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Enterprise Credit Default Swaps and Market Discipline: Preliminary Analysis

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Abstract

Financial regulators are interested in harnessing market information and market discipline to improve the supervision and performance of financial institutions. Recent growth in the market for credit default swaps (CDS), derivative instruments that allow for the trading of credit risk, presents the possibility of a new and important source of such information. The current paper explores the potential role of the rapidly expanding CDS market in providing market information relative to Fannie Mae and Freddie Mac (the Enterprises). Since there is an inherent link between CDS and bonds, a preliminary question is whether the CDS market provides information not captured in the bond market. With respect to the Enterprises, this question takes on added importance in light of the previous research that failed to find default risk signals in bond market and stock market information. Thus, if CDS markets only replicate bond market information, little reason exists to invest additional regulatory resources monitoring them. To explore this topic, the paper first summarizes theory and evidence linking CDS pricing and bond pricing. This summary focuses on reasons why and evidence that the information from these markets may differ. The paper then documents a CDS dataset purchased from Markit Group, noting certain data limitations, and explores the behavior of CDS prices for the Enterprises and for other large U.S. financial institutions. In the process, the paper explores the relationship between CDS and bond pricing for the Enterprises.

The evidence indicates that CDS market participants evaluate and price the credit risk associated with the Enterprises differently from bond market participants. In particular, CDS market participants do not always price the credit risk associated with the obligations of the Enterprises lower than the credit risk associated with other large financial firms. In addition, a significant amount of the variation in the price of credit risk on the Enterprises' subordinated debt is not explained by the pricing of credit risk on their senior debt, a very different result than found in bond market data. The paper concludes with suggestions for further research.

Enterprise Credit Default Swaps and Market Discipline: Preliminary Analysis

Financial regulators have long been interested in market discipline—using market information or market forces to promote safety and soundness within financial institutions and the financial system. Many of the reforms instituted in the wake of the financial crises of the 1980s and 1990s promoted the complementary roles of market information and market forces. In the early 1990s, the Basel Committee on Banking Supervision identified market discipline as one of the three pillars of the Basel II initiative, the other two pillars being minimum capital and the supervisory review process.

For market discipline to be effective, market participants must assess changing financial conditions and risks of firms and securities correctly, price securities accordingly, and, through pricing, influence the actions of management (Bliss and Flannery, 2001). However, effective market discipline may be limited for large financial institutions, including Fannie Mae and Freddie Mac (collectively, the Enterprises), because many market participants believe such institutions are "too-big-to-fail" (TBTF). In addition, many market participants believe that the Federal Government will not allow a default on the obligations issued by a government-sponsored Enterprise (GSE), big or small. Such perceptions limit market discipline because market participants do not expect to pay the full price of bad outcomes from the risk-taking of the institutions. As a result, such institutions face market incentives to choose to take more risk than is socially optimal (Frame and Wall, 2002). Supporting this observation in the context of the Enterprises, previous OFHEO working papers (Smith, 2007; Collender, Roberts, and Smith, 2007) find little evidence that bond market participants monitor the credit risk posed by Fannie Mae and Freddie Mac.

Financial regulators have recently expressed an interest in credit default swaps (CDS), derivative instruments that allow for the trading of credit risk, as an additional source of market-derived information about the credit risk of very large financial institutions. Such information includes probabilities of default for individual institutions, the overall functioning of credit markets (as revealed by the dispersion of credit spreads), and as a leading indicator of macroeconomic developments (e.g., Marsh, 2003). For example, financial regulators may look

to market estimates of the probability of default in their efforts to ensure the safety and soundness of a supervised financial institution (Evanoff and Wall, 2001). Such estimates could be used as a check on in-house supervisory judgment or to support the supervisor's conclusions about the institution's default risk. Supervisors could also use market estimates as a trigger for more in-depth examination or for prompt supervisory action in the spirit of that required under FDICIA (Evanoff and Wall, 2002a and 2002b).

The current paper explores the potential role of the CDS market in providing market information relative to the Enterprises. To do so, the paper starts by explaining credit default swaps and the theoretical linkage between CDS prices and bond prices. The latter topic is important because it is unclear whether the CDS market should be expected to provide information not captured in the bond market. If not, there is little reason for regulator to invest resources in monitoring them. The paper then proceeds with a summary of research relating to CDS market behavior and pricing. Finally, the paper documents the behavior of CDS prices for the Enterprises and for other large U.S. financial institutions using CDS data purchased from Markit Group. The paper ends with a summary and suggestions for further research.

Credit Default Swaps

A credit default swap (CDS) is an over-the-counter derivative contract designed to transfer the credit risk associated with a particular firm's outstanding debt from one party to another. The borrowing firm is called the reference entity and the particular debt instrument covered by the swap is called the reference obligation. In the swap transaction, the seller offers protection against the credit risk to the buyer. Much like an insurance contract, the party buying the protection agrees to pay an annual fee, known as the CDS premium or CDS spread, until the swap agreement ends either by reaching maturity or through the occurrence of a recognized credit event. In exchange, the seller stands obligated to pay the buyer the par value of the obligation should a credit event occur, less the obligations' value at the time of the credit event. That is, the seller is bound by the swap contract to make up any difference between the market value and face value of the reference obligation at that time of the credit event.

At yearend 2007, the CDS market reached $62.2 trillion in notional amounts outstanding, according to the International Swaps and Derivatives Association's (ISDA) semi-annual flash survey of OTC swap and derivative activity.[1] From 2001 to 2007, the CDS market grew at an annual rate in excess of 100 per cent. By way of comparison, the same survey reveals that the total notional amounts outstanding in the currency and interest rate derivatives markets reached $382.3 trillion at yearend 2007; those markets have been growing at a slower, but still robust, 33% annual rate.

Market observers attribute the rapid growth in the CDS market to the standardization of the required documentation by the ISDA, the reliability of CDS performance in high profile corporate failures (e.g., Enron), and the recognition of benefits on both sides of CDS transactions (i.e., buyers and sellers of protection). The ISDA documentation provides definitions of CDS terms, including what constitutes a credit event. Such standardization provides greater certainty to the parties about how terms will be interpreted and what will happen when a credit event occurs. Thus, standardization improves the process flow and efficiency of the initial contracting and of the resolution process following a credit event, making credit default swaps more attractive to investors. Under the defined terms, the payout is linked to a credit event and performance of a reference entity (i.e., the underlying obligor) not to a specific bilateral transaction. The credit event is usually a default, bankruptcy, or restructuring. ISDA provides a variety of model "documentation clauses" that very in terms of what constitutes a credit event (see Appendix A).

CDS contracts provide benefits to both buyers and sellers of credit protection. CDS benefit buyers of protection by allowing them to lay-off, or redistribute, credit risk exposures, improving their ability to optimize their credit portfolios. For regulated financial firms the shedding of risk can free up regulatory capital and facilitate additional business. In comparison to insurance or other risk redistribution options, CDS may make it easier to purchase and match protection for a desired maturity; may prove less expensive; and may provide faster payout for covered risks. For example, the lag time between a credit event and payout on a CDS has been approximately four to six weeks compared to much more for a direct resolution. A CDS

[1] http://isda.org/statistics/pdf/ISDA-Market-Survey-historical-data.pdf

transaction is also cheaper and more flexible than a debt assignment since there is no transfer of ownership of the debt obligation. Again, the standardization provided by ISDA makes the documentation and trading of CDS relatively straightforward.

Sellers of credit protection also benefit from the CDS market. Benefits to sellers stem from the potential of CDS to improve the profitability and risk characteristics of their asset portfolio by adding another source of both return and diversification that requires no initial cash outlay. In other words, CDS allow sellers to take positions in assets or types of asset classes that might not otherwise be readily available. CDS also allow sellers to better control the maturity of their exposure or match it to their investment appetite.

Links to the bond market

The link between the bond market and the CDS market can be demonstrated by a simple arbitrage argument. Consider an investor who can choose to buy or sell any of these three assets: a (default) risk-free bond, a risky bond, and a credit default swap covering the default risk of the risky bond. The investor can create a default-risk free investment in two ways: by (a) simply investing in the risk-free bond or by (b) investing in the risky bond and buying the CDS. Ignoring transactions costs, the returns to investment (a) and investment (b) should be identical. If returns were not identical, investors could buy the investment with the higher returns and sell the investment with the lower returns and make an immediate, risk-free profit. In mathematical terms, let r represent the yield on the risk-free bond, y represent the yield on the risky bond, and s represent the CDS premium. Investors should act such that $y - s = r$, or equivalently, $s = y - r$. That is, economically rational investors seeking profit opportunities will force the CDS premium (s) to be equal to the spread between the risky bond and the default-risk-free bond ($y - r$).

Given this linkage, the question then becomes why one might expect the CDS market to supply information—and facilitate market monitoring and discipline—that the bond spread does not. O'Kane and McAdie (2001) cite a number of reasons why the simple arbitrage story might not adequately describe the relationship between bond and CDS spreads – dividing them into fundamental factors and market factors as indicated in table 1. Fundamental factors are those

that arise because of the divergence between complex financial market reality and the simplifying assumptions that underpin the simple arbitrage story. Market factors are those relating to market imperfections or frictions.

In terms of fundamental factors, O'Kane and McAdie specifically cite funding issues, counterparty risk, and the option to physically settle a CDS contract through delivery of a specific security. Funding issues arise from the fact that a bond sale requires an exchange of principal (i.e., it is a "funded" transaction), while a CDS contract sale does not. This is important because research has shown that CDS spreads appear to be priced off LIBOR (Houweling and Vorst, 2005) while funded transactions will lock in rates tied to the credit quality of the investor. Thus, highly rated investors or those with other low-cost funding such as core deposits may borrow at sub-LIBOR rates which lead them to prefer to buy the bond rather than sell protection. Investors whose ratings force them to borrow at supra-LIBOR rates and wishing to acquire credit risk would prefer the unfunded CDS transaction. O'Kane and McAdie argue that most participants fund above LIBOR, which means they prefer selling CDS to purchasing bonds to gain exposure to credit risk and, in equilibrium, are willing to accept a lower CDS spread than bond spread for any particular issuer/obligator.

With respect to a bond purchase transaction, counterparty risk dissipates with the settlement and transfer of title. In contrast, a CDS transaction entails on-going and asymmetric counterparty risks. This is true because the CDS buyer owes the seller periodic payments until maturity or until a covered credit event occurs; in return the seller must make the buyer whole if a credit event occurs. Since the payments from the buyer to the seller are periodic and relatively small and the payment to the buyer from the seller is potentially quite large and its specific timing potentially hard to predict, most of the counterparty risk is borne by CDS buyers. In equilibrium, the asymmetry in counterparty risk lowers the rate the CDS spread relative to the bond spread. The existence of significant counterparty risk means that access to CDS markets is limited to highly rated entities, whereas bond markets are open to anyone with sufficient cash to fund their transactions.

Finally, the option to physically deliver an eligible bond as part of the CDS settlement following a credit event affords the buyer the ability to choose the "least-costly-to-deliver" bond from the eligible set specified in the CDS contract. This option affords the buyer some economic advantage that will tend to raise the CDS spread relative to the bond spread. However, changes to the ISDA documentation clauses have reduced the value of the delivery option.

In terms of market factors, O'Kane and McAdie (2001) cite liquidity and supply and demand factors as reasons why CDS spreads can deviate from bond spreads. They note that the relative liquidity of bond and CDS markets differs in ways that are not systematic across maturities. Thus, the four most liquid CDS markets, by maturity, are those with maturities (or tenors) of 5, 3, 10, and 1 year. In contrast, bond market liquidity for a given issue or issuer depends on such factors as the notional amount outstanding of a given maturity and the frequency of issuance. In addition, the liquidity of the bond market for a given issue shifts as the issue ages, and bond market liquidity varies considerably among issuers.

Differing rules and arrangements in the CDS and bond markets may shift demand or supply between them. For example, many financial institutions have an advantage over other investors in assessing and managing credit risk. It is less costly for financial institutions to exercise this comparative advantage in the CDS market than in the bond market. This may lower CDS spreads relative to bond spreads. Similarly, the limited availability of bonds to repo for short sales makes it more difficult to take a short position in a bond than it is to take an equivalent position in CDS. As credit quality deteriorates, the difficulty of shorting bonds relative to CDS means that CDS spreads may increase faster than bond spreads. A transitory factor that may cause divergence in CDS and bond spreads is that at issuance, banks and underwriters may seek protection via CDS to reduce exposure or free up capital. Doing so in sufficient quantity would widen the at-issuance CDS spread relative to the bond spread.

Results of Previous Research

Existing research gives some reason to believe that CDS markets provide information that is not available through bond markets. Although this research has shown that CDS premiums and yield spreads of risky debt instruments to default-free instruments (U.S. Treasuries or swaps) have much in common, the CDS market may offer advantages in terms of the speed of price discovery after news is revealed to the market and the purity of the default risk signal.

- Cossin and Hricko (2002) showed that the same factors determine both bond and CDS spreads including third-party ratings, the shape of the yield curves, stock prices, and leverage ratios.
- Houweling and Vorst (2005) found that if swap rates are used as the risk-free rate, discrepancies between bond and CDS spreads are small. Zhu (2006) confirms this result and suggests the use of swap rates in CDS pricing is tied to tax considerations.
- Blanco et al. (2005) and Zhu (2006) show that CDS and bond spreads are similar in long run.
- Blanco et al. (2005), Zhu (2006), and Longstaff et al. (2005) find evidence that in the short run CDS spreads tend to respond more quickly to changes in credit conditions than do bond spreads.
- Zhu (2006) also found that the relative importance of the two markets for price discovery can vary substantially across reference entities (debt issuers). Zhu documents that in the shortrun the simple arbitrage story breaks down, with the two markets registering substantial price discrepancies, largely due to their different responses to changes in credit quality of reference entities.
- Longstaff et al. (2005) and Chen et al (2007) found that a large proportion of bond spreads are determined by liquidity factors and do not reflect default risk of underlying assets.

At the same time, research has revealed a number of reasons to be cautious in interpreting bond spreads as information about default risk:

- Jones, Mason, and Rosenfeld (1984) found predicted credit spreads are far below observed spreads.
- Longstaff and Schwartz (1995), Leland (1994), and Leland and Toft (1996) all found that such factors as stochastic interest rates, endogenously determined default boundaries,

strategic factors, and mean-reverting leverage ratios fail to explain the discrepancy between predicted and observed credit spreads.

- Collin-Dufresne, Goldstein, and Martin (2001) found that the power of default risk factors to explain credit spreads is small, while Elton, Gruber, Agrawal, and Mann (2001) found temporal changes in bond spreads are not directly related to expected default risks.
- Huang and Huang (2003) found that credit risk accounts for only a small fraction of observed corporate yield spreads for investment grade bonds, but accounts for a larger share of high-yield bond spreads, while predicted yield spreads are similar across different structural models.
- Eom, Helwege, and Huang (2004) compared empirically five structural models for pricing corporate bonds and found large pricing errors. For some models the predicted spreads are implausibly low, but for others implausibly high. In particular, models tend to overestimate the credit spreads for firms with high leverage or volatility and underestimate spreads from safer bonds.

In addition, research has shown that

- CDS markets anticipate negative credit rating announcements (Hull et al., 2004; Norden and Weber, 2004).
- Changes in CDS spreads also appear to incorporate some information that may not be reflected in stock price movements, which also anticipates such actions (Norden and Weber, 2004).
- Delivery option in CDS contracts and short-sale restrictions in the cash market only have minor impacts on credit risk pricing (Zhu, 2006).
- Contractual terms related to definition of credit events and deliverables are priced into CDS spreads, with CDS spreads being higher for contracts with broader definitions of credit events and less restrictive definitions of deliverable securities. Pricing the differences in contract terms appears to have converged over time. (Packer and Zhu, 2005).
- Both systematic (market-wide) and firm- or bond-specific factors account for the variation in differences between bond and CDS spreads, but the bulk of those discrepancies is explained by the firm- or bond-specific factors rather than market-wide factors. (Zakrajsek, Levin, and Perli, 2005).

