Results of the 2004 Loss Data Collection Exercise for Operational Risk

May 12, 2005

Federal Reserve System

Office of the Comptroller of the Currency

Office of Thrift Supervision

Federal Deposit Insurance Corporation

This Page Intentionally Left Blank

Results of the 2004 Loss Data Collection Exercise for Operational Risk

I. Introduction

This paper summarizes the operational risk information collected in the recent Loss Data Collection Exercise (LDCE) and in the questionnaire of Quantitative Impact Study 4 (QIS-4). The LDCE and QIS-4 were two studies conducted by U.S. federal bank and thrift regulatory agencies in 2004. The studies were designed to assist the Agencies in evaluating the likely impact of Basel II on minimum regulatory capital requirements.[1] Participation in these studies was limited to institutions with a presence in the U.S. and was voluntary. QIS-4 requested information on both credit and operational risk in two parts, a questionnaire and a series of worksheets. The operational risk questionnaire focused on the methodology used to measure operational risk and the worksheets requested certain operational risk exposure estimates. The LDCE requested information on the internal loss data underlying the QIS-4 submissions. This paper summarizes the LDCE data and the questionnaire information from the operational risk portion of QIS-4.[2] All results in this paper are presented in such a manner as to maintain full confidentiality of respondents.

A total of 27 institutions participated in the two exercises. Twenty-three provided LDCE data and 24 institutions provided an estimate of their operational risk exposure in QIS-4, with 20 institutions providing both types of information. A review of the submissions indicates that progress has been made in operational risk data collection and quantification efforts, but also that certain challenges remain. Regarding loss data, progress is evident from the LDCE by the

[1] Basel II is a new international capital adequacy framework for banking. As discussed in more detail in Section IV, those institutions in the U.S. that plan to use the Basel II framework will be required to use the Advanced Measurement Approaches (AMA) for calculation of operational risk capital.

increase in the number of firms collecting operational risk data over the last five years and by the volume of data submitted by individual institutions. In fact, about half of the LDCE respondents submitted over 1,000 losses of $10,000 or more. However, some institutions report that they are still working towards collecting a complete operational loss data set. Regarding quantification, the QIS-4 questionnaires suggest that while many institutions are developing sophisticated approaches for measuring operational risk exposure, there continue to be significant challenges in implementing a full AMA framework.

Section II of this paper provides background information on the 2004 LDCE and QIS-4. Section III presents results from the 2004 LDCE. This section begins with information on methodologies used to standardize individual submissions, and also provides summary data on the scope of the LDCE. In aggregate, approximately 1.5 million losses were submitted, totaling $25.9 billion. However, there was significant variation in the number of losses submitted by participating institutions. Six respondents provided data for less than 250 losses and four provided data for over 2,500 losses while thirteen institutions provided data for between 250 and 2,500 losses.[3]

Section III also provides information regarding operational loss frequency and severity. We find that the distribution of loss frequency across business lines and event types is quite similar to results from two previous LDCEs, with the highest number of losses occurring in the Retail Banking business line and in the External Fraud and Execution, Delivery and Process Management event types. Loss severity, on the other hand, has varied materially across the three LDCEs, with the 2004 results being dominated by large "Clients, Products, and Business Practices" losses spanning multiple business lines. In the final portion of Section III, we provide

[2] This paper does not address the operational risk data contained in the worksheet portion of QIS-4 as this information is still being reviewed.

some preliminary statistical analyses aimed at understanding the severity distribution of operational losses, the frequency of operational losses as it relates to various measures of firm size, and the expected value of operational losses.

Section IV provides an overview of the responses to the QIS-4 questionnaire. Fourteen of the 24 respondents use an AMA framework, with considerable variation in how they weigh and combine the four AMA elements. Of these fourteen, most use internal data as a direct input to their AMA, and about half use external data as a direct input. Incorporating scenario analysis and qualitative factors directly was not as common with less than half of the institutions using each.

Section V concludes by discussing the challenges that remain with respect to the development and implementation of AMA frameworks at those institutions that participated in QIS-4 and the LDCE.

II. Background

QIS-4 was the fourth quantitative impact study conducted to assess the potential impact of Basel II on regulatory capital requirements. QIS-4 differs from previous quantitative impact studies in several important respects. The previous studies collected information from international banking institutions, while QIS-4 asked for information from U.S. institutions only. Unlike the prior two studies, both QIS-3 and QIS-4 requested some operational risk data. The operational risk portion of QIS-4 consisted of two parts: a worksheet that requested estimates of operational risk exposure and a questionnaire that requested information regarding the derivation of these exposure estimates.

