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Bank Commercial Loan Fair Value Practices

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This study is based on in-depth discussions with a number of large internationally-active banks on their use and measurement of loan fair values for internal purposes. Other Federal Reserve staff participating in these discussions include Nicola Cetorelli and James Cheatham of the Federal Reserve Bank of New York; Laurie Priest and Steven Merriett of the Federal Reserve Board; and Greg Sierra of the Federal Reserve Bank of Richmond. Comments and suggestions provided by Arthur Angulo, Charley Holm, Laurie Priest, Lance Auer, Nicola Cetorelli, Greg Sierra, and Mike Gibson and assistance with data and empirical exercises by Mark Carey and Mike Gibson are gratefully acknowledged.

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Abstract

Recent accounting changes, for the first time, permit the use of fair value in the primary financial statements for held-to-maturity (HTM) bank loans. While the use of fair value has historically attracted significant discussion and debate, there is little information in the public domain on how banks would measure fair value or use it in loan management. This study presents and analyzes results from in-depth discussions with seven large internationally-active banks on their fair value use and measurement for HTM commercial loans and commitments. The objectives of the discussions and those of the study are to: identify the extent to which fair value is used for HTM commercial loan facilities and how it is used; describe valuation methodologies used and consider the roles of market price sources and modeling and their relative importance in fair value estimation; consider model validation and price verification; draw conclusions as permitted and suggest areas for future research.

Table of Contents

A. BACKGROUND

1. Rationale and Objectives

The use of fair value in financial reporting for loans has attracted significant discussion and debate in recent years. Some have argued that fair value will reflect the most current economic information about loans' valuations and will enable a more timely recognition of deterioration in loan values than the current provisioning approach. In addition, the adoption of loan fair values can reduce or eliminate the current mismatch in financial reporting stemming from the simultaneous use of amortized cost and fair or market value for different but related instruments. A third argument is that fair value can make more transparent to the bank the economic value of its loan extensions, especially when they involve customer relationships.

A principal concern expressed by others, however, is that most bank loans do not have market prices, raising issues about the reliability of estimated fair values. These issues include the use of valuations that will depend on models with the potential for model error and on model assumptions that will involve subjectivity and possible model bias. Further, in the absence of market prices, validation of reported loan fair values will be difficult. Other issues concern the potential for reallocation of bank lending away from small business and long-term financing and the potential adverse consequences for financial or economic stability.

Much of this discussion and debate has been conducted with relatively little factual reference to how banks would actually use fair value in loan management or how fair value would be measured. Indeed, the literature on valuing bank loans is small. At least partly as a result, conclusions as to the likely consequences of fair value reporting have been limited.

The debate on the desirability of loan fair valuation notwithstanding, a number of large financial institutions have begun to manage risks in some loan portfolios on a fair value basis over the past few years. These valuations have not yet found their way into the primary financial statements; indeed, until recently, they could not do so, since accounting standards generally required loans categorized as held to maturity (HTM) to be measured at amortized cost.[1] However, changes recently adopted in international accounting standards and in the U.S. offer the option of incorporating fair value measurements in financial statements for virtually any financial asset or liability, including loans.

Given developments in accounting standards and risk management, Federal Reserve staff initiated a project involving in-depth discussions with seven large and internationally active banks to gain a better understanding of the use and measurement of loan fair value. During the spring and summer of 2006, these discussions were held with senior staff, including representatives from the credit portfolio management, risk management,

[1] Fair value estimates of nearly all financial assets and liabilities are provided in footnote disclosures as required by FAS 107.

financial control, model validation, accounting policy and internal audit functions. The discussions focused on loan fair value practices primarily for commercial loans and commitments currently categorized as HTM. Of the seven banks interviewed, five had an active fair value program underway. For comparison purposes, briefer discussions were held with three large and internationally active U.S. securities firms.

In important respects, the commercial loan facilities of these large banks are not representative of those for smaller banks. In particular, previous estimates indicate that more than half of outstanding commercial loans for the largest banks are investment grade. The percentage is likely higher for credit exposures that included loan commitments. For smaller but still large banks, substantially less than half of outstanding loans are at the investment grade level.[2]

The objectives of the bank discussions and the study's objectives are as follows:

- Identify the nature and extent to which fair value is used for HTM commercial loan portfolios in risk management and financial reporting,
- Gain insight into valuation methodologies used, the roles of market prices and modeling and their relative importance in fair value estimation,
- Identify the nature and adequacy of valuation controls concerning model validation and price verification, particularly when fair values are substantially model-based, and
- Summarize findings, draw conclusions as permitted, and suggest areas of future research.

While assessing the merits of fair value was not one of the objectives of this study, the information it provides may help to inform future discussions on this issue.

2. Current Accounting Treatments for Bank Loans

Under current accounting standards, bank investments intended to be held to maturity are generally reported at amortized cost in the primary financial statements. Under this valuation method, HTM loans are measured at the original amount loaned to the borrower, adjusted for amortization of any loan origination fees or direct origination costs. This amortized cost is adjusted by the allowance for loan losses. [3]

Amortized cost traditionally has been considered an appropriate valuation method for loans because banks typically acquire these assets with the intention of holding them to maturity. Therefore, aside from those caused by default events, short-term fluctuations in value do not have tangible consequences because, assuming performance, these assets are

[2] Treacy and Carey (1998) estimated that 55 percent of the commercial loans of largest banks were investment grade, compared with 40 percent for regional banks, and 25 percent for smaller banks.

[3] This allowance is comprised of a component for individual loans that are determined to be "impaired" (i.e., where it is probable that the bank will not collect all amounts under the loan agreement) measured pursuant to FAS 114 and a component for loans evaluated for impairment on a collective basis pursuant to FAS 5.

worth their face value at maturity. Despite this traditional view, accounting standard-setters have for some time set a long-term goal to record all financial assets and liabilities at fair value, assuming that the measurement issues can be resolved. Their goal is based on the view that fair or market value represents the most relevant measurement attribute of a financial asset or liability and that the complexity of the current accounting system, under which some instruments are measured at cost and others at fair value, is best resolved by moving to full fair value.

The challenge faced in moving to a wider use of fair value is greatest for those assets, such as loans, for which an active market does not exist or is limited. Recent developments in other credit markets, however, have provided new means to estimate fair values of individual loans and loan commitments. These approaches, while used by some banks only internally for risk management purposes, potentially offer avenues for fair valuing loans for financial reporting as well, now that accounting standards offer an option to do so.

A fair value option (FVO) has recently been adopted by the Financial Accounting Standards Board (FASB). Under FASB's FVO, a company can elect to measure nearly any financial asset or liability at fair value in its financial statements. This standard is effective as of the beginning of an entity's first fiscal year that begins after November 15, 2007, with early adoption permitted. This election is generally available at inception of a financial instrument on an instrument-by-instrument basis; however, once the decision to use fair value is made for a particular instrument, it is irrevocable for that instrument. Loans and unfunded loan commitments would be eligible to be measured at fair value under FASB's FVO.

FASB's FVO follows a similar standard issued earlier under International Financial Reporting Standards (IFRS) in June 2005. However, the International Accounting Standards Board's (IASB) version also imposes certain eligibility restrictions that govern the use of the option. Specifically, the option to fair value financial assets or liabilities is permitted only if (a) using it eliminates or significantly reduces an "accounting mismatch" that arises from measuring assets or liabilities or recognizing the gains and losses on them on different bases; or (b) it is used for a group of assets or liabilities that is managed and whose performance is evaluated on a fair value basis, in accordance with a documented risk management or investment strategy.

3. Regulatory Concerns in a Fair Value Environment

While generally supportive of fair value measurement for certain assets, such as traded financial instruments, the U.S. bank regulatory agencies have expressed concerns about an expanded use of fair value accounting for non-traded, illiquid financial instruments such as loans. This is primarily due to issues regarding the ability of financial institutions to measure these assets at fair value reliably.[4] The reliability of fair values is important to

[4] These concerns were expressed in an April 14, 2006 comment letter sent to the FASB by the five financial institution regulatory agencies.

supervisory agencies because of its possible effects on the accurate measurement of bank capital and ultimately bank "safety and soundness."

The Basel Committee on Banking Supervision issued recommendations to national supervisors regarding banks' use of a fair value option. Although the guidance was written based on the fair value option allowed under International Financial Reporting Standards, the concepts described are expected to be generally applicable to other national jurisdictions. This guidance identifies a number of supervisory expectations relevant to the use of the option, including that banks would not use it for financial instruments for which they were not able to reliably estimate fair values. In particular, the guidance notes that "a key issue underlying fair values in general is whether they can be obtained directly from observable market prices or through a robust valuation technique." [5]

4. Commercial and Investment Banks Lending Profiles

Loans, including loan commitments, represent a significant portion of the commercial banks' business activities, and are offered to a broad spectrum of customers, ranging from very large corporations to small individual consumers. On the other hand, lending represents a much smaller portion of the securities firms' business activities and in general is offered to existing large corporate customers. Traditionally, securities firms have used fair value for all of their financial positions including loans and loan commitments. Table 1 (next page) compares the business profiles and lending activities for commercial banks and securities firms.

Notwithstanding this traditional distinction between commercial banks and securities firms, practices are converging between the largest firms—the commercial banks increasingly profess an "originate to distribute" model and the securities firms have become more active in the syndicated loan market (focusing particularly on leveraged loans).

[5] *Supervisory Guidance on the Use of the Fair Value Option for Financial Instruments by Banks,* Basel Committee on Banking Supervision, June 2006.

Table 1. Business and Lending Profiles for Commercial and Investment Banks

Categories	Commercial Banks	Securities Firms
Core Business	Investment banking, trading, asset management, commercial banking, retail financial services, card services.	Investment banking, trading, asset management.
Commercial Lending	Loans and commitments to large corporate, middle market, small and private companies. The large corporate sector consists of both investment grade and non-investment grade borrowers.	Loans primarily to large corporate clients, consisting of both investment grade and non-investment grade companies. Lending is typically driven by the demands of clients rather than initiated by the securities firms. Lending is also made in connection with bridge financing, with high turnover and short maturities.
Consumer Lending	Most have significant consumer lending activity.	Most do not have significant consumer lending activity.
Credit Card	Some have significant credit card lending; for some, this represents the largest portion of the firms' total lending activities.	Most do not have significant credit card lending activity.

B. CURRENT USE OF FAIR VALUE FOR COMMERCIAL LOANS

1. Financial Reporting

Primary Financial Statements

All of the commercial banks in this study used fair values for loans in the primary financial statements only for held for sale (HFS) or trading portfolios. HFS loans in general consist of loans awaiting securitization in residential real estate, commercial real estate, and other loan portfolios. FAS 65 requires such loans to be reported at the lower of cost or market value (LOCOM). Commercial banks also engage in secondary loan trading, generally of high yield and distressed corporate loans, and such loans classified as trading are reported in the primary financial statements at fair value.

Commercial banks generally have an intent to hold most of their loans for the foreseeable future or until maturity. Loans that fall into this category generally are required to be reported on the balance sheet at amortized cost, subject to loan loss provisioning, unless banks elect the FVO for them.

In contrast, the use of fair value for financial reporting is more prevalent in securities firms since they are dealers in financial instruments and as such follow accounting guidelines in the *Audit and Accounting Guide, Brokers and Dealers in Securities*. As a result, these firms treat loans in a similar fashion to other trading positions and in general fair value their loan exposures.

FAS 107 Disclosures

While accounting standards require differing treatment of loans within the primary financial statements, FAS 107 requires all companies, including commercial banks and securities firms, to disclose the fair value of most financial instruments, including loans, in the footnotes to annual financial statements. Where estimating fair value is not practicable, FAS 107 requires disclosure of descriptive information pertinent to estimating the value of the financial instrument.

To the extent the banks measure loans at fair value for internal risk management or portfolio management purposes, those valuations are typically used in the FAS 107 disclosures as well. Thus, the fair value disclosures would incorporate results from the same valuation methodologies and approaches that are used to measure corporate loans portfolios at fair value for risk and portfolio management purposes (e.g., those discussed later in this paper). However, for loans where fair value methodologies are not developed for such purposes, firms generally utilize a simplified discounted cash flows (DCF) model for FAS 107 disclosures. In addition, fair value disclosures for short-term loans with remaining maturities of less than, say, six months and variable rate loans which reset within three months generally use the carrying value of such loans.

Applying a DCF model to estimate the fair value of loans generally involves discounting either the contractual or expected cash flows of a loan facility using a secondary market interest rate for the same or similarly categorized loans. In determining the appropriate cash flows to be discounted, a distinction is made between performing and non-performing loans. For performing loans, contractual future cash flows of a loan facility are used. In the case of non-performing loans, expected future cash flows are used to reflect doubt about the ability to collect interest and principal in the future. Where contractual cash flows are used, the discount rate should be one that incorporates expected credit losses plus a risk premium. Where expected cash flows are used, the estimated cash flows incorporate expected losses.

When loans are fair valued for FAS107 purposes using DCF models, default and survival probabilities of the obligor of a loan facility are generally not formally estimated, although some default probability assumptions, as well as assumptions for expected recovery, are incorporated when *expected* cash flows are applied (except in cases where the loan is already in default, in which case default probability is not estimated). Banks generally indicated that the DCF valuation methodologies would have to be substantially improved if they were to be used for reporting in the primary financial statements under the FVO.

2. Risk and Portfolio Management

The five banks in the survey that measure fair values for commercial loans do so for risk and portfolio management purposes. These banks measure a substantial portion of their commercial or wholesale loan portfolio credit exposures at fair value, approximately 50 to 90 percent depending on the bank. The credit exposures include both loans and undrawn loan commitments.