The Markit Credit Default Swaps Dataset

In November 2006, OFHEO purchased CDS data covering several large financial institutions from Markit Group. Usable data was received for the Enterprises (Fannie Mae and Freddie Mac), other government-sponsored enterprises (Farmer Mac and the Federal Home Loan Bank System), a former GSE (Sallie Mae), five large commercial banks (Citigroup, Bank of America, Chase, Wachovia, and Wells Fargo), four large investment banks (Merrill Lynch, JP Morgan, Lehman Brothers, and Morgan Stanley), and one mortgage-oriented businesses (Countrywide).

The Markit dataset data provides daily firm-level data on CDS spreads for the period from January 2001 through November 2006. The reported spreads are composites of the mid-point between the daily bid and ask quotes that Markit collects from CDS dealers. To maintain data quality, Markit subjects all quotes to a series of tests and cleans the data accordingly. Those tests check for stale data (i.e., quotes that do not change for an extended period), outliers, flat CDS term structures inconsistent across data contributors, and consistency of quotes across documentation clauses. The reported composite spread is Markit's computation of the average spread for an instrument after the removal of quotes that fail the data quality tests (Zakrajsek et al., 2005).

Table 2 presents the numbers of days with quotes and the percentage of possible days with quotes for each of the issuers (reference entities) and each CDS maturity in the Markit dataset. For several issuers, the data is very limited for several possible reasons. Some issuers underwent mergers during the data period and the CDS series were discontinued or restarted with each merger. This explanation covers the limited number of observations for JPMorganChase (which merged with BankOne in 2004 when its data series starts). For other issuers with limited observations (the FHLB System, Farmer Mac), the explanations are less clear.

For comparison, the last line of table 2 includes percentage information by maturity from the larger Markit data set used by Zakrajsek et al. (2005). That line confirms that the most liquid maturity for both datasets is 5 years followed by the 3-, 1-, 7-, and 10- year maturities in a

similar (but not exactly the same) order in both datasets. The least liquid maturity is four years followed by the 30-, 1-, and 20-year maturities.

Table 3 provides information on the ranges of dates for which quotes are available for each issuer and each maturity. Of course, quotes are not available for most issuers for every trading day within these ranges. Together, the data in Tables 2 and 3 provide information on the liquidity of CDS from particular issuers and at particular maturities.

Table 4 presents information on CDS liquidity by documentation clause, showing the numbers of quotes and the percentage of quotes per year accounted for by each of the documentation clauses. The most common documentation clause in the dataset is the "modified restructuring" (MR) -- consistent with observations in the literature. Over time, the "full restructuring" (CR) documentation clause has lost popularity to the XR (no restructuring clause). The MM (modified-modified restructuring) documentation clause appears to have rapidly gained popularity after its introduction, but that popularity fell off in the last year of data. These clauses are discussed in appendix A. Buyers and sellers of CDS mutually agree on the documentation clause contained in any particular contract; the reference entity has no say. Thus, for any reference entity, including the Enterprises, CDS containing different documentation clauses may be traded at any given time. Following the extant literature on CDS, the analysis here focuses on the most liquid CDS in the U.S. market: those with the MR documentation clause and 5 year maturities unless noted otherwise.

Information from Markit Data

This section compares the behavior of CDS referencing Enterprise obligations (both senior and subordinated) to that of CDS referencing the other large financial institutions firms in the dataset. In addition, the section provides evidence to shed light on the question of whether the CDS market captures different information from the market for Enterprise debt obligations.

The liquidity of CDS across reference entities can be illuminated by statistics on the frequency of quotes and changes in quotes, the number of unique values that composite quotes

take over time and their percentage of total quotes, and the number of contributors whose quotes are incorporated into composite quotes. As a CDS becomes more liquid, the number of days with composite quotes should increase as more firms provide quotes to Markit. If those quotes reflect independent assessments of value based on trades and order flows, the number of days where the composite quote is unchanged should fall and percent of composite quotes that are unique values will increase.

Table 5a provides information for 5-year, MR CDS referencing senior debt of firms in our dataset, while table 5b provides the same information for CDS referencing subordinated debt. Again, more liquid CDS should have more daily quotes, fewer day-to-day price changes equal to zero, a greater percentage of composite quotes that are unique values, and more firms contributing quotes that are used in the daily composite quotes. By these measures, table 5a shows that CDS referencing the senior debt of investment banks is more liquid than the CDS referencing commercial bank senior debt, which in turn is more liquid than CDS referencing GSE senior debt. By some measures, the liquidity of some of the CDS may be an issue. For example, several references entities (Bank of America, Countrywide, Farmer Mac, and the FHLBs) have low average composite depth and large percentages of composite quotes that rely on less than five inputs. For some of these reference entities (Farmer Mac and the FHLBs), the percent of daily changes equal to zero and the percent of observations that represent unique values also indicate relatively low activity. The statistics for Fannie Mae and Freddie Mac also indicate relatively few day-to-day price changes and unique values, but quotes are provided by many more firms. Interestingly, the CDS referencing the former GSE, Sallie Mae, are among the most liquidity by these measures.

Turning to CDS referencing subordinated debt, Table 5b shows that the liquidity characteristics of subordinated debt are not so well behaved. For all firms, CDS referencing senior debt appear to be more liquid than CDS referencing subordinated debt. The measures associated with composite depth indicate that CDS referencing GSE subordinated debt are more liquid than CDS referencing firm private debt. However, like CDS referencing GSE senior debt, CDS referencing GSE subordinated debt tend to have a greater percent of day-to-day price changes equal to zero and fewer unique values for their daily composite quotes. Turning to

individual entities, the mean composite depth is very low for most firms, with a very high percent of composite quotes relying on fewer than five inputs. Statistics for the Enterprises are similar to those for CDS referencing their senior debt: relatively few day-to-day price changes and unique values. The information from table 5 serves as a caveat to the observations drawn from this data.

Figures 1 through 6 present information related to CDS spread means and standard deviations for senior and subordinated debt. For simplicity, this paper presents results for the MR documentation clause. Figures 1 through 4 provide information on the means and standard deviations of CDS spreads across the CDS term structure, while figures 5 and 6 provide pairwise comparisons of 5-year CDS spreads across reference entities.

Figure 1 presents the means of daily CDS spreads for senior debt, by maturity, for each of the reference entities. The order of mean daily CDS spreads across maturities generally conforms to expectations that they should increase in magnitude as maturity rises. Where this rule fails to hold, differences in the numbers of days with quotes exist across maturities. For instance, the less liquid 4-, 15-, 20-, and 30-year maturities frequently violate the general pattern. (As shown in table 2, these maturities tend to have relatively fewer daily quotes.) Figure 2 graphs the standard deviations of daily CDS spreads for senior debt by maturity for each of the reference entities. In contrast to the pattern in the term structure of mean quotes, no general pattern emerges with respect to maturity except that maturities with fewer days of quotes tend to have lower standard deviations.

Figures 3 and 4 present means and standard deviations for CDS referencing subordinated debt analogous to the information in figures 1 and 2 for CDS referencing senior debt. As was true in figure 1 for CDS referencing senior debt, figure 3 shows that the mean spreads for CDS referencing subordinated debt increase with CDS maturity. Similarly, figure 4 shows that standard deviations of CDS referencing subordinated debt lack a general pattern with respect to maturity just as figure 2 showed for CDS referencing senior debt. Significant differences in the

number and timing of days with quotes makes other comparisons from these charts more problematic.

The information in figures 1 through 4 is helpful for understanding the general behavior of CDS spreads with respect to maturity, but is of limited value for comparisons across reference entities. CDS spreads have varied systematically over time, so comparisons that do not control for the time of the quotes can be misleading. To facilitate a more meaningful comparison across reference entities, I compared means and standard deviations of CDS quotes on a paired basis with each of the Enterprises. That is, I compared the mean and standard deviation of CDS quotes on senior and subordinated debt for days when an Enterprise and another reference entity in the dataset both had quotes. That information with Fannie Mae as the base comparison (graphs using Freddie Mac as the base are qualitatively similar) is presented in figures 5 and 6. Note that, due to missing data, pairwise comparisons are not available for every reference entity.

Several interesting results emerge from figures 5 and 6. First, the Enterprises do not always have the lowest mean daily CDS spreads for either senior or subordinated debt. During the sample period the Bank of America had lower mean CDS spreads on senior debt and Wachovia, Wells Fargo, and Citigroup had lower mean CDS spreads on subordinated debt than either Enterprise. That result does not appear to be related to maturity or documentation clause. The fact that the CDS spreads on the Enterprises' subordinated debt are higher than those of the commercial banks but lower than those of investment banks may reflect differences in the use of subordinated debt in the different types of firms as well as variation in CDS liquidity across reference entities. Differences in CDS spreads across GSEs and between GSEs and other firms may also reflect the differential impact of perceptions of "too-big-to-fail" policies related to the Enterprises and other systemically important financial institutions. Changes in those perceptions over time can move relative CDS spreads, and distinguishing between changes in such policies and changes in underlying default risk may be difficult.

The second interesting result is that the standard deviations of CDS spreads on the Enterprises' subordinated debt are larger than those for every other reference entity with sufficient observations on CDS spreads on subordinated debt. In light of the data in table 5

showing that CDS referencing the Enterprises' had many more days when price changes were equal to zero, the greater standard deviations of the Enterprises' CDS quotes implies that when quotes change, they change by greater amounts. In addition, for many reference entities, the volatility of CDS quotes on senior debt is higher than the volatility of CDS quotes on subordinated debt. That result appears to arise from differences in the liquidity of and the timing of quotes for CDS referencing senior debt and CDS referencing subordinated debt. For most references entities, quotes on CDS referencing subordinated debt are more heavily weighted toward the later years of the sample when overall volatility was low compared to quotes on CDS referencing senior debt.

Also of interest is the behavior of CDS spreads across GSEs. CDS referencing the debt of the Federal Home Loan Banks (FHLBs) have the lowest mean spreads and the lowest standard deviations, whereas Farmer Mac has the highest mean spreads and the highest standard deviation. This observed pattern is consistent with the relatively low risk of FHLB bonds since they are secured by super-senior liens on the assets of FHLB members and by the joint and several liability among the FHLBs themselves. In contrast, Farmer Mac is a small GSE with a relatively weak market position compared to its competition. Finally, it is interesting to note the behavior of CDS referencing the former GSE, Sallie Mae. Sallie Mae's CDS display mean spreads and standard deviations similar to the investment banks but far lower than those associated with Countrywide or Farmer Mac.

Across reference entities, both means and standard deviations are linked to credit quality. To demonstrate this, table 6 presents means and standard deviations for 5-year CDS referencing senior debt along with ratings from Moody's and Standard and Poor's. Firms with high ratings tend to have low mean CDS spreads and low standard deviations of CDS spreads. The highest mean spreads for a GSE are for Farmer Mac which has not been rated by an independent rating agency. Despite Farmer Mac's GSE status, its mean CDS spreads are higher than any other reference entity in the dataset.

Table 7 presents sample statistics and correlations for CDS spreads on senior and subordinated debt for reference entities with a significant number of quotes for both types of debt

for 2003 through 2006. As one would expect, for all reference entities in all years, mean CDS spreads on subordinated debt are higher than mean CDS spreads on senior debt. However, standard deviations are usually, but not always higher. Part of the difference in standard deviations between CDS referencing senior and subordinated debt is explained by the sometimes fewer days with quotes for CDS referencing subordinated debt. Correlations between quotes for CDS referencing senior and subordinated debt vary considerably from year to year. For example, the correlation for Fannie Mae ranges from 0.40 in 2003 to 0.94 in 2005. In fact, in 2005 these correlations were uniformly high (over 0.90). Their range is considerably greater in other years. Finally, while most correlations are significantly positive, they are negative for both the Bank of America in 2004 and Lehman is negative in 2006. While those negative correlations appear to be driven by low liquidity in the CDS referencing subordinated debt as evidenced by the number of quotes and their low standard deviations, the correlations in 2006 are also lower but positive for other investment banks for which debt are available. Thus, one might expect the relationship between CDS quotes for different seniority debt to change considerably with the fortunes of a firm or industry, potentially providing important market information to the regulatory community.

The next information I explore is the term structure of CDS spreads on senior debt over time. Figure 7 presents such term structures for each of the Enterprises and for groups of three groups of private firms: "mortgage lenders," "investment banks," and "depositories." "Mortgage lenders" includes Washington Mutual and Countrywide; "investment banks" includes JP Morgan, Morgan Stanley, Merrill Lynch, and Lehman Bros.; and "depositories" includes Citigroup, Bank of America, Wells Fargo, and Wachovia. For each Enterprise and firm grouping, figure 7 includes CDS term structures for three years. The top graph in each column is the term structure for 2002, the middle graph is for 2004, and the bottom graph is for 2006. Each graph also has three lines: for each maturity, the blue line is the average quote, the green line is the maximum quote, and the red line is the minimum quote. These graphs confirm some of our earlier observations. For example, that mean quotes tend to increase with maturity. That pattern becomes more regular with time as the liquidity of the CDS markets (and therefore the number of days with quotes for many entities) increased. The dispersion of quotes may also increase with maturity (here measured by the range rather than the standard deviation) although that

pattern is less regular. In addition, these graphs show a general tightening of range of CDS spreads over time and lowering of levels across all groups consistent with the general trend toward lower credit risk premiums in credit markets during this period. If the data extended into 2007, that trend would be reversed. In any event, the commonality across the industry groups indicates a systemic component to CDS pricing.

In addition to exploring summary statistics, I performed two sets of regression to provide evidence with which to compare the information captured by the CDS market to that captured in the markets for Enterprise senior and subordinated debt. The first set looks at the relationship between CDS spreads on Enterprise subordinated debt to CDS spreads on Enterprise senior debt. The second set looks at the relationship between yield spreads between Enterprise senior debt and similar Treasury debt to CDS spreads on Enterprise senior debt.

The regression analysis mirrors that previously published with respect to the bond markets in Smith (2007) and in Collender, Roberts, and Smith (2007). That research showed an extraordinarily close link between Enterprise senior and subordinated debt, a link not replicated for banks that issue subordinated debt. As Smith notes (pp. 33-36):

> The more investors perceive no difference in the credit risk of Fannie Mae and Freddie Mac senior and sub debt, the more changes in the yield of an Enterprise's senior debt should explain changes in the yields of its sub debt. Simple regression models were used to test for a statistically significant relationship between the yields of non-callable, 10-year Fannie Mae and Freddie Mac sub and senior debt. Those models predict that a 1 basis point change in the yield of either Enterprise's 10-year senior debt produces a 1 basis point change in the yield of each Enterprise's 10-year sub debt. Changes in the yield of each Enterprise's senior debt explain 95 to 96 percent of changes in the yield of its sub debt. A similar model predicts that a 1 basis point change in the yield of non- callable, 10-year Bank of America senior debt produces a 0.17 basis point change in the yields of its 10-year sub debt. Changes in the yield of the senior debt explain 3 percent of changes in the yield of the BoAC sub debt. Those findings provide strong evidence that investors perceive little difference in the credit risk of Enterprise sub and senior debt, but believe that Bank of America sub debt poses much greater credit risk than its senior debt.

