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# Assessing the Impact of Credit Derivative Seller Disclosure

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ASSESSING THE IMPACT OF CREDIT

DERIVATIVE SELLER DISCLOSURE

by

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Assessing the Impact of Credit Derivative Seller Disclosure

Thesis directed by Associate Professors Yonca Ertimur and Jonathan Rogers

The 2008 U.S. financial crisis raised questions about the quality of derivative disclosure by banks. I investigate banks that sell credit derivatives and the impact of recent disclosure mandated for these banks. Using measures of information asymmetry, I find banks that sell credit derivatives are more opaque than those that do not. Furthermore, difference-in-difference tests indicate improved bank transparency following mandatory increases in credit derivative seller disclosure. Because credit derivative sellers act as market makers in the credit default swap (CDS) market, I extend my analysis to investigate the effect of disclosure on liquidity in the CDS market. Results from these tests are consistent with a *decrease* in CDS market liquidity following mandatory disclosure. This finding comports with recent analytical studies of markets where liquidity providers have an information advantage. In these markets, information asymmetry spurs competition among market makers which, in turn, drives market liquidity. Taken together, my results suggest that mandated disclosure for sellers of credit derivatives provided transparency for investors in the equity market at the cost of decreased liquidity in the CDS market.

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# CHAPTER 1

# INTRODUCTION

> *Investors can't truly understand the nature and quality of [bank] assets and liabilities. They can't readily assess the reliability of the capital to offset losses. They can't assess the underlying sources of the firm's profits.* – Kevin Warsh, former U.S. Federal Reserve Governor, quoted in *The Atlantic* Jan. 1, 2013

In the wake of the financial crises in the United States and abroad, investors, regulators, and the media expressed concerns about the riskiness of assets at banks and insurance companies. A main source of this concern is derivatives. Derivative contracts are primarily executed bilaterally between a seller and a purchaser with little public disclosure of the risks being exchanged. As a result, investors trying to value companies that buy and sell derivatives find it difficult to assess the attendant risks.[1] I investigate banks that sell credit derivatives and the impact of recent disclosure mandated for these banks. Specifically, I examine whether the sale of credit derivatives is associated with more bank opacity by examining proxies for information asymmetry among investors. Next, I investigate whether recently mandated disclosure succeeds at providing transparency for these banks. Finally, I consider the effect of these disclosure requirements on liquidity in the over-the-counter (OTC) market for credit derivatives.

Understanding the impact of disclosures made by credit derivative sellers matters because selling credit derivatives is risky and the market for these derivatives is vast. A credit derivative is a contract that derives its value from default risk and the most common form is the credit default swap (CDS). A CDS buyer pays a fee (the CDS price) in exchange for insurance against default

[1] Some degree of opacity at banks is inevitable because of the sorts of assets that they hold. For example, trading positions can change instantaneously, which makes them difficult to monitor externally. See Section 2.1 for a discussion of bank opacity.

on a debt contract (usually a bond sold by a "reference entity"). The contract names a "notional amount" specifying the amount of debt for which the buyer will be insured. If the reference entity defaults, then the seller of the CDS pays the buyer the difference between the value of the debt after default and the notional amount. Thus the risk of default is transferred from the CDS buyer to the CDS seller. Of particular interest to those purchasing a CDS is the probability that they can collect from the seller if the contract is triggered.[2] Appendix A provides a diagram showing potential outcomes from a CDS contract.

The Bank for International Settlements estimates that, as of December 2013, $21 trillion of CDS contracts (notional value) were traded in over-the-counter markets. The major players involved in this market are large banks, insurance companies, and other institutional investors. Typically, a CDS buyer obtains price quotes from a group of major banks that sell CDS contracts[3] and purchases the derivative based on the price offered and the creditworthiness of the seller. Major banks act as liquidity providers. That is, after they sell CDS protection, they find another institution and buy an identical CDS with the goal of profiting on the difference between the sales price and the purchase price (the CDS bid-ask spread). For investors in bank equity, the question becomes, where does this risk end up? As documented in Morgan (2002), banks and insurers are more opaque than firms in other industries, making identification of these risks difficult, if not impossible.

The major institutions involved in the CDS market disclose information about their holdings in SEC filings and Federal Reserve regulatory reports. Since 1998, disclosure of

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[2] This counterparty credit risk in the CDS market and its relation to systemic risk in the financial system has been the subject of several research papers including Arora, Gandhi, and Longstaff (2012); Jorion and Zhang (2009); and Duffie and Zhu (2011).

[3] The largest American CDS sellers include J.P. Morgan, Bank of America, Citigroup, Goldman Sachs, Merrill Lynch, Morgan Stanley, and, before bankruptcy, Lehman Brothers.

derivatives in SEC filings has been governed under Financial Accounting Standard 133 (now ASC 815). Before the financial crisis, FAS 133 required disclosure of the *aggregate* notional and fair values of all derivatives held by the company. That is, FAS 133 allowed interest rate swaps, credit default swaps, forward contracts, and other derivatives to be lumped together. In response to the crisis, the FASB issued a staff position on FAS 133 requiring separate disclosures about sales of credit derivatives. The FASB focused on selling because of investor concerns after American International Group (AIG) and others had incurred large unanticipated losses on their credit derivative sales. The staff position added requirements for disclosing information about the terms of CDS sales and the maximum potential payout on the contracts.

Further disclosure is required for bank holding companies, some of the largest players in the CDS market. These disclosures are made in quarterly regulatory filings to the Federal Reserve (Federal Reserve Form FR Y9-C). Beginning in 1997, Form Y9-C required data on the notional amount of CDS contracts bought and sold. The Federal Reserve extended disclosure in 2002 by including the fair value of credit derivatives bought and sold as required disclosure on form Y9-C. I provide a timeline of major CDS related disclosure events in Appendix B.

These changes in disclosure requirements were aimed at improving investor ability to decipher the risks stemming from CDS sales. However, it's possible that an even more complete disclosure regime is needed to reveal the risks that these contracts represent. Thus Acharya (2011) and others suggest that the improved disclosure remains inadequate. For example, disclosure of the fair value of credit derivatives sold does not provide information on where the risk of payout is concentrated. Similarly, disclosure required in SEC statements about CDS terms and collateral arrangements is nonstandardized and difficult to compare across banks.

A stream of literature suggests that more transparent firms have less investor information asymmetry (e.g., Leuz and Verrecchia 2000; Brown and Hillegeist 2007; Lang, Lins, and Maffett 2012). I hypothesize that banks that sell credit derivatives are less transparent and thus have more information asymmetry than those that do not. That is, uninformed investors are at a greater disadvantage when investing in banks that sell credit derivatives than other banks, all else equal. While anecdotal evidence suggests that the risks involved with credit derivative selling are not communicated clearly, banks argue that these risks are immaterial because of collateralization agreements and hedging programs. Using a sample of 824 credit derivative seller observations from the first quarter of 2000 to the second quarter of 2013, I find banks that sell credit derivatives have higher information asymmetry (as measured by bid-ask spread and analyst dispersion) than those that do not. This result is robust to controls for bank size and structure (e.g., the proportion of bank assets that are loans) as well as market characteristics.

Next, I explore whether mandated disclosure for credit derivative sellers improves transparency. A goal of recent regulation is to make disclosure useful for less sophisticated investors (e.g., Cox 2006). Thus I test the informativeness of the additional disclosures by examining changes in information asymmetry after the rules take effect. Specifically, using a difference-in-differences research design, I find that credit derivative sellers have lower bid-ask spreads in the two quarters after the Federal Reserve required firms to report fair values in their regulatory filings compared to the two previous quarters. I find a similar decrease in bid-ask spreads in the two quarters after the FASB staff position on FAS 133 came into effect. When I use analyst dispersion as a measure of information asymmetry, I find that the FASB staff position on FAS 133 is associated with reduced analyst dispersion while the Federal Reserve fair value reporting requirement is not related to analyst dispersion. These results indicate that each of these disclosure changes decreased bank opacity. One potential reason for the differences in results across measures for the Federal Reserve fair value reporting requirement is that, while bid-ask spread is a market measure that subsumes all available information, analyst dispersion only captures the opinions of analysts, which, in turn, reflect their incentives and biases (e.g., Clement and Tse 2005). These could have precluded analysts from using bank regulatory reports in their forecasts.

To this point, my analyses have focused on credit derivative sellers and the effect of mandatory disclosures on the equity market. In my next analysis, I shift my attention to assessing the effect of mandatory disclosure on the market for CDS contracts. The traditional view is that disclosure is associated with improved liquidity, but I conjecture that this relationship may not hold in the CDS market. In the relatively opaque CDS market, high volume buyers and sellers of CDS contracts (dealers) act as market makers. When trading activities are not disclosed, informed investors act as market makers because they have the most accurate pricing data and high volume trading does not diminish their information advantage. However, when trading activities are disclosed, informed investors exit liquidity production in order to maintain their information advantage. Thus disclosure is associated with reduced liquidity production.[4] I find evidence consistent with this prediction. Specifically, I find that the FASB staff position on FAS 133 was associated with an increase in CDS bid-ask spreads and CDS price volatility, suggesting that this disclosure was costly in that it limited CDS market liquidity. This result holds after controlling for CDS-bond basis arbitrage strategies.

This study provides evidence that mandatory disclosure directed at credit derivative sellers benefitted equity investors at the cost of liquidity in the CDS market. However, the overarching effect of

[4] This line of reasoning is based on theory presented in Boulatov and George (2013) and empirical evidence in the CDS market presented in Qiu and Yu (2012). For additional discussion of these papers, see section 3.3.

this disclosure on social welfare remains unclear. Disclosure benefits the economy by allowing investors to efficiently allocate funds to firms. This disclosure appears to aide in this goal. However, a liquid CDS market also has benefits. CDS markets are an important source of liquidity in debt markets and aide in price discovery. Furthermore, the ability to isolate and trade default risk with credit derivatives allows for more accurate risk allocation across the economy. A limitation of this study is that, while I observe reduced liquidity in CDS markets after mandated disclosure, I am unable to assess how it affects CDS market benefits directly.

This paper contributes to the literature on bank disclosure in several ways. To my knowledge, it is the first study of the sale of credit derivatives as a source of bank opacity. I provide evidence of the informativeness of credit derivative seller disclosure. Current disclosure may still be inadequate to fully assess the riskiness of selling credit derivatives, but I find evidence that additional disclosures mandated by the Federal Reserve and the FASB have made selling banks more transparent. My study also contributes to the literature by presenting novel evidence of a cost of the additional disclosures. I show that they seem to have undercut liquidity provision in OTC derivative markets. My findings should matter to regulators and investors concerned with poor disclosure at banks.

This paper proceeds as follows. Section 2 describes background and prior research on credit derivatives and accounting. Section 3 presents my hypotheses and the theory that leads me to them. Section 4 presents my sample and variables. Section 5 presents my research design and results for tests in the bank equity market. Section 6 presents my research design and results for tests in the CDS market. Section 7 concludes.

# CHAPTER 2

# BACKGROUND AND PRIOR RESEARCH

## Bank Opacity

Banks are complicated businesses that suffer from a lack of transparency. Morgan (2002) documents the relative opacity of banks and insurers compared to other companies. He warns that "absent the steadying hand of government … the opacity of banks exposes the entire financial system to bank runs, contagion and other strains of 'systemic' risk." This concern manifested itself when the US economy suffered the financial crisis of 2008. Why, then, is there a lack of disclosure at banks?

Simply put, banks have both the incentive and the ability to hide risk. First, bank assets are opaque. The largest assets at banks are loans which may be made to customers on the basis of relationships or other soft information that is difficult to disclose. Second, banks trade in liquid markets and their trading positions are "slippery" (Morgan 2002). That is, trading positions are easy to change and difficult to monitor. Finally, banks are highly leveraged, creating a conflict between investors' desire for risk taking and creditors' concerns about repayment (Jensen and Meckling 1976). This agency problem provides reason for banks to avoid disclosing their full risks.

Inadequate derivative disclosure appears to be a manifestation of these issues. The risks of derivatives are difficult to convey because they are complex, and the contracts are not standardized. Furthermore, while derivative positions are not as liquid, or slippery, as equity positions, recent growth in derivative markets provides banks with a greater ability to hide their risk-taking. As a result, disclosure related to derivatives represents a challenge to regulators.

**Credit Derivatives**

A credit default swap is essentially an insurance contract on a referenced entity's debt (generally a bond). The seller receives a payment (the CDS spread or price[5]) in exchange for agreeing to pay the difference between the debt's after-default value and its held-to-maturity value, in the case of default. Generally, these contracts are written using the International Swaps and Derivatives Association (ISDA) master agreement which provides some standardization. Prior studies cite standardization as a reason that the CDS market grew quickly (e.g., Stulz 2009; Partnoy and Skeel Jr. 2006) from $3.7 trillion notional in 2003 to its peak of $62.2 trillion notional at the end of 2007. Recent trade compression efforts by market participants, whereby they maintain the same risk profile but reduce redundant contracts, has shrunk the total notional value of the market for CDS.[6] The market as of 2013 was estimated as $21 trillion by the Bank for International Settlements.

*The Market for Credit Default Swaps and Liquidity*

CDS contracts were developed by JP Morgan in 1994 and since then have been executed bilaterally on OTC markets. OTC markets do not rely on centralized trading to aggregate bids and offers, and to organize the trading process. Instead, contracts are privately negotiated between counterparties with little public information about prices. Furthermore, before regulation in the Dodd-Frank Act of 2010 came into effect, there was no mandate to register timely information about CDS trade activity (Sirri 2008). As a result, much of the CDS market data was hidden from the public. For a detailed review of OTC markets see Duffie (2012).

