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CREDIT DEFAULT SWAP SPREADS AS VIABLE SUBSTITUTES FOR CREDIT RATINGS

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In this Article, we evaluate the viability of credit default swap (CDS) spreads as substitutes for credit ratings. We focus on CDS spreads based on the obligations of financial institutions, particularly fifteen large financial institutions that were prominently involved in the recent financial crisis. Our data from 2006 through 2009 show that CDS spreads incorporate new information about as quickly as equity prices and significantly more quickly than credit ratings. Although CDS spreads did not identify accumulating risk exposures before 2007, they quickly reflected disclosures and developments beginning in the summer of 2007 at the latest. Thus, CDS spreads are a promising market-based tool for regulatory and private purposes, and they may serve as a viable substitute for credit ratings.

(2085)

INTRODUCTION

In response to the recent financial crisis, commentators have criticized certain credit rating agencies, known as Nationally Recognized Statistical Rating Organizations (NRSROs),[1] and credit default swaps (CDSs).[2] Regulators have proposed a range of reforms in both areas but have not considered the links between them. This Article considers one potential link: whether CDS markets could play a role in financial reform related to NRSROs.

More specifically, one set of proposals suggests that legislators and regulators reduce the dysfunctional incentives associated with overreliance on NRSRO credit ratings.[3] Although there is support for this proposal in theory,[4] one objection forestalling reform has been that,

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[1] NRSROs are private for-profit institutions that, in exchange for fees, issue letter ratings (e.g., AAA, AA, A, BBB, BB, B, and so forth) reflecting the credit risk of specified financial obligations.

[2] By "CDS," we are referring generally to the private, over-the-counter market for swap contracts with payoffs based on the default, or related credit event, of a specified reference entity.

[3] *See* References to Ratings of Nationally Recognized Statistical Rating Organizations, Securities Act Release No. 9069, Exchange Act Release No. 60,790, Investment Advisers Act Release No. 2932, Investment Company Act Release No. 28,940, 74 Fed. Reg. 52,374, 52,374-75 (proposed Oct. 9, 2009) (reopening the comment period on proposed rule amendments removing references to the NRSRO ratings in order to address the risk of encouraging "investors to place undue reliance on NRSRO ratings" and "to preclude manipulative conduct by persons" interested in an offering's outcome); *see also* SEC, Comments on Proposed Rule: References to Ratings of Nationally Recognized Statistical Rating Organizations, http://www.sec.gov/comments/s7-17-08/s71708.shtml (last visited Apr. 15, 2010) (listing the comments received in response to the proposed rule changes).

[4] *See* SEC, ROUNDTABLE TO EXAMINE OVERSIGHT OF CREDIT RATING AGENCIES 87-89, 101 (2009), *available at* http://www.sec.gov/spotlight/cra-oversight-roundtable/cra-oversight-roundtable-transcript.txt (recording comments of Alex Pollock and Lawrence J. White in support of regulation that would decrease investor reliance on ratings); *see also* Oliver Hart & Luigi Zingales, *A New Capital Regulation for Large Financial Institutions* 25, 33 (Univ. of Chi. Booth Sch. of Bus., Working Paper No. 09-36, 2009), *available at* http://ssrn.com/abstract=1481779 (recommending a new capital requirement based on

notwithstanding the problems associated with credit rating agencies, there do not appear to be viable substitutes for credit ratings. Indeed, ongoing skepticism and criticism about CDS markets has reinforced the objection. In simple terms, the objection is that regulators and investors should not replace one broken system (credit ratings) with another broken system (CDSs).[5]

In a typical CDS transaction, one counterparty (the buyer of protection) agrees to pay a periodic premium to the other counterparty (the seller of protection).[6] In return, the seller of protection agrees to compensate the buyer of protection if a reference entity specified in the CDS contract experiences a default or similar "credit event."[7] For simple CDSs, the reference entity might be a corporation or government entity.[8] For more complex CDSs, the reference entity might be a portfolio of structured financial instruments. Parties usually document the various CDS terms through a standard form agreement created by the International Swaps and Derivatives Association (ISDA).[9]

One of the most important terms in a CDS agreement is the definition of a "credit event," which has become largely standardized. The most common credit event is the failure to pay by the reference entity. Bankruptcy or restructuring credit events can vary depending on how much interest reduction or maturity extension the parties wish to specify in the CDS agreement.[10]

CDSs instead of credit ratings, and noting that "the reputational incentives underlying the rating mechanism, which worked very well for more than one hundred years, do not seem to have performed as expected during the last crisis").

[5] A related proposal, which we do not consider here, is to rely on bond credit spreads instead of credit ratings. If there are objections to reliance on CDSs, or limits to the liquidity or coverage of the CDS market, bond credit spreads are another alternative. *See generally* Frank Partnoy, *The Siskel and Ebert of Financial Markets?: Two Thumbs Down for the Credit Rating Agencies*, 77 WASH. U. L.Q. 619 (1999) (suggesting the replacement of credit ratings with credit spreads, the market-risk measure for bonds).

[6] ISDA CDS Marketplace, What Is a Credit Default Swap?, http://www.isdacdsmarketplace.com/about_cds_market/cds_faq#what_is_cds (last visited Apr. 15, 2010).

[7] *Id.*

[8] ISDA CDS Marketplace, What Is a Reference Entity?, http://www.isdacdsmarketplace.com/about_cds_market/cds_faq#what_is_reference_entity (last visited Apr. 15, 2010).

[9] *See* ISDA, Why is Derivatives Documentation (Such as the ISDA Master Agreement) Important?, http://www.isda.org/educat/faqs.html#28 (last visited Apr. 15, 2010) (explaining that the agreement standardizes "non-economic" terms so that repeat players are free to negotiate the "economic" terms).

[10] ISDA CDS Marketplace, What is a Credit Event?, http://www.isdacdsmarketplace.com/about_cds_market/cds_faq#what_are_different_types_credit_events (last visited Apr. 15, 2010).

CDS "prices," as measured in the market, represent the size of the premium paid by the buyer of protection and are generally known as CDS "spreads." CDS spreads change over time based on supply and demand for particular CDS contracts. CDS spreads are analogous to insurance premiums and similarly reflect market participants' assessment of the risk of a default or credit event associated with the underlying obligation.

In general, CDSs are widely and deeply traded, and they help to reflect market information about the credit risk of underlying financial obligations. Several studies have shown that CDS markets generally reflect valuable information.[11] Broad market participation suggests that CDS prices should convey information about counterparties' as-

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[11] *See* Viral V. Acharya & Timothy C. Johnson, *Insider Trading in Credit Derivatives*, 84 J. FIN. ECON. 110, 113 (2007) ("[W]e find that the CDS markets appear to be transmitting non-public information into publicly traded securities such as stocks . . . ."); Roberto Blanco et al., *An Empirical Analysis of the Dynamic Relationship Between Investment-Grade Bonds and Credit Default Swaps*, 60 J. FIN. 2255, 2256-57 (2005) (characterizing CDSs as "an upper bound on the price of credit risk" and noting that their prices "lead in the price discovery process," which makes them "useful indicators for analysts interested in measuring credit risk"); Caitlin Ann Greatrex, *Credit Default Swap Market Determinants*, J. FIXED INCOME, Winter 2009, at 18, 29 (concluding that "a CDS rating-based index that accounts for both credit risk and overall market conditions" reflects credit conditions better than "either macroeconomic interest rates or aggregate equity returns"); John Hull et al., *The Relationship Between Credit Default Swap Spreads, Bond Yields, and Credit Rating Announcements*, 28 J. BANKING & FIN. 2789, 2809 (2004) (concluding that the CDS market tends to anticipate changes in credit ratings); Francis A. Longstaff et al., *Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit Default Swap Market*, 60 J. FIN. 2213, 2214 (2005) (noting that CDS premiums can "provide direct measures of the size of the default and nondefault components in corporate yield spreads"); Lars Norden & Martin Weber, *The Co-movement of Credit Default Swap, Bond and Stock Markets: An Empirical Analysis*, 15 EUR. FIN. MGMT. 529, 530 (2009) [hereinafter Norden & Weber, *Co-movement*] ("[T]he CDS market mainly contributes to price discovery."); Lars Norden & Martin Weber, *Informational Efficiency of Credit Default Swap and Stock Markets: The Impact of Credit Rating Announcements*, 28 J. BANKING & FIN. 2813, 2815 (2004) [hereinafter Norden & Weber, *Informational Efficiency*] (finding that CDS markets anticipate rating downgrades and reviews for downgrade by three major credit rating agencies); Haibin Zhu, *An Empirical Comparison of Credit Spreads Between the Bond Market and the Credit Default Swap Market*, 29 J. FIN. SERVICES RES. 211, 213 (2006) (finding that CDS premiums and bond spreads should reach equilibrium over the long term but that CDS prices tend to lead the cash market in anticipating ratings events, and discrepancies between the markets can lag for up to two to three weeks). These prior studies did not analyze Markit data from the recent financial crisis, although the CDS-based capital regulation proposal by Oliver Hart and Luigi Zingales originated partially from Bloomberg-based data. This data is consistent with our findings in that it shows an increase in CDS spreads for six major financial institutions before and during the recent financial crisis. *See* Hart & Zingales, *supra* note 4, at 37 figs.3a & 3b, 38 figs.4a & 4b, 39 fig.5, 40 fig.6 (illustrating increasing CDS spreads for several major banks leading up to the most recent financial crisis).

sessments of this risk. Notwithstanding the evidence that CDS markets generally reflect valuation information, regulators and market participants have resisted moving away from NRSRO credit ratings toward CDS spreads.

In this Article, we present recent evidence that CDSs based on financial institutions' obligations are potentially useful for regulatory purposes and private investors. Overall, the data show that changes in CDS spreads reflect information more promptly than changes in credit ratings, even during a period of intense market discord. CDS spreads increased during 2007 and 2008 as information became available showing that the probability of defaults by financial institutions was increasing. During this same period, credit ratings nevertheless remained relatively unchanged. We explore the implications of this evidence for the debate about whether markets or institutions are better for regulatory purposes. We argue that CDS spreads are a viable alternative to credit ratings in reflecting information because of their market-based nature. In other words, markets (CDSs) responded to new information more promptly and responsively than institutions (credit rating agencies) did.

In Part I, we summarize some of the problems associated with reliance on credit ratings and discuss the need for a viable substitute. Part II presents our analysis of our CDS-spread data. We examine the relationship between CDS spreads and ratings on an aggregate basis and provide firm-specific examples showing the utility of CDS spreads relative to credit ratings. We also investigate how the CDS spreads for selected firms in the sample respond to specific, high-profile events. In Part III, we test the efficiency of CDS spreads compared to equity prices and find that the information in CDS spreads, like the information in equity prices, is timely and accurate. In other words, CDS markets, though not perfect, were generally efficient before and during the recent financial crisis. We conclude by suggesting some promising areas of future research and discussing the implications of these findings for monitoring purposes.

I. THE PROBLEM OF CREDIT RATINGS

In theory, credit ratings are a potentially valuable source of information. During the early 1900s, John Moody intuited that investors would pay him if he could synthesize the complex data in various re-

ports on the railroad industry into a single letter rating.[12] By the 1920s, Moody and his competitors were rating most new bond issues, including government bonds. These private companies, which came to be known as rating "agencies," acted as information intermediaries, and their letter ratings reflected valuable information. Investors—not issuers—paid for ratings.[13]   Indeed, bond issuers complained about credit rating agencies and opposed the concept of credit ratings as intrusive.[14]

Over time, rating agencies shifted from selling information to selling "regulatory licenses,"[15] the "keys that unlock the financial markets."[16] By regulatory licenses, we mean the property rights associated with the "ability of a private entity, rather than a regulator, to determine the substantive effect of legal rules."[17] The regulatory-license model of information intermediaries differs substantially from the traditional reputational-capital model. According to the reputational-capital model, ratings providers survive and prosper primarily because of the continuing value of the information their ratings incorporate and reflect. In contrast, raters who benefit from regulatory licenses can continue to earn economic rents even if their ratings do not reflect valuable information. The regulatory-license view seeks to explain why market participants might continue to rely on particular rating agencies and why those rating agencies might continue to earn high margins even after a sustained period during which their ratings did not reflect valuation information.