CDS Senior vs. CDS sub. I test for a similar link in the CDS market in our first set of regressions, as summarized in table 8. If the markets were perfectly linked, the intercept would

be equal to zero and the coefficient on the senior debt CDS spread would be one. I run these tests for the 5- and 10-year maturities for both Enterprises. While the hypothesis that the intercept is equal to zero can only be rejected for the ten year maturities, the hypothesis that the coefficient is equal to one can be rejected in all four regressions. In addition, the adjusted-R^2's—the percent of variation in the data explained by the regressions—while high, are quite a bit less than those found in the bond markets and cited in the above quote. The reported regressions are sufficient to conclude that further exploration of CDS markets as a possible source of useful market signals and a potential source of market discipline is warranted. However, the results are not robust enough to conclude that the coefficients can be interpreted to represent the underlying relationship between CDS spreads for each Enterprise's senior and subordinated debt. Tests of the data indicate that they are nonstationary and therefore that the estimated regression coefficients may not reflect the true relationships in the data. Such relationships would best be analyzed after first differencing the data. However, the large number of observations for which the first difference is zero (as reported in table 5) precludes further analysis of the relationships between the CDS spreads on senior and subordinated Enterprise debt at this time.

CDS senior vs. debt senior. The second set of regressions, summarized in table 9, present further evidence that the markets for Enterprise CDS are generating different information than the bond markets. These regressions show that although there is a positive and significant relationship between CDS spreads and senior debt spreads to Treasuries, that relationship explains one-quarter or less of the variation in CDS spreads for Fannie Mae. For Freddie Mac the relationship explains between 28 and 63 percent of the variation in CDS spreads on senior debt, still considerably less than in the bond market. Given the results presented in table 8 for the first set of regressions, one can infer that less of the variation in CDS spreads on subordinated debt is explained by the bond market spreads. Again, and for the same reasons, the coefficients themselves should not be interpreted to represent the underlying relationships between CDS spreads for each Enterprise's senior and subordinated debt.

Thus, in contrast to previous research with respect to the bond market, the evidence presented here indicates that CDS market participants evaluate and price the credit risk associated with the Enterprises differently from bond market participants. In particular, CDS

market participants do not always assess (price) the credit risk associated with the obligations of the Enterprises lower than the credit risk associated with other large financial firms. In addition, more variation exists with respect to the price of credit risk on the Enterprises' subordinated debt that is not explained by the pricing of credit risk on their senior debt.

Conclusions and suggestions for further research

This paper is meant as a first step in the exploration of the CDS market as a potential source of information and discipline to enhance Enterprise safety and soundness. The paper started with explanations of the CDS instruments and of the linkage between CDS pricing and bond pricing, including some reasons why that linkage might breakdown. The paper continued with a brief summary of the academic literature on CDS behavior including its pricing relative to the bond market. Finally, the paper presented summary information and regression results that indicate important qualitative differences between the information generated by the CDS markets and the bond markets. Those differences include differences in the relative pricing of credit risk among firms and among instruments (senior versus subordinated debt). Regression analysis indicates greater independence between the pricing of CDS referencing Enterprise senior and subordinated debt compared to the bond market yields on the underlying instruments. Regression analysis also indicates that contemporaneous bond market spreads on senior Enterprise debt explain relatively little of the variability in CDS spreads on the same instruments, especially for Fannie Mae.

The evidence presented in this paper suggests that participants in the CDS market may put less weight than bond market participants on perceptions that the Enterprises are "too-big-to-fail." This is important because, for supervisory purposes, the availability of a market-based measure of default risk is desirable. Thus, financial regulators would like to distinguish between changes in CDS spreads caused by changes in their default risk and those caused by changes in the perceived probability of government support.

Several possible avenues for additional research exist. These include CDS-based event studies similar to the approach taken in Hull et al. (2004). Further and more sophisticated work on the linkages between Enterprise debt markets and CDS markets would be useful as the

apparently disparate behavior in the two markets begs for an explanation, especially given the linkage created by physical delivery in the CDS market. Such work could include interviews with market participants as well as more quantitative work similar to that undertaken by Zakrajsek et al. (2005) to explain disparities across the markets more generally. Another line of research would be to explore ways to more immediately use information from the CDS market in the regulatory process. One possibility would be to identify a dynamic market signal of default risk similar to that modeled and found by Gonzalez-Rivera and Nickerson (2006) for the banking market and explored without success by Collender et al. for the Enterprises using information from the debt and equities markets.

Tables and Figures

Table 1: Factors influencing the CDS spread relative to the bond spread

	Expected effect on CDS spread relative to bond spread
Fundamental Factors	
Funding issues	-
Counterparty risk	-
CDS Physical settlement option	+
Market Factors	
Liquidity	+/-
Cost of taking a position on a firm's credit risk	-
Difficulty in shorting bonds (especially as a credit event becomes more likely)	+
Desire of underwriters to hedge their credit risk exposure at the time a bond is issued	+

Table 2: Numbers and percentages[2] of quotes by reference entity and CDS maturity

Reference Entity	Total quotes	Days with quotes	Maturity									
			6 mo	1 yr	2 yr	3 yr	4 yr	5 yr	7 yr	10 yr	20 yr	30 yr
Fannie Mae	11779	1448	1067	1285	1287	1285	342	1398	1446	1446	1222	1001
	76	93	74	89	89	89	24	97	100	100	84	69
Freddie Mac	11043	1264	991	1246	1246	1245	342	1264	1237	1237	1227	1008
	71	81	78	99	99	98	27	100	98	98	97	80
FHLB	3872	772	0	623	610	623	23	763	615	615	0	0
	25	50	0	81	79	81	3	99	80	80	0	0
Sallie Mae	8198	1015	702	918	919	920	321	1015	885	876	840	802
	53	66	69	90	91	91	32	100	87	86	83	79
Farmer Mac	6257	1199	639	717	708	840	290	1158	919	716	264	6
	41	78	53	60	59	70	24	97	77	60	22	1
Citigroup	12855	1539	993	1535	1494	1535	321	1535	1494	1522	1336	1090
	83	100	65	100	97	100	21	100	97	99	87	71
Bank of America	9990	1262	678	1141	1147	1246	276	1238	1216	1220	1093	735
	65	82	54	90	91	99	22	98	96	97	87	58
Wachovia	11603	1532	1023	1468	1397	1507	302	1532	1450	1294	933	697
	75	99	67	96	91	98	20	100	95	84	61	45
Wells Fargo	12371	1535	1001	1522	1439	1527	321	1535	1484	1529	1203	810
	80	99	65	99	94	99	21	100	97	100	78	53
Countrywide	10684	1487	720	1392	1412	1412	321	1487	1354	1242	700	644
	69	96	48	94	95	95	22	100	91	84	47	43
JP Morgan	5802	610	606	610	610	610	321	610	610	610	610	605
	38	40	99	100	100	100	53	100	100	100	100	99
Lehman	12949	1535	999	1533	1535	1535	321	1535	1535	1535	1325	1096
	84	99	65	100	100	100	21	100	100	100	86	71
Merrill Lynch	13214	1535	1111	1533	1534	1535	302	1535	1535	1535	1384	1210
	86	99	72	100	100	100	20	100	100	100	90	79
Morgan Stanley	13231	1535	1086	1524	1528	1535	302	1535	1523	1523	1398	1277
	86	99	71	99	100	100	20	100	99	99	91	83
Average percent across all issuers			52	85	81	86	19	97	86	84	60	49
Average percent reported by Zakrajsek et al.*			34	76	71	82	N/A	90	75	73	46	29

Source: Computed from Markit CDS Data

*4,295,962 observations; MR doc clause only

[2] The percentages in the first two columns indicate the percentage of quotes and days with quotes of total possible if quotes were given for every maturity on every trading day (column one) and for every trading day (column two). In other columns, percentages are the number of days with quotes for the given maturity divided by the total days with quotes for the issuer.

Table 3: Date ranges for CDS quotes by issuer and maturity from Markit dataset						
	Overall	Spread6M	Spread1Y	Spread2Y	Spread3Y	Spread4Y
Bank of America	1/31/2002 to 11/30/2006	8/22/2003 to 11/30/2006	1/31/2002 to 11/30/2006	1/31/2002 to 11/30/2006	1/31/2002 to 11/30/2006	11/8/2005 to 11/30/2006
Citigroup	1/2/2001 to 11/20/2006	4/30/2002 to 11/20/2006	1/2/2001 to 11/20/2006	2/28/2001 to 11/20/2006	1/2/2001 to 11/20/2006	8/29/2005 to 11/20/2006
Countrywide	2/9/2001 to 11/20/2006	11/25/2003 to 11/20/2006	2/26/2001 to 11/20/2006	2/9/2001 to 11/20/2006	2/9/2001 to 11/20/2006	8/29/2005 to 11/20/2006
FAMC	4/3/2002 to 11/20/2006	10/30/2003 to 11/20/2006	4/5/2002 to 11/20/2006	4/5/2002 to 11/20/2006	4/5/2002 to 11/20/2006	10/11/2005 to 11/20/2006
FHLB	10/30/2003 to 11/20/2006		6/22/2004 to 11/20/2006	7/7/2004 to 11/20/2006	6/22/2004 to 11/20/2006	10/19/2006 to 11/20/2006
FHLMC	2/14/2002 to 12/19/2006	6/28/2002 to 12/19/2006	3/12/2002 to 12/19/2006	3/12/2002 to 12/19/2006	2/28/2002 to 12/19/2006	
FNMA	3/28/2001 to 12/19/2006	2/6/2002 to 12/19/2006	1/16/2002 to 12/19/2006	1/14/2002 to 12/19/2006	1/16/2002 to 12/19/2006	8/29/2005 to 12/19/2006
JP Morgan	7/20/2004 to 11/20/2006	7/20/2004 to 11/20/2006	7/20/2004 to 11/20/2006	7/20/2004 to 11/20/2006	7/20/2004 to 11/20/2006	8/29/2005 to 11/20/2006
Lehman	1/2/2001 to 11/20/2006	5/30/2002 to 11/20/2006	1/2/2001 to 11/20/2006	1/2/2001 to 11/20/2006	1/2/2001 to 11/20/2006	8/29/2005 to 11/20/2006
Merrill Lynch	1/2/2001 to 11/20/2006	10/15/2001 to 11/20/2006	1/2/2001 to 11/20/2006	1/2/2001 to 11/20/2006	1/2/2001 to 11/20/2006	9/23/2005 to 11/20/2006
Morgan Stanley	1/2/2001 to 11/20/2006	3/18/2002 to 11/20/2006	1/2/2001 to 11/20/2006	1/9/2001 to 11/20/2006	1/2/2001 to 11/20/2006	9/23/2005 to 11/20/2006
SLMA	11/14/2002 to 11/20/2006	8/29/2003 to 11/20/2006	1/16/2003 to 11/20/2006	1/16/2003 to 11/20/2006	1/16/2003 to 11/20/2006	8/29/0005 to 11/20/2006
Wachovia	1/2/2001 to 11/20/2006	11/28/2001 to 11/20/2006	1/2/2001 to 11/20/2006	3/28/2001 to 11/20/2006	1/2/2001 to 11/20/2006	9/23/2005 to 11/20/2006
Wells Fargo	1/2/2001 to 11/20/2006	3/4/2002 to 11/20/2006	1/2/2001 to 11/20/2006	3/27/2001 to 11/20/2006	1/2/2001 to 11/20/2006	8/29/2005 to 11/20/2006

Source: Computed from Markit CDS Data

Table 3 (continued): Date ranges for CDS quotes by issuer and maturity from Markit dataset						
	Spread5Y	Spread7Y	Spread10Y	Spread15Y	Spread20Y	Spread30Y
Bank of America	1/31/2002 to 11/30/2006	1/31/2002 to 11/30/2006	1/31/2002 to 11/30/2006	1/31/2002 to 11/30/2006	1/31/2002 to 11/30/2006	1/31/2002 to 11/30/2006
Citigroup	1/2/2001 to 11/20/2006	2/28/2001 to 11/20/2006	1/2/2001 to 11/20/2006	6/11/2001 to 11/20/2006	8/16/2001 to 11/20/2006	3/25/2002 to 11/20/2006
Countrywide	2/9/2001 to 11/20/2006	2/9/2001 to 11/20/2006	2/9/2001 to 11/20/2006	2/5/2002 to 11/20/2006	2/5/2002 to 11/20/2006	2/11/2004 to 11/20/2006
FAMC	4/3/2002 to 11/20/2006	4/5/2002 to 11/20/2006	5/28/2002 to 11/20/2006	9/16/2004 to 11/20/2006	11/22/2004 to 11/20/2006	8/24/2005 to 11/20/2006
FHLB	10/30/2003 to 11/20/2006	6/21/2004 to 11/20/2006	6/21/2004 to 11/20/2006			
FHLMC	2/14/2002 to 12/19/2006	3/25/2002 to 12/19/2006	3/25/2002 to 12/19/2006	3/25/2002 to 12/19/2006	3/25/2002 to 12/19/2006	7/1/2002 to 12/19/2006
FNMA	8/10/2001 to 12/19/2006	3/28/2001 to 12/19/2006	3/28/2001 to 12/19/2006	1/14/2002 to 12/19/2006	2/28/2002 to 12/19/2006	9/4/2002 to 12/19/2006
JP Morgan	7/20/2004 to 11/20/2006	7/20/2004 to 11/20/2006	7/20/2004 to 11/20/2006	7/20/2004 to 11/20/2006	7/20/2004 to 11/20/2006	7/20/2004 to 11/20/2006
Lehman	1/2/2001 to 11/20/2006	1/2/2001 to 11/20/2006	1/2/2001 to 11/20/2006	8/1/2001 to 11/20/2006	8/20/2001 to 11/20/2006	8/20/2001 to 11/20/2006
Merrill Lynch	1/2/2001 to 11/20/2006	1/2/2001 to 11/20/2006	1/2/2001 to 11/20/2006	1/9/2001 to 11/20/2006	1/9/2001 to 11/20/2006	9/25/2001 to 11/20/2006
Morgan Stanley	1/2/2001 to 11/20/2006	1/9/2001 to 11/20/2006	1/9/2001 to 11/20/2006	6/5/2001 to 11/20/2006	6/4/2001 to 11/20/2006	8/16/2001 to 11/20/2006
SLMA	11/14/2002 to 11/20/2006	6/30/2003 to 11/20/2006	6/30/2003 to 11/20/2006	7/9/2003 to 11/20/2006	7/9/2003 to 11/20/2006	7/9/2003 to 11/20/2006
Wachovia	1/2/2001 to 11/20/2006	4/20/2001 to 11/20/2006	11/18/2001 to 11/20/2006	2/28/2002 to 11/20/2006	2/28/2002 to 11/20/2006	3/25/2002 to 11/20/2006
Wells Fargo	1/2/2001 to 11/20/2006	2/28/2001 to 11/20/2006	1/2/2001 to 11/20/2006	8/16/2001 to 11/20/2006	8/16/2001 to 11/20/2006	7/1/2002 to 11/20/2006

Source: Computed from Markit CDS Data

Table 4: Numbers and distribution of quotes by document clause, 2001-2006

Year	Document Clause Frequency and percent of yearly total				Yearly total—all documentation clauses
	Full Restructuring (CR)	Modified-Modified Restructuring (MM)	Modified Restructuring (MR)	No Restructuring (XR)	
2001	2995	0	3977	677	7649
	39.16	0	51.99	8.85	100
2002	5008	70	6768	4179	16025
	31.25	0.44	42.23	26.08	100
2003	7319	1599	11638	3753	24309
	30.11	6.58	47.88	15.44	100
2004	9383	8263	20576	5836	44058
	21.3	18.75	46.7	13.25	100
2005	11158	8221	27005	7550	53934
	20.69	15.24	50.07	14	100
2006	11404	5210	28636	7800	53050
	21.5	9.82	53.98	14.7	100
All years	47267	23363	98600	29795	199025
	23.75	11.74	49.54	14.97	100

