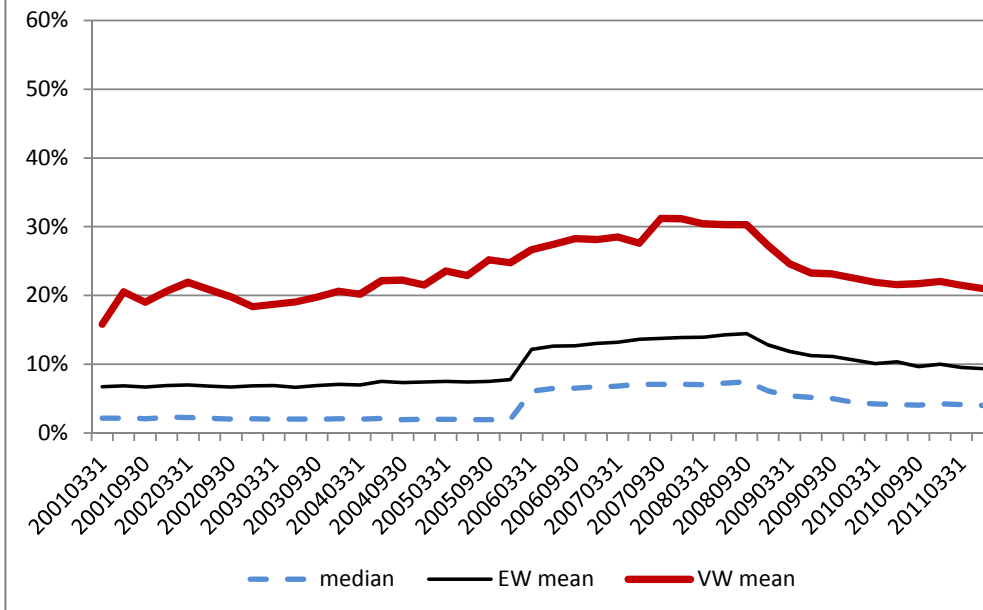




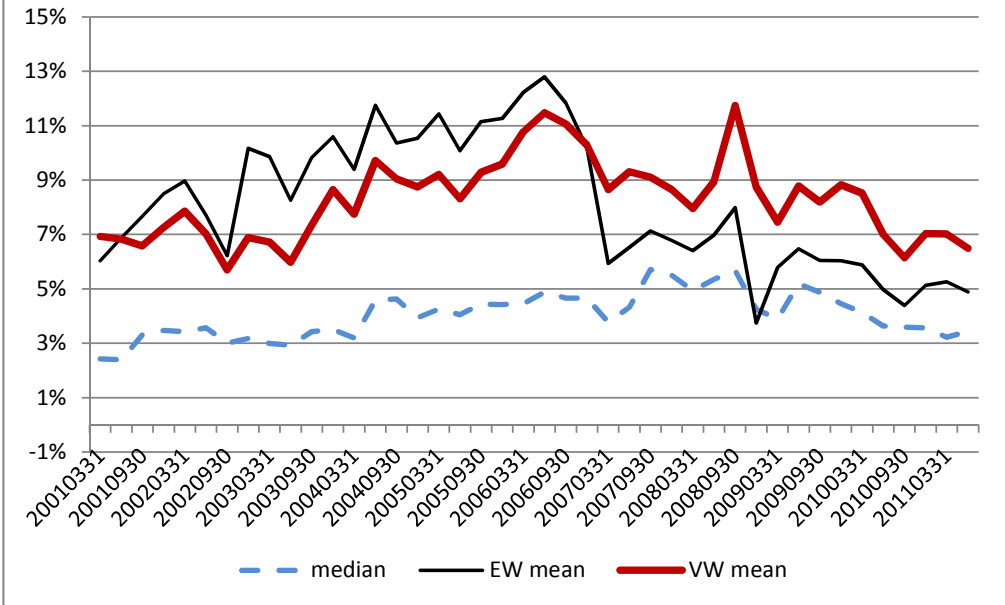
**Figure 6: All Intangibles / BVEQ, Top 25 BHC**



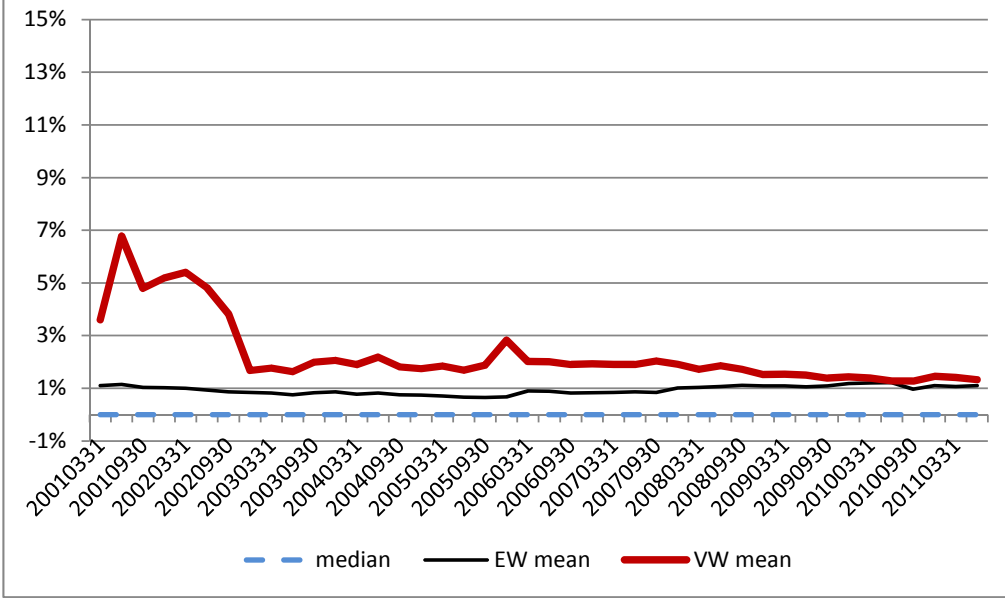
**Figure 7: All Intangibles / BVEQ, Smaller BHC**



**Figure 8: (Tier 1 Intangibles) / BVEQ, Top 25 BHC**



**Figure 9: (Tier 1 Intangibles) / BVEQ, Smaller BHC**



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# Should Banks' Stress Test Results be Disclosed? An Analysis of the Costs and Benefits.<sup>1</sup>

Itay Goldstein

The Wharton School, University of Pennsylvania

Haresh Sapra

The University of Chicago Booth School of Business

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## Abstract

The argument for disclosing banks' stress test results is that it improves market discipline. Market discipline, in turn, improves resource allocation in the economy. In this paper, we argue that, market discipline is a necessary but not sufficient condition for economic efficiency. We highlight three potential endogenous costs of disclosing banks' stress test results. First, while these disclosures might improve price efficiency and hence market discipline, they might also induce sub-optimal *ex ante* decisions in financial institutions. Second, these disclosures might induce *ex post* market externalities that lead to excessive and inefficient reaction to public news. Third, such disclosures might also reduce traders' incentives to gather information, which reduces market discipline because it hampers the ability of regulators to learn from market data for their regulatory actions.

Overall, we believe that disclosure of stress test results is beneficial because it promotes financial stability. However, in promoting financial stability, disclosure of stress test results may exacerbate bank-specific inefficiencies. We provide some guidance on how such inefficiencies could be minimized.

# 1 Introduction

The recent financial crisis has raised concerns about bank capitalization, especially among the largest financial institutions. The Dodd-Frank Wall Street Reform and Consumer Protection Act (hereafter, "Dodd-Frank") requires the Board of Governors of the Federal Reserve to undertake annual stress tests for systemically important financial institutions under at least three economic scenarios—baseline, adverse, and severely adverse.<sup>1</sup> The objective of the tests is to ascertain whether banks have enough capital to absorb a new financial crisis. In particular, these tests are forward-looking in nature because they investigate whether a bank has enough capital cushion to sustain losses as a result of adverse economic conditions.

While these stress tests have been controversial on many fronts, perhaps one of the most controversial features of these tests—unlike traditional supervisory examinations whose results are kept confidential—is the proposal that stress test results be *publicly disclosed*.

Many proponents of public disclosure of stress test results have linked the severity of the recent financial crisis to bank opacity. They argue that many banks took on excessive risks that were not adequately disclosed so that such risks could not be properly priced by the market. Disclosure of stress test results allows investors and other counterparties to better understand the risk profiles of each institution, thereby enhancing *market discipline*. Such market discipline, in turn, would have prevented insiders from engaging in excessive *ex ante* risk taking behavior that may have contributed to the recent financial crisis. Greater transparency of a bank's risks would have also allowed banking regulators to better monitor the banks and allowed them to intervene early enough to take corrective actions by recapitalizing weak or insolvent banks. Unfortunately, by the time regulators intervened, it was too late as there was a widespread panic because the market could not distinguish a solvent bank from an insolvent bank and such panic brought the whole financial system to its knees. By disclosing stress test information, investors' confidence in the banking sector would be

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<sup>1</sup>The tests must cover bank holding companies (BHCs) and non bank financial firms supervised by the Board and can be extended to include other financial institutions at the Board's discretion.

restored and such a boost in investor confidence would, in turn, positively influence the real economy. While the rationales for disclosing the results of these stress tests seem intuitive, others have argued that disclosing the results of these stress tests may actually have unintended consequences. For example, instead of providing market discipline, if not properly designed, disclosure of these stress test results may actually create more panic, thereby lowering confidence in the banking sector. A lower confidence in the banking sector may have more negative consequences on the real sector.<sup>2</sup>

In any debate regarding the desirability of disclosures, the objective of such disclosures must be specified. In the case of stress tests, these tests could serve either a microprudential and/or macroprudential objective. A microprudential goal implies that an individual bank has enough capital buffer to absorb potential losses, thereby ensuring its solvency. A macroprudential goal implies that the banking system as a whole has the ability to survive a systemic crisis, thereby promoting financial stability. In this paper, we will argue that these two goals may not necessarily be compatible with each other—while stress test results accompanied with appropriate disclosures could promote financial stability, they might induce simultaneously inefficiencies at the individual banks.

We will also argue that—while the benefits of disclosing stress test results are clear—there are endogenous costs associated with such disclosures. We believe that a proper understanding of the sources of these costs would better inform the debate and guide regulators in both the design of these tests as well as the nature of the disclosures. More precisely, we believe that—at least from a financial stability perspective—the benefits of disclosing stress test results are undeniable. Instead, our goal is to explain how, conditional on disclosure of these stress test results, the costs associated with these tests could be minimized.

To better understand the sources of the endogenous costs, we will first review several theoretical frameworks for discussing the costs and benefits of greater disclosure. In the absence of a clear sense of the potential costs and benefits associated with greater disclosure, the knee

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<sup>2</sup>This debate is described in the article "Lenders Stress over Test Results," Wall-Street Journal; March 5, 2012.

jerk reaction is that more information is always better, since usually more information provides better market discipline. However, we will explain why the conventional wisdom that more disclosure leads to better market discipline need not hold in many *second-best* environments, i.e., environments with market and informational frictions. In such environments, greater disclosure may actually sometimes impede welfare. The main insight of our paper is that, when it comes to the disclosure of stress test results, perhaps too much importance has been attached to how such disclosure would improve market discipline.<sup>3</sup> If the goal of disclosure of stress tests' results is to improve market discipline, we will show that market discipline is a necessary but not sufficient condition for economic efficiency. Furthermore, in second-best environments, the incentives of all market participants need to be taken into account in understanding how and when would disclosure affect market discipline.

In Section 2, we elaborate on the conventional wisdom of how higher transparency via greater disclosure may lead to more market discipline and how such market discipline may indeed have a positive impact on economic efficiency. We then discuss environments in which this conventional wisdom holds up well and environments in which it breaks down. In Section 3, we discuss environments in which even though greater disclosure may lead to market discipline, such higher market discipline may not necessarily result in higher economic efficiency. More precisely, we will argue that even though greater disclosure is *ex post* efficient, *ex post* efficiencies need not translate into *ex ante* inefficiencies. Disclosure of the stress test information may be beneficial *ex post* in the sense that it improves market discipline. However if the bank's operations are opaque so that market participants do not have an adequate understanding of a bank's operations, market discipline may be hampered by inducing the bank to choose sub-optimal portfolios or inefficient asset sales, thereby reducing economic efficiency. In section 4, we will discuss environments in which there are strategic interactions among market participants. In such strategic environments, greater disclosure may be harmful because it induces market participants to put *excessive weight* on the public

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<sup>3</sup>We discuss later how the benefits of disclosure of stress-test results might be due to supervisory discipline in addition to market discipline.

information. In fact, if the public information is not very precise, then such excessive weight may actually hamper market discipline because market participants would rely too much on the non-fundamentals or noise component of the disclosure. In such strategic environments, the role of disclosure of stress test information in improving market discipline is ambiguous. In section 5, we discuss another important channel of how disclosure of stress test results may impede efficiency. In releasing the stress test results to the market, regulators should be mindful of the fact that such disclosure might reduce the incentives of market participants to produce information on their own and trade on such information. By reducing the incentives of market participants to gather and trade on such information, the information content of market prices could be damaged. Less informative prices could then reduce market discipline and harm the ability of the regulator to use this important input in its supervision policy.

With the benefits of the insights gained from the discussions in sections 3, 4, and 5, we will explain, in section 6, that there is a non-trivial trade-off associated with disclosure of stress test results. We believe that disclosure serves an important purpose in promoting financial stability, in particular at the aggregate level. However, there are costs associated with excessive reaction by market participants and adverse effects on ex-ante incentives. We provide guidelines as to how such costs can be minimized. In particular, we suggest that disclosing aggregate, rather than bank-specific, results can help in this dimension.