[3] Losses of $10,000 or more.

The 2004 LDCE is the third such exercise in which U.S. banking institutions have participated. The previous two exercises were conducted by the Risk Management Group of the Basel Committee on Banking Supervision, and were conducted on an international basis.[4] The first exercise collected data for the three year period, 1998-2000, for 30 participating banks in 11 countries. The second collected data for the year 2001 for 89 banks in 19 countries.

The 2004 LDCE requested several types of information. First, participating banks were asked to provide detailed data on operational losses underlying their QIS-4 submissions. This information included the date of the loss, the associated internal business line and event type, the loss amount, the amount of insurance recovery (if any), and the internal code of the legal entity where the loss occurred. Second, information was requested regarding whether loss data included only losses exceeding certain reporting thresholds, and whether data exceeding these thresholds were deemed complete. Third, institutions were asked to provide mappings from their internal business lines and event types to the standardized Basel II business lines and event types. Finally, institutions were asked to provide estimates of their operational risk exposure by business line and event type – if this information was readily available.

The 2004 LDCE differed from the prior two exercises in several ways. In the 2004 LDCE, U.S. banking institutions were asked to provide data based on their internally-defined business lines and event types and were not required to submit the data by Basel-defined business lines and event types. In addition, no specific loss threshold was required in the 2004 LDCE while prior studies requested use of a 10,000 USD or Euro threshold. Data collected covered varying time periods rather than a standard time period, as the current LDCE requested

[4] The results of these two studies, QIS-Tranche 2 and the 2002 Loss Data Collection Exercise, were released by the Basel Committee in January 2002 and March 2003, respectively.

all loss data underlying an institution's QIS-4 submission through June 30, or September 30, 2004.

III. The 2004 LDCE

A. Methodology

Twenty-three institutions participated in the 2004 LDCE. All of these participants provided data on individual losses, and most provided information regarding data collection thresholds, data completeness, and business line/event type mappings.[5] All of this information was used in converting the raw data submissions into a consolidated data set suitable for descriptive and statistical analysis.

Given that institutions submitted LDCE data based on their internal data structures, several steps were taken to standardize the data for comparative analysis. First, losses were mapped from internal bank business lines to nine standardized business lines using mapping guidance provided by the respondents. These standardized business lines consist of the eight Basel-defined business lines, and an "Other" category.[6] In cases where banks did not provide mapping guidance, mappings were completed using public information, such as business line descriptions in annual reports and guidance provided by bank examiners familiar with the structure of those institutions. Even with this information, loss data did not necessarily map on a one-to-one basis to Basel business lines either because institutions did not apportion losses across business lines or because there was not sufficient information to complete a mapping. Per the LDCE instructions, losses that were not apportioned across business lines by an institution

[5] Only a few LDCE participants provided estimates of operational risk exposure by business line and event type. It was hoped that these data would allow an evaluation of consistency between loss data and exposure estimates at a business and event type line level. It was also hoped that these data would allow a better understanding of diversification of operational risk among different business lines and event types.

could be submitted using either a "Corporate Center" or "Multiple" business line designation. The majority of institutions submitted losses in at least one of these categories or in a separate "other" category.[7] In this paper, these three types of losses, along with those losses that we could not map to Basel business lines are combined into one business line category, "Other."

Second, internal event types were mapped to the seven Basel event types.[8] Unlike the business line mappings, the event type mappings were more straightforward as most institutions use Basel-defined event types as their internal event types. In this paper we include two additional event types: Other, for event types that did not map on a one-to-one basis to Basel event types, and Fraud, for events for which institutions did not provide a distinction between internal and external fraud.[9]

B. Scope of the LDCE

The 2004 LDCE data are summarized in Tables 1-9. Table 1 shows the varying levels of the loss data collection threshold, which is defined as the minimum dollar amount that a loss must equal to be included in an institution's data. Thresholds ranged from $0 to more than $10,000 across participating institutions. While 17 of the participating institutions used one data collection threshold for their entire organization, six institutions had thresholds that varied by business line, event type, or a combination of the two. Six institutions used a $0 threshold for