The leading rating agencies began to shift from the reputational-intermediary role to the regulatory-license role after the 1929 crash, when regulators turned to particular rating agencies, notably Moody's and Standard & Poor's, for measures of bond quality to be used in banking and insurance guidelines.

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[12] Moody first published a rating system in a 1909 book entitled *Moody's Analyses of Railroad Investments. Cf.* Partnoy, *supra* note 5, at 637-40 (recounting Moody's success story).

[13] *See* Partnoy, *supra* note 5, at 638 (explaining that Moody made his money by selling his ratings to the public).

[14] *Id.* at 640.

[15] *Id.* at 623.

[16] FRANK PARTNOY, COUNCIL OF INSTITUTIONAL INVESTORS, RETHINKING REGULATION OF CREDIT RATING AGENCIES: AN INSTITUTIONAL INVESTOR PERSPECTIVE 4 (2009).

[17] Partnoy, *supra* note 5, at 623. Interestingly, Moody's vice president, Thomas J. McGuire, recognized the dangers associated with the regulatory use of ratings and warned in 1995 that if regulatory reliance on ratings were not curtailed, "the credibility and integrity of the ratings system itself will inevitably be eroded." Mark J. Flannery, *Supervising Bank Safety and Soundness: Some Open Issues*, 92 FED. RES. BANK ATLANTA ECON. REV. 83, 89 (2007).

> Federal Reserve examiners proposed a system for weighting the value of a bank's portfolio based on credit ratings. Bank and insurance regulators expressed the "safety" or "desirability" of portfolios in letter ratings, and used such ratings in bank capital requirements and bank and insurance company investment guidelines. States relied on rating agencies to determine which bonds were "legal" for insurance companies to hold. The Comptroller of the Currency made similar determinations for federally chartered banks.[18]

A second wave of regulatory reliance began in the mid-1970s, when the Securities and Exchange Commission (SEC) introduced the concept of NRSROs and thus further encouraged regulators to rely on their ratings.[19] Not coincidentally, NRSROs shifted the focus of their business model from investors to issuers during this time: specifically, they began charging the issuers of the debt they rated.

> The issuer-pay model introduced significant new conflicts of interest—chiefly, the challenge for credit raters to impartially rate securities of companies that generate their revenues. But the rating agencies believed that they could manage these conflicts internally.
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> Regulators now mandate that institutions of all types pay heed to NRSRO credit ratings as a necessary step for regulatory compliance. Some rules require that certain investors can only buy bonds with high ratings. Other rules reduce capital requirements for institutions that purchase highly rated bonds. Without high ratings, bond issuers cannot access certain markets, because they do not have a "regulatory license" from the NRSROs to comply with NRSRO-dependent regulations.[20]

Tying regulations to ratings has created more demand for rating agencies' services and increased agency profits. Importantly, the demand for private ratings no longer depends exclusively on their accuracy. Rather, regulatory licenses allow private agencies—as opposed to government supervisors—to determine the substantive effect of le-

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[18] PARTNOY, *supra* note 16, at 4.

[19] Credit ratings especially proliferated after the SEC tied broker-dealer requirements to the new ratings.

> More precisely, the regulatory dependence on credit ratings began in 1973, when the SEC proposed amending broker-dealer "haircut" requirements, which set forth the percentage of a financial asset's market value a broker-dealer was required to deduct for the purpose of calculating its net capital requirement. Rule 15c3-1, promulgated two years later, required a different "haircut" based on the credit ratings assigned by NRSROs. Since the mid-1970s, statutes and regulations increasingly have come to depend explicitly on NRSRO ratings.

Id. at 4 n.3 (citation omitted).

[20] *Id.* at 4-5.

gal rules. "Too often, rating changes lagged the revelation of public information about rated issuers and instruments. Prominent examples included California's Orange County and Enron, both of which received high credit ratings until just before they filed for bankruptcy protection."[21] We examine more recent examples from the financial crisis below.

In recent years, financial engineers created a vast number of security-issuing entities. Credit rating agencies therefore began rating substantially more issuers and increasingly complex instruments. The resources expended per rating declined.[22] As ratings expanded to cover large numbers of structured financial products, including tranches of various collateralized debt obligations, some NRSROs neglected to devote resources to update their models and methodologies or to recruit additional staff needed to ensure quality.[23] As a senior analytical manager at one of the largest rating agencies wrote in a February 2007 e-mail, "We do not have the resources to support what we are doing now."[24] Ultimately, tens of thousands of highly structured financial instruments were downgraded in 2007 and 2008, shortly after their initial rating.[25]

The dubious quality of the NRSROs' ratings did not hamper their increasing profitability:

> Paradoxically, the leading NRSROs became more profitable even as the quality of their ratings declined. Operating margins in recent years topped fifty percent; Moody's profit margins were higher than any other company in the S&P 500 for five consecutive years during the early 2000s. Moody's market capitalization was nearly $20 billion at its peak; S&P was similarly profitable and large. The companies that owned NRSROs drew savvy investors, looking to profit from the reliable returns associated with the sale of regulatory licenses.[26]

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[21] *Id.* at 5.

[22] For example, the SEC found that "[w]ith respect to CDOs, . . . two rating agencies' staffing increases did not appear to match their percentage increases in deal volume." OFFICE OF COMPLIANCE INSPECTIONS & EXAMINATIONS, SEC, SUMMARY REPORT OF ISSUES IDENTIFIED IN THE COMMISSION STAFF'S EXAMINATIONS OF SELECT CREDIT RATING AGENCIES 10 (2008), *available at* http://www.sec.gov/news/studies/2008/craexamination070808.pdf.

[23] *See id.* (noting that while a number of agencies increased their staffing with respect to increases in residential mortgage-backed securities (RMBSs), some did not increase their staffing to match the increase in CDOs).

[24] *Id.* at 21 n.29.

[25] *Id.* at 2.

[26] PARTNOY, *supra* note 16, at 5.

Warren Buffett has been a major investor in Moody's and as of early 2010 held more than thirteen percent of its outstanding common shares.[27]

One explanation of this paradox—increasing rating-agency profits despite declining informational responsiveness of ratings—is that profits from the sale of regulatory licenses need not depend greatly on whether credit ratings reflect information.[28]

> If regulators and private actors defer to private standard setters, those private standard setters will earn profits from that deference even if their standards are not useful. Over time, both regulators and private actors might decide to shift to alternative sources of information and analysis. However, to the extent they do not shift, the private standard setters will continue to prosper, even if their standards lack informational value.[29]

The paradox of credit ratings has persisted during the recent financial crisis. Even after so many NRSROs downgraded their ratings, portions of the U.S. government's rescue efforts relied on NRSROs, making their ratings more important than ever.

> [T]he Federal Reserve's $1 trillion Term Auction Lending Facility (TALF) plan, which was created to lend money to investors to purchase new securities backed by consumer debt, mandates that only securities rated by two or more major NRSROs are eligible for government support.[30] Likewise, when government officials anticipated the potential

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[27] Berkshire Hathaway Inc., Quarterly Holdings Report (Form 13F) (Feb. 16, 2010) (showing Berkshire Hathaway holding 31,814,610 shares in Moody's); *cf.* PARTNOY, *supra* note 16, at 5 (describing Warren Buffett's investments in Moody's as of 2008).

[28] The lack of a deterrent effect from civil liability also helps sustain the high profitability of rating agencies, despite the poor quality of their ratings:

> Another explanation is that rating agencies have been effectively exempt from civil liability. With rare exceptions, rating agencies have not suffered damages from litigation even when they were negligent or reckless in issuing overly optimistic ratings. To some extent, the rating agencies' success in avoiding liability is due to legislative policy, such as the explicit statutory exemption from liability under section 11 of the Securities Act of 1933, [15 U.S.C. § 77k (2006),] or the limitations on private rights of action in the Credit Rating Agency Reform Act of 2006, [15 U.S.C. § 78o-7 (2006)]. But the exemption is also due to a handful of judicial decisions accepting the rating agencies' assertion that ratings are merely "opinions," which, under the First Amendment, should be afforded the same protection as opinions of publishers.

Id. at 5-6; *see, e.g.*, *In re* Enron Corp. Sec., Derivative & "ERISA" Litig., 511 F. Supp. 2d 742, 816 (S.D. Tex. 2005) ("[G]enerally the courts have not held credit rating agencies accountable for alleged professional negligence or fraud and that plaintiffs have not prevailed in litigation against them.").

[29] PARTNOY, *supra* note 16, at 5.

[30] *Id.* at 6; *see also* Fed. Reserve, Term Asset-Backed Securities Loan Facility (TALF) Terms and Conditions (Nov. 25, 2008), http://federalreserve.gov/newsevents/

negative impact of AIG's announcement of quarterly earnings in March 2009, they implemented a fourth rescue package for the insurer and consulted privately with representatives of the dominant NRSROs, to be sure the plan would be attractive enough to avoid a downgrade of AIG, which would have killed the company.[31]

Many regulators appear to understand these criticisms of NRSROs. Some have accepted the "regulatory license" view of credit ratings.[32] However, the SEC has proposed rules to eliminate certain aspects of regulatory dependence on ratings.[33] Most prominently, the SEC recommended replacing the regulatory license associated with Rule 2a-7 under the Investment Company Act[34] with a requirement that money market fund boards of directors determine "that each portfolio instrument presents minimal credit risks."[35] International banking regulators have considered removing the regulatory licenses associated with the Basel II agreement issued by the Basel Committee on Banking Supervision. Basel II explicitly allows banking regulators to permit the use of credit ratings from approved rating agencies to calculate banks' net capital reserve requirements.[36] Similarly, many institutional investors have considered removing references to credit

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monetary20081125a1.pdf (describing the terms and conditions on the issuance of TALF funds when TALF was first established).

[31] PARTNOY, *supra* note 16, at 6; *cf. NewsHour with Jim Lehrer: Markets Plunge After Government Adds Billions to AIG Rescue* (PBS television broadcast Mar. 2, 2009), *transcript available at* http://www.pbs.org/newshour/bb/business/jan-june09/aigmarkets_03-02.html (discussing AIG's move to a riskier secondary business in derivatives, which helped lead to government intervention to prevent AIG's default on its contracts).

[32] *See Assessing the Current Oversight and Operations of Credit Rating Agencies: Hearing Before the S. Comm. on Banking, Housing, and Urban Affairs,* 109th Cong. 1 (2006) (statement of Sen. Richard Shelby, Chairman, S. Comm. on Banking, Housing, and Urban Affairs) (labeling NRSRO ratings as "regulatory license[s]" because of the SEC's reliance on them).

[33] *See* References to Ratings of Nationally Recognized Statistical Rating Organizations, Investment Company Act Release No. 28,327, Investment Advisers Act Release No. 2751, 73 Fed. Reg. 40,124, 40,136 (proposed July 11, 2008) (explaining that by reducing overreliance on ratings, the SEC aimed to promote investor protection and increase market efficiency).

[34] Rule 2a-7 limits a money market fund's portfolio investments to securities that have received credit ratings from NRSROs in one of the two highest short-term rating categories. SEC Money Market Funds, 17 C.F.R. § 270.2a-7 (2009).