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[5] To avoid confusion between "CDS spread" and "bid-ask spread" I will refer to this as the "CDS price."

[6] Trade compression typically entails two CDS counterparties submitting portfolios of contracts with each other and eliminating any perfectly matching trades. Setting up perfectly matching trades has been a widely used strategy for eliminating derivative contracts because derivative contracts permit netting. Basel III banking requirements are the basis for trade compression efforts as they restrict the amount of derivative netting banks can use in capital ratios.

Informed traders have a competitive advantage as liquidity providers in the market for CDS because they are best informed about what the CDS prices should be. This creates a unique market structure. Boulatov and George (2013) model such a market and find that competition among market makers to exploit their information advantage can improve market liquidity. When information advantages are diminished, liquidity providers leave the market and liquidity is reduced. Qiu and Yu (2012) empirically examine this model by examining information transfers from the CDS market to the equity market. The authors assume high levels of information transfers indicate informed trading. Qiu and Yu (2012) find that the number of firms providing CDS quotes is positively associated with the amount of information transfers and thus the amount of informed trading, in line with predictions made in Boulatov and George (2013). Thus the information advantage that CDS sellers exhibit appears to be an important determinant of liquidity provision in the CDS market.

My study extends this literature by providing evidence of the effect of credit derivative seller disclosure on liquidity in the CDS market. Because of the unique structure of the CDS market the general belief that "more disclosure improves market characteristics" may not hold. I provide evidence on this relationship, which is particularly timely given the abundance of current regulation aimed at bringing transparency to OTC markets.

*Current Developments*

In 2010, Congress passed the Dodd-Frank Wall Street Reform and Consumer Protection Act, which, among other provisions, makes four notable changes aimed at improving market transparency in OTC derivatives markets. First, the act requires that entities report their CDS, interest rate swap and other OTC swap transactions to a swap data repository. Regulators will review this data and make data on trades (notional amount and reference entity) public starting in

2015. However, counterparty names will not be released. Second, the act requires central counterparty clearing for eligible OTC derivatives. Third, it requires electronic trading platforms. Fourth, the act imposes higher capital and minimum margin requirements for uncleared swaps.

Early evidence suggests that these changes have been effective in reducing counterparty credit risk in OTC credit derivative markets (Loon and Zhong 2014). However, CDS holdings remain a source of bank opacity. Investors hoping to understand the risks associated with a bank's credit derivative portfolio still are unable to do so (Acharya 2011). The CDS market is also still conducted over-the-counter and relies on the major banks to provide liquidity.

**Disclosure by Credit Derivative Sellers**

Credit derivative sellers must disclose a variety of information about their holdings if they wish to provide investors with the information necessary to understand the banks' exposure to risk. Acharya (2011) presents a framework for disclosure that includes information about types of exposures, their size, and the level of collateralization in the event the contracts require payment. Under this framework, the type of exposures would be summarized by product types (single name vs. index CDS), currency categories, maturities of contracts, the type of counterparties (bank, corporation, insurance company etc.), and the credit ratings of counterparties. The size of the exposure would be presented as the maximum notional exposure, the fair value, and the net exposure after accounting for offsetting contracts and collateral. Finally, this disclosure would also include a "stress test" that discloses the potential exposure a company faces if its counterparties have their ratings downgraded or if a hedging contract collapses. To understand the stress test, there would be a report detailing the entity's largest CDS counterparty exposures and the total additional liability that would be created if the entity's credit rating were downgraded and a margin call were to take place. Some of this disclosure is provided in SEC filings and bank regulatory reports. Below I summarize these disclosures.

*SEC Disclosure*

Statement of Financial Accounting Standards No. 133, issued in June 1998 and codified as ASC 815, provides guidance for disclosures related to derivative financial instruments including credit derivatives. This standard requires that all derivative assets and liabilities be measured at fair value and provides guidelines for the application of hedge accounting.[7] Before the financial crisis there was no specific mandate to break out derivatives into different categories and uses. Thus the common practice was to provide only the total notional value and fair value of derivative assets and liabilities. These aggregate values often include different types of derivatives, inhibiting assessment of risks associated with CDS contracts.

In response to the financial crisis, investors demanded disaggregated disclosure about derivatives to better assess potential risk.[8] FASB Staff Position (FSP) on FAS 133, issued in September 2008 and effective for reporting periods *ending* after November 15, 2008, requires additional disclosures for sellers of credit derivatives and financial guarantees. Specifically, under the FSP on FAS 133, credit derivative sellers must disclose (1) the approximate term of the credit derivative and the events or circumstances that would require the seller to perform under the credit derivative; (2) the maximum potential amount of future payments that the seller could be required to make under the credit derivative (not reduced by collateral amounts); and (3) the nature of any

[7] Credit derivatives rarely qualify for hedge accounting even if they are used to hedge default risk. While CDS values track the default risk associated with a reference entity's bonds they do not adjust for changes in interest rates and thus do not hedge changes in bond prices well enough to qualify as a fair-value hedge.

[8] The FASB also issued FAS 161 in March 2008 (effective for periods *starting* after November 15, 2008). Under FAS 161, entities must provide enhanced disclosures about (a) how and why an entity uses derivative instruments, (b) how derivative instruments and related hedged items are accounted for under Statement 133 and its related interpretations, and (c) how derivative instruments and related hedged items affect an entity's financial position, financial performance, and cash flows.

recourse provisions that would enable the seller to recover from third parties any of the amounts paid under the credit derivative. Recourse provisions that must be disclosed include collateral as well as other hedging, such as the purchase of credit protection with identical underlying entities.

The FSP on FAS 133 applies to all public companies including nonbanks that sell credit derivatives. However, before this disclosure requirement, banks already disclosed some of this information. The main value of this disclosure was that is applied to *all* credit derivatives sellers and provided comparison between bank portfolios and those of other companies.

*Federal Reserve Regulatory Disclosure*

Bank holding companies with over $500 million in assets must file financial data on a quarterly basis with the Federal Reserve using form FR Y-9C. This data is released publicly and is available in database form from the Chicago Federal Reserve website. Included in this report are a consolidated balance sheet, an income statement, and detailed supporting schedules. The content of the supporting schedules is frequently revised to address developments in the banking industry and changes in supervisory, regulatory, and analytical needs (Federal Reserve 2014).

The advent of credit derivatives spurred the Federal Reserve to require additional disclosure by bank holding companies that engage in credit derivative contracts. Since March 31, 1997, bank holding companies have been required to report the total notional amount of credit derivatives sold (i.e. where the bank holding company is the guarantor) as well as the total notional amount of credit derivatives bought (i.e. where the bank holding company is the beneficiary). I use this data to determine which banks were selling credit derivatives. Beginning in March 31, 2002, the Federal Reserve required additional disclosure of the positive fair value and negative fair value of credit derivatives bought and sold. I exploit this increase in disclosure in my research design.

Appendix B provides a timeline of increases in disclosure and other main events in the CDS market.

# CHAPTER 3

# HYPOTHESIS DEVELOPMENT

## Selling Credit Derivatives and Bank Opacity

I begin by investigating whether credit derivative sellers are relatively more opaque than other banks. I define an opaque firm as one that has relatively more information asymmetry among investors. Information asymmetries may impede the functioning of capital markets (e.g., Akerlof 1970). Absent regulatory intervention, companies voluntarily disclose information to facilitate contracting objectives (Healy and Palepu 2001). For instance, when there is information asymmetry between managers and investors, investors must be compensated for the level of information risk they face when investing in the company. Managers respond by voluntarily disclosing information and reducing the level of information risk to investors to reduce the cost of capital to the firm (e.g., Merton 1987).[9] However, to the extent that disclosure is costly, the optimal disclosure will not be complete disclosure. For example, Leung (2012) studies voluntary disclosure of order backlogs by industrial firms. She finds that, while disclosure of order backlogs reduces cost of capital, it is not disclosed by firms that are heavily reliant on suppliers because suppliers could exploit this information and raise prices.

As I discuss in Section 2.2, current disclosure appears to be inadequate to fully assess the risk involved with selling credit derivatives. However, this risk may be so small that it is immaterial. Major banks that sell credit derivatives argue their businesses are actually low risk

[9] Leuz, Lambert and Verrecchia (2011) show that, in a perfectly competitive market, information asymmetry does not affect firm cost of capital. Instead, voluntary disclosure is required to increase information precision among investors and, thereby, lower the cost of capital to the firm.

because credit derivatives are highly collateralized. Furthermore, when banks act as market makers they reduce risk by buying credit derivative contracts that are identical to the ones they sell. If these practices make credit derivative selling immaterial to investor valuation, I will fail to detect additional opacity for sellers.

However, if credit derivative selling is material to investor valuation, and disclosure does not fully communicate the risks of credit derivatives, informed investors will price the risk based on their private information about the company's credit derivative selling program. If some traders in the equity market have more accurate private information about the firm's credit derivative selling business than other investors, their trading will differ and I will detect information asymmetry among investors. This leads me to my first hypothesis stated in the alternative form:

> **H1:** Credit derivative selling is positively associated with information asymmetry in the equity market.

**The Impact of Mandatory Credit Derivative Seller Disclosure in the Equity Market**

Next, I investigate whether mandatory disclosures required by the Federal Reserve and the SEC reduce opacity at credit derivative sellers. Regulated disclosure may arise for a number of reasons (Watts and Zimmerman 1986). First, prospective investors act as free riders in the market for voluntary disclosure by consuming information without paying for it. This potential market inefficiency could result in an underproduction of information. Second, absent market inefficiencies, regulators may want to improve the welfare of unsophisticated investors who cannot afford to obtain the information necessary to invest in a company. In this case, regulators impose disclosure regulations to redistribute wealth rather than to improve economic efficiency.

I examine two regulatory changes in disclosure requirements, disclosure of the fair value of credit derivatives sold by bank holding companies and the FSP on FAS 133 that was enacted after the financial crisis. For me to find a relation between the disclosure change and information asymmetry, the new information must be useful for the valuation of the company. As discussed above and in Acharya (2011), a wide range of information is required to adequately assess the riskiness of a credit derivative seller. The information required by these regulatory changes may be useless when not accompanied by complementary information. For instance, the amount of maximum potential payout on CDS contracts means little when not accompanied by the probability of that payout.

Thus regulated disclosure of information should reduce information asymmetry if the new information is useful for the valuation of the company. That is, previously uninformed investors will acquire new information and update their valuation of the firm to more closely align with the valuation of informed investors after enactment of mandatory disclosure rules. This leads to my next hypothesis in the alternative form.

> **H2:** Mandated credit derivative seller disclosure reduces information asymmetry associated with the sale of credit derivatives.

**The Impact of Mandatory Credit Derivative Seller Disclosure in the Market for CDS**

In my final analysis, I examine the effect of credit derivative seller disclosure on CDS market liquidity. Information conveyed in mandatory disclosures by credit derivative sellers may provide market transparency for the CDS market. Market transparency is defined in Bessembinder, Maxwell and Venkataraman (2006) as the amount of information regarding market conditions made public on a timely basis. Because sellers of credit derivatives provide liquidity in the market for CDS, information about their holdings and their trading provides information about the market as a whole. Thus an increase in disclosure by sellers is informative about market conditions and represents an increase in market transparency. An increase in market transparency reduces the rents that market makers can charge as well as the costs that they face when setting bid and ask prices against informed investors. Consistent with this argument Edwards, Harris, and Piwowar (2007) find that an increase in transparency in the OTC market for corporate bonds after regulation required trades to be publicly disseminated resulted in greater liquidity.

However, liquidity in the market for CDS is contingent upon sellers providing liquidity. As I discuss in section 2, the sellers who provide liquidity in the CDS market benefit from an information advantage over other market participants. An increase in disclosure reduces this information advantage, resulting in reduced competition for market making. Under this scenario, information about CDS seller holdings may reduce incentives for banks to provide liquidity (Qiu and Yu 2012). If this is the case, mandatory disclosure by credit derivative sellers will reduce liquidity in the market for CDS contracts. This leads me to my final hypothesis in the alternative form.

> **H3:** Increased credit derivative seller disclosure is associated with an increase or decrease in CDS market liquidity.

CHAPTER 4

# SAMPLE AND VARIABLE DESCRIPTION

## Sample – Disclosure and Equity Market Effects

I obtain my initial sample from bank holding company data reported each calendar quarter to the Federal Reserve on form FR Y-9C, available in database form at the Federal Reserve Bank of Chicago website.[10] The database includes quarterly data on bank holding companies from 2000 to 2013. I begin with 21,973 bank quarter observations from Q1 2000 to Q2 2013 and merge this data with CRSP[11], Compustat and IBES and require nonmissing data for all control variables. Before 2006 bank holding companies had to report on form FR Y 9-C if they had assets greater than $125 million. Beginning in 2006, the Federal Reserve raised the threshold to $500 million in assets to account for inflation. Given this change, I remove banks with assets of less than $500 million to ensure that my sample is consistent across years. Finally, I remove banks that do not have a Dec. 31 fiscal year-end to obtain the set of banks that are adopting mandated disclosure requirements for the first time. My final sample has 16,041 firm-quarter observations.