[6] The eight Basel-defined business lines are: Corporate Finance, Trading & Sales, Retail Banking, Commercial Banking, Payment & Settlement, Agency Services, Asset Management, and Retail Brokerage.
[7] Some banks also provided information on insurance activities such as underwriting and brokerage. As not all banks participating in this business line provided data and because this is not one of the eight Basel business lines, we present insurance losses in the aggregate data, but do not include them as a separate business line in the tables.
[8] The seven Basel-defined event types are: Internal Fraud, External Fraud, Employment Practices & Workplace Safety, Clients, Products & Business Practices, Damage to Physical Assets, Business Disruption & System Failures, and Execution, Delivery & Process Management.
[9] Aside from reporting institution-specific business lines and event types, institutions reported their loss data in numerous ways. Some reported all positive losses, some reported losses as negative numbers, and others reported a mix of positive and negative losses.

most or all of their business lines and therefore collect data on most or all of their operational losses. These institutions submitted 96.3% of the reported losses and 21.8% of the total dollar amount of losses. In contrast, nine institutions submitted data only for losses of $10,000 or more. These nine submitted 1.5% of the number of losses, but 74% of the total dollar amount. Given this wide range of practice for data collection thresholds, we will focus throughout this paper on losses of $10,000 or more to maintain consistency across institutions.

As shown in Table 2a, the data contain approximately 1.5 million operational losses totaling $25.9 billion from 23 participating U.S. banking institutions. Of the 1.5 million losses submitted, almost 56,000 exceed the $10,000 threshold chosen for data analysis. The first two columns of Table 2a indicate that six institutions reported fewer than 250 losses of $10,000 or more in the 2004 LDCE; five institutions reported between 250 and 1,000 losses of $10,000 or more; and eight institutions reported between 1,000 and 2,500 such losses. The majority of losses were reported by four institutions each with more than 2,500 losses of $10,000 or more. These four institutions submitted 71% of all losses of $10,000 or more, and accounted for 67% of the dollar value of all losses in the 2004 LDCE.

Table 2a also provides a summary of how institutions assessed the comprehensiveness of their internal loss data. For the purposes of this table, an institution's data are considered fully comprehensive if the institution indicated that loss data above its internal threshold were complete for all business lines for recent years. An institution's data are considered partially comprehensive if it indicated that the percentage of losses reported was less than 100% for one or more business lines. Ten banks, or less than half of the LDCE respondents, indicated that the loss data submitted were fully comprehensive, while seven banks indicated that their data were only partially comprehensive. Six banks did not provide information on data completeness. It is

important to stress that Table 2a relies on self-assessments by individual institutions to characterize comprehensiveness, and that each of these institutions may have different internal standards and definitions for completeness.

Table 2b provides the distribution of loss data by year. While all institutions submitted at least one year of data, some provided less than two years while others provided more than five years. Three institutions provided loss data for years prior to 1999. The trend shown in Table 2b suggests an increase in the number of firms collecting operational loss data.

C. Summary Data by Business Line and Event Type

Tables 1 and 2 include all loss data submitted by institutions participating in the 2004 LDCE. However, inspection of the bank-level data suggests that many institutions were not consistently thorough in their data collection over time. This is confirmed by the responses to the data completeness questions, which indicate that most institutions characterize their more recent data as more complete than data from earlier periods. For many submissions, there is an initial period of between one and several years during which data collection is either sporadic, or where the number of reported losses increases with each successive quarter.

To obtain meaningful results regarding loss frequency and loss severity, it is important that the sampling properties of the data be as consistent as possible over time. We thus examined each participating institution's data, and selected only those losses greater than or equal to $10,000 that occurred during a time period over which loss frequency appeared relatively stable.[10] The resulting sample, which we refer to as Sample 1, contains different time periods of data for different institutions. To ensure that aggregate results were not influenced by the use of

[10] The "stable" loss period for each institution represents the time series of contiguous quarters for which there was no extreme changes in the number of losses between quarters.

different time periods, we compare Sample 1 results to those for a sample that uses a consistent time period of data. This sample, Sample 2, consists of a subset of Sample 1 that includes only data from the period 2002-2004. As we find that the two samples yield similar results, the body of this paper focuses on Sample 1. Tables summarizing Sample 2 data are contained in the appendix.

Table 3 provides the average annual number of losses by business line and event type for Sample 1.[11] More than half of the losses (60.1%) occurred in Retail Banking. Within this business line, the majority of losses were attributed to two event types: External Fraud (56.3%) and Execution, Delivery, and Process Management (20.4%). There were relatively few losses in the remaining business lines. Six business lines each comprised 4.5%-8.0% of the loss data, with the smallest number of losses reported for Asset Management (2.4%) and Corporate Finance (0.3%). These results are influenced to some degree by the fact that almost all respondents submitted data for Retail Banking while less than half provided information on Corporate Finance. The business line with the second largest number of losses is the Other category with 8.0% of the total losses. Almost all respondents reported losses that fell within this category, suggesting that classification of losses affecting more than one business line remains an industry challenge.