Two banks in the survey do not fair value their loans for risk or portfolio management purposes. These banks felt that fair value measurement was not useful for the risk management of their loan portfolios. Their explanations were specific to their respective portfolios and risk management practices.

<u>Nature of Commercial Loans Fair Valued</u>

In general, the commercial banks using fair value began to do so for investment grade loans made to large corporations in the U.S. and Europe for risk or portfolio management purposes during the period from 2001 to 2003. This coincides with the time frame during which high quality credit default swap (CDS) spreads that could be used to value these loans became available. The banks started fair valuing the loans because they represented their largest concentrated credit exposures and the banks felt the need to actively manage the loans' credit risk. While there has also been an increase in secondary loan trading for large corporate names in the last few years, the banks noted that there is still insufficient depth in the investment grade segment of this market for direct pricing of these facilities.

Currently, most of the banks also include mid-capitalization and smaller corporate loans in their HTM loan fair valuations. However, these loans constitute a substantially smaller fraction of HTM credit exposures being fair valued for most of the banks and, depending on the bank, the application of fair value to these loans may be at less frequent intervals or only at the time of origination.

Rationale for Fair Valuing Loans

For the banks using fair value, risk and portfolio management staff believe that fair values provide additional information that is useful in the management of their loan portfolios. Some uses of fair value involve active loan management, while other uses are relatively passive and chiefly involve communicating information to senior management.

Active Uses

Banks making active use of fair value do so for managing their portfolio risk and for loan pricing and origination decisions. The following are specific uses cited by these banks:

Credit Risk Management. Some banks who hedge their credit exposures with liquid credit instruments indicated that fair value was helpful in setting up their hedges. CDSs are an important tool used by banks to hedge default risk or reduce concentration risk in large corporate loans (and commitments) while preserving client relationships. A fair value platform covering the different credit exposures to an obligor (e.g., loans, commitments, bonds, derivatives) enables the bank to track changes in the aggregate value of its credit exposure to the obligor and make potentially better informed decisions in managing concentration risk as well as credit risk more generally.

If banks choose not to hedge their loans at origination, the ongoing fair value process can nevertheless serve as a potential early warning signal for credit deterioration of their loans and allow those banks to hedge or otherwise limit further credit deterioration.

Loan Pricing and Origination Decisions. Some of the banks rely on fair values as a guideline for determining market-consistent prices for new loans. Fair value estimates for loans based on recent market data are intended to represent the market's perception of the loans' risks, rather than the bank's own view. These banks utilize fair values in analyzing proposed new deals to determine if those loans are correctly priced given the market's view of the obligor's risk and to modify proposed terms as needed. The analyses are believed to improve the bank's transaction decisions on new originations; for example, a loan under-priced when compared to a market-based fair value might not be originated unless that bank can make up for the shortfall from other business with the obligor. Similarly, some banks rely on the fair value process to determine market-based exit prices for their loans should they decide to sell the loans they hold.

Making Transparent the Cost of Relationship Lending. Some banks also indicated that they use loan fair values to make transparent the cost of relationship lending by internal transfer bookkeeping. For example, loans from the originating business unit's book might be transferred to an independent business unit at the modeled fair value, which is determined based on market price information and agreed to by the originating business unit. For customer relationship lending, any shortfall between the customer loan price and the fair value would represent a cost of relationship lending, which the lending officers are expected to cover with ancillary revenue from the customer relationship. The transfer bookkeeping of loan fair values also allows the bank to better understand both the sources of profitability and total profitability of a relationship over time.

Passive Uses

Communicating Hedge Effectiveness. Most of the banks use loan fair values to communicate the economic results of hedges to senior management on a monthly basis. While loans are reported on an accrual basis, the CDSs typically used to hedge loan credit risk are reported at fair value. Thus, any losses (or gains) incurred on the credit derivatives will not necessarily be offset by reported gains (losses) in the financial statements. As a result, the banks indicate that a fair value reporting process helps senior management to better understand the economic impact of the loan hedging strategies.

After-the-Fact Reporting. Most of the banks also use fair value for daily after-the-fact reporting such as profit and loss attribution. Banks may review the output of the fair value process and identify for senior management the impact on the fair value of various market factors (e.g., changes in credit spreads, interest rates, and foreign exchange rates), with a greater focus on the portfolio level effects, rather than those of the individual obligor. Some banks also periodically conduct fair value sensitivity analysis on loans, as they would for their other trading assets.

Practices at Securities Firms

In addition to the commercial banking institutions, three securities firms were surveyed to gain additional perspective on loan fair value methodologies.

Generally, securities firms embed fair values in their risk management processes more completely than commercial banks and that was the case for two of the firms. Loan valuation changes are included in daily P&L reporting in the same manner as trading exposures. These firms stated that fair values can telegraph credit deterioration in advance of rating downgrades.

The fair value measurement practices observed at the securities firms for commercial loans varied, with some similarities to those observed at the commercial banks. (See next section for the description of the commercial banks' practices.) Fair value practices observed at the securities firms include the following:

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- While not all of the securities firms use fair value measurement for buy-and-hold loan portfolios, those that do choose a market price source for measuring a loan facility's fair value according to some defined hierarchy similar to that used by the commercial banks, with market price quotes for a loan on the same or a related obligor at the top of the hierarchy.

- When a market price for the loan facility is not available, the securities firms mostly use a valuation approach calibrated to the obligor's market prices of bond CDS contracts. The security firms' calibration methods, however, differed significantly in their level of sophistication.

    - The use of a less sophisticated approach did not account for the loan facilities payment features. This was justified as appropriate for loan facilities whose unique features the firm believed would be unlikely to be important to loan market-makers in pricing such facilities, most of which were investment grade.

    - The use of a more sophisticated approach, one closer to that employed by the commercial banks, referenced both the market price source and the specific features of the loan facilities. This approach reflected a preference in loan fair value measurement to formally measure loan facility payment features not reflected in the market price sources.

C. FAIR VALUE MEASUREMENT AND MODELING

The banks using fair value have developed approaches that are broadly similar. The common elements in the measurement of fair values are as follows: a market price source chosen according to a hierarchy; a common valuation framework; estimation of loan facility default and survival probabilities using a market price source when a market price for the facility itself is not available; and loan facility payments directly estimated by the bank. These four elements of fair value measurement are first described. The role of modeling and its potential importance in fair value measurement is then considered.

1. Fair Value Measurement Procedures

Choosing a Market Price Source: The Waterfall Approach

In measuring fair values for corporate loan facilities, the banks employ a hierarchy among different fair value methods based on market price source, termed a waterfall. The price sources higher in the waterfall are believed to provide more reliable fair values. Therefore, in valuing a particular loan facility, the banks stipulate that the available price source highest in the waterfall should be used. In this way, the waterfall approach is intended to provide bank management with objective and consistent guidelines for choosing a fair value method.

At the broad category level, the waterfall employed by the banks is similar. Table 2 shows the banks' waterfall at this level with additional information on its use.

At the top of the waterfall are secondary market loan prices that would be used directly to value the loan facility. The main source of loan facility prices is the secondary market for syndicated loans, which consists primarily of non-investment grade loans. The banks obtain daily price quotes from their dealers' screens and/or several price service providers. The service providers' quotes are bid and ask prices, each of which is an average of quotes from a small number of dealers that trade the particular loan facilities. Dealer quotes may be indicative rather than based on transactions; and prices may be stale. The banks typically impose limits on the age of a price quote that can be used, varying from 10 to 30 days. A stale price may be adjusted based on an estimate of likely recent price changes. However, secondary loan market prices account for no more than a small fraction of the banks' fair values, as traded loans are not characteristic of those common in HTM loan portfolios.

When the market price for the loan facility itself is not available, the market price sources used play an important but more limited role. Instead of being used for valuing the entire loan facility, the market price source is used to estimate the loan facility obligor's default and survival ("default/survival") probabilities. The general reason for this more limited role is that the payment features of loan facilities can be highly individualistic and would not be adequately represented by other credit instruments for which prices might be available, including individual loans sold in secondary markets or loan securitizations.

Table 2. Choosing a Market Price Source: The Waterfall Approach

Market Price Sources	Relation to Facility/Obligor	Use	Prevalence in Loan Fair Valuations[1]
Secondary loan market price	1. same facility; 2. obligor in same or related legal entity	used directly as fair value	least
Obligor credit default swap curve (CDS)	1. same obligor 2. obligor in same or related legal entity 3. possibly independent but highly correlated entity	used to estimate default/survival probabilities	most
Obligor bond credit curve			limited
Generic credit curve; Firm equity value			generic curve: depends on the bank equity value: limited use
1. Expressed in terms of the total credit exposure of HTM loan facilities being fair valued.			

In the absence of a market price for the facility itself, the most preferred price source is a CDS spread curve. The spread curve refers to market premiums quoted on bond CDS contracts with different maturities. The premiums would be analogous to spreads between an obligor's bond yields and those on risk-free bonds having the same respective maturities. The preferred CDSs are those for the bonds of the obligor whose loan facility is being valued but CDSs for an obligor in the same or a related legal entity may also be used. Depending on the bank, this market price source accounts for at least half and sometimes a considerably higher fraction of the commercial loan credit exposures being fair valued. Its dominance reflects the high position of obligor CDSs in the waterfall, the high proportion of large investment grade corporations with CDSs in the banks' corporate portfolios, and some limitations on what loan facilities will be fair valued.[6,7]

[6] In a more limited analysis based on interviews of commercial and investment banks, the GAO (2005) considered the use of CDSs and limitations for determining the value of loan commitments.

[7] Loan CDSs represent an alternative market price source to obligor bond CDSs. The banks indicated the loan CDS market is presently too limited to be of use as a market price source. Nonetheless, this market has recently experienced significant growth and represents a potential future market price source for loan valuation.

CDS spreads are preferred over an obligor's bond credit spreads for several reasons. Quotes are available for a standard set of maturities. The market for CDSs is typically more active than for the obligor's bonds.[8] The possible inclusion in bonds of certain payment features, such as call or put provisions, can cause their credit spreads to reflect more than default risk.

The banks typically use generic CDS or bond spread curves for loan facilities whose obligors do not have market-traded bonds. Generic curves are estimated to represent the spread curves for typical loan facility obligors in each generic category. The categories are based on firm credit ratings and can also include industry, country/region or possibly currency. Obligors whose loan facilities are valued using generic credit spreads are often middle-market firms and may include some smaller private firms.

There is limited use of firm market equity values by one bank. Like credit spreads, market equity values are used in determining the obligors' default and survival probabilities. The valuation methodology comes from a provider of loan valuation software, Moody's KMV, who provide users a choice of market equity or market credit spreads as a market price source. The prevalence of either generic curves or equity prices in loan fair values varies by bank but, for most of those, the use of either source is substantially less than that for obligor-specific CDS spreads.

Valuation Framework

When secondary market prices are not available, the banks estimate fair value employing a common valuation framework. To describe this framework, consider a loan facility that consists of a loan commitment and an outstanding loan balance, with T-periods remaining on the contract. In each period, given that the obligor has not defaulted, various payments will be made to the bank or by the bank. Payments to the bank include interest on the loan balance, fees associated with the loan commitment, and principal payment at maturity. An obligor may also have the option to prepay or possibly refinance a loan balance at any time or draw down on the unutilized commitment (a payment by the bank). If there is a default, the banks assume that the unused commitment or some part of it can be drawn down. A default can occur during any period.

The banks' estimation of the loan facility fair value can be explained in terms of the following highly simplified formula:

$$\text{Fair Value} = \sum_{t=1}^{T} \mathrm{E}\left[\text{loan facility payments}_t \mid \text{survival}_t\right] \times \text{Prob}[\text{survival}_t] \times \text{discount}_t$$
$$+ \sum_{t=1}^{T} \mathrm{E}\left[\text{loan recovery}_t - \text{commit drawdown}_t \mid \text{default}_t\right] \times \text{Prob}[\text{default}_t] \times \text{discount}_t$$

[8] However, while dealers provide quotes for corporate bond CDS contracts over a range of maturities, trading activity is concentrated in only a few CDS maturities, particularly the five-year maturity.

In this formula, there are T periods remaining on the contract. The top line in the formula is the sum of the discounted expected payments (positive and negative) to be made in each period t, given the obligor has survived through t, and multiplied by the probability of surviving through t. The bottom line is the sum of the discounted expected payments for each period t, given default occurred at t, and multiplied by the probability of defaulting at t. Payments given default equal the recovery on the outstanding loan balance, including any commitment drawdown at default, minus the commitment drawdown. As previously indicated, the default/survival probabilities for each period are estimated using market price sources. The expected loan facility payments given survival or given default are separately estimated by the banks, mostly without the use of market price sources. The estimation procedures are described in detail below. A formula with more detail on loan facility payments is provided in Appendix A.

There are a number of features to note about the banks' valuation framework:

- The default/survival probabilities, which are obtained from market price sources, are not the actual probabilities but include investor premiums for bearing systematic credit risk and are referred to as "risk-neutral" probabilities.[9]
- Because risk premiums are included in the measurement of default/survival probabilities, future payments are discounted using a risk-free rate.
- Only payments directly associated with the loan facility are valued. Any customer relationship benefits, for example, are not included.
- Loan illiquidity due to the absence of an active loan market is not accounted for. However, a few banks make adjustments in fair values for smaller (illiquid) firms when the market price source does not account for the firm's size.
- The bank's own counterparty credit risk in extending committed funding is not included in the valuation of a loan commitment.
- The conceptual basis for the loan facility valuation approach follows that underlying methods currently used to value credit market instruments.