Table 1 displays descriptive statistics for this sample. Panel A focuses on the total sample, while Panels B and C show credit derivative seller and nonseller bank holding companies, respectively. The average credit derivative seller is larger than the average bank, with a median market value of equity of $15.7 billion as compared to the median market value of

[10] http://www.chicagofed.org/webpages/banking/financial_institution_reports/bhc_data.cfm
[11] This merge requires a link table provided by the Federal Reserve Bank of NY at http://www.newyorkfed.org/research/banking_research/datasets.html

**Table 1**

*Descriptive Statistics*

**Panel A: Total Sample**

| Variable | N | Mean | Std Dev | p75 | Median | p25 |
|---|---|---|---|---|---|---|
| Bid-ask spread | 16,002 | 0.014 | 0.020 | 0.017 | 0.006 | 0.002 |
| Analyst dispersion | 10,134 | 0.147 | 1.033 | 0.059 | 0.022 | 0.011 |
| Market value of equity (in millions) | 16,041 | 2,955 | 14,281 | 851 | 242 | 99 |
| Income before extraordinary items (in millions) | 16,040 | 47 | 397 | 12 | 4 | 1 |
| Stock return volatility | 16,041 | 0.026 | 0.020 | 0.030 | 0.020 | 0.014 |
| Share turnover | 16,041 | 0.003 | 0.004 | 0.003 | 0.001 | 0.000 |
| Allowance for loan losses | 16,041 | 0.204 | 0.795 | 0.124 | 0.068 | 0.046 |
| Tier one capital ratio | 16,041 | 11.747 | 3.300 | 13.200 | 11.280 | 9.800 |
| Stock price | 16,041 | 22.386 | 17.352 | 28.875 | 19.600 | 11.990 |
| Derivatives ratio | 16,041 | 3.672 | 36.246 | 0.467 | 0.034 | 0.000 |
| Loan ratio | 16,041 | 8.862 | 17.856 | 7.591 | 4.970 | 3.571 |
| Forecast horizon | 12,673 | 179 | 103 | 231 | 139 | 47 |
| Analyst following | 12,673 | 6 | 6 | 8 | 4 | 2 |

**Panel B: CDS Sellers**

| Variable | N | Mean | Std Dev | p75 | Median | p25 |
|---|---|---|---|---|---|---|
| Bid-ask spread | 814 | 0.003 | 0.005 | 0.002 | 0.001 | 0.001 |
| Analyst dispersion | 807 | 0.172 | 0.982 | 0.081 | 0.030 | 0.014 |
| Market value of equity (in millions) | 824 | 37,739 | 49,735 | 49,925 | 15,705 | 4,025 |
| Income before extraordinary items (in millions) | 824 | 634 | 1,623 | 850 | 274 | 33 |
| Stock return volatility | 824 | 0.025 | 0.021 | 0.029 | 0.019 | 0.012 |
| Share turnover | 824 | 0.009 | 0.009 | 0.011 | 0.005 | 0.003 |
| Allowance for loan losses | 824 | 0.150 | 0.307 | 0.156 | 0.072 | 0.045 |
| Tier one capital ratio | 824 | 10.000 | 2.272 | 11.830 | 9.380 | 8.135 |
| Stock price | 824 | 32.711 | 19.384 | 43.000 | 32.290 | 17.100 |
| Derivatives ratio | 824 | 58.209 | 149.193 | 24.071 | 7.286 | 1.911 |
| Loan ratio | 824 | 6.072 | 7.802 | 6.517 | 4.326 | 2.998 |
| Forecast horizon | 822 | 185 | 103 | 315 | 225 | 133 |
| Analyst following | 822 | 19 | 8 | 24 | 19 | 14 |

**Panel C: Non-CDS Sellers**

| Variable | N | Mean | Std Dev | p75 | Median | p25 |
|---|---|---|---|---|---|---|
| Bid-ask spread | 15,188 | 0.014 | 0.020 | 0.018 | 0.007 | 0.002 |
| Analyst dispersion | 9,327 | 0.145 | 1.037 | 0.057 | 0.022 | 0.010 |
| Market value of equity (in millions) | 15,217 | 1,071 | 3,482 | 656 | 222 | 94 |
| Income before extraordinary items (in millions) | 15,216 | 15 | 65 | 10 | 3 | 1 |
| Stock return volatility | 15,217 | 0.026 | 0.020 | 0.030 | 0.020 | 0.015 |
| Share turnover | 15,217 | 0.002 | 0.003 | 0.003 | 0.001 | 0.000 |
| Allowance for loan losses | 15,217 | 0.207 | 0.813 | 0.122 | 0.068 | 0.047 |
| Tier one capital ratio | 15,217 | 11.842 | 3.320 | 13.300 | 11.340 | 9.900 |
| Stock price | 15,217 | 21.827 | 17.058 | 28.020 | 19.270 | 11.840 |
| Derivatives ratio | 15,217 | 0.719 | 3.350 | 0.352 | 0.020 | 0.000 |
| Loan ratio | 15,217 | 9.013 | 18.231 | 7.652 | 5.005 | 3.599 |
| Forecast horizon | 11,851 | 179 | 103 | 231 | 139 | 47 |
| Analyst following | 11,851 | 5 | 5 | 7 | 3 | 2 |

**Table 1**

*Descriptive Statistics*

**Panel D: CDS Sellers over time**

| Year-Quarter | Non CDS Sellers | CDS Sellers | Total |
|---|---|---|---|
| 2000q1 | 239 | 14 | 253 |
| 2000q2 | 247 | 11 | 258 |
| 2000q3 | 247 | 11 | 258 |
| 2000q4 | 291 | 10 | 301 |
| 2001q1 | 251 | 11 | 262 |
| 2001q2 | 254 | 11 | 265 |
| 2001q3 | 258 | 11 | 269 |
| 2001q4 | 288 | 12 | 300 |
| 2002q1 | 257 | 10 | 267 |
| 2002q2 | 271 | 10 | 281 |
| 2002q3 | 274 | 12 | 286 |
| 2002q4 | 311 | 12 | 323 |
| 2003q1 | 285 | 11 | 296 |
| 2003q2 | 293 | 9 | 302 |
| 2003q3 | 287 | 10 | 297 |
| 2003q4 | 323 | 11 | 334 |
| 2004q1 | 290 | 11 | 301 |
| 2004q2 | 287 | 10 | 297 |
| 2004q3 | 292 | 10 | 302 |
| 2004q4 | 319 | 11 | 330 |
| 2005q1 | 292 | 12 | 304 |
| 2005q2 | 294 | 12 | 306 |
| 2005q3 | 301 | 13 | 314 |
| 2005q4 | 335 | 13 | 348 |
| 2006q1 | 313 | 12 | 325 |
| 2006q2 | 321 | 13 | 334 |
| 2006q3 | 315 | 15 | 330 |
| 2006q4 | 342 | 15 | 357 |
| 2007q1 | 307 | 17 | 324 |
| 2007q2 | 302 | 18 | 320 |
| 2007q3 | 295 | 18 | 313 |
| 2007q4 | 321 | 18 | 339 |
| 2008q1 | 290 | 18 | 308 |
| 2008q2 | 307 | 16 | 323 |
| 2008q3 | 294 | 17 | 311 |
| 2008q4 | 317 | 15 | 332 |
| 2009q1 | 299 | 18 | 317 |
| 2009q2 | 300 | 19 | 319 |
| 2009q3 | 290 | 20 | 310 |
| 2009q4 | 303 | 20 | 323 |
| 2010q1 | 286 | 21 | 307 |
| 2010q2 | 284 | 21 | 305 |
| 2010q3 | 278 | 22 | 300 |
| 2010q4 | 281 | 23 | 304 |
| 2011q1 | 270 | 23 | 293 |
| 2011q2 | 265 | 21 | 286 |
| 2011q3 | 259 | 22 | 281 |
| 2011q4 | 263 | 21 | 284 |
| 2012q1 | 259 | 21 | 280 |
| 2012q2 | 261 | 20 | 281 |
| 2012q3 | 257 | 19 | 276 |
| 2012q4 | 264 | 19 | 283 |
| 2013q1 | 254 | 20 | 274 |
| 2013q2 | 34 | 14 | 48 |
| Total | 15,217 | 824 | 16,041 |

**Table 1**

*Descriptive Statistics*

**Panel E: Correlation Matrix**

| | Bid-ask spread | Analyst dispersion | Market value of equity | Income before extraordinary items | Stock return volatility | Share turnover | Allowance for loan losses | Tier one capital ratio | Stock price | Derivatives ratio | Loan ratio | Forecast horizon | Analyst following |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bid-ask spread | 1.0000 | | | | | | | | | | | | |
| Analyst dispersion | 0.0274* | 1.0000 | | | | | | | | | | | |
| Market value of equity | -0.1118* | -0.0179* | 1.0000 | | | | | | | | | | |
| Income before extraordinary items | -0.0689* | -0.0154 | 0.6977* | 1.0000 | | | | | | | | | |
| Stock return volatility | 0.5065* | 0.1495* | -0.0597* | -0.1040* | 1.0000 | | | | | | | | |
| Share turnover | -0.2588* | 0.0828* | 0.1557* | 0.0314* | 0.2570* | 1.0000 | | | | | | | |
| Allowance for loan losses | 0.2382* | 0.0769* | -0.0293* | -0.0429* | 0.4255* | 0.0908* | 1.0000 | | | | | | |
| Tier one capital ratio | -0.0801* | 0.0707* | -0.1101* | -0.0544* | -0.1519* | -0.0375* | -0.2395* | 1.0000 | | | | | |
| Stock price | -0.3137* | -0.1065* | 0.1988* | 0.1503* | -0.3372* | 0.0267* | -0.1995* | -0.0127 | 1.0000 | | | | |
| Derivatives ratio | -0.0471* | 0.0311* | 0.5754* | 0.3325* | 0.0416* | 0.1970* | 0.0164* | -0.0468* | 0.0538* | 1.0000 | | | |
| Loan ratio | 0.3572* | 0.0950* | -0.0548* | -0.0611* | 0.5198* | 0.0723* | 0.9180* | -0.2613* | -0.2778* | 0.0106 | 1.0000 | | |
| Forecast horizon | -0.0400* | 0.0405* | 0.0067 | 0.0202* | -0.0526* | 0.0333* | -0.0208* | 0.003 | 0.0128 | 0.0042 | -0.0272* | 1.0000 | |
| Analyst following | -0.3195* | -0.0176* | 0.5234* | 0.3454* | -0.1123* | 0.4471* | -0.0866* | -0.1615* | 0.3068* | 0.2287* | -0.1395* | 0.0552* | 1.0000 |

Table 1 presents discriptive statistics of the sample used in tests of H1 and H2. Panels A, B and C present information on the sample distribution of all banks, credit derivative sellers and non-sellers, respectively. Panel D presents the sample distribution of credit derivative sellers and non-sellers over time. Panel E presents Pearson correlation coefficients for key variables; * represents significance at the 5% level. Please refer to Appendix C for variable definitions.

equity for nonsellers of $222 million. However, there is some overlap in size as the largest nonsellers resemble the sellers with the top quartile of market value of equity for nonsellers between $656 million and $95.5 billion. I perform robustness checks using this quartile of nonsellers as the reference group (see section 5.4).

In Panel D, I report the split between sellers and nonsellers by year and quarter. The fewest seller observations occurred in 2003 when only nine bank holding companies sold credit derivatives as compared to 2010 and 2011 when 22 of them sold credit derivatives. Between 2004 and 2010, there was an almost monotonic increase in the number of bank holding companies selling credit derivatives with the number stabilizing at about 20.

**Sample – Disclosure and CDS Market Effects**

For my test of credit derivative seller disclosure on CDS markets, I begin by using credit default swap data from Credit Market Analysis (CMA) DataVision, available through Bloomberg Professional Service. This dataset includes 635,344 daily CDS prices on 402 unique reference entities from 2002 through 2014. Each observation has the price that a buyer would pay for a five-year CDS contract with a $1,000 notional value. Prices are organized by reference entity. CMA prices have been used extensively in prior research (e.g., Loon and Zhong 2014; Mayordomo, Pena and Schwartz 2014) and are based on quotes from around 40 members of the buy-side community (hedge funds, asset managers and major investment banks) who participate in the CDS market. I require that firms have adequate daily CDS pricing. I also require that these observations have Compustat data, which reduces my sample to 229,842 daily observations over 2002 through 2014.Using these daily observations I generate quarterly average variables around the FSP on FAS 133 enactment date.

Table 2 displays descriptive statistics for this sample. Panel A focuses on the two quarters before the FASB staff position, while Panel B shows the sample for the two quarters afterward. I have 428 observations for the two quarters before the FASB staff position and 422 observations for the two quarters afterward. The two quarters before the enactment include some companies that had large net losses, resulting in a negative average income. The largest of these losses was AIG's loss of $61.7 billion for fourth quarter 2008, a record quarterly loss at the time.

**Measures of Information Asymmetry in the Equity Market**

I employ two measures of information asymmetry: bid-ask spreads and analyst forecast dispersion. Bid-ask spread is the difference between the price that a market maker charges for an asset and the price at which it will buy the asset. In an efficient market for market makers, the bid-ask spread equals the cost of providing liquidity. Hence, it is one of the most widely used measures of liquidity. Information asymmetry is one cost of providing liquidity because of the adverse selection risk that market makers face when pricing on total order flow (Kyle 1985, Glosten and Milgrom 1985).[12] In the equity market, the bid-ask spread is a reasonable measure for information asymmetry because other costs (inventory costs and clearing costs) are low.[13] As a result, bid-ask spread has been used in numerous empirical studies as a measure of information asymmetry.