[35] References to Ratings of Nationally Recognized Statistical Rating Organizations, 73 Fed. Reg. at 40,125.

[36] *See* BASEL COMM. ON BANKING SUPERVISION, BANK FOR INT'L SETTLEMENTS, REVISIONS TO THE BASEL II MARKET RISK FRAMEWORK 6-7 (2009), *available at* http://www.bis.org/publ/bcbs158.pdf (listing specific risk capital charges based on external credit ratings).

ratings from their investment guidelines.[37]

However, most of these proposals have not passed. One objection has been the lack of a substitute for credit ratings.[38] The credit rating agencies have argued that although their rating system is not perfect, they are well positioned to improve their metholodogies and restore confidence in the system.[39] Although regulators have considered market-based alternatives to ratings, they have also confronted the argument that credit ratings themselves increasingly reflect market-based measures. Letter ratings have essentially become shorthand labels based on assumptions about key variables, such as the probability of default and the expected recovery in the event of default.

As this argument goes, if rating agencies generate letter ratings based on market estimates of these variables, market-based measures would not be a superior alternative. The real question is whether institutions are better than the measures themselves at reflecting this information. One view would be that institutional expertise would lead to better ratings than would market measures, which simply reflect the views of market participants. Another view would be that the market measures reflect the views of participants who are better informed and incentivized than credit rating agencies. The best way to resolve the argument that rating agencies incorporate market-based measures better than the market itself is to compare ratings to market measures.

Hence, the key question, which has not previously been studied in detail, is whether the data show that market-based measures, such as CDS spreads, actually are a viable substitute for NRSRO credit ratings. We now turn to answering this question.

II. CDS SPREADS VERSUS CREDIT RATINGS

The Markit Group Limited provided us with a time series of CDS spreads for 302 North American financial firms from January 2006 to

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[37] *See* PARTNOY, *supra* note 16, at 17-18 (proposing the use of the variables underlying the ratings, the default probability implied by a bond's price, or blended information sources in lieu of credit ratings).

[38] *See id.* at 17-18 ("[C]ompetition in the credit rating business has not been effective.").

[39] *See* SEC, *supra* note 4, at 20-26 (containing comments of Raymond M. McDaniel, Jr., Chairman and CEO of Moody's Corporation, and Deven Sharma, President of Standard & Poor's, discussing how their agencies are strengthening their ratings methodologies by providing for more reviews and transparency).

March 2009.[40] Each spread corresponds to a single-name, five-year-maturity CDS based on the standard form ISDA documentation described above.[41] In addition to CDS spreads, the data include the priority of the debt (whether senior or subordinate) and the corresponding credit rating. The vast majority of reported CDS contracts had regular quotes throughout the entire period. Indeed, the frequency of these quotes, even during the period prior to the financial crisis, confirms that there has been extensive trading in the CDS market during the past few years.

Markit collects CDS-spread data from several banks that use its data platform and own a majority of the firm.[42] Each institution contributes end-of-day, mark-to-market CDS credit curves.[43] Markit assimilates the data and publishes composite reports for these dealers and its other subscribers.[44] Markit eliminates outlier data and publishes CDS data only when several dealers have reported pricing; it does not publish CDS spreads for one-off transactions.[45] We analyze this data in aggregate and then at the firm-specific level.

A. *Aggregate Analysis*

As a starting point, we examine the evolution of CDS spreads over our sample time period for the entire sample of firms. Figure 1, contained in the Appendix, plots the daily CDS spreads for four different ratings classes (AAA, AA, A, and BBB) over the first half of the sample (January 2006 through June 2007). The AAA line reflects the CDS spreads for the highest-rated financial institutions, whereas the BBB line reflects spreads for institutions rated in the lowest investment-grade category.

Overall, CDS spreads traded in a fairly narrow range during this period. The average spreads for the BBB group were generally between forty and fifty basis points, while the spreads for the AAA and AA groups were between ten and twenty basis points. Indeed, from

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[40] We ended the sample period in March 2009 in part because that month marked the end of declines in the market and in part because we needed to close the sample at some convenient date.

[41] *See supra* text accompanying note 9.

[42] Shane Kite, *Raising Its Ante in Derivatives, Markit Buys Communicator*, SEC. INDUSTRY NEWS, May 15, 2006, at 1, 17.

[43] *Id.*

[44] *Id.*

[45] *Id.*

early 2006 until early 2007, CDS spreads actually declined somewhat, reflecting a period of calm.

Then, beginning in March 2007, CDS spreads increased and became more volatile. The movements at this time were relatively small, particularly compared to more recent volatility, but they correspond to two important early events in the financial crisis. First, various measures of subprime mortgage risk, including the ABX indices, had begun to increase in early 2007. The ABX indices, also published by Markit, reflect CDS prices of the mortgage-backed securities themselves, as contrasted with the obligations of the financial institutions we are examining. Second, New Century Financial, a prominent subprime mortgage broker, filed for bankruptcy on April 2, 2007.[46] Although market participants did not yet know the extent of various financial institutions' exposure to subprime mortgages, the increase in risk was associated with an increase in the level and volatility of CDS spreads on fiancial institutions. This increase appears in the "hump" on the right part of Figure 1, as CDS spreads increased during March and April 2007.[47]

Despite this negative information, average CDS spreads had increased only slightly by the end of June 2007.[48] Average spreads for AAA and AA firms were just under twenty basis points, and the spreads for the A and BBB firms were twenty-five and forty-seven basis points respectively.[49] On an aggregated basis, the CDS spreads for all financial firms did not warn of the troubles ahead until March 2007 at the very earliest, and even that signal was a quiet one.[50]

Figure 2, also contained in the Appendix, reflects the period extending from July 2007 through the end of 2008.[51] It is a completely different picture. Note the change in scale between Figures 1 and 2: even the early increases of Figure 2, from July and August 2007, would be "off the chart" on Figure 1's scale. Negative information was disclosed throughout the summer and fall of 2007, and CDS spreads increased to reflect that information. By the beginning of 2008, average spreads exceeded 100 basis points in each of the categories, and by

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[46] *See* Jerome S. Fons, *Shedding Light on Subprime RMBS*, J. STRUCTURED FIN., Spring 2009, at 81, 81-91.

[47] *See infra* app. fig.1.

[48] *See id.*

[49] *See id.*

[50] *See id.* (illustrating a small total increase in the AAA and AA CDSs from ten to twenty basis points that nevertheless indicated a doubling of the spread).

[51] *See infra* app. fig.2.

June 2008 they exceeded 200 basis points.[52] At the end of 2008, the average CDS spreads for the AA, A, and BBB firms were 340, 377, and 842 basis points, respectively.[53]

Two conclusions emerge from the data presented in Figures 1 and 2. First, CDS spreads responded quickly to the events surrounding the financial crisis beginning in 2007. Second, credit ratings did not capture informational changes as quickly as market-based measures of information, such as CDS spreads. Credit ratings remained largely unchanged through the period reflected in Figures 1 and 2, even as disclosures about the increased riskiness of rated financial institutions accelerated.

Credit ratings did not respond to available information about financial institutions' credit risks, especially beginning in mid-2007. Instead, they remained relatively constant, while market-based measures of information, such as CDS spreads, reflected increased credit risk. Because credit ratings remained largely unchanged during the period, one cannot test more precisely their responsiveness to the revelation of information about financial institutions' credit risks. Nevertheless, the evidence suggests that the rating agencies were not incorporating information as quickly as CDS spreads did when responding to changing events. CDS spreads reflected increases in both systemic risk (that all financial firms might collapse) and individual institutional risk (that a particular firm might collapse). These conclusions are reinforced by the fact that standardized CDS spreads are based on five-year agreements, and if the market is reflecting an assessment that the average default probability over a five-year period has risen, one might reasonably expect even a relatively small change in CDS spreads to be reflected in diligent ratings. We next examine this individual risk more closely by looking at a subsample of individual firms.

B. *Firm-Level Analysis*

For our firm-level examination, we selected fifteen large financial institutions that were heavily involved in the crisis: five investment

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[52] *See id.*

[53] *See id.* Surprisingly, throughout the second half of the sample period, the AAA-rated firms regularly traded at spreads that were considerably higher than the spreads for the AA- and A-rated firms. In many cases, AAA spreads even exceeded the spreads on BBB-rated firms. By the end of 2008, the average spread for the AAA firms was 805 basis points. *Id.* However, it is worth noting that by the end of our sample period, there were only six AAA firms in the sample and at least two of these firms had CDS spreads in excess of 1400 basis points. The market's perceived five-year default probabilities for these firms seem far above those usually associated with AAA ratings.

banks, five large commercial bank holding companies, and five other firms of interest.[54] They are set forth below in Table 1.

Table 1: Financial Institutions Used in Firm-Level Analysis

Investment Banks	Commercial Banks	Other
Bear Stearns (BSC)	Bank of America (BAC)	AIG (AIG)
Goldman Sachs (GS)	Citigroup (C)	Countrywide Financial (CFC)
Lehman Brothers (LEH)	JPMorgan Chase (JPM)	Fannie Mae (FNM)
Merrill Lynch (MER)	Wachovia (WB)	Freddie Mac (FRE)
Morgan Stanley (MWD)	Wells Fargo (WFC)	Washington Mutual (WM)

It is important to note up front that all fifteen of these financial institutions had high investment-grade credit ratings (in the range of A to AAA) during the sample period. There were periodic upgrades, all during 2006, and a few downgrades, primarily during 2008. However, the downgrades were minor; overall, these institutions' credit ratings remained remarkably stable, even during and following the height of the financial crisis in the fall of 2008.

For example, there were only three letter-category downgrades for the five investment banks in the sample.[55] Merrill Lynch was downgraded from AA to A on October 25, 2007, after it disclosed billions of dollars in losses on collateralized debt obligations (CDOs) and subprime mortgages.[56] Morgan Stanley was downgraded from AA to A on September 11, 2008. Goldman Sachs was also downgraded from AA to A on December 16, 2008.[57] The ratings of both

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[54] When analyzing the individual firms, we focused exclusively on the CDSs that correspond to senior debt obligations. It is possible that events had a more profound (and earlier) influence on the CDSs corresponding to subordinate securities with more credit risk.

[55] In addition, some NRSROs placed institutions on a ratings "watch," suggesting increased scrutiny or changed ratings within a particular letter category. However, these adjustments were minor and typically inconsequential for regulatory and investment-guideline purposes. Consequently, we focus on letter-category downgrades, which were significant to regulators and investors.

[56] *See* Matt Ackermann, *3Q Earnings: Merrill Admits Errors in Managing Securities Risk*, AM. BANKER, Oct. 25, 2007, at 7, *available at* 2007 WLNR 20926818 (describing S&P's characterization of the downgrade as a "startling announcement").

[57] Notably, in responding to questions about the Goldman Sachs downgrade, Moody's analyst Peter Nerby said, "This crisis has demonstrated that the business model of wholesale investment banks is not as resilient as it appeared." Andrew Clark, *Goldman*

Bear Stearns and Lehman Brothers remained in the A category through the sample period until both firms failed in March and September 2008, respectively.[58] Similar conclusions hold for the other two categories of financial institutions.

In sum, the letter ratings that matter so much to regulators and institutional investors remained relatively constant throughout our sample period. This was particularly true in the rating categories that matter for regulatory purposes. It is fair to conclude that credit ratings remained largely unchanged and reflected virtually no deterioration in financial institutions' credit quality from 2006 through March 2009.

In sharp contrast, credit default spreads reflected emerging information about the health of these financial institutions. Table 2 below sets forth the CDS spreads and credit ratings for each of the five investment banks in our sample for particular dates during the sample period.

