

# 13. Market Discipline for Financial Institutions and Markets for Information

Apanard P. Angkinand, Clas Wihlborg and Thomas D. Willett

Apanard P. Angkinand, *Milken Institute and University of Illinois at Springfield*

Clas Wihlborg, *Chapman University*

Thomas D. Willett, *Claremont Graduate University and Claremont McKenna College*

## 1. Introduction

Under ideal conditions competitive markets should induce firms to adopt good governance procedures that lead to the maximization of shareholder value. Firms that do not approximate such behavior will face penalties in the form of lower profitability and higher costs of financing. Ultimately the wayward firms will be forced out of business or at least shrink or be taken over. Ideally market discipline would begin to come into play as soon as a firm begins to go astray and markets provide early warning signals and incentives in sufficient time for management to take corrective actions well before bankruptcy or financial market disruptions occur.

The recent global financial crisis has again shown that once concern arises in the markets they place enormous pressure on public as well as private sector entities. As we will document in sections 4 and 5, however, financial markets generally failed in the run-up to the crisis in terms of giving strong warning signals in a timely enough fashion for disaster to be avoided.

A major purpose of this paper is to analyze why such early warning signals were not forthcoming and consider what, if anything, can be done to help induce financial markets to

provide early warning signals that provide corrective discipline in advance of the generation of crisis conditions. We also consider theoretical arguments and empirical evidence on whether some types of financial instruments have tended to be better than others at providing early warning signals.

Forward looking market signals are one aspect of market discipline provided by financial markets. Another aspect is incentives for risk-taking. Prices on financial instruments are based on forward looking information and trading in financial markets is based on differences in perceptions and uncertainty about the future. Much of the theory of financial institutions views them as information intermediaries and risk managers.<sup>1</sup>

When economists observe a failure of market discipline in the sense of excessive risk taking a first impulse is usually to look for sources of government induced moral hazard that has blunted the normal operation of market incentives. Undoubtedly this often plays an important role, but in the recent crisis we argue that it is far from the only factor at work.

Many economists have stressed that for market discipline to work there must be a group of monitors who both have access to sufficient reliable information and the incentives to gather and act on it. Moral hazard of course blunts these incentives, but even in its absence there are important conditions in many financial markets that also impede the generation of early market discipline. One difficulty is the merger mania that led to large financial conglomerates which in the view of many experts became not only “too big to fail” (TBTF) but also too big and complex to manage.

Numerous recent books and articles on the crisis suggest that many high level managers of large financial institutions had little idea of the risks that their institutions were taking on despite their access to internal information. In some cases this may have been due to some of the

---

<sup>1</sup> A comprehensive theoretical view of financial institutions is presented in Bhattacharya and Thakor (1993).

types of behavioral biases pointed to by studies in the rapidly growing field of behavioral economics and finance. For example, a manager may not want to look too hard at the processes which are generating high short run profits. Creditors should not be subject to this wishful thinking inducing them to not do due diligence, but as outsiders it may be very difficult if not impossible for them to obtain the information necessary to make sound judgments about the overall risk levels of a large conglomerate financial firm.

In order to arrive at principles for government involvement in the regulation of financial markets and institutions we review literature and evidence on market discipline before interpreting market discipline in terms of informativeness of financial market activity. This view is based on the assumption that “available information” is endogenous relative to the regulatory framework and the structure of financial markets. The reason is that information is costly to acquire and absorb, as well as costly to disclose and signal from a financial institutions point of view. Thus, we reinterpret financial markets as markets providing incentives for acquiring and revealing information. With costly information there is no unambiguous concept of efficient markets but we develop four “informativeness principles” for regulators, supervisors and government action.

In Section 2 we discuss and review the conceptual literature on market discipline with respect to risk-taking in financial institutions (FIs). The empirical literature is reviewed in Section 3. Market discipline with respect to timeliness of information is discussed in section 4 where empirical evidence prior to the crisis and within the crisis is reviewed. We also discuss how different debt-based and equity-based financial instruments provide more or less timely information. In Section 5 we discuss the behavior of CDS spreads and equity prices around events associated with insolvency of some financial institutions during the financial crisis 2007-

2009. An alternative view of financial markets as providing incentives to acquire and produce costly information is developed in Section 6. This leads up to four “informativeness principles” for public sector intervention presented in Section 7. Concluding comments follow in Section 8.

## **2. Market discipline on risk-taking in financial institutions**

There is a substantial literature on market discipline with respect to risk-taking in banking and financial institutions (FIs) more generally. Two aspects are emphasized.<sup>2</sup> First, market discipline requires that the cost of funding reflects an FI’s risk-taking in the sense of probability of default. Second, an FI’s management must respond properly to the information provided by the costs of different sources of funding. In well functioning markets the management of an FI would choose asset- and liability positions that maximize shareholder value.

The first aspect of market discipline refers to pricing of default risk. It is well-known that limited liability of shareholders of corporations provides incentives for the latter to shift risk to creditors and these incentives become stronger when equity capital is low. For this reason creditors of corporations in general have incentives to monitor default risk and “loss given default” (LGD) and demand compensation for this risk. The credit risk premium can be viewed as the premium on a put option on the corporation’s assets purchased by the shareholders with a strike price equal to value of the debt. If the credit risk premium on a corporation’s debt is too low shareholders have an incentive to take on too much relatively low cost debt and increase default risk at the expense of debt holders.

The second aspect of market discipline refers to governance issues. For market discipline to be effective, the corporate governance structure must provide incentives for management to maximize shareholder value. These two aspects of market discipline are both parts of what is

---

<sup>2</sup> See, for example, Benink and Wihlborg (2002).

often called direct market discipline in the banking literature. Indirect market discipline refers to the use of price signals with respect to risk being used by supervisors as indicators that may trigger intervention.<sup>3</sup>

Direct market discipline may fail in the financial industry for several reasons providing arguments for regulation of risk-taking and supervision. Creditors may not be able to obtain information to assess an FI's riskiness. The opaqueness of banks in particular is often referred to as an argument for supervision of banks based on the presumption that supervisors are better able to gather the information required to assess risk. The second common argument for market discipline failure is that FI's creditors are explicitly or implicitly protected from losses in case of default. In particular, explicit insurance of banks' depositors reduce their incentives to monitor banks and to demand a risk-premium on deposits. Implicit insurance exists if an FI's creditors expect to be bailed out in case of insolvency because the FI is considered "too big to fail" or a government blanket guarantee is expected in case FI's face distress. Explicit and implicit insurance of creditors induces FIs to take on too much debt and to shift default risk to a deposit insurance funds and/or tax payers.

The recent financial crisis has also high-lighted poor corporate governance as a source of market discipline failure. In particular, compensation schemes for executives as well as traders and risk managers have been blamed for excessive risk-taking. Several chapters in this volume address this issue.

The mentioned sources of market failure with respect to FI's risk-taking may explain excessive risk-taking on the level of a particular FI. They provide the rationale for micro prudential regulation.

---

<sup>3</sup> The distinction between direct and indirect market discipline has been made by Flannery (1996). Literature on the two types of discipline is reviewed in the next section.

An additional social concern with risk-taking is that the default of one FI has systemic consequences meaning that one FI's failure or actions in response to distress increases the probability of other FIs' failure through contagion. Potential systemic consequences of an FI's failure provide the rationale for macro prudential regulation and supervision. The systemic aspect of market discipline failure implies that potential systemwide losses of one FI's distress are not reflected in the risk-premium for the individual FI. Contagion effects of one or more FI's distress are often viewed as externalities. Even if the credit risk of the individual FI is priced efficiently externalities caused by an FI distress may exist.

The literature on different channels of contagion has expanded rapidly since the outbreak of the financial crisis in 2008. Prior to the crisis contagion through runs on opaque banks and through interbank claims was considered the main source of systemic risk<sup>4</sup> but other channels of contagion have been emphasized in recent literature.<sup>5</sup> This literature emphasizes that in the modern financial system where FI rely on securities markets for funding, contagion arises as a result of price and liquidity effects of one bank's distress. The implementation of mark-to-market and fair value accounting has amplified the strength of contagion through the price and liquidity channels.

The policy concern with systemic financial crisis is amplified by the possibility that events in the financial sector cause substantial (real) effects on growth, employment, and productivity. Although financial crises often originate outside the financial sector in, for example, a decline in economic activity or sharply falling asset prices, contagion through the

---

<sup>4</sup> Diamond and Dybvig (1983) model contagious bank-runs that occur after one bank's failure when depositors are unable to distinguish between solvent and insolvent banks.

<sup>5</sup> See, for example, Brunnermeier et al (2009) and Kashyap et al (2008) for summaries of the new views of contagion.

financial system amplifies the real effects when FI's reduce the supply of credit and liquidity dries up.

### **3. Empirical Evidence on Market Discipline on Risk-taking**

There is a large literature asking whether there is market discipline in the sense that the cost of funding of banks and other financial institutions reflect their riskiness. Since a large part of banks' liabilities are insured by deposit insurance systems the empirical literature focuses on yields of non-insured bank debt and equity returns. If yields do not respond to changes in the risk of an FI, market discipline is lacking either because market participants are unable to become informed about risk of individual FI's or because there is implicit protection of debt.

Flannery (1998) reviews the early literature on private investors' ability to assess risk in banking. He concludes that bank share prices generally behave similarly to equity prices of non-financial firms and that bank liability investors also respond to changes in conditions of banks. The evidence refers to yields on CDs as well as bank debentures. Even retail depositors seem to respond to insolvency problems of banks. Flannery and Sorescu (1996) come to similar conclusions with respect to subordinated debentures.

Flannery (1998) concludes that "there is little evidence that broadly contagious runs would be a problem for banks even in the absence of the federal safety net protection for depositors". This conclusion refers only to the traditional source of contagion in banking and has no bearing on contagion through short term borrowing in the securities markets.

A more recent literature focuses on subordinated debt as an instrument for imposing direct as well as indirect market discipline. Calomiris (1999), Evanoff and Wall (2000, 2001), Federal Reserve Board (1999), Jagtiani, Kaufman and Lemieux (2002) and Levonian (2000) are

examples of subordinated debt studies from a US perspective. Sironi (2003) uses evidence from subordinated debt issues by European Banks. The general conclusion for the USA as well as for Europe is that investors in this kind of debt are sensitive to bank risk in the sense that they require a higher yield for banks that are perceived as relatively risky.

The mentioned empirical results must be interpreted with care. They do not imply that default risk of banks is efficiently priced, only that there is some effect on price. Furthermore, the measures of bank risk are based on different kinds of proxies obtained from publicly available accounting data such as capital ratios and asset types. Thus, one implicit, imperfect proxy for risk is regressed on other imperfect proxies for risk for opaque, relatively large banks. The results show that these proxies are correlated, however.

Evanoff, Jagtiani and Nakata (2007) show that the sensitivity of subordinated yield spreads depends on the development of markets for the instruments. In a fully implemented mandatory subordinated debt program liquidity of the markets would increase and, thereby, the sensitivity of yield spreads to risk.

There is evidence that the sensitivity of debt yields depends on the degree of implicit protection of banks' creditors. The results in Sironi (2003) indicate that subordinated debt yields of large "too big to fail banks" are less sensitive to risk proxies than the yields of other banks. Perhaps surprisingly in light of bail-out experiences in the recent financial crisis, Sironi finds that the perception of implicit, "too big to fail" guarantees weakened during the 1990s in Europe. Other studies indicate that the value of the implicit subsidy provided to "too big to fail" financial institutions is substantial. Hart and Zingales (2009) refer to a newspaper article<sup>6</sup> stating that the differential interest rate on interbank loans between large and small banks dropped from negative 8 points to negative 34 points after September 2008. Gandh and Lustig (2010) compare a

---

<sup>6</sup> Cho (2009) in Washington Post, August 28

portfolio long in the largest US banks and short in the smallest yields a return 8 percent higher than an equally (beta) risky portfolio of non-financial firms. This difference increases in crisis periods.

Another type of evidence indicating that market discipline is relatively weak for “too big to fail” banks comes from literature analyzing how risk-taking depends on explicit and implicit insurance of banks’ creditors. This literature uses proxies for riskiness such as non-performing loans/capital, the volatility of equity returns, so-called z-scores and the incidence of banking crisis. These proxies are regressed on bank-specific variables, country specific macro variables and country specific institutional variables such as explicit deposit insurance coverage, proxies for implicit protection of creditors and governance variables for the country as well as the bank level.