## 2 Disclosure and Market Discipline

The view among many policy-making and academic communities is that more disclosure is always socially desirable because it allows market participants to impose market discipline earlier and more effectively.<sup>4</sup> The intuition is as follows: more disclosure allows market

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<sup>4</sup>Note that, proprietary costs arising from information leakage to competing firms is commonly believed to be a potent force that limits disclosure. For examples, see Dye (1986), Darrough and Stoughton (1990), and Gigler (1994). However, if disclosure triggers proprietary costs that damage the cash flows of the disclosing firm, such disclosures enhance the cash flows of competing firms, so the *social* costs to such disclosure could be small or even non-existent. Thus a regulator, concerned with social welfare and overall economic efficiency, is unlikely to be swayed by proprietary cost arguments.

participants to have better insights into the risk exposures of a bank so that the bank's risks would be impounded in its market price. A higher price efficiency will, in turn, discipline insiders as follows: if the bank's activities are viewed as too risky so that the bank could become insolvent, such risks will be reflected in lower prices of the bank's debt and equity claims. Anticipating this, insiders' would be deterred from engaging in excessive risk taking. These are precisely some of the arguments made in favor of disclosing the results of banks' stress tests.

The US Savings and Loans (S&Ls) crisis of the 1980s is a case in point (see, for instance, Michael, 2004). The crisis stemmed in part from the fact that the (variable) interest rates on the S&Ls' deposit liabilities rose above the (fixed) rates earned on their mortgage assets. However, S&Ls were not using market prices to value their mortgage assets. Rather, they used historical cost accounting that kept the assets at their original values. The use of historical cost accounting masked the problem by allowing an increase in interest rate to show up only gradually through negative annual net interest income. The insolvency of many S&Ls became clear eventually, but using market prices to value the mortgage assets would arguably have provided market discipline by highlighting the problem to outsiders much earlier, and the S&L problem could have been resolved at a lower fiscal cost. Similarly, the protracted problems faced by the Japanese banking system in the 1990s are also cited as a case where slow recognition of losses due to poor disclosure practices on the banks' balance sheet exacerbated the problems. Therefore, enhanced disclosures and market discipline are viewed as two sides of the same coin.

We will now explain why the preceding view—more disclosure is desirable—holds up quite well in certain environments but may fall apart in many realistic environments. In other words, we will describe environments in which more disclosure could actually lower economic efficiency. This result may seem counterintuitive in the light of Blackwell's (1951) theorem, but begins to make sense once we deal with environments in which information has *strategic* consequences. Blackwell (1951) shows that for a single decision maker, her *ex ante* expected

utility under information set  $X$  is weakly higher than under information set  $Y$  as long as information set  $X$  is finer than information set  $Y$ . Therefore, in the context of a single investor, more information about fundamentals is always desirable because it allows the investor to form more precise posteriors about fundamentals. However, Blackwell's famous result hinges upon two important assumptions. First, the investor is playing against nature where the fundamentals are exogenous and fixed. Second there is a *single* decision maker, i.e., there are no strategic interactions among different investors. If any one of these assumptions is relaxed, it is not immediate that a finer information set is always preferable.

Using the preceding logic, in the context of banks, disclosure of stress test results would be desirable as long as *both* of the following assumptions are maintained:

1. Banks are passive technologies that don't respond to changes in their disclosure environment.
2. Banks operate in environments where the major source of friction is information asymmetry between insiders and outsiders.

It is obvious that the two preceding assumptions are unrealistic because they apply more to a Robinson Crusoe economy but do not hold up very well in most strategic environments particularly those of banks. Assumption 1 implies that banks are machines that mechanically produce probability distributions of underlying cash flows. Rather, banks are run by insiders with well-defined objective functions or incentives that, in turn, induce those insiders to respond to changes in their disclosure environment by changing the nature of their risk taking behavior. Assumption 2 implies that banks' operate in relatively frictionless environments where the only source of friction is information asymmetry between insiders and outsiders. In fact, one could argue that what makes banks special is that, by the very nature of their business, they operate in second-best environments with *multiple* imperfections. Besides information asymmetry between insiders and outsiders, banks have claims that trade in illiquid and incomplete markets that are prone to externalities among the various market

participants. Further, the market participants of a bank are not a homogenous group and hence do not act as a single decision maker. Therefore, using Blackwell's theorem that more disclosure is desirable because it improves market discipline is not so obvious.

We explain below why—in the presence of multiple market imperfections—more disclosure may result in endogenous costs that hamper the benefits of greater disclosure. We want to emphasize that the preceding statement does not imply that disclosure of stress test results is not desirable. Rather, if the goal of disclosure of stress test results is to promote financial stability, then a proper understanding of these endogenous costs is necessary in order to ensure that financial stability is not achieved at too high a cost. More precisely, we will explain that such tests—if not properly designed—may actually destabilize prices, thereby reducing market discipline and hence economic efficiency. Perhaps more surprisingly, we will also illustrate that *even if* more disclosure to the capital market improved price efficiency and hence enhanced market discipline—and therefore financial stability—such market discipline need not necessarily improve welfare.

Before we discuss the potential costs associated with the disclosure of stress test results, we want to point out another potential benefit of such disclosures that have not received much attention in the debate. Namely, the benefits from disclosure of stress test results are likely to be derived also from supervisory discipline, not only from market discipline. Disclosure of stress test results serves as a commitment device. By disclosing stress test results, regulators could be held accountable because their supervisory approach—whether in terms of how credible the tests are and what supervisory actions are taken in light of banks that fail the tests—would be subject to greater scrutiny and discussion. For example, one might argue that an important reason why the Supervisory Capital Assessment Program (SCAP) was successful is because a key part of the supervisory disclosure is to hold supervisors accountable for their actions by asking them to indicate ahead of time about (1) what was needed for firms to meet the tests, (2) what firms that did not meet the test would be expected to do, (3) what steps would supervisors take in connection with firms that did not

meet the tests.

### 3 Impact of Disclosure on Ex Ante Incentives of Banks

A leading rationale for public disclosure of stress test results is that it provides better market discipline (Tarullo, 2010). In this section, we will explain why market discipline is not necessarily a panacea for economic efficiency. More disclosure may indeed improve market discipline, but such market discipline may harm *ex ante* incentives. To illustrate this, we will draw upon recent work by Gigler, Kanodia, Sapra, Venugopalan (2011) (hereafter GKSV) who study the following issue: how frequently should publicly traded firms be required to disclose the results of their operations to the capital market? This is an important policy issue that accounting standard setters such as must grapple with. In the United States the frequency of mandatory reporting has risen from annual reporting to semi-annual reporting to quarterly reporting, with this last change occurring in 1970. With the current regulatory environment calling for greater accountability and higher transparency of financial information, it is likely there will be pressure on firms to disclose the results of their operations even more frequently. The arguments for more frequent disclosure are identical to those made regarding the disclosure of bank stress test results: more timely information would increase price efficiency and hence enhance market discipline. Market discipline, in turn, implies economic efficiency because it leads to efficient resource allocation. But, as GKSV illustrate below, in a second best environment with multiple market imperfections, these arguments are incomplete.

Our objective is to illustrate the main arguments in the GKSV paper while keeping the technical details to a bare minimum. To provide the main intuition behind their results, we will only focus on the essential ingredients of their model.<sup>5</sup> Bank insiders choose to invest in either a short term loan portfolio or a long term loan portfolio. Each portfolio (hereafter project) generates stochastic cash flows over  $N$  periods where  $N > 2$ . The short term project

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<sup>5</sup>While the GKSV model applies to any firm, we will apply it to the environment of a bank.

differs from the long term project in two ways:

1. The short term (long term) project generates higher (lower) stochastic cash flows in the early periods but lower (higher) stochastic cash flows in the future periods.
2. But, the long term project maximizes social welfare because it has a higher net present value than the short term project.

In their model, the bank's shareholders are one of two types: either long-term investors who sell in future periods or short-term investors who sell in early periods. The proportion (or, equivalently, the probability) of short-term investors is assumed common knowledge and is parameterized by  $\alpha$  which captures the degree of impatience of the investors. To capture this feature, GKSJ assume that, *ex ante*, i.e., in period 0, before an investor knows his type, the bank's insiders (equivalently, the firm's current shareholders) choose(s) its investment strategy, i.e., invest in the short term versus the long term project to maximize:

$$\alpha E_0(\tilde{P}_1) + (1 - \alpha) E_0(\tilde{P}_2)$$

where  $P_1$  and  $P_2$ , respectively, denote the period 1 and period 2 market prices of the firm, and  $E_0(\cdot)$  denotes the expectations operator conditional on period 0 information of insiders. Note that the objective function in GKSJ implies that there are no conflicts of interest between insiders and their current shareholders, no managerial career concerns, and therefore no incentive issues that would generate a demand for compensation contracts. Instead, the conflict of interest is between the firm's current shareholders or insiders and the capital market. Therefore the objective function captures the feature that, in choosing between the short term versus the long term project, the manager faces price pressure or market discipline from the capital market.

In a fully informed world, a world with no frictions between insiders and outsiders, prices

play their proper role of fully reflecting all future cash flows of the firm so that:

$$P_1 = E_1(\tilde{P}_2)$$

so that, using the law of iterated expectations, the objective function of insiders collapses to:

$$E_0(\tilde{P}_i), i \in \{1, 2\}$$

which does not depend on  $\alpha$ , the degree of impatience of the investors. Regardless of the extent of price pressure, insiders therefore choose the long term project because it maximizes the expected value of the bank. Note that, in a world of no frictions, market discipline therefore works very well because prices are playing their proper role of fully reflecting all future cash flows. Therefore the cost of any myopic behavior is fully internalized by the firm's current shareholders—they cannot possibly gain by choosing the short term project to produce attractive short-term cash flows at the expense of long-term cash flows.

GKSV model a second-best environment with two frictions. First, there is information asymmetry between insiders and outsiders (i.e., investors in the capital market) about the profitability of the underlying projects. Insiders have superior information about the profitability of the projects but because of the conflict of interest between insiders and the capital market, they cannot credibly disclose this information to outsiders—they have incentives to overstate the profitability of the project to the market as it would result in higher stock prices.<sup>6</sup> Second, while outsiders may observe the cash flows from the projects, they cannot discern whether the cash flows are generated from the short term project or the long term project.

Given these two frictions, it is natural to ask whether standard setters could possibly alleviate the information asymmetry between insiders and outsiders—via more disclosure. GKSV study two disclosure regimes: a frequent disclosure regime where operating cash flows

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<sup>6</sup>Note that because information about profitability is soft and therefore, *ex post*, non-verifiable, there are no explicit mechanisms such as legal liability that could discipline such overstatement.

are disclosed every period, i.e., in periods 1 and 2 and an infrequent disclosure regime in which all operating cash flows are not disclosed until the end of period 2. There is therefore strictly more information in the frequent disclosure regime in the sense that outsiders observe the operating cash flows of the firm in period 1. Disclosing the operating cash flows of the project every period would seem desirable because such cash flows would be reflected earlier, rather than later, in the stock price. As we saw above, more informed prices could, in turn, induce the manager to choose the project that maximizes the expected total cash flows, i.e., the long term project. However, GKS<sup>V</sup> show that in a second-best environment with strategic interactions this intuition is, at best, incomplete.

More precisely, GKS<sup>V</sup> generate the following results:

- a.** If the firm's decision is treated as exogenous, i.e., taking the project choice as given, then more frequent disclosure improves price efficiency and therefore market discipline.
- b.** However, if the firm's decision is endogenous, while more frequent disclosure does indeed improve price efficiency, such price efficiency does not necessarily imply economic efficiency—insiders may be induced to choose the short term project rather than the long term project.

Result (a) is consistent with Blackwell's theorem that more information is always desirable. By treating the firm's as exogenous, more disclosure improves price efficiency. Because the firm's decision is exogenous, by definition, price efficiency is equivalent to economic efficiency. However, Result (b) implies that, when insiders behave strategically to maximize their payoffs, price efficiency does not necessarily translate into economic efficiency.

When *both* project choice and project profitability are unobservable, then the market's inference problem becomes more subtle. Disclosure of operating cash flows every period as in the frequent disclosure regime would now be used by the market to form inferences about *both* the project choice and the project profitability. GKS<sup>V</sup> show that the market conjectures the firm's project choice and uses disclosure of operating cash flows to form inferences about

the project's profitability. In the frequent disclosure regime, GKSv show that the period 1 market price,  $P_1$ , is strictly increasing in period 1 operating cash flows and the period 2 market price,  $P_2$ , is strictly increasing in the period 2 operating cash flows. Since the short-term project produces stochastically higher cash flows in period 1, insiders now face a non-trivial trade-off when choosing between the short and long term project. The larger the degree of impatience of the investors, i.e., the larger  $\alpha$  is, the more likely it is that insiders choose the short-term project. However, in the infrequent disclosure regime, insiders always choose the long term project.

To understand why insiders may choose the short term project, it is important to understand how the capital market prices the firm given the firm's disclosure. Because the firm's project choice is not observable, prices do not reflect the firm's *actual* choice of its project but rather the market's conjecture. However, in period 0, insiders can now influence the distribution of the market prices via their choice of the project. Because the short-term project produces stochastically higher cash flows in period 1, in the frequent disclosure regime, greater market discipline pressures insiders to act sub-optimally by choosing the short-term project rather than long term project. Unlike the case when the firm's project is observable, insiders can now benefit by producing short term attractive cash flows at the expense of long term cash flows. Insiders respond to the richer disclosure environment by investing in the sub-optimal project that reduces economic efficiency. If there is no information in period 1, as in the infrequent disclosure regime, insiders are not prone to market pressure in period 1—they therefore choose the efficient long term project as it maximizes the expected period 2 market price.

It is important to note that, relative to the infrequent disclosure regime, prices are more efficient in the frequent disclosure regime because prices impound more firm specific information, i.e., the operating cash flows in period 1, earlier. The GKSv study thus highlights the importance of distinguishing “price efficiency” from “economic efficiency.” The view that price efficiency or market discipline is equivalent to economic efficiency always holds in a first

best world or in environments when enhanced disclosure is so rich that it moves the economy to a first best world. In such environments, prices play their proper role of providing market discipline because they impound information about future cash flows so that  $P_1 = E_1(\tilde{P}_2)$ . However, when the firm's project choice is not observable,  $P_1 \neq E_1(\tilde{P}_2)$  and therefore insiders may now care about the distribution of the prices in period 1 versus period 2 and if insiders are very sensitive to period 1 prices, they may be induced to choose the short term project.<sup>7</sup> In strategic environments, market discipline could motivate firms to change their business decisions in such a way that economic efficiency suffers even though price efficiency is enhanced. The above study has shown that *less* disclosure could actually provide better incentives for investment by destroying information.