Table 2: Firm-Specific CDS Spreads and Credit Ratings

	Goldman Sachs		Morgan Stanley		Merrill Lynch		Lehman Brothers		Bear Stearns	
	Spread	Rating	Spread	Rating	Spread	Rating	Spread	Rating	Spread	Rating
1/2/06	21	A	22	A	21	A	25	A	24	A
1/1/07	21	AA	22	AA	16	AA	21	A	21	A
4/2/07	32	AA	33	AA	35	AA	38	A	38	A
7/10/07	41	AA	41	AA	42	AA	45	A	57	A
8/17/07	81	AA	83	AA	83	AA	150	A	165	A
1/1/08	67	AA	99	AA	126	A	120	A	176	A
3/14/08	240	AA	311	AA	339	A	448	A	737	A
9/12/08	198	AA	265	A	454	A	702	A		
9/15/08	324	AA	458	A	343	A	703	A		
9/16/08	420	AA	681	A	421	A				
9/17/08	596	AA	909	A	530	A				
9/18/08	491	AA	875	A	397	A				
9/19/08	369	AA	554	A	331	A				
9/22/08	282	AA	422	A	271	A				
3/13/09	285	A	387	A	428	A				

Sachs Workers Net $2.6bn Bonuses Despite Losses, GUARDIAN (London), Dec. 17, 2008, at 25, *available at* LEXIS.

[58] *See infra* tbl.4.

At the beginning of the sample period, both the CDS spreads (in the range of twenty-one to twenty-five basis points) and the credit ratings (all A) reflect very little risk of default associated with the five investment banks. Moreover, the risks associated with each institution were comparable throughout 2006. Put another way, neither CDS spreads nor credit ratings reflected increased credit risks during 2006 at investment banks associated with investments in CDOs and subprime mortgages.

By April 2, 2007, when New Century Financial filed for bankruptcy,[59] CDS spreads had increased to a range of thirty-two to thirty-eight basis points from earlier ranges in the low twenties. This increase appears to have reflected new information about the exposure of the investment banks to the risks associated with subprime mortgages.

By July 10, 2007, credit rating agencies had expressed concern about subprime mortgage–backed CDOs and either downgraded or put numerous CDO tranches on a negative-ratings watch or review.[60] However, the credit ratings of the investment banks, the institutions with exposure to these instruments, remained high and unchanged. Meanwhile, CDS spreads increased again, reflecting the increased perceived risk of default at investment banks. In particular, the CDS spreads for Bear Stearns increased by more than those of the other investment banks, indicating that Bear Stearns had more exposure to risk in subprime markets.

On August 17, 2007, news spread about problems at Countrywide Financial, a leading subprime lender.[61] Again, CDS spreads at the investment banks widened while credit ratings remained constant. At the same time, spreads on Lehman Brothers CDSs grew to reflect risks comparable to those at Bear Stearns.

By the beginning of 2008, CDS spreads reflected particularly increased risks at Bear Stearns. CDS spreads also reflected greater risks at Lehman Brothers and Merrill Lynch than at Morgan Stanley or Goldman Sachs. CDS spreads ranged widely, from a low of sixty-seven basis points at Goldman Sachs to a high of 176 basis points at Bear Stearns.

On March 14, 2008, Bear Stearns failed and was taken over by JPMorgan Chase.[62] By this time, CDS spreads for all of the investment banks reflected a high probability of default, as well as considerable

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[59]   *See infra* tbl.4.
[60]   *See id.*
[61]   *See id.*
[62]   *See id.*

discrimination among the banks' riskiness, with Goldman Sachs's CDS spreads reflecting the least risk and Lehman Brothers's CDS spreads reflecting the most.

CDS spreads increased again leading up to September 15, 2008, when Lehman Brothers filed for bankruptcy protection.[63] Spreads remained highly volatile during the following days, although they declined sharply from the immediate postbankruptcy spike. This reflected the increased probability and potential magnitude of government intervention in financial markets. Throughout this period, CDS spreads continued to reflect less risk associated with Goldman Sachs than with other investment banks.

One might argue that high credit ratings were justified throughout this period, notwithstanding the negative news, because they reflected the high probability of government intervention and rescue. This argument is convenient in hindsight, but it has no support in the data. With respect to these investment banks, we are not aware of any published statement by the major credit rating agencies noting that the reason ratings remained high was the likelihood of government intervention. More importantly, the likelihood of government intervention was not constant across either periods or firms.[64]

C. *Event-Specific Analysis*

Next, we assess the nature of changes in CDS spreads during the sample period. Specifically, we ask whether CDS spreads reacted to particular news events that plausibly conveyed important credit-related information. To generalize our analysis of the data, we estimated a regression model over the entire sample period to test the effects of crisis-related news on cumulative CDS-spread changes for each of the fifteen individual financial firms.

We constructed a timeline of significant events based on the financial crisis literature and our own investigations.[65] Table 4 in the Appendix summarizes of these events. Our timeline begins with the April 2007 bankruptcy filing by New Century Financial, and it extends

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[63] *See id.*

[64] The argument that constantly high credit ratings reflected the likelihood of government intervention rather than any individual assessment of the probability of default, would be stronger for the government-sponsored entities, such as Fannie Mae and Freddie Mac.

[65] *See, e.g.*, Gary Gorton, *The Panic of 2007*, at 79-81 (Yale ICF, Working Paper No. 08-24, 2008), *available at* http://ssrn.com/abstract=1255362 (chronicling events of the financial crisis from 2007 through the summer of 2008).

through the announcement in September 2008 that Citigroup was taking over Wachovia.[66] Most of these events were clustered during the late summer and fall of 2008.

We then estimated the effects for cumulative spreads over three-day windows surrounding each event. Table 5a in the Appendix reports the results for the 2007 events, and Table 5b in the Appendix reports the results for 2008. Table 5a indicates that the earliest events did not have a statistically significant impact on the CDS spreads of the top commercial and investment banks. Although spreads generally increased from January through July of 2007—more than doubling overall—the increases do not appear to have been in response to specific public disclosures. The first statistically significant increase is the August 6, 2007, event in which American Home Mortgage Investment Corporation filed for bankruptcy protection. This event coincided with a 39.6-basis-point increase in the CDS spread for Bear Stearns, though no other commercial or investment bank shows a statistically significant change at this time.

Interestingly, eleven days later, on August 17, 2007, a run on Countrywide Financial[67] triggered a widespread *decline* in CDS spreads at many of the top commercial and investment banks. Bear Stearns's cumulative CDS spread fell more than 100 basis points in the three days surrounding this event. A likely explanation for this decline in spreads was the market's positive response to the prospect of government intervention, including the Federal Reserve's announcement that it was cutting the discount rate.[68]

Table 5b shows that the CDS market's response to the events in 2008 was more dramatic. In early March 2008, spreads widened as policymakers announced a $40 billion increase in the Term Auction Facility, along with plans to expand their securities lending program.[69] Most notably, this event was associated with a 148-basis-point increase in Lehman's CDS spread and a 258-basis-point increase in Bear Stearns's spread. A week later, Bear Stearns failed.[70] During the three days surrounding this event, Bear Stearns's spread fell by 182 basis points, while the CDS spreads of its acquiror, JPMorgan Chase, in-

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[66] Because of changing market conditions, Citigroup never completed the acquisition of Wachovia. Wachovia was ultimately purchased by Wells Fargo on December 31, 2008.

[67] *See infra* tbl.4.

[68] *See id.*

[69] *See id.*

[70] *See id.*

creased by thirty-two basis points. Lehman Brothers (which many market participants perceived as the most likely to fail next) had a fifty-six-basis-point increase in its CDS spread.

The crisis deepened in September 2008. During a period of ten days, the government seized Fannie Mae and Freddie Mac, Lehman failed, and the government announced it would make an emergency $85 billion loan in an attempt to rescue AIG. During this period, CDS spreads for Morgan Stanley increased dramatically (its spread in the three-day window, which included the Lehman decline and the rescue of AIG, increased by a staggering 540 basis points). CDS spreads for Goldman Sachs and Wachovia by increased 346 basis points and 268 basis points, respectively. The CDS spreads of commercial banks such as Bank of America, Wells Fargo, and JPMorgan Chase increased by roughly forty to fifty basis points over this time period, reflecting market participants' views that these banks were "safer."

It is interesting to look at the response of AIG's CDS spreads to these events. Its spreads traded at less than ten basis points in early 2007. A year later, in January 2008, its spread was around sixty-five basis points. Table 5b shows that AIG's spread did not respond significantly to any particular event. However, there was still a lot of movement in its spread throughout 2008. Its spread rose to more than 250 basis points in mid-March and then fell to below 100 basis points in mid-May. From that point forward, its spread steadily increased. Two weeks before the government rescue, its spread was 375 basis points. Over the next two weeks, the spread increased dramatically, exceeding 2500 basis points on the day of the announced rescue. By the end of 2008, the spread had declined to around 500 basis points. More recently, the spread increased and was again above 1000 basis points in March 2009.[71]

We also performed event studies for the entire sample, not just the fifteen selected financial institutions. We tested the responsiveness of the entire sample of CDS spreads for the different credit rating letter categories. We estimated a regression model over the entire sample period, in which the dependent variable was the daily change in the average CDS spread for an equal-weighted portfolio of all CDS spreads in the sample, as well as a model that focused on equal-weighted port-

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[71] The volatility of AIG's credit spreads suggests that a rolling average might be a better measure of risk than credit spreads for individual dates. For example, one of the authors of this Article has suggested a rolling-average market-based substitute for credit ratings, based on thirty or ninety days of trading data. *See* PARTNOY, *supra* note 16, at 17-18 ("Rolling averages also more accurately reflect available information than credit ratings and are not likely to be subject to manipulation or abuse.").

folios for different rating categories. We used the return on the S&P 500 Index, the daily change in the three-month Treasury rate, and the daily change in the slope of the term structure as control variables. Explanatory variables included a set of dummy variables surrounding each of the event dates listed in Table 4.

More specifically, we estimated dummy-variable coefficients for the date of each event and for the ten days before and after the event. Over various event windows within each of these twenty-one-day periods, we calculated the cumulative spread changes and their standard errors. This approach enabled us to estimate the effect that each event had on the average CDS spreads for an equal-weighted portfolio of all financial firms in the overall sample (EW) and for each of the five ratings classes.

Table 6 in the Appendix reports the CDS-spread changes for the three-day windows (day minus one to day plus one) surrounding each event. The (unreported) results for the longer event windows are qualitatively similar.[72] Looking at the top half of Table 6, we see that none of the 2007 events had a statistically significant impact (at the five-percent level or less) on the average CDS spreads for any of the ratings classes.

A different picture emerges from the bottom half of Table 6, in which we see that several of the events in 2008 had a positive and statistically significant impact on at least some groups' CDS spreads. For many of the events, the cumulative spread increases were of similar magnitude across all ratings classes. There is no evidence suggesting that the lower-rated firms were negatively affected by the events of 2008. Indeed, in a few cases, the AAA firms had the largest increase in cumulative spread. For example, when Bear Stearns collapsed in March, only the AAA firms experienced a meaningful increase in cumulative spread changes, with the average spread rising by 23.5 basis points. Likewise, in June 2008, when MBIA and Ambac lost their AAA rating, the average spread increased by 72.5 basis points for the AAA firms, 33.7 basis points for the AA firms, 13.6 basis points for the A firms, and 1.2 basis points for the BBB firms. The spread increases for the A and BBB firms were not statistically significant. A similar pattern exists for the first AIG bailout and for Citigroup's announcement on September 29, 2008, that it would acquire Wachovia: the spreads on

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[72] One complicating factor is that the event windows often overlap in the summer and fall of 2008, which makes it harder to interpret the longer event windows. The results corresponding to the longer event windows are available from the authors upon request.