Several empirical studies show that effects of explicit deposit insurance on banks’ risk taking depends on ownership, governance factors and other institutional characteristics of a country. Demirgüç-Kunt and Detragiache (2002), Barth, Caprio and Levine (2004) and Cull, Senbet and Sorge (2005) find that high quality of domestic institutions and legal systems reduces the moral hazard effect of deposit insurance. Hovakimian et al. (2003) emphasize that effects of explicit deposit insurance depend on its design and credibility. Fernández and González (2005) find that the adverse effect on risk taking can be reduced by enhancing the effectiveness of accounting and auditing systems. Gonzales (2005) suggests that the finding in some papers that deposit insurance reduces risk-taking can be explained by the positive impact of deposit insurance on banks’ charter values in a strictly regulated environment.

Other studies including Angkinand and Wihlborg (2010), Gropp and Vesala (2004) and Nier and Baumann (2006) emphasize the role of implicit insurance as a contributing factor to

failing market discipline on risk taking of banks. Based on a sample of European banks Gropp and Vesala (2004) find that explicit deposit insurance is associated with lower moral hazard and reduced risk taking if banks have large uninsured liabilities and small assets relative to the total assets of a banking system. Angkinand and Wihlborg (2010) hypothesize and estimate a U-shaped relationship between explicit deposit insurance coverage and banks' risk-taking using country-level data. The U-shaped relationship implies that banks' incentives to shift risk to a deposit insurance fund is minimized by a deposit insurance system offering a partial deposit insurance coverage because market discipline is likely to be weak at low as well as high levels of deposit insurance coverage. The weak discipline at low levels is caused by a high likelihood that governments find themselves compelled to issue blanket guarantees to creditors of distressed banks, or to bail them out. The weak discipline at high levels is due to moral hazard generated by high deposit insurance coverage.

Nier and Baumann (2006) study the market discipline effect for individual banks. Risk-taking is measured by the share of non-performing loans in total assets, by provisions for non-performing loans and by the volatility of the bank's equity market return. Market discipline has several dimensions including the extent of explicit deposit protection on the country level, the amount of uninsured funding of a bank, and Fitch ratings of the expected extent of government support of a bank to capture implicit insurance. Their results indicate that lack of explicit deposit insurance and high amounts of uninsured deposits are likely to reduce risk-taking by increasing desired capital while the likelihood of government support reduces market discipline both directly and through the effect on desired capital.

Risk-taking incentives of bank managers can be expected to depend on the objectives and, therefore, on the governance structures of banks. In the literature, it is usually assumed that

managers in a “high quality” governance structure maximize shareholders’ wealth while the incentives to serve the interests of other stakeholders are provided by market forces, law, and regulation.

There is a limited number of studies on the impact of bank governance on risk-taking. Early studies were limited to US data. For instance, Saunders, Strock and Travlos (1990) using a sample of 38 bank holding companies in the U.S. during 1978-85 find a positive relation between managerial ownership and risk-taking. On the other hand, Chen et al. (1998) find a negative relation between managerial ownership and the level of risk taking in a larger sample of 302 banks and savings institutions during the period 1988-1993. Their explanation is that managers become more risk-averse when their ownership stake increases. Risk-taking is measured by the volatility in daily stock returns and market interest rates.<sup>7</sup>

Related studies focus on the impact of ownership on risk-taking and performance. Several studies indicate that state ownership of banks leads to inefficiency and poor performance (e.g. La Porta et al., 1998) as a result of reduced exposure to market discipline in equity markets. Caprio and Martinez-Peria (2000), Barth, Caprio and Levine (2004), Berger et al. (2005) and Byström (2004) find evidence that state-owned banks are inclined towards higher risk-taking as captured by the ratio of non-performing loans to total loans and bank failure rates.

The large share of foreign ownership of the banking sectors in many emerging market economies in Eastern Europe and Latin America has stimulated research on the effects of foreign ownership on banking operations there. According to Lensink and Hermes (2004) the entry of foreign banks improves the performance of domestic banks although costs increase as well.

---

<sup>7</sup> Anderson and Fraser (2000) argue that the different results can be explained by changes in the regulatory environment between the 80s and the 90s. These changes affected banks’ charter values in the USA. In the Japanese banking sector Konoshi and Yasuda (2004) observe that the relationship “between the stable shareholders’ ownership and bank risk is nonlinear”.

However, the evidence with respect to effects of foreign ownership on banks' risk taking is, not surprisingly, mixed since market discipline on foreign owned banks would depend on host as well as home country factors.<sup>8</sup>

Caprio, Laeven and Levine (2007) and Barth, Caprio and Levine (2006) analyze whether the quality of bank governance across countries is influenced by rules with respect to shareholder rights and disclosure. They use the market to book values of banks as a proxy for quality of governance. The results show that greater transparency and stronger minority shareholder rights are associated with higher market values but also that concentration of ownership substitutes for shareholder protection. Tadesse (2005), Fernández and González (2005), and Nier and Baumann (2006) find that greater disclosure and transparency strengthen market discipline and reduce risk-taking of banks.

The quality of governance can be expected to have an indirect impact on risk-taking by influencing management's response to capital regulation, deposit insurance coverage and restrictions on banks' activities. Laeven and Levine (2009) ask whether the marginal effects of these variables on risk-taking depend on concentration of ownership. They find that concentrated ownership is associated with relatively large marginal effects. Thus, the impact on market discipline of, for example, deposit insurance becomes less pronounced if ownership is dispersed.

Management turnover is often used as an indicator of the responsiveness of a governance system to market signals. In this vein, Cihak, et al (2009) analyze whether market discipline in the US banking industry is exerted through management turnover in response to market signals in equity and debt markets. Focusing on banks that are not large enough to enjoy substantial implicit protection through regulatory forbearance the authors find that forced management

---

<sup>8</sup> See, for example, Demirgüç-Kunt, Levine and Min (1998), Claessens, Demirgüç-Kunt, Huizinga (2001), Barth, Caprio and Levine (2004), and Levine (2004).

turnover is associated with deteriorating bank soundness as reflected in reduced dividend payments and a decline in the share of non-insured deposits. A relatively high level of subordinated debt is also associated with turn-over of management. These results indicate that bank governance is responsive to market signals in equity as well as deposit markets. The authors do not find evidence of improved performance and reduced risk after turnover, however.

In summary, there is strong evidence that a degree of market discipline on risk-taking is imposed by increased costs of funding for more risky FIs. Market discipline is weakened by explicit as well as implicit protection of FIs creditors; in particular implicit protection of too big to fail banks. The evidence with respect to the impact of governance variables on risk-taking is more ambiguous. Theoretically, this ambiguity can be explained by interaction between governance characteristics and protection of FIs creditors. Effective governance structures from shareholders point of view can contribute to risk-shifting to deposit insurance funds and tax payers when creditor protection is strong. Although the evidence indicates that market discipline works if there are creditors facing credible risk of losses, it is harder to draw strong conclusions about its effectiveness with respect to incidence of bank failures and, in particular, the incidence of financial crises.

#### **4. The timeliness of market discipline**

Failure of market discipline can be the result of FI's cost of funding not reflecting available information about factors affecting the value of an FI's assets and its sources of funding. An important question for management as well as for supervisors is whether market prices related to an FI's cost of funding can provide early warnings about impending distress of individual FIs, as well as about the financial system as a whole in time for managers of FIs and

governments to take action to stave off a crisis. According to research reviewed below and data presented in the next section the recent crisis was clearly not widely foreseen even six months in advance by FI managers, nor by supervisors and central bankers. This observation is to some extent obvious since if a dramatic fall in asset values with all its consequences had been foreseen well in advance the crisis would most likely have been averted.

Market discipline obviously does not imply perfect foresight about the quality of an FI's portfolio. Absence of market discipline must be associated with a market failure as a reason for prices not reflecting information. A genuine lack of information is not a financial market failure while inefficiency in the pricing of available information is. The issue of market failure is more complicated than that, however, because "available" information is itself a function of incentives to acquire and reveal information in financial markets. We emphasize this point in Section 6 where we interpret financial markets as instruments for creating incentives for information production. Even when there is no market failure market failure can be weak when the level of information is low.

The conclusion of the "Turner Review" of the financial crisis published by the Financial Services Authority (2009) of the UK is that market discipline in the sense that market prices would provide early warning signals "cannot be expected to play a major role in constraining bank risk taking." This conclusion in the "Turner review" seems to contradict the results in several papers mentioned in the previous section stating that yields on financial instruments issued by FIs could be used by supervisors as indicators of impending distress. The contradiction could be explained the Turner Review's focus on early warnings of systemic crises while the papers referred to in the previous section focused on market signals with respect to individual FI's distress.

Evidence presented by Berger, Davies and Flannery (2000) leads to more ambiguous conclusions with respect to the ability of supervisors to assess developments and risk ahead of market participants. These authors conclude that market prices usually lead supervisors' access to information except after on site bank examinations.

There are reasons to suspect that the pessimistic view of the timeliness of market signals relative to supervisors' access to information may be exaggerated even if one has a pessimistic view of the value of market signals as early warning indicators. This is because the record of regulation is also not strong. Supervisors and regulators certainly did not act with more foresight than markets in the initial stages of the recent crisis. The failure of supervisors in the Northern Rock case is well-known and described by Hamalainen, Pop and Howcroft (2008). Only a few weeks before the collapse of Northern Rock the UK FSA gave the mortgage bank permission to lower its required capital by nearly 30 percent by adopting the "Advanced Internal Measurement Approach" under Basel II. At the same time a simple leverage ratio indicated that the bank's capital had already declined substantially. There are similar examples in the US.

Another weakness of the "Turner review's" conclusions is that they do not take into account that perceptions of strong protection of creditors of large FIs, in combination with absence of warning signals from supervisors on both sides of the Atlantic, may have contributed both to lax risk management practices and a relaxed attitude of investors to risk of FIs distress. It is possible that a financial system with less implicit protection could provide more effective early warning signals. We return to this issue in Section 6 where we argue that a fuller analysis of timeliness of information in market signals and regulatory implications must take into account that much information is costly for both market participants and supervisors.

Ratings agencies also failed to provide early warnings of the impending crisis in 2007. There is a literature on the timeliness of market signals relative to ratings changes for FIs. For example, Distinguin, Rous and Tarazi (2006) analyze whether banks' stock returns reflect information about bank risk by asking whether the returns contribute to predictions of distress for individual banks in Europe. Distress is defined as a two-step decline in ratings within a year. They find weak predictive ability of stock returns with respect to ratings declines when controlling for a number of observable factors. But neither the market nor the ratings agencies have a strong record.

The literature discussed in the previous section on the responsiveness of subordinated yield spreads has bearing on timeliness as well. The empirical articles include both time series and cross-section analysis. Results in the time dimension indicate that changes in factors influencing perceptions of risk trigger adjustment in yields. On these grounds Calomiris (1999), Flannery (1998), Evanoff and Wall (2001), Evanoff, Jagtiani and Nakata (2007) and others have recommended that yields spreads should be used as an informative tool by supervisors. Thereby, the financial instruments would provide indirect market discipline.

Many countries financial supervisors employ a variety of market and non-market signals to assess the health of banks including debt ratings, stock prices, estimated default frequencies (see below), market capitalization, asset volatility, subordinated debt yield spreads and analysts' opinions to complement information obtained from banks as noted by Furlog and Williams (2006).

There is a growing literature after the financial crisis on the timeliness of different market signals with respect to increasing insolvency risk of FIs. Stock returns are generally viewed as an inferior predictor of distress relative to debt instruments for non-financial corporations because

limited liability of shareholders weaken the price effect of increasing insolvency risk and the incentives of shareholders to monitor this risk. Debt holders, on the other hand, have strong incentives to monitor insolvency risk since they must bear the losses once there is no equity capital. The price sensitivity of debt instrument to insolvency risk would depend on the instrument's priority in insolvency. Subordinated debt yields are expected to be the first to indicate increasing insolvency risk since holders of this debt are the first to bear losses once equity capital is lost. However, we show below that this expected relationship did not hold up strongly in the recent crisis.