Recent studies provide evidence for the theoretical prediction of GKSJ that more public disclosure could lead to sub-optimal decisions, even though such disclosures are viewed to be *ex post* efficient. Bhojraj and Libby [2005] manipulated reporting frequency and price pressure in a laboratory experiment, with experienced financial managers from publicly traded corporations, and empirically demonstrated that corporate managers become myopic when faced with intense price pressure and greater disclosure frequency. These results were obtained in the absence of any agency frictions and even when managers had the opportunity to make voluntary disclosures. Chen, Subramanian, and Zhang [2010] provide empirical evidence that firms that frequently issue quarterly earnings guidance behave myopically, where myopic behavior is defined as sacrificing long-term growth for the purpose of meeting short-term goals. They find that dedicated guiders invest significantly less in research and development (R&D) than occasional guiders. They also find that, in comparison to occasional guiders, dedicated guiders meet or beat analyst consensus earnings forecasts more frequently and they both manage expectations downward and cut R&D expenditures to achieve this goal. However, they find that dedicated guiders' long-term earnings growth rates are significantly lower than those of occasional guiders. Overall, their results are consistent with

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<sup>7</sup>Put differently, in the presence of incomplete information, the law of iterated expectations fails so that  $P_1 \neq E_1(\tilde{P}_2)$ .

dedicated guiders engaging in myopic R&D investment behavior and meeting short-term earnings targets with possible adverse effects for long-term earnings growth.

The insights from GKS's study are quite general and highlight the importance of distinguishing between *ex post* efficiencies versus *ex ante* efficiencies in second-best environments. For example, Burkart, Gromb and Panunzi (1997) is another study that highlights this trade-off in a second best environment in which there are no market discipline. They study such an environment in which insiders of a firm make firm-specific noncontractible investments that increase shareholder value. Such noncontractible investments also allow insiders to extract private benefits *ex post*. The authors show how tight control by outside shareholders may be *ex post* efficient because it reduces the amount of private control benefits that insiders extract. Unfortunately, in reducing *ex post* inefficiencies, such tight control could be inefficient *ex ante* as it reduces insiders' incentives to invest in noncontractible investments. Stated differently, even if managerial discretion is *ex post* detrimental to shareholders, it can be beneficial *ex ante* as it favors firm-specific investment, like searching for new investment projects. The manager is less inclined to show such initiative when shareholders are likely to interfere.

The implications of the above discussion are particularly relevant for the debate on whether stress test results for individual banks should be disclosed to the public. Banks clearly operate in second-best environments in which the risks that they undertake are opaque. We believe that, regarding the costs and benefits of stress tests, too much emphasis may have been placed on how disclosure of a bank's stress test results would affect the *ex post* risk profiles of a bank without a proper understanding of how the *ex ante* behavior of the bank would be impacted. As we have argued, both *ex post* disclosures which enhance market discipline and *ex ante* decisions are inherently linked. More importantly, while disclosure of stress test information may indeed enhance market discipline, in the sense that the market prices the risks of the bank more efficiently, it is not at all obvious that higher price efficiency translates into higher economic efficiency. In order to pass the stress-tests, banks may be

choosing sub-optimal portfolios that reduce ex ante efficiency. Individual banks could also engage in window dressing behavior by engaging in inefficient asset sales.

The practical implications of the above discussion is that, regulators need to be mindful of the trade-off between ex post efficiency versus ex ante inefficiency when it comes to disclosure of stress test results. If the purpose of disclosing stress test results is to improve market discipline, then these disclosures should be enhanced with detailed disclosures of the underlying risk exposures of the banks. The market can then evaluate the stress test results together with the underlying risk exposures to get a better understanding of the extent to which the bank has been engaging in sub-optimal behavior for the purpose of passing the stress test. However, if the bank's portfolios are opaque so that its risk exposures are difficult to credibly disclose, market discipline may be harmful because it may induce banks to window dress their performance by engaging in such sub-optimal behavior. More precisely, banks may be induced to engage in ex ante risks that make the bank appear healthy in the eyes of the market but that reduce its long term value.

Another practical implication is about the distinction between disclosure of individual banks' stress test results vs. disclosure of aggregate results. The above concern about potential sub-optimal actions by banks' insiders is expected to be relevant when banks' individual results are disclosed, but not when only aggregate results are disclosed. This is because if only aggregate results are disclosed, then banks cannot affect them as much by changing their own risk choices. Hence, to prevent such sub-optimal behavior at the level of individual banks, regulators may want to consider disclosing only aggregate results. Admittedly, this solution is not ideal because the avoidance of disclosure of individual bank's results will reduce the effectiveness of market discipline.

## 4 Impact of Disclosure on Ex Post Actions of Market Participants

One of the main concerns about disclosure of stress test results is that, in case they are disclosed, the *ex post* reaction to these results will not be efficient. In theory, this might occur if the reaction is coming from multiple market participants, who exert externalities on each other, and fail to coordinate their reactions in an efficient way. The concern usually is that there will be a too strong reaction to public information, and so regulators should be cautious in disclosing information publicly.

A formal analysis of these ideas appears in an influential paper by Morris and Shin (2002). In the model presented in their paper, there are many small market participants, each one making a decision on an action. The action taken by market participant  $i$  is denoted as  $a_i$ . The average action by market participants is denoted as  $\bar{a}$ . and the economic fundamentals by  $\theta$ . Market participant  $i$  chooses his action with two things in mind. First, he wants the action to be as suitable as possible to the fundamentals  $\theta$ . This is captured in the model by the assumption that he wants his action to be as close as possible to the economic fundamentals  $\theta$ . Second, he wants his action to be compatible with the actions taken by other market participants. This is captured in the model by the assumption that he wants his action to be as close as possible to the average action  $\bar{a}$ . Then, the action taken by market participant  $i$  is given by the following decision rule:

$$a_i = (1 - r) E_i(\theta) + r E_i(\bar{a}).$$

Here,  $r$  takes values between 0 and 1. It captures the weight that market participants put on having their actions close to those of other market participants. The term  $E_i(\theta)$  captures the expected level of the fundamentals  $\theta$  given all the information available to market participant  $i$  when he makes the decision. The term  $E_i(\bar{a})$  captures the expected

level of the average action  $\bar{a}$  given all the information available to market participant  $i$  when he makes the decision. A crucial element for the mechanism discussed here is that market participants make their decisions under incomplete information. In particular, each market participant has access to some private information about the fundamentals  $\theta$  and also to public information about  $\theta$ . The public information comes partly as a result of the disclosure by a regulator such as the government.

The situation described in the above setting is often referred to in the economics literature as a “beauty contest” following Keynes (1936). Keynes argued that stock market investing and other related settings look like a beauty contest in the sense that people act not only according to what they think the “right” action is – i.e., the one that is justified by fundamentals – but also according to what they think other people think about which action is the right action. As a result, as in the above expression, they end up making a decision based on two components: the expected level of the economic fundamentals and the expectation of what other people will do.

This setting may describe well the decisions made by market participants following disclosure of stress test results concerning the strength of a particular bank. The ability of the bank to keep operating depends on the economic fundamentals it is facing, but also on the willingness of creditors and other counterparties to extend credit, loosen collateral requirements, reduce interest rates, etc. Just like in a bank-run model (e.g., Diamond and Dybvig, 1983), for the bank to survive, it is sometimes not enough that the fundamentals are adequate, but it is important that creditors/depositors have confidence in the bank and keep their money there. If some market participants lose confidence and “run”, others want to do so as well, because the run by some creditors destabilizes the bank, making it in the best interest of others to run as well. As a result, every market participant that needs to make a decision concerning its relationships with the bank – i.e., whether to rollover the debt, extend more credit, loosen collateral requirements, etc. – will make a decision, just like in the decision rule described above, based on what he thinks the economic fundamentals of

the bank are, and based on what he thinks other creditors and counterparties are going to do. A creditor will be “tough” with the bank if he expects other creditors to be tough as well. This is similar to the “beauty contest” setting described by Keynes.

As Morris and Shin (2002) show in their paper, a setting like this leads each market participant to put more weight on public information than what is justified by the precision/quality of this information. This is because the public information provides indication, not only about the level of economic fundamentals, but also about what other market participants know, and as a result, about what they are going to do. Since every market participant puts direct weight on the actions of other market participants in his objective function, he ends up increasing the weight put on public information and reducing the weight put on private information, as the latter provides information only about the economic fundamentals of the bank whereas the former also provides information about what other market participants will do.

To be more precise, denoting the precision of the public information as  $\alpha$  and that of the private information as  $\beta$  (and assuming normal distributions of the signals around the realization of the fundamentals  $\theta$ ), the weight that a market participant puts on his private signal ends up being

$$\kappa \equiv \frac{\beta(1-r)}{\beta(1-r) + \alpha},$$

and that on his public signal,  $1 - \kappa$ . We can see that when there is no beauty-contest motive, i.e., when  $r = 0$ , the weight that is put on the private signal is the appropriate one based on the precisions of the two signals, that is, the ratio between the precision of the private signal and the sum of precisions of the two signals. But, as the beauty-contest motive appears and increases, i.e.,  $r$  increases above 0, then the weight on the private signal decreases and that on the public signal increases, consistent with the discussion above.

This framework illustrates well the trade-off associated with disclosure of stress test results. The usual argument is that disclosure is good because it enables greater market discipline. That is, when more information about the economic fundamentals of the bank

is available, market participants can make more informed decisions, and reduce the capital available to a weak bank. This, in turn, improves economic efficiency, by transferring capital to institutions that can make more adequate use of it. This point is captured by the fact that the action of market participants is directly affected by their assessment of the fundamentals. When the government discloses the information it has gathered during the stress test, this information improves the precision with which market participants know the economic fundamentals, and enables them to make a more informed decision. This represents a benefit of disclosure.

On the other hand, there is a negative effect of disclosure, captured by the fact that the action of market participants is directly affected by their assessment of the actions of others. When the government discloses its information, market participants will put excessive weight on this information due to the beauty-contest motive, which implies that public information gets more weight because it is observed publicly. Then, they will reduce the weight they put on their own private information, implying that valuable information does not get to have proper impact on market participants' actions. This is the precise sense in which there is over-reaction to the public information. Indeed, in the above equation, we see that the weight on the private information decreases by more than is warranted due to precisions alone. Assuming that from the point of view of the social planner (government) the only thing that matters is the extent to which market participants' actions are consistent with fundamentals,<sup>8</sup> this over-reaction to public news reduces the efficiency of their actions. Hence, while disclosure provides market discipline, it might provide too much discipline, causing market participants to act too much on the basis of public information and too little on the basis of private information.

Recent empirical evidence provides support to this amplified role of public information in a related context. Hertzberg, Liberti, and Paravisini (2010) study a natural experiment

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<sup>8</sup>This is probably true in the situation discussed in this paper because there is no social benefit from having market participants act like each other, perhaps only a social cost, due to the destabilizing aspect of this.

based on the expansion of the Public Credit Registry in Argentina in 1998. The role of the registry is to aggregate information about borrowers and to make it available to potential lenders. The information includes assessments by current lenders of the creditworthiness of the borrower. Prior to 1998, the registry only provided information about borrowers, whose total debt was above \$200,000. This is because of the cost of distributing information for a large number of small borrowers. In 1998, following the adoption of CD-ROMs, the need for the threshold was eliminated, leading to the disclosure of information about 540,000 borrowers, for which credit assessments were previously only known privately. The reform was announced in April 1998 and implemented in July of that year. Hertzberg, Liberti, and Paravisini study the change in lenders' behavior after the announcement of the new policy. Consider a lender who had negative information about a borrower, for whom the information was not initially disclosed (since the borrower owed less than \$200,000 in total). From the point of view of this lender, no new information has arrived. The only difference is that he realizes that the information will become available publicly. The authors show that for these borrowers, the amount of credit has decreased after the announcement. This is supposedly because the lenders realized that making this information public will make other lenders reduce credit. Hence, they essentially put more weight on the information only because of the fact that it was about to become public.

The implication coming out of this theoretical analysis and the empirical support it received in the literature is clear: disclosure is a mixed blessing. It helps with market discipline by providing more information, on the basis of which market participants can act. But, because of the beauty-contest aspect, which is typical of financial settings, such market discipline is based too strongly on the public information and not strongly enough on private information available to market participants. Disclosure of more information by the government crowds out their use of other sources of information, which might reduce the efficiency of the market discipline. Analytically, the result that comes out of such models is that disclosure is beneficial only when the quality / precision of the information being

disclosed is sufficiently high.

As a result, the government should be mindful of the fact that even if the information being disclosed is not biased, it may still be harmful when it is not precise enough. Due to externalities among market participants, the weight being put on the disclosed information is excessively high, not adjusting enough to the fact that its precision is low. Hence, information should be disclosed only when there is enough confidence about its precision. Practically, this implies that information should be disclosed after multiple checks and examinations, and hence not very frequently. The above discussion also provides some guidance about the nature of the stress-test disclosures: one possibility would be for supervisors to release aggregate results of their tests across banks of similar risk exposures without disclosing the results of individual banks. Aggregating the results would eliminate idiosyncratic noise and measurement errors across individual banks and reduce the destabilizing effects of the information. Again, this would come at the cost of not achieving the full benefit of market discipline at the individual bank level.

Another important point to note is that not all banks are equal in this regard. Being cautious about disclosure and making sure that only very precise information is being disclosed is important only for banks, for whom the beauty contest forces are relatively strong. These are banks whose creditors face strong strategic complementarities (i.e., their motive to act like each other is particularly strong) and are more likely to fall into a coordination failure. Based on the literature (see, Chen, Goldstein, and Jiang, 2010), this is likely to be the case in the following situations:

- The bank faces a severe maturity mismatch, having short-term liabilities and long-term assets. In this case, the bank is more prone to be subject to a run, and creditors are more strongly affected by what they think other creditors are likely to do.
- The bank's assets are more illiquid. In this case, the bank faces large discounts when selling assets to pay to creditors, and this implies that creditors impose a stronger externality on other creditors.

- The bank’s base of creditors is less concentrated, being characterized by many small creditors rather than by a few large creditors. In this case, creditors are less likely to internalize the externalities, making a coordination failure more likely.