Source: Computed from Markit CDS Data

Table 5a: Measures of market liquidity and data quality, CDS referencing senior debt

Reference Entity	Days with quotes	Percent of daily changes equal to zero	Number of unique values	Percent of observations that represent unique values	Composite depth		
					Mean	Standard deviation	Percent of composite quotes based on less than 5 inputs
Bank of America	1228	39	673	55	3.80	1.23	69
Wells Fargo	1534	23	1106	72	7.11	5.24	41
Citigroup	1534	13	1245	81	11.34	5.66	10
Wachovia	1530	21	1151	75	8.14	4.13	24
Morgan Stanley	1534	10	1345	88	12.58	6.44	12
Merrill Lynch	1534	10	1349	88	11.91	6.37	14
JP Morgan	609	1	604	99	18.07	5.27	0
Lehman Bros.	1534	9	1350	88	10.97	5.65	10
Countrywide	1482	25	1033	70	5.06	3.05	57
Fannie Mae	1397	84	29	2	13.89	6.84	12
Freddie Mac	1263	50	572	45	15.55	6.87	6
Farmer Mac	1144	56	424	37	3.83	1.51	62
FHLB	756	69	212	28	3.51	1.00	87
Sallie Mae	1011	13	861	85	10.66	4.92	15
Averages							
GSEs	1140.00	65	309.25	28	9.20	4.06	42
Commercial Banks	1456.50	24	1043.75	71	7.60	4.06	36
Investment Banks	1302.75	7	1162.00	91	13.38	5.93	9

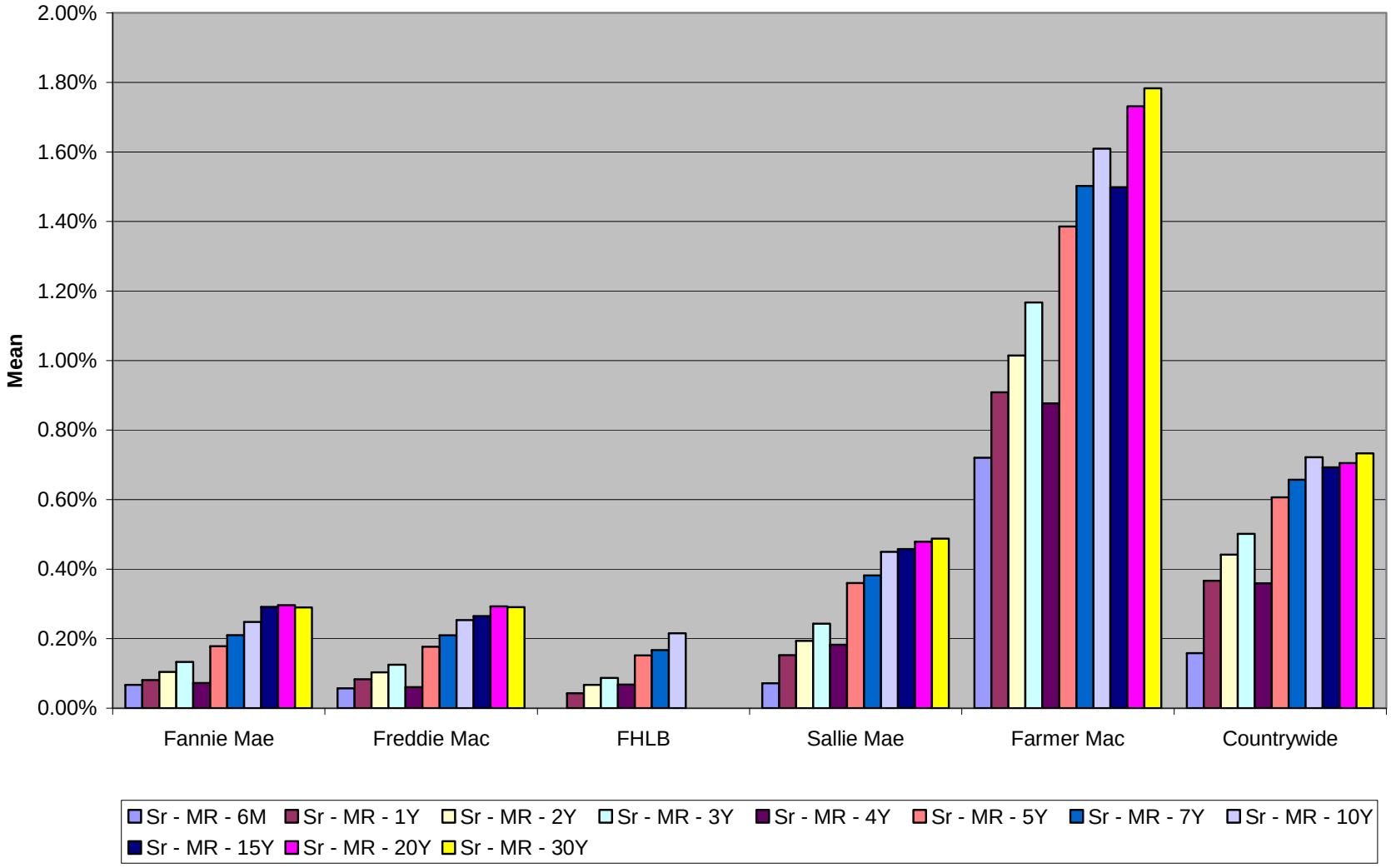
Source: Computed from Markit CDS Data

Table 5b: Measures of market liquidity and data quality, CDS Referencing Subordinated Debt

Reference Entity	Days with quotes	Percent of daily changes equal to zero	Number of unique values	Percent of observations that represent unique values	Composite depth		
					Mean	Standard deviation	Percent of composite quotes based on less than 5 inputs
Bank of America	150	87	24	16	2.10	0.29	100
Wells Fargo	856	34	550	64	5.61	2.15	36
Citigroup	1446	32	936	65	6.58	3.62	42
Wachovia	1132	38	659	58	4.90	2.11	47
Morgan Stanley	600	23	441	74	3.09	0.88	95
Merrill Lynch	346	47	186	54	2.24	0.53	100
JP Morgan	609	3	591	97	10.76	3.49	3
Lehman Bros.	165	24	125	76	3.62	0.51	100
Fannie Mae	1108	75	52	5	10.39	5.29	22
Freddie Mac	1045	58	360	34	9.65	4.46	19
Farmer Mac	--	--	--	--	--	--	--
FHLB	--	--	--	--	--	--	--
Sallie Mae	--	--	--	--	--	--	--
Averages							
GSEs	1076.50	67	206.00	20	10.02	4.87	20
Commercial Banks	896.00	48	542.25	51	4.80	2.04	56
Investment Banks	430.00	24	335.75	75	4.93	1.35	74

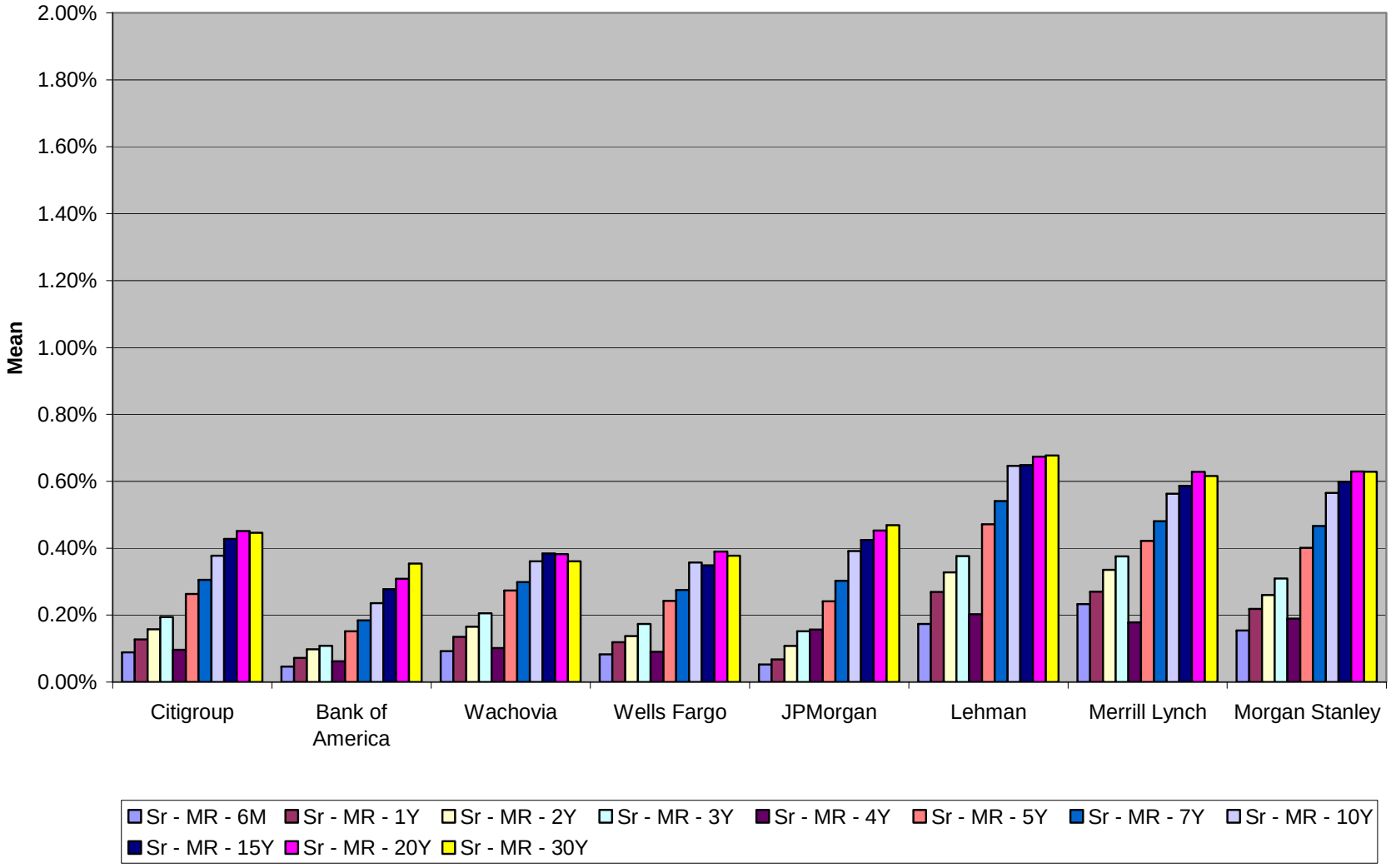
Source: Computed from Markit CDS Data

Figure 1: Mean CDS spreads, senior debt, by maturity, MR documentation clause



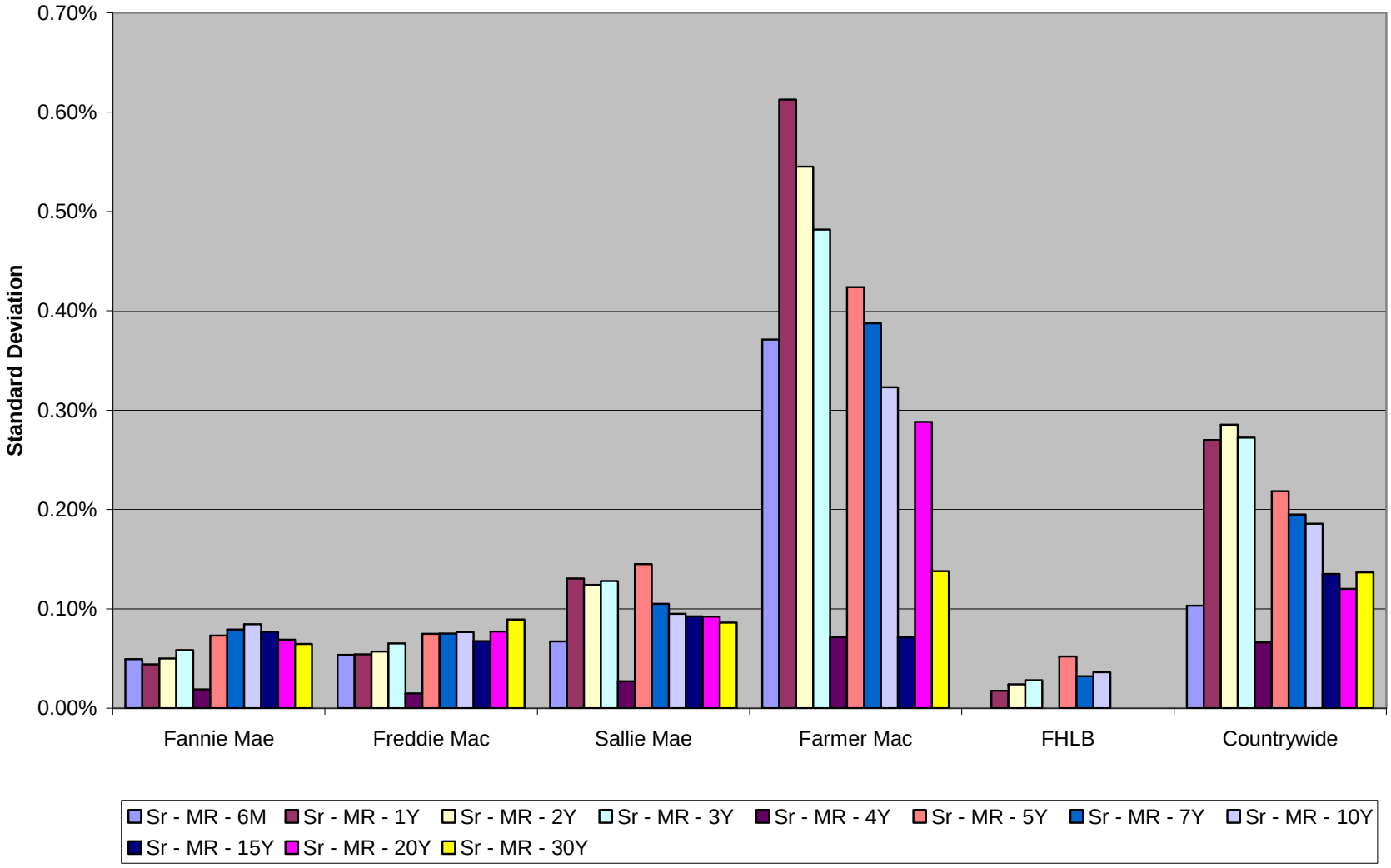
Source: Computed from Markit CDS Data

Figure 1 (continued): Mean CDS spreads, senior debt, by maturity, MR documentation clause