AAA firms increased sharply (by 69.8 basis points), while the spreads on lower-rated securities rose more moderately.

These results confirm that many crisis-related events led to dramatic increases in the average CDS spreads for financial institutions. The contrast to steady credit ratings is sharp, and these results suggest that CDS spreads reflected information in a more accurate and timely manner than did credit ratings. CDS spreads responded to many of the news events during the sample period, while credit ratings did not.

In other cases, CDS spreads increased or decreased more gradually, or at different times, than the events we have identified as particularly important. There are several ways to interpret this result. One possibility is that we have not chosen the full set of important event dates. A more detailed look at how market participants assimilated information might generate more robust results. Another possibility is that market participants became aware of information relevant to financial institutions at times other than the event dates and then traded CDS contracts based on that information. Regulators and commentators have alleged in individual cases that market participants traded CDS on the basis of nonpublic information, and it is possible that the more graduated increase in CDS spreads at various times in the sample reflects such trading.[73] A final possibility is that, although CDS spreads respond to certain information, they do not react as quickly or as accurately as other markets, such as equity markets. We test, and reject, this possibility in Part III, which demonstrates that CDS spreads respond to particular news events comparably to equity markets and satisfy typical definitions of efficiency.

III. CDS SPREADS VERSUS EQUITY PRICES

Other researchers have concluded that the CDS market incorporates new information more quickly than does the traditional bond market.[74] However, the timeliness of CDS spreads relative to stock re-

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[73] *See* Press Release, SEC, SEC Files First Credit Default Swap Insider Trading Case (May 5, 2009), *available at* http://www.sec.gov/litigation/litreleases/2009/lr21023.htm (reporting the first suit alleging insider trading of CDSs); *see also* Acharya & Johnson, *supra* note 11, at 134-37 (quantifying the effects of trading on nonpublic information in CDS markets).

[74] *See* Blanco et al., *supra* note 11, at 2270-71 (comparing price volatilities after the introduction of new information and finding that, compared to the cash bond market, "the CDS market contributes around 80% of price discovery"); Zhu, *supra* note 11, at 227 ("This implies that the derivatives market does a better job in incorporating future rating events into the price.").

turns is not so clearly identified.[75] Accordingly, we collected stock return data from the Center for Research in Security Prices (CRSP) for each financial firm with available CDS data and then ran several tests comparing stock returns to CDS returns.

In some of our tests, we aggregated CDS quotes by the underlying security's credit rating. This breakdown enabled us to gauge whether the markets for high- and low-rated firms responded differently, in terms of either magnitude or timing, to key events.

As part of our assessment of the informational content of the CDS market, it is interesting to compare how information affects the CDS market and the stock market. To address this issue, we conducted Granger causality tests relating stock returns and changes in CDS spreads for the fifteen profiled firms.[76] These tests were run for each month between 2006 and 2008. Using the daily CDS spreads and stock returns for the fifteen firms, we ran the following tests:[77]

(1) $RETURNS_{jt} = a0 + a1*RTB_t + a2*SLOPE_t + a3*SP500_t + \sum_{j=1,4} a4_i*SPREAD_{jt-i} + \sum_{j=1,4} a5_i*RETURN_{jt-i}$

(2) $SPREAD_{jt} = b0 + b1*RTB_t + b2*SLOPE_t + b3*SP500_t + \sum_{j=1,4} b4_i*SPREAD_{jt-i} + \sum_{j=1,4} b5_i*RETURN_{jt-i}$

Where $RETURNS_{jt}$ is the daily return to the *j*th company's equity; $SPREAD_{jt}$ is the CDS spread on the *j*th company's senior debt; RTB_t is the daily change in a three-month Treasury bill's yield to maturity; $SLOPE_t$ is the daily change in the slope of the yield curve, measured as the difference between the ten-year constant maturity Treasury rate and the two-year constant maturity Treasury rate; and $SP500_t$ is the daily return to the S&P 500 index, as computed by CRSP.

For brevity, we only summarize the estimated coefficients for the three control variables for each of the seventy-two monthly regressions

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[75] *See* Norden & Weber, *Co-movement, supra* note 11, at 554 (finding that the CDS and stock markets have a negative intertemporal relationship and that the sensitivity of the CDS market to prior stock market movements is related to the firm's credit quality and the size of bond issues).

[76] The results in Table 7 of the Appendix test a statistical concept known as Granger causation, which asks whether the changes in one series reliably precede the changes in another one. If CDS spreads "Granger cause" stock returns, this means that CDS spreads incorporate information that becomes impounded in stock returns only later. As it turns out, Table 7 illustrates bidirectional Granger causation: CDS spreads help explain subsequent stock returns, and vice versa. In terms of economics, each series includes some information that is relevant to the other.

[77] For a summary of the various factors that are likely to influence daily CDS spreads, see generally Greatrex, *supra* note 11.

(two sets of regressions for each of the thirty-six months).[78]   In the *SPREAD* regressions, we generally found a negative and statistically significant link between a firm's daily CDS spreads and the contemporaneous return of the S&P 500.   That coefficient was insignificant in some months, and it was significantly positive only in January 2007.   Moreover, the absolute value of this coefficient became much larger later in the sample period.   During the height of the crisis in 2008, the estimated values for *b3* were strongly negative and became larger in absolute value.

In the *RETURNS* regressions, we consistently found (as expected) a significantly positive correlation between the returns on the individual financial firms and the returns on the overall market.   In both sets of regressions, the coefficients on the other two control variables have no consistent pattern and are often statistically insignificant.

Table 7 in the Appendix reports the results from the monthly Granger causality tests.   The Table's left half reports the results from estimating regression (1) for fifteen large financial institutions in one sample month.   For each month, we report test statistics for the following hypotheses:

a)   The sum of the four lagged coefficients on *SPREAD* equals zero, and

b)   The four lagged coefficients on *SPREAD* all equal zero.

In other words, we test whether lagged CDS spreads help predict contemporaneous equity returns after controlling for lagged equity returns.   The right half of Table 7 reports statistics from regression (2), testing whether lagged stock returns significantly affect contemporaneous CDS spreads after controlling for lagged CDS spreads.

The results reported in Table 7 indicate that causation regularly works in both directions: CDS spreads Granger cause stock returns and stock returns Granger cause CDS spreads.   The statistical significance of these tests increases later in the sample period, consistent with the greater variation in the regressions' variables.   These results confirm that there is a relative efficiency between the CDS market and the stock market.   If anything, the causation is somewhat stronger in the direction of spreads causing returns.[79]   On balance, these results reinforce the conclusion that the CDS market is efficient.

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[78]   Results for the other variables are available from the authors upon request.

[79]   Some other researchers have concluded that stock returns lead CDS spreads. *See, e.g.*, Santiago Forte & Juan Ignacio Peña, *Credit Spreads: An Empirical Analysis of the Informational Content of Stocks, Bonds, and CDS*, 33 J. BANKING & FIN. 2013, 2022 (2009) (concluding that "stocks lead CDS and bonds more frequently than the opposite");

CDS spreads and equity prices do not move in lockstep or even with the same degree of correlated movement one might expect from markets closely related by arbitrage opportunities, such as stocks traded in two different markets or stocks and options traded in related markets. In particular, it appears that, at least in certain instances, the one-day CDS market reaction was significantly greater than the one-day equity market reaction. For example, CDS spreads increased dramatically on certain days when equity prices declined only slightly, particularly during July 2007. We describe one such instance for illustrative purposes.[80]

Specifically, we compared the spread reaction for CDSs based on senior obligations of AIG to the AIG stock price reaction for the ten-day period ending on August 1, 2007. We also compared these data to the performance of the ABX subprime mortgage index for A-rated obligations as well as AIG's credit ratings for the same period. The data are summarized below in Table 3.

Table 3: AIG CDS Spread Reaction Versus Stock Price Reaction for Ten Days, Ending August 1, 2007

	AIG Stock	AIG CDS	ABX A Index	Credit Rating	% Change AIG Stock	% Change AIG CDS	% Change ABX A Index
7/19/07	69.66	20.45	90.21	AA			
7/20/07	69.04	21.57	88.39	AA	-0.89%	5.48%	-2.02%
7/23/07	68.85	27.61	87.25	AA	-0.28%	28.00%	-1.29%
7/24/07	67.71	28.42	85.04	AA	-1.66%	2.93%	-2.53%
7/25/07	68.16	29.56	80.61	AA	0.66%	4.01%	-5.21%
7/26/07	66.62	33.77	77.11	AA	-2.26%	14.24%	-4.34%
7/27/07	65.36	44.88	76.28	AA	-1.89%	32.90%	-1.08%
7/30/07	65.21	50.25	76.11	AA	-0.23%	11.97%	-0.22%
7/31/07	64.18	48.40	76.75	AA	-1.58%	-3.68%	0.84%
8/01/07	64.57	64.44	76.75	AA	0.61%	33.14%	0.00%

Norden & Weber, *Co-movement, supra* note 11, at 530 (finding that from 2000 to 2002, "stock returns clearly lead both CDS and bond spread changes from the same firm").

[80] Similar conclusions hold for other financial institutions during this same time period, although the specific dates of CDS-spread increases vary interestingly. For example, Bear Stearns's CDS spreads increased by nearly fifty percent on August 2, 2007, while different categories of Citigroup's CDS spreads increased by comparable or even greater percentages on July 19, 27, 30, and 31.

First, consider the columns for *AIG CDS* and *% Change AIG CDS.* Note that on several dates (July 23, 26, and 27, along with August 1), AIG's CDS spreads increased by more than ten percent. Neither AIG's stock price nor the overall subprime mortgage market index declined proportionally with those increases on these dates. It is difficult to isolate the information associated with these declines from news articles and analyst reports during this period. In any event, AIG's stock price declined by just over seven percent during the ten-day period, and the ABX subprime index declined by fifteen percent. AIG's CDS spreads, in contrast, more than tripled. Throughout this period (and for more than a year thereafter), AIG's credit rating remained unchanged at AA.

There are several possible interpretations of these reactions. The CDS market might have been reacting to information, including nonpublic information, while the equity market was not. The CDS market might have been reflecting information incorrectly, over- or underreacting, or responding to price manipulation. Alternatively, CDS markets might have been reflecting information that did not affect the expected value of equity investments but increased the probability of default. CDS-spread movements without corresponding equity price movements might reflect differential reactions to news by different slices of a financial institution's capital structure. Finally, that significant CDS-spread increases were not associated with simultaneous equity price declines suggests that market participants were not effectively executing a manipulative strategy of buying CDS protection and simultaneously shorting stocks. At least in this instance, to the extent parties both bought AIG's CDS protection and shorted AIG's stock during July 2007, the significant increase in CDS spreads was not associated with a similarly significant decline in price.

One might hope that CDS markets would predict a firm's financial conditions more than a few days in advance. One way to assess whether the CDS market sent "early warning signals" regarding the current financial crisis is to compare the CDS spread and equity price reactions to particular events.

Tables 8a and 8b in the Appendix examine how the stock market returns for these fifteen profiled firms responded to the same events. The results in Table 8a suggest that the events prior to 2008 did not have a large effect on the stock returns of the top commercial and investment banks. An exception was the August 17, 2007, run on Countrywide Financial stock: in the three days surrounding this event, an equal-weighted average of the abnormal returns of the top ten commercial and investment banks was 7.3%. This positive response is like-

ly attributable to the Federal Reserve's announced discount-rate cut.[81] Table 8b shows that the stock market responded more strongly to the events in 2008. Comparing the results of Tables 5b and 8b, we see that the CDS and stock markets generally responded similarly to the same events—although, as expected, the responses are negatively correlated. Increases in spreads are generally accompanied by declines in returns and vice versa.