Indeed, studying redemptions by investors from open-end mutual funds, Chen, Goldstein, and Jiang (2010) have shown empirically that funds that have less liquid assets and are held by a less concentrated base of shareholders experience a stronger sensitivity of outflows to bad performance. This implies that the response of investors to public news (bad past performance) is amplified for these funds due to the fact that their investors are subject to stronger strategic complementarities and coordination failures.

Finally, our focus in this section was on the theoretical paper by Morris and Shin (2002), where investors have a beauty-contest motive, wishing to act like each other – running on a bank if others do so – but the social planner only cares about whether actions are suitable to fundamentals – running on the bank when the bank is managed inefficiently. The literature that followed Morris and Shin (2002) has shown that their results about the excessive and inefficient reliance on public information might be reversed in other settings (see Angeletos and Pavan, 2007). For example, one could think of a case where homogeneity across agents is socially, but not individually, desirable. In this case, the social planner (government) would like to encourage agents to act similarly by disclosing more information publicly even if it is not very precise. Bolton, Brunnermeier, and Veldkamp (2010) describe such a model in the context of an organization. In their model, it is desirable for the organization that agents will act similarly to each other, yet this is not in agents’ self interest. Hence, there is a role here for increased public communication to induce coordination. Similarly, different conclusions will arise if we consider strategic substitutes instead of strategic complementarities. We focused on the Morris and Shin (2002) framework here because, as stated earlier, we believe that it is the most relevant for the case discussed in this paper.

## 5 Impact of Disclosure on Learning from the Market

An important input into bank supervision by the government is the information gathered from market prices of bank securities. The attraction in using market information for bank supervision is best summarized by the following quote from Gary Stern – the former President of the Federal Reserve Bank of Minneapolis:

“Market data are generated by a very large number of participants.

Market participants have their funds at risk of loss. A monetary incentive provides a perspective on risk taking that is difficult to replicate in a supervisory context.

Unlike accounting-based measures, market data are generated on a nearly continuous basis and to a considerable extent anticipates future performance and conditions.

Raw market prices are nearly free to supervisors. This characteristic seems particularly important given that supervisory resources are limited and are diminishing in comparison to the complexity of large banking organizations.”<sup>9</sup>

As Gary Stern argues, market data is useful because it aggregates information from many different participants,<sup>10</sup> who have a strong (monetary) incentive to trade on their information and opinions. Also, this information is produced continuously in a forward-looking manner, and is freely available to regulators. The information aggregated into market prices of bank securities is not the traditional inside information that is featured in models of financial markets. Rather, these are the results of analysis by many market participants based on their experiences with the bank and their assessment of the bank’s prospects. It is very likely that such information can prove to be useful for regulators, who are far from being fully informed about the state of the bank.

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<sup>9</sup>See: <http://www.minneapolisfed.org/pubs/region/01-09/stern.cfm>

<sup>10</sup>This idea goes back to Hayek (1945).

Indeed, existing research establishes that government actions do indeed reflect market prices: Feldman and Schmidt (2003), Krainer and Lopez (2004), and Furlong and Williams (2006) empirically document that supervisors make substantial use of market information.<sup>11</sup> Moreover, numerous policy proposals call for governments to make even more use of market prices, particularly in the realm of bank supervision (see, e.g., Evanoff and Wall, 2004, and Herring, 2004). Such policy proposals are increasingly prominent in the wake of the recent economic crisis and the perceived failure of financial regulation prior to it.<sup>12</sup>

However, several papers – e.g., Bond, Goldstein, and Prescott (2010), Goldstein, Ozdenoren, and Yuan (2011), and Bond and Goldstein (2011) – show theoretically that the informational content of market prices should not be taken as given, and that the use of market information by the government and the disclosure of government information to the market might adversely affect the ability of the government to learn from market prices. Hence, when the government discloses information about stress test results to the market, it should be mindful of the fact that this might reduce the incentives of traders in the market to produce information and trade on information that they have, which will make market prices less informative and harm the ability of the government to use this important input in its supervision policy.

Consider the model of Bond and Goldstein (2011). In their model, the government takes an action to intervene in a financial institution. In some cases the action is corrective, e.g., bailing out an institution that is perceived to be in a bad state. In other cases the action may be amplifying, e.g., ordering the closure or liquidation of an institution that is perceived to be in a bad state. The type of action is determined by the objective function of the government, but for the purpose of understanding the consequences of disclosure, this is not of first order

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<sup>11</sup>The usefulness of market prices has been established empirically in other contexts, showing that managers learn from the prices of their own securities when making investment decisions, see Luo (2005), Chen, Goldstein, and Jiang (2007), and Bakke and Whited (2010).

<sup>12</sup>For example, Hart and Zingales (2009) propose a mechanism, by which the government will perform a stress test on banks whose market price deteriorates below a certain level, in order to evaluate whether there is a need for intervention. Other recent proposals say that banks should issue contingent capital (i.e., debt that converts to equity) with market-based conversion triggers (see Flannery (2009), McDonald (2010)).

importance. The important element is that the government is using two types of information in its decision: the information from the market where a security of the financial institution is traded, and the government's own information collected in the supervision process (e.g., following a stress test conducted by the government).

In order to understand the tradeoff associated with disclosure, it is important to understand how security prices in financial markets get to reflect information about the fundamentals of the financial institution. The process by which this happens has been studied in a large literature on financial markets pioneered by Grossman and Stiglitz (1980). Importantly, for information to get aggregated and reflected in market prices, speculators must have the incentive to produce information and trade on the information. This incentive originates from their access to information that is not publicly available, but is mitigated by the exposure to risk that they have to bear when trading in financial markets.

In general, when the government discloses information of its own (e.g., the results of stress tests), there are two effects on traders' incentives, and they go in opposite directions. First, when more information is available publicly, traders lose some of their informational advantage, and so produce less information and trade less aggressively. This leads market prices to be less informative. Second, when more information is available publicly, traders bear less exposure to risk when they trade in financial markets, and so have an incentive to produce more information and trade more aggressively. As Bond and Goldstein (2011) show, when the first effect dominates, disclosure makes the government worse off by harming its ability to promote its policy goals using its own information and information produced by the market. On the other hand, the opposite is true when the second effect dominates.

The practical implication coming out of this discussion, which is developed by Bond and Goldstein (2011), is that disclosure is undoubtedly beneficial when the government discloses information about issues that traders in financial markets have no information on. But, the government has to be mindful of the fact that when disclosing information about issues that other market participants may be informed about, it discourages market participants from

trading on this information and having it reflected in market prices, and hence it harms its ability to learn from the market.

More generally, disclosure of government information, collected in the process of stress tests, might harm rather than promote market discipline. If market discipline is partly achieved via trading of bank securities in financial markets that aggregates market participants' views into market prices, the disclosure of government information might hamper this process by reducing market participants' incentives to trade on their information and views. Hence, disclosure is surely beneficial only to the extent that it is about parameters that are unlikely to be known to market participants and that the government is unlikely to want to learn from market participants.

Here again, disclosing only aggregate information may ease the problem. This is because the government is less likely to be at an informational disadvantage to market participants about aggregate issues, such as the state of the banking system as a whole. Hence, disclosing such information to the market is less likely to reduce the ability of the government to learn from the market. Again, however, disclosing only aggregate information will also reduce the benefit from market discipline.

## **6 Policy Recommendations**

According to conventional wisdom, there is a clear benefit in disclosing the results of stress tests conducted for financial institutions. This disclosure will provide more information to various market participants and allow them to make informed decisions concerning the financial institution that came under examination. Moreover, knowing that the market reaction will be better informed due to the disclosure of the results of stress tests, financial institutions may behave more appropriately. In that sense, disclosure of stress test results may enhance market discipline. We have also pointed out another potential benefit of disclosure of stress test results: it provides regulatory discipline. By disclosing the assumptions,

methods, results of the tests and the supervisory actions that will be taken in the light of the results, regulators would increase the credibility of those tests and have greater incentive *ex ante* to take the right action in light of the available information.

While the benefits of such disclosure are straightforward, the costs associated with such disclosure are more subtle and less apparent. We highlighted three such endogenous costs in the previous sections. First, disclosing the results of stress tests might adversely affect the incentives within financial institutions, encouraging them to hold loan portfolios that generate good performance in order to pass the stress tests but may not be beneficial in the long term. Second, disclosing the results of stress tests might lead to over-reaction by market participants *ex post* due to the fact that they exert externalities on each other and want to act like each other and hence put excessive weight on public information. This, for example, might lead to a run on a financial institution following a negative stress-test assessment. Third, the disclosure of stress test results might deter financial-market speculators from trading on their views and information in financial markets and hamper the ability of the government to learn from market data for its regulatory actions.

Throughout the paper, we argued that the costs of disclosure mentioned above can be reduced if only aggregate, rather than bank-specific, results are disclosed. In that, disclosure of stress test results will achieve the macro-prudential role of helping to stabilize the financial system as a whole, but not the micro-prudential role of providing market discipline for individual banks. This may be desirable in order to reduce the costs of disclosure that are particularly prominent when it comes to disclosure of information about individual banks.

Specifically, concerning the first disadvantage of disclosure, if regulators do not disclose the results of individual banks, but only aggregated results, then the incentive to window-dress banks' portfolios for the purpose of passing the stress test will be significantly reduced. Again, if the goal is to promote financial stability, then this is a viable solution. However, this solution may not provide enough market discipline for individual banks. A possible

compromise is that stress test results be accompanied by a detailed description of the exposures of the individual banks. The market can then evaluate the stress test results together with the underlying risk exposures to get better understanding of the potential for existence of sub-optimal risk choices or window-dressing.

Concerning the second disadvantage of disclosure, if regulators do not disclose the results of individual banks but only aggregated results, then market participants do not attach excessive weight to specific loss numbers of individual banks, which might be very noisy. Aggregating can significantly reduce the noise and prevent the destabilizing effect of making information public. Again, if the goal is to promote financial stability this is a good solution. However, to provide some market discipline, individual bank results should be disclosed. In this case, it is important that disclosure is made only when results are as precise and reliable as possible. This is particularly important for financial institutions that are exposed to panic because they have short-term liabilities, illiquid assets, and a dispersed base of investors. Moreover, if bad news is disclosed, it may be wise to disclose it with a description of the corrective actions that are about to be taken, so that panic is not triggered. For example, if a bank is found to be solvent but also to suffer from risk of illiquidity, then it should be provided with access to borrowing to mitigate the illiquidity problem.

Concerning the third disadvantage of disclosure, the government may want to minimize disclosure of information on issues on which market participants are well informed. Disclosing such information might hamper the incentives of market participants to trade on their information and interfere with the ability of the government to use the information from the market in its regulatory actions. Again, disclosing aggregate information, on which the government is less likely to be at an informational disadvantage relative to market participants, can reduce the severity of this cost of disclosure.

## 7 Conclusion

We believe that, from a macroprudential perspective, disclosure of stress test results can be beneficial because they promote financial stability. Even from a microprudential perspective, disclosure can be quite useful in providing market discipline for individual banks and helping with the accountability of regulators who need to make decisions about these banks. However, we believe that perhaps too much importance has been attached to the beneficial role of market discipline without accounting for the underlying mechanisms. Our objective in this paper was to highlight those mechanisms. Our main takeaway is that in promoting financial stability, disclosure of stress test results may exacerbate bank-specific inefficiencies. We provide some guidance on how such inefficiencies could be minimized.

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# STRESS TESTING BANKS

**Til Schuermann\***

Oliver Wyman

Wharton Financial Institutions Center

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## Abstract

How much capital and liquidity does a bank need to support its risk taking activities? During the recent (and still ongoing) financial crisis, answers to this question using standard approaches, e.g., regulatory capital ratios, were no longer credible, and thus broad-based supervisory stress testing became the new tool. Bank balance sheets are notoriously opaque and susceptible to asset substitution (easy swapping of high risk for low risk assets), so stress tests, tailored to the situation at hand, can provide clarity by openly disclosing details of the results and approaches taken, allowing trust to be regained. With that trust re-established, the cost-benefit of stress testing disclosures may tip away from bank-specific towards more aggregated information. This paper lays out a framework for the stress testing of banks: why it is useful and why it has become such a popular tool for the regulatory community in the course of the recent financial crisis; how stress testing is done (design and execution); and finally, with stress testing results in hand, how one should handle their disclosure, and whether it should be different in crisis vs. “normal” times.

**Keywords:** capital requirements, leverage, systemic risk.

**JEL Codes:** G21, G28, G20.

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\* Oliver Wyman and Wharton Financial Institutions Center; [til.schuermann@oliverwyman.com](mailto:til.schuermann@oliverwyman.com). I would like to thank John Fell, Mark Flannery, Itay Goldstein, Bengt Holmstrom, Bill Janeway, Umit Kaya, Ugur Koyluoglu, Andy Kuritzkes, John Lester, Clinton Lively, Hashem Pesaran, Brian Peters, Barry Schachter, Hal Scott, and members of the Committee for Capital Markets Regulation for helpful discussions and suggestions, and Cary Lin for helpful research assistance. All errors remain mine, of course.

## 1. Introduction

There are three kinds of capital and liquidity: 1) the capital/liquidity you have; 2) the capital/liquidity you need (to support your business activities); and 3) the capital/liquidity the regulators *think* that you need.<sup>1</sup> Stress testing, regulatory capital/liquidity and bank-internal (so-called “economic capital/liquidity”) models all seek to do the same thing: to assess the amount of capital and liquidity needed to support the business activities of the financial institution. Capital adequacy addresses the right side of the balance sheet (net worth), and liquidity the left side (share of assets that are “liquid”, however defined). If all goes well, both economic and regulatory capital/liquidity are less than the required regulatory minimum, and their difference (between economic and regulatory) is small, namely that regulatory models do not deviate substantially from internal model results.