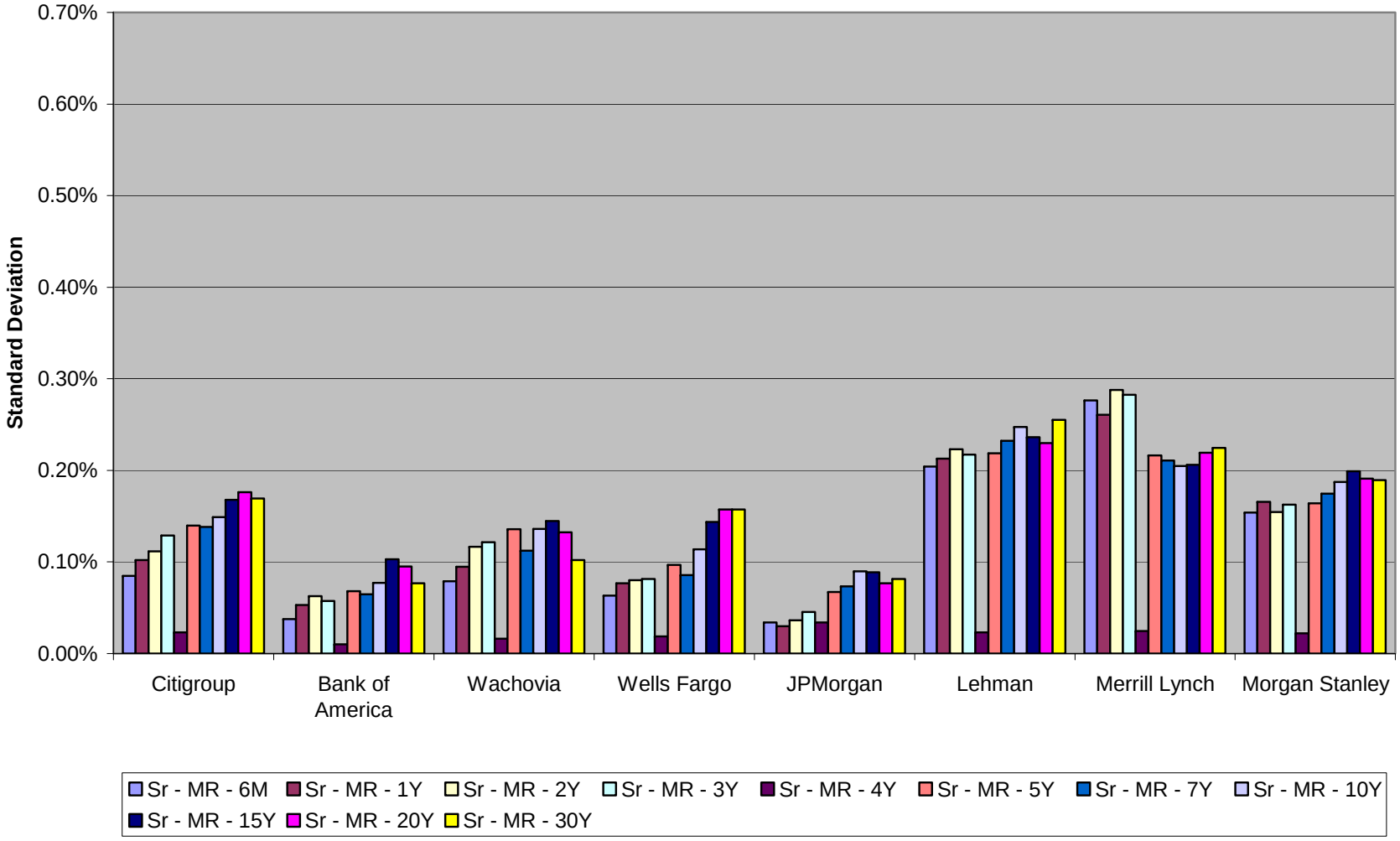
Source: Computed from Markit CDS Data

Figure 2: Standard deviation of CDS spreads, senior debt, by maturity, MR documentation clause



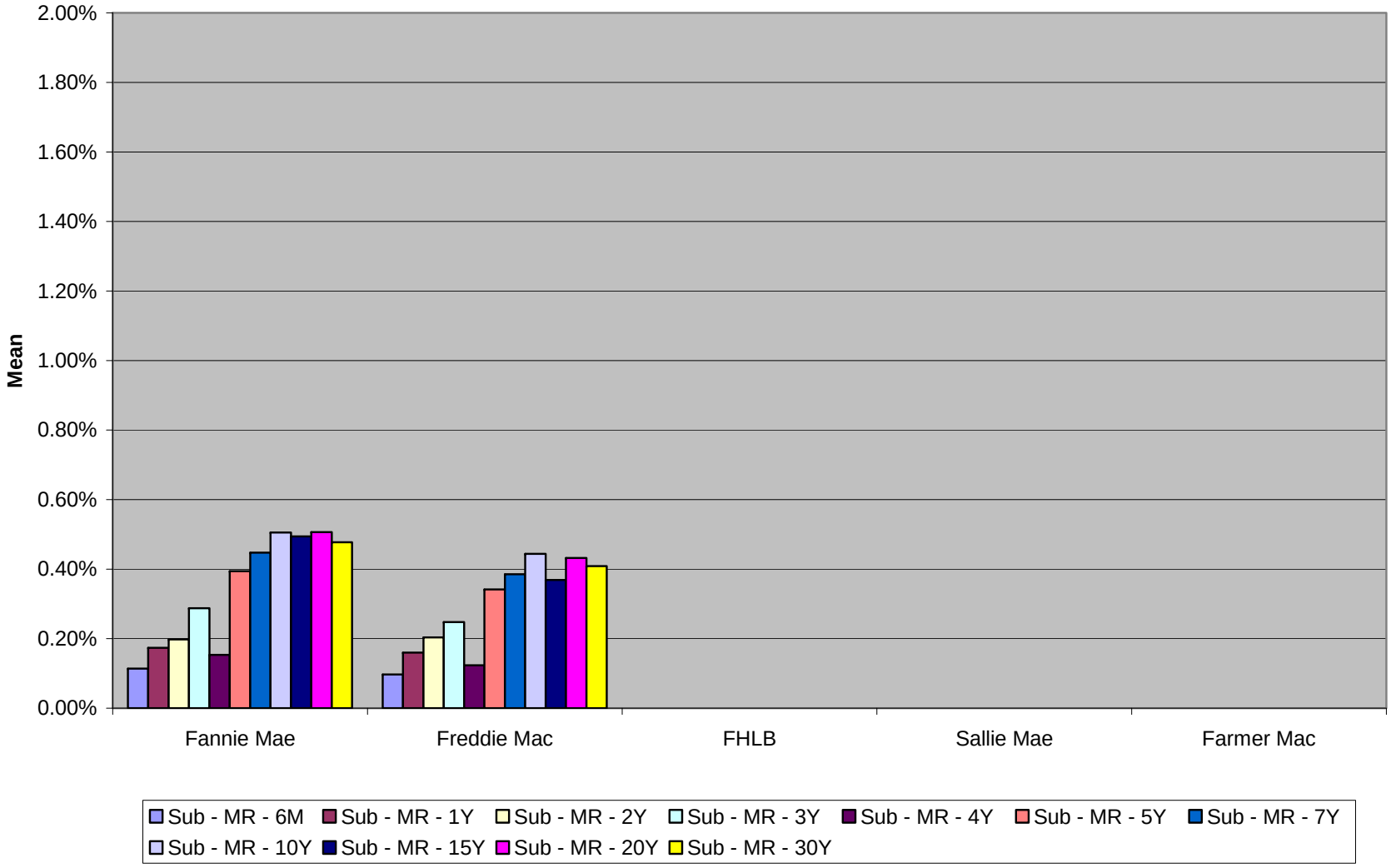
Source: Computed from Markit CDS Data

Figure 2 (continued): Standard deviation of CDS spreads, senior debt, by maturity, MR documentation clause



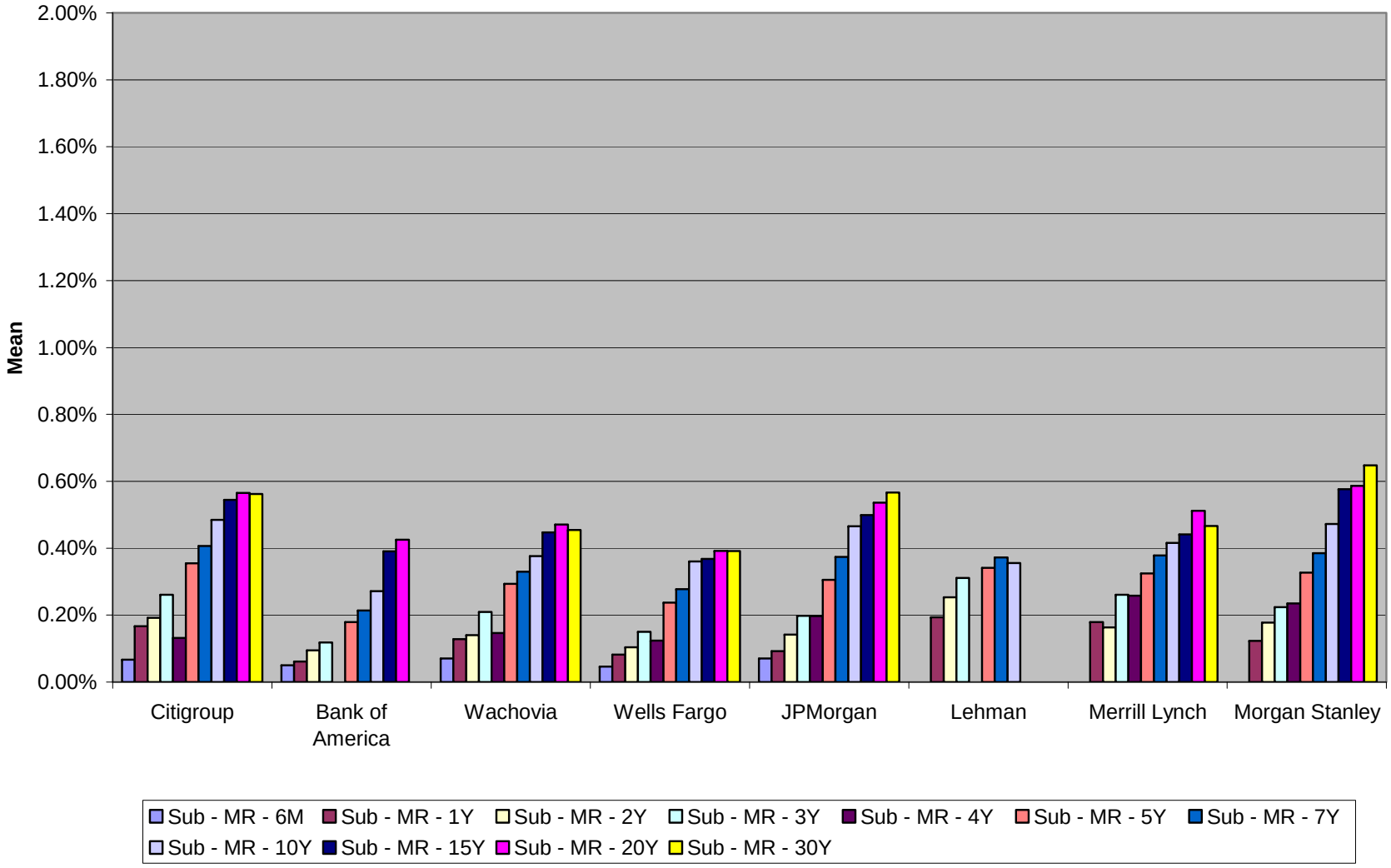
Source: Computed from Markit CDS Data

Figure 3: Mean CDS spreads, subordinated debt, by maturity, MR documentation clause



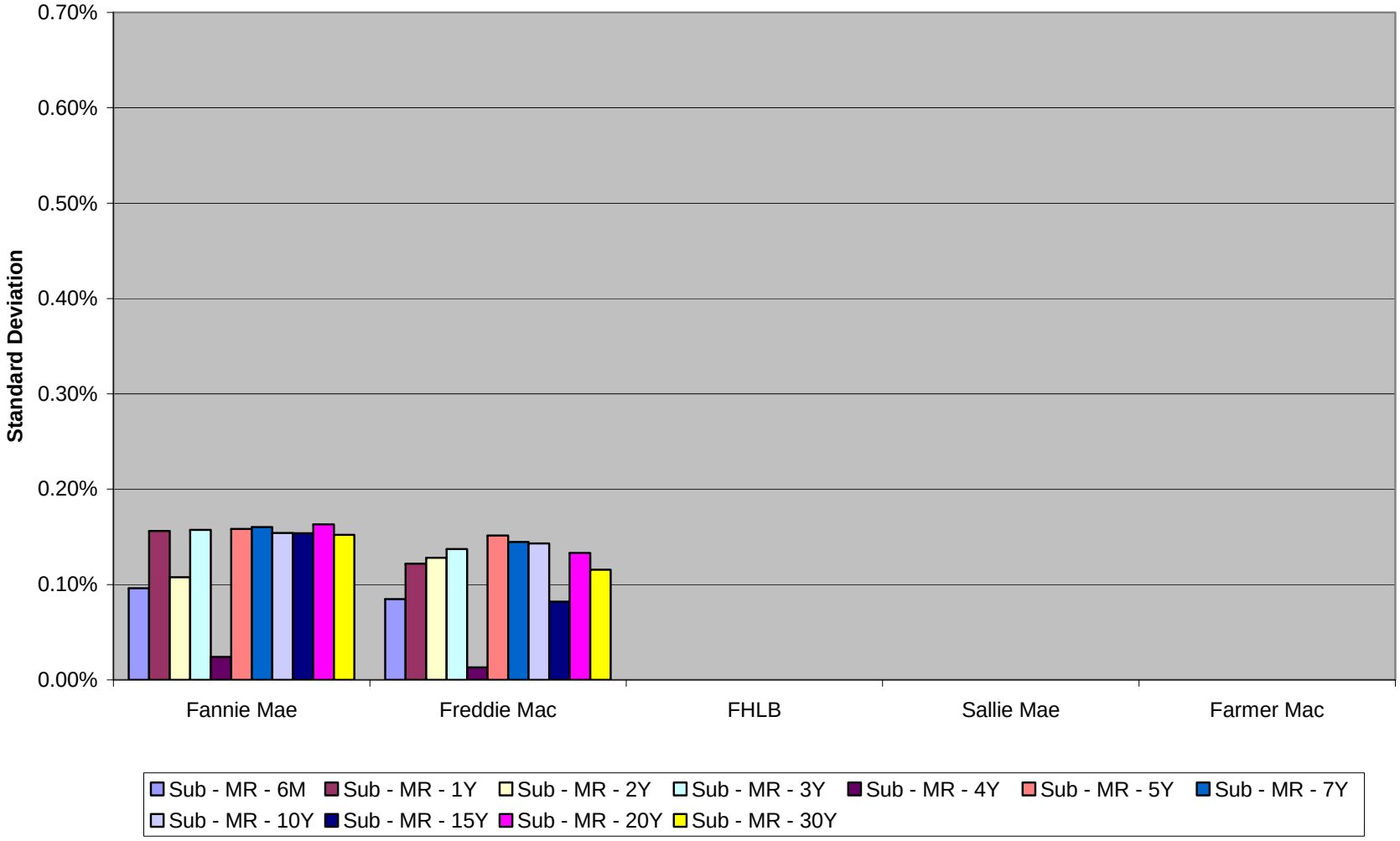
Source: Computed from Markit CDS Data

Figure 3 (continued): Mean CDS spreads, subordinated debt, by maturity, MR documentation clause