With respect to event type, External Fraud and Execution, Delivery and Process Management (EDPM) had the largest number of losses per year with 39.0% and 35.3% of the reported losses, respectively. External Fraud losses were primarily in Retail Banking, while a high frequency of EDPM losses occurred in numerous business lines. EDPM had the largest

[11] To obtain the results presented in Tables 3 and 4, we first annualized the loss data for each participating institution separately. That is, we divided an institution's number of losses and total loss amount occurring in each business line/event type category by the number of years of data for that institution, thus obtaining the annualized number of

number of losses for six of the nine business lines. Aside from Retail Banking, EDPM losses were also prevalent in transaction-oriented businesses such as Trading and Sales and Agency Services. This is not surprising, as EDPM events are losses from failed transaction processing events such as data entry errors and loss or damage to client assets. Event types with a comparatively low frequency were Damage to Physical Assets and Business Disruption and System Failures.

Table 4 presents the total loss amount per year across all respondents by business line and event type.[12] The majority of the total loss amount (70.8%) was reported in the Other business line as losses that were not allocated to separate business lines. That these same losses accounted for only 8.0% of annual loss frequency suggests that the industry's loss experience is dominated by a small number of large losses spanning multiple business lines. Indeed, the five largest losses observed in the 2004 LDCE all fall into the Other business line, and together account for between 35% and 65% of the total loss amount of $25.9 billion reported in Table 2a.[13]

Of the eight actual Basel business lines, Retail Banking had the highest share (12.3%) of the annualized total loss amount, followed by Trading and Sales (8.6%). Corporate Finance (0.5%) and Payment and Settlement (0.6%) had the lowest total loss amounts. With respect to event type, 79.8% of the total loss amount per year was attributable to Clients, Products and Business Practices (CPBP), as this event type was associated with the largest amount of losses in six of the eight Basel business lines as well as in the Other category. This category is defined as "an unintentional or negligent failure to meet a professional obligation to specific clients, or from

losses and total loss amounts for that institution. These annualized number of losses and annualized total loss amounts were summed across institutions to obtain the results presented in Tables 3 and 4.

[12] See footnote 11.

[13] The 35% to 65% range is reported to preserve confidentiality of the underlying loss data.

the nature or design of a product." Most of the large, well-known losses that have beset the U.S. financial sector in recent years clearly would fall into this event type category.

A comparison of Tables 3 and 4 suggests that while Retail Banking has the highest number of losses and highest dollar amount of losses, losses in this business line are relatively small. Categories that appear to have more severe losses are External Fraud and CPBP in the Trading and Sales business line, Internal Fraud in Corporate Finance, and CPBP events in Asset Management.[14]

Figures 1-4 compare the frequency and severity data in Tables 2 and 3 to similar data from the previous two LDCEs. These figures provide a comparison by business line and event type. Although the first LDCE covered three years (1998-2000), the figures focus on data collected only for 2000 because the more recent data were thought to be more complete. Data used for the second LDCE is for 2001 as that was the only year for which data were collected in the study. It is important to note that the population of respondents increased for the first two LDCEs, both by number of institutions and countries. The 2000 results reflect the loss experience of 30 banking institutions in 11 countries and the 2001 results reflect the experience of 89 banks in 19 countries. The 2004 results reflect varying time periods of data for 23 U.S. banking institutions. For all three LDCEs, data underlying Figures 1-4 were based on a $10,000 or €10,000 loss threshold.

Figure 1 illustrates that the distribution of loss frequency across business lines is quite similar for the three LDCEs. In all three exercises, the majority of losses reported (approximately 60%) were in Retail Banking, while each of the other business lines had 10% or less of all reported losses. Loss frequency for event types was also fairly stable, except for

[14] Tables A1 and A2 in the Appendix recreate Tables 2 and 3 for Sample 2. As it is evident from a comparison of these tables that Samples 1 and 2 yield similar results, we focus on Sample 1 in our analysis.

External Fraud and EDPM.[15] Both Figures 1 and 2 reflect an increase in the No information/Other category, as this category had an expanded definition for the 2004 LDCE. In the two previous LDCEs, this category reflected only those losses for which no business line or event type information was provided. In the 2004 LDCE, this category also reflects losses that could not be mapped to individual Basel business line or event type categories.