Prior to their failure or near-failure, financial institutions such as Bear Stearns, Washington Mutual, Fannie Mae, Freddie Mac, Lehman and Wachovia were adequately or even well capitalized, at least according to regulatory capital rules disclosed in their public filings.<sup>2</sup> This set of institutions spans a broad range of regulatory capital regimes and regulators: the SEC and Basel 2 capital rules (Bear Stearns, Lehman), the OCC and the Federal Reserve and Basel 1 (Wachovia), the OTS (WaMu), and OFHEO (Fannie and Freddie) – the last actually based on a narrow stress scenario. All firms had broad exposure to residential real estate assets, either in the form of whole loans (mortgages) or securities (MBS) or both, and all had internal risk models which may or may not have deviated materially from the regulatory models (we don’t know as this is/was firm proprietary information).<sup>3</sup> Yet to the question of what is the capital you need vs. the capital you have, in each case the answer came out wrong. To be sure, neither firm-internal (economic) nor regulatory capital and liquidity models can guarantee failure prevention; indeed, that is not their purpose as every firm accepts some probability of failure, sized by its risk appetite. But the cascading of defaults, and the resulting deep skepticism of stated capital adequacy by the market, forced regulators to turn to other tools for assessing, in a credible way, the capital adequacy of banks. That tool turned out to be stress testing.<sup>4</sup>

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<sup>1</sup> This pithy summary I owe to Peter Nakada.

<sup>2</sup> Kuritzkes and Scott (2009) make the case for a more market-oriented assessment of capital adequacy.

<sup>3</sup> Lester et al. (2012) report that 4 out of 16 banks (US and non-US) that publicly disclosed economic capital before the crisis actually experienced losses exceeding those requirements, all of which were calibrated to at least the 99.9% level (implying an acceptable annual default probability of no more than 10bp).

<sup>4</sup> Flannery (2012) argues that stress tests should be evaluated on a fair value (rather than book capital) basis.

This paper lays out a framework for the stress testing of banks: why is it useful and why has it become such a popular tool for the regulatory community in the course of the recent financial crisis; how is stress testing done – design and execution; and finally, with stress testing results in hand, how should one handle their disclosure, and should it be different in crisis vs. “normal” times. The framework is equally applicable to capital and liquidity adequacy, but for simplicity the bulk of the discussion will focus on capital.

A successful macro-prudential stress testing program, particularly in a crisis, has at least two components: first, a credible assessment of the capital strength of the tested institutions to size the capital “hole” that needs to be filled, and second a credible way of filling that hole. The U.S. bank stress test in 2009, the Supervisory Capital Assessment Program or SCAP, may serve as a useful example. The U.S. entered 2009 with enormous uncertainty about the health of its banking system. Absent more concrete and credible understanding of the problems on bank balance sheets, investors were reluctant to commit capital, especially given the looming threat of possible government dilution. With a credible assessment of losses under a sufficiently stressful macroeconomic scenario, the supervisors hoped to draw a line in the sand for the markets: fill this hole, and you won’t risk being diluted later because the scenario wasn’t tough enough. Moreover, if some institutions could not convince investors to fill the hole, a U.S. government program, namely Treasury’s Capital Assistance Program (CAP), stood ready to supply the needed capital. Importantly, the U.S. Treasury was a sufficiently credible debt issuer that the CAP promise was itself credible.<sup>5</sup> All banks with assets greater than \$100bn (YE 2008) were included, accounting for two-thirds of total assets and about half of total loans in the U.S. banking system. In the end, ten of the 19 SCAP banks were required to raise a total of \$75bn in capital within six months, and indeed raised \$77bn of Tier 1 common equity in that period.<sup>6</sup> None needed to draw on CAP funds.

The European experience in 2010 and 2011 stands in stark contrast to the 2009 SCAP. Against the background of a looming sovereign debt crisis in the peripheral euro-zone countries, the Committee of European Bank Supervisors (CEBS) conducted a stress test of 91 European banks in 2010 covering about two-thirds of total European bank assets and at least half in any given participating country. The stress test included imposing haircuts on the market value of sovereign bonds held in the trading book; the bulk of the sovereign exposure, however, was (and

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<sup>5</sup> Note that the act of a sovereign recapitalizing its banks involves that sovereign issuing debt and then investing (“downstreaming”) it as equity in the bank(s).

<sup>6</sup> <http://www.federalreserve.gov/bankinfo/reg/scap.htm>.

is) in the banking book. Of the 91 banks, only seven were required to raise a total of €3.5bn (< \$5bn at the time) in capital. The level of disclosure provided was rather less than in the SCAP. For instance, loss rates by firm were made available only for two sub-categories: overall retail and overall corporate.<sup>7</sup> By contrast, the SCAP results released loss rates by major asset class such as first-lien mortgages, credit cards, commercial real estate, and so on. Markets reacted benignly nonetheless – until a few months later when Ireland requested financial assistance from the EU and the IMF. Subsequent stress tests of just the Irish banks, conducted largely by outside independent advisors (BlackRock) revealed a total capital need of €24bn; all had previously passed the CEBS stress test. Moreover, to help close the credibility gap, the extent and degree of disclosure was far greater than any of the stress testing exercises to date.<sup>8</sup> The markets reacted favorably, with both bank and Irish sovereign credit spreads tightening. The stakes for the 2011 European stress test, now conducted by the successor to the CEBS – the European Banking Authority (EBA) – had risen substantially.

The results of 2011 EBA stress test of 90 banks in 21 countries were at first blush similarly mild as the previous year's.<sup>9</sup> Eight banks were required to raise a total of only €2.5bn. However, the degree of disclosure was much more extensive, approaching the high bar set by the Central Bank of Ireland in March 2011, including information on exposure by asset class by geography. Importantly, all bank level results are available to download in spreadsheet form to enable market analysts to easily impose their own loss rate assumptions. In this way the “official” results were no longer so final: analysts could (and did) easily apply their own sovereign haircuts on all exposures and thus test the solvency of any of the 90 institutions themselves.

In an uncomfortable parallel to the Irish experience in 2010, the 2011 EBA stress test did nothing to alleviate concerns about the Spanish banking system. Five of the 25 Spanish banks in the EBA stress test did not pass, though once provisions and mandatory bond conversions (to equity) were taken into account, the required additional capital raise was €0. By the spring of 2012, Spain was engaged in or had announced several additional stress tests. First was the IMF's Financial Sector Assessment Program (FSAP), conducted jointly with the Banco de España. The

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<sup>7</sup> <http://www.eba.europa.eu/EU-wide-stress-testing/2010/2010-EU-wide-stress-test-results.aspx>.

<sup>8</sup> <http://www.centralbank.ie/regulation/industry-sectors/credit-institutions/Documents/The%20Financial%20Measures%20Programme%20Report.pdf>.

<sup>9</sup> <http://www.eba.europa.eu/EU-wide-stress-testing/2011/2011-EU-wide-stress-test-results.aspx>.

results of which were released on June 8, 2012,<sup>10</sup> with 11 of 29 bank requiring a total of €17.7bn capital using a similar post-stress hurdle as the SCAP (4% core Tier 1 capital) or 17 banks requiring a total of €37.1bn using the higher hurdle of 7% core Tier 1 capital.<sup>11</sup> Second was a short (4-week) top-down exercise conducted by two outside advisers (working in parallel to provide, ostensibly, two further independent assessments), and those results were released on June 21, 2012. No firm-specific results were provided, only an overall capital need. The first estimate, provided by Roland Berger, was €51.8bn, while Oliver Wyman provided a range of €51–62bn.<sup>12</sup> A more detailed and intensive bottom-up analysis by Oliver Wyman followed, with results released on September 28, 2012, showing that 7 of 14 banking groups needed a total of €57.3bn using the post-stress core Tier 1 threshold of 6%; merger activity had resulted in significant reduction in independent banking entities.<sup>13</sup>

A summary of the major macro-prudential stress tests to date is provided in Table 3, and a summary of their disclosures in Table 1.

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<sup>10</sup> <http://www.imf.org/external/pubs/ft/scr/2012/cr12137.pdf>

<sup>11</sup> Most European exercises have tested to a post-stress hurdle of 6% core Tier 1; see discussion in Section 3.

<sup>12</sup> Roland Berger:

[http://www.bde.es/webbde/GAP/Secciones/SalaPrensa/InformacionInteres/ReestructuracionSectorFinanciero/Ficheros/en/informe\\_rolandbergere.pdf](http://www.bde.es/webbde/GAP/Secciones/SalaPrensa/InformacionInteres/ReestructuracionSectorFinanciero/Ficheros/en/informe_rolandbergere.pdf)

Oliver Wyman:

[http://www.bde.es/webbde/GAP/Secciones/SalaPrensa/InformacionInteres/ReestructuracionSectorFinanciero/Ficheros/en/informe\\_oliverwymane.pdf](http://www.bde.es/webbde/GAP/Secciones/SalaPrensa/InformacionInteres/ReestructuracionSectorFinanciero/Ficheros/en/informe_oliverwymane.pdf)

<sup>13</sup> [http://www.bde.es/f/webbde/SSICOM/20120928/informe\\_ow280912e.pdf](http://www.bde.es/f/webbde/SSICOM/20120928/informe_ow280912e.pdf)

	Base & Stress Scenario	Bank level results	Asset/Product level loss rates	Exposure detail (asset class, maturity, geography)	Bank vs. supervisory/3rd party estimates
SCAP March 2009	Stress	✓	✓	--	--
CEBS July 2010	Both	✓	Retail, all corporate only	--	--
CCAR March 2011	--	--	--	--	--
Ireland March 2011	Both	✓	✓	Sovereign only	✓
EBA July 2011	Both	✓	Retail, corporate, CRE	High	--
CCAR March 2012	Stress	✓	✓	--	--
Spain (IMF) June 8, 2012	Both	--	--	Asset class (aggregate)	--
Spain (top-down) June 21, 2012	Both	--	✓	Asset class (aggregate)	--
Spain (bottom-up) Sept. 28, 2012	Both	✓	✓	Asset class (aggregate)	--

**Table 1: Summary of disclosures across stress test exercises.**

The SCAP was the first of the macro-prudential stress tests of this crisis. But the changes at the micro-prudential or bank-specific level were at least equally significant, and they are summarized in Table 2. With the SCAP, stress testing at banks went from mostly single (or a handful) factor shocks to using a broad macro scenario with market-wide stresses; from product or business unit stress testing focusing mostly on losses to firm-wide and comprehensive, encompassing losses, revenues and costs; all tied to a post-stress capital ratio to ensure a going concern.

<b>Pre-SCAP</b>	<b>Post-SCAP</b>
<ul style="list-style-type: none"> <li>• Mostly single shock</li> </ul>	<ul style="list-style-type: none"> <li>• Broad macro scenario and market stress</li> </ul>
<ul style="list-style-type: none"> <li>• Product or business unit level</li> </ul>	<ul style="list-style-type: none"> <li>• Comprehensive, firm-wide</li> </ul>
<ul style="list-style-type: none"> <li>• Static</li> </ul>	<ul style="list-style-type: none"> <li>• Dynamic and path dependent</li> </ul>
<ul style="list-style-type: none"> <li>• Not usually tied to capital adequacy</li> </ul>	<ul style="list-style-type: none"> <li>• Explicit post-stress common equity threshold</li> </ul>
<ul style="list-style-type: none"> <li>• Losses only</li> </ul>	<ul style="list-style-type: none"> <li>• Losses, revenues and costs</li> </ul>

**Table 2: Features of stress testing, pre- and post-SCAP**

The remainder of the paper proceeds as follows. Section 2 briefly reviews the scant literature, and Section 3 provides a discussion of how to design the stress scenario, including the choice of post-stress capital hurdle. Section 4 describes modeling approaches for the three components needed to implement stress testing: losses, net revenues (profitability), and balance sheet dynamics. Section 5 reviews the disclosure regimes across the different stress tests to date in more detail, presents a discussion of disclosure in “normal” times, and Section 6 provides some concluding remarks.

## **2. Stress testing in the literature**

Stress testing has been part of the risk manager’s toolkit for a long time. It is perhaps the most basic of risk-based questions to want to know the resilience of an exposure to deteriorating conditions, be it a single position or loan or a whole portfolio. Typically the stresses take the form of sensitivities (spreads double, prices drop, volatilities rise) or scenarios (black Monday 1987, autumn of 1998, post-Lehman bankruptcy, severe recession, stagflation). These types of stresses lend themselves naturally to understanding financial risks, particularly in a data rich environment such as found in a trading operation. Nonfinancial risks like operational, reputational and other business risks are much harder to quantify and parameterize yet rely heavily on scenario analysis (earthquakes and other natural disasters, computer hacking, legal risks, and so on). While the original Basel I Accord of 1988 did not make formal mention of stress testing, with the Market Risk Amendment of 1995 stress testing merited its own section

and thus became embedded in the regulatory codex. Indeed evidence of stress testing capabilities is a requirement for regulatory approval of internal models.

Risk management as a technical discipline came into its own with the publication of the RiskMetrics technical document in 1994, and stress testing (of both kinds, sensitivities and scenarios) is mentioned throughout. The first edition of Jorion's standard-setting VaR book (1996) had a subsection devoted to the topic – it was elevated to a chapter in subsequent editions – and surely there are earlier examples. Stress testing as a risk management discipline was found largely in the relatively data rich environment of the trading room, with the closely related treasury function conducting interest rate scenarios and shocks.<sup>14</sup> The Committee on Global Financial Systems (CGFS) of the BIS conducted a survey on stress testing in 2000, and it reinforces this view.<sup>15</sup> In their summary of the CGFS report, Fender, Gibson and Mosser (2001) point out that most of the scenarios manifest in terms of shocks to market rates, prices or volatilities. Typical examples are equity market crashes such as October 1987, rates shocks such as 1994, credit spread widening such as during the fall of 1998, and so on. Such stress scenarios have the virtue of being unambiguously articulated and defined and are thus transparent and easy to implement and communicate – on assets that have themselves natural market prices or analogs, as is mostly the case in the trading book. More typical banking assets, such as corporate loans (especially to privately held firms) and consumer loans (e.g. auto loans), are less naturally amenable to this approach.

Formal stress testing of the banking book, which is dominated by credit risk, is more recent, in part because quantitative credit risk modeling is itself a newer discipline.<sup>16</sup> Perhaps stimulated by the success of RiskMetrics, the late 1990s saw a spurt of activity in the development of credit portfolio models, the two prominent examples being CreditMetrics (1997) and CreditRisk+ (Wilde, 1997).<sup>17</sup> Stress testing, however, did not feature in these papers. Yet as Koyluoglu and Hickman (1998) show quite clearly, all of these credit portfolio models share a common framework of mapping outcomes in the real economy, often represented by an abstract state vector, to the credit loss distribution, and thus should lend themselves naturally to stress testing. With that in mind, Bangia et al. (2002), following broadly the CreditMetrics framework, show

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<sup>14</sup> See Kupiec (1999) and Berkowitz (2000) for more extensive discussions of VaR-based stress testing.