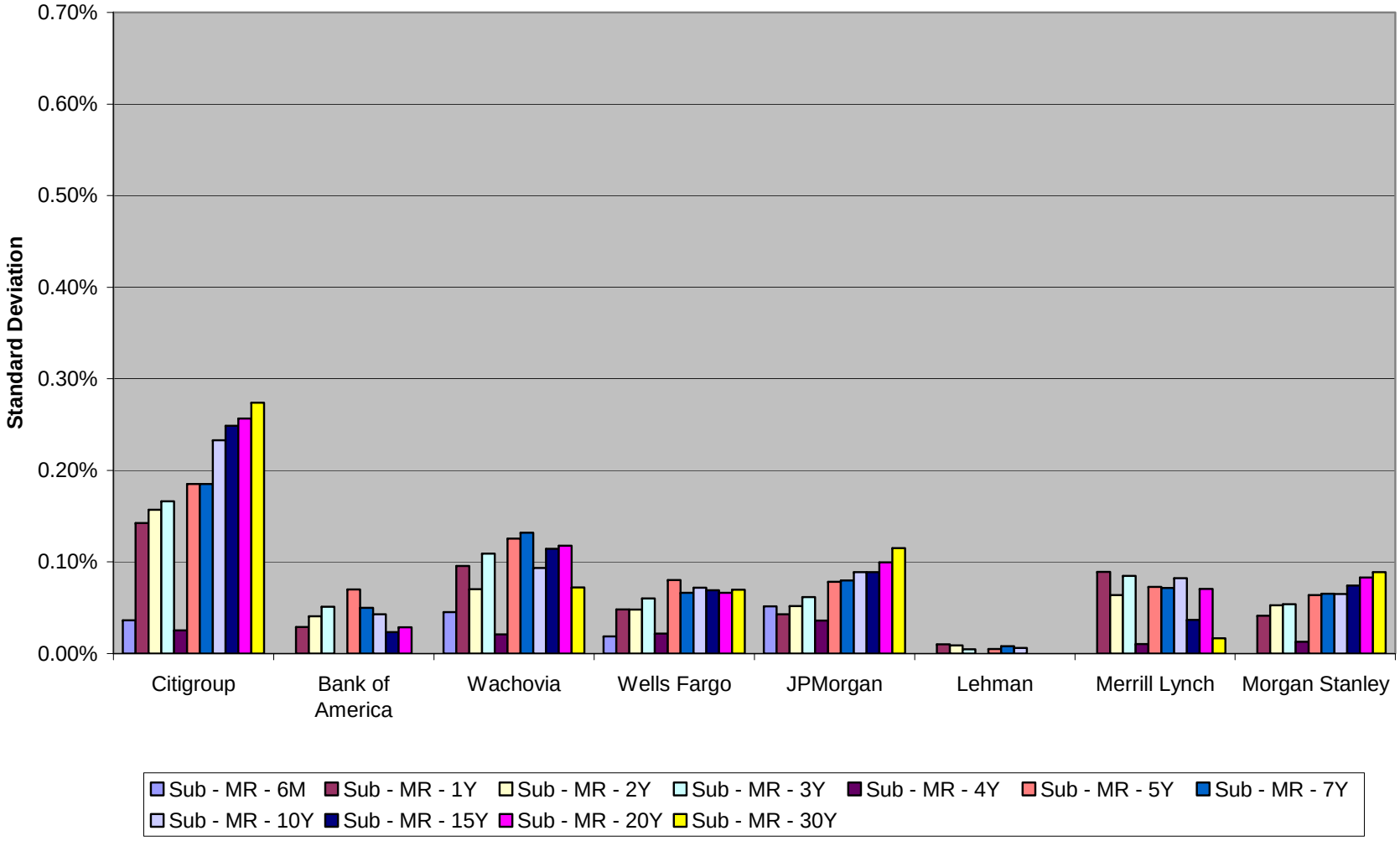
Source: Computed from Markit CDS Data

Figure 4: Standard deviation of CDS spreads, subordinated debt, by maturity, MR documentation clause



Source: Computed from Markit CDS Data

Figure 4 (continued): Standard deviation of CDS spreads, subordinated debt, by maturity, MR documentation clause



Source: Computed from Markit CDS Data

Table 6: Average 5-year CDS spreads on senior debt, MR documentation clause and issuer ratings

Issuer	Average CDS spread (percent)	Standard deviation of CDS spread (percent)	Number of observations	Rating*	
				Moody's	S&P
Fannie Mae	0.1784	0.0730	1398	Aaa	AAA
Freddie Mac	0.1768	0.0749	1264	Aaa	AAA
FHLB	0.1515	0.0521	763	Aaa	AAA
Sallie Mae	0.3600	0.1450	1015	Baa1	--
Farmer Mac	1.3853	0.4239	1158	--	--
Countrywide	0.6067	0.2185	1487	Ba1	A-
Citigroup	0.2632	0.1397	1535	Aa1	AA
Bank of America	0.1513	0.0680	1238	Aa1	AA
Wachovia	0.2741	0.1359	1532	Aa3	AA-
Wells Fargo	0.2430	0.0968	1535	Aa1	AA+
JP Morgan	0.2412	0.0672	610	Aa2	--
Lehman	0.4720	0.2186	1535	A1	A+
Merrill Lynch	0.4219	0.2165	1535	Aa3	AA-
Morgan Stanley	0.4013	0.1641	1535	Aa3	AA-

Source: Computed from Markit CDS Data
*Ratings taken from www.Moody's.com and www2.standardandpoors.com as of 9/27/2007. Countrywide was rated A3 by Moody's during the period of the data.

Figure 5a: Mean daily quotes on 5-year CDS referencing senior debt

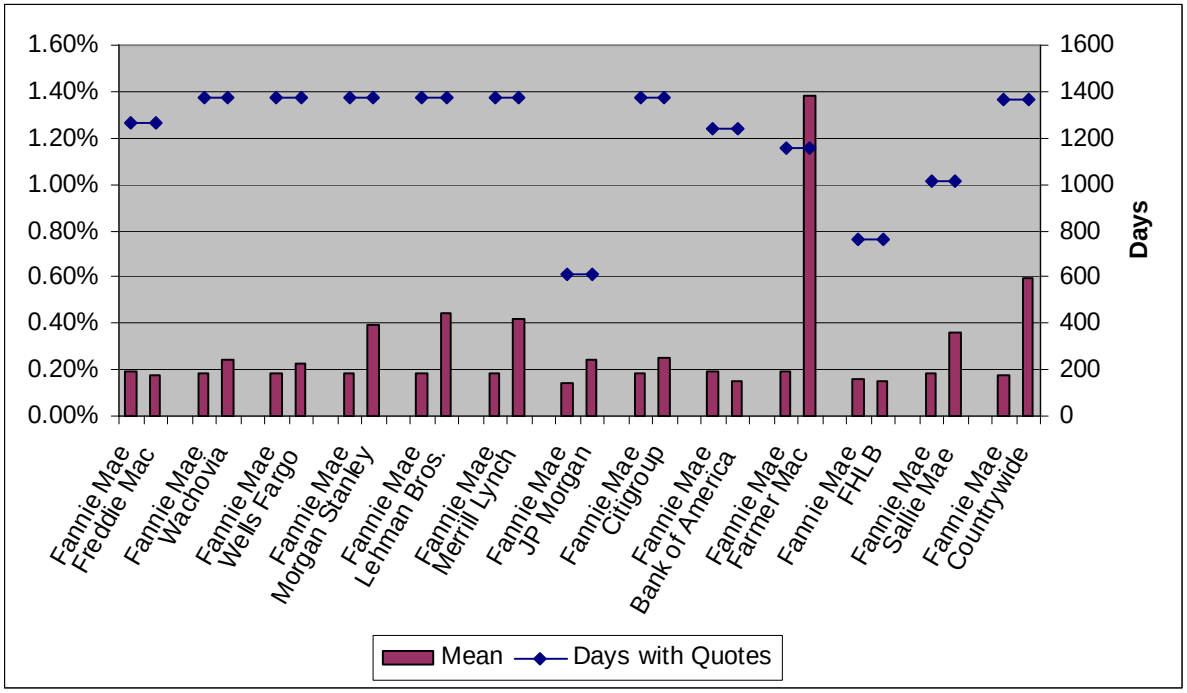
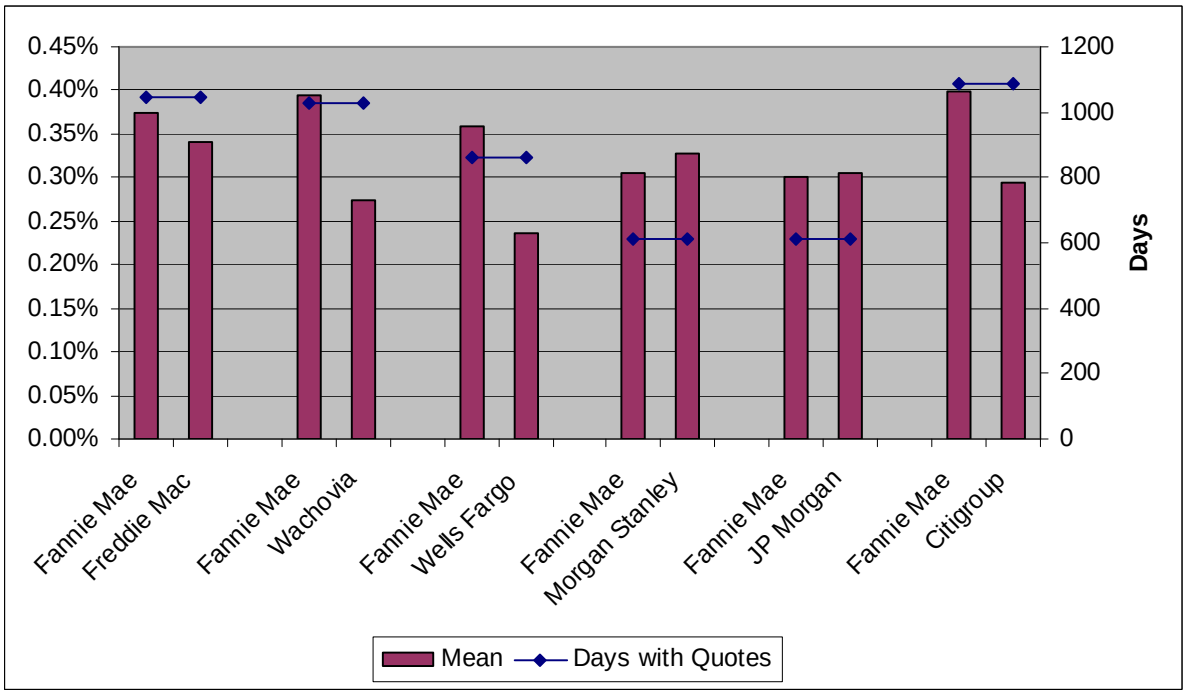


Figure 5b: Mean daily quotes on 5-year CDS subordinated debt



Source: Computed from Markit CDS Data

Figure 6a: Standard deviations of daily quotes on 5-year CDS referencing senior debt

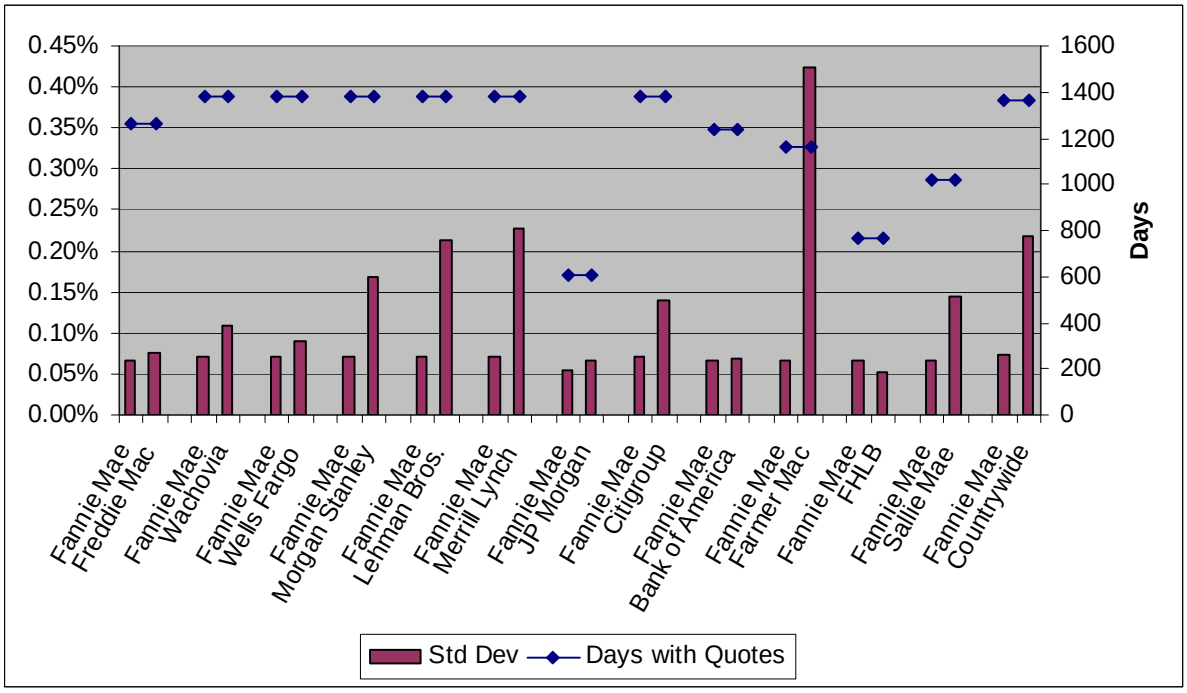
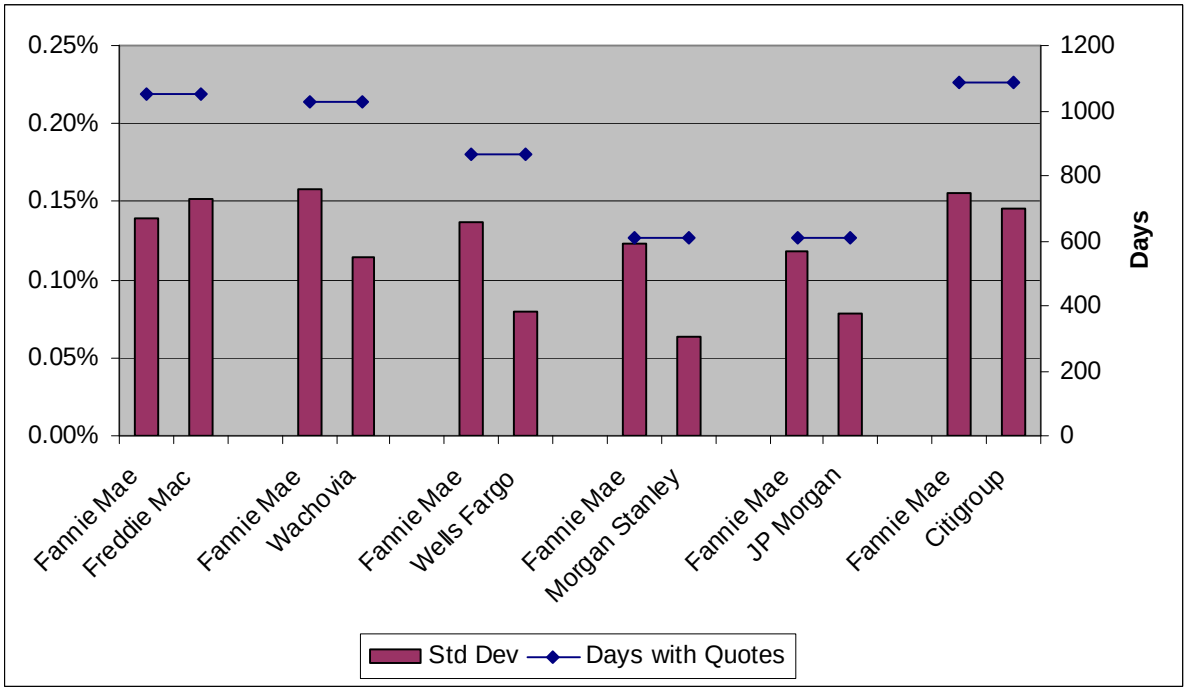


Figure 6b: Standard deviations of daily quotes on 5-year CDS referencing subordinated debt



Source: Computed from Markit CDS Data

Table 7: CDS spreads on subordinated and senior debt by issuer, 2003-2006

Issuer	Seniority	Mean	Std Dev	Minimum	Maximum	Pearson Correlation Coefficients*, N
2003						
Fannie Mae	Senior	0.236	0.037	0.180	0.330	0.40
	Subordinated	0.501	0.053	0.400	0.700	261
Freddie Mac	Senior	0.235	0.057	0.160	0.347	0.72
	Subordinated	0.508	0.044	0.390	0.596	260
Citigroup	Senior	0.260	0.064	0.150	0.396	0.95
	Subordinated	0.375	0.100	0.221	0.620	260
Bank of America	Senior	0.203	0.040	0.117	0.319	0.80
	Subordinated	0.289	0.050	0. 220	0.360	33
Wachovia	Senior	0.265	0.041	0.179	0.353	0.79
	Subordinated	0.340	0.080	0.240	0.630	200
Wells Fargo	Senior	0.291	0.043	0.175	0.388	0.96
	Subordinated	0.352	0.051	0.268	0.471	102
Merrill Lynch	Senior	0.442	0.108	0.283	0.663	0.38
	Subordinated	0.391	0.0270	0.351	0.428	49

Source: Computed from Markit CDS Data

*All correlation coefficients are significantly different from 0 at a minimum confidence level of 99.5 percent.