I measure bid-ask spreads using CRSP data as the difference between daily closing bid and ask prices divided by the midpoint between closing bid and ask prices. Chung and Zhang (2014) show that this CRSP-based spread is highly correlated (between .83 and .99 depending on

[12] In these studies, information asymmetry exists among investors, and the market maker chooses its price so that it yields zero profit. If the market maker provides prices based on the total order flow it receives it will continually lose to informed traders. To compensate for this adverse selection risk, the market maker must increase the spread. Thus bid-ask spreads should be higher when information asymmetry exists among investors, all else equal.
[13] As I will discuss in the next section, this is not true in the market for credit default swaps. See Glosten and Harris (1988) for a discussion of the components of the bid/ask spread

**Table 2**

*Descriptive Statistics - CDS Market Sample*

**Panel A: Pre FSP on FAS 133**

| Variable | N | Mean | Std Dev | p75 | Median | p25 |
|---|---|---|---|---|---|---|
| CDS bid-ask spread | 428 | 0.073 | 0.021 | 0.083 | 0.068 | 0.058 |
| CDS price volatility | 428 | 0.174 | 0.116 | 0.239 | 0.145 | 0.083 |
| CDS price | 428 | 250 | 387 | 274 | 133 | 76 |
| Market value of equity (in millions) | 428 | 25,291 | 37,555 | 27,678 | 12,024 | 4,803 |
| Income before extraordinary items (in millions) | 428 | -129 | 3,629 | 420 | 162 | 30 |
| Return on assets | 428 | 0.03% | 6.41% | 1.99% | 1.11% | 0.16% |
| Bond Amihud | 384 | 3.390 | 22.000 | 2.500 | 1.000 | 0.406 |
| Bond price dispersion | 384 | 0.591 | 0.589 | 0.772 | 0.445 | 0.209 |

**Panel B: Post FSP on FAS 133**

| Variable | N | Mean | Std Dev | p75 | Median | p25 |
|---|---|---|---|---|---|---|
| CDS bid-ask spread | 422 | 0.088 | 0.028 | 0.103 | 0.082 | 0.068 |
| CDS price volatility | 422 | 0.189 | 0.091 | 0.233 | 0.178 | 0.125 |
| CDS price | 422 | 251 | 445 | 239 | 107 | 62 |
| Market value of equity (in millions) | 421 | 24,163 | 35,150 | 26,253 | 11,503 | 4,753 |
| Income before extraordinary items (in millions) | 422 | 441 | 796 | 513 | 188 | 56 |
| Return on assets | 422 | 1.23% | 1.55% | 1.89% | 1.14% | 0.44% |
| Bond Amihud | 330 | 5.760 | 53.800 | 1.350 | 0.589 | 0.297 |
| Bond price dispersion | 330 | 0.658 | 0.816 | 0.785 | 0.524 | 0.323 |

Table 2 presents discriptive statistics of the sample used in tests of H3. Panels A and B present information on the sample distribution before and after FASB Staff Position on FAS 133 took effect, respectively. Please refer to Appendix C for variable definitions.

the year) with spreads based intraday data from the New York Stock Exchange's Trade and Quote (TAQ) database.

Numerous empirical studies use the dispersion of analyst forecasts to measure information asymmetry (e.g., Leuz 2003; Krishnaswami and Subramaniam 1999). Analysts are an important source of information for stock market participants. Higher quality information from analysts should be associated with a reduction in the informational advantages that insiders enjoy and thus a reduction in information asymmetry for a company.

A greater degree of disagreement among analysts (i.e., analyst dispersion) indicates that the firm's prospects for future profitability are not clear to all analysts. Selling credit derivatives impacts firm profitability directly through profit derived from trading credit derivatives and indirectly through the risk of having to pay in the case that a contract is triggered by a default. If there is disagreement among analysts about the value of CDS selling programs, it should show up in a higher level of analyst dispersion at banks with CDS selling programs. I define analyst dispersion as the standard deviation of analysts' annual EPS forecasts weighted by the mean consensus forecast. Following Cheng, Dhaliwal, and Neamtiu (2011), I calculate analyst dispersion in the middle of the second month in each quarter.

**Measures of CDS Market Liquidity**

I use two measures of liquidity in the market for CDS contracts: CDS bid-ask spread and CDS price volatility. As I discuss in Section 4.3, bid-ask spreads measure the cost to provide liquidity in a market. In the market for CDS contracts, market makers face significant inventory and order-processing costs when providing liquidity. That is, they face a risk when selling a CDS because they must find an identical, offsetting contract to buy. Because the CDS market is decentralized, there may be a time lag between selling a CDS and purchasing an offsetting contract, which is risky to the CDS dealer. These market characteristics make it likely that the CDS bid-ask spread is determined by more than information asymmetry among CDS investors. Thus, while I attribute changes in bid-ask spread to information asymmetry in the equity market, I attribute changes in the CDS bid-ask spread to changes in CDS market liquidity and am agnostic about which component of liquidity is driving these changes.

Bid and ask prices are provided daily by CMA beginning in January 2004. CMA obtains its prices by calculating a consensus price from a panel of 30 leading financial institutions. I calculate the CDS bid-ask spread as the difference between daily closing bid and ask prices divided by the midpoint between closing bid and ask prices.

The other market characteristic I use is CDS price volatility. While price volatility is not a direct measure of liquidity, it is an important determinant of liquidity, and many studies have shown an inverse relation between volatility and liquidity (e.g., Copeland and Galai 1983; Amihud 2002; Engle, Fleming, Ghysels, Nguyen 2011). Furthermore, volatility is positively related to information asymmetry, a source of market illiquidity (e.g., Lang and Lundholm 1993; Frankel, Kothari, and Weber 2006). Given these relationships, I include volatility as a measure of liquidity.

I measure CDS price volatility as the standard deviation of the CDS price divided by the average CDS price during each quarter. Hence I expect an increase in CDS liquidity to be associated with a decrease in CDS price volatility.

# CHAPTER 5

# CREDIT DERIVATIVE SELLING, INFORMATION ASYMMETRY AND SELLER DISCLOSURE IN THE EQUITY MARKET

**Research Design – Tests of H1: Credit Derivatives Selling and Information Asymmetry**

To test the hypothesis that the sale of credit derivatives is associated with increased information asymmetry, I estimate the following regression:

(1) $Ln(Bid\text{-}ask\ spread) = \alpha + \beta_1 CDS\ seller + Controls + e$

The dependent variable, bid-ask spread, is the difference between daily closing bid and ask prices divided by the midpoint between closing bid and ask prices. Following prior literature (e.g., Daske, Hail, Leuz and Verdi 2013), I use the natural logarithm of this variable in my tests to account for positive skewness and to diminish the influence of outliers on my results. The variable of interest in this equation is *CDS seller*, an indicator variable equal to one when a bank reports that it has sold any amount of credit derivatives on form FR Y-9C and zero otherwise. I expect that the coefficient on *CDS seller* will be positive and statistically significant if selling any amount of CDS is correlated with an increase in the bank's bid-ask spread. This would imply that the sale of credit derivatives is associated with information asymmetry.

I control for factors that may be correlated with both the sale of credit derivatives and bid-ask spreads. I control for size by including the natural logarithm of the market value of equity. I expect a negative coefficient on *Ln(Market value of equity)* because there is greater information available about larger companies, which should reduce information asymmetry.

*Share Turnover*, daily trade volume divided by shares outstanding, controls for the effect of volume on bid-ask spreads. Prior literature shows that spreads decrease with trading volume (e.g. Glosten and Harris 1988). As a result I expect the coefficient on *Share Turnover* to be negative. I also include *Ln(Stock price)*, the natural logarithm of the stock price, to control for the effect of bank performance on information asymmetry.

The sale of credit derivatives may generate uncertainty with regard to the riskiness of a bank's future profits. To capture the effect of risk generated by the sale of credit derivatives, I must separate this effect from other intrinsic risks at these firms. Thus I include *Stock return volatility*, measured as the standard deviation of daily returns, as a proxy for firm risk because more uncertain profit may lead to greater adverse selection problems for liquidity providers and thus greater bid-ask spreads. As a result I expect a positive coefficient on this variable.

To control for bank specific risks, I include the tier one capital ratio (*Tier one capital ratio*) and *Allowance for loan losses*, the loan loss allowance deflated by market value of equity. Regulators use the tier one capital ratio, calculated as the ratio of core equity capital to risk-weighted assets, to measure banks' financial strength. Thus I expect it to be negatively associated with the bid-ask spread. *Allowance for loan losses* measures the riskiness of the bank's loan portfolio. To the extent that investors face greater uncertainty in assessing the profitability of banks with exposure to riskier loans, I expect that this variable will be positively associated with the bid-ask spread.

Banks with exposure to different types of assets may have less predictable future cash flows. To control for bank asset composition I include *Loan Ratio*, the ratio of total loans to total assets. I remain agnostic about the direction of this association because prior literature (e.g., Flannery et al 2004; Morgan 2002) finds mixed results with respect to the riskiness of having a higher proportion of loans.

I include a control for the total notional amount of derivative contracts other than credit derivatives, *Derivatives ratio*. Because many other derivatives are also complex and difficult to value they could create information asymmetry among investors. Also, the use of other derivatives is likely correlated with the sale of credit derivatives. Finally, I include year fixed effects to control for changes in bid-ask spreads across time.

I estimate the following alternative specification to provide additional evidence on the hypothesis that the sale of credit derivatives is associated with increased information asymmetry:

(2) $Ln(Analyst\ dispersion) = \alpha + \beta_1 CDS\ seller + Controls + e$

The dependent variable, *Analyst dispersion*, is the standard deviation of analysts' annual EPS forecasts deflated by the mean consensus annual forecast calculated in the middle of the second month of the each quarter. As in Equation (1), I use the natural logarithm of this variable in my tests. Again, the variable of interest is *CDS seller*, which is defined as above. H1 predicts a positive coefficient on this variable, $\beta_1 > 0$. That is, a positive and significant coefficient implies that being a credit derivative seller is positively related to information asymmetry.

I include a slightly different set of control variables to address factors that may be associated with both analyst forecasts and the sale of credit derivatives. I include *Horizon*, the forecast horizon, measured as the number of days between the last consensus forecast and the report date. This variable captures the variation in the timing of forecasts—as the report date draws nearer more information would be available, and information asymmetry will have decreased. I expect this coefficient to be positively associated with analyst dispersion.

I also include *Analyst following* because a greater number of analysts following a firm could increase the amount of information available and thereby reduce information asymmetry. I expect this coefficient to be negatively associated with analyst dispersion. I include *Loss indicator*, an indicator for firms that report negative earnings in the year being forecasted. Studies, such as Burgstahler and Eames (2003), have shown that earnings are asymmetric around zero. This may generate differential forecasting accuracy for loss versus gain firms.

**Research Design – Tests of H2: Credit Derivative Seller Disclosure and Information Asymmetry**

Next, I address whether seller disclosure succeeds at mitigating information asymmetry associated with the sale of credit derivatives. I estimate the following difference-in-differences model to examine the effect of disclosure changes on information asymmetry at credit derivative sellers:

(3) $$Ln(Bid\text{-}ask\ spread)/\ Ln(Analyst\ dispersion) = \alpha + \beta_1 CDS\ seller + \beta_2 Post + \beta_3 Post*CDS\ seller + Controls + e$$

I estimate this model for two changes in disclosure, the Federal Reserve fair value reporting requirement and the FSP on FAS 133. These disclosure changes are explained in detail in Section 2.3. The dependent variables, *Bid-Ask Spread* and *Analyst Dispersion*, are defined as in Section 5.1. *CDS seller* is an indicator variable equal to one when a bank reports that it has sold any amount of credit derivatives on form FR Y-9C. The *Post* variable is equal to zero in the two quarters before the disclosure and one in the two quarters afterward.[14] Specifically, when I examine the effect of the change in disclosure required by the Federal Reserve for bank holding companies, I set *Post* equal to (*i*) zero for the fourth quarter of 2001 and the first quarter of 2002 and (*ii*) one for the third and fourth quarters of 2002 to identify the post-period for this disclosure. For the change in disclosure required by the SEC (FSP on FAS 133), I set *Post* to (*i*) zero for the third and fourth quarters of 2008 and (*ii*) one for the second and third quarters of 2009. The coefficient on *Post*

[14] Results are qualitatively the same when I use the year before and after the disclosure change in my analysis.

captures the change in bid-ask spread around the changes in disclosure for bank holding companies that do not sell credit derivatives in my sample after controlling for other factors.

The coefficient of interest is the interaction term *Post*CDS seller*. *Post*CDS seller* represents the difference in the bid-ask spread for credit derivative sellers after additional disclosure is required incremental to the difference for bank holding companies that do not sell credit derivatives. I expect the coefficient on *Post*CDS seller* to be negative and significant if disclosure reduces information asymmetry, as measured by bid-ask spreads, related to credit derivatives sold. To control for factors associated with credit derivatives and bid-ask spreads (analyst forecast dispersion) I include the same set of control variables as in Equation (1) (Equation (2)).

**Results**

Table 3 presents the results of tests of H1, whether credit derivative selling is associated with information asymmetry. In Panel A, I test this hypothesis using the bid-ask spread as my proxy for information asymmetry. In Panel B, I use analyst forecast dispersion as an alternate proxy. I find that the *CDS seller* indicator is positive and significant in both tests—$\beta_1$= 0.930, significant at the 1% level in Panel A, and $\beta_1$=0.291, significant at the 1% level in Panel B. That is, being a credit derivative seller is associated with more bank opacity. These results suggest that investors consider credit derivative selling at the sample banks to be material to their valuation decisions and that the risks associated with selling are not being clearly communicated to investors and analysts. This result comports with my hypothesis and with investor concerns that credit derivative holdings are a source of bank opacity. Furthermore, my control variables, when significant, operate as predicted.