<sup>15</sup> See CGFS (2000) and the summary of its principal findings in Fender, Gibson and Mosser (2001).

<sup>16</sup> To be sure, the credit rating agencies, having been in the business of rating corporate bonds for nearly a century, likely employ stress testing in their bond rating methodology, but old documentation to this effect is hard to come by.

<sup>17</sup> For an excellent overview and comparison of these and related models, see Koyluoglu and Hickman (1998).

how to use credit migration matrices to conduct macroeconomic stress tests on credit portfolios. Foglia (2008) provides a survey of the literature (at least through late 2008) of stress testing credit risk, both for individual banks or portfolios as well as banking systems. More recently, Rebonato (2010) with his suggestively titled book *Coherent Stress Testing* (we return to the problem of coherence below), argues for a Bayesian approach to financial stress testing, i.e. one which is able to formally include expert knowledge in the stress testing design, with an emphasis on exploring causal relations using Bayesian networks.

With few exceptions, regulatory requirements on stress testing were thin prior to the crisis, though considerable expectations about stress testing capabilities were voiced in supervisory guidance in the U.S. Examples include the Joint Policy Statement on Interest Rate Risk (SR 96-13), guidance on counterparty credit risk (SR 99-03<sup>18</sup>), as well as country risk management (SR 02-05). But banks had significant discretion with regard to specific design and implementation of their stress tests. Brian Peters, then head of risk in bank supervision at the New York Fed, observed in March 2007 at an industry conference that no firm had a fully-developed program of integrated stress testing that captured all major financial risks on a firm-wide basis.<sup>19</sup> Market risk stress tests were most advanced, while corporate or enterprise-wide stress testing, whereby all businesses were subjected to a common set of stress scenarios, was at best in a developmental phase.

### **3. Stress Testing Design**

Perhaps the most fundamental choice in stress testing design is the risk appetite of the authorities: how severe and how long should the stress scenario be; and what is the post-stress hurdle. To take a sailing analogy: how severe and how long is the storm, and how solid does the boat still need to be once the storm has passed. In stark contrast to standard capital regimes, the target calibration is not strict solvency (i.e. just enough capital to have positive net worth), but rather some notion of adequate capitalization *post-stress*. For instance, the 2009 SCAP in the U.S. presented a two-year scenario with a post-stress hurdle of 4% Tier 1 common capital. The 2012 bottom-up Spanish stress test used a three-year scenario with a post-stress hurdle of 6% core Tier 1 capital, suggesting a lower risk appetite by the Spanish authorities than the American.

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<sup>18</sup> The most recent guidance on counterparty credit risk, SR 11-10, has greatly expanded on stress testing expectations. All SR letter can be found at <http://www.federalreserve.gov/bankinforeg/srletters/srletters.htm>.

<sup>19</sup> Presentation delivered at Marcus Evans conference “Implementing Stress Tests into the Risk Management Process”, Washington DC, March 1-2, 2007.

While length and post-stress hurdles are easy to compare across macro-prudential stress tests, scenario severity is not. Authorities are reluctant to make statements like “a 1 in 100 scenario” which would allow such comparison, in part because such a statement is very difficult to make credibly. The Federal Reserve in its stress testing program makes available time series of relevant variables to allow users to assess the severity of a given scenario at least for those variables.<sup>20</sup> A multivariate assessment is, of course, much more difficult.

With the risk appetite established, one of the principal challenges faced by both the supervisors and the firms in designing stress scenarios is coherence. The scenarios are inherently multi-factor: we seek to develop a rich description of adverse states of the world in the form of several risk factors, be they financial or real, taking on extreme yet coherent (or possible) values. It is not sufficient to specify only high unemployment or only significant widening of credit spreads or only a sudden drop in equity prices; when one risk factor moves significantly, the others don't stay fixed. The real difficulty is in specifying a coherent joint outcome of all the relevant risk factors. For instance, not all exchange rates can depreciate at once; some have to appreciate. A high inflation scenario needs to account for likely monetary policy responses, such as an increase in the policy interest rate. Every market shock scenario resulting in a flight from risky assets – “flight to quality” – must have a (usually small) set of assets that can be considered safe havens. These are typically government bonds from the safest sovereigns (e.g. U.S., Japan, Germany, Switzerland). To be sure, as sovereign government budgets are increasingly strained, questioning the ultra-low risk assumption of those treasury instruments would certainly be a worthwhile stress scenario, but it would need to define an alternative “risk-free” asset class to which capital can flee.

While the problem of coherence is generic to scenario design, it is especially acute when considering stress scenarios for market risk, i.e. for portfolios of traded securities and derivatives. These portfolios are typically marked to market as a matter of course and risk managed in the context of a value-at-risk (VaR) system. Practically this means that the hundreds of thousands (or more) positions in the trading book are mapped to tens of thousands of risk factors, and those risk factors are tracked on a (usually) daily basis and form the “data” used to estimate risk parameters like volatilities and correlations. Finding coherent outcomes in such a high dimensional space, short of resorting to historical realizations, is daunting indeed.

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<sup>20</sup> See <http://www.federalreserve.gov/bankinfo/bcreg20121115a3.xlsx>

Compounding the problem is the challenge of finding a scenario where the real and the financial factors are jointly coherent. The 2009 SCAP had a rather simple scenario specification. The state space had but three dimensions – GDP growth, unemployment, and house price index (HPI) – and the market risk scenario was based in historical experience: an instantaneous risk factor impact reflecting changes from June 30 to December 31, 2008. This period represented a massive flight to quality, the markets experienced the failure of at least one global financial institution (Lehman), and risk premia at the time arguably placed a significant probability on the kind of adverse real economic outcome painted by the tri-variate SCAP scenario. This solution achieved a loose coherence of the real and financial stress. The price one pays for choosing a historical scenario is the usual one: it does not test for something new. Figures 3 and 4 compare some of these risk factors (real GDP, unemployment, equity and home prices indices) across the four U.S. stress tests to date, both to each other as well as to actual realizations since 2008 Q4.

For the 2011 EBA test, the supervisors specified over 70 risk factors for the trading book, eight macro-factors for each of 21 countries (macro-factors such as GDP growth, inflation, unemployment, real estate price indices – residential and commercial, short and long term government rates, and stock prices), plus sovereign haircuts across seven maturity buckets. The macroeconomic stress scenario was generated by economists at the ECB with reference to the EU Commission baseline economic forecast.

All supervisory stress tests to date have imposed the same scenario on all banks. Naturally, any scenario may be especially severe for some banks and much less so for others, depending on the business mix and geographic footprint. This one-size-fits-all approach is analogous to the problem of regulatory vs. internal economic capital models: the former by design is the same for all banks, while the latter, being bespoke to a given bank, directly takes account of the particular business mix of that bank. This problem of same vs. bespoke stress scenario becomes especially acute when we move from crisis times, when there may be less debate about what a relevant adverse scenario might look like, to “normal” times. The US CCAR program, in operation since 2011, recognized this problem and asks banks to submit results using their own scenarios (baseline and stress) in addition to results under the common supervisory stress scenario. This was an important step forward from the 2009 SCAP: by asking banks to develop their own stress scenario(s), which was to reveal the particular sensitivities and vulnerabilities of their portfolio and business mix, supervisors could learn from the banks about what they thought to be the high risk scenarios. This is useful not just for micro-prudential supervision – learning about the risk

of a given bank – but also for macro-prudential supervision by allowing for the possibility of learning about common risks across banks hitherto undiscovered or under-emphasized. With this dual approach, supervisors could directly compare results across banks from the common scenario without sacrificing risk-discovery.

#### **4. Executing the stress scenario: losses and revenues**

With the macro-scenario in hand, how does one arrive at the corresponding micro-outcomes: losses and revenues under adverse market and macroeconomic conditions? To date there is very little discussion in the public domain on how to solve this problem, except perhaps for stress testing the trading book. Indeed, one of the more important contributions of the supervisory stress tests in the U.S. and Europe has been the accompanying methodology documents disclosed by the supervisors which are, understandably, more heavily focused on the banking book.<sup>21</sup>

##### **4.1. Modeling losses**

For a firm active in many markets (product and geography), the first task is to map from the few macro-factors into the many intermediate risk factors that drive losses for particular products by geography. The EBA was forced to confront the geographic heterogeneity problem directly by virtue of spanning 21 sovereign nations with rather different economies. U.S. supervisors, stress testing an economic region just somewhat smaller than that of the EBA, left the task of accounting for the not inconsiderable geographic heterogeneity to individual firms. Regional differences are critical in modeling losses for real estate lending (residential and commercial) but is hardly limited to those products. Since the U.S. experiences regional business cycles – the national business cycle obscures considerable variation across states – nearly all lending has some geographic component. For example, credit card losses are especially sensitive to unemployment, and in July 2011, with the national rate at 9.1%, the state-level unemployment rate ranged from 3.3% in North Dakota to 12.9% in Nevada. Similar dynamics are at work in wholesale lending, particularly for SME (small and medium enterprise) lending whose performance has a strong geographic component.

The problem of mapping from macro to more intermediate risk factors is not limited to geography. An interesting example is auto lending and leasing where the collateral assets are

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<sup>21</sup> For SCAP, see <http://www.federalreserve.gov/bankinforeg/bcreg20090424a1.pdf>. For EBA, see <http://www.eba.europa.eu/EU-wide-stress-testing/2011/The-EBA-publishes-details-of-its-stress-test-scena.aspx>. For 2011 and 2012 CCAR, see <http://www.federalreserve.gov/newsevents/press/bcreg/bcreg20110318a1.pdf> and <http://www.federalreserve.gov/newsevents/press/bcreg/bcreg20120313a1.pdf> respectively.

used cars. While auto sales invariably decline in a recession, and the decline in 2008-2009 was unprecedented in the post-war period, used car sales typically suffer less. Yes, households buy fewer cars in a recession, but if they do need to purchase a car, it is relatively more likely to be a used car. So even if the default rate on auto loans increases significantly during a recession, the corresponding loss given default (LGD) or loss severity need not. A useful indicator of the health of the used car market, and thus the collateral of an auto lending portfolio, is the Manheim index. Over the course of the most recent recession (Dec. 2007 – June 2009), the index rose 4% while total new auto and light truck sales declined by 37%.

The problem of loose coupling of loss severity to the business cycle is not limited to auto loans. Acharya et al. (2007) show that for corporate credit, an important determinant of LGD is whether the industry of the defaulted firm is in distress at the time of default. The authors make a compelling asset specificity argument: if the airline industry is in distress, and a bank is stuck with the collateral on defaulted aircraft loans or leases, it will be hard to sell those aircraft except at very depressed prices. The healthcare sector may be relatively robust at that time, as indeed it has been in the recent recession, but it is difficult to transform an airplane into a hospital.

The EBA disclosure on methodology is especially rich. In the March 2011 document, for example, detailed guidance is provided on stressed probabilities of default (PDs) and stressed LGDs. Note that such guidance presumes that a bank has implemented an internal credit rating system for its commercial loan portfolio. For a Basel II bank this may not be unreasonable since internal ratings, mapped to a common external scale such as those used by the rating agencies, are a cornerstone of the Accord. With a credit rating (internal or external) in hand, computing stressed default rates for the portfolio becomes a straightforward exercise, either by assigning higher PDs to a given rating, or by imposing a downward migration on the current portfolio.<sup>22</sup> Since the EBA stress test was based on risk weighted assets (RWA) computed using Basel II risk weights which are ratings sensitive, banks were forced to make use of stress migration matrices to compute not only increased defaults (the last column of the matrix) but also the entire future ratings distribution to arrive at the correct RWA value. The U.S. stress tests were conducted under Basel I risk weights which are not obligor ratings sensitive. The fuss about RWA calculations matters since the denominator of capital ratios, used to determine whether or not a

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<sup>22</sup> Of the 90 participating banks, 59 were so called IRB (internal ratings based) banks, meaning their internal models were validated to the supervisor's satisfaction for at least one regulatory portfolio (e.g. corporate, commercial real estate, etc.). Non-IRB banks were given very non-specific guidance (EBA 2011a, Section 5.5.1.1).

bank needs to raise capital, is RWA. To be sure, this complicates any comparison of U.S. and European stress test results.

Implementation in the trading book is more straightforward and has a rich discussion in the public domain; see inter alia Allen, Boudoukh, and Saunders (2004), Jorion (2007), or Rebbonato (2010). In a nutshell, existing positions are simply repriced using the stress scenario risk factors, subject to the proviso that the risk factor mapping problem, discussed in Section 3, has been solved. The corresponding problem of stressing the counterparty credit risk that comes with derivatives activities has received less attention.<sup>23</sup> Counterparty credit risk arises when, in a derivative transaction revalued to the stress scenario, the bank finds itself in the money (i.e. enjoys a derivative receivable) yet cannot be sure that the counterparty to the transaction will be solvent to make good on the payment. Thus the value is discounted, where the discount is a function of the expected default likelihood of the counterparty *under the stress scenario*, which presumably is higher than today. This adjustment is called a credit value adjustment (CVA), and banks with significant derivative activities manage CVA as a matter of course. As Canabarro (2010) and Hopper (2010) point out, the modeling challenge to stress testing counterparty credit risk is considerable. Not only does the PD of the counterparty change in a stressful environment, but so does the exposure. Thus any CVA stress test involves two distinct simulation exercises. If the collateral posted by the counterparty is anything other than cash or cash equivalent, a revaluation of that collateral under the same stress scenario needs to be added to the process.<sup>24</sup>

#### **4.2. Modeling revenues**

Implementing stress scenarios on the revenue side of the equation remains largely a black box and seems far less well developed than stress testing for losses. Neither the 2009 SCAP nor the otherwise richly documented 2011 EBA disclosures devoted much space nor revealed much detail about the methods and approaches for computing revenues under stressful conditions. Total income in banks can be roughly divided into interest and non-interest income. Interest income is clearly a function of the yield curve and credit spreads posited under the stress scenario, but what the net impact of rising or falling rates are on bank profitability remains ambiguous, perhaps in part because of interest rate hedging strategies (English 2002, Purnanandam 2007). The impact of stress scenarios on noninterest income, which includes service charges, fiduciary, fees, and other income (e.g. from trading), is far harder to assess, and

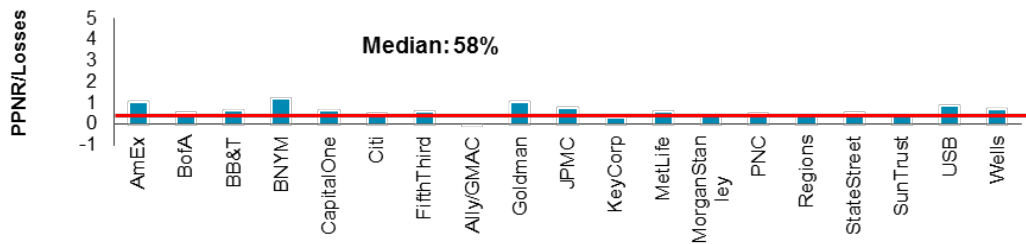
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<sup>23</sup> For an excellent treatment, see Canabarro (2010) and Hopper (2010).