The banks' estimation of default and survival probabilities and expected loan facility payments given survival or default are described in turn.

Estimation of Default and Survival Probabilities

The estimation of loan facility default and survival probabilities are described for the different market price sources listed in Table 2 above.

[9] Both default/survival probabilities and expected payments given survival or default should allow for investor risk premiums, i.e., be in a "risk-neutral" form. The banks' valuation models at present give at most limited recognition to risk premiums in these expected payment components of the fair value estimates. See discussion of expected facility payments below.

Obligor CDS and Bond Credit Spread Curves

For obligor CDS or bond credit spread curves:

- CDS or bond term structures of credit spreads, i.e., spread curves, are used to estimate the obligor's default/survival probabilities over the term of the loan facility.
- To obtain default/survival probabilities from the market spreads requires separate estimation of the reference bond's expected recovery rate in default.
- CDS spreads are mainly used, with the use of bond spreads being limited.

Discussion. As described earlier, bond CDS spreads for individual obligors are available for a standard range of maturities and believed to provide more accurate measures of the respective obligors' default probabilities than the obligors' bond credit spreads. In Figure 1, CDS spread curves for several firms are illustrated in 2002, when spreads were relatively high and volatile, and in 2004, when spreads were low and stable. The spread curves show a variety of levels and shapes. The different curves indicate variability in the market's assessment of the reference bonds' default risk over time and across obligors. The different shapes of each curve indicate variability in the market's assessment of default risk at different horizons for a given obligor.

Formally, the spread on a bond CDS reflects a risk-neutral, i.e., risk premium adjusted, expected loss from default on the reference bond over the remaining term of the CDS contract per-dollar of bond face value. For each period, e.g., each quarter, the expected loss is equal to the probability of surviving up to that period and defaulting in the period multiplied by the expected loss given default (LGD). LGD is equal to 1 minus the expected recovery rate on the bond. Consequently, with an estimate of the expected recovery rate for each period, the default probability for each period can be determined using CDS spread curves. Using the estimated default probabilities, the survival probabilities, i.e., the probability of survival up through each respective period, can also be estimated. Because default is treated as an obligor event, the estimated reference bond default/survival probabilities are used to estimate the loan facility's fair value.[10]

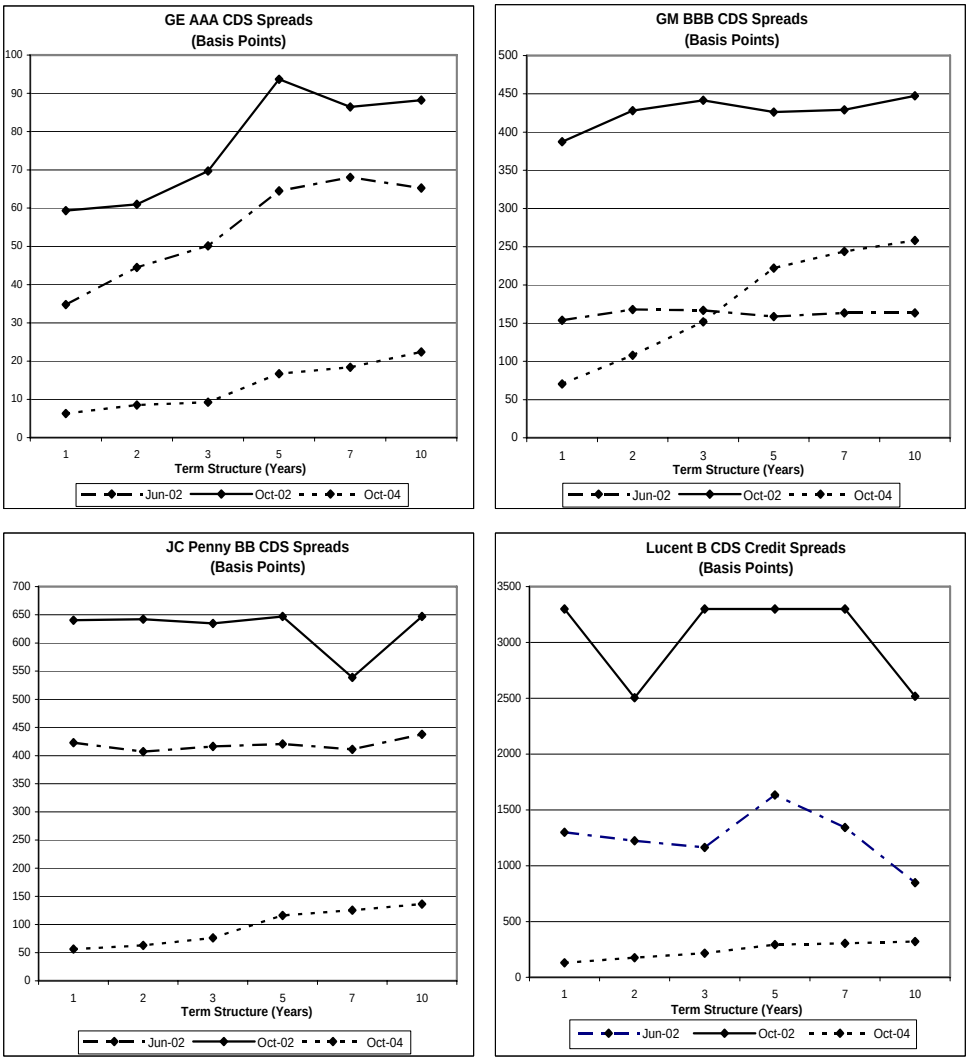
The banks assume the same expected recovery rate on a bond regardless of when the default may occur. The estimation of the expected recovery rate differs somewhat among the banks (e.g., a constant expected recovery rate for all reference bonds, recovery rates provided by CDS dealers, or estimates that can vary depending on the type of bond). Estimates of about 40 percent for banks reporting recovery estimates appear to be generally consistent with historical recovery rates on senior unsecured corporate bonds.

Finally, the observed CDS market credit spreads may be influenced by factors other than the obligor's default risk, for example the liquidity of the CDS market or the market for particular obligors' CDSs or particular maturities. Estimates of default probabilities based on CDS spreads will include any such influences.

[10] For more detail on this estimation, see P. Schonbucher (2003), Chap. 3, or J. Hull (2003), Chap. 27.

Figure 1. CDS Credit Spreads

(Data Source: Markit Partners)



Generic Credit Spread Curves

In using generic curves as the market price source:

- Credit spreads for individual obligor CDSs or bonds with different maturities are obtained and sorted into different categories according to the obligors' characteristics—obligor credit rating, industry, and possibly country/region or currency.
- For each category, individual obligors' CDS or bond credit spreads are used to obtain a term structure of the default/survival probabilities that would represent those of a typical obligor in the category.

- The bank's loan facility obligors are mapped to the different generic categories and the generic curve default/survival probabilities are applied to the individual loan facilities.

Discussion. The estimated generic default/survival probabilities are unlikely to be accurate for individual loan obligors in the bank's generic category. However, if they are representative of a typical obligor in each category, their use may lead to an accurate estimation of loan facility fair values at the portfolio level. Also, a change in an individual loan obligor's default probabilities due to factors common to the generic category would be reflected in the obligor's loan facility fair value estimate. Further, as the bank's individual loan facility obligors migrate to different credit rating categories due to changes in credit quality, the loan facility fair value estimates also will change in the appropriate direction.

There are, nonetheless, issues in estimating generic curves that affect the methods and accuracy of curve estimations. One important issue is limited availability of obligor market credit spreads for estimating the different generic categories. For example, CDS spreads are more readily available for investment grade than for non-investment grade obligors. Bond spreads are available for both investment grade and non-investment grade obligors but have other shortcomings, including a limited range of maturities for individual obligors. Where spread data are limited, the granularity of the generic categories may be limited, small samples may also be used to populate generic curves, compromises on the quality of the market credit spreads that are used may be tolerated, and curves may be interpolated where there are gaps in the data.

Banks also will impose restrictions on the estimated curves, at least partly necessitated by data limitations and possibly also by limitations in curve estimation procedures. Restrictions include requiring that the estimated curves generate only non-negative default probabilities between any two points in time (i.e., that implied survival probabilities decrease with the accumulation of time) and that curves for lower-rated generic categories have higher default probabilities than for the higher-rated categories when compared over any specific horizon. Curve estimation methods, while based on formal statistical procedures, also may differ across the banks.

In addition to generic curve estimation, the bank's loan facilities need to be mapped to the different generic categories to obtain loan obligor default probability estimates. The banks' methods for mapping loans to generic curves were not discussed in any detail, although for mapping to different credit quality categories, internal credit ratings on the obligors may be used. In principle, the mapping procedure should align the *risk-neutral* default probabilities (not actual default probabilities) of the typical loan facility obligor in each generic category with the respective category's estimated generic curve risk-neutral default probabilities.

Finally, market CDS or bond credit spreads used to estimate the generic curves come from larger public corporations, whereas the loan obligors for whom generic curves are used tend to be mid-capitalization and possibly smaller firms. The debt of the latter are

likely to be less liquid and subject to higher credit spreads. One bank attempts to account for this difference in credit spreads by adjusting upward the estimated default probabilities using information on credit spreads in loan securitizations in which smaller firms are more heavily represented.

Market Equity Values

The procedure for estimating default probabilities using market equity values (via Moody's KMV [MKMV] loan value software) is generally as follows:

- Using an obligor's market equity value and a measure of debt obligations, an indicator of the obligor's default probability ("distance-to-default" or DD) is estimated.
- Using the firm's DD, an estimate of the firm's default probability (expected default frequency or EDF) is obtained for some stipulated horizon(s).
- Separately, a market default risk premium is estimated and used to convert the EDFs to risk-neutral EDFs.

Discussion. There is some limited use of firm equity values when obligor CDS or bond credit spreads are not available using MKMV loan fair value software. The theoretical basis for the MKMV method is a "structural model" of the value of a firm's debt—the "Merton model."[11] In this model, the value of a firm's debt is determined by the value of the firm's assets, its debt obligations and asset return volatility. MKMV estimate the firm asset value and asset return volatility by using the value of the firm's equity and a measure of its debt obligations. Within this structural model, the firm fundamentals can be used to determine the market credit spreads for the firm's debt. However, in the academic literature, the Merton model and variants of this model have been notable for their inability to explain observed corporate bond spreads and their variation.[12]

MKMV do not use the estimates of the firm fundamentals within the Merton model to directly determine the obligor's credit spreads. Instead, they use the firm fundamental information to empirically estimate the firm's default probability over a given horizon. Specifically, they combine the firm fundamentals with an estimate of expected asset value growth into a variable termed "distance to default" (DD). For a large historical sample of firms, MKMV have fit equations relating the firms' historical default/survival frequencies to their respective DDs. The historically estimated equations can be used to estimate a firm's default probability (expected default frequency or EDF) given its DD.

For an obligor with publicly-traded stock, the firm's DD can be estimated using its current market equity value and debt obligations for different default horizons. Applying the historically-estimated relation between EDF and DD, the firm's EDFs for different default horizons can then be estimated. The EDFs estimates are for actual, not "risk-

[11] See Merton (1974).
[12] See, for example, Eom, Helwge, Huang (2004).

neutral," default probabilities. MKMV empirically estimate market risk premiums and adjust the EDFs to include these risk premiums to obtain risk-neutral EDFs.

Given the firm's estimated risk-neutral EDFs, MKMV make a further adjustment for smaller firms to account for higher spreads typically required for smaller firms with a given default risk. This adjustment is an option provided to MKMV software users.

For private firms, MKMV have private firm EDFs that are estimated using a combination of a DD estimate based on an aggregate of public companies in the obligor's industry sector and the obligor's financial ratios (e.g., ROA, leverage). Users of MKMV software have the option to use these private firm EDFs in valuation.[13]

Expected Loan Facility Payments Given Survival or Default

Bank loan facilities payments are variable and can be complex. Loans and commitments will include not only various payments to the bank but also borrower options. A list of payments typical of a loan facility—a loan and/or a commitment—is presented in Table 3, with payments by the bank preceded by a negative sign. Because the payments are uncertain, the bank estimates their expected values. (For a fair value formula including these more detailed payments, see Appendix A.)

Especially for non-investment grade obligors, loan facilities are likely to have collateral and restrictive covenants. Covenants often include financial ratios the firm must maintain over the loan facility term. Covenant violations can lead to some action by the bank, possibly affecting the status of the contract.[14] Loan covenants tend to be more extensive and customized than bond covenants. Covenant effects are not explicitly recognized in loan fair value estimation, although they may be captured to some degree through other information used in estimating fair values, for example historical loan recovery rates.

Expected Payments Given Survival

Principal features of the banks' measurement of expected loan facility payments given survival are as follows:

- Expected loan facility payments may be based on an extrapolation of current payments or payments normally expected given a continuation of the facility's current status.
- Several banks, however, model the dependency of future loan facility payments on the obligor's potential credit migration

[13] For information on MKMV's fair value methods, see McAndrew (2004). For default risk modeling for publicly-traded firms, see Crosbie and Bohn (2003). For private firms, see Dwyer, Kocagil, Stein (2004).

[14] For example, financial covenants may require the firm to maintain a minimum cash flow relative to its debt or debt service requirement. Covenant violations can lead to a closer monitoring of the firm, additional restrictions, covenant renegotiation, limiting the use of the loan facility, increasing the interest rate and, as a last resort, terminating the contract. For further information on loan covenants, their use and consequences, see Standard and Poor's (2006), Dichev and Skinner (2001), and Sufi (2007a).