Figures 3 and 4 show that between the three LDCEs, loss severities have been less stable than loss frequencies. It is not surprising that there is greater variation in the severity data, as such variation can result from one or a few large-impact events that would not affect frequency in the same manner. Interestingly, loss amounts for most Basel business lines were lower for the 2004 LDCE, for which the "Other" category comprises 70.8% of total loss amount. This illustrates the extent of loss classification issues, as business line severities would be greater if losses categorized as Other were attributed to specific business lines. In comparing loss severities by event type, there is significant variation across LDCEs in the loss amounts for CPBP with a high degree of severity in the 2004 data. All other event types had relatively lower severity in the 2004 data as compared to the prior exercises.

Table 5 focuses on the frequency of large-impact losses and provides the number of losses greater than or equal to $1 million as a percentage of losses greater than or equal to $10,000. These results are useful as a gauge of large-loss severity (i.e., likelihood of very large losses relative to smaller losses) for individual business line/event type combinations. These results may also be useful in deriving loss frequencies applicable to severity distributions derived from "public" external data, as such data typically have a $1 million loss collection threshold. An important *caveat* regarding this table is that several cells with high percentages of losses

[15] The frequency of both Business Disruption and System Failures and EDPM losses was highest for the first LDCE, which covered the year 2000. It is possible that this result is related to Y2K losses incurred by financial institutions,

above $1 million contain very few actual loss observations (e.g., Agency Services/Internal Fraud with 38.2% of losses above $1 million but only 0.5 losses per year). It may thus be more informative to focus on business line/event type "cells" with a high percentage (10% or more) of losses over $1 million and also a non-trivial annual loss frequency (more than 10 losses per year). The four cells that meet this criteria fall under Clients, Products and Business Practices and relate to the business lines of Corporate Finance, Trading and Sales, Commercial Banking and Other.

D. Insurance Recoveries

Unlike the previous two LDCEs which requested detailed information on insurance and other recoveries, the 2004 LDCE requested one recovery item for each loss: the amount that was recovered from insurance within one year of the loss occurrence. These data are summarized in three columns in Tables 6a-6c for the fourteen institutions that reported insurance recoveries. The first column reports the number of losses with an insurance recovery as a percentage of the total number of losses in the sample. The second column reports the recovery rate, which is defined as the dollar amount recovered as a percentage of the total loss amount for all losses associated with a recovery. The third column reports the dollar amount recovered as a percentage of the total loss amount for all losses in the sample.

The data are presented with the caveat that most institutions submitted less than 100 recoveries.[16] Inspection of institution-level data indicates that the majority of recoveries occurred at a small number of institutions, and the associated losses were for the most part small. It is also important to note that the insurance recovery data are only for those institutions that

---

or at least to a heightened inclination to record such losses when they did occur.

reported recoveries, as it seemed more likely that an institution did not report recovery information rather than that they did not make any insurance recoveries associated with operational losses. As shown in Table 6a, only 2.2% of losses greater than $10,000 (Sample 1) had an associated insurance recovery, compared to 8.4% for all losses submitted. For losses in Sample 1, institutions were able to recover 63.8% of the total loss amount for all losses with recoveries and 5.4% of the total loss amount for all losses. Tables 6b-6c report insurance recovery data by business lines and event type for Sample 1. Commercial Banking and Retail Banking were the two business lines with the highest proportion of losses with an associated recovery (4.0% and 2.9%, respectively). The data contained few insurance recoveries for most other business lines and none for Corporate Finance and Asset Management. With respect to event type, Damage to Physical Assets had the largest number of losses with recoveries (20.8%) and the greatest recovery amount as a percentage of the total loss amount (72.7%). Business Disruption and System Failures was the only other business line with a significant recovery amount as a percentage of total loss amount (69.0%).

E. Analysis of Loss Data

Previous sections of this paper have discussed the structure of the LDCE data, and have provided basic descriptive statistics. In this section, we provide some preliminary statistical analyses aimed at understanding the severity distribution of operational losses, the frequency of operational losses as it relates to various measures of firm size, and the average annual loss amount.

[16] It is not clear whether this low frequency reflects actual experience or difficulties linking recoveries to individual losses.