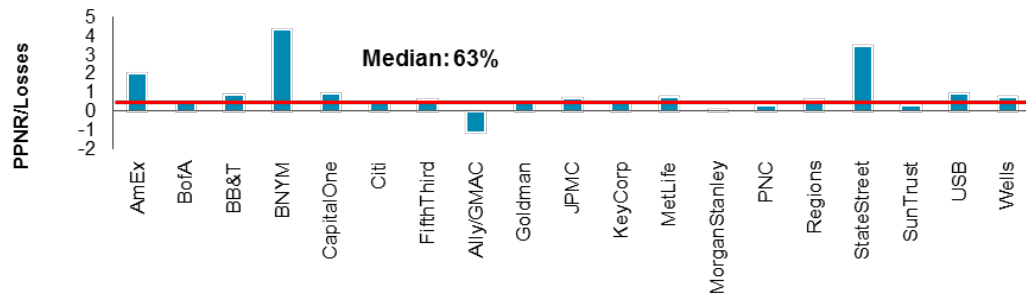
<sup>24</sup> There is the added complication that major derivatives dealers actively manage CVA risk using a range of strategies and instruments that themselves vary in price and availability depending on market conditions.

there is precious little discussion of its determinants in the literature. This is concerning since Stiroh (2004) shows that not only has the share of noninterest income been steadily rising in U.S. banks, from 25% in 1985 to 43% in 2001, but it is associated with greater volatility and lower risk-adjusted returns. If we compare the 2009 SCAP, the 2011 EBA and the 2012 CCAR stress tests, the median bank in the U.S. was able to cover about 58% of its total projected losses with profits (including reserve releases, if any) in 2009 and 63% in 2012,<sup>25</sup> compared with 66% in the European case. As Figure 1 shows, there is considerable variability across banks, especially in the EBA test, where in some cases profits even under the stress scenario are projected to outpace losses 4:1!

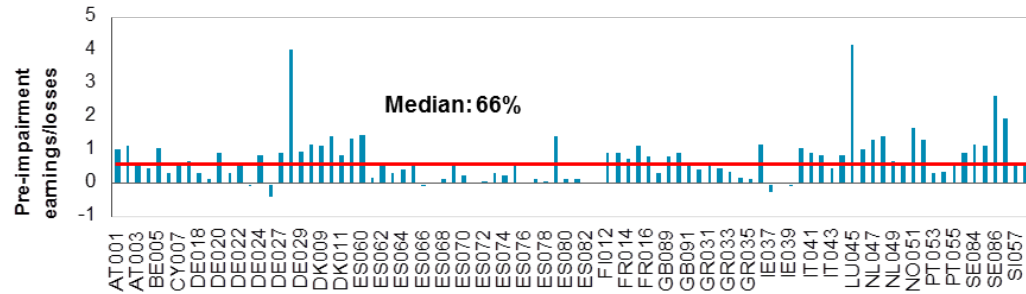
### 2009 SCAP P/L coverage



### 2012 CCAR P/L coverage



### 2011 EBA P/L coverage (adverse scenario)



<sup>25</sup> PPNR calculations in the 2012 CCAR were net of operational risk related losses, OREO expenses, as well as mortgage repurchase and put-back costs, meaning these items were not reported separately (though they totaled \$115bn for all 19 banks) (Board of Governors, 2012).

**Figure 1: Projected coverage of losses with profits in 2009 SCAP and 2011 EBA stress tests.**

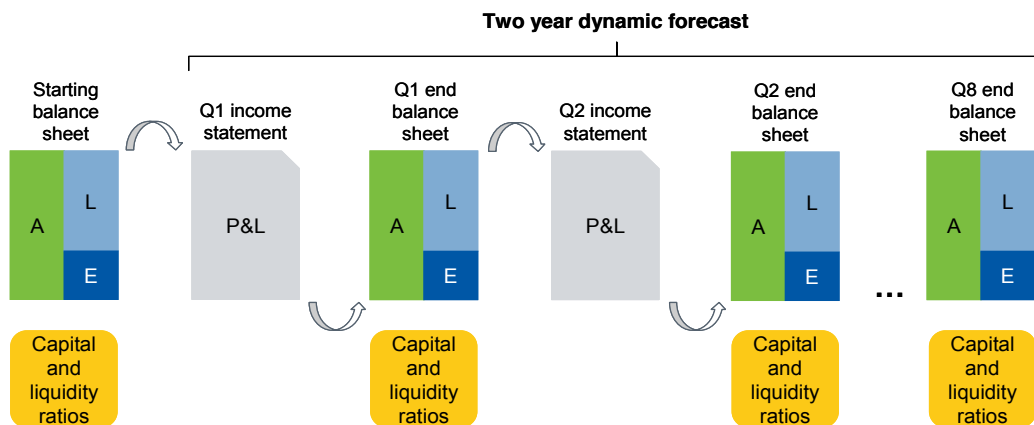
### **4.3. Modeling the balance sheet**

Recall that capital adequacy is defined in terms of a capital ratio, roughly capital over assets. Of course both the numerator and denominator are nuanced. All supervisory stress tests have insisted to varying degrees that the relevant form of capital be common equity. The 2010 CEBS test allowed for some forms of hybrid capital typical of state participations, but the requirements were tightened a year later. As discussed in Section 4.1, the denominator is typically risk-weighted assets (RWA), where the risk weights are determined by the prevailing regulatory capital regime, namely Basel I (in the U.S. cases of the SCAP and CCAR) and Basel II (in the European stress tests). The many subtleties of what this implies is beyond the scope of this paper, but suffice it to say that a bank may be forced to raise capital under one regime but not the other, and without considerable detail about the portfolio, there is no way to know which regime will result in a more favorable treatment.

Regardless of the risk weight regime, determining post-stress capital adequacy requires modeling both the income statement and the balance sheet, both flows and stocks, over the course of the stress test horizon, which is typically two years.<sup>26</sup> This is illustrated in Figure 2 below. The point of departure is the current balance sheet, at which point the bank meets the required capital (and, if included, liquidity) ratios. The starting balance sheet generates the first quarter's income and loss, which in turn determines the quarter-end balance sheet. The modeler is then faced with the problem of considering the nature and amount of new assets originated and/or sold during the quarter, and any other capital depleting or conserving actions such as acquisitions or spin-offs, dividend changes or share (re-)purchase or issuance programs, including employee stock and stock option programs. The problem of balance sheet modeling exists under a static (be it in raw form, as in the 2011 EBA, or in risk weighted form, as in the 2009 SCAP) or dynamic balance sheet assumption. The bank should not drop below the required capital (and liquidity) ratios in any quarter. Moreover, at the end of the stress horizon, the bank needs to estimate the amount of reserves needed to cover expected losses on loans and leases for the following year. In this way the stress tests are really three years (or T+1 years for a T-year stress test).

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<sup>26</sup> The horizon is 9 quarters for the CCAR as it is based on Q3, not Q4, balance sheets.



**Figure 2: Stress testing balance sheet and income statement dynamics.**

## 5. Stress testing disclosure

Stress testing is here to stay, whether because it is just good risk management practice, or because it is enshrined in legislation (through the Dodd-Frank Act). In the debate on disclosure regimes, it is not clear that more is always better. We divide the discussion into crisis and non-crisis or normal times, with the simple point that normal times may not require or even desire the same degree of transparency as is clearly needed in times of crisis.

We have seen very large differences in disclosure across the different supervisory stress tests, as summarized in Table 1. The SCAP in 2009 opened Pandora’s box by disclosing projected stress losses for each of the 19 participating banks, for eight different categories or asset classes, as well as resources other than capital to absorb losses (mostly pre-provision net revenue and reserve releases, if any). Until then, regulatory disclosures (e.g. Y-9C reports for U.S. bank holding companies) reported only realized losses (the past), not projected losses (a possible future). This allowed the market to easily check the severity of the stress test, not just in terms of the scenario, but much more importantly in terms of the resulting outcomes at the bank level. Given the crisis of confidence prevalent in the market at the time, this amount of transparency was crucial. Two years later, the CCAR displayed a radically different disclosure regime: only the macro-scenario was published, but no bank level results. The only indication of bank level outcomes were subsequent dividend and other capital actions announced by some banks: banks allowed to raise their dividends were interpreted to have “passed” the stress test. The market digested this meager information event without a hiccup.

Dodd-Frank, however, requires the Fed to disclose results of regular stress testing, and with the 2012 CCAR, and the accompanying rules (final and proposed<sup>27</sup>), we got a glimpse of what regular disclosure might look like. The 2012 CCAR disclosed nearly the same level of detail as the 2009 SCAP, namely bank-level loss rates and dollar losses by major regulatory asset class (following the categories of the FR Y-9C bank holding company reports): first and second lien mortgages, commercial and industrial (C&I) lending, CRE, credit cards, other consumer, and other loans. In addition, the Fed reported dollar PPNR, gains/losses on the AFS/HTM securities portfolio, as well as trading and counterparty losses for those firms who were required to conduct the trading book stress.<sup>28</sup> And, as with the 2009 SCAP, the numbers reported were supervisory estimates, not the bank-own estimates of losses (and PPNR) under the stress scenario.

By contrast, the 2011 Irish and 2011 Europe-wide EBA stress tests, both of which disclosed after the CCAR, were considerable in their detail, including comparison of bank and third-party estimates of losses in the Irish case (revealing the bias any bank is likely to have when estimating its own potential losses), and data in electronic, downloadable form in the EBA case. Ireland especially was suffering from an acute credibility problem, having emerged in July 2010 from the CEBS stress test with flying colors only to require massive external aid four months later.

This divergent experience between Europe and the U.S. provides some hints on how to design a disclosure regime during “normal” times. The discussion on the benefits *and* costs of stress test disclosures in Goldstein and Sapra (2012) will help us. They argue persuasively that in a world with frictions and strategic environments, the benefits (better market discipline) may not outweigh the costs: banks may make poor portfolio choices designed to maximize the chance of passing the test (window dressing) and thereby give up longer term value; traders may place too much weight on the public information of stress test disclosure and be dis-incentivized to produce private information about the banks; and finally, with information content of market prices now damaged, market discipline is harmed, and supervisors will find market prices less useful for policy decisions (micro- as well as macro-prudential).

To be sure, some disclosure is still preferable to no disclosure, and Goldstein and Sapra propose disclosing aggregated but not necessarily bank-specific results, with sufficient information about category outcomes (loss rates by major asset class, for instance). Aggregation has the advantage of being less wrong since idiosyncratic errors in estimating bank conditions

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<sup>27</sup> <http://www.gpo.gov/fdsys/pkg/FR-2011-12-01/pdf/2011-30665.pdf>

<sup>28</sup> In 2012, these were the six institutions with the largest trading portfolios.

under hypothesized stress scenarios are averaged out. In this way supervisors can still provide useful macro-prudential information which only they can provide – loss rates by asset class, total capital decline in the system (or significant fraction of the banking system) – without drowning out signals about individual banks from the market participants themselves. Such disclosure gives the market an anchor point for system-wide possibilities without diluting the incentive to dig hard into a particular firm’s financials.

During times of crisis, with enormous uncertainty about the health of the banking system, the benefit of detailed bank-specific stress test disclosure is significant given the ability of supervisors to correctly assess the health of individual firms, and the resulting inability of the market to be able to tell a good bank from a bad. Indeed Goldstein and Sapra argue that stress test disclosures, when more disaggregated, ought to be accompanied by detailed descriptions of the exposures of the banks. This is precisely what was done in the Irish bank stress test of 2011, an acute case of loss of confidence (and subsequent regaining), as well as the 2011 EBA stress test. Because credibility of European supervisors was rather low by that point, only with very detailed disclosure, bank by bank, of their exposures by asset class, by country, by maturity bucket, could the market do its own math and arrive at its own conclusions.

Between March 2009 and March 2011, the 19 SCAP banks had raised about \$300bn in capital, the S&P500 had increased by 65%, the economy was no longer in recession, and arguably the supervisory agencies had regained credibility. The non-event of the non-disclosure of the 2011 CCAR suggests that the market seemed content to live in a state of “symmetric ignorance,” to borrow a term from Dang, Gorton and Holmstrom (2010). Of course this might change should the economy receive another adverse shock, but until it does, it is not clear that an EBA-like disclosure regime is necessarily desirable nor stability enhancing. Europe, by contrast, is not out of the weeds (as of this writing). Yet even the EBA is not limitless with its disclosure of the 2011 stress test results. It is worth noting that funding liquidity was also stressed at banks but without disclosing the results. Because liquidity positions are highly dynamic and thus subject to rapid change, snapshot disclosure, especially with delay (the as-of date for the 2011 EBA stress test was YE 2010), is unlikely to be informative at the time of disclosure.<sup>29</sup>

Recall the discussion in the introduction: regulatory capital models (risk weighting), internal economic capital models and stress testing all have the same goal, namely to determine the

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<sup>29</sup> Reuters, Sept. 2, 2011, “EBA won’t seek disclosure of bank liquidity.” Available at <http://www.reuters.com/article/2011/09/02/idUSL5E7K23PI20110902>.

amount of capital needed to support the business (risk taking) of the bank. Both regulatory and economic capital models (and especially the former) evolve very slowly and thus have difficulty adapting to financial innovation and rapidly changing macro conditions. Indeed, some of the innovation is motivated by those slowly evolving, one-size-fits-all regulatory capital rules. Moreover, bank balance sheets are notoriously opaque and subject to easy-to-hide asset substitution (higher risk for lower risk assets); Morgan 2002. Stress tests, especially macro-prudential supervisory stress tests, are by construction adapted to the then current environment and bank portfolios. Between balance sheet opacity, asset substitution and regulatory arbitrage, it is easy to see the value of a “pop quiz” in the form of bespoke stress testing (Acharya et al. 2011).