Table 7 (continued): CDS spreads on subordinated and senior debt by issuer

Issuer	Seniority	Mean	Std Dev	Minimum	Maximum	Pearson Correlation Coefficients*, N
			2004			
Fannie Mae	Senior	0.224	0.034	0.150	0.280	0.98
	Subordinated	0.450	0.065	0.310	0.550	262
Freddie Mac	Senior	0.221	0.042	0.129	0.289	0.98
	Subordinated	0.437	0.077	0.262	0.534	262
Citigroup	Senior	0.221	0.038	0.145	0.269	0.97
	Subordinated	0.292	0.046	0.209	0.361	262
Bank Of America	Senior	0.160	0.053	0.079	0.289	-0.26**
	Subordinated	0.226	0.012	0.220	0.253	20
Wachovia	Senior	0.220	0.038	0.151	0.270	0.92
	Subordinated	0.284	0.047	0.206	0.388	261
Wells Fargo	Senior	0.220	0.037	0.147	0.274	0.95
	Subordinated	0.291	0.044	0.192	0.358	256
JP Morgan	Senior	0.308	0.032	0.257	0.365	0.97
	Subordinated	0.381	0.036	0.320	0.454	119
Merrill Lynch	Senior	0.332	0.043	0.248	0.401	0.90
	Subordinated	0.384	0.003	0.324	0.442	146
Morgan Stanley	Senior	0.336	0.043	0.250	0.405	0.90
	Subordinated	0.412	0.055	0.316	0.505	118

Source: Computed from Markit CDS Data

*All correlation coefficients are significantly different from 0 at a minimum confidence level of 99.5 percent unless otherwise noted.

** Not significantly different from zero.

Table 7 (continued): CDS spreads on subordinated and senior debt by issuer

Issuer	Seniority	Mean	Std Dev	Minimum	Maximum	Pearson Correlation Coefficients*, N
			2005			
Fannie Mae	Senior	0.164	0.038	0.090	0.220	0.95
	Subordinated	0.353	0.097	0.210	0.550	260
Freddie Mac	Senior	0.130	0.031	0.070	0.170	0.96
	Subordinated	0.263	0.072	0.150	0.400	260
Citigroup	Senior	0.169	0.025	0.111	0.221	0.97
	Subordinated	0.228	0.027	0.162	0.287	260
Bank Of America	Senior	0.169	0.025	0.111	0.221	0.97
	Subordinated	0.228	0.027	0.162	0.287	260
Wachovia	Senior	0.158	0.024	0.104	0.213	0.96
	Subordinated	0.217	0.024	0.154	0.271	260
Wells Fargo	Senior	0.150	0.020	0.099	0.195	0.96
	Subordinated	0.204	0.023	0.140	0.259	260
JP Morgan	Senior	0.273	0.046	0.186	0.432	0.97
	Subordinated	0.344	0.053	0.249	0.495	260
Merrill Lynch	Senior	0.272	0.042	0.202	0.438	0.85
	Subordinated	0.348	0.003	0.344	0.354	10
Morgan Stanley	Senior	0.279	0.045	0.210	0.451	0.91
	Subordinated	0.332	0.043	0.263	0.495	260

Source: Computed from Markit CDS Data

*All correlation coefficients are significantly different from 0 at a minimum confidence level of 99.5 percent.

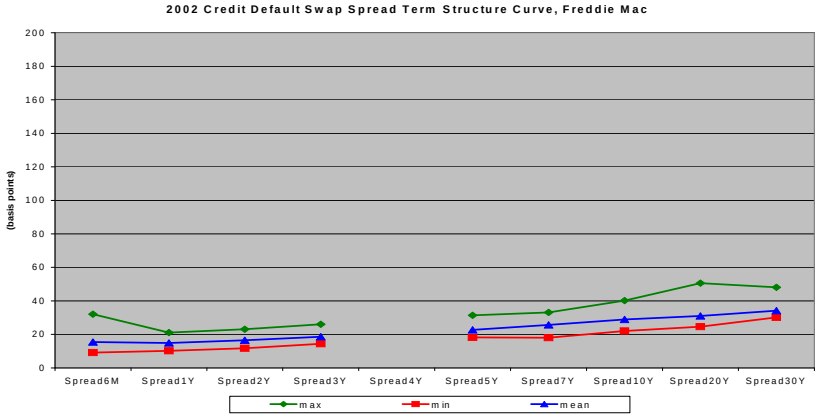
Table 7 (continued): CDS spreads on subordinated and senior debt by issuer

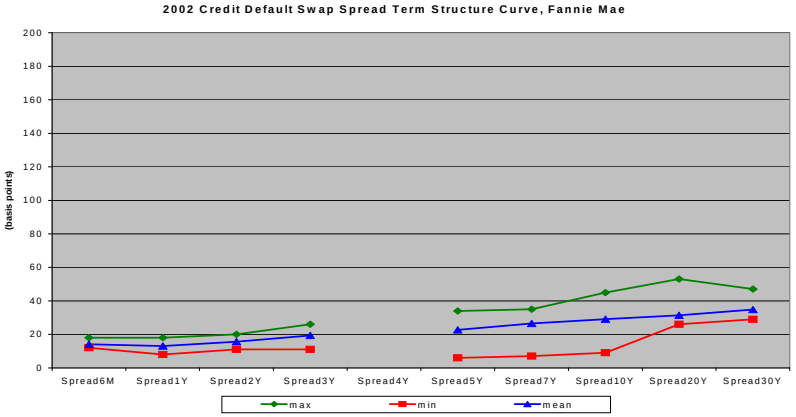
Issuer	Seniority	Mean	Std Dev	Minimum	Maximum	Pearson Correlation Coefficients*, N
2006						
Fannie Mae	Senior	0.084	0.013	0.060	0.110	0.75
	Subordinated	0.178	0.020	0.130	0.220	252
Freddie Mac	Senior	0.073	0.016	0.040	0.100	0.75
	Subordinated	0.149	0.014	0.110	0.170	252
Citigroup	Senior	0.112	0.022	0.069	0.148	0.98
	Subordinated	0.160	0.029	0.105	0.200	231
Bank Of America	Senior	0.072	0.012	0.050	0.088	0.87
	Subordinated	0.135	0.018	0.108	0.175	104
Wachovia	Senior	0.121	0.016	0.093	0.163	0.89
	Subordinated	0.169	0.022	0.134	0.219	231
Wells Fargo	Senior	0.107	0.021	0.068	0.132	0.98
	Subordinated	0.153	0.028	0.096	0.191	231
JP Morgan	Senior	0.171	0.027	0.113	0.221	0.98
	Subordinated	0.224	0.032	0.150	0.280	231
Lehman	Senior	0.238	0.025	0.180	0.295	-0.72
	Subordinated	0.341	0.003	0.334	0.347	140
Merrill Lynch	Senior	0.207	0.026	0.152	0.277	0.27
	Subordinated	0.251	0.031	0.203	0.318	166
Morgan Stanley	Senior	0.225	0.025	0.173	0.287	0.39
	Subordinated	0.277	0.029	0.211	0.410	231

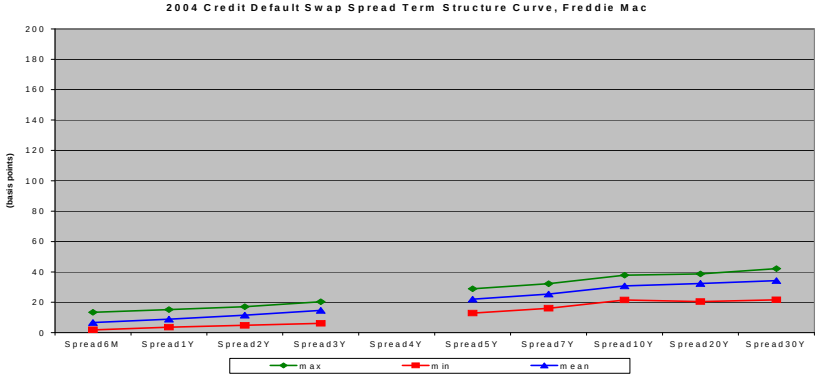
Source: Computed from Markit CDS Data

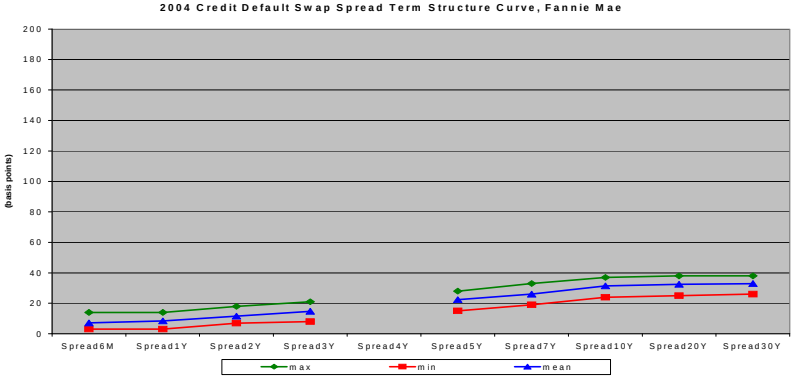
*All correlation coefficients are significantly different from 0 at a minimum confidence level of 99.5 percent.

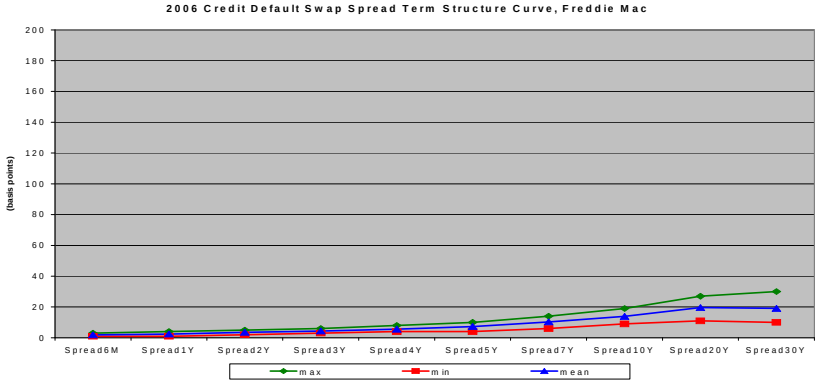
Figure 7: Term structure of CDS spreads, GSEs and industry groups, select years

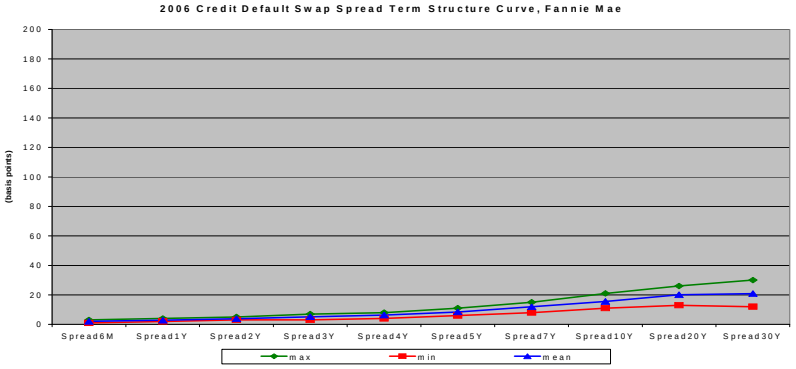






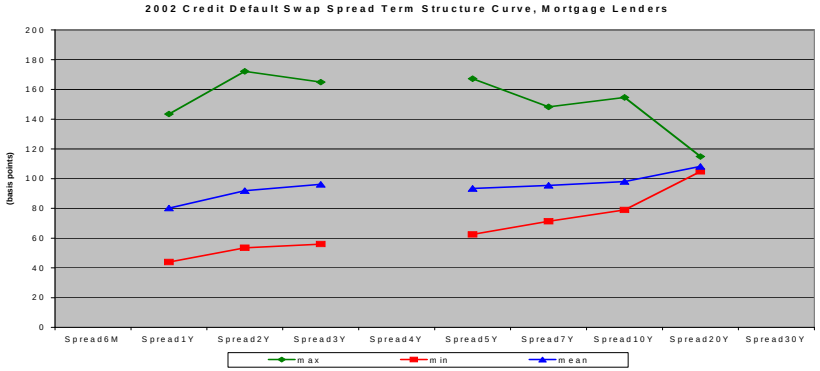


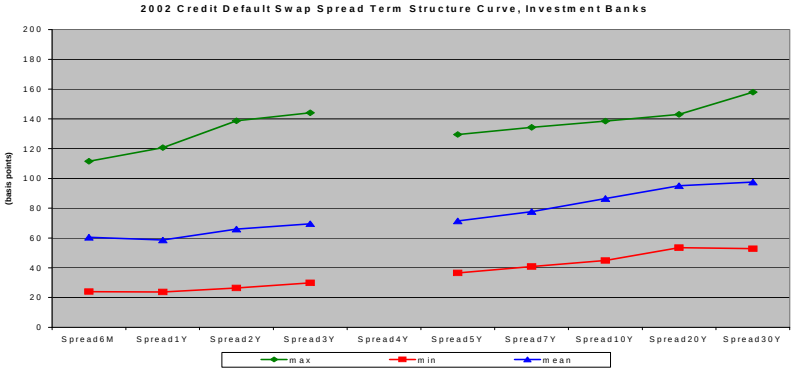


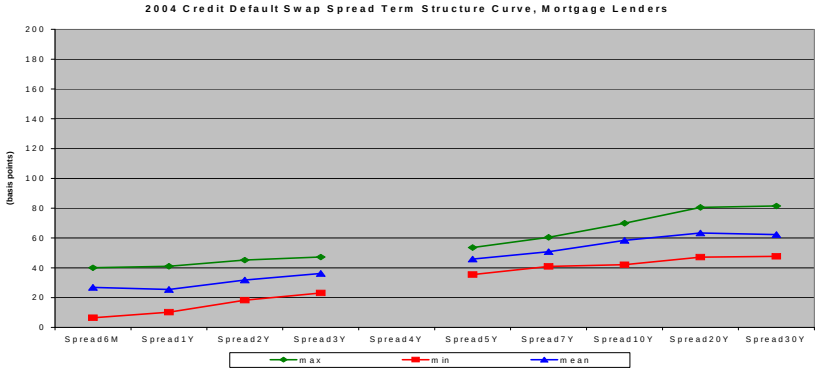


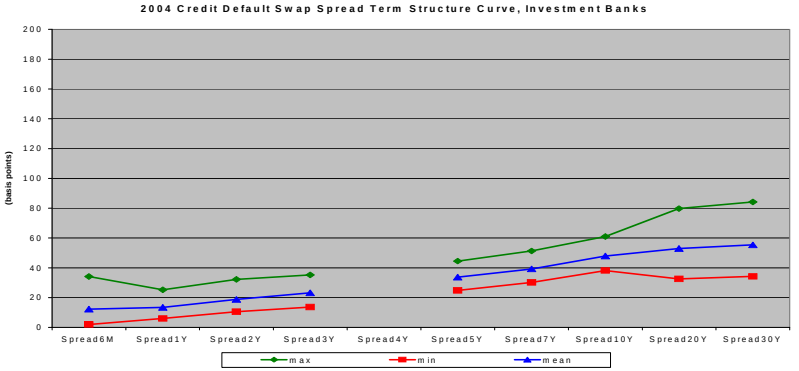
Source: Computed from Markit CDS Data

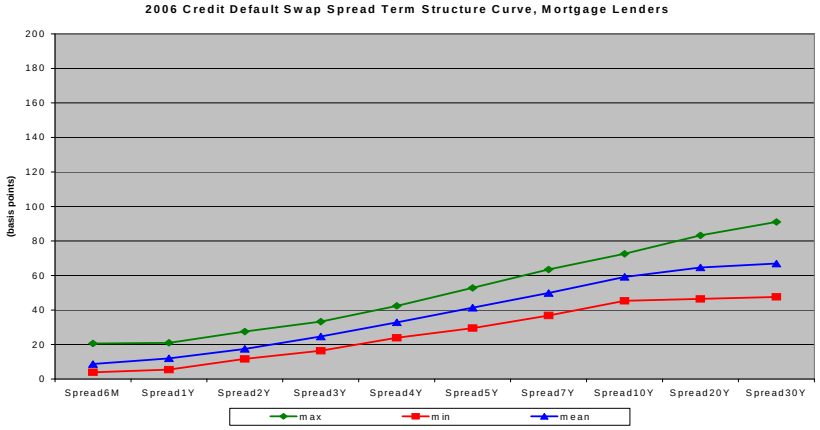
Figure 7 (continued): Term structure of CDS spreads, GSEs and industry groups, select years