**Table 3**

*CDS Selling and Information Asymmetry*

**Panel A: Bid-Ask Spread as a Measure of Information Asymmetry**

| Variable | Coefficient (t-statistic) |
|---|---|
| Constant | -1.103*** |
| | (-6.902) |
| **CDS seller** | **0.930*** ** |
| | **(6.577)** |
| Ln(Market value of equity) | -0.566*** |
| | (-21.433) |
| Stock return volatility | 14.256*** |
| | (14.067) |
| Share turnover | -80.485*** |
| | (-10.250) |
| Allowance for loan losses | -0.024 |
| | (-0.708) |
| Tier one capital ratio | 0.000 |
| | (0.054) |
| Ln(Stock price) | -0.005 |
| | (-0.108) |
| Derivatives ratio | 0.003*** |
| | (4.793) |
| Loan ratio | -0.003 |
| | (-1.278) |
| Year Fixed Effects | Yes |
| N | 15,992 |
| Adjusted $R^2$ | 0.783 |

**Table 3 -** *Continued*

**Panel B: Analyst Dispersion as a Measure of Information Asymmetry**

| Variable | Coefficient (t-statistic) |
|---|---|
| Constant | -5.996*** |
| | (-30.831) |
| **CDS seller** | **0.291*** ** |
| | **(3.878)** |
| Ln(Market value of equity) | -0.190*** |
| | (-6.938) |
| Stock return volatility | 12.013*** |
| | (9.229) |
| Share turnover | 23.757*** |
| | (4.335) |
| Allowance for loan losses | -0.268* |
| | (-1.748) |
| Tier one capital ratio | 0.040*** |
| | (4.362) |
| Loan ratio | 0.006 |
| | (0.971) |
| Ln(Horizon) | 0.429*** |
| | (31.455) |
| Ln(Analyst following) | 0.151*** |
| | (2.670) |
| Loss indicator | 0.723*** |
| | (11.068) |
| Derivatives ratio | 0.002*** |
| | (10.994) |
| Year Fixed Effects | Yes |
| N | 9,576 |
| Adjusted $R^2$ | 0.515 |

Table 3 presents results for H1; whether selling credit derivatives is associated with information asymmetry. The dependent variable in Panel A is the natural logarithm of bid-ask spread. The dependent variable in Panel B is the natural logarithm of analyst dispersion. Coefficient t-statistics are shown in parentheses below the coefficient. Standard errors are robust to heteroskedasticity and clustered at the firm level. All variables are defined in Appendix C. ***, **, * represent significance at the 1%, 5% and 10% levels, respectively.

In terms of economic significance, my coefficient estimates suggest that the effect of being a CDS seller is a 153 percent increase in bid-ask spreads as a percent of price. For the median firm this is an increase in bid-ask spreads from 0.60 percent of price to 1.52 percent of price. For reference, Cheng, Dhaliwal and Neamtiu (2011) find that firms with uncertain recourse on securitized assets have bid ask spreads that are 0.13 percent of price higher than those that do not. Thus coefficient estimates of the effect of CDS selling on bid-ask spreads appear to be high, perhaps due to sample selection issues. These issues are addressed in additional robustness tests (see sections 5.4 and 5.5) which produce estimates that are more reasonable.

Coefficient estimates for my regression of CDS selling on analyst dispersion suggest that the effect of being a CDS seller is an increase in the standard deviation of analyst forecasts of 34 percent. For the median firm this means that the standard deviation of forecasts is 0.74 percent higher for CDS sellers as a percentage of price as compared to nonsellers. For reference Cheng, Dhaliwal and Neamtiu (2011) find that firms with uncertain recourse on securitized assets have a standard deviation of forecasts that is 0.69 percent of price higher than those that do not. Thus my estimates of the effect of CDS selling on analyst dispersion appear more reasonable than those on bid-ask spreads when compared to prior literature.

Table 4 displays the results of tests of H2, the hypothesis that mandatory disclosure has mitigated information asymmetry associated with credit derivative selling. Model 1 in each panel focuses on changes around the first disclosure event, fair value at bank holding companies, and Model 2 focuses on the second disclosure event, FSP on FAS 133. In Panel A, where the bid-ask spread is the measure of information asymmetry, the coefficient on *Post*CDS seller* is negative and significant in Model 1 ($\beta_3$=-0.615, significant at 1% level). In Model 2, the coefficient on *Post*CDS seller* is also negative and significant ($\beta_3$=-0.393, significant at 10% level).

**Table 4**
*CDS Selling and Disclosure*

**Panel A: Bid-Ask Spread as a Measure of Information Asymmetry**

| Variable | Model 1: Fair Value at BHCs<br>Coefficient<br>(t-statistic) | Model 2: FSP on FAS 133<br>Coefficient<br>(t-statistic) |
|---|---|---|
| Constant | -3.079*** | -0.506* |
| | (-9.811) | (-1.718) |
| CDS seller | 1.314*** | 1.420*** |
| | (5.907) | (4.901) |
| **Post*CDS seller** | **-0.615*** ** | **-0.393* ** |
| | **(-3.720)** | **(-1.863)** |
| Post | -0.338*** | -0.398*** |
| | (-15.374) | (-9.129) |
| Ln(Market value of equity) | -0.277*** | -0.851*** |
| | (-6.130) | (-16.926) |
| Stock return volatility | 28.175*** | 5.978*** |
| | (10.378) | (3.801) |
| Share turnover | -177.785*** | -20.428*** |
| | (-7.019) | (-2.913) |
| Allowance for loan losses | -0.597 | -0.041 |
| | (-1.637) | (-0.912) |
| Tier one capital ratio | 0.012 | -0.007 |
| | (1.330) | (-0.553) |
| Ln(Stock price) | -0.109 | 0.239*** |
| | (-1.507) | (4.036) |
| Derivatives ratio | 0.001*** | 0.004*** |
| | (2.755) | (5.188) |
| Loan ratio | 0.012 | -0.005** |
| | (0.795) | (-2.030) |
| N | 1,168 | 1,272 |
| Adjusted $R^2$ | 0.650 | 0.797 |

**Table 4 -** *Continued*

**Panel B: Analyst Dispersion as a Measure of Information Asymmetry**

| Variable | Model 1: Fair Value at BHCs<br>Coefficient<br>(t-statistic) | Model 2: FSP on FAS 133<br>Coefficient<br>(t-statistic) |
|---|---|---|
| Constant | -5.999*** | -5.245*** |
| | (-10.652) | (-7.883) |
| CDS seller | 0.167 | 0.430** |
| | (0.932) | (2.313) |
| **Post*CDS seller** | **-0.159** | **-0.446*** |
| | **(-0.876)** | **(-1.915)** |
| Post | -0.368*** | 1.137*** |
| | (-4.758) | (7.116) |
| Ln(Market value of equity) | -0.060 | -0.284*** |
| | (-1.184) | (-5.289) |
| Stock return volatility | 17.414*** | 17.750*** |
| | (3.127) | (6.328) |
| Share turnover | 17.362 | 7.255 |
| | (0.858) | (0.753) |
| Allowance for loan losses | 3.261 | -0.340 |
| | (1.565) | (-1.457) |
| Tier one capital ratio | 0.044** | -0.005 |
| | (2.301) | (-0.222) |
| Loan ratio | 0.060 | -0.004 |
| | (1.220) | (-0.504) |
| Ln(Horizon) | 0.230*** | 0.487*** |
| | (6.535) | (5.733) |
| Ln(Analyst following) | -0.040 | 0.456*** |
| | (-0.358) | (3.691) |
| Loss indicator | 0.480** | 0.571*** |
| | (2.156) | (5.004) |
| Derivatives ratio | 0.002*** | 0.002*** |
| | (5.495) | (3.042) |
| N | 620 | 715 |
| Adjusted $R^2$ | 0.246 | 0.387 |

Table 4 presents results for H2; whether credit derivative seller disclosure mitigates information asymmetry. The dependent variable in Panel A is the natural logarithm of bid-ask spread. The dependent variable in Panel B is natural logarithm of analyst forecast dispersion. Model 1 presents results using disclosure changes required by the Federal Reserve for bank holding companies in 2002. Model 2 uses the 2008 SEC disclosure change. Coefficient t-statistics are shown in parentheses below the coefficient. Standard errors are robust to heteroskedasticity and clustered at the firm level. All variables are defined in Appendix C. ***, **, * represent significance at the 1%, 5% and 10% levels, respectively.

These results illuminate the benefits of disclosure by credit derivative dealers. Both disclosure changes appear to have provided useful information to uninformed investors. I find this result despite the fact that fair value disclosure tells investors very little about concentrations of risk or risk hedging at credit derivative sellers. Moreover, the FSP on FAS 133 appears to benefit investors even though some of the information (e.g., fair values and maximum potential payment) was already available in the FR Y-9C.

In Panel B, where analyst dispersion is the measure of information asymmetry, the coefficient on *Post*CDS Seller* is negative and significant in Model 2 ($\beta_3$=-0.446, significant at 10% level) but not different from zero in Model 1. This result implies that after the FSP on FAS 133 credit derivative sellers experienced a reduction in analyst dispersion. A reason that I fail to find a result for analysts on the fair value disclosure may be that analysts suffer from biases (e.g., herding; see Clement and Tse 2005) and do not react to new information as quickly as investors. Nevertheless, my results provide some evidence that additional disclosure requirements relating to credit derivative sellers have reduced opacity at these banks.

**Additional Tests – Bank Size**

Banks that sell credit derivatives tend to be larger than those that do not (see Table 1 Panels B and C). While I include a control variable for size in my main tests, the effect of size may still cause a sample selection issue as size effects could be correlated with many differences in structure and regulation. Thus I perform an additional test aimed at addressing this concern. Specifically, I re-run my analysis for bid-ask spread using the top quartile of nonsellers as my comparison group.

Table 5 presents results from this additional test. In Panel A I present results from my test of H1 using this alternative sample. Coefficient estimates and significance are similar to those presented in Table 3 suggesting that sample selection issues correlated with size are not driving

**Table 5**
*Robustness Check: Top Quartile of Banks by Size*

**Panel A: Sale of CDSs and Bid-Ask Spread as a Measure of Information Asymmetry**

| Variable | Coefficient (t-statistic) |
|---|---|
| Constant | -3.229*** |
| | (-5.171) |
| **CDS seller** | **0.240*****|
| | **(2.608)** |
| Ln(Market value of equity) | -0.192*** |
| | (-5.743) |
| Stock return volatility | 17.362*** |
| | (11.095) |
| Share turnover | -43.189*** |
| | (-6.225) |
| Allowance for loan losses | 0.122 |
| | (0.226) |
| Tier one capital ratio | 0.011 |
| | (0.920) |
| Ln(Stock price) | -0.154 |
| | (-1.199) |
| Derivatives ratio | 0.001 |
| | (1.386) |
| Loan ratio | 0.008 |
| | (0.247) |
| Year Fixed Effects | Yes |
| N | 4,576 |
| Adjusted $R^2$ | 0.636 |

**Table 5** - *Continued*

**Panel B: CDS Seller Disclosure and Bid-Ask Spread as a Measure of Information Asymmetry**

| Variable | Model 1: Fair Value at BHCs<br>Coefficient<br>(t-statistic) | Model 2: FSP on FAS 133<br>Coefficient<br>(t-statistic) |
|---|---|---|
| Constant | -5.741*** | -4.642*** |
| | (-4.987) | (-7.662) |
| CDS seller | 0.822*** | 0.111 |
| | (2.953) | (0.881) |
| **Post*CDS seller** | **-0.432*** ** | **-0.134** |
| | **(-2.801)** | **(-0.958)** |
| Post | -0.517*** | -0.499*** |
| | (-5.551) | (-7.118) |
| Ln(Market value of equity) | 0.045 | -0.259*** |
| | (0.473) | (-7.659) |
| Stock return volatility | 38.927*** | 8.230*** |
| | (3.306) | (4.700) |
| Share turnover | -131.532*** | -10.016** |
| | (-3.408) | (-2.006) |
| Allowance for loan losses | -7.515* | 1.229*** |
| | (-1.949) | (3.636) |
| Tier one capital ratio | 0.043 | 0.008 |
| | (1.240) | (0.505) |
| Ln(Stock price) | -0.294 | 0.116 |
| | (-1.284) | (1.011) |
| Derivatives ratio | -0.000 | -0.000 |
| | (-0.829) | (-0.209) |
| Loan ratio | 0.177 | -0.026 |
| | (1.587) | (-1.270) |
| N | 310 | 386 |
| Adjusted $R^2$ | 0.217 | 0.549 |

Table 5 presents results for additional tests using the top quartile of banks by size for tests of H1 and H2. The natural logarithm of bid-ask spread is the dependent variable. Panel A presents results on H1. Panel B presents results on H2. In Panel B. Model 1 presents results using disclosure changes required by the Federal Reserve for bank holding companies in 2002 while Model 2 uses the 2008 SEC disclosure change. Coefficient t-statistics are shown in parentheses below the coefficient. Standard Errors are robust to heteroskedasticity and clustered at the firm level. All variables are defined in Appendix C. ***, **, * represent significance at the 1%, 5% and 10% levels, respectively.

the results of my test of H1. Panel B reports the results from my test of H2 with this alternative sample. I find a negative and significant coefficient on *Post*CDS seller* in Model 1 ($\beta_3$=-0.432, significant at 1% level) consistent with results presented in Table 4. However, in Model 2 the coefficient is not different from zero. This result suggests that the FSP on FAS 133 did not provide meaningful information about CDS sellers.

My failure to find a result in Model 2 casts doubt on the efficacy of the FSP on FAS 133. The lack of a result may be a result of the fact that some of this information (e.g., fair values and maximum potential payment) was already available in the FR Y-9C. Another possible reason for the lack of a significant coefficient is that much of this information was voluntarily disclosed in the year prior to the rule change. As the financial crisis began and CDS became a topic of concern, banks voluntarily released information about their holdings.[15]

**Additional Tests – Propensity Score Matched Control Sample**

There are differences other than size between CDS sellers and other banks (e.g., bank structure, performance and risk) that could also result in sample selection issues. While I control for these in my main regressions, CDS sellers may be so significantly different than other banks that the linearity assumption required for OLS regression may not hold. In order to address this potential problem I employ propensity score matching to test H1 and H2.