## **6. Conclusion**

The problem of sizing the amount of capital needed to support the risk taking of a bank is not new; but the use of broad-based supervisory stress tests for an entire banking system is. The first use was in 2009 in the U.S., and its success there has made it the supervisory and risk management hammer to deal with all nails. A critical component of the exercise is the disclosure of the results. The reason stress testing became an imperative was precisely because existing approaches that were publicly disclosed, such as regulatory capital ratios, were no longer informative and heavily (if not entirely) discounted by the market. To regain credibility, supervisory authorities needed to disclose enough to allow the market to “check the math.”

But broad-based supervisory stress testing has not been universally successful, as the 2010 and 2011 European experience has shown. Nor is it clear how useful such broad supervisory stress testing with concomitant disclosure will be as a matter of routine. Its value in the crisis was undoubtedly its “pop quiz” nature. It was sprung on the banks at short notice, and thus very difficult to manipulate through careful pre-positioning, and it was tailored to the situation at hand, genuinely revealing new information to all participants and the public. As a result, trust was regained. Once trust has been re-established, the cost-benefit of stress testing disclosures may tip away from bank-specific towards more aggregated information. This still provides the market with unique information (supervisors, after all, have access to proprietary bank data) without dis-incentivizing market participants from producing private information and trading on it – with all the downstream benefits of information-rich prices and market discipline.

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	Target capital ratio*	# of participating banks	Participation criteria (total coverage)	Balance sheet assumptions	Total required capital raise (for # of banks)	Risk types included: Market, Credit, Liquidity (funding), Operational
SCAP March 2009	<ul style="list-style-type: none"> <li>• 4% T1C</li> <li>• 6% T1</li> </ul>	19	<ul style="list-style-type: none"> <li>• All bank holding companies with at least \$100 bn total assets</li> <li>• (~2/3 of total banking assets)</li> </ul>	Constant RWA	\$75 bn (19)	M, ** C
CEBS July 2010	<ul style="list-style-type: none"> <li>• 6% T1</li> </ul>	91 (20 countries)	<ul style="list-style-type: none"> <li>• Largest banks in country until at least 50% of total assets are included</li> <li>• (~2/3 of total banking assets)</li> </ul>	Constant total assets	€3.5 bn (7)	M, C
CCAR March 2011	<ul style="list-style-type: none"> <li>• 5% T1C</li> </ul>	19	<ul style="list-style-type: none"> <li>• Original SCAP-19</li> </ul>	none	--	M, C
Ireland March 2011	<ul style="list-style-type: none"> <li>• 6% T1C</li> <li>• 10.5% T1C (in base)</li> </ul>	4	<ul style="list-style-type: none"> <li>• Largest banks not in wind-down mode</li> </ul>	Allowed for balance sheet shrinkage	€24bn (4)	M, C, L, O
EBA July 2011	<ul style="list-style-type: none"> <li>• 5% T1C</li> </ul>	90 (21 countries)	<ul style="list-style-type: none"> <li>• Largest banks in country until at least 50% of total assets are included</li> <li>• (~2/3 of total banking assets)</li> </ul>	Constant total assets	€2.5 bn (8)	M, C, L <sup>***</sup> , O
CCAR March 2012	<ul style="list-style-type: none"> <li>• 5% T1C</li> <li>• 4% T1; 8% Total; 3-4% leverage</li> </ul>	19	<ul style="list-style-type: none"> <li>• SCAP-19</li> <li>• An additional 11 BHCs with assets &gt;\$50bn</li> </ul>	none	****	M, C, O

**Table 3a: Summary of macroprudential stress tests to date**

\*: T1: Tier 1 capital ratio; T1C: Tier 1 Common (or Core) capital ratio

\*\* : Only banks with at least \$100 bn in trading assets were required to conduct the market risk stress test

\*\*\*: Liquidity risk was not directly assessed, though funding stresses were taken into account, especially as related to sovereign stress impacting funding costs for financial institutions.

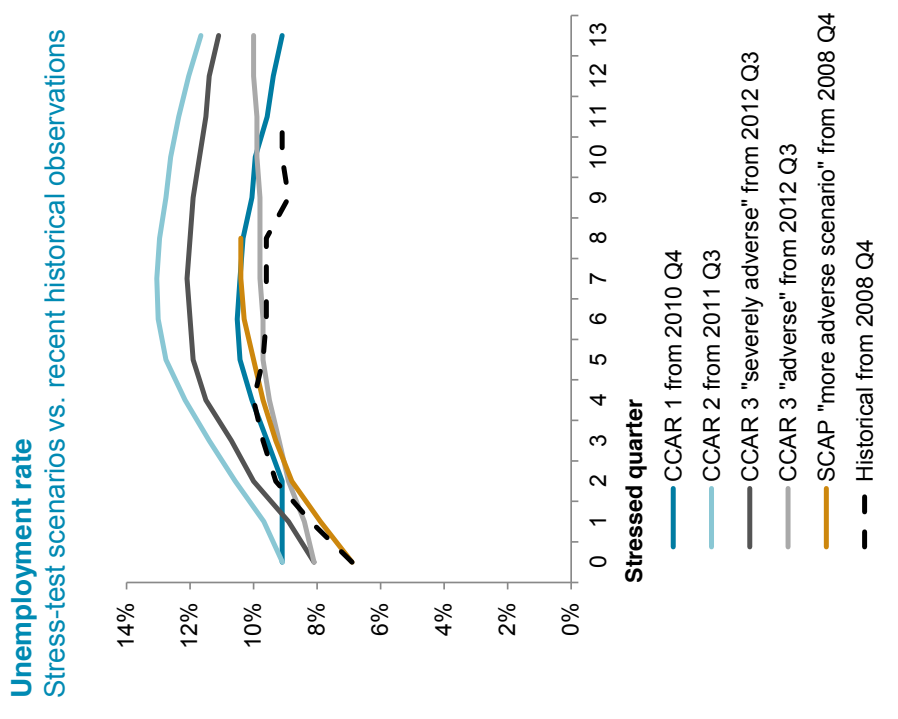
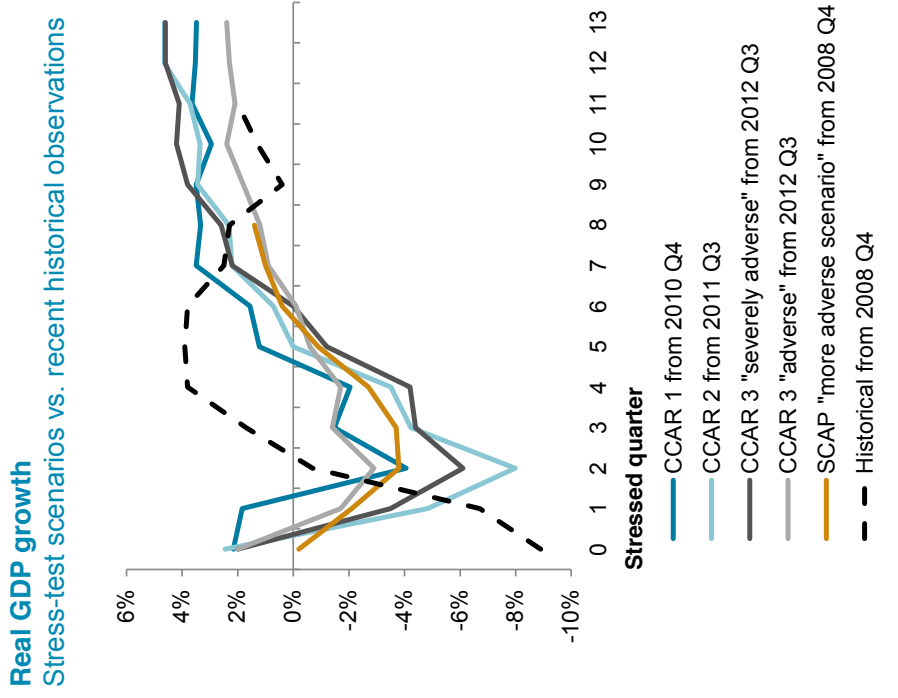
\*\*\*\*: 4 of the 19 did not pass in the sense of having not gaining non-objection to their submitted capital plans.

Target capital ratio*	# of participating banks**	Participation criteria (total coverage)	Balance sheet assumptions	Total required capital raise (for # of banks)	Risk types included: Market, Credit, Liquidity (funding), Operational
IMF June 8, 2012	29	• Large and medium banks and cajas, together making up ~90% of total bank assets	Deleveraging	• €37.1 (17) under 7% TIC	C, L
Top-down June 21, 2012	14 entities	• Large and medium banks and cajas, together making up ~90% of total bank assets	Deleveraging	• €16-25 [base] • €51-62 [stress]	C, L
Bottom-up Sept. 28, 2012	14 entities	• Large and medium banks and cajas, together making up ~90% of total bank assets	Deleveraging	• €24.1 (5) [base] • €57.3 (7) [stress]	C, L

**Figure 3b: Summary of macroprudential stress tests to date – Spain 2012**

\*: T1: Tier 1 capital ratio; TIC: Tier 1 Common (or Core) capital ratio

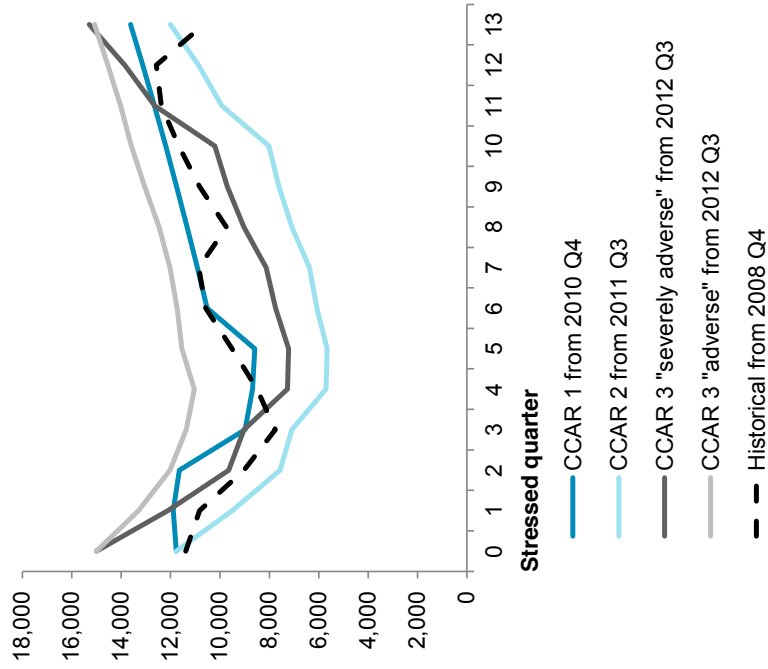
\*\*.: The 14 entities are the result of mergers



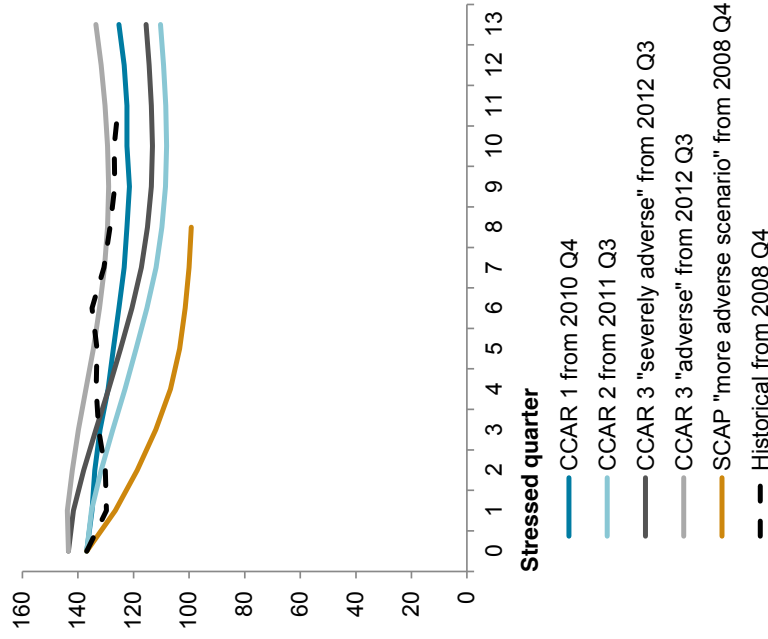
Source: Fed, The Supervisory Capital Assessment Program: Design and Implementation, 24 April 2009; Fed, Comprehensive Capital Analysis and Review: Objectives and Overview, 18 March, 2011; Fed, "Comprehensive Capital Review" document and "Capital Plan review" 22 November 2011; Fed, "2013 Supervisory Scenarios" 15 November 2012; Datastream

**Figure 4: U.S. real GDP and unemployment scenarios compared**

**Dow Jones total stock market index level**  
Stress-test scenarios vs. recent historical observations



**House Price index**  
Stress-test scenarios vs. recent historical observations



Source: Fed, The Supervisory Capital Assessment Program: Design and Implementation, 24 April 2009; Fed, Comprehensive Capital Analysis and Review: Objectives and Overview, 18 March, 2011; Fed, "Comprehensive Capital Review" document and "Capital Plan review" 22 November 2011; Fed, "2013 Supervisory Scenarios" 15 November 2012; Datastream

**Figure 5: U.S. equity and house price indices compared**

134 Mount Auburn Street, Cambridge, MA 02138  
[www.capmksreg.org](http://www.capmksreg.org)