Table 3. Loan Facility Payments*

Payments given survival	Description
LIBOR interest rate (floating)	paid on outstanding loan balance
loan margin	spread over LIBOR paid on loan balance; margin may be changed based on measure of obligor credit condition
loan prepayment/refinancing	loans can be prepaid or refinanced, possibly with a prepayment penalty
loan repayment at maturity	if no default, the outstanding loan balance is paid at maturity
commitment facility fee	fixed periodic fee paid for a loan commitment
commitment fee	periodic fee based on unused commitment
– commitment drawdown	drawdown on the unused commitment
– term-out option exercise	loan commitment can be converted to a fixed term loan at maturity at obligor's discretion
Payments given default	
– commitment drawdown	the obligor may drawdown on the unused commitment when default is imminent
recovery of loan balance	the amount that the bank recovers after a loan defaults (including any commitment drawdown at default)

* Possible upfront payments to the bank are not included.

Discussion. In estimating expected loan facility payments, the majority of banks presently recognize only two possible credit conditions: non-default and default. This limits their ability to account for variation in payments due to non-default credit quality changes. While the exact assumptions used differ, the banks extrapolate forward current facility payments or estimate payments normally expected given a continuation of the current status of the facility. For example, future loan prepayment or refinancing may be ignored or estimated based on the current loan margin and obligor credit quality. In either case, the dependency of prepayment on potential credit migration of the obligor is not modeled. Also, variation in commitment utilization due to the obligor's credit migration is accounted for only in the event of default (see below) and the future commitment level is set at the unused commitment at the time of valuation. Some banks indicated further model development underway would give more recognition to variation in facility payments in non-default states.

Several banks estimate potential variation in future loan payments, including the exercise of obligor payment options due obligor credit migration using MKMV software. MKMV estimate probabilities of obligor migration to different credit categories defined by "distance-to-default" (DD) using historical data on credit migrations of firm cohorts. With bank input, loan facility components—including loan margin, prepayment, commitment drawdown, term-out option—are estimated conditioned on an obligor being

at different credit categories in each future period. With these estimates, MKMV use a lattice model to determine the loan facility's fair value. The lattice model is an iterative procedure that systematically accounts for all of the possible credit migration paths, the paths' probabilities of occurrence, and the expected payments conditioned on the respective credit categories in obtaining the sum of the discounted expected loan facility payments over the loan facility's remaining term.[15] In this manner, potential credit-related variation in future payments is accounted for.

Credit migration probabilities estimated with historical migration frequencies are unlikely to be consistent with the default/survival (risk-neutral) probabilities estimated using the market price sources. To obtain consistency, the estimated credit migration probabilities are adjusted using the market price source default/survival probability estimates.

Expected Recovery and Commitment Utilization in Default

Key features of the banks' modeling of loan recovery rates in default include the following:

- Procedures for estimating expected recovery rates for unsecured loans vary by bank.
- For secured loans, expected recovery rates are dependent on the collateral and tend to be higher than for unsecured.
- Formal econometric models for estimating expected recovery rates presently are not used by most of the banks.
- Unused commitments are assumed to be completely or almost completely drawn down in the event of a default.

Discussion. In estimating expected loan recovery rates given default, the banks distinguish between unsecured and secured loans. For unsecured loans, expected recovery estimation procedures vary. These include a fixed recovery rate for all unsecured loans, historical recovery rates for loans broadly similar to the loan in question, and recovery rates based on a loss rate somewhat less than that estimated for the obligors' bonds. Where numerical estimates were given, expected loan recovery rates were between 40 and 60 percent. For secured loans, the banks indicated that the expected recovery rates depend on loan collateral. There is no explicit accounting for market risk premiums, i.e., risk-neutral expected recovery rates. For comparison, several recent studies have reported historical average/median loan recovery rates on senior unsecured loans between 45 and 50 percent. For senior secured loans, average/median historical recovery rates were estimated to be 60 to 70 percent. For senior bonds, average/median recovery rates are lower than on loans, conditioned on the bond and loan being secured or not being secured.[16]

[15] For further detail on MKMV's use of credit migration and the lattice model in measuring loan facility fair value, see McAndrew (2004).

[16] Recoveries are measured using either market value shortly after default or present value of the amount eventually recovered. For statistics from Moody's loan default data base, see Emery, Cantor, and Arner

While in one instance an LGD loan scoring model is used, most of the banks presently do not estimate expected loan recovery rates based on explicit modeling (e.g. regression equations) of recovery rate dependence on an obligor's financial condition, industry condition, or macro-economic factors.

In the treatment of loan commitments, the banks generally assume that all or most of the unused loan commitment will be drawn down by the obligor in the event of a default, with the majority assuming 100 percent drawdown. The assumption of a 100 percent drawdown means that the fair value at any time over the life of a commitment will reflect a maximum drawdown default risk. Consequently, this risk and its influence on fair value will not be affected by commitment usage in survival states. However, different levels of usage in survival states may still affect the expected facility payments, as commitment usage may have effects on net fee and interest payments.

Finally, it is important to note that, in estimating expected loan facility payments given survival or default, the banks limit information used to that which is verifiable and whose effects on the expected payments can be objectively determined and potentially available in a market transaction, such as the principal features of the loan facility and payments historically observed for similar facilities. The estimation procedures described by the banks do not include the use of private information the bank may have on a facility based on its dealings with obligors or loan facility monitoring and management.[17] This approach helps provide consistency in fair value measurement for different loan facilities and makes independent model validation easier. Nonetheless, certain bank information on obligor credit quality may be omitted from the fair value estimates. This raises some issues for validating reported fair values, which are discussed in section D.2 below.

2. Modeling in Fair Value Measurement

The different areas of loan facility modeling and model estimation issues are categorized here and briefly discussed, with some statistical evidence presented on when modeling may be more or less important.

Areas of Modeling

Principal areas where modeling is required are shown in Table 4. As the table indicates, at least some modeling is required in determining both default (and survival) probabilities and expected loan facility payments given survival or default.

Default Probabilities

Using an obligor's market CDS or bond credit spreads to estimate default probabilities requires the least amount of modeling. A principal estimation is the reference bond's

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(2004) and Gupton and Stein (2005), p. 7; and for recovery rates from defaulted borrowers at a single bank, JPMorgan Chase, see Araten, Jacobs, and Varshney (2004).

[17] In one instance, certain loan department information is used in estimating loan commitment utilization in survival states, although this practice is under review.

Table 4. Areas of Modeling in Fair Value Measurement

Default Probability by Market Price Source	Expected Payments Given No Default	Expected Payments Given Default
CDS and bond spreads: 1. expected bond recovery estimation	Payments dependency on obligor credit quality migration including: 1. loan margin 2. loan prepayment 3. commitment utilization 4. term-out option	1. loan recovery rate estimation 2. commitment utilization estimation
Generic curves: 1. curve estimation, 2. mapping loans to generic categories		
Market equity value: 1. default probability estimation from equity value and related information		

expected recovery rate. If, for example, the estimate is too low, the default probability will be under-estimated. Factors affecting reference bond expected recovery rates will be similar or related to those affecting expected loan recovery rates and are discussed below with loan recovery rate estimation.

When generic curves are used, the market price source consists of CDS or bond market spreads for obligors who are not those whose loan facilities are being valued. As a result, the default probability estimates are primarily model-based. This includes the estimation of the generic curves using individual obligor CDS or bond credit spreads, i.e., fitting curves to individual obligor market spreads to obtain a representative spread curve in each generic category and dealing with market data limitations for different generic categories. Loan facility obligors also have to be mapped to the different generic categories, possibly using the bank's internal risk rating system. Because *risk-neutral* default probabilities are needed for the loan facility fair value, the mapping is more stringent than just matching loan obligors to market obligors according to *historical-based* default probabilities. Matching according to risk-neutral probabilities requires a matching of both historical-based default probabilities and market risk premiums.

In using market equity values, the conceptual basis for estimating the obligor default probabilities is less direct than that when using credit spreads, as it based on commonalities between the determinants of a firm's default probability and its equity value. This is the case whether the MKMV or another equity-based structural model approach is used.[18] As a consequence, determining the obligor's default probability requires a model of what determines default probability and important determining variables need to be estimated. Hence, modeling is extensive. Nonetheless, for loan obligors with publicly-traded equity, market equity values are obligor-specific, which by itself may be a significant advantage over the use of generic curves.

[18] For other models, see Eom, Helwege, and Huang (2004) .

Loan Facility Payments

A prominent feature of loan facility payments given survival is variability that is possibly dependent on an obligor's credit migration, particularly those payments identified in the middle panel of Table 4. Credit migration-dependent payments require determining (1) probabilities of different migrations in an obligor's credit quality over the term of the loan facility, (2) effects on loan facility payments of different credit migrations, (3) how this payments uncertainty affects the risk premium that investors would require to hold the loan facility, and (4) how to calibrate the model. Each of these modeling requirements will encounter potentially significant theoretical and empirical issues.[19]

The majority of banks presently do not employ models of credit migration in estimating loan facility payments given survival. Those that do employ MKMV's credit migration model to determine migration probabilities (requirement (1)) using historical frequencies of firm credit migration and bank input in estimating payment sensitivities to credit migration (requirement 2). Estimating payment sensitivities to credit migration, such as prepayment and commitment drawdown, requires not only estimation but also theoretical considerations as to what determines whether an obligor action is likely when there is credit migration. For loan prepayment, this may depend on how the credit migration affects the value of the prepayment option. This determination can involve forward-looking considerations, e.g., the possibility of future migrations. Backward-looking considerations can also affect loan prepayments, e.g., prepayment will be limited by pre-payment in a prior period. There are similar modeling issues regarding decisions to draw down on loan commitments.

Regarding requirement (3), without appropriate market price data, it will be difficult if not impossible to account for any risk premium effects on the loan facility fair value due to payment risks in survival states. In particular, any such risk premium effects won't be accounted for in the market-based risk-neutral default/survival probabilities since the market price sources (e.g., CDSs) are unlikely to have similar payments.

There are also important model calibration considerations in accounting for credit migration and payments in calculating the loan fair value. MKMV employ a lattice calibration method. The method is advantageous, for example, in accounting for payments decisions that are based on forward-looking considerations, e.g., whether it is optimal to exercise a prepayment option now or wait. However, there are also backward-looking considerations that need to be accounted for in the model calibration, specifically early prepayment or commitment utilization. Calibration issues are important because of the computational burdens they impose. Particular modeling choices for loan facility payments and migration probabilities will affect model calibration choices but the latter will also be affected by computational burdens. This in turn will impose limits on payments and migration probability modeling.

[19] The literature on valuing credit instruments includes variable obligor default probabilities, i.e., credit migration, estimated using market credit spreads and also using historical firm credit migration frequencies. Lando (2004, chps. 5 and 6) and Schonbucher (2003, chps. 7 and 8) provide advanced-level literature reviews and commentary on both approaches.

While modeling loan facility payments given survival is potentially extensive and difficult, the extent of modeling actually required for reasonably accurate fair value estimation is not clear. One determining factor will be the importance of the payments on loan facility default risk. Exercise of the prepayment option and drawdown on commitments in response to credit risk changes can increase loan facility default risk.[20] However, loan facility fee and interest rate structuring, particularly contractual loan margin adjustments, can provide some deterrence to obligor incentives to prepay or drawdown on commitments as its credit quality changes.[21] Also, banks who do not model credit migration effects on commitment utilization in survival states assume most or all of an unused commitment is drawn down in default. With full commitment utilization in default, credit migration-related drawdowns in survival states will not affect the loan facility's default risk. The only payment effects not accounted for will be those effects on fee and interest payments.[22]

Unpredictable loan prepayment and commitment utilization may also occur for reasons unrelated to changes in obligor credit quality. This however need not affect expected loan facility payments, although it can introduce uncertainty into the timing and amount of the lending with possible effects on valuations.

Regarding payments given default, modeling issues mainly concern expected loan recovery rates. Other things equal, the higher the obligor's default probability, the more important will be the expected recovery rate in determining the loan facility fair value. For lower credit quality obligors, the estimation of the expected recovery rate can be very important to the fair value estimate. Expected loan recovery estimation may also be important for higher credit quality obligors with large credit exposures.

The majority of the banks interviewed employ limited modeling of expected loan recovery rates beyond accounting for loan seniority (loans are usually senior) and collateral. Additionally, the expected recovery rate is based on historical data, rather than being a risk-neutral expected rate, i.e., adjusted for an investor premium.

There is no one accepted modeling approach or set of variables for estimating expected loan (or bond) recovery rates to guide recovery rate modeling. However, there is a

[20] If prepayment occurs mainly when credit quality improves, the average quality of loan facility obligors worsens. If commitment drawdowns occur mainly when credit quality worsens, the size of loans is negatively correlated with loan credit quality.

[21] Loans facilities need not have variable loan margins. Also, syndicated loan data suggest that the variation in loan margins in response to changes in credit quality is somewhat limited. For a sample of 2295 syndicated loan facilities from Dealscan (originated between 2001-2006) with variable loan margins based on senior debt rating, the difference between the highest possible loan margin and the lowest was on average 74 basis points. For 2910 loan facilities with variable margins based on total-debt-to-cash-flow, the difference between the highest possible loan margin and the lowest was on average 82 basis points. More that half of this latter group were unrated. Regarding loan commitments, using a large data base of corporate lines of credit at Spanish banks, Jimenez, Lopez, and Saurina (2007) found that credit line utilization rates (based on the initial credit line) for firms that eventually defaulted increased much more than those for firms who did not default over the last 4 years of the loan facilities' respective lives.