In the financial industry debt instruments may be less sensitive to insolvency risk than in other industries as a result of implicit creditor protection. In particular, creditors of large and complex banks, including holders of subordinated debt, enjoyed a degree of "too big to fail" protection already before the crisis. The relative informativeness of equity prices and yields for FIs' debt instrument is therefore an open question.

Implicit protection affects the information value of Credit Default Swap (CDS) spreads as well. CDS spreads have become a common tool for analysis of insolvency risk since the spread interpreted as a put option premium is a direct implicit measure of insolvency risk. The downside of the CDS spread as a measure of risk is that liquid markets for this instrument exist only for relatively few large FIs.

The implicit estimates of insolvency risk in CDS spreads are derived from standard option pricing models under the assumption of risk-neutrality with respect to pricing. Other measures of insolvency risk like Moody KMV's Expected Default Frequency (EDF) based on equity price volatility, equity price and leverage do not depend on the risk-neutrality assumption. On these grounds Singh and Youssef (2010) view the ratio of the CDS spread to the EDF signal

for an FI as the “price of risk” for this FI. They analyze how this “price of risk” for several FIs developed before and during the crisis.<sup>9</sup> They argue that during crisis periods measures of probability of default should be adjusted for increased “price of risk.” For this reason CDS spreads may be biased proxies for insolvency risk during crisis periods. Both CDS spreads and EDF signals are sensitive to assumptions about Loss Given Default (LGD).

Implicit estimates of probability of default in the debt market, besides CDS spreads, can be obtained from subordinated debt yields (SND). These yields like other debt instrument yields have a disadvantage relative to CDS spreads in that they reflect interest rate risk as well as insolvency risk. This means that an assumption must be made about interest rate risk in order to derive an implicit measure of insolvency risk. Equity based measures besides EDF are distance to default (DD) and implicit estimates based on option prices for equity of FIs. Use of the latter is of course constrained by the existence of a liquid market for a particular stock. DD estimates require only equity prices, volatility and leverage information which means that they can be obtained for all FI’s with traded equity. The information value with respect to probability of default can be reduced by “contamination” of a multitude of risk sources affecting equity prices with different implications for insolvency risk. Some sources of risk may have substantial effects on volatility but little impact on probability of default.

We turn now to empirical evidence about the relative timeliness and early warning properties of different market signals. Jagtiani and Lemieux (2001) examine the bond pricing behavior of bank holding companies in the period prior to failure of their bank subsidiaries during the sample period of 1980-1995, and conclude that debt holders can effectively monitor their banks in their sample. Lack of bond data at the time of the study limited the sample to 5

---

<sup>9</sup> Singh and Youssef also consider how different assumptions about time varying loss given default (LGD) affect the implicit price of risk.

failed banks. For these banks the authors find that bond spreads rose as early as six quarters prior to failure although spreads did not always change much.

Gropp, Vesala and Vulpes (2006) estimate DDs and implicit measures based on SND spreads for European banks well in advance of bank failures during the period of 1991-2001. They conclude that SDN spreads have information value only close to a bank's distress while DDs reveal insolvency risk six to 18 months in advance. Thus, the two measures may reflect different information. The authors also find evidence that the implicit safety net weakens the predictive power of SND spreads. Both measures improve predictions based on accounting information alone.

Stephanou (2010) looks at the performance of equity, debt, and 5-year CDS for three U.S. banks (Citigroup, Bear Stearns, Lehman Brothers) from 2006 to January 2009, and compares them with a market benchmark financial instrument capturing broader market wide movements. The analysis indicates that the decline in prices of some bank instruments differentiated the three troubled financial institutions from the market benchmarks only a few months in advance of events defined as revelation of large losses in the financial system.<sup>10</sup> The first instruments to reveal bank specific insolvency risk information were equity prices and CDS spreads while SND and senior bond yields responded more slowly and weaker.

Hamalainen et al (2008) use the UK mortgage bank Northern Rock's failure in September 2007 to compare the information in four measures of insolvency risk: DD, implied volatilities from equity option markets, CDS spreads and SND yields. They also analyze developments of equity prices, volume and volatility. The results conform with those in Gropp, Vesala and Vulpes (2006) in that equity based indicators including DD and options on equity

---

<sup>10</sup> The events were revelation of losses and capital injections in Citibank in November 2008 and February 2009, Bear-Sterns merger in March 2008 and Lehman Brothers failure in September 2008.

reveal impending distress before debt instrument based indicators. The first indications of trouble appear in February 2007 but Northern Rock cannot be distinguished from eight other UK FI's until June 2007, three months before emergency lending was provided by the Bank of England. CDS spreads showed signs of impending distress in June 2007 followed by SND a month later when markets essentially shut down.

The evidence presented reveal that bank specific indicators did not reveal information about impending distress until about three to six months ahead of failure or government intervention during the recent financial crisis. In all cases the timeliness of equity based measures of insolvency risk was superior to debt based measures including CDS spreads. Evidence from the 1990s and the early 2000s shows better timeliness of insolvency risk indicators with lead times up to 18 months. One explanation could be that investors during the recent systemic crisis could not identify which banks were subject to the most stress until very late. In fact, bank managers seem to have had little knowledge about their banks' exposure until large losses were realized. Citibank is a case in point. The CEO, Vikram Pandit, who took over in December 2007 revised loss estimates repeatedly in spite of attempts to reveal relatively pessimistic information after having taken over the helm of the bank.

Any evaluation of timeliness depends on the time needed by managers or supervisors to take effective countermeasure when distress or crisis is approaching. Hart and Zingales (2009, 2010) propose a trigger rule to issue equity capital based on CDS spreads. They show that if their rule had been applied to Bear Stearns, the investment bank would have had to raise equity in August 2007, eight months before it was rescued by J.P. Morgan. The authors argue that their trigger rule would have forced a number of US FIs to raise equity up to 12 months before distress occurred. This does not mean that the crisis necessarily would have been averted. The lack of

differentiation of insolvency risk measures across FIs imply that the trigger most likely would have forced many FIs to raise equity at the same time in a market with little willingness to invest in FIs.

In the next section we present further evidence with respect to the early warning properties of CDS spreads and equity prices during the period 2007-2009. In relation to the studies reviewed above we expand the data set to include European and Japanese banks. We also include data for a recently developed early warning measure geared towards providing a signal for the contribution of individual FIs to systemic risk. This measure, the Marginal Expected Shortfall (MES), represents the expected loss an equity investor in an FI would suffer if the overall market declined substantially. Its function is to provide investors and supervisors with information about which FI's deserve particular scrutiny from a systemic perspective.

The MES is described in Brownlee and Engle (2010). It is an equity market based signal and it depends on the volatility of an FI's equity price, the correlation with the market return, and the co-movement of the tails of the distributions. Thus, it is designed to capture special characteristics of the tails of distributions associated with systemic shocks.

MES has been developed by a group of researchers at the Stern School of Business at New York University. There is a website where the MES of the 102 FIs is updated and analyzed on a weekly basis.<sup>11</sup> Relative to the previously mentioned indicators, the MES is expected to provide a signal ahead of the CDS spread since it is equity based, and it takes into account tail characteristics of distributions, the correlations with market returns, and the relative size of an FI.

## **5. Evidence of market prices as a early warning signals of the financial crisis of 2007-2009**

---

<sup>11</sup> <http://vlab.stern.nyu.edu/analysis/RISK>

In this section we add to the evidence presented in the previous section about the timeliness of market signals during the recent crisis. The analysis is similar to Hamalainen, Pop and Howcroft (2008) and Stephanou (2010) but we include data for a larger number of large financial institutions in United States as well as in Europe and Japan, and we include data for the Marginal Expected Shortfall for a few FIs in addition to data for CDS (credit default swaps) spreads, SND (subordinated debt) yields and equity prices. We ask whether the market signals for individual distressed FIs relative to a composite signal for a peer group helped identify the downside risks ahead of events defined by the failure or bailout of the individual FIs.

Data for three financial instruments—stock price index, CDS spreads and SND yields—were collected for 19 FIs in the United States, 20 FIs in the EU and 7 in Japan. Table 1 shows that these FIs include commercial banks, investment banking firms, and insurance companies. In order to be included in our sample, an FI must have both stock prices and CDS data available.<sup>12</sup> A list for European and Japanese financial institutions is largely drawn from Ohno (2010).

#### TABLE 1 Here

Before looking at the data for market signals Figure 1 presents the timing of warning signs in the US housing markets from 2003. As shown in Figure 1-1a, the annual growth rate of home prices increased at a declining rate after January, 2006. The first month with declining home prices was January 2007. Figure 1-1b shows that both new and existing home sales started to fall after they had record-high sales in late 2005. About the same time, subprime home mortgage originations started to decline, after increasing dramatically earlier in the decade. The prime home mortgage originations, on the other hand, did not fall until the third quarter of 2007

---

<sup>12</sup> Sometimes CDS data is for a bank and stock prices for bank holding companies. One example: Nomura Securities & Nomura holdings.

(Figures 1-1c and 1-1d).<sup>13</sup> The summer of 2007 is widely acknowledged as a starting point of the U.S. subprime mortgage crisis. However, some housing indicators had shown market weakness as early as in the beginning of 2006.<sup>14</sup>

FIGURE 1 here

Figures 2 and 3 present the development of equity prices, CDS spreads and SND yields from January 2006 through 2008 for Bear Stearns, Lehman Brothers, Bank of America and Citigroup in comparison with developments for a peer group. Bail out and failure events are marked in the figures. These events are listed in Table 2.

TABLE 2 here

Figure 4 presents the MES for Bank of America and Citigroup relative to the average MES for 102 US FIs for the same period and events. AIG is compared to a peer group in Figure 5. In Figure 6 the EU and Japan are brought into the picture. Stock price indices for the EU, Japan and the US are compared around the events. The list of the US, EU and Japanese FIs included in the peer groups and the composite indices is shown in Table 1 above.

The dotted lines in Figures 2-6 indicate the key institution-specific events listed in Table 2. Examination of the figures describing the developments of equity prices, CDS spreads, SND yields and MES data generates several observations.

1. Stock prices and CDS spreads performed in a similar way. Generally they provided forewarning of risks of these institutions relative to the peer group only a few months prior to the events. Subordinated debt spreads reacted at a slower rate, and remain relatively flat until the intervention occurred. According to evidence for Northern Rock presented in the previous section the SND yield for Northern Rock seems to have reacted

---

<sup>13</sup> See Barth et al (2010) for comprehensive analyses of the buildup and meltdown of the U.S. mortgage markets.

<sup>14</sup> For discussion of the early identification of the looming crisis by some hedge funds see Lewis (2010)

more clearly relative to its peer group but more slowly than the other signals (Hamalainen et al, 2008).

These observations are consistent with those reported in the previous section except that we cannot clearly distinguish between the timeliness of equity prices and CDS spreads. The reviewed literature found that equity based prices generally reflected increased insolvency risk ahead of CDS spreads. A more refined analysis using statistical criteria for early warning signals may lead to a differentiation between the two instruments.

2. MES for Citigroup and Bank of America in Figure 4 seems to provide early warnings for insolvency risk of these two FIs well ahead of the other instruments. In particular, the MES of the two banks seem to diverge substantially from the average about four months ahead of the event BA 2/C 2 (10/28 2008 when TARP funds were first allocated to Citigroup and Bank of America) while the divergence for equity prices and CDS spreads seems to occur only about two months in advance. MES depends on equity price volatility like the DD, EDF and equity option based indicators discussed above. The relatively early warning of MES is consistent with the evidence presented in the previous section with respect to indicators depending on equity price volatility.
3. There is volatility in the different indicators of insolvency risk of individual FIs relative to the peer group. The indicators sometimes diverge for a brief period before they converge again. Thus, it is possible that specific trigger points for divergence of indicators relative to the peer group were reached well in advance of the final divergence before an event. This observation may explain why Hart and Zingales (2010) find that early warning signals provided information that could have been used by banks to

strengthen their capital base around six months in advance. An in depth analysis of the value of the indicators should consider both Type I and Type 2 errors.

