

Should Banks' Stress Test Results be Disclosed? An Analysis of the Costs and Benefits.¹

Itay Goldstein

The Wharton School, University of Pennsylvania

Haresh Sapra

The University of Chicago Booth School of Business

April 2, 2012

¹Prepared for the Committee on Capital Markets Regulation. We thank Mitchell Berlin, Mark Flannery, Fred Furlong, Anil Kashyap, Hamid Mehran, Til Schuermann, Hal Scott, Larry Wall, Luigi Zingales, participants at the JAR-NY Fed Pre-Conference on Disclosure in Financial Institutions, and members of the Committee on Capital Markets Regulation for helpful comments.

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 tests 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.¹ 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

¹The 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.²

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

²This 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.³ 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

³We 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.⁴ The intuition is as follows: more disclosure allows market

⁴Note 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), Darrrough 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 GKS_V) 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 GKS_V 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 GKS_V 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.⁵ 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

⁵While the GKS_V 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 α 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 α , 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.⁶ 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

⁶Note 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, GKSJ show that in a second-best environment with strategic interactions this intuition is, at best, incomplete.

More precisely, GKSJ 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. GKSJ 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, GKS_V 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 α 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 GKS_V 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.⁷ 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

⁷Put 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 θ . 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 θ . This is captured in the model by the assumption that he wants his action to be as close as possible to the economic fundamentals θ . 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 θ 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 θ and also to public information about θ . 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 α and that of the private information as β (and assuming normal distributions of the signals around the realization of the fundamentals θ), 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,⁸ 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

⁸This 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.”⁹

As Gary Stern argues, market data is useful because it aggregates information from many different participants,¹⁰ 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.

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

¹⁰This 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.¹¹ 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.¹²

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

¹¹The 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).

¹²For 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.

References

- [1] Angeletos, G. M., and A. Pavan. 2007. Efficient Use of Information and Social Value of Information. *Econometrica* 75: 1103-1142.
- [2] Bakke, T. E., and T. M. Whited. 2010. Which Firms Follow the Market? An Analysis of Corporate Investment Decisions. *Review of Financial Studies*: forthcoming.
- [3] Bhojraj, S., and R. Libby. 2005. Capital Market Pressure, Disclosure Frequency-Induced Earnings/Cash Flow Conflict, and Managerial Myopia. *The Accounting Review* 80: 1-20.
- [4] Blackwell, D. 1951. Comparison of experiments. In: *Proceedings of the Second Berkeley Symposium on Mathematical Statistics and Probability*. University of California Press, 93-102.
- [5] Bond, P., and I. Goldstein. 2011. Government Intervention and Information Aggregation by Prices. Working Paper, University of Pennsylvania.
- [6] Bond, P., I. Goldstein, and E. S. Prescott. 2010. Market-Based Corrective Actions. *Review of Financial Studies* 23: 781-820.
- [7] Brunnermeier, M., P. Bolton, and L. Veldkamp. 2010. Leadership, Coordination and Mission Driven Management. Working paper, Princeton University.
- [8] Burkart, M., D. Gromb, and F. Panunzi. 1997. Large Shareholders, Monitoring, and the Value of Firms. *The Quarterly Journal of Economics* 112: 693-728.
- [9] Chen, Q., I. Goldstein, and W. Jiang. 2007. Price Informativeness and Investment Sensitivity to Stock Price. *Review of Financial Studies* 20: 619-50.
- [10] Chen, Q., I. Goldstein, and W. Jiang. 2010. Payoff Complementarities and Financial Fragility: Evidence from Mutual Fund Outflows. *Journal of Financial Economics* 97: 239-262

- [11] Cheng, M., K.R. Subramanyam, and Y. Zhang. 2010. Earnings Guidance and Managerial Myopia. Working Paper, Columbia Business School.
- [12] Darrough M., and N. Stoughton. 1990. Financial Disclosure Policy in an Entry Game. *Journal of Accounting and Economics*: 219-243.
- [13] Diamond, D., and P. Dybvig. 1983. Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy* 91: 401-419.
- [14] Dye, R. 1986. Proprietary and Nonproprietary Disclosures. *Journal of Business* 59: 331-366.
- [15] Evanoff, D. D., and L. D. Wall. 2004. Subordinated Debt as Bank Capital: A Proposal for Regulatory Reform. *Federal Reserve Bank of Chicago Economic Perspectives* 24: 40-53.
- [16] Feldman, R., and J. Schmidt. 2003. Supervisory Use of Market Data in the Federal Reserve System. Working Paper, Federal Reserve Bank of Minneapolis.
- [17] Flannery, M. 2009. Stabilizing Large Financial Institutions with Contingent Capital Certificates. Working Paper.
- [18] Furlong, F., and R. Williams. 2006. Financial Market Signals and Banking Supervision: Are Current Practices Consistent with Research Findings? *Federal Reserve Bank of San Francisco Economic Review*: 17-29.
- [19] Gigler, F., C. Kanodia, H. Saprà, and R. Venugopalan. 2011. An Equilibrium Analysis of the Costs and Benefits of More Frequent Financial Reporting. Working paper, The University of Chicago Booth School of Business.
- [20] Goldstein, I., E. Ozdenoren, and K. Yuan. 2011. Learning and Complementarities in Speculative Attacks. *Review of Economic Studies* forthcoming.

- [21] Greenlaw, D., A. Kashyap, K. Schoenholtz, and H. S. Shin. 2011. Stressed Out: Macroeprudential Principles for Stress Testing. Working Paper, The University of Chicago Booth School of Business.
- [22] Grossman, S. J., and J. E. Stiglitz. 1980. On the Impossibility of Informationally Efficient Markets. *American Economic Review* 70:393-408.
- [23] Hart, O., and L. Zingales. 2009. A New Capital Regulation for Large Financial Institutions. Working Paper. Harvard University.
- [24] Hayek, F. A. 1945. The Use of Knowledge in Society *American Economic Review* 35: 519-30.
- [25] Herring, R. J. 2004. The Subordinated Debt Alternative to Basel II. *Journal of Financial Stability* 1: 137-55.
- [26] Hertzberg, A., J. M. Liberti, and D. Paravisini. 2011. Public Information and Coordination: Evidence from a Credit Registry Expansion. *Journal of Finance* 66: 379-412.
- [27] Keynes, J. M. 1936. *The General Theory of Employment, Interest, and Money*. London: Macmillan.
- [28] Krainer, J., and J. A. Lopez. 2004. Incorporating Equity Market Information into Supervisory Monitoring Models. *Journal of Money Credit and Banking* 36: 1043-67.
- [29] Luo, Y. 2005. Do Insiders Learn from Outsiders? Evidence from Mergers and Acquisitions. *Journal of Finance* 60: 1951-82.
- [30] McDonald, R. 2010. Contingent Capital with a Dual Price Trigger. Working Paper.
- [31] Michael, I. 2004. Accounting and Financial Stability. *Financial Stability Review* June 2004: 118 - 128, Bank of England.

- [32] Morris, S., and H. S. Shin. 2002. The Social Value of Public Information. *American Economic Review* 92: 1521-1534.
- [33] Tarullo, D. 2010. Lessons from the Crisis Stress Tests. Remarks Made to the International Research Forum on Monetary Policy, Washington D.C.