[22] This modeling, however, ignores the potential for the bank to reduce its loan commitment to an obligor whose credit quality is deteriorating. For evidence on this potential, see A. Sufi (2007a).

literature on different approaches and historical data on loan and bond recovery rates. Based on historical recovery rate evidence, seniority and collateral are two principal predictors of debt recovery rates. Various studies also have identified other variables with potential predictive power. These include the obligor's default probability and possibly industry condition and the business cycle (to which default probability is also related).[23] Estimates of loan default probabilities inferred from market price sources also can be used to estimate expected recovery rates that depend on default probability.

Modeling the expected loan recovery rate and the recovery rate on the obligor's bonds (the latter used in estimating obligor default probability) may also need to be considered together. Recovery rates on both types of debt will have similar or related determinants and a consistent modeling can have opposite effects on the fair value estimate. For example, over-estimation of the expected loan recovery rate will tend to produce overestimation of the loan facility fair value, while overestimation of the bond recovery rate will tend to produce overestimation of the obligor's default probability and hence under-estimation of fair value. Thus, similar modeling errors or omissions in expected loan and bond recovery rate estimation can have offsetting effects. More generally, modeling an obligor's expected loan and bond recovery rates may require considering the nature of their relationship.[24]

While an evaluation of these and other modeling issues will require empirical evidence and study, the importance of modeling for fair value estimation ultimately will be determined by how closely the market price source represents the market value for the loan facility or represents components of the loan facility and their importance to the facility's value. Several statistical exercises were undertaken to provide some indication as to when modeling may be more or less important to fair value estimation.

Statistical Exercises

The exercises focus on market credit spreads as the market price source. In one exercise obligor-specific bond CDS spreads are considered. A second exercise looks at generic curve estimation methods. Both exercises consider the effects of the obligor's credit quality on the appropriateness of the market price source for measuring fair value and hence the potential importance of modeling in determining appropriate fair value estimates. Also, the data cover periods of both high and low market credit spreads and spread volatility, so that the effects of these different market conditions on modeling importance are also considered. The details of the statistical exercises, including tables and figures, are presented in Appendix B. Here, results are summarized and conclusions drawn about the importance of the market price source versus modeling in the fair value measurement.

[23] For example, see Frye (2000); Altman, Brady, and Sironi, (2005); Acharya, Bharath, and Srinivasan (2005); and Gupton and Stein (2005).

[24] A direct link between an obligor's loan and bond recovery rates is that the bank and bondholders have a potential claim for the assets of the same defaulted firm. This link and its implications for debt recovery modeling is studied in Carey and Gordy (2007).

Individual Obligor Credit Spreads

A sample of syndicated loans (primarily lines of credit but also including term loans) was obtained for obligors with different S&P-equivalent bond ratings who also had bond CDSs with issue dates between January 2001 and February 2006. Differences between the loan credit spreads (excluding fee income) and the CDS spreads for the matched obligors at the loan origination dates were calculated. Participants in the syndications fund the loans at par and the loan spreads are used to represent par value market spreads.[25] If spread differences between a market price source and loan facilities are known to be small, modeling will be more likely to play a small role in fair value estimation. That is, modeling would be constrained so that the estimated loan facility fair value implied a credit spread close to the observed market spread. If the credit spread differences were known to be large and variable, modeling would be permitted to exert a greater influence on the estimated fair value.

The results indicate that differences in loan-CDS spreads will depend on the obligors' credit quality and the level and volatility of market credit spreads. Mean and median spread differences are mostly negative (loans spreads are lower than CDS spreads), especially for lower-rated obligors. Loan-CDS spread differences also become more dispersed in going from the higher-rated to lower-rated obligors. Further, the dispersion was substantially larger between 2001 and mid-2003, when market spreads and spread volatility were high, than between December 2003 and February 2006, when spreads and spread volatility were low.

Between early 2001 and mid-2003 when market credit spreads and volatility were high, the range of loan-CDS spread differences between the 10th and 90th percentiles was about 150 basis points for BBB-rated obligors and 50 basis points for A-rated obligors. For non-investment grade obligors, the range of spread differences was about 1100 basis points for B-rated obligors and 440 basis points for BB-rated obligors. It is important to keep in mind that the exercises are limited to syndicated loans at origination. Also, sample sizes are small, especially for non-investment grade obligors.

The results provide support for a generally close relation between obligor-specific CDS spreads and the obligors' loan spreads for investment-grade obligors, especially when market spreads and spread volatility are low. For non-investment grade obligors, the results imply that obligors' CDS spreads may not be closely related to their loan facility credit spreads, especially when market spreads are high and volatile. Overall, when the market price source is the loan obligor's CDS spreads, modeling may be more likely to play a small role in fair value estimation when the obligor is investment grade and more likely to play a large role when the obligor is non-investment grade.

[25] The majority of loans are not traded in the secondary market and thus will not have secondary market prices. However, similar results to those reported here were obtained for a smaller sample of secondary market syndicated loans. Most of these loans had a market price quote near the issue date, with all prices being close to par and an average price of 99.7. For more detail, see footnote to Appendix Table B1.

Some other results for non-investment grade loan and CDS spreads indicate the need for caution in drawing conclusions about the potential for fair value estimation error. One is that loan spreads on average are lower than CDS spreads, especially when market spreads are high and variable. A second is that the variation in loan spreads across obligors is also much smaller than that for the CDS spreads, especially when market spreads are high and volatile. The first difference suggests that obligors' loans are typically being priced as less risky than their bonds, and the second that loan credit risk is less variable across obligors. These differences may reflect the strong effects of loan collateral and covenants in limiting loan credit risk. Less variability in credit risk and lower average credit risk also could mean that loan credit risk is easier to estimate than that of bonds and that large underestimation of credit risk is also less likely.

Generic Credit Spreads

A second exercise looks at generic curves estimated with different methods for obligors in different rating categories. For this exercise, samples of individual name CDS curves were obtained for BBB (lower investment grade) and BB (higher non-investment grade) obligors on June and October 2002 and October 2004 (month-end). Credit spreads increased substantially between June and October 2002 but were low in October 2004

In one set of calculations, three estimation methods were employed: the mean spreads at each maturity, the median spreads at each maturity, and a "best fit" method. The "best fit" method minimizes the sum of squared differences between the individual spreads and the estimated generic curve spreads, and excludes outlier observations.

With low market credit spreads in October 2004, the three generic curves are similar in both level and slope for both BBB- and BB-rated obligors. For June and especially October 2002, there are differences both in level and slope for both BBB- and BB-rated obligors. Most striking is the larger magnitude of generic curve differences for the BB-rated obligors compared with the BBB-rated obligors. For the latter, basis point differences among the three generic curves (levels and slopes) are small. For the former basis point differences in curve levels and slopes are orders of magnitude larger. This suggests that the sensitivity of the generic curve to the estimation method could be greater for non-investment grade obligors than for investment grade obligors.

A second set of calculations considers how well the generic curves might represent the individual obligor curves. For this calculation, the "best fit" curves for each of the three dates for BBB- and BB-rated obligors are plotted along with individual obligor curves. For October 2004, when credit spreads were low, the generic curves for both the BBB- and BB-rated obligors appear to well-represent the slopes of the individual obligor curves. For June and especially October 2002, the individual curves are considerably less concentrated or uniform in shape than in October 2004 and the generic curves in 2002 less well represent the individual obligor curves. Again, most striking is the much larger magnitude of level and slope differences among individual curves, as well as between individual curves and the generic curves, for the BB-rated obligors. Absolute basis point differences among the BBB-rated obligor curves are still fairly small.

D. VALUATION CONTROLS

Valuation controls are used by banks to insure the integrity of and ultimately help to provide reliability for reported values for financial positions. Valuation controls include model validation and independent price verification (IPV). Their current and potential use for HTM loan fair values is discussed. While reference here is to internal controls, the discussion would apply as well to validation by outside auditors.

1. Model Validation

Model validation generally has been conducted for loan pricing models used for financial reporting purposes, but generally not for those used solely for risk or portfolio management purposes. This reflects the high standards imposed on firms for ensuring the reliability of their public financial statements and the negative consequences of restatements. The banks generally have formal model validation policies in place which describe the responsibilities of business units for developing, approving, validating and maintaining the models used for financial reporting purposes. The validations are usually performed by independent model validation groups for both new valuation models and material changes to existing models. The validation process typically entails the following:

- Checking the soundness of the theoretical framework and model design,
- Reviewing the model parameters and assumptions,
- Applying the model to test cases,
- Determining whether the model is appropriate for its intended use, and
- Identifying any model limitations.

The model validation group usually is required to formally document its analysis to support the work performed and conclusions reached.

Where loan fair value models are used solely for risk or portfolio management purposes, model risk controls are generally not as rigorous as when used in the primary financial statements. In part, this reflects the still early stage of development of HTM fair value programs, as well as the more limited use of the fair values in these institutions. One bank did subject its loan fair value measurement for HTM loans to its formal model validation process. Some other banks reported that their intention to do in the future, using the same procedures as for validating models used in financial reporting.

Business units responsible for developing or using the fair value models have done a limited amount of informal model testing and sensitivity exercises. Examples of these include the following:

<u>Comparing Model Valuations to Secondary Loan Market Prices</u>

Most of the banks surveyed applied their valuation models to loans in secondary markets for which there are market prices. This type of test can be considered the most direct way to determine model reliability. However, the banks' applications of this test were limited

in scope. They have included only a small number of secondary market facilities, possibly limited to those in which the banks had positions. In addition, they have been performed primarily to aid in model development as *ad hoc* checks of soundness, rather than as independent exercises to evaluate the accuracy of the fair value models.

Since only the fair value methodology is being tested, the sample of loan facilities carrying secondary market prices does not have to be limited to the banks' own facilities, of which the number will be small, but potentially can be increased to all secondary market facilities that are similar to those held by the bank. The secondary market for syndicated loan facilities is a principal source of loan (and line of credit) facility market prices. Current and historical daily price data for at least several thousand syndicated loan facilities are available from loan pricing services. While these data correspond predominantly to non-investment grade obligors, they still contain significant numbers of investment grade obligors and obligors with traded CDSs. However, there may be staleness in quoted loan prices.[26]

Comparing Model Valuations Based on Generic Spreads with those Based on Obligor-specific CDS Spreads

There has also been some assessment done of the adequacy of fair values derived from generic curves by making comparisons between such values and fair values based on obligor-specific CDS spreads. Under this approach, the bank selects loan facilities currently valued using the obligors' name-specific CDS spreads and compares their estimated fair values with those that would be estimated were generic curves used instead. These comparisons are done at infrequent intervals and are intended to ensure that the output based on the generic curve does not greatly diverge from that which would be based on the name-specific CDS curves.

Again, since only the methodology is being tested, this approach to model evaluation can be expanded beyond the bank's own facilities to include other loan facilities (e.g., syndicated loans) where the obligor also has CDSs. Further, since the comparison here is between the use of two different market price sources, evaluations might also be limited to comparisons of the estimated default probabilities obtained from each market price source. This expanded comparison would not require that the reference name for the CDS also have an identifiable loan facility.

Measuring Sensitivity of Model Fair Values to Variation in Model Parameters

Some banks measure the sensitivity of modeled fair values to variation in the inputs for model components used in estimating expected facility payments, particularly loan commitment utilization and loan recovery rates. These exercises help them to understand the significance of the different model parameters to the fair value estimates.

In addition to sensitivity exercises, tests of the modeling of components of loan facility payments can be done. Such tests might include the modeling of the expected recovery

[26] For an application of this testing approach using syndicated loan prices, see Bohn and Zeng (2003).

rate, loan prepayments, and commitment utilization. Testing would require historical data on individual facilities payments components and variables that would determine the components. The estimated values of the component (e.g., the estimated expected recovery rates) would be compared to realized values (e.g., the realized recovery rates or average recovery rates on the defaulted loans).

2. Independent Price Verification

Verification of the fair values reported in financial statements is usually the responsibility of IPV groups. These units typically ensure that trader "marks" reflected in financial statement valuations closely reflect current market pricing. Independent validation of these valuations is conducted at least monthly and sometimes more frequently. The IPV unit typically follows a hierarchy of sources for market prices or market parameters to verify the traders' marks and to categorize the IPV results to senior management.

IPV groups do not generally validate HTM loans that are fair valued since changes in these fair values do not have a direct impact on the banks' earnings. However, the reliability of these valuations will become more critical should they be included in the primary financial statements under IASB's or FASB's fair value option. In this case, IPV groups could broaden their responsibility to ensure loan fair value methodologies are appropriately and accurately used. IPV groups could ensure that the market price sources used are correct and properly follow the waterfall hierarchy, as well as ensure the adequacy of data systems and the correct application of algorithms used in fair value modeling. Several banks in our study indicated that they would use IPV groups to validate loan fair values if they were included in the primary financial statements. This should include periodic reviews of the valuation models and their adequacy for the bank's loan portfolios. This is important since HTM loan facility fair values are a combination of market price sources and modeling.

There are nonetheless difficulties in verifying HTM loan facility fair values that are not encountered in or are more severe than those typical for trading positions. These difficulties arise when the market price source is not itself a good indicator of the loan facility fair value and modeling is thus important to obtaining an appropriate fair value estimate, as is likely to be the case loans to non-investment grade obligors. For such facilities, while model validation and standard IPV practices are still important, they may not be sufficient to establish the reliability of reported fair values.