4. The markets signals largely failed to indicate increased insolvency risk of Bear Stearns, the first of the FIs encountering distress in Figure 2. The markets were moderately successful in indicating the risks of Bank of America and Citigroup as well as AIG in Figures 3 and 5. It seems likely that Bear Stearns sensitized market participants to insolvency risk.
5. Markets seem to punish individual FIs harshly after their risks become apparent. The stock price abruptly falls and the spread of CDS and subordinated debts yields widen relative to peers.
6. Observation of developments in the EU and Japan in Figure 6 shows that stock prices reacted the same way in all three regions, but CDS spreads diverged more although they moved in the same direction. The pattern for equity prices implies that the international linkages among FIs in the three regions were strong. The weaker reactions in CDS spreads in the EU and Japan to US events indicate that perceptions of insolvency risk diverged much more than the risk facing shareholders.
7. None of the market indicators aggregated over FIs revealed a serious systemic crisis approaching until early 2008. The stock market index, the average CDS spread, and the average MES revealed some negative information in July 2007 but they all recovered again before the trend-wise increase in risk began in 2008.

FIGURES 2-6 here

In summary, there is little doubt that while market signals provided some information they did not provide timely early warning about impending distress of FIs during the pre-crisis year 2007 and the crisis years 2008 and 2009. The empirical evidence reviewed in previous sections indicates that early warnings from the market were more effective during the decades prior to the crisis. The fact that early warning signals failed prior to the recent crisis may help explain why the crisis became so severe.

## **6. Market discipline with respect to informativeness with costly information.**

An important property of effective market discipline is informational efficiency of financial markets. As noted in Section 4 in the discussion of timeliness of information the question asked in most finance literature is whether “available information” is fully reflected in prices. Available information is an ambiguous concept, however, and it should not be considered exogenous in an analysis of whether financial markets perform efficiently if information acquisition, analysis of information, and information provision are costly. In this case a key function of financial market is to provide incentives to acquire, analyse and disperse information as noted in Wihlborg (1990). In this section we discuss the how informational efficiency depends on informational incentives in financial markets. Financial regulation is likely to affect these incentives and, therefore, the information reflected in market prices. We discuss implications for financial market regulation of considering information to be costly and endogenous in Section 7.

Grossman and Stiglitz (1982) demonstrate that informationally efficient markets cannot exist if information is costly. If all information is reflected in prices there is no incentive to acquire costly information and if information is not acquired it cannot be reflected in prices

unless information is freely available to insiders. They show that equilibrium prices with costly information will only partially reflect the costly information. The degree to which the costly information is reflected depends on the cost of acquiring it. The information revelation to the uninformed remains imperfect and possibly incorrect as a result of confusion about different types of shocks that may cause price changes. There is some free-riding on the information acquired at a cost as a result of partial informativeness of prices. In financial markets the degree of free-riding would depend on the market micro structure.

There is little doubt that most information in the market place is costly, if not to acquire then to interpret and put to use. Michael Lewis (2010) demonstrates in his book *The Big Short; Inside the Doomsday Machine* that a few investors had sufficient information well in advance of the crisis about the risks associated with subprime mortgages. They were able to predict large scale failures and an impending crash in the value of mortgage backed securities years in advance. They also dared to invest based on their forecast. The investor stories also reveal that much research time was devoted to reading of prospectus for mortgage backed securities. Much relevant information seems to have been available but only a few investors had the time, patience and resources to go deeply into the information contained in these inaccessible documents. As a result, the investors going short hardly made a dent in the valuation of securities until large scale failures of subprime mortgages became a reality. Other investors as well as supervisors seem to have remained under the illusion that real estate prices in the US could not decline. Market prices and yields on securities issued by FIs and supervisors' (non-) actions reflected this view.

Information about the overvaluation of mortgage backed securities prior to the crisis was evidently available to the few investors able to invest resources in research and analysis but

prices did not reflect this information. Is this evidence of financial market inefficiency and, if so, what is the appropriate regulatory response?

In the words of Llewellyn and Mayes (2003) efficiency with respect to yields on securities issued by FIs requires that there must exist monitors of FI's with sufficient incentives to become informed and to analyze this information. Even if financial markets are "well-functioning" in terms of trading costs, opportunities and liquidity, the market for information used in pricing of securities may not function well. Monitoring is costly and if these costs are very high, a large number of potential investors will remain uninformed about sources of disturbances and risk-taking.

There is no unambiguous definition of what level and quality of information is required for financial markets to be called well-functioning from an informational point of view. Demand as well as supply of information must be considered. Demand based on incentives to become informed is influenced, for example, by the existence of explicit and implicit protection of creditors of FIs. Supply based on incentives to make relevant information available to investors exists if an FI can reduce its cost of capital by revealing positive information affecting, for example, insolvency risk by means of disclosure and signaling. Such information revelation by high quality FIs would also reveal that others are low quality FIs<sup>15</sup>.

We noted above that the availability of information in the markets for mortgage backed securities was limited to a few individuals in the run-up to the crisis. Similarly, it is clear from the data presented in the previous section that the available information about insolvency risk of major FIs was poor during the crisis. The available information would depend on a combination of demand and supply factors. It is important for policy to determine the weight of demand and

---

<sup>15</sup> After the first round of signaling quality the relatively high quality among those, who did not reveal information to begin with, have incentives to reveal information. The process continues until all FIs have revealed information.

supply factors in explaining the dearth of information about insolvency risk of FIs. We return to this issue below and its regulatory implications.

If there are incentives to become informed or to provide information there is scope for “information intermediaries” to develop to exploit economies of scale in the acquisition and analysis of information. Ratings agencies can be viewed as such intermediaries charging the firm interested in supplying information by means of being rated. Their existence is evidence of demand as well as supply of information. Unfortunately, however, ratings agencies did not do a good job of providing correct and timely information to market participants.

Much economic analysis of regulation is based on the assumption that information is costless in well functioning markets. An implication of this view is that there is a case for public policy action as soon as markets are not informationally efficient. However, if information is costly the relevant question is how the best information can be made available for decision makers at the lowest possible costs. Regulatory intervention can be justified if it can achieve a better resource allocation at a certain cost of information or a certain resource allocation at a lower cost of information.

The benefit in terms of information of decentralized markets is that widely dispersed information and a variety of interpretations of information can be reflected in market prices that provide incentives for resource allocation. Trading in financial markets, in particular, is based on differences in information or in interpretations of existing information. The markets provide incentives for a variety of participants to become informed and put information to use in order to make profits. Financial decision making by a centralized entity, on the other hand, may achieve some economies of scale in information gathering and analysis but the range of available information will be limited.

In spite of the inevitable duplication of information costs occurring in decentralized markets we assume in the following that informational efficiency depends on the demand side primarily on the number and variety of individuals engaged in acquisition and analysis of information. In other words, pluralism is an important source of informational efficiency in decentralized financial markets. On the supply side informational efficiency would depend on the perceived costs and benefits for firm subject to market valuation to disclose and signal relevant information honestly. If the incentives for all firms to remain opaque and to actually mislead even when demand for information is strong, the case for government intervention is strong as well. Such government intervention could be regulatory constraints on risk-taking and examination of FIs' asset allocation by supervisors. Of course, one should also consider the political economy incentives that may lead to government failure.

#### 7. "Informativeness principles" for government policy

The view of financial markets as instruments for creating incentives to acquire, analyze, disclose and signal information at a cost has implications for regulation and supervision of financial markets and institutions, as well as for policy intervention in crisis situations. We offer the following four general "informativeness principles" for regulation, supervision and government intervention in financial markets:

1. Regulation, supervision and intervention in financial markets should minimize disincentives for private market participants to acquire and analyze information, recognizing that a central agency cannot substitute for a multitude of agents to determine what information is relevant for evaluation of a securities and default risk.

2. Regulation, supervision and intervention should minimize disincentives for issuers of securities to provide and signal information about characteristics of the securities.
3. Regulation, supervision and intervention should aim at reducing information costs. Some kinds of information may be gathered by a government agency for purposes of supervision or to be made available to market participants. Such activities should not reduce incentives of private market participants to acquire other kinds of information.
4. Regulators and supervisors should help identify market failures affecting particular types of information. In case there are such failures disclosure rules may be implemented. It is necessary to recognize that forced disclosure carries with it incentives to obfuscate.

As stated, these principles are very general and they are not easily operationalized. We view efforts to do so an important direction for further analysis. Here, we will conclude by trying to provide illustrations of the principles in operation with respect to FIs. Thereby, we also illustrate how current regulatory practices may have contributed to failures of market discipline with respect to availability of information as documented in previous sections.

The first “informativeness principle” applies directly to explicit and implicit protection of depositors and other creditors of FIs. Such protection reduces the value of information about insolvency risk of FIs.

Externalities associated with insolvency of an FI can justify a degree of protection of depositors in particular, but if externalities can be addressed in other ways, implicit and explicit protection could be reduced. For example, specific insolvency law for FIs enabling them to be closed down with a minimum of systemic repercussions would reduce implicit protection by reducing the need for bailouts in crisis situations. We return to this issue below.

The empirical evidence presented in previous sections indicates quite clearly that protection of FIs' creditors reduces the information values of prices on debt-based financial instruments. Furthermore, the implicit protection of "too big too fail" FIs implies that the informational efficiency of markets for these systemically important FIs is particularly low.

Implicit protection of FI's creditors is relevant for the second "informativeness principle" as well, since governments are most likely to bail out large financial institutions with complex interconnections with other FIs. The perceived bail out bias in favor of large complex FIs implies that they obtain reduced costs of funding. Thus, the incentives to become large, complex and opaque seem to be strong. They have been strengthened further during the crisis.

In the early days of the crisis liquidity in interbank markets and short term markets for financing of FIs dried up. A major cause of this generalized seizing up of the liquidity in the markets was widespread uncertainty about who had bad debt and how much. An informationally efficient market would have induced solvent FIs to signal and provide information about their quality. This would have allowed market participants to distinguish between solvent and distressed FIs. Thereby, the liquidity crunch would have become less severe for FIs with less default risk.

Why did financial markets fail in their informational role to provide incentives to reveal and signal relevant information about FIs? The role of implicit protection through expected bail-outs has been mentioned. Although most bank managers would most likely try to avoid being bailed out, they would be hard-pressed in times of crisis to say No to offers of aid available to competitors. Managers revealing positive information about probability of insolvency face the risk that they disqualify their FIs from aid. The Troubled Asset Relief Program (TARP) and other programs outside the US, included promises to make funds available to any FI in need.

Such programs are likely to have discouraged revelation of positive information about the financial health of FIs.

The design of Lender of Last Resort (LOLR) facilities in Central Banks can also discourage information release of a positive nature if access to cheap LOLR funding is made conditional on the FI's financial health. Unlike TARP, the Federal Reserve cannot be strongly criticized on these grounds, however, since its lending facilities during the crisis were linked to specific types of assets rather than to the financial health of the FI.<sup>16</sup>

Another explanation for the lack of information of relevance for judging FI's insolvency risk is that top management in large FIs simply did not know their exposures as a result of the complexity of domestic and international interconnections as well as failures of internal risk management controls in a number of cases. Frequent updating of, for example, Citibank's loss estimates indicates lack of internal knowledge of this kind. One must ask how a bank can operate with inability to quickly grasp its own exposures and potential losses? A reasonable explanation is that such knowledge does not have much value. If market participants do not penalize the bank for lack of information about risk and opaqueness, and the government is expected to bail out the bank if losses materialize the efforts of bank management can be devoted towards other activities than information disclosure and signaling.

One aspect of proposals for "living wills" is that they would force management to more or less continuously update exposure and interconnectedness information. However, one may question how well "living wills" will achieve this objective if incentives to provide this information are weak. We return to this issue below in connection with the fourth "informativeness principle."

---

<sup>16</sup> In hindsight the Federal Reserve has been criticised for low cost lending to relatively healthy FIs although from an informational efficiency point of view the Federal Reserve's lending policies were sound.

The third “informativeness principle” refers to reducing costs of information. As mentioned there are economies of scale in the collection of information. Thus, a central agency responsible for gathering and publishing certain kinds of information would economize on information costs. As noted, ratings agencies already perform this function although incentives of these agencies to disclose negative information have come under scrutiny.