These general results suggest that CDS and equity market participants identify changes in risk when they occur. The data also suggest that neither CDS nor equity markets gave an early warning of significant problems at the major banks before 2007, when spreads and prices were relatively constant. Statistical analyses of the important event dates suggest that neither CDS nor equity markets were early-warning indicators during 2007. There is anecdotal evidence, however, that during limited periods in 2007, certain financial institutions' CDS spreads reflected significantly more risk than did their equity prices. It is difficult to determine whether CDS spreads or equity prices more accurately reflected the risks during these periods, or whether the differential reaction was consistent. Still, one reasonable interpretation of the data is that CDS spreads were an early-warning indicator of risk at major financial institutions as early as July 2007.

CONCLUSION

Our findings suggest some promising areas for future research. First is the question whether CDS spreads reflect the generalized risk of counterparty defaults. CDS trades include no general mechanism to assure that counterparties perform on their contractual obligations. Some swaps specify collateral requirements, but a buyer of protection generally takes on some counterparty credit risk when purchasing a CDS. These counterparty risk exposures apparently present no substantial problems under normal market conditions.

However, in the fall of 2008, policymakers feared that the bankruptcy of one large counterparty might exacerbate widespread solvency concerns, further disrupting financial markets. These concerns provided much of the motivation for bailing out AIG in September 2008. Hayne Leland observes that default probabilities (implied cre-

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[81] On August 17, 2007, the Federal Reserve reduced its discount-window primary-credit rate, known as the discount rate, from 6.25% to 5.75%. *See* Fed. Reserve, Historical Daily Discount Window Primary Credit Rate, http://www.federalreserve.gov/releases/h15/data/Daily/H15_DWPC_NA.txt (last visited Apr. 15, 2010).

dit spreads) can be computed from other securities that trade on organized exchanges and therefore reflect no counterparty risk.[82] Acharya, Engle, Figlewski, Lynch, and Subrahmanyam present a graph comparing the CDS spread on Goldman Sachs to an implied spread constructed from Goldman's equity and options on its equity.[83] In the fall of 2008, the CDS spread rose sharply relative to the synthetic, counterparty-default-free measure of Goldman Sachs's default risk.[84] One could apply this methodology to a larger number of financial firms over a longer time period.[85]

Second, we have only evaluated CDSs written on senior underlying bonds. In part, this decision was motivated by the (slightly) greater availability of spread data for the senior underlying reference instruments. We also felt it was important to consider homogeneous securities and thought that senior debt would provide the best estimate of default probabilities. However, one could replicate some of the analysis for CDSs written on subordinated underlying securities. One hypothesis would be that the junior CDSs might respond sooner to developing information about a firm's credit quality.

Third, building on our interest in implied credit default premiums, one might attempt to replicate some of our Granger causality tests by comparing CDS spreads to implied spreads constructed from equity values and option prices. Santiago Forte and Juan Ignacio Peña argue that implied credit spreads should produce more meaningful results about the relative information content of CDS and equity prices.[86]

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[82] Hayne Leland, Structure Models and the Credit Crisis, Presentation at the China International Conference in Finance 9-14 (July 8, 2009) (unpublished manuscript), *available at* http://haas.berkeley.edu/groups/finance/CHINA7.pdf.

[83] Viral V. Acharya et al., *Centralized Clearing for Credit Derivatives*, *in* RESTORING FINANCIAL STABILITY 251, 257 (Viral V. Acharya & Matthew Richardson eds., 2009).

[84] *Id.*

[85] *See* Santiago Forte & Lidija Lovreta, Credit Risk Discovery in the Stock and CDS Markets: Who Leads, When and Why? 21 (Dec. 17, 2009) (unpublished manuscript), *available at* http://ssrn.com/abstract=1183202 (examining ninety-four companies over two years and concluding that the probability of the stock market leading credit risk discovery increases with the level of credit risk, although the probability of the CDS market leading credit-risk discovery is positively related to the presence of severe credit deterioration shocks). The null hypothesis to be tested by observed data would be that these two spread measures are equal. (At minimum, the difference between observed CDSs and implied credit premiums should not vary much over time.) If the observed data are very unlikely, rejecting the null hypothesis would imply that counterparty uncertainty in the CDS market may have been a factor in the financial-market turmoil of late 2008.

[86] *See* Forte & Peña, *supra* note 79, at 2014 (arguing that implied credit spreads incorporate changes in equity prices, interest expenses, risk-free rates, and cash dividends, and predicting that the implied credit spreads are integrated with CDS spreads).

Fourth, we have limited ourselves to analyzing large North American financial institutions. One could extend the analysis to some of the large institutions affected elsewhere, particularly in Europe.

Finally, one could attempt to assess more precisely how relying on CDS spreads might affect the CDS market and perhaps have unanticipated consequences.[87] Although relying on a market measure would not create the kinds of agency costs and externalities associated with relying on institutions, it might generate other effects. Put another way, once the use of CDS spreads changes, how will other market and regulatory behavior change? These are questions for future research.

Although there is much more work to do in assessing CDS spreads, our analysis has yielded some interesting conclusions. In evaluating CDS spreads during a time of unprecedented turbulence in U.S. financial markets, we find that both CDS and stock markets play important roles in impounding new credit information. Throughout 2006 the stock returns considerably led CDS-spread changes. During 2007, and even more in 2008, the ability of CDS spreads to predict stock returns increased.

From these results, it is hard to say whether one market "leads" the other consistently. At a minimum, both markets appear to impound new information quickly. Although we have no information here about the relative efficiency of the cash market for corporate bonds, other authors' results that the bond market is a relatively late mover seem consistent with our findings.[88]

More generally, it is apparent that CDS spreads reflect available information, which makes them useful for regulatory and risk-management purposes, even if they are not necessarily suitable for forecasting. Most of our aggregate CDS spreads remained flat until mid-2007, or March 2007 at the earliest, but reflected new information after that.

This approach to gathering and publishing CDS-spread data is a promising model for both regulators and private institutions to implement for monitoring purposes. CDS markets help banks reduce agency costs by providing an external check on their internal assess-

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[87] *Cf.* Robert E. Lucas, Jr., *Econometric Policy Evaluation: A Critique* (arguing that econometric models are well designed to achieve success in short-term forecasting but that the models do not provide information on the actual consequences of alternative economic policies), *in* THE PHILLIPS CURVE AND LABOR MARKETS 20 (Karl Brunner & Allen H. Meltzer eds., 1976).

[88] *See* Zhu, *supra* note 11, at 234 ("[T]he derivatives market moves ahead of the bond market in price discovery.").

ments of valuation and risk. Some regulators have investigated the way CDS spreads are gathered and published.[89] We argue, contrary to this criticism, that market participants might benefit from adopting a similar model to that used for CDS markets.

CDS markets also have been criticized as involving mere gambling by traders who frequently do not have insurable interests in the underlying obligations.[90] We argue that this criticism ignores the benefits associated with price discovery. CDS markets are like other speculative markets, including prediction markets, which are useful for assimilating information. Just as the condition of banks can be assessed based on stock returns, debenture risk premiums, and uninsured deposit spreads and amounts, so too can CDS spreads be used to assess bank health.

At a minimum, our analysis supports the conclusion that CDS spreads reflect information more quickly and accurately than credit ratings. Specifically, we find that as information about the subprime mortgage exposure of financial institutions was disclosed during 2007 and 2008, CDS spreads reflected that information, whereas credit ratings remained relatively unchanged.

If regulators and investors had looked to CDS spreads to assess the riskiness of financial institutions during this period, they would have found as early as April 2007 that such risks were significant and increasing. By early 2008, CDS spreads reflected a significant likelihood of default by one or more investment banks. In contrast, credit ratings reflected little or none of this information.

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[89] For example, the Department of Justice notified Markit that it was conducting an inquiry into how the firm gathered and published CDS information from various banks. *See, e.g.*, Eric Dash, *Derivatives Are Focus of Antitrust Investigators*, N.Y. TIMES, July 15, 2009, at B1.

[90] *See, e.g.*, *Hearing to Review the Role of Credit Derivatives in the U.S. Economy: Hearing Before the H. Comm. on Agriculture*, 110th Cong. 79-81 (2008) (statement of Eric Dinallo, Superintendent, Insurance Department, State of New York) ("In sum, in 2000 as a society we chose not to regulate credit default swaps, whether as insurance, as a security or gaming.").

APPENDIX

Table 4: Listing of Prominent Events[91]

	Event
4/02/07	New Century Financial bankruptcy.
6/11/07	Moody downgrades $5 billion of subprime RMBs; CDOs go on review.
7/10/07	S&P places $7.3 billion of 2006 asset-backed securites on negative ratings watch and announces review of CDS deals.
7/24/07	Countrywide Financial (CFC) earnings decline, warns on earnings.
7/31/07	American Home Mortgage Investment Corp. funding problem; Sowood shuts down.
8/06/07	American Home Mortgage Investment Corp. bankruptcy.
8/17/07	Run on CFC; Federal Reserve reduces discount rate from 6.25% to 5.75%.
9/17/07	Repeated large writedowns; several CEOs step down.
11/13/07	Bank of America, Legg Mason, SEI, and SunTrust prop up money market funds.
12/10/07	UBS further writes down $10 billion. Bank of America shuts $12 billion money market fund.
3/07/08	$40 billion increase in Term Auction Facility; Fed. Reserve expands securities lending activities.
3/14/08	Bear Stearns fails and is taken over by JPMorgan Chase.
6/05/08	MBIA and Ambac lose AAA rating.
7/14/08	Fed. Reserve Bank of NY authorized to lend to Fannie Mae and Freddie Mac.
9/08/08	Government seizes Fannie Mae and Freddie Mac.
9/15/08	Lehman Brothers (LEH) files for bankruptcy.
9/16/08	Government announces $85 billion loan to rescue AIG.
9/22/08	Goldman and Morgan Stanley become BHCs; Bernanke and Paulson testify.
9/29/08	Citigroup announces acquisition of Wachovia.

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[91] *See* Gorton, *supra* note 65, at 79-81 (including a similar table of crucial events during the "Panic of 2007"). Table 4 is supplemented by the authors' own investigations.