The difficulty is that the level of specificity in individual loan facilities and obligors needed to measure the facilities' credit quality may easily surpass what will or can be objectively modeled and verified. This is due to the variety of payment features and contingencies in loan facility contracts, their customization to individual obligors, and the dependency of some of the contingencies on the obligors' behavior and financial condition. To be sure, payment complexities, customization, and contingencies have counterparts in complex derivatives and structured products typically held in trading. However, few of the contractual and contingency features of loan facilities can be

informed by market price sources to be used in valuing the entire facility, in contrast to the more common situation for complex derivatives and structured products.

In using an objective approach to fair value estimation, the banks' modeling of expected payments for individual loan facilities will tend to reflect payments conditioned on more general loan facility and obligor categories, and will be limited in reflecting risks based on the specific loan facility features. This makes it possible for fair value estimates to systematically under- (or over) value the loan facilities because of bank loan selection and loan management policies. Model validation procedures, such as those described above, may not be easily geared toward identifying this possibility; but rather toward testing the reliability of fair value estimates for loan facilities that are selected without bias with respect to loans generally found in the broader categories.

A test of the performance of reported fair values, i.e. backtesting, could be effective. However, backtesting reported fair values is only possible if the loan facilities are subsequently sold rather than held-to-maturity. Some backtesting may be possible for the predicted values of certain modeled components used in the fair value estimates. For example, estimates of expected recovery rates and default probabilities may be compared with the loan facilities' realized recovery rates and observed default frequencies.[27] This information, however, is limited and may lack timeliness.

As a consequence of these testing limitations, there may be a need to examine loan portfolios, or selected parts, at a granular level and to validate their consistency with the broader assumptions underlying the fair value modeling. This might require, for example, an independent IPV unit reviewing or determining loan facility obligors' financial conditions, the value of collateral, and the extent and effectiveness of covenant protections. Ultimately, there would also need to be verification of the model validation and IPV results by professionals independent of the bank.[28]

3. Third Party Pricing Services/Models Due Diligence

Banks generally perform due diligence on third party pricing services and models when they initially contract with these services, and then on periodic basis going forward. Due diligence on pricing services includes an investigation of the breadth of coverage of positions, pricing methodologies, controls of data quality (including the extent of stale or spike prices), and the pricing vendors' independence from the firm. Banks follow their internal model validation protocols to validate models developed by external vendors. However, several banks indicated that there are challenges in performing model validation or due diligence, owing to the fact that vendors are outside providers whose systems and models are proprietary.

[27] Since the estimated default probabilities include market risk premiums, observed default frequencies should be less than the estimated default probabilities used in the fair value estimates.

[28] Opaqueness issues in verifying reported fair values of commercial loans held-to-maturity have parallels in the sale and syndication of commercial loans. For a recent study of these issues and how they are resolved in loan syndication, with references to the broader literature, see Sufi (2007b).

E. SUMMARY AND CONCLUSIONS

This study has described and analyzed commercial loan fair value measurement at a number of large commercial banks. The banks' fair value programs for commercial loan investments represent a significant contribution to the implementation of fair value in loan management and in advancing loan valuation techniques, particularly for practical use. The following summarizes the main results and conclusions of the study.

Extent of Coverage and Use of Fair Value

Most of the banks interviewed have some commercial loan fair value practice underway. Current application extends to loans and loan commitments for large and smaller public and private corporations. Consistent with the commercial loan profiles of the largest banks, loan facilities for large investment grade corporations constitute the largest part of loan fair values for most of the banks. The banks expressed the most comfort with applying fair value to loan facilities for these large corporate customers, where CDSs on the obligor's debt can serve as the market price source for determining the loan fair value.

Some banks use fair value for loan management, while others primarily for communicating information on the loans' fair values to senior management. Loan management uses include the managing of loan credit risk generally and the hedging of credit risk specifically. Fair value also is calculated to help in determining market consistent prices for new loans and to provide an opportunity cost for relationship lending. Other uses include communicating to senior management hedging effectiveness, and after-the-fact reporting such as profit attribution and risk sensitivity analyses.

Fair Value Measurement and Modeling

Most loan facilities do not have secondary market prices and fair values must be estimated by the banks. For valuing loans and commitments, the banks have developed approaches that are broadly similar. These include the use of a market price source hierarchy, a common valuation framework, market prices to estimate default probabilities, and modeling of loan facility payments. The conceptual valuation framework is based on standard valuation methods used for credit market instruments, although one or two banks make valuation adjustments for smaller illiquid firms. Loan facility payments are also complex and there are differences among banks in payments modeling, as well as in the use of different market price sources.

The banks take an objective approach to measuring fair value. Besides the use of objective market information, expected loan facility payments are determined based on objective measures that might be expected to be available to a knowledgeable potential transactor with the bank. Reliance on objective information, however, limits the specificity of information on its loan facilities that the bank will or can use and does not eliminate the need for judgment in the modeling process.

Modeling becomes important when the market price source does not closely approximate the loan facility fair value. Modeling can be extensive and there are important modeling issues in estimating loan facility fair values. Ultimately, the importance of modeling will depend on how closely the market price source represents the loan facility's fair value. Some statistical results suggest that, for investment grade obligors, the obligors' bond CDS spreads may provide a good representation for their loan facility fair value credit spreads, while this is less likely for non-investment grade obligors and especially when generic curves are used. Bond CDS spreads may also be a less representative market price source for loan facilities when market credit spreads are high and volatile, especially for non-investment grade obligors.

Model Validation

The banks' application of model validation processes and price verification controls presently is limited. The banks' formal and independent systems for model validation and price verification primarily focus on trading and HFS loans. A limited amount of informal model testing and price verification is done for HTM loans by the business unit. The limited application of validation and control systems reflects the early stage of model development and the absence to date of HTM loan fair values in the primary financial statements. Independent testing of loan fair value methods and the development of programs suitable for such testing will be necessary to assess fair value reliability, though potentially less critical for investment grade obligors with name-specific credit spreads.

While initial and periodic model validation is necessary, it is not sufficient to establish the reliability of reported fair values where modeling is important. Modeled components of fair value estimates are not sufficiently flexible to fully reflect the credit risks of individual loan facilities, even if validated as reliable in their general application. As a consequence, a bank's loan selection or management policies may influence the loans' actual credit risk such that it is systematically different from that reflected in substantially model-based fair values. Because of this potential, there may be need to validate the consistency of the loan portfolio with the modeling assumptions at a more granular level than that normally required for mark-to-market traded positions whose fair values tend to be substantially based on market price information.

Future Research

The banks' development of loan valuation techniques and the further analysis in this study may help to identify areas for future research. Areas for future research in loan valuation include: modeling the dependency of future loan facility payments in survival states on the obligor's current credit condition and potential credit migration; consideration of the effects on expected payments in both survival and default states of observable obligor, industry, and economy-wide factors; estimating obligor default probabilities in the absence of obligor-based market price information, particularly regarding the use of generic curves; and, more generally, determining the information most appropriate to estimate fair values that are both verifiable and reflective of a market valuation.

Testing of loan fair value methods and validation of reported values are also important areas for research. Reliability of fair value methodologies can be studied using loan facilities for which market prices are available. Individual modeled components such as prepayment, loan commitment utilization, and loan and bond recovery in default may be studied and modeling methods tested using historical data on individual facilities. Validation procedures for reported loan fair values will also need to be further developed as these may require levels of investigation beyond what is currently done for marked-to-market trading book exposures.

Finally, while various issues in estimating loan facility fair values have been considered, no attempt was made to evaluate the accuracy of fair value in any absolute sense or relative to amortized cost reporting methods. However, the banks' uses of fair value and estimation methods as described and analyzed here may prompt further analysis of fair value accuracy and issues relevant to the broader implications of moving to loan fair value for bank lending practices and financial markets more generally.

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Appendix A: Loan Facility Fair Value Framework

The loan facility valuation formula presented here is simplified by assuming that the various loan facility payments are all made at scheduled payment dates $t = 1 \cdots T$ and payments are made in arrear. Payments associated with a default also occur at the next scheduled payment date. Loans are charged a margin over a risk risk-free floating rate, represented here by libor. Default and default probability are independent of the risk-free rate. With these assumptions, the current (t = 0) value of a loan facility consisting of a loan commitment for T periods and an initial loan balance can be expressed by

$$\begin{aligned}\text{Fair Value}_0 = &\sum_{t=1}^{T} \text{E}[\text{loan facility payments}_t \mid \text{survival}_t] \times \text{Prob}[\text{survival}_t] \times \text{disc}_t \\ &+ \sum_{t=1}^{T} \text{E}[\text{loan recovery}_t - \text{commit drawdown}_t \mid \text{default}_t] \times \text{Prob}[\text{default}_t] \times \text{disc}_t\end{aligned} \tag{A.1}$$

The notation is as follows:

$\text{E}[\cdots]$ = expected value (in principal a risk-neutral value)

$\text{Prob}[\cdots]$ = unconditional risk-neutral probability of survival (default at) at t

disc_t = present value of one dollar paid with certainty at time t

Detailed components for the loan facility payments in survival and default states in (A.1) include the following:

$$\begin{aligned}\text{facility payments}_{t<T} \mid \text{survival}_{t<T} = &(\text{libor}_{t-1} + \text{margin}_{t-1}) \times \text{loan bal}_{t-1} + \text{commit fee}_{t-1} \times \text{unused commit}_{t-1} \\ &+ \text{facility fee}_{t-1} \times \text{commit}_0 + \text{prepay}_t + \text{prepay penality}_t - \text{commit drawdown}_t\end{aligned}$$

$$\text{facility payment}_T \mid \text{survival}_T = (\text{libor}_{T-1} + \text{margin}_{T-1} + 1) \times \text{loan bal}_{T-1} - \text{term-out opt}_T$$

$$\text{loan recovery}_t \mid \text{default}_t = \text{recovery rate}_t \times (\text{loan bal}_{t-1} + \text{commit drawdown}_t)$$

$$\text{loan bal}_t = \text{loan bal}_{t-1} - \text{prepay}_t + \text{commit drawdown}_t$$

$$\text{unused commit}_t = \text{unused commit}_{t-1} - \text{commit drawdown}_t$$

where

term-out opt_T = value of option to extend loan value for a fixed term at period T

loan bal_0 = initial loan balance

commit_0 = initial loan commitment

$\text{unused com}_0 = \text{commit}_0$

Using these individual loan facility payment components, the loan fair value can be expressed in a more expanded form:

$$
\begin{aligned}
\text{Fair Value} = \sum_{t=1}^{T-1} E[&(\text{libor}_{t-1} + \text{margin}_{t-1}) \times \text{loan bal}_{t-1} + \text{commit fee}_{t-1} \times \text{unused commit}_{t-1} \\
&+ \text{facility fee}_{t-1} \times \text{commit}_0 + \text{prepay}_t + \text{prepay penality}_t \\
&- \text{commit drawdown}_t \mid \text{survival}_t] \times \text{Prob}[\text{survival}_t] \times \text{disc}_t \\
+ \sum_{t=1}^{T} E[&\text{recovery rate}_t \left(\text{loan bal}_{t-1} + \text{commit drawdown}_t\right) \\
&- \text{commit drawdown}_t \mid \text{default}_t] \times \text{Prob}\left[\text{default}_t\right] \times \text{disc}_t \\
+ E[&\text{loan bal}_{T-1} - \text{term-out opt}_T \mid \text{survival}_T] \times \text{Prob}[\text{survival}_T] \times \text{disc}_t
\end{aligned}
\tag{A.2}
$$

While not recognized in the formula, the loan facility payments in each period are subject to restrictions that also need to be accounted for in the formulation and estimation of expected payments and the loan facility fair value. These restrictions include prepayment not exceeding the outstanding loan balance and commitment usage not exceeding the outstanding commitment balance. The loan balance and the outstanding commitment at any time must also be non-negative. Formally,

$$
\text{loan bal}_t \geq 0;\ 0 \leq \text{prepay}_t \leq \text{loan bal}_{t-1};\ 0 \leq \text{commit drawdown}_t \leq \text{unused commit}_{t-1}
$$

Appendix B: Statistical Exercises

Two statistical exercises, whose results were summarized in section C.2 (Statistical Exercises), are described here. One concerns the potential importance of modeling in fair value measurement when obligor-specific CDS spreads are the market price source. The second looks at generic curve estimation under different estimation methods. Both exercises consider whether obligor credit quality and credit market conditions might affect the relevance of the market price source and hence the importance of modeling for determining loan fair value measurement.

Individual Obligor Credit Spreads

For the first exercise, syndicated loan credit spreads were obtained for obligors with different S&P (or S&P equivalent) bond ratings who also have bonds for which there are credit default swaps. In this exercise, the credit spreads on the loans at the issue date (excluding fee income) are compared to the obligor's CDS spreads. The sample consists of 1060 loan facilities (February 2001 to January 2006). For this sample, the majority of loans will not be traded in the secondary market and thus will not have secondary market prices. However, participants in the syndications fund the loans at par and, for purposes here, the loan spreads are used to represent par value market spreads. Similar results to those reported here were obtained for a smaller sample of secondary market syndicated loans. Most of these loans had a market price quote near the time of origination, with all prices being close to par and an average price of 99.7 (see footnote to Table B1).

For the analysis, differences between each obligor's loan spread over LIBOR (in a few cases EURIBOR) and CDS spread for approximately the same maturity as the loan facility and issue date were calculated. The loan facilities are predominantly lines of credit but also include term loans. [29] Further detail on the loan facility data and several variants to the exercises presented here are given in the footnote to Table B1.