A government agency responsible for information disclosure must be concerned that its information release does not reduce incentives of private market participants to gather additional relevant information. The centralized information gathering should therefore be restricted to uncontroversially relevant information that cannot be subject to widely different interpretations. It is possible that forecasting of some macroeconomic variables represents information of this nature.

The Basel rules for calculation of regulatory capital can be used to illustrate the dangers of centralization of rules for assessing risk. Basel II specifies in its standardized approach how risk weights should be allocated to different types of assets. The Internal Ratings Approach allows banks to use internal models for assessment of risk weights. Since the models must be approved by supervisors it is inevitable that internal models also become highly standardized. Furthermore, Basel II is complex and resource consuming to implement.

One possible consequence of Basel II is that risk assessment becomes oriented towards satisfying the regulatory requirements. Since this activity is resource consuming the capacity to develop independent economically valid risk assessment declines. Incentives to develop credit evaluation models become geared towards satisfying the supervisor. As a result diversity in risk assessment declines. Markets generally are more robust when a number of different views are present. If the risk assessment implied by Basel II is not economically valid the bank is

nevertheless hedged to some extent by having lived up to the supervisor's expectations. Thereby, the likelihood of being bailed out increases since large losses are no longer the fault of the bank alone.

Moral hazard created by explicit and implicit protection implies that intellectual power within the bank will be devoted to manipulating risk assessment for the purpose of reducing capital requirements rather than for the purpose of developing improved risk assessment. The incentive to reveal useful exposure information to market participants is not likely to be high under these circumstances. The most that will be revealed is what conforms to the information developed to satisfy the supervisor.

The fourth informativeness principle refers to market failure with respect to information acquisition and release. As noted regulation may be a source of market failure but there are no doubt other sources as well. For example, the conflict of interest facing ratings agencies, which are paid by borrowers, is often mentioned as an explanation for the poor performance with respect to ratings of mortgage backed securities prior to the crisis.

The large number of layers of actors in a financial system characterized by trading in risk through securities markets relative to a bank dominated financial system increases the number of potential agency conflicts that may have to be monitored from the point of view of information revelation or obfuscation.

Explicit and implicit guarantees have already been mentioned as sources of market failure with respect to both information acquisition and revelation. Information disclosure rules are often viewed as an antidote to information market failure but if incentives to obtain, and to release and signal information are not present, disclosure may not be very effective. A particular type of information can be packaged along with other kinds of information in such a way that the

information value becomes very low. A case in point is the prospectus that must accompany issues of securities in the US in particular. These are often so long, complicated and overloaded with information that few readers are able to absorb the relevant information.

The strongest case for government involvement in the information process arises as a result of the potential systemic consequences of an FI's distress. The different channels of contagion in financial markets can be considered externalities. The individual FI has little incentive to provide information to the public about all its interconnections that could be channels of contagion. These interconnections are particularly important in case of distress of an FI. Without information about them an orderly closing of a large FI by a court or administrator without causing systemic effects is impossible. US bank insolvency procedures include the forming of a "bridge bank" to keep critical operations going, and "haircuts" for various non-insured creditors. These procedures have been implemented by the FDIC for many banks except the very large ones. Bailouts of large banks' creditors seem to be considered necessary because the information required to identify creditors, which would take a haircut before a bridge bank could be reopened quickly, is lacking. The administrator's or the court's access to the living will information mentioned above could help resolve this problem.

FIs may have incentives to obfuscate the information required by the supervisor in order to have it available in case an FI fails. Market discipline on the provision of this kind of information would seem to be ineffective since it would not be made publicly available. Investors with claims on FIs have a stake in the quality of the information, however. Therefore, market discipline could be utilized by supervisors to create incentives for FIs to provide relevant information if supervisors would publicize their assessment of the information they obtain.

## **8. Concluding comments on market discipline and informativeness**

It is not a controversial statement that market discipline on major financial institutions in the US and Europe failed in the run up to the 2007-2009 financial crisis, and contributed to the depth of the crisis. A much harder question is why market discipline failed and what legal and regulatory reforms could improve market discipline in the future? Alternatively, policy makers may give up on market discipline and approach the financial sector by creating a much more interventionist regulatory structure.

We have reviewed literature on market discipline for financial institutions distinguishing between market discipline on risk-taking and discipline in the sense of timely information being revealed in yields on securities such as equity and debt issued by the financial institutions. There is little doubt that market discipline failed to restrain excessive risk-taking and did not reveal relevant information about insolvency risk of individual financial institutions as well as of systemic risk. Information was out there in the run-up to the crisis about factors influencing the values of mortgage backed securities and financial institutions holding them. Nevertheless, the stock markets tended to reward those financial institutions which turned out to be taking greater risks. This is essentially the logic underlying Charles Prince's infamous comment that as long as the music was still playing the banks needed to keep dancing.

In order to understand the sources of the failure of market discipline we take the view that a major role of financial markets is to provide incentives for investors to acquire costly information and for issuers of securities to disclose and signal relevant information. Both types of information production are costly and they affect the informativeness of securities prices with respect to risk-taking and factors influencing values.

The most important market failure of informativeness in our view is that major financial institutions seem to have had incentives to remain opaque and not to disclose information that would have helped investors assess the solvency of financial institutions. The puzzle is to determine why markets do not seem to provide sufficient incentives for high quality institutions to reveal information that enable investors to identify their quality, why financial institutions issued opaque securities that required enormous investments of time and knowledge to evaluate, and why investors bought them.

Viewing financial markets as sources of incentives to produce information we identified factors that may have created the failure of informativeness. Explicit and implicit protection of creditors are clearly such factors. Furthermore, incentives for creating opaqueness are strengthened in times of systemic stress by the policy measures implemented to dampen the consequences of failures of financial institutions, as well as by the regulatory framework for capital adequacy. For example, the financial institution disclosing low risk might not obtain the same kinds of subsidies that distressed financial institutions receive. The capital adequacy framework commits resources of financial institutions to formally satisfy the supervisory principles for risk evaluation while at the same time taking risks that produce higher returns. Resources are drained from more effective economic risk evaluation and, as a result the main objective of information revelation becomes to demonstrate abidance by the regulation.

In the last section we laid out four “informativeness principles” for regulators, supervisors and government intervention in financial markets. These principles aim at creating incentives for information production and acquisition in order to improve market discipline. Disclosure rules without incentives to acquire, analyze, disclose and signal relevant information are likely to produce information that is nearly impossible to comprehend. Thus, financial

markets will not be efficient in the sense prices reflect the information that can be made available at a cost.

## References

- Anderson, Ronald C. and Donald R. Fraser (2000) "Corporate Control, Bank Risk Taking, and the Health of the Banking Industry", *Journal of Banking and Finance*, 24, 1383-1398.
- Angkinand, Apanard P. and Clas Wihlborg (2010) "Deposit Insurance Coverage, Ownership, and Banks' Risk-taking in Emerging Markets", *Journal of International Money and Finance*, V. 29, 254-274
- Barth, James R., Gerard Caprio Jr., and Ross Levine (2004). "The Regulation and Supervision: What Works Best?", *Journal of Financial Intermediation*, 13, 205-248.
- Barth, James R., Gerard Caprio Jr., and Ross Levine (2006), *Rethinking Bank Regulation; Till Angels Govern*, Cambridge University Press.
- Barth, James, Tong Li, Wenling Lu, Triphon Phumiwasana, and Glenn Yago (2010) *The Rise and Fall of the U.S. Mortgage and Credit Market*. New Jersey: John Wiley & Son, Inc.
- Benink, Harald A. and Clas Wihlborg (2002) "The New Basel Capital Accord: Making it Effective with Stronger Market Discipline." *European Financial Management*, 8, 103-115.
- Berger, Allen N., George R. G. Clarke, Robert Cull, Leora F. Klapper, and Gregory F. Udell (2005). "Corporate Governance and Bank Performance: A Joint Analysis of the Static, Selection, and Dynamic Effects of Domestic, Foreign, and State Ownership." *Journal of Banking & Finance*, 29, 2179-2221.
- Berger, Allen N., Sally M. Davies and Mark J. Flannery (2000), "Comparing Market and Supervisory Assessments of Bank Performance: Who Knows What and When?" *Journal of Money, Credit and Banking* 32, 641-667.
- Bhattacharya, Sudipto, and Anjan V. Thakor (1993). "Contemporary Banking Theory." *Journal of Financial Intermediation*, 3; 2-50.
- Brownlee, Christian T. and Robert Engle (2010), "Volatility, Correlation and Systematic Risk Measurement", Department of Finance, Stern School of Business, New York University; available on <http://vlab.stern.nyu.edu/analysis/RISK>
- Brunnermeier, Markus, Andrew Crocket, Charles Goodhart, Martin Hellwig, Avinash D. Persaud and Hyun Shin (2009), "The Fundamentals Principles of Financial Regulation," Geneva Report on the World Economy 11

- Byström, Hans N.E. (2004) “The Market’s View on the Probability of Banking Sector Failure: Cross-Country Comparisons”, *International Financial Markets, Institutions, and Money* 14, 419-438.
- Calomiris, Charles (1999), “Building an Incentive Compatible Safety Net”, *Journal of Banking and Finance*, 23(10), 1499-1519.
- Caprio, Gerard, Luc Laeven, and Ross Levine (2007), “Ownership and bank valuation”, *Journal of Financial Intermediation*, 16, 584-617.
- Caprio, Gerard and Maria Soledad Martinez-Peria (2000), “Avoiding Disaster: Policies to Reduce the Risk of Banking Crises”, *Discussion Paper*, Cairo, Egypt: Egyptian Center for Economic Studies.
- Chen, Carl R., Thomas L. Steiner and Anne Marie Whyte (1998), “Risk-Taking Behavior and Management Ownership in Depository Institutions”, *Journal of Financial Services Research*, 21 (1), pp 1-16.
- Cho, David (2009), “Behemoths Born of the Bailout Reduce Consumer Choice, Tempt Corporate Moral Hazard”, *Washington Post*, Friday August 28
- Cihak, M, A. Maechler, K. Schaeck, and S. Stolz (2009) “Who Disciplines Bank Managers.” *IMF Working Paper* no. 272. International Monetary Fund.
- Claessens, Stijn, Asli Demirgüç-Kunt, and Harry Huizinga (2001). “How Does Foreign Entry Affect Domestic Banking Markets?”, *Journal of Banking and Finance*, 25(5), pp. 891–911.
- Cull, Robert, Lemma W. Senbet, and Marco Sörgé (2005). “Deposit Insurance and Financial Development”, *Journal of Money, Credit, and Banking*, 37(1), 43-82
- Demirgüç-Kunt, Asli and Enrica Detragiache (2002). “Does Deposit Insurance Increase Banking system Stability? An Empirical Investigation”, *Journal of Monetary Economics* 49, 1373-1406.
- Demirgüç-Kunt, Asli, Ross Levine, and Hong-Ghi Min (1998) “Opening to Foreign Banks: Stability, Efficiency and Growth”, in *The Implications of Globalization Financial Markets*, ed. by A. Meltzer (Korea: Bank of Korea).
- Diamond, Douglas W. and Philip H. Dybvig (1983). “Bank Runs, Deposit Insurance, and Liquidity”, *Journal of Political Economy*, 91(3); 401-419.
- Distinguin, Isabelle, Philippe Rous and Amine Tarazi (2006), “Market Discipline and the Use of Stock Market Data to Predict Financial Distress” *Journal of Financial Services Research*, 30, 151-176.
- Evanoff, Douglas and Lawrence Wall (2000), “Subordinated Debt and Bank capital Reform”, in Kaufman, George G. (ed), *Research in Financial Services: Private and Public Policy*, 12, pp 53-119.