I generate propensity scores using a probit regression of CDS selling on the set of control variables used for my bid-ask spread and analyst dispersion regressions. Propensity score matching requires common support. That is, each treated firm (i.e., CDS seller) must have an untreated firm (i.e., nonseller) with a similar probability of being a treated firm (i.e., propensity score). 82% (81%)

[15] In untabulated results I attempt to address this concern by including an indicator variable for sellers that voluntarily disclosed information about their CDS sales before the FSP on FAS 133 became effective. However, I am still unable to find a significant reduction in bid-ask spreads following the rule change.

of CDS sellers have a control observation with common support in my sample where bid-ask spread (analyst dispersion) is the outcome variable. Because nearly 20% of my sample of CDS sellers lacks common support I only include those observations with common support in my matched sample.

I report descriptive statistics comparing CDS sellers to nonsellers in the total sample and in the propensity score matched sample in Table 6 Panel A. In the full sample, all variables are statistically significantly different for CDS sellers with some particularly striking economic differences. For example, the mean derivative ratio for CDS sellers is 80 times larger than that of nonsellers. In the propensity score matched sample differences between all variables are attenuated. In particular, stock return volatility, share turnover, and the allowance for loan losses are no longer significantly different between CDS sellers and nonsellers. While CDS sellers remain statistically significantly larger than control firms in the matched sample, the difference in size has reduced from 36.6 billion to 7.6 billion. Furthermore, differences in tier one capital ratio were reduced from 1.84 to 1.269, differences in stock price were reduced from $10.884 to $3.505, differences in derivatives ratios were reduced from 57.489 to 15.969, and differences in loan ratios were reduced from 2.941 to 2.297.

Interestingly, CDS sellers appear to be less risky (lower stock return volatility and lower allowance for loan losses) when compared to average banks. However, when compared to a matched sample, they are similar with regard to risk but have significantly lower tier one capital ratios than nonsellers. This suggests that they were undercapitalized as compared to their peer banks during my sample period, which may come as no surprise given that my sample includes the financial crisis period.

**Table 6**

*Robustness Check: Propensity Score Matching*

**Panel A: Full and Propensity Score Matched Samples**

| | **Full sample** | | | | **Propensity Score Matched Sample** | | | |
|---|---|---|---|---|---|---|---|---|
| | CDS Sellers | Non-sellers | Difference | p-value | CDS Sellers | Non-sellers | Difference | p-value |
| Variable | Mean | Mean | in Means | | Mean | Mean | in Means | |
| Market value of equity (in millions) | 37,739 | 1,071 | 36,668 | 0.000 | 19,874 | 12,248 | 7,626 | 0.000 |
| Stock return volatility | 0.025 | 0.026 | -0.001 | 0.052 | 0.024 | 0.025 | -0.001 | 0.653 |
| Share turnover | 0.009 | 0.002 | 0.006 | 0.000 | 0.008 | 0.008 | 0.000 | 0.329 |
| Allowance for loan losses | 0.150 | 0.207 | -0.058 | 0.047 | 0.151 | 0.170 | -0.019 | 0.526 |
| Tier one capital ratio | 10.000 | 11.842 | -1.841 | 0.000 | 10.127 | 11.396 | -1.269 | 0.000 |
| Stock price | 32.711 | 21.827 | 10.884 | 0.000 | 31.711 | 35.216 | -3.505 | 0.003 |
| Derivatives ratio | 58.209 | 0.719 | 57.489 | 0.000 | 8.618 | 15.969 | -7.351 | 0.000 |
| Loan ratio | 6.072 | 9.013 | -2.941 | 0.000 | 6.288 | 8.585 | -2.297 | 0.070 |

**Table 6 -** *Continued*

**Panel B: Sale of CDSs and Bid-Ask Spread as a Measure of Information Asymmetry**

| Variable | Coefficient (t-statistic) |
| --- | --- |
| Constant | -1.040** |
| | (-2.556) |
| **CDS seller** | **0.145**** |
| | **(2.012)** |
| Ln(Market value of equity) | -0.233*** |
| | (-5.500) |
| Stock return volatility | 10.557*** |
| | (4.744) |
| Share turnover | -12.199** |
| | (-2.131) |
| Allowance for loan losses | -0.064 |
| | (-0.658) |
| Tier one capital ratio | -0.013 |
| | (-1.327) |
| Ln(Stock price) | -0.456*** |
| | (-10.221) |
| Derivatives ratio | 0.002 |
| | (0.613) |
| Loan ratio | -0.003 |
| | (-0.616) |
| Year Fixed Effects | Yes |
| N | 1,248 |
| Adjusted $R^2$ | 0.807 |

**Table 6** - *Continued*

**Panel C: CDS Seller Disclosure and Bid-Ask Spread as a Measure of Information Asymmetry**

| Variable | Model 1: Fair Value at BHCs<br>Coefficient<br>(t-statistic) | Model 2: FSP on FAS 133<br>Coefficient<br>(t-statistic) |
|---|---|---|
| Constant | -5.645*** | -3.285*** |
| | (-3.808) | (-3.088) |
| CDS seller | 0.435 | 0.005 |
| | (1.400) | (0.028) |
| **Post*CDS seller** | **-0.052** | **-0.231** |
| | **(-0.125)** | **(-0.965)** |
| Post | -0.976** | -0.491*** |
| | (-2.680) | (-2.726) |
| Ln(Market value of equity) | 0.158** | -0.355*** |
| | (2.269) | (-3.639) |
| Stock return volatility | 71.603** | 7.078 |
| | (2.599) | (1.633) |
| Share turnover | -465.248*** | 2.280 |
| | (-3.508) | (0.378) |
| Allowance for loan losses | -9.211** | 0.873 |
| | (-2.286) | (1.474) |
| Tier one capital ratio | 0.037 | 0.002 |
| | (1.464) | (0.046) |
| Ln(Stock price) | -0.309 | -0.038 |
| | (-0.717) | (-0.421) |
| Derivatives ratio | -0.015** | 0.008 |
| | (-2.625) | (0.881) |
| Loan ratio | 0.179 | -0.032 |
| | (1.575) | (-1.336) |
| N | 57 | 99 |
| Adjusted $R^2$ | 0.617 | 0.660 |

**Table 6 -** *Continued*

**Panel D: Sale of CDSs and Analyst Dispersion as a Measure of Information Asymmetry**

| Variable | Coefficient (t-statistic) |
|---|---|
| Constant | -6.577*** |
| | (-11.024) |
| **CDS seller** | **0.180**** |
| | **(2.153)** |
| Ln(Market value of equity) | -0.185*** |
| | (-2.821) |
| Stock return volatility | 12.210*** |
| | (4.234) |
| Share turnover | 26.436** |
| | (2.227) |
| Allowance for loan losses | 0.089 |
| | (0.335) |
| Tier one capital ratio | 0.044 |
| | (1.577) |
| Loan ratio | -0.001 |
| | (-0.317) |
| Horizon | 0.471*** |
| | (12.058) |
| Analyst following | 0.274* |
| | (1.738) |
| Loss indicator | 0.492*** |
| | (3.637) |
| Derivatives ratio | -0.004 |
| | (-0.987) |
| Observations | 1,216 |
| Adjusted R-squared | 0.667 |

**Table 6** - *Continued*

**Panel E: CDS Seller Disclosure and Analyst Dispersion as a Measure of Information Asymmetry**

| Variable | Model 1: Fair Value at BHCs<br>Coefficient<br>(t-statistic) | Model 2: FSP on FAS 133<br>Coefficient<br>(t-statistic) |
|---|---|---|
| Constant | -3.682** | -2.161 |
| | (-2.220) | (-0.791) |
| CDS seller | -0.123 | 0.077 |
| | (-0.558) | (0.178) |
| **Post*CDS seller** | **0.043** | **0.190** |
| | **(0.145)** | **(0.343)** |
| Post | -0.132 | 0.346 |
| | (-0.536) | (0.526) |
| Ln(Market value of equity) | -0.147 | -0.647*** |
| | (-1.146) | (-3.103) |
| Stock return volatility | -8.739 | 22.947** |
| | (-0.741) | (2.294) |
| Share turnover | 19.432 | -12.933 |
| | (0.286) | (-0.769) |
| Allowance for loan losses | 15.268*** | 4.960*** |
| | (3.279) | (2.996) |
| Tier one capital ratio | -0.112 | 0.047 |
| | (-1.265) | (0.551) |
| Loan ratio | -0.374*** | -0.163** |
| | (-3.147) | (-2.554) |
| Horizon | 0.477*** | 0.228 |
| | (7.380) | (0.769) |
| Analyst following | -0.064 | 1.274*** |
| | (-0.214) | (4.533) |
| Loss indicator | 0.051 | -0.473 |
| | (0.178) | (-1.156) |
| Derivatives ratio | -0.000 | 0.006 |
| | (-0.089) | (0.341) |
| Observations | 71 | 99 |
| Adjusted R-squared | 0.596 | 0.513 |

Table 6 presents results using propensity score matching as a robustness check for tests of H1 and H2. Panel A presents descriptive statistics while Panels B, C, D and E present regression results. In Panels B and C Bid-Ask Spread is the dependent variable. In Panels D and E Analyst Dispersion is the dependent variable. Panels B and D present results on H1 while Panels C and E presents results on H2. In Panels C and E, Column 1 presents results using disclosure changes required by the Federal Reserve for BHCs in 2002 while Column 2 uses the 2008 SEC disclosure change. Coefficient t-statistics are shown in parentheses below the coefficient. Standard Errors are robust to heteroskedasticity and clustered at the firm level. All variables are defined in Appendix C. ***, **, * represent significance at the 1%, 5% and 10% levels, respectively.

Table 6 Panels B and D present the results of my tests of H1 on bid-ask spread and analyst dispersion, respectively, using the propensity score matched sample. Consistent with initial results presented in Table 3, I find that the *CDS seller* indicator is positive and significant in both tests—$\beta_1$= 0.145, significant at the 5% level in Panel B, and $\beta_1$=0.180, significant at the 5% level in Panel D. These results appear more reasonable from an economic significance standpoint than the results presented in Table 3. The coefficient on *CDS seller* suggests that CDS sellers have bid-ask spreads that are 15.6 percent greater than nonsellers. For the median firm this is an increase from 0.60 percent of price to 0.69 percent of price. With respect to analyst dispersion, the median effect of being a CDS seller is an increase in standard deviation of forecasts of 20 percent or an increase for the median firm from 2.2 percent of price to 2.63 percent of price.

As presented in Table 6 Panel C and Panel E, I am unable to confirm my results on H2 for either bid-ask spread or analyst dispersion using the propensity score matched sample. That is, the coefficient on *Post*CDS seller* is not significant for either disclosure change using either measure. My failure of to find a result may suggest that these disclosure changes may not have provided transparency to investors. However, a greatly reduced sample size in these models may be driving my lack of a result.

**Additional Tests – Alternative Analyst Measures**

In my main tests I measure analyst forecast dispersion using dispersion in analyst earnings per share estimates and assume that this measure captures differing beliefs about a firm's fair value. However, earnings per share forecasts estimate changes in book value which may be different than changes in fair value because book value is an output of the accounting system. In additional tests I use additional measures of analyst dispersion to understand whether the relation between credit derivative selling and analyst dispersion is related to firm value or to the accounting system.

I re-run my tests of H1 and H2 using two alternative measures of analyst dispersion; dispersion in analyst recommendations and dispersion in analyst target prices. Table 7 presents my results from these tests. Consistent with prior results on H1, I find that CDS selling is associated with increased dispersion in analyst recommendations. However, I am unable to find a similar result for target prices. Consistent with prior results on H2, I find that the FSP on FAS 133 is associated with decreased dispersion in analyst recommendations. However, I find no result for target prices. Furthermore, I find no relation between my alternative measures of analyst dispersion and CDS fair value disclosure in bank regulatory reports. My failure to find a relation is consistent with my main results on H2.

Analyst recommendations are related directly to analyst beliefs about firm value. For example, an analyst who issues a buy recommendation is telling investors that the firm is undervalued. By finding similar results for dispersion in analyst recommendations I confirm that analysts are have different beliefs about the firm value of credit derivatives sellers and that dispersion in EPS estimates cannot be attributed specifically to accounting methods. However, I fail to confirm these results using dispersion in target prices. My failure to find a result using target prices might be due to the fact that target prices typically include a range estimate and it may be more important to analysts to accurately forecast the target price range than the exact price.