In Figure B1, the loan-CDS spread differences are plotted for each ratings category, along with a daily market index credit spread. The market spread indices shown in Figure B1 (solid lines) indicate that market credit spreads were considerably higher and more volatile prior to about mid 2003 and were low and stable from late 2003 through the end of the sample period (note differences in spread axis scale for each panel). Two clear patterns in the behavior of the loan-CDS credit spreads can be discerned. One is that when market spreads are high and volatile, the loan-CDS spread differences are more dispersed and tend to be lower (more negative) than when market credit spreads are low and stable. The second is that the loan-CDS spread differences tend to be lower (more negative) and more dispersed the lower the credit rating category.

To consider these patterns further, two sub-samples were taken. One extends from January 2001 through February 2003 and the second from December 2003 through February 2006. The first period is one of relatively high and volatile market credit

[29] For lines of credit, the spread is on a credit drawdown indicated in the contract at the issue date.

spreads based on the daily spread indices and the second period is one of low and stable credit spreads. For the second period, average spreads were almost 50 percent lower than they were for the first period and spread volatility (daily spread standard deviation) was 50 to 80 percent lower than the earlier period depending on the index. The behavior of the obligor loan-CDS spread differences for these two periods are described and compared in Table B1, with details of the exercises in the footnote to the Table.

Panel a in Table B1 presents sample sizes, mean and median loan-CDS spread differences, and spread differences at different percentiles for each rating category during the January 2001 – June 2003 period of high and volatile market spreads. Panel b presents the same statistics for the December 2003 – February 2006 period of low and stable spreads.

For the later period (panel b), the range of spread differences for investment-grade obligors (BBB and higher) indicated by the percentiles in the last four columns is small. For BBB-rated obligors, the difference between the 10^{th} and 90^{th} percentiles is about 75 basis points (30 basis points for A-rated obligors). Median (mean) spread differences are close to zero. For the earlier period (panel a), the range of spread differences between the 10^{th} and 90^{th} percentiles for BBB-rated obligor loan-CDS spread differences is larger—150 basis points (55 basis points for A obligors). Median and mean loan-CDS spread differences are also moderately negative for the earlier period, i.e., loan spreads on average were slightly lower than the CDS spreads.

For non-investment grade obligors rated BB and B, there is significant disperion in the loan-CDS spread differences even in the later period of low and stable credit spread. For B- rated obligors, the difference between the 10^{th} and 90^{th} percentiles is about 325 basis points. During the earlier period (panel a), the loan-CDS spread differences for the non-investment grade obligors are widely dispersed. For B-rated obligors, the range of spread differences between the 10^{th} and 90^{th} percentiles is almost 1100 basis points. For both periods median and mean spread differences are negative—loan spreads are lower than the obligors' CDS spreads—with the median and mean differences considerable more negative in the period of high and volatile market spreads.

The large dispersion in the loan-CDS spread differences for lower credit quality obligors, especially during the period of high and variable market spreads, does not rule out a systematic relation between the obligor's loan spread and CDS spread. To examine this possibility further, the obligors' loan spreads are plotted against their respective CDS spreads using the full 5 year sample in Figure B2. Upward sloping least squares lines estimated from these points and plotted in the various panels show that the obligors' loan spreads tend to increase with their CDS spreads. The dispersion in loan spreads about the regression lines represents variation in the loan spread not explained by the obligor's CDS spread. The plots show that there is a lot of variation in the loan spreads about the regression lines for the non-investment grade obligors, which becomes noticeably greater as the CDS spread levels increase.

There are several important limitations of these results. One is the small sample size, especially for non-investment grade obligors, so that sampling error may be large. A second limitation is that the exercises cover only loan spreads at the loan issue dates, when the loans would be priced at or near par. Results may be different for more seasoned loans that may not be close to par.

There are, however, some additional important features of the loan and CDS spreads for non-investment grade obligors. As shown in Table B1, average loans spreads are substantially lower than average CDS spreads for non-investment grade obligors, especially in the earlier period when market spreads were high and volatile. A further difference between the loan and CDS spreads is indicated in Table B2. As shown in the Table, loan spreads at non-investment grade levels are considerably less varied than are the CDS spreads. This is especially the case during the earlier period when market spreads were high and volatile. At the investment grade level, the dispersion of loan spreads across obligors during the period of high market spreads is also lower for loans than for CDSs but the difference in dispersion is much more modest. The lower average spreads and lower spread variation for non-investment grade loans than for bond CDSs suggest that the loans are priced as having less credit risk and possibly less cross-section variability in credit risk. These results may reflect the greater prevalence of collateral and more extensive covenants among sub-investment grade loans than for bonds.

Generic Credit Spreads

A second exercise looks at the potential importance of methodologies in estimating generic curves for different obligor ratings. For this exercise, samples of individual name CDS curves were obtained for BBB-rated (lower investment grade) and BB-rated (higher non-investment grade) obligors on June and October 2002 and October 2004 (month-end). Three generic curve estimation methods are used: the mean spreads at each maturity, the median spreads at each maturity, and a "best fit" method. The best fit method estimates a generic curve that minimizes the sum of squared differences between the individual spreads and the estimated generic curve spreads over the entire range of CDS maturities. The method also constrains the curve estimation such that default probabilities at every maturity are non-negative and excludes outlier observations.[30]

Plots of the generic curve using the three estimation methods are shown in Figure B3. The left panel shows the three curves for the BBB-rated (investment grade) category. For this category, the curves are very similar in October 2004, when market spreads were low. For 2002, there are differences in the levels of the spread curves, particularly in October when market spreads increased substantially from June. The high levels of the mean-based curves come from the right skewness of the distribution of credit spreads, for which the mean gives more weight than the other methods.

For the BB-rated (non-investment grade) obligors, the spread curves are similar in October 2004 but, in 2002, there are large differences in the levels and slopes of the curves. Most striking is the magnitudes of the curve differences for the BB-rated

[30] The calculation of the best fit curve was provided by Michael Gibson.

category versus the BBB-rated category. For the latter, the differences among the three generic curves (levels and slopes) are less than 100 basis points. For the BB-rated generic curves, differences in curve levels are of the order of 300 to 500 basis points. Differences in slopes also tend to be large. These illustrations suggest that, in estimating generic curves, the sensitivity of the curve to the estimation method could be substantially greater for non-investment grade obligors than for investment grade obligors. It also appears that in periods of high market credit spreads the sensitivity of the estimated curves to the estimation method used may increase, especially for non-investment grade obligors.

To consider the generic curves' ability to represent individual obligor curves, the best fit curves for BBB- and BB-rated obligors is plotted along with individual obligor curves in Figure B4. The circles are the individual obligor CDS spread curves without joining the points on the obligor's respective curves. CDS curves with connected points are plotted for a small subset of obligors to give an indication of the slopes of individual obligor curves.

For October 2004, when market spreads were low, the generic curves for both the BBB- and BB-rated obligors appear to well-represent the slopes of the individual obligor curves. The levels of the individual obligor curves also tend to be concentrated near the generic curves, though more so for the BBB-rated obligors. For June and especially October 2002, the individual curves are considerably less concentrated or uniform in shape. The generic curves in 2002 less well represent the individual obligor curves. Most striking, however, is the much larger order of magnitude of level and slope differences among individual curves and between individual curves and the generic curves for the BB-rated obligors as compared to the BBB-rated obligors, where absolute basis point differences in the curves are still fairly small.

These exercises suggest that generic curve estimation could be more sensitive to the curve estimation method for lower than for higher credit quality obligors. Additionally, generic curves may better represent the individual curves of the higher credit quality than the lower credit quality obligors. Estimation and interpretation issues also may be greater when market credit spreads are high and volatile.

Table B1. Loan Facility – CDS Spread Differences for Matched Obligors* (basis points)

a. January 2001 – June 2003

Rating	No of Obser	Ave Matur (years)	mean diff	med diff	CDS and Loan Spread Differences by Percentile			
					10th percentile	25th percentile	75th percentile	90th percentile
A and higher	143	2.4	-16.0	-11.4	-48.5	-27.0	-0.7	6.7
BBB	188	2.0	-63.1	-36.6	-136.2	-88.6	-7.2	13.5
BB	49	2.9	-194.5	-160.9	-462.3	-227.5	-60.3	-20.4
B	39	3.3	-354.2	-162.7	-1075	-490.8	-42.3	17.3
CCC	28	2.8	-483.8	-258.0	-1156.7	-666.6	-156.4	-15.7

b. December 2003 - February 2006

Rating	No of Obser	Ave Matur (years)	mean diff	Med diff	CDS and Loan Spread Differences by Percentile			
					10th percentile	25th percentile	75th percentile	90th percentile
A and higher	136	3.6	2.6	1.3	-12.0	-5.8	9.3	18.4
BBB	268	3.9	10.0	5.8	-25.5	-9.1	24.8	50.3
BB	120	4.7	-38.5	-26.8	-124.0	-66.6	10.5	47.3
B	74	5.1	-94.6	-77.9	-285.1	-184.3	-25.7	42.8
CCC	15	3.7	-2190	-108.4	-9903.6	-1208.5	-91.7	14.0

*Data for loan facilities is from Loan Pricing Corporation's Dealscan database and covers syndicated loans and lines of credit from February 2001 to January 2006. About 85 percent of the observations are lines of credit. Obligors with syndicated loan facilities were matched with bond CDS reference names for which there are CDS quotes on the loan facility issue date. The loan spreads are contractual spreads over LIBOR (and several EURIBOR) rates at the loan issue date. For each loan facility, the obligor's CDS spread was that for a CDS maturity closest to that for the loan facility (CDS spreads used were 1, 2, 3 5, 7, and 10 years). In a small number of cases, the loan maturity was missing, in which case the average maturity for the rating category was used.

Some variants of the exercise whose results are reported in Table B1 were carried out with similar results. In one variant, loan-CDS spreads differences were calculated using the obligor's 2-year CDSs, regardless of the loan facility maturity. Results are similar to those in Table B1, except that the mean and median absolute spread differences are moderately smaller. Exercises also were done separately for term loans and lines of credit, with results similar to each other, as well as to those presented in Table B.1. An exercise was also performed using a sample of 234 loan facilities from Jan 2001 to Dec 2005, with 73 percent of the facilities having secondary market prices at approximately the loan issue date (prices and loan facility information obtained from Markit Loans). All price quotes for these syndicated loans were close to par, with an average price of 99.7. For the 2001 – 2005 sample data, the median loan-CDS spread differences for different ratings in basis points (sample sizes in parentheses) are: A: -32 (12); BBB: -21 (36); BB: -46 (75); B: -285 (82); CCC: -559 (29). Spread differences for the 10th and 90th percentiles are: A: -40, 1; BBB: -121, 23; BB: -235, 52; B: -977, 1; CCC: -8879, 10.

Table B 2. Percentiles for Loan and CDS Credit Spreads (basis points)

a. January 2001 – June 2003

	Loan Spreads		CDS spreads	
Rating	10th percentile	90th percentile	10th percentile	90th percentile
A and higher	13	40	16	71
BBB	25	116	35	224
BB	47	450	118	865
B	84	400	191	1300
CCC	39	505	100	1540

b. December 2003 – February 2006

	Loan Spreads		CDS spreads	
Rating	10th percentile	90th percentile	10th percentile	90th percentile
A and higher	14	35	8	34
BBB	25	113	19	80
BB	75	225	87	297
B	150	426	225	535
CCC	225	500	310	10299

Figure B1. Syndicated Loan-CDS Differences for Matched Obligors: Jan 2001 – Feb 2006 (basis points)