Table 5a: Responses of CDS Spreads to Events in 2007, by Firm[92]

	4/2	6/11	7/10	7/24	7/31	8/6	8/17	9/17	11/13	12/10
BAC	0.638	-2.621	4.643	-0.009	-5.963	9.875	-17.562	-5.063	-7.132	-6.026
	(0.110)	(-0.45)	(0.803)	(-0.00)	(-1.03)	(1.703)	(-2.90)*	(-0.87)	(-1.22)	(-1.04)
C	2.716	-5.089	1.718	-5.472	-6.243	11.112	-39.791	-9.163	2.109	-0.614
	(0.108)	(-0.20)	(0.068)	(-0.21)	(-0.24)	(0.441)	(-1.51)	(-0.36)	(0.083)	(-0.02)
JPM	0.925	-1.466	8.289	4.019	-9.861	4.002	-26.539	-7.098	-7.070	-7.545
	(0.142)	(-0.22)	(1.281)	(0.620)	(-1.52)	(0.616)	(-3.91)*	(-1.09)	(-1.08)	(-1.16)
WB	1.205	-2.987	3.051	-0.907	-6.783	10.669	-26.027	-7.024	-0.734	-6.677
	(0.093)	(-0.23)	(0.237)	(-0.07)	(-0.52)	(0.828)	(-1.93)	(-0.54)	(-0.05)	(-0.51)
WFC	1.355	-1.765	0.932	-2.670	-5.165	10.581	-18.182	-4.502	-9.748	-5.021
	(0.171)	(-0.22)	(0.117)	(-0.33)	(-0.65)	(1.330)	(-2.19)*	(-0.56)	(-1.22)	(-0.63)
BSC	2.706	-5.664	7.831	2.571	5.463	39.641	-108.422	-28.058	-27.393	-23.689
	(0.195)	(-0.40)	(0.564)	(0.184)	(0.393)	(2.830)*	(-7.28)*	(-2.00)*	(-1.94)	(-1.70)
GS	5.632	-3.897	6.401	-3.615	-10.897	6.671	-32.922	-14.311	-13.743	-2.201
	(0.220)	(-0.15)	(0.250)	(-0.14)	(-0.42)	(0.259)	(-1.22)	(-0.55)	(-0.53)	(-0.08)
LEH	3.470	-6.992	6.380	1.682	4.777	17.094	-64.107	-33.431	-14.629	-7.174
	(0.290)	(-0.58)	(0.533)	(0.140)	(0.398)	(1.416)	(-5.01)*	(-2.77)*	(-1.20)	(-0.59)
MER	6.663	-2.872	6.240	0.053	-10.818	7.077	-38.250	-10.930	-8.597	-4.959
	(0.344)	(-0.14)	(0.322)	(0.002)	(-0.55)	(0.364)	(-1.88)	(-0.56)	(-0.44)	(-0.25)
MWD	13.002	-8.077	2.988	-17.540	-1.368	14.495	-47.576	-9.581	5.733	9.288
	(0.176)	(-0.10)	(0.040)	(-0.23)	(-0.01)	(0.195)	(-0.61)	(-0.12)	(0.077)	(0.125)
AIG	11.684	-5.457	1.864	-3.349	18.927	9.237	-21.675	-4.415	20.039	1.525
	(0.083)	(-0.03)	(0.013)	(-0.02)	(0.134)	(0.065)	(-0.14)	(-0.03)	(0.141)	(0.010)
CFC	14.724	7.052	3.792	43.959	48.944	44.653	-205.395	-56.376	-27.577	-9.372
	(0.149)	(0.071)	(0.038)	(0.444)	(0.495)	(0.448)	(-1.93)	(-0.56)	(-0.27)	(-0.09)
WM	13.004	-5.869	4.413	12.077	3.489	24.969	-72.123	-35.703	-23.427	-18.841
	(0.448)	(-0.20)	(0.152)	(0.415)	(0.120)	(0.852)	(-2.32)*	(-1.22)	(-0.79)	(-0.64)
FRE	-0.137	-1.165	2.656	1.582	2.618	3.886	-7.420	-6.999	-14.525	2.886
	(-0.06)	(-0.53)	(1.231)	(0.733)	(1.213)	(1.795)	(-3.25)*	(-3.22)*	(-6.67)*	(1.335)
FNM	-0.121	-1.201	2.701	2.671	4.624	0.907	-8.853	-6.048	-15.497	1.785
	(-0.05)	(-0.56)	(1.273)	(1.258)	(2.178)*	(0.425)	(-3.94)*	(-2.83)*	(-7.23)*	(0.839)

[92] In Table 5a, t-statistics are shown in parentheses below each estimated coefficient, and * indicates statistical significance.

Table 5b: Responses of CDS Spreads to Events in 2008, by Firm[93]

	3/7	3/14	6/5	7/14	9/8	9/15	9/16	9/22	9/29
BAC	24.266	3.671	2.720	20.361	1.011	49.057	38.013	-40.027	2.910
	(4.179)*	(1.164)	(0.470)	(3.511)*	(0.174)	(8.238)*	(6.094)*	(-6.45)*	(0.493)
C	15.674	7.831	2.252	21.362	-4.043	58.864	108.402	-49.155	56.986
	(0.621)	(1.181)	(0.089)	(0.847)	(-0.16)	(2.274)*	(3.999)*	(-1.82)	(2.224)*
JPM	25.700	31.761	4.634	19.847	4.714	51.591	50.319	-37.098	8.977
	(3.955)*	(9.529)*	(0.715)	(3.059)*	(0.726)	(7.742)*	(7.209)*	(-5.34)*	(1.360)
WB	76.146	0.750	24.537	123.361	4.971	252.883	267.606	-46.556	-312.446
	(5.908)*	(0.159)	(1.911)	(9.585)*	(0.386)	(19.13)*	(19.32)*	(-3.38)*	(-23.8)*
WFC	27.818	3.859	5.004	27.469	1.750	36.380	41.243	-38.742	15.526
	(3.493)*	(1.038)	(0.630)	(3.454)*	(0.220)	(4.455)*	(4.822)*	(-4.55)*	(1.920)
BSC	258.215	-182.160							
	(18.44)*	(-56.8)*							
GS	56.700	-1.989	5.333	11.248	11.181	199.896	346.045	-86.074	37.578
	(2.205)*	(-0.29)	(0.208)	(0.438)	(0.435)	(7.580)*	(12.52)*	(-3.13)*	(1.439)
LEH	147.973	55.592	-21.754	56.571	157.283	171.052	-23.675		
	(12.26)*	(12.41)*	(-1.81)	(4.707)*	(13.03)*	(16.68)*	(-3.14)*		
MER	86.608	41.482	5.954	51.972	28.984	22.898	24.291	-60.807	77.984
	(4.457)*	(7.174)*	(0.307)	(2.678)*	(1.494)	(1.149)	(1.163)	(-2.92)*	(3.952)*
MWD	65.214	11.519	18.101	1.270	1.880	371.440	540.132	-291.808	89.917
	(0.878)	(1.013)	(0.244)	(0.017)	(0.025)	(4.881)*	(6.776)*	(-3.68)*	(1.193)
AIG	17.850	15.594	40.664	2.945	44.065	1819.791	873.402	-411.150	322.723
	(0.126)	(0.995)	(0.289)	(0.020)	(0.313)	(12.59)*	(5.771)*	(-2.73)*	(2.256)*
CFC	112.782	-11.769	25.736						
	(1.132)	(-0.89)	(0.260)						
WM	165.121	40.201	12.607	184.273	398.295	1067.348	42.005	1528.145	-754.370
	(5.641)*	(5.694)*	(0.433)	(6.319)*	(13.60)*	(34.98)*	(1.290)	(47.65)*	(-44.6)*
FRE	9.796	-6.618	-1.463	-33.246	0.665				
	(4.519)*	(-3.42)*	(-0.67)	(-15.3)*	(0.531)				
FNM	8.836	-7.893	-1.503	-32.328	0.744				
	(4.144)*	(-4.12)*	(-0.70)	(-15.1)*	(0.605)				

[93] In Table 5b, t-statistics are shown in parentheses below each estimated coefficient, and * indicates statistical significance.

**Table 6: Responses of CDS Spreads to Events in 2007 (top panel)
and 2008 (bottom panel), for an Equal-Weighted Portfolio
of All Financial Firms in the Sample (EW)
and by Ratings Group[94]**

	4/2/07	6/11/07	7/10/07	7/24/07	7/31/07	8/6/07	8/17/07	9/17/07	11/13/07	12/10/07
EW	-0.520	-3.969	-0.621	0.706	1.405	4.090	-22.765	-6.786	-3.072	-6.236
	(-0.04)	(-0.31)	(-0.04)	(0.056)	(0.111)	(0.323)	(-1.72)	(-0.53)	(-0.24)	(-0.49)
AAA	2.007	-6.628	0.302	-2.620	4.157	16.970	-39.295	-12.505	-6.008	-9.939
	(0.091)	(-0.30)	(0.013)	(-0.11)	(0.189)	(0.772)	(-1.71)	(-0.56)	(-0.27)	(-0.45)
AA	0.434	-4.187	0.648	2.040	2.872	8.606	-22.958	-9.412	-5.645	-9.599
	(0.028)	(-0.27)	(0.041)	(0.132)	(0.185)	(0.555)	(-1.41)	(-0.60)	(-0.36)	(-0.62)
A	1.343	-3.044	0.771	0.255	5.545	7.955	-18.022	-7.991	-2.263	-8.274
	(0.145)	(-0.32)	(0.083)	(0.027)	(0.598)	(0.856)	(-1.85)	(-0.85)	(-0.24)	(-0.89)
BBB	-0.809	-4.232	-2.874	-3.434	0.765	2.800	-10.272	-1.565	2.924	-2.368
	(-0.07)	(-0.38)	(-0.25)	(-0.30)	(0.068)	(0.251)	(-0.88)	(-0.14)	(0.261)	(-0.21)
BB	-4.215	-2.172	4.550	10.103	-13.605	-7.851	-54.616	-8.074	-4.124	-9.625
	(-0.05)	(-0.03)	(0.064)	(0.143)	(-0.19)	(-0.11)	(-0.74)	(-0.11)	(-0.05)	(-0.13)

	3/7/08	3/14/08	6/5/08	7/14/08	9/8/08	9/15/08	9/16/08	9/22/08	9/29/08
EW	15.293	-1.938	15.339	1.678	-0.518	35.519	30.478	1.757	28.409
	(1.209)	(-0.41)	(1.217)	(0.132)	(-0.04)	(2.738)*	(2.242)*	(0.129)	(2.211)*
AAA	40.117	23.501	72.503	-1.742	-3.800	48.511	57.142	24.439	69.798
	(1.824)	(3.797)*	(3.309)*	(-0.07)	(-0.17)	(2.151)*	(2.419)*	(1.040)	(3.126)*
AA	18.992	1.698	33.725	8.529	4.588	60.756	52.828	0.980	32.684
	(1.224)	(0.326)	(2.182)*	(0.550)	(0.296)	(3.819)*	(3.170)*	(0.059)	(2.075)*
A	28.369	-3.992	13.598	1.545	2.747	48.842	41.678	3.826	41.470
	(3.049)*	(-0.99)	(1.467)	(0.166)	(0.295)	(5.119)*	(4.170)*	(0.384)	(4.390)*
BBB	2.104	-2.191	1.224	2.203	-2.130	24.305	28.948	-4.775	19.396
	(0.188)	(-0.49)	(0.110)	(0.197)	(-0.19)	(2.125)*	(2.416)*	(-0.40)	(1.712)
BB	-3.993	-11.780							
	(-0.05)	(-1.06)							

[94] In Table 6, t-statistics are shown in parentheses below each estimated coefficient, and * indicates statistical significance.

**Table 7: Granger Causality Tests, by Month,
for Fifteen Large Financial Firms[95]**

For each month, we estimated regressions (1) and (2) for a panel of fifteen large financial institutions. We report the following here:

a) The sum of the four lagged coefficients on SPREAD (or RE-TURNS), and stars indicating the significance level of this sum's difference from zero.

b) An F-test for the hypothesis that the four lagged coefficients on SPREAD (or RETURNS) all equal zero.

Rejecting either of these hypotheses is consistent with the lagged variable causing the regression's dependent variable.

	RETURNS **Caused by** *SPREAD*				*SPREAD* **Caused by** *RETURNS*			
	Sum of Coeffs		**All Coeffs = 0**		**Sum of Coeffs**		**All Coeffs = 0**	
1/2006	0.64		0.74		4.89	*	2.57	*
2/2006	0.88		1.28		1.95		1.59	
3/2006	1.49		3.44	**	4.04	*	1.59	
4/2006	3.43		3.6	**	4.46	*	3.46	**
5/2006	2.14		2.11		3.56		1.82	
6/2006	2.61		5.07	***	2.07		1.27	
7/2006	1.82		4.91	***	0.44		4.83	***
8/2006	6.12	*	4.32	**	0.53		2.78	*
9/2006	1		1.29		0.14		5.69	***
10/2006	5.28	*	3.75	**	27.07	***	9.21	***
11/2006			1.98		1.05		2.99	*
12/2006	17.53	***	5.08	***	26.82	***	6.81	***
1/2007	1.8		5.41	***	3.87		1.59	
2/2007	0.21		7.36	***	6.04	*	5.94	***
3/2007	6.46	*	11.55	***	1.11		10.32	***
4/2007	0.33		5.77	***	39.23	***	11.9	***
5/2007	2.97		0.99		18.5	***	7.62	***
6/2007	5.29	*	2.68	*	0.22		3.13	*
7/2007	0.36		6.3	***	9.07	**	6.11	***
8/2007	12.58	***	13.7	***	8.64	**	9.12	***
9/2007	4.17	*	5.96	***	6.33	*	10.63	***
10/2007	4.92	*	48.31	***	0.32		5.73	***

[95] In Table 7, *, **, and *** indicate statistical significance at the .10, .05, and .01 percent level respectively.