- (2001), “Sub-Debt Yield Spreads as Bank Risk Measures”, *Journal of Financial Services Research*, 20(2/3), 121-145.
- Evanoff, Douglas D., Julapa Jagtiani and Taisuke Nakata (2007), “The Potential Role of Subordinated Debt Programs in Enhancing Market Discipline in Banking”, *Federal Reserve Bank of Kansas City Economic Research paper* 07-07.
- Federal Reserve Board (1999), *Using Subordinated Debt as an Instrument of Market Discipline*, Staff Study No 172, Washington D.C.
- Fernández, Ana and Francisco González (2005) “How accounting and auditing systems can counteract risk-shifting of safety-nets in banking: Some international evidence”, *Journal of Financial Stability*, 1(4), 466-500
- Financial Services Authority (FSA) (2009). The Turner Review: A regulatory response to the global banking crisis.
- Flannery, Mark J. (1998), “Using Market Information in Prudential Bank Supervision: A Review of the US Empirical Evidence”, *Journal of Money, Credit and Banking*, 39 (3), Part 1, pp 273-305.
- Flannery, Mark J. and Sorin M. Sorescu (1996), “Evidence of Bank Market Discipline in Subordinated Debenture Yields: 1983-1991”, *The Journal of Finance*, 52 (4), Sept., pp 1347-1377.
- Fulong, F. and Williams R. (2006), “Financial Market Signals and Banking Supervision: Are Current Practice Consistent with Research Findings?” *Federal Reserve Bank of San Francisco Economic Review*, 17-29.
- Gandh, Priyank and Hannes Lustig (2010), “Size Anomalies in US Bank Stock Returns; A Fiscal Explanation”, *NBER Working Paper No 16553*, National Bureau of Economic Research.
- Gonzales, Francisco (2005), “Bank Regulation and Risk-taking Incentives: An International Comparison of Bank Risk”, *Journal of Banking and Finance*, 29(5), May, 1153-84.
- Gropp, Reint and Jukka Vesala (2004), “Deposit Insurance, Moral Hazard and Market Monitoring”, *Review of Finance*, 8, 571-602.
- Gropp, R., J. Vesala, and G. Vulpes (2006) “Equity and Bond Market Signals as Leading Indicators of Bank Fragility.” *Journal of Money, Credit and Banking*, 28, 399-428.
- Grossman, Sanford J. and Joseph E. Stiglitz (1980), “On the Impossibility of Informationally Efficient Markets”, *American Economic Review*, 70 (3), pp 393-408
- Hamalainen, Paul, Adrian Pop, and Barry Howcroft (2008) “Did the Market Signal Impending Problems at Northern Rock? An Analysis of Four Financial Instruments” *Discussion Paper* 2008-11, Department of Economics, Loughborough University.

- Hart, Oliver and Luigi Zingales (2009), “A New Capital Regulation for Large Financial Institutions”, University of Chicago Booth Working Paper No 09-36.
- Hart, Oliver and Luigi Zingales (2010) “How to Improve the Financial-Reform Law: A Brief Proposal to Protect the System without Stifling Innovation.” *City Journal*, 23 November 2010.
- Hovakimian, A., Edward Kane, and Luc Laeven (2003), “How Country and Safety-Net Characteristics Affect Bank Risk Shifting”, *Journal of Financial Services Research*, 23(3), 177-204.
- Jagtiani, Julapa, George Kaufman, and Catharine Lemieux (2002), “The Effect of Credit Risk on Bank and Bank Holding Company Bond Yields: Evidence from the Post-FDICIA Period”, *Journal of Financial Services Research*, 25 (4), Dec., 559-575.
- Jagtiani, J. and Lemieux C. (2001) “Market Discipline Prior to Bank Failure”, *Journal of Economics and Business*, 53, 313-324.
- Kashyap, Anil K., Raghuram G. Rajan and Jeremy C. Stein (2008), “Rethinking Capital Regulation”, Paper prepared for Federal Reserve Bank of Kansas City symposium on “Maintaining Stability in a Changing Financial System”, Jackson Hole, Wyoming, August 21-23
- Konishi, Masaru and Yukihiro Yasuda (2004), “Factors Affecting Bank Risk-taking; Evidence from Japan”, *Journal of Banking and Finance*, 28 (1), pp 215-232
- La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert W. Vishny (1998). “Law and Finance”, *Journal of Political Economy*, 106(6), 1113-1155.
- Laeven, Luc and Ross Levine (2009) “Bank Governance, Regulation and Risk Taking” *Journal of Financial Economics*, 93, 259-275.
- Lensink, Robert and Niels Hermes (2004), “The Short-term Effects of Foreign Bank Entry on Domestic Bank Behavior. Does Economic Development Matter?” *Journal of Banking and Finance*, 28(3), 553-568.
- Levine, Ross (2004) “Denying Foreign Bank Entry: Implications for Bank Interest Margins” in *Banking Market Structure and Monetary Policy* by Luis Antonio Ahumada and J. Rodrigo Fuentes (eds), Santiago, Central Bank of Chile.
- Llewellyn, David T. and David G. Mayes (2003), “The Role of Market Discipline in Handling Problem Banks”, Bank of Finland Discussion Paper No 21, Helsinki
- Lewis, Michael (2010), *The Big Short; Inside The Domsday Machine*, W. W. Norton, New York Short,
- Levonian, M. (2000), “ Subordinated Debt and Quality of Market Discipline in Banking”, Paper, Federal Reserve Bank of San Francisco

- Nier, Erlend and Baumann, Ursel (2006). "Market Discipline, Disclosure and Moral Hazard in Banking", *Journal of Financial Intermediation*, 15, 332–361
- Ohno, Sanae (2010) "Liquidity Crunch and Interdependence Among Major Financial Institutions during Global Financial Turmoil: Evidence from Credit Default Swap Spread." Presented at the Asia-Pacific Economic Association Conference.
- Saunders, Anthony, Elizabeth Strock and Nickolaos G. Travlos (1990) "Ownership Structure, Deregulation and Bank Risk Taking." *The Journal of Finance*, Vol. XLV, No. 2, 643-654.
- Singh, Manmohan and Karim Youssef (2010) "Price of Risk - Recent Evidence from Large Financials." *IMF Working Paper* No. 10/190. International Monetary Fund.
- Sironi, A. (2003) "Testing for Market Discipline in the European Banking Industry: Evidence from Subordinated Debt Issues." *Journal of Money, Credit, and Banking*, 35, 443-472.
- Stephanou, Constantinos (2010) "Rethinking Market Discipline in Banking: Lessons from the Financial Crisis." *Policy Research Working Paper*, 5227. The World Bank.
- Wihlborg, Clas (1990), "The Incentive to Acquire Information and Financial Market Efficiency", *Journal of Economic Behavior and Organization*, 56, July.

Table 1: Sample coverage

Name	Country	Sector
Bank of America	United States	Banks
Citigroup	United States	Banks
JP Morgan Chase and Company	United States	Banks
United States Bancorp	United States	Banks
Wells Fargo and Company	United States	Banks
American Express	United States	Financial Services
Bear Stearns	United States	Financial Services
Capital One Financial	United States	Financial Services
Goldman Sachs Group	United States	Financial Services
Lehman Brothers Holdings	United States	Financial Services
Merrill Lynch and Company	United States	Financial Services
Morgan Stanley	United States	Financial Services
Aetna	United States	Health Care Equipment & Service
American International Group	United States	Nonlife Insurance
Berkshire Hathaway	United States	Nonlife Insurance
Cigna	United States	Health Care Equipment & Service
Hartford Financial Services Group	United States	Nonlife Insurance
MetLife	United States	Life Insurance
Prudential Financial	United States	Life Insurance
Barclays	United Kingdom	Banks
Banco Santander	Spain	Banks
Banco Comercial Portugues	Portugal	Banks
Banque Nationale de Paris Paribas	France	Banks
Credit Suisse Group	Switzerland	Banks
Credit Agricole	France	Banks
Commerzbank	Germany	Banks
Deutsche Bank	Germany	Banks
HSBC Holdings	United Kingdom	Banks
Lloyds Banking Group	United Kingdom	Banks
Royal Bank of Scotland Group	United Kingdom	Banks
Societe Generale	France	Banks
Standard Chartered	United Kingdom	Banks
United Bank of Switzerland 'R'	Switzerland	Banks
Northern Rock	United Kingdom	Banks
AXA	France	Life Insurance
Aegon	Netherlands	Life Insurance
Aviva	United Kingdom	Life Insurance
ING Group	Netherlands	Life Insurance
Prudential	United Kingdom	Life Insurance
Mitsubishi UFJ Financial Group	Japan	Banks
Mizuho Financial Group	Japan	Banks
Sumitomo Mitsui Financial Group	Japan	Banks
Daiwa Securities Group	Japan	Financial Services
Nomura Holdings	Japan	Financial Services
Sompo Japan Insurance (Frankfurt)	Japan	Nonlife Insurance
Tokio Marine Holdings	Japan	Nonlife Insurance

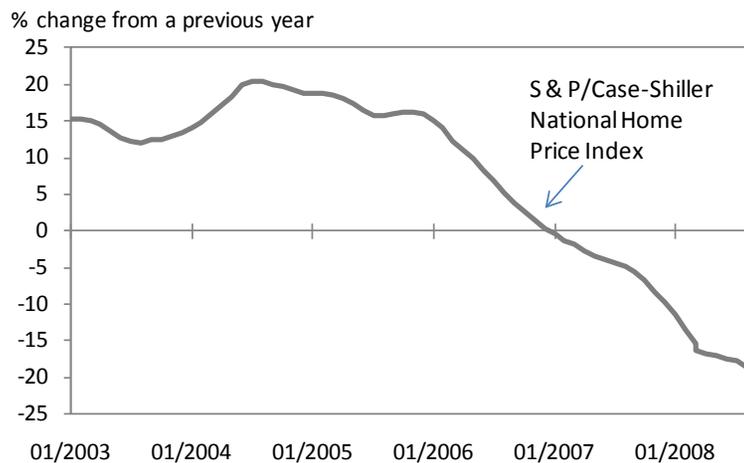
Table 2: Key events

<b>Bear Stearns</b>		
<b>BS-1</b>	6/7/2007	Bear Stearns informs investors that it is suspending redemptions from its High-Grade Structured Credit Strategies Enhanced Leverage Fund.
	7/31/2007	Bear Stearns liquidates two hedge funds that invested in various types of mortgage-backed securities.
<b>BS-2</b>	3/16/2008	JPMorgan Chase & Co. announces it is acquiring Bear Stearns for \$2 per share.
<b>Lehman Brothers</b>		
<b>LB-1</b>	9/15/2008	Lehman Brothers files for Chapter 11 bankruptcy protection.
<b>Northern Rock</b>		
<b>NR-1</b>	9/14/2007	The Chancellor of the Exchequer authorizes the Bank of England to provide liquidity support for Northern Rock, the United Kingdom's fifth-largest mortgage lender.
<b>NR-2</b>	2/17/2008	Northern Rock is taken into state ownership by the Treasury of the United Kingdom.
<b>Citigroup and Bank of America</b>		
<b>BA/C-1</b>	11/5/2007	Citigroup CEO Chuck Prince resigns after an announcement that Citigroup may have to write down up to \$11 billion in subprime bad debts.
	11/13/2007	Bank of America says it will have to write off \$3 billion of subprime debt.
	6/5/2008	The Federal Reserve Board announces approval of the notice of Bank of America to acquire Countrywide Financial Corporation in an all-stock transaction worth approximately \$4 billion.
<b>BA/C-2</b>	10/28/2008	TARP funds are initially allocated to Citigroup and Bank of America. Bank of America and Citigroup each receive \$25 billion. Bank of America receives the second allocation of \$20 billion on 1/9/2009, shortly after it acquires Merrill Lynch. Citigroup received an additional \$20 billion on 11/23/2008, after its stock price plummeted 60% in one week.
	11/26/2008	The Federal Reserve Board announces approval of the notice of Bank of America Corporation to acquire Merrill Lynch & Co for \$50 billion.
<b>American International Group (AIG)</b>		
<b>AIG-1</b>	2/28/2008	AIG reported a fourth-quarter of 2007 net loss of \$5.2 billion (the biggest loss to date), due largely to write down on mortgage-related investments. The company's financial products took a pretax charge of \$11.12 billion from a net unrealized market valuation loss of its large credit default swap portfolio.
<b>AIG-2</b>	9/16/2008	The Federal Reserve Board authorizes the Federal Reserve Bank of New York to lend up to \$85 billion to AIG, of which \$40 billion is allocated from the TARP program on 11/25/2008.