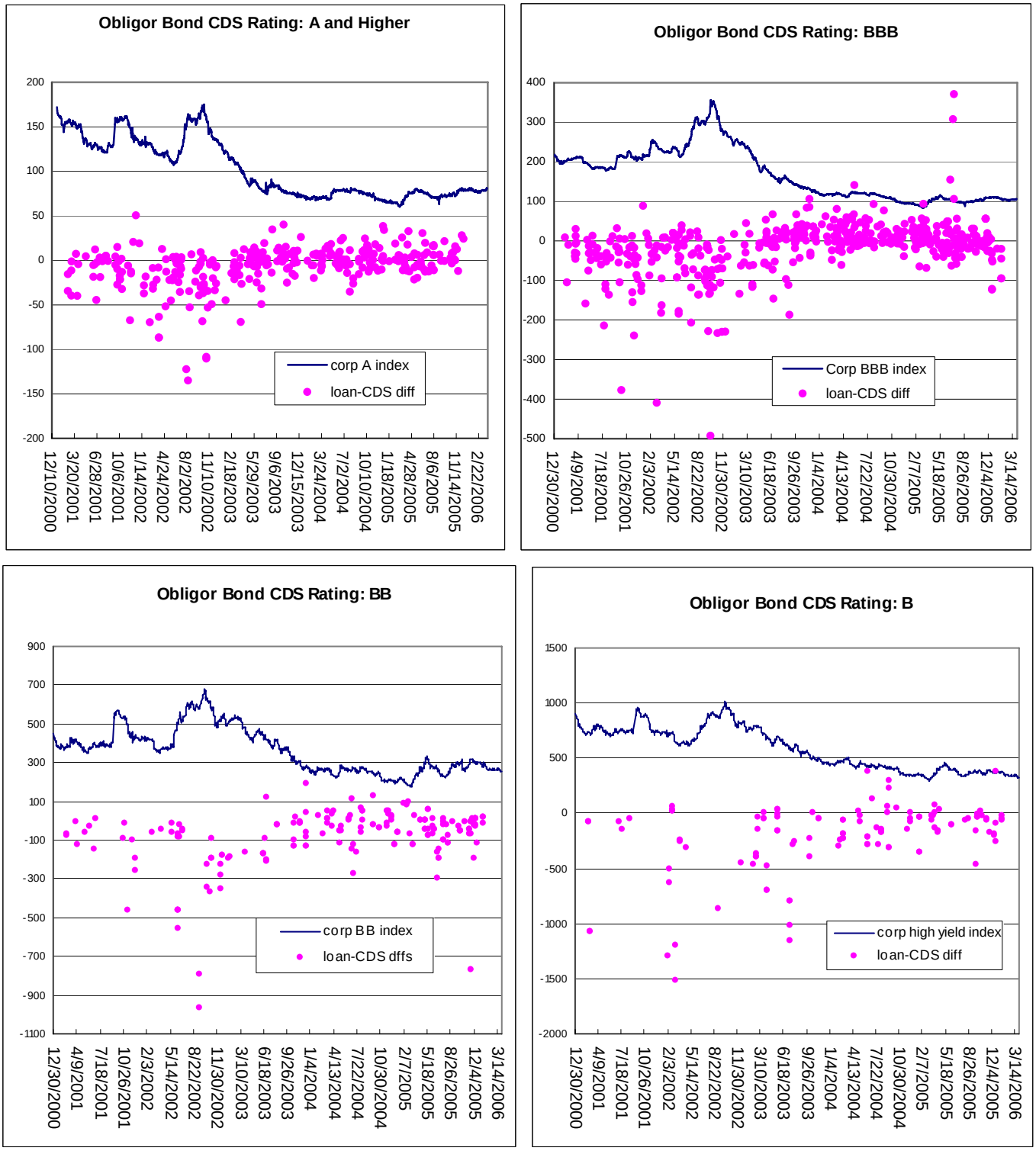
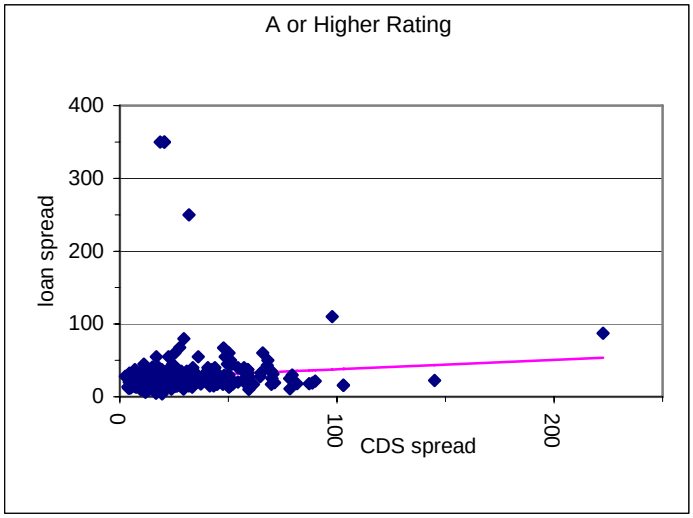
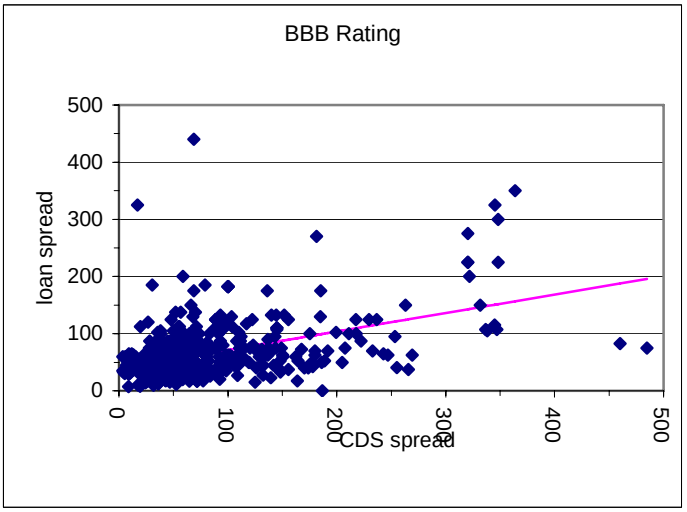
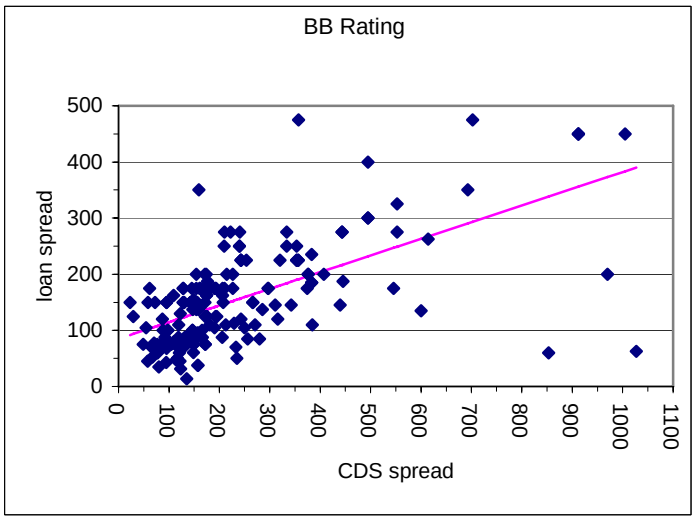


Figure B2. Syndicated Loan and CDS Spreads for Matched Obligors by S&P Rating (basis points)







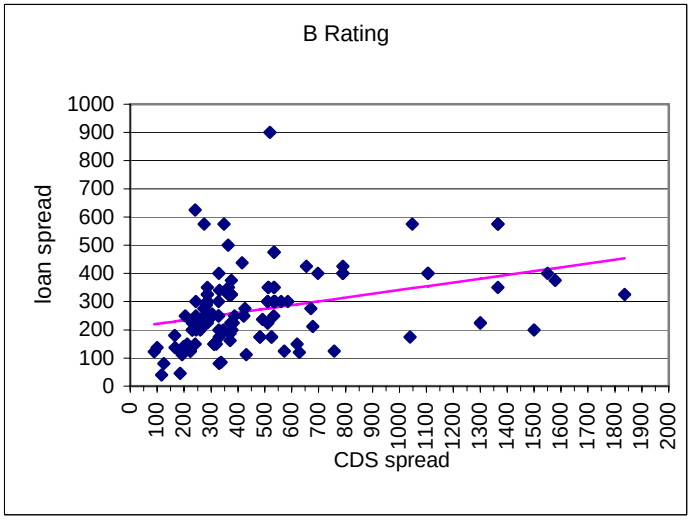


Figure B3. Comparison between BBB and BB Generic Curves Based on Individual CDS Curves

Three BBB Generic Curves
mean (–•–); median (– –•– –); fitted (–)

Three BB Generic Curves
mean (–•–); median (– –•– –); fitted (–)

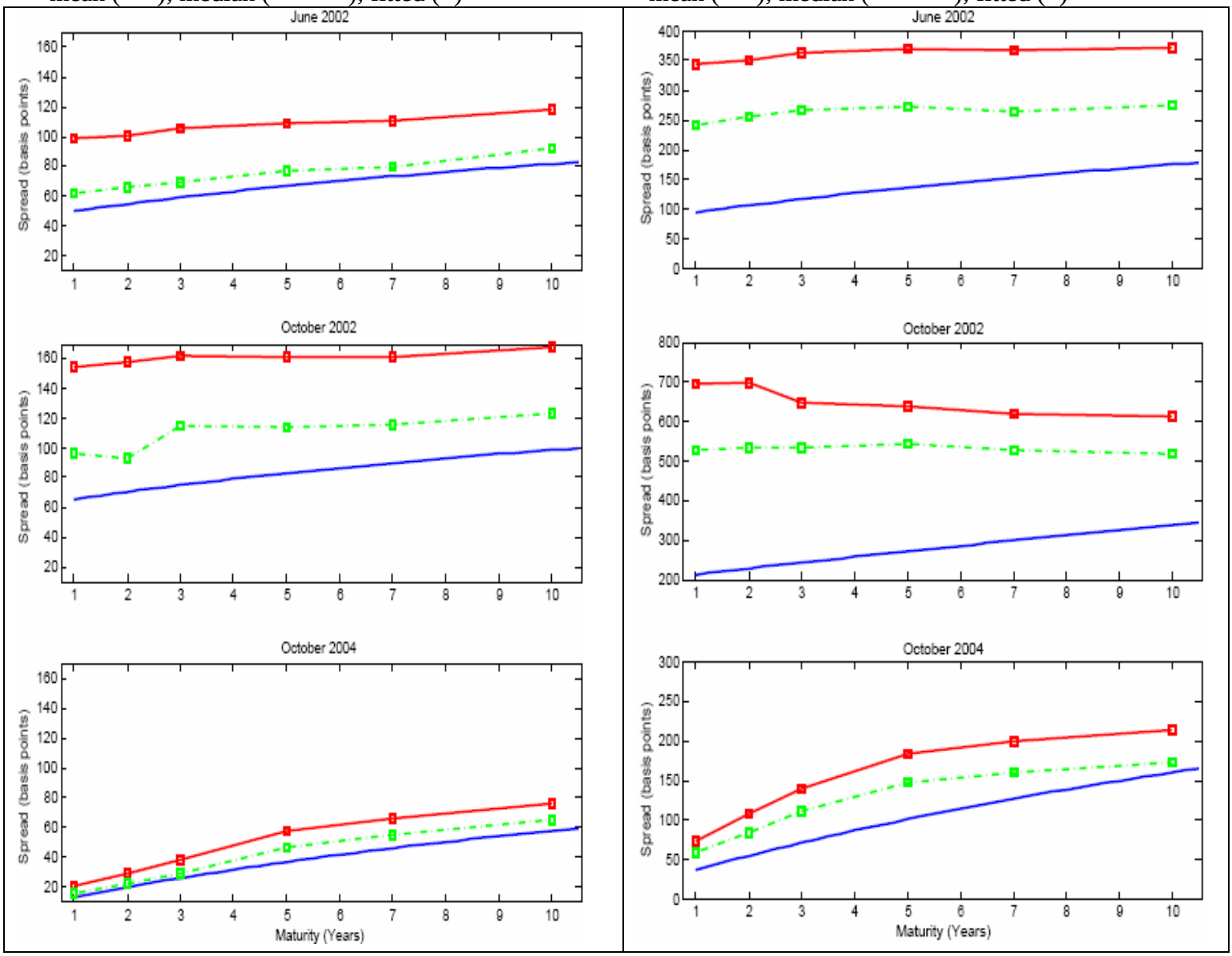
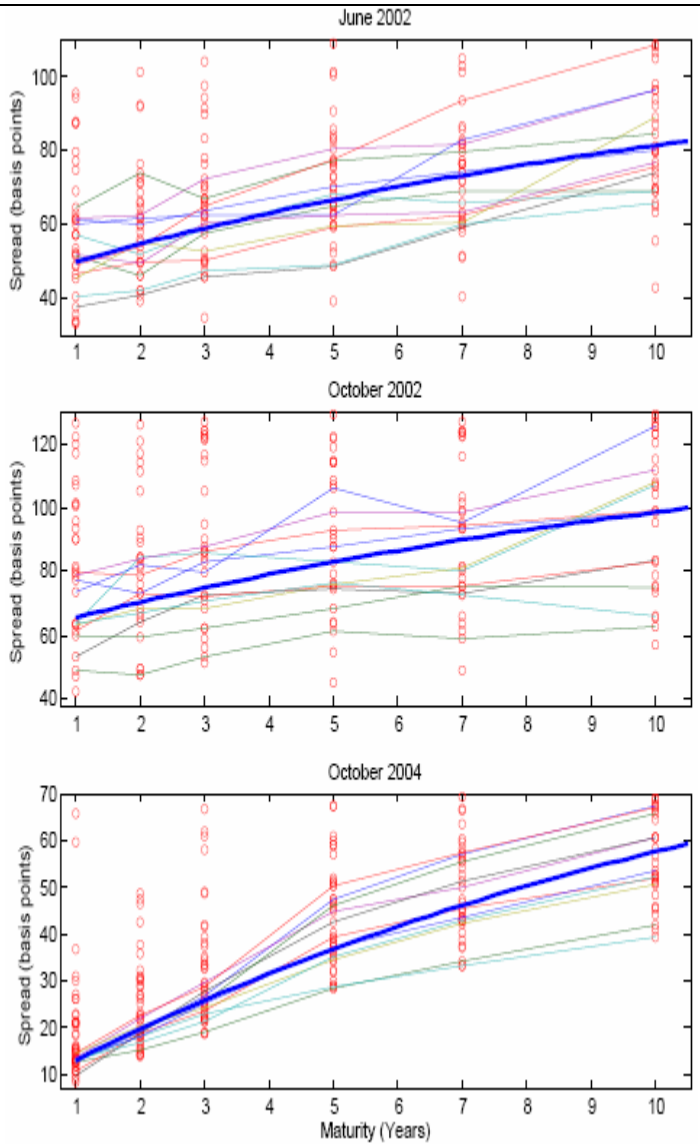


Figure B4. BBB and BB Generic Curves and Individual CDS Curves Comparison

BBB Fitted Generic Curve (thick line) and Individual CDS Curves



BB Fitted Generic Curve thick line and Individual CDS Curves