	RETURNS **Caused by** *SPREAD*				*SPREAD* **Caused by** *RETURNS*			
	Sum of Coeffs		**All Coeffs = 0**		**Sum of Coeffs**		**All Coeffs = 0**	
11/2007	7.23	**	6.67	***	0.34		1.14	
12/2007	20.52	***	17.23	***	8.28	**	2.36	
1/2008	30.5	***	60.08	***	6.99	**	2.34	
2/2008	19.09	***	7.3	***	0.35		8.25	***
3/2008	2.7		5.87	***	2.79		3.05	*
4/2008	27.79	***	14.86	***	13.55	***	5.33	***
5/2008	22.08	***	10.1	***	5.06	*	1.59	
6/2008	13.76	***	12.98	***	0.03		5.28	***
7/2008	0.24		5.46	***	3.34		2.69	*
8/2008	2.88		1.11		0.18		1.76	
9/2008	0.22		7.36	***	0.52		3.02	*
10/2008	9.28	**	13	***	10.11	**	3.69	**
11/2008	6.76	*	3.62	**	0.55		1.72	
12/2008	0.01		1.07		0.01		3.59	**

Table 8a: Responses of Stock Returns to Events in 2007, by Firm[96]

	4/2	6/11	7/10	7/24	7/31	8/6	8/17	9/17	11/13	12/10
BAC	-0.010	0.001	-0.003	-0.001	0.004	0.010	0.068	-0.004	0.037	0.002
	(-0.28)	(0.031)	(-0.07)	(-0.01)	(0.106)	(0.267)	(1.825)	(-0.09)	(1.020)	(0.065)
C	-0.002	0.012	0.012	0.016	-0.005	0.045	0.039	0.001	0.044	-0.003
	(-0.03)	(0.209)	(0.206)	(0.272)	(-0.08)	(0.764)	(0.629)	(0.010)	(0.736)	(-0.04)
JPM	-0.001	0.007	-0.012	-0.032	-0.001	0.014	0.090	0.017	0.048	0.032
	(-0.03)	(0.222)	(-0.37)	(-0.97)	(-0.02)	(0.428)	(2.567)*	(0.493)	(1.436)	(0.955)
WB	-0.035	0.016	-0.012	-0.020	-0.022	0.006	0.067	0.013	0.042	0.005
	(-0.84)	(0.371)	(-0.27)	(-0.48)	(-0.52)	(0.142)	(1.524)	(0.297)	(1.000)	(0.125)
WFC	-0.010	0.004	-0.013	-0.013	0.023	0.008	0.099	-0.004	0.070	-0.016
	(-0.29)	(0.111)	(-0.38)	(-0.39)	(0.672)	(0.227)	(2.767)*	(-0.13)	(2.047)*	(-0.45)
BSC	-0.009	0.009	-0.030	-0.014	-0.048	-0.047	0.147	0.039	0.007	0.095
	(-0.11)	(0.111)	(-0.38)	(-0.18)	(-0.62)	(-0.61)	(1.792)	(0.508)	(0.085)	(1.237)
GS	-0.016	0.012	-0.007	-0.029	-0.030	-0.007	0.019	0.027	0.047	0.000
	(-0.43)	(0.325)	(-0.20)	(-0.80)	(-0.83)	(-0.20)	(0.497)	(0.750)	(1.296)	(0.013)
LEH	-0.023	0.044	-0.020	0.011	-0.062	-0.041	0.102	0.029	0.050	0.052
	(-0.65)	(1.240)	(-0.55)	(0.310)	(-1.75)	(-1.16)	(2.727)*	(0.824)	(1.392)	(1.475)
MER	-0.002	-0.008	0.003	-0.016	-0.030	0.019	0.038	-0.010	0.035	0.036
	(-0.03)	(-0.17)	(0.057)	(-0.36)	(-0.68)	(0.442)	(0.836)	(-0.21)	(0.802)	(0.822)
MWD	-0.014	0.049	-0.015	-0.003	-0.018	-0.011	0.082	0.021	0.022	0.038
	(-0.21)	(0.759)	(-0.23)	(-0.04)	(-0.27)	(-0.16)	(1.230)	(0.322)	(0.344)	(0.592)
AIG	-0.001	-0.001	0.005	0.026	-0.011	0.003	-0.006	-0.004	-0.013	0.021
	(-0.01)	(-0.01)	(0.110)	(0.549)	(-0.23)	(0.070)	(-0.12)	(-0.07)	(-0.27)	(0.441)
CFC	-0.043	-0.013	0.005	-0.055	-0.104	-0.016	-0.133	0.152	-0.057	0.149
	(-0.63)	(-0.18)	(0.070)	(-0.81)	(-1.53)	(-0.23)	(-1.83)	(2.227)*	(-0.83)	(2.190)*
WM	-0.022	-0.009	-0.008	-0.019	-0.036	-0.047	0.099	0.012	0.009	0.031
	(-0.42)	(-0.17)	(-0.15)	(-0.36)	(-0.68)	(-0.88)	(1.774)	(0.228)	(0.170)	(0.586)
FRE	-0.004	0.002	0.005	0.010	-0.011	0.058	0.086	-0.028	0.019	-0.012
	(-0.04)	(0.022)	(0.060)	(0.115)	(-0.13)	(0.678)	(0.955)	(-0.32)	(0.219)	(-0.13)
FNM	-0.006	0.058	-0.023	0.016	-0.004	0.058	0.095	-0.037	-0.024	-0.002
	(-0.06)	(0.607)	(-0.24)	(0.164)	(-0.04)	(0.608)	(0.946)	(-0.39)	(-0.25)	(-0.02)

[96] In Table 8a, t-statistics are shown in parentheses below each estimated coefficient, and * indicates statistical significance.

Table 8b: Responses of Stock Returns to Events in 2008, by Firm[97]

	3/7	3/14	6/5	7/14	9/8	9/15	9/18	9/22	9/29
BAC	0.009	-0.023	-0.049	-0.066	0.073	-0.121	-0.033	0.191	0.023
	(0.239)	(-0.09)	(-1.37)	(-1.85)	(2.034)*	(-3.29)*	(-0.85)	(5.002)*	(0.638)
C	-0.005	-0.048	-0.033	-0.052	0.056	-0.139	-0.116	0.324	0.058
	(-0.07)	(-0.14)	(-0.55)	(-0.88)	(0.939)	(-2.28)*	(-1.82)	(5.110)*	(0.956)
JPM	-0.004	-0.023	-0.018	-0.052	0.056	0.003	0.057	0.090	0.117
	(-0.12)	(-0.09)	(-0.53)	(-1.56)	(1.675)	(0.086)	(1.582)	(2.509)*	(3.444)*
WB	-0.034	-0.068	-0.099	-0.322	0.125	-0.235	-0.096	0.587	-0.993
	(-0.81)	(-0.25)	(-2.36)*	(-7.64)*	(2.963)*	(-5.43)*	(-2.11)*	(13.04)*	(-23.2)*
WFC	0.008	-0.049	-0.013	-0.074	0.090	0.030	0.092	0.005	0.057
	(0.229)	(-0.20)	(-0.37)	(-2.16)*	(2.647)*	(0.869)	(2.513)*	(0.142)	(1.630)
BSC	-0.031	-0.521							
	(-0.40)	(-2.46)*							
GS	0.008	-0.001	0.009	-0.040	0.016	-0.093	-0.103	0.009	0.008
	(0.231)	(-0.00)	(0.247)	(-1.09)	(0.433)	(-2.48)*	(-2.64)*	(0.236)	(0.211)
LEH	0.029	-0.079	-0.018	-0.379	-0.149	-0.555	-0.112		
	(0.820)	(-0.32)	(-0.51)	(-10.7)*	(-4.21)*	(-18.4)*	(-5.06)*		
MER	-0.044	-0.012	-0.066	-0.113	-0.010	-0.232	0.223	0.343	-0.041
	(-0.99)	(-0.04)	(-1.50)	(-2.56)*	(-0.22)	(-5.14)*	(4.718)*	(7.304)*	(-0.91)
MWD	0.020	-0.002	0.004	-0.025	0.032	-0.077	-0.159	0.109	0.010
	(0.319)	(-0.00)	(0.064)	(-0.38)	(0.502)	(-1.17)	(-2.30)*	(1.595)	(0.159)
AIG	-0.009	-0.037	-0.002	-0.125	0.030	-0.875	-1.119	0.907	-0.137
	(-0.18)	(-0.12)	(-0.03)	(-2.63)*	(0.639)	(-17.9)*	(-21.8)*	(17.83)*	(-2.82)*
CFC	-0.088	-0.065	-0.036						
	(-1.28)	(-0.18)	(-0.52)						
WM	-0.168	-0.093	-0.069	-0.495	-0.049	-0.034	-0.107	0.616	-0.287
	(-3.18)*	(-0.31)	(-1.31)	(-9.40)*	(-0.92)	(-0.61)	(-1.81)	(10.65)*	(-9.42)*
FRE	-0.076	0.121	0.004	-0.295	-0.023				
	(-0.88)	(0.312)	(0.045)	(-3.45)*	(-0.47)				
FNM	-0.065	0.077	0.004	-0.374	-0.068				
	(-0.68)	(0.190)	(0.039)	(-3.92)*	(-1.24)				

[97] In Table 8b, t-statistics are shown in parentheses below each estimated coefficient, and * indicates statistical significance.

**Figure 1: Mean CDS Spreads (in Basis Points) of
Financial Firms by Bond Rating
January 2006–June 2007**
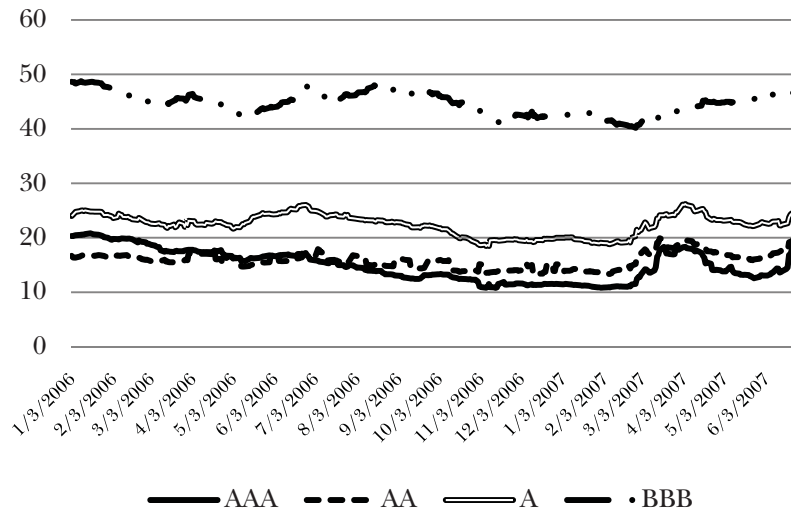

──AAA – – – AA ══⟩A ── ·BBB

**Figure 2: Mean CDS Spreads (in Basis Points) of
Financial Firms by Bond Rating
July 2007–December 2008**

──AAA – – – AA ══⟩A ── ·BBB