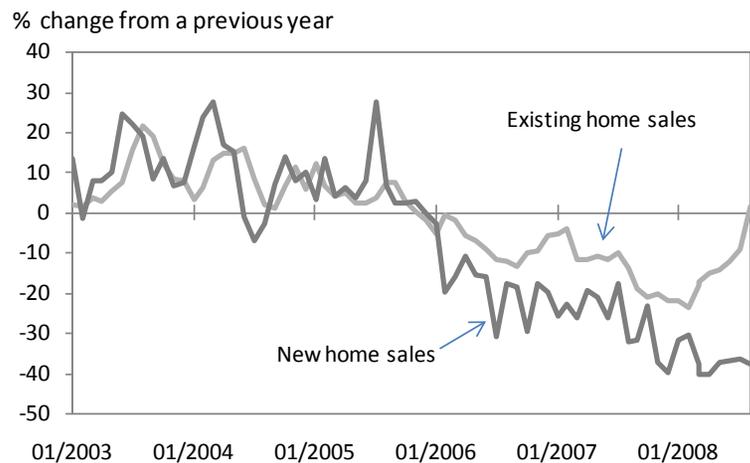
Sources: Adapted from Federal Reserve Bank of St. Louis and other various sources.

Figure 1: Warning signs in the U.S. housing market

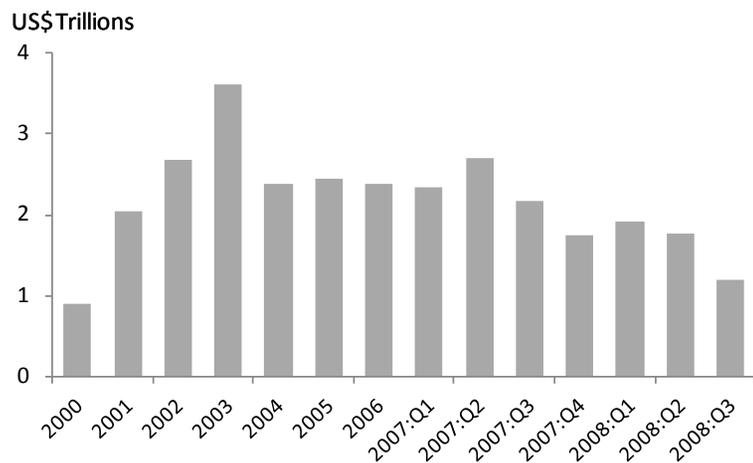
(1a) Change of home price (monthly data)



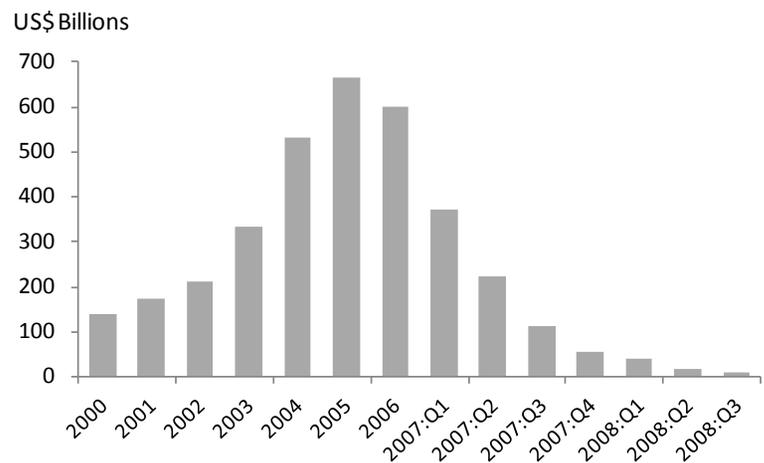
(1b) Change of home sales (monthly data)



(1c) Prime home mortgage originations

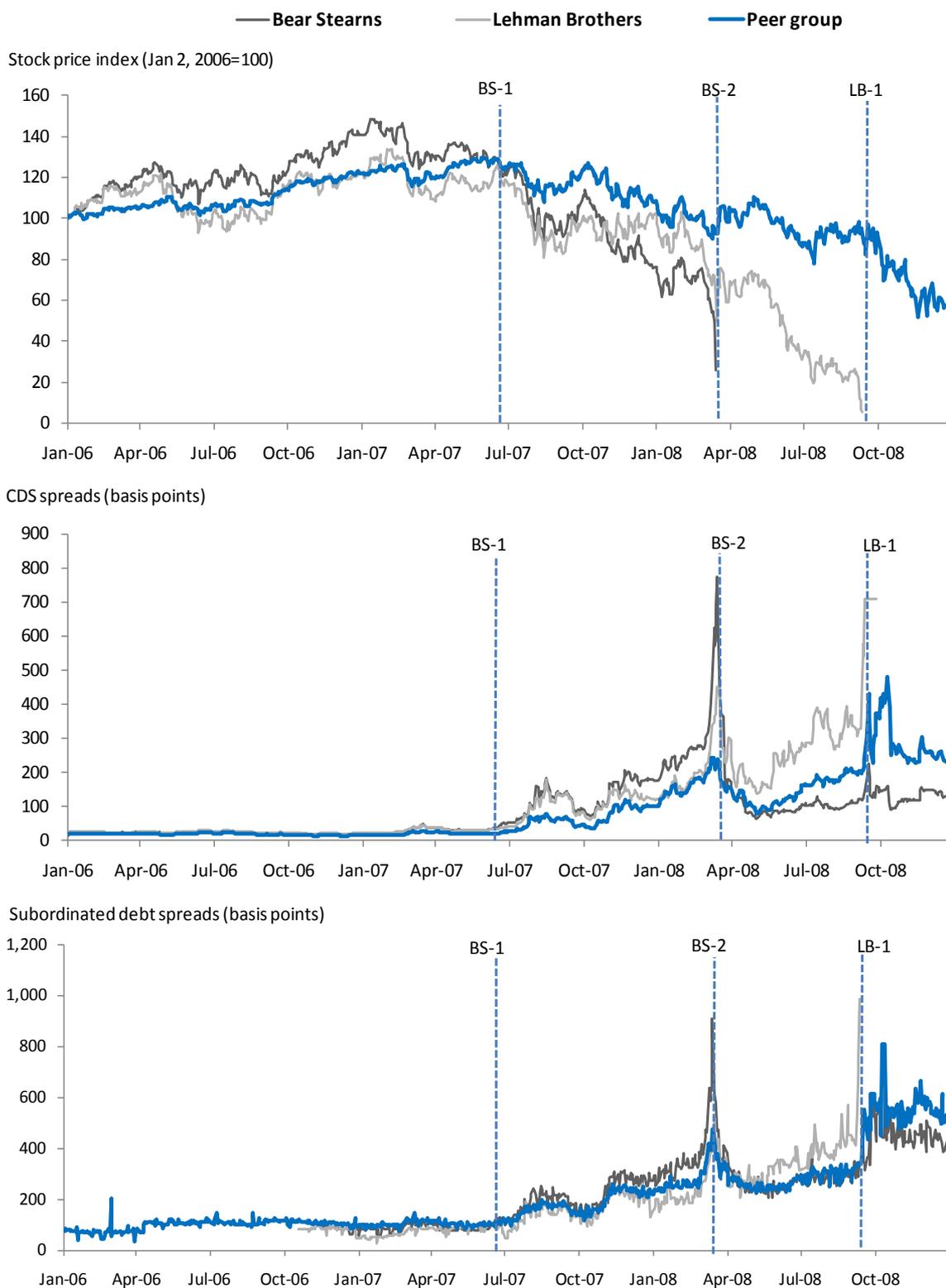


(1d) Subprime home mortgage originations



Note: The quarterly data for home mortgage originations are annualized.  
Sources: Inside Mortgage Finance, Barth et al, (2010).

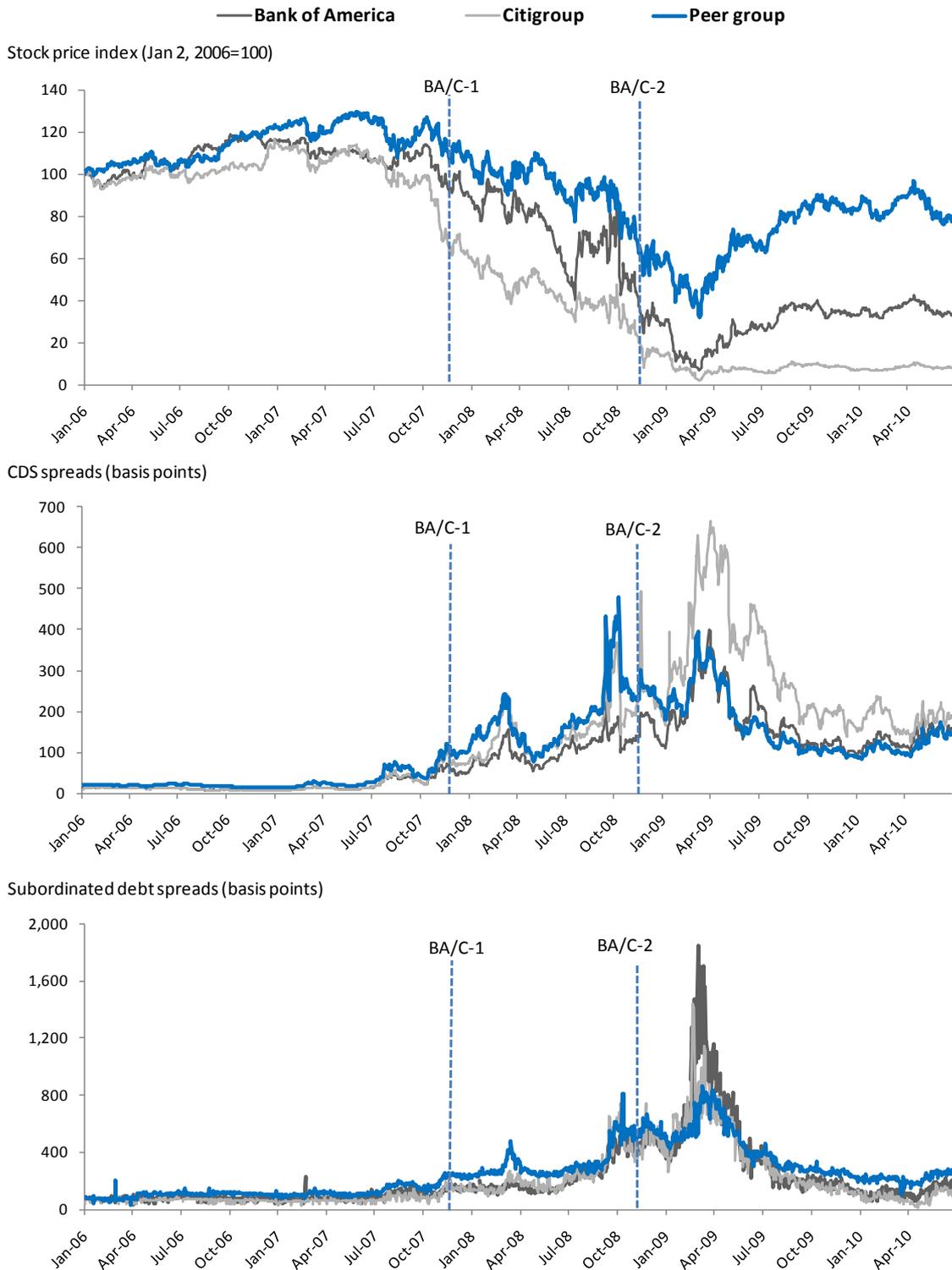
Figure 2: Selected closed investment banking firms



Notes: the vertical dot lines indicate key institution-specific events. See Table 1 for descriptions of these key events. Peer group includes American Express, Capital One, Goldman Sachs, JPMorgan, Merrill Lynch, Morgan Stanley, U.S. Bank, and Wells Fargo.

Sources: Bloomberg, DataStream.