**Table 7**

*Robustness Check: Alternative Analyst Dispersion Measures*

**Panel A: Sale of CDSs and Alternative Analyst Dispersion Measures**

| Variable | Model 1: Recommendation Dispersion<br>Coefficient<br>(t-statistic) | Model 2: Price Target Dispersion<br>Coefficient<br>(t-statistic) |
|---|---|---|
| Constant | -0.874*** | -3.133*** |
| | (-9.319) | (-27.183) |
| **CDS seller** | **0.162*** ** | **0.069** |
| | **(3.297)** | **(1.585)** |
| Ln(Market value of equity) | -0.014 | -0.014 |
| | (-0.983) | (-0.936) |
| Stock return volatility | -1.388** | 8.585*** |
| | (-2.016) | (7.835) |
| Share turnover | 1.419 | 16.491*** |
| | (0.548) | (5.171) |
| Allowance for loan losses | -0.104** | 0.021 |
| | (-2.415) | (0.275) |
| Tier one capital ratio | 0.008** | 0.014*** |
| | (1.970) | (2.597) |
| Loan ratio | 0.003* | 0.009** |
| | (1.756) | (2.427) |
| Horizon | -0.006 | 0.017** |
| | (-1.188) | (2.431) |
| Analyst following | -0.086*** | 0.160*** |
| | (-3.535) | (5.143) |
| Loss indicator | -0.030 | 0.184*** |
| | (-1.087) | (4.914) |
| Derivatives ratio | 0.000*** | 0.000 |
| | (2.786) | (0.943) |
| Observations | 7,955 | 8,140 |
| Adjusted R-squared | 0.054 | 0.312 |

**Table 7** - *Continued*

**Panel B: CDS Seller Disclosure and Alternative Analyst Dispersion Measures**

| | *Recommendation Dispersion* | | *Price Target Dispersion* | |
|---|---|---|---|---|
| | Model 1: Fair Value at BHCs | Model 2: FSP on FAS 133 | Model 3: Fair Value at BHCs | Model 4: FSP on FAS 133 |
| | Coefficient | Coefficient | Coefficient | Coefficient |
| Variable | (t-statistic) | (t-statistic) | (t-statistic) | (t-statistic) |
| Constant | -0.979*** | -0.512 | -4.396*** | -2.667*** |
| | (-4.713) | (-1.426) | (-10.172) | (-6.087) |
| CDS seller | 0.248** | 0.337*** | 0.197 | 0.086 |
| | (2.559) | (3.616) | (1.459) | (0.698) |
| **Post*CDS seller** | **-0.167*** | **-0.110** | **-0.033** | **0.238** |
| | **(-1.760)** | **(-1.292)** | **(-0.292)** | **(1.645)** |
| Post | -0.023 | -0.029 | -0.043 | 0.158 |
| | (-0.664) | (-0.416) | (-0.543) | (1.626) |
| Ln(Market value of equity) | -0.018 | -0.068** | 0.024 | -0.074** |
| | (-0.794) | (-2.053) | (0.547) | (-2.146) |
| Stock return volatility | 1.067 | -1.836 | 20.565*** | 5.715** |
| | (0.380) | (-1.276) | (3.425) | (2.335) |
| Share turnover | 30.141*** | 2.134 | 30.263* | 7.442 |
| | (3.353) | (0.538) | (1.754) | (1.651) |
| Allowance for loan losses | -1.524* | -0.111 | 2.420 | 0.272* |
| | (-1.670) | (-1.513) | (1.228) | (1.668) |
| Tier one capital ratio | 0.008 | -0.002 | 0.057*** | 0.012 |
| | (0.881) | (-0.120) | (3.575) | (0.644) |
| Loan ratio | 0.018 | 0.001 | 0.011 | 0.004 |
| | (0.890) | (0.256) | (0.238) | (0.749) |
| Horizon | -0.006 | -0.009 | 0.033 | 0.002 |
| | (-0.446) | (-0.276) | (1.135) | (0.046) |
| Analyst following | -0.042 | -0.079 | 0.132 | 0.284*** |
| | (-1.009) | (-1.142) | (1.285) | (4.097) |
| Loss indicator | -0.065 | 0.006 | 0.244 | 0.092 |
| | (-0.697) | (0.105) | (1.223) | (1.350) |
| Derivatives ratio | -0.000 | 0.001** | -0.000 | -0.000 |
| | (-0.083) | (2.398) | (-1.477) | (-0.868) |
| Observations | 620 | 534 | 490 | 598 |
| Adjusted R-squared | 0.042 | 0.069 | 0.171 | 0.325 |

Table 7 presents regression results using alternative analyst dispersion measures for tests of H1 and H2. Panel A presents results on H1 while Panel B presents results on H2. In Panel A, Column 1 analyst recommendation dispersion is the dependent variable while in Panel A, Column 2 analyst price target dispersion is the dependent variable. In Panel B, Columns 1 and 3 present results using disclosure changes required by the Federal Reserve for BHCs in 2002 while Columns 2 and 4 uses the 2008 SEC disclosure change. Further, in Columns 1 and 2 analyst recommendation dispersion is the dependent variable while in Columns 3 and 4 analyst price target dispersion is the dependent variable. Coefficient t-statistics are shown in parentheses below the coefficient. Standard Errors are robust to heteroskedasticity and clustered at the firm level. All variables are defined in Appendix C. ***, **, * represent significance at the 1%, 5% and 10% levels, respectively.

## CHAPTER 6

## CREDIT DERIVATIVE SELLER DISCLOSURE'S EFFECT ON THE MARKET FOR CDS

**Research Design – Tests of H3 Credit Derivative Seller Disclosure and CDS Market Transparency**

To provide some insight on the relationship between credit derivative seller disclosure and the market for CDS contracts, I examine CDS price volatility and the CDS bid-ask spread before and after additional disclosure rules take effect. Specifically, I estimate the following equations:

(4) $Ln(CDS\ bid\text{-}ask\ spread) = \alpha + \beta_1 Post + Controls + e$
(5) $Ln(CDS\ price\ volatility) = \alpha + \beta_1 Post + Controls + e$

The dependent variable in equation (4) is *CDS bid-ask spread* is the average CDS bid-ask spread over the quarter. The dependent variable in equation (5) is *CDS price volatility* is the standard deviation of CDS prices over the quarter. Again, I use the natural logarithm of these variables in my tests to account for positive skewness and to diminish the effect of outliers.

The variable of interest is *Post*, which is equal to zero in the two quarters before a disclosure change and one in the two quarters afterward. Because the CMA data on CDS prices begins in 2004, I can explore only the effect of the increase in SEC disclosure related to the FSP on FAS 133. If disclosure by CDS sellers increases market liquidity, I expect the coefficient on *Post* to be negative in both tests. If disclosure by CDS sellers reduces liquidity, I expect the coefficient to be positive.

I control for determinants of CDS liquidity and factors that may be correlated with the way disclosure affects liquidity. Thus I include the natural log of the CDS price (*Ln(CDS price)*); the natural log of the market value of equity of the reference entity; and return on assets for the reference entity. In particular, these variables control for CDS demand, an important determinant of CDS liquidity. A major source of CDS demand is the probability that a reference entity will go into default and trigger payouts on CDS contracts. Default risk is captured by the market value of equity and return on assets because larger and more profitable firms are less likely to default. Other important sources of demand for CDS are firm specific. For example, Qiu and Yu (2012) show that insider trading may drive CDS demand. Thus, I also include reference entity firm fixed effects.

CDS market demand is also tied to debt market liquidity by arbitrage strategies aimed at profiting on the CDS-bond basis, the difference between the CDS price and the par-equivalent bond yield spread. Typical strategies exploit illiquidity in the bond market by trading in the CDS market. Thus bond market liquidity is an important driver of CDS market liquidity.

I include two measures of bond market liquidity calculated with bond trading data from TRACE. The first measure is based on the Amihud (2002) illiquidity measure which captures the price impact of trades. It is calculated as the average volume-weighted percentage price change per trade for the quarter. I log this variable before including it in my model to control for outliers. I also measure liquidity in the bond market using price dispersion as suggested in Jankowitsch, Nashikkar, and Subrahmanyam (2011). This measure is calculated as the volume weighted standard deviation of trade prices.

**Results**

Results from my test of credit derivative seller disclosure and the market for CDS are displayed in Table 8. Model 1 in each panel shows baseline results, and Model 2 includes my variable of interest, *Post*, defined for the FSP on FAS 133. Models 3 and 4 include controls for bond market liquidity. In Panel A, where the bid-ask spread is the measure of liquidity, I find a positive and significant coefficient on the *Post* indicator variable ($\beta_1$=0.149, significant at 1% level), consistent with decreased liquidity following the additional disclosure. Furthermore, I find

**Table 8**
*CDS Seller Disclosure & the Market for CDS*

**Panel A: CDS Bid Ask Spread as a Measure of CDS Market Liquidity**

| Variable | Model 1: Baseline<br>Coefficient<br>(t-statistic) | Model 2: FSP on FAS 133<br>Coefficient<br>(t-statistic) | Model 3: Baseline with Bonds<br>Coefficient<br>(t-statistic) | Model 4: FSP on FAS 133 with Bonds<br>Coefficient<br>(t-statistic) |
|---|---|---|---|---|
| **Post** | | **0.149***** | | **0.147***** |
| | | **(6.923)** | | **(6.293)** |
| Ln(CDS Price) | -0.655*** | -0.254*** | -0.664*** | -0.244*** |
| | (-19.260) | (-5.172) | (-20.570) | (-5.099) |
| Ln(Market value of equity) | -0.381*** | -0.157*** | -0.411*** | -0.147*** |
| | (-9.906) | (-4.979) | (-10.486) | (-4.177) |
| Return on assets | -0.612** | -0.208 | -0.038 | -0.106 |
| | (-2.588) | (-1.630) | (-0.135) | (-0.763) |
| CDS price volatility | 0.699*** | 0.395** | 0.554*** | 0.393** |
| | (6.005) | (2.634) | (5.280) | (2.517) |
| Ln(Bond Amihud) | | | 0.015*** | -0.001 |
| | | | (3.821) | (-0.236) |
| Bond price dispersion | | | 0.012 | 0.006 |
| | | | (1.161) | (0.646) |
| Reference Entity Firm Fixed Effects | Yes | Yes | Yes | Yes |
| N | 7,335 | 849 | 5,463 | 711 |
| Adjusted $R^2$ | 0.712 | 0.850 | 0.766 | 0.849 |

**Table 8** - *Continued*

**Panel B: CDS Price Volatility as a Measure of CDS Market Liquidity**

| Variable | Model 1: Baseline<br>Coefficient<br>(t-statistic) | Model 2: FSP on FAS 133<br>Coefficient<br>(t-statistic) | Model 3: Baseline with Bonds<br>Coefficient<br>(t-statistic) | Model 4: FSP on FAS 133 with Bonds<br>Coefficient<br>(t-statistic) |
|---|---|---|---|---|
| **Post** | | **0.250**** | | **0.257**** |
| | | **(2.672)** | | **(2.676)** |
| Ln(CDS Price) | 0.164*** | 0.468*** | 0.186*** | 0.467*** |
| | (9.040) | (4.030) | (9.857) | (4.047) |
| Ln(Market value of equity) | -0.155*** | -0.331** | -0.181*** | -0.330** |
| | (-4.085) | (-2.659) | (-4.632) | (-2.480) |
| Return on assets | -0.654** | -0.665 | 0.140 | -0.245 |
| | (-2.068) | (-1.289) | (0.360) | (-0.438) |
| Ln(Bond Amihud) | | | 0.028** | 0.025 |
| | | | (2.550) | (0.957) |
| Bond price dispersion | | | 0.017 | 0.032 |
| | | | (0.654) | (0.789) |
| Reference Entity Firm Fixed Effects | Yes | Yes | Yes | Yes |
| N | 7,321 | 849 | 5,452 | 711 |
| Adjusted $R^2$ | 0.137 | 0.452 | 0.164 | 0.468 |

Table 8 presents results for H3; whether credit derivative seller disclosure is associated with CDS market transparency. The dependent variable in Panel A is the natural logarithm of CDS bid-ask spread. The dependent variable in Panel B is the natural logarithm of CDS price volatility. Coefficient t-statistics are shown in parentheses below the coefficient. Standard errors are robust to heteroskedasticity and clustered at the firm level. All variables are defined in Appendix C. ***, **, * represent significance at the 1%, 5% and 10% levels, respectively.

a similar result after including controls for bond market liquidity ($\beta_1$=0.147, significant at 1% level). Results on CDS volatility, presented in Panel B, corroborate those presented in Panel A. The coefficient on the *Post* indicator is once again positive and significant ($\beta_1$=0.250, significant at 5% level), suggesting that price volatility in the CDS market increased following FSP on FAS 133. Again, the result is similar after controlling for bond market liquidity ($\beta_1$=0.257, significant at 5% level).

The estimated coefficients suggest that CDS bid-ask spreads increased by 16% as a percentage of price in the post period. For the median reference entity this is an increase from 6.8% of CDS price to 7.89% of CDS price after controlling for other factors. For reference, Loon and Zhong (2014) found that CDS central clearing decreased median CDS bid-ask spreads from 7.6% of CDS price to 6.4% of CDS price. Furthermore, the coefficient on CDS price volatility suggests that price volatility (the standard deviation of CDS prices divided by the average CDS price) increased by 28% from 14.5% in the pre period to 18.62% in the post period for the median firm. This would be an increase in standard deviation for firm with the median CDS price ($133) from $19.29 in the pre period to $24.76 in the post period. For reference, Loon and Zhong (2014) have a $27.09 average standard deviation of CDS prices in their sample.

Taken together, these results suggest that mandatory disclosures made by credit default swap sellers have reduced competition to provide liquidity in the CDS market. As a result, liquidity appears to have diminished following the mandatory disclosure requirements in the FSP on FAS 133. This is in line with theory provided by Boulatov and George (2013) and the empirical results in Qiu and Yu (2012). However, my study is the first to provide evidence that disclosure by derivative dealers reduces liquidity in derivatives markets.

While I find mixed results in my size-adjusted test of the effectiveness of the 2008 FSP on FAS 133 at reducing information asymmetry in the equity market, I find strong evidence for its ability to diminish liquidity. This may be related to the type of information contained in the FSP and the broad reach that this disclosure requirement had for CDS sellers. Prior disclosure about credit derivative selling applied only to bank holding companies while the FSP on FAS 133 applied to all credit derivative sellers. Thus, while the disclosure may not have been very important to investors in bank holding companies who already had some of this data, buyers of credit derivatives could now compare all sellers. Furthermore, CDS buyers could aggregate credit derivative seller data and potentially learn something about the market for CDS.