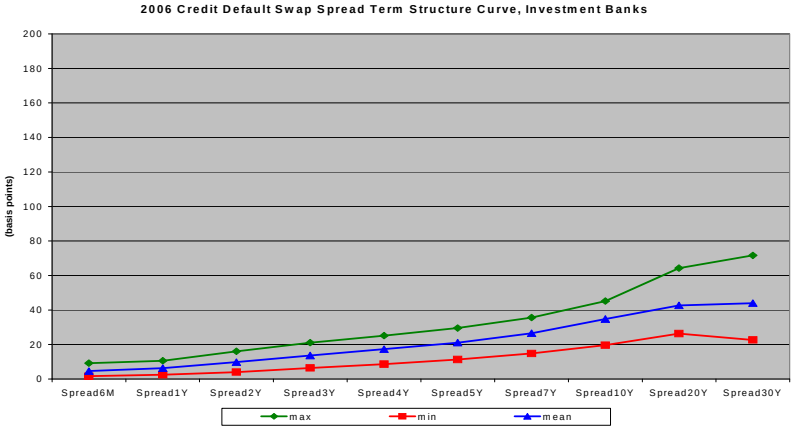






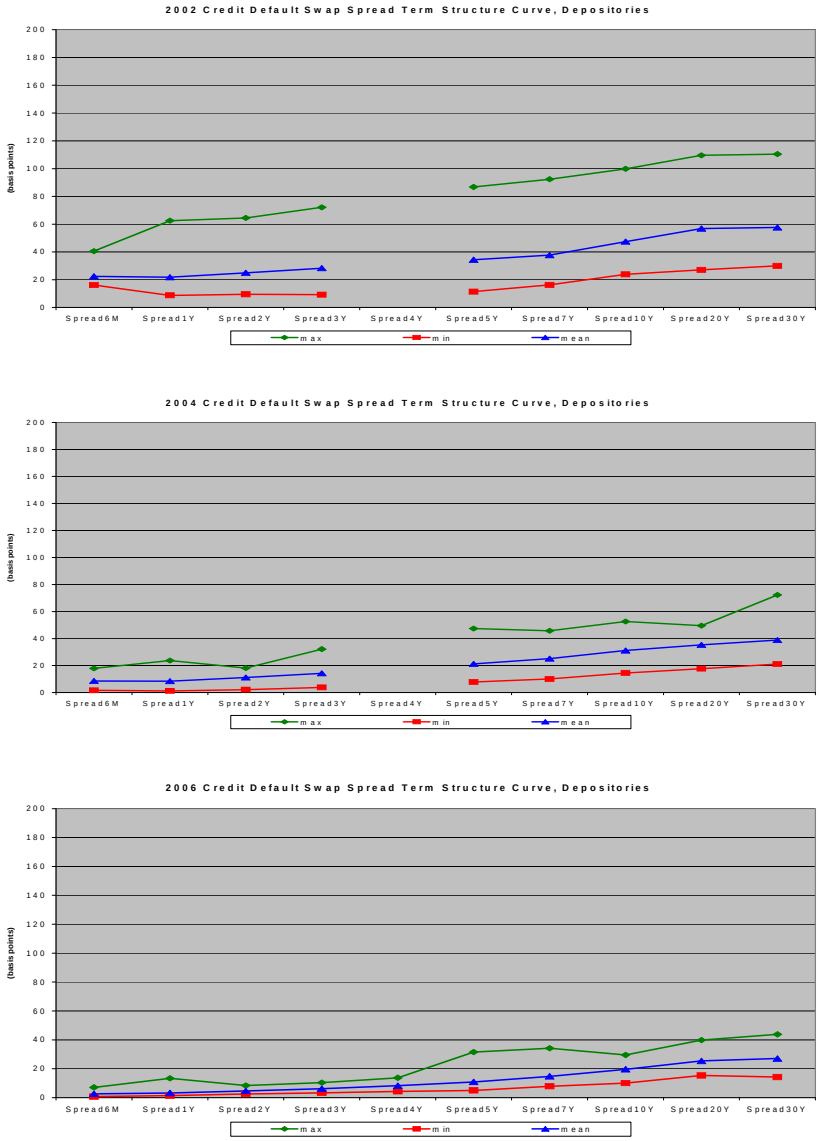






Source: Computed from Markit CDS Data

Figure 7 (continued): Term structure of CDS spreads, GSEs and industry groups, select years



Source: Computed from Markit CDS Data

Table 8: CDS spread on subordinated debt = α + β * CDS spread on senior debt + ε

	Fannie Mae		**Freddie Mac**	
	Maturity		*Maturity*	
	5 year	10 year	5 year	10 year
Intercept (α)	-0.00006 (1.12)	.0003 (8.71)	-.00006 (-0.82)	.00018 (5.40)
CDS spread on Enterprise senior debt (β)	2.11 (79.83)	1.86 (94.61)	1.97 (74.81)	1.73 (134.93)
Adjusted R-squared	0.85	0.90	0.85	0.95
N	1109	1048	1018	1026

Source: Computed from Markit CDS Data. T-statistics are in parentheses.

Table 9: CDS spread on senior debt = α + β * (senior debt yield - Treasury yield) + ε

	Fannie Mae		**Freddie Mac**	
	Maturity		*Maturity*	
	5 year	10 year	5 year	10 year
Intercept (α)	0.0494 (5.81)	.00117 (15.38)	-.093 (-15.64)	.00079 (9.59)
Senior –Treasury spread (β)	.178 (15.55)	.00325 (20.19)	.383 (46.45)	.0038 (21.56)
Adjusted R-squared	0.15	0.25	0.63	0.28
N	1395	1220	1264	1186

Source: Computed from Markit and Bloomberg Financial LP data. T-statistics are in parentheses.

Appendix A: Settlement types and documentation clauses

Settlement types--Cash or physical delivery

The ISDA originally defined six types of credit events: bankruptcy, failure to pay, repudiation/moratorium, obligation acceleration, obligation default, and restructuring. For corporate borrowers, the important credit events are bankruptcy, failure to pay, and restructuring. Settlement occurs in the wake of a recognized credit event and the CDS contract can specify either cash or physical settlement. Under cash settlement a market auction of the reference obligation takes place with benefits of the auction going to CDS buyers. The seller then makes a cash payment to the buyer for the difference, if any, between the insured value (the calculation amount) and the recovery value of the reference obligation. Under physical settlement, the buyer delivers ownership of a deliverable obligation of the reference entity as specified in the CDS contract to the seller. The seller then makes a cash payment to the buyer for the face value of the bonds.

Documentation Clauses

Of the ISDA defined credit events, restructuring presents the greatest difficulties in CDS contracting for two reasons. First, restructuring may not create an obvious or immediate loss to the owner of a reference obligation. Second, restructuring interacts with the cheapest-to-deliver option in a way that enhances that option's value and may create profit opportunities for CDS buyers unrelated to changes in credit quality (Packer and Zhu, 2005). In response to the complexities presented by restructuring, the ISDA has, over time, developed four alternative contract terms described below:

Full restructuring. The standard set by the ISDA in 1999, the full-restructuring clause classifies any restructuring as a credit event and any bond of maturity up to 30 years as deliverable. The distortion created by this combination of classifications soon became apparent with the restructuring of Conseco Finance's bank debt. That restructuring was undertaken in such a way so as not to disadvantage debtholders; yet, it was a classified as a credit event allowing CDS buyers the opportunity to buy Conseco Finance's long-term bonds which were selling at a discount and receive par value from CDS sellers. This option is the most favorable to CDS buyers.

Modified restructuring. In response to the distortions associated with the full restructuring clause, the ISDA introduced a modified restructuring clause in 2001. The modification still classifies restructuring as a credit event, but limits deliverable obligations to those that mature within 30 months of the termination date of the CDS contract.

Modified-modified restructuring. The modified-modified restructuring clause was introduced in 2003 and differs from the modified restructuring clause in that it defines deliverable obligations to be those that mature within 60 months of the termination date of the CDS contract for restructured obligations and within 30 months for other obligations. The motivation for this modification was that the modified restructuring clause was too limiting in its definition of deliverable obligations.

No restructuring. The no restructuring clause differs from the other documentation clause options in that it does not define restructuring as a credit event. This option is the most favorable to CDS sellers.

The documentation clause chosen determines to some extent the value of the CDS to the buyer of protection. Thus, in order of advantage to the buyer the documentation clause options can be ranked as follows: Full restructuring, modified-modified restructuring, modified restructuring, and no restructuring. An analysis of documentation clauses undertaken at the Bank for International Settlements using Markit data from February 2003 through June 2004 (Packer and Zhu, 2005) found that the modified restructuring documentation clause was the most widely used in the U.S (accounting for 61% of quotes) followed by full restructuring (23%) and no restructuring (16%). The quotes for contracts with modified-modified documentation clauses were rare, accounting for less than 0.1 percent of quotes.

References

Blanco, R., S. Brennan and I.W. Marsh (2005), "An Empirical Analysis of the Dynamic Relationship between Investment-Grade Bonds and Credit Default Swaps," Journal of Finance 60 (5).

Bliss, R.R. and M.J. Flannery (2001), "Market Discipline in the Governance of U.S. Bank Holding Companies: Monitoring vs. Influencing," in Prudential Supervision: What Works and What Doesn't, ed. F.S. Mishkin (Chicago: The University of Chicago Press), pp. 107-143.

Chen, Long, David Lesmond, and Jason Wei (2007), "Corporate Yield Spreads and Bond Liquidity," Journal of Finance, vol. 62, 119–149.

Collender, Robert, Samantha Roberts, and Valerie Smith (2007), "Signals from the Markets for Fannie Mae and Freddie Mac Subordinated Debt," OFHEO Working Paper 07-4.

Collin-Dufresne, P., R.S. Goldstein, and J.S. Martin (2001), "The Determinants of Credit Spread Changes," Journal of Finance 56, 6.

Cossin, Didier and Tomas Hricko (2002), "Exploring for the Determinants of Credit Risk in Credit Default Swap Transaction Data," FAME Working Paper , University of Lausanne (HEC-Lausanne).

Elton, E., M Gruber, D. Agrawal, and C. Mann (2001): "Explaining the rate spread on corporate bonds," Journal of Finance, vol. LVI, no 1, pp 247-77.

Eom, Young Ho, Jean Helwege, and Jing-Zhi Huang (2004), "Structural Models of Corporate Bond Pricing: An Empirical Analysis," Review of Financial Studies, vol. 17, 499–544.

Evanoff, Douglas D., and Larry D. Wall (2001), "Measures of the Riskiness of Banking Organizations: Subordinated Debt Yields, Risk-Based Capital, and Examination Ratings." *Journal of Financial Services Research,* pp. 121-145.

Evanoff, Douglas D., and Larry D. Wall (2002a), *Subordinated Debt and Prompt Corrective Regulatory Action*. FRB Atlanta Working Paper No. 2002-18.

Evanoff, Douglas D., and Larry D. Wall (2002b), "Sub-Debt Yield Spreads as Bank Risk Measures." *Journal of Banking and Finance*, pp. 989-1009.

Frame, W. S. and Larry D. Wall, "Fannie Mae's and Freddie Mac's Involuntary Initiatives: Lessons from Banking," Federal Reserve Bank of Atlanta, *Economic Review*, First Quarter 2002.

González-Rivera, Gloria, and David Nickerson, "Dynamic Monitoring of Financial Intermediaries with Subordinated Debt," Journal of Risk Finance, 2006, pp. 463-487.

Houweling, P. and T. Vorst (2005), "Pricing Default Swaps: Empirical Evidence," Journal of International Money and Finance, December 2005, 1200-1225.

Huang, Jing-Zhi and Ming Huang (2003), "How Much of the Corporate-Treasury Yield Spread Is Due to Credit Risk?" Working Paper, Penn State University.

Hull, J., M. Predescu and A. White (2004), "The Relationship between Credit Default Swap Spreads, Bond Yields, and Credit Rating Announcements," *Journal of Banking and Finance*, 28 (Nov 2004), 2789-2811.

Jones, E. Philip, Scott P. Mason, and Eric Rosenfeld (1984), "Contingent Claims Analysis of Corporate Capital Structures: An Empirical Investigation," Journal of Finance, vol. 39, 611–625.

Leland, H. E. (1994): "Corporate debt value, bond covenants, and optimal capital structure," Journal of Finance, vol. 49, no 4, pp 1213-52.

Leland, H. E., and K. B. Toft (1996): "Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads," Journal of Finance, vol. 51, no 3, pp 987-1019.

Longstaff, F. A. and Schwartz, E. S. (1995), `Valuing credit derivatives," Journal of Fixed Income (June), 6-12.

Longstaff, Francis A., Sanjay Mithal, and Eric Neis (2005), "Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit-Default-Swap Market," Journal of Finance, vol. 60, 2213–2253.

Marsh, I. (2005), "What central banks can learn about default risk from credit markets," BIS Papers No. 12, pp. 329-39.

Nier, Erlend, and Ursel Baumann (2003), "Market Discipline, Disclosure and Moral Hazard in Banking," April 2003, available online at http://www.chicagofed.org/news_and_conferences/conferences_and_events/files/2003_bank_structure_market_discipline_disclosure.pdf

Norden, L. and M. Weber (2004), "The Comovement of Credit Default Swap, Bond and Stock Markets: an Empirical Analysis," Center for Financial Studies Working Paper, 2004/20.

O'Kane, D., and McAdie, R. (2001), Explaining the basis: Cash versus default swaps, Fixed Income Research, Lehman Brothers, London.

Packer, F., and Zhu, H. (2005), "Contractual terms and CSD pricing," BIS Quarterly Review, March 2005, pp. 89-100.

Smith, Valerie L., "Subordinated Debt Issuance by Fannie Mae and Freddie Mac," OFHEO Working Paper 07-3, June 2007.

Zakrajsek, Egon, Andrew Levin, and Roberto Perli, 2005, "The Determinants of Market Frictions in the Corporate Market," Computing in Economics and Finance

Zhu, Haibin (2006), "An Empirical Comparison of Credit Spreads between the Bond Market and the Credit Default Swap Market," Journal of Financial Services Research, vol. 29, 211–235.