Figure 3: Selected U.S. commercial banks that received government financial assistance

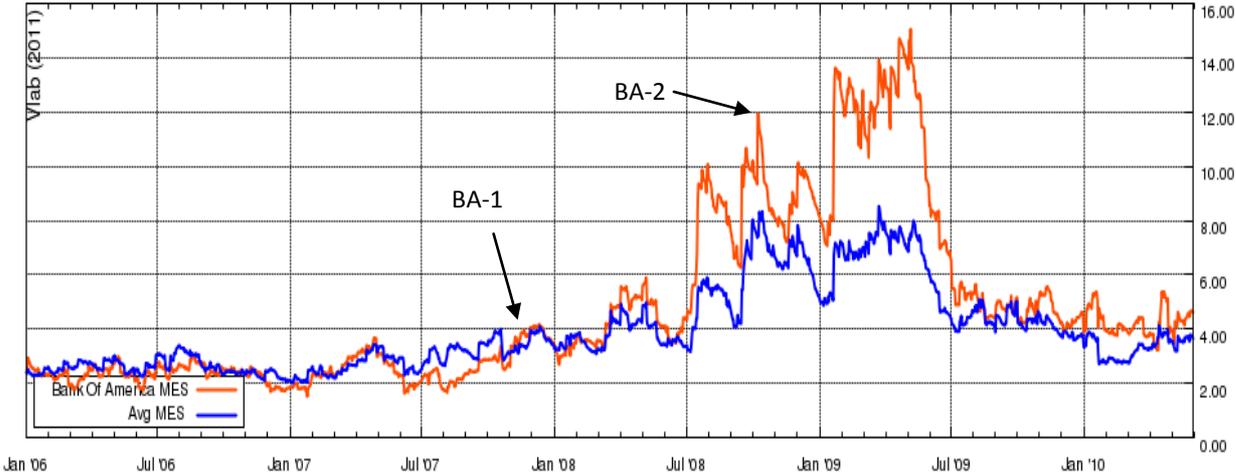


Notes: the vertical dot lines indicate key institution-specific events. See Table 1 for descriptions of these key events. Peer group includes American Express, Capital One Goldman Sachs, JPMorgan, Merrill Lynch, Morgan Stanley, U.S. Bank, and Wells Fargo.

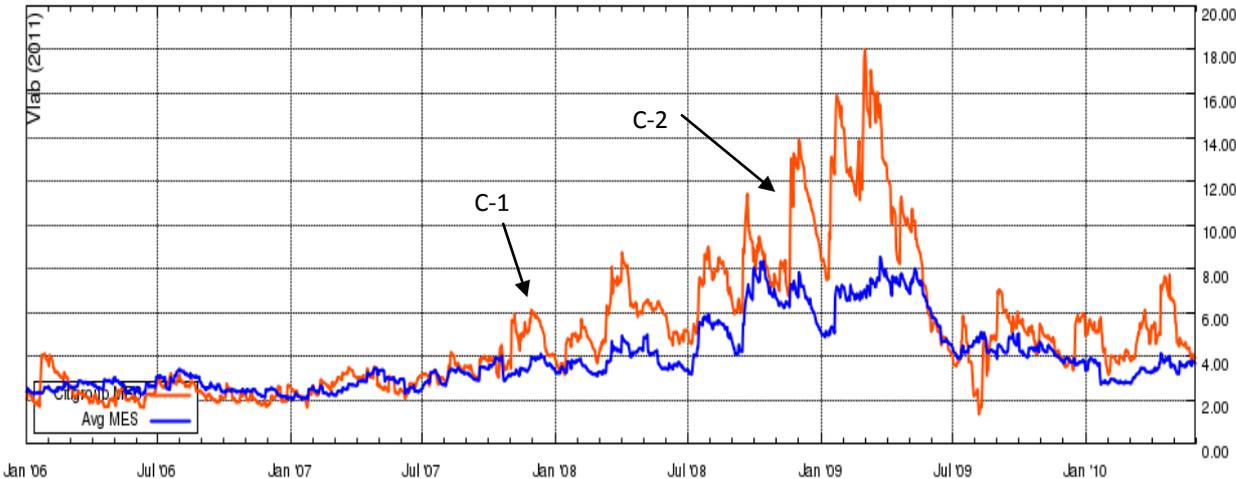
Sources: Bloomberg, DataStream.

Figure 4: Marginal Expected Shortfall (MES)

Bank of America

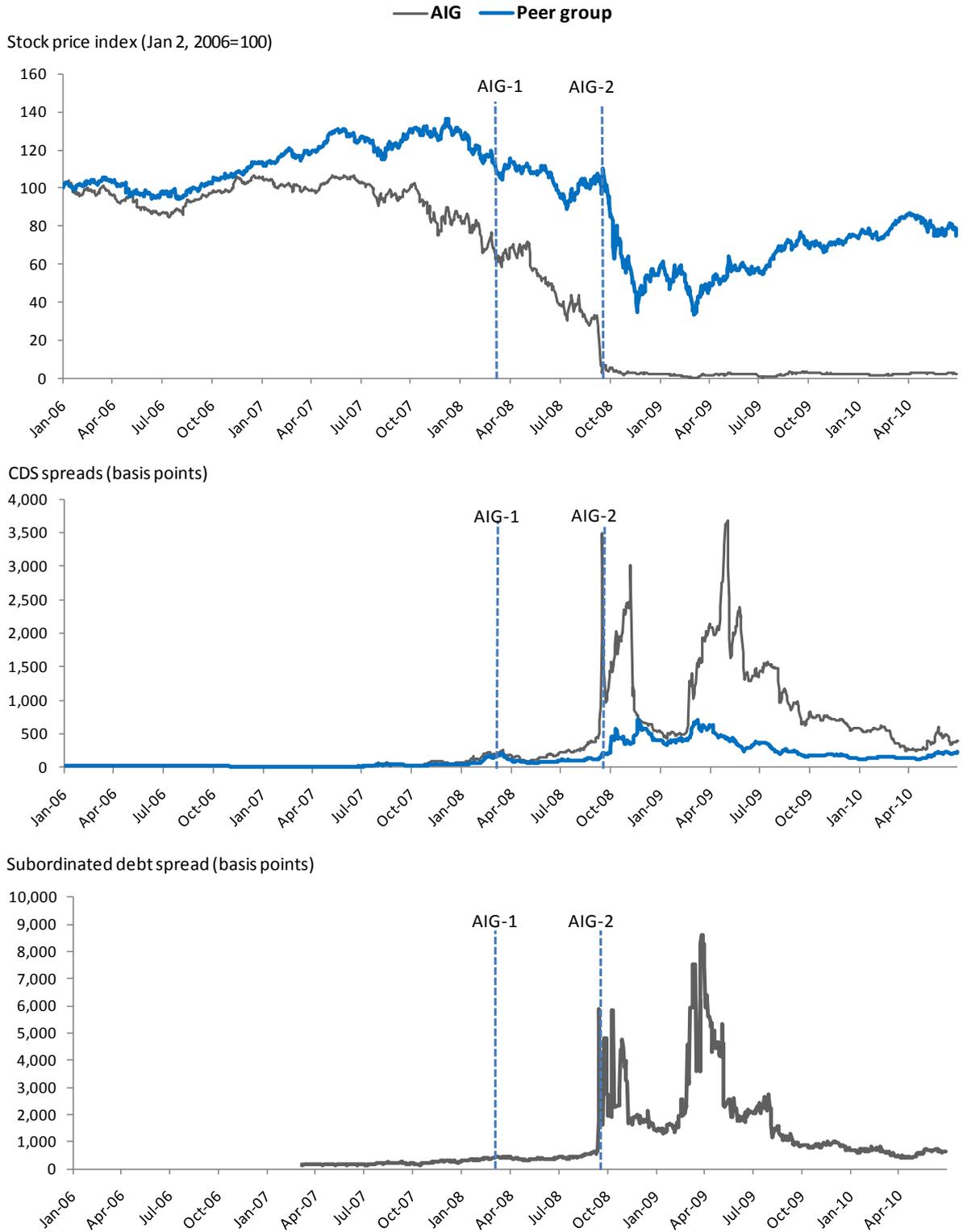


Citigroup



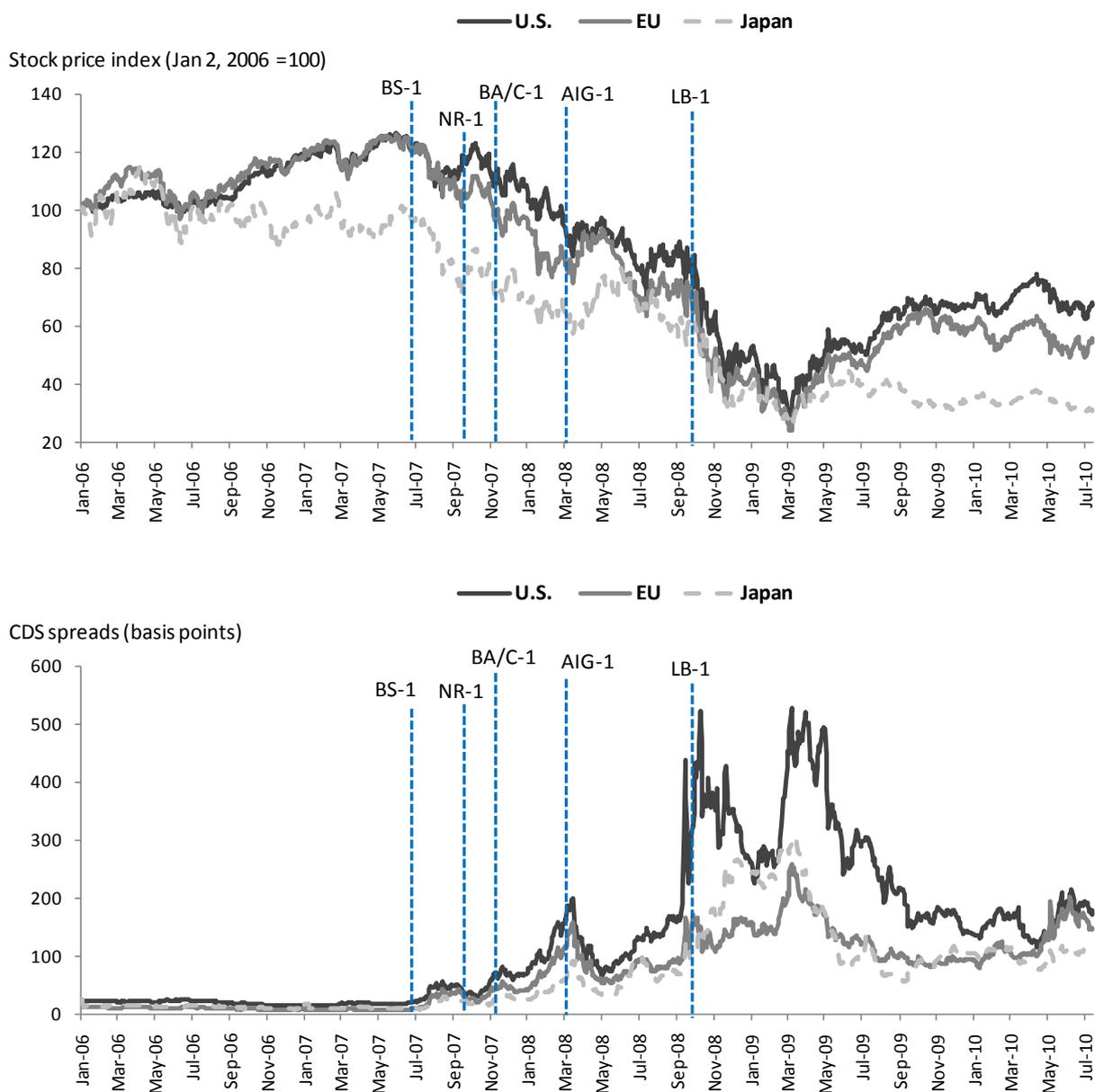
Source: Vlab, Stern School of Business, New York University

Figure 5: American International Group (AIG)



Notes: the vertical dot lines indicate key institution-specific events. See Table 1 for descriptions of these key events. Peer group includes Aetna, Berkshire Hathaway, Cigna, Hartford, MetLife, and Prudential.  
Sources: Bloomberg, DataStream.

Figure 6: Composite market signals



*Notes:* the vertical dot lines indicate key institution-specific events. See Table 1 for descriptions of these key events. The composite market signal is a simple average value of market indicators of financial institutions in United States, European countries and Japan. A list of these financial institutions is shown in Data Appendix.  
*Sources:* Bloomberg, DataStream.