**Additional Tests – Alternative Windows**

It may be that liquidity in the credit derivative market decreased in response to the financial crisis in general and not due to changes in disclosure. If this were the case, I would expect to see a decrease in liquidity around alternative windows in 2008 and 2009. In order to address this concern, I re-define the *Post* variable around the four quarters before and after the FSP on FAS 133. That is, in my primary regression I define *Post* as the two quarters before and after Q1 2009 whereas in this test I define the *Post* variable as the two quarters around Q4 2008 and estimate the coefficient, then I define the *Post* variable as the two quarters around Q2 2009 and estimate the coefficient and so on.

I present the coefficient estimates of *Post* in Table 9. The first row presents estimates of *Post* when the dependent variable is CDS bid-ask spread. I find positive and significant coefficients for *Post* when it is defined around Q4 2008, Q1 2009 (the enactment period of on FSP on FAS 133) and Q2 2009. When defined around other quarters, I find either a negative relation or no relation for the *Post* variable. The second row presents estimates of *Post* when the dependent variable is CDS price volatility. When CDS price volatility is the dependent variable I find positive and significant coefficients for *Post* when it is defined around Q4 2008 and Q1 2009 (the enactment period of on FSP on FAS 133). Again, when defined around other quarters, I find either a negative relation or no relation for the *Post* variable.

My results indicate that liquidity was diminished in the quarter before the FSP on FAS 133 took effect, the quarter that the FSP took effect and the quarter after the FSP took effect. Taken together, these findings indicate that there was not a trend of reduced liquidity in the CDS market during the financial crisis and that this effect was localized in the quarters around the disclosure requirement. Furthermore, evidence of a reduction in liquidity in the quarter prior to the FSP suggests that banks may have reduced liquidity when they knew disclosure was going to be required.

**Table 9**

*Robustness Check: Alternative Pre-post periods for tests of H3*

| | | | | | **FSB on FAS 133** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Q1 2008 | Q2 2008 | Q3 2008 | Q4 2008 | **Q1 2009** | Q2 2009 | Q3 2009 | Q4 2009 | Q1 2010 |
| | Coefficient | Coefficient | Coefficient | Coefficient | **Coefficient** | Coefficient | Coefficient | Coefficient | Coefficient |
| Dependant Variable | (t-statistic) | (t-statistic) | (t-statistic) | (t-statistic) | **(t-statistic)** | (t-statistic) | (t-statistic) | (t-statistic) | (t-statistic) |
| CDS Bid-Ask Spread | -0.067* | -0.101*** | 0.056 | 0.155*** | **0.149*** ** | 0.055*** | -0.036 | -0.146*** | -0.115*** |
| | (-1.749) | (-3.932) | (1.569) | (4.881) | **(6.923)** | (2.839) | (-1.606) | (-9.662) | (-7.287) |
| CDS Price Volatility | -0.188 | -0.734*** | -0.392*** | 0.396*** | **0.250** ** | -0.037 | -0.311*** | -0.368*** | -0.422*** |
| | (-1.339) | (-10.212) | (-3.761) | (4.214) | **(2.672)** | (-0.305) | (-3.215) | (-4.287) | (-5.264) |

Table 9 presents coefficient estimates of the *Post* variable for pre-post regressions around quarters before and after FASB Staff Position on FAS 133. The dependent variable in the first row is the natural logarithm of CDS bid-ask spread. The dependent variable in the second row is the natural logarithm of CDS price volatility. Coefficient t-statistics are shown in parentheses below the coefficient. Standard errors are robust to heteroskedasticity and clustered at the firm level. All variables are defined in Appendix C. ***, **, * represent significance at the 1%, 5% and 10% levels, respectively.

# CHAPTER 7

# CONCLUSION

I study sellers of credit derivatives to learn about the impact of mandatory credit derivative disclosure on bank opacity and OTC derivative markets. I predict that banks that sell credit derivatives are more opaque and that recent mandatory disclosure changes have been valuable at bringing transparency to these banks. I employ two mandatory changes in disclosure, FSP on FAS 133 and disclosure of the fair value of credit derivatives sold by bank holding companies on form FR Y-9C. My results confirm my prediction: selling credit derivatives appears to be a source of information asymmetry at banks and increases in mandatory disclosure have mitigated this effect. To my knowledge, this is the first empirical evidence of bank opacity at credit derivative sellers and the effectiveness of credit derivative seller disclosure at mitigating this effect.

I hypothesize that increased disclosure of credit derivative sales affects liquidity in the OTC market for credit default swaps. I find that FSP on FAS 133 is associated with increased CDS bid-ask spreads and price volatility. This suggests that increased disclosure may have decreased competition to provide liquidity in the OTC market consistent with theory provided in Boulatov and George (2013). As a result, this disclosure is associated with a decrease in CDS market liquidity.

My results matter to regulators and investors considering methods to reduce bank opacity. While additional mandatory disclosure requirements for derivatives providers appear to increase bank transparency, they may have the cost of reduced liquidity in OTC derivatives markets. This tradeoff is important to recognize when considering new disclosure initiatives.

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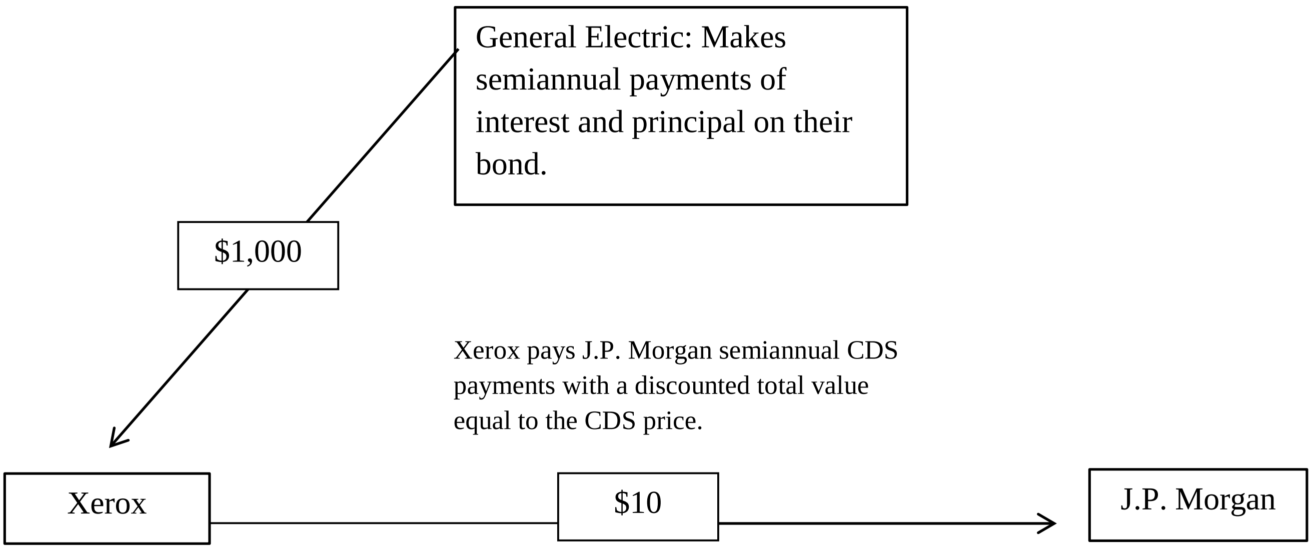
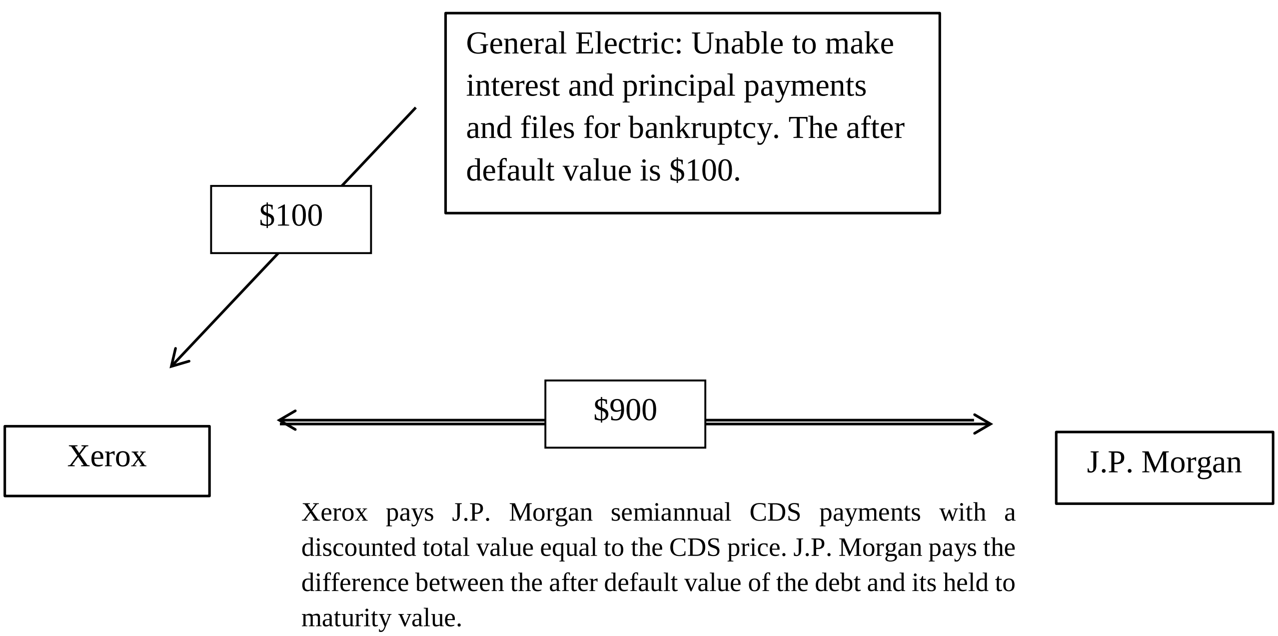
## APPENDIX A – CREDIT DEFAULT SWAP SCENARIOS

This diagram depicts the transfer of default risk for cash payments in a CDS contract. Suppose Xerox Corporation wants to protect against default risk on $1,000 of five-year corporate bonds from General Electric issued at par. To this end, Xerox Corporation buys a CDS from J.P. Morgan at a price of $10. Consider the following two scenarios:

### **No Default Scenario**




### **Default Scenario**



## APPENDIX B - TIMELINE OF CREDIT DERIVATIVE DISCLOSURE AND MAJOR EVENTS

1994 - JP Morgan invents the credit default swap

March 31, 1997 - Bank holding companies are required to report notional value of credit derivatives sold on form FR Y-9C

**Disclosure Event #1: March 31, 2002 - Bank holding companies are required to report the fair value of credit derivatives sold on form FR Y-9C**

September 15, 2008 – Lehman Brothers files for bankruptcy

**Disclosure Event #2: November 15, 2008 - FSP on FAS133 requires disclosure by all CDS sellers of maximum potential payout on CDS along with other descriptive information on CDS selling programs**

January 2013 – Dodd-Frank mandated swap data repositories report derivative trading activity of largest swap dealers

# APPENDIX C – VARIABLE DESCRIPTIONS

| Variable | Description |
|---|---|
| Bid-ask spread | The mean bid-ask spread for the quarter ((ask-bid)/((ask+bid)/2) in CRSP) |
| Analyst dispersion | The standard deviation of analyst forecasts (stdev in IBES) weighted by the mean IBES consensus annual forecast |
| CDS bid-ask | The mean bid-ask spread for each reference entity CDS price defined as (ask-bid)/((ask+bid)/2) |
| CDS price volatility | Standard deviation of each reference entity's CDS price for the quarter deflated by the mean CDS price |
| CDS seller | An indicator variable equal to one when any notional amount of credit derivatives sold is indicated in federal reserve regulatory reports and zero otherwise |
| Market value of equity | The stock price (prc in CRSP) multiplied by the average total number of shares outstanding (shrout in CRSP) at the end of the quarter |
| Stock return volatility | The standard deviation of stock returns (ret in CRSP) in the quarter |
| Share turnover | The natural log of the median daily share turnover (vol/shrout in CRSP) for the quarter |
| Allowance for loan losses | Loan loss allowance (rllq in Compustat) deflated by market value of equity |
| Tier one capital ratio | Tier 1 risk-adjusted capital ratio (capr1q in Compustat) |
| Stock price | Closing stock price or bid-ask midpoint (prc in CRSP) |
| Loan ratio | Net loans (lgq in Compustat) deflated by market value of equity |
| Horizon | The difference between the consensus forecast date (statpers in IBES) and the forecast period end date (fpedats in IBES) |
| Analyst following | The number of analysts issuing a forecast in the consensus forecast (numest in IBES) |
| Income before extraordinary items | Net income before extraordinary items (Compustat ibq) |
| Loss indicator | An indicator variable equal to one when EPS<0 in IBES (actual<0 in IBES) |
| CDS price | The quarterly average CDS Price |
| Return on assets | Income before extraordinary items divided by total assets (ibq/atq in Compustat) |
| Derivatives ratio | Total notional amount of Interest Rate Swaps, Futures, Forwards and Options as reported in form FR Y-9C deflated by market value of equity |
| Bond Amihud | The Amihud (2002) measure of illiquidity calculated for the bond associated with the CDS |
| Bond price dispersion | The quarterly average bond price dispersion measured as in Jankowitsch, Nashikkar, and Subrahmanyam (2011) |
| Recommendation Dispersion | The standard deviation of analyst recommendations (stdev in IBES) |
| Price Target Dispersion | The standard deviation of analyst price targets (stdev in IBES) weighted by the mean IBES consensus annual price target |