Throughout this section, analysis will be based upon cross-firm medians rather than on analysis of all loss data consolidated across institutions. The cross-firm median approach was chosen because of its robustness to potential data issues at individual institutions. (That is, even severe data problems at a small group of firms would not grossly distort calculation of the cross-firm median.) The cross-firm median approach also preserves data confidentiality for the four firms that submitted the majority of the individual loss observations. Because the cross-firm median approach does increase sensitivity to variability resulting from small sample sizes at individual firms, we segregated the 23 institutions into two groups according to the number of losses exceeding $10,000. Group 1 contains the 12 institutions that submitted more than 1,000 losses exceeding $10,000, and Group 2 contains the 11 institutions that submitted less than 1,000 such losses.[17]

Table 7a reports percentiles of the loss severity distribution calculated across all business lines and event types. As discussed above, results are reported as cross-firm medians.[18] For example, the 50th percentile of $20,738 for all institutions indicates that eleven institutions had a median loss severity of less than $20,738 and eleven institutions had a median loss severity of greater than $20,738. Similarly, the 95th percentile of $206,492 for Group 1 institutions indicates that six Group 1 institutions had a 95th percentile loss severity of less than $206,492 and six institutions had a 95th percentile loss severity of greater than $206,492. Although the Group 2 severity distribution appears more heavy-tailed than the Group 1 severity distribution, this result may be driven by statistical variation in the Group 2 results as the median Group 2 participant reported only 169 observations.

[17] The 1,000 loss criterion was selected to yield roughly equal numbers of institutions in each group.
[18] For reference, in Tables 3a and 3b in the Appendix, we present this data in a different format, as the percentage of losses within the following severity ranges: $10k-$20k, $20k-$50k, $50k-$100k, $100k-$1 million, and $1million+.

Table 7b reports percentiles of the loss severity distribution calculated separately by Basel business line. Corporate Finance is the heaviest-tailed business line with a 95th percentile of $730,909 – although it should be noted that this result is based on a very small number of observations. Commercial Banking is the business line with the next-highest loss severity, reporting a 95th percentile of $332,927. Retail Banking, Payment and Settlement, and Retail Brokerage are the three Basel business lines reporting the lowest loss severity (at the 95th percentile).

Table 8 considers the relationship between the frequency of losses exceeding various thresholds and three measures of firm size: Total Assets, Tier 1 Capital, and Gross Income.[19] As was the case with Tables 7a and 7b, results are presented as cross-firm medians. Consider the annual number of losses exceeding $100,000 relative to Total Assets. Table 8 indicates that for Group 1, the cross-firm median of this frequency-to-assets ratio is 0.35. That is, the typical (i.e., median) firm experiences 0.35 losses per year exceeding $100,000 for each billion dollars in Total Assets. Table 8 also reports the interquartile range associated with each cross-firm median. The interquartile range is that range of values containing half the firms in the sample, with one quarter of the firms lying below the range, and one quarter of the firms lying above the range.[20] Examination of the interquartile range enables one to assess the consistency of the reported ratios across firms. Continuing with the annual number of losses exceeding $100,000 relative to Total Assets, the interquartile range reported in Table 8 indicates that half the firms in Group 1 report a frequency-to-assets ratio between 0.31 and 0.40. Table 8 also indicates that for Group 1, the

---

In these tables and Tables 7a-7b, for those institutions with cutoffs greater than $10,000, data were adjusted to reflect a $10,000 cutoff based on the distribution of the data for those banks with losses between $10k and $20k.

[19] Total Assets, Tier 1 Capital, and Gross Income are as of 12/31/04. Gross income is calculated as the sum of Net Interest Income and Total Noninterest income, minus Insurance and Reinsurance Underwriting Income and Income from other Insurance and Reinsurance. Due to data limitations for thrifts, gross income for these institutions is calculated as the sum of Net Interest Income and Noninterest Income.

cross-firm median of loss frequency divided by Tier 1 Capital is 6.11 with an interquartile range of 4.20-7.56. In other words, the typical firm experiences 6.11 losses per year exceeding $100,000 for each billion dollars of Tier 1 Capital and half of the firms in Group 1 experienced between 4.20 and 7.56 losses per year exceeding $100,000 for each billion dollars of Tier 1 Capital.

One interesting finding is that the difference between Group 1 and Group 2 results is more pronounced when smaller losses are considered than when analysis is restricted to the frequency of losses greater than $1 million. A potential explanation for this finding is that loss data collection for Group 2 firms tends to be more complete for large losses than for smaller losses. This explanation seems plausible, as very large losses may be recorded in multiple locations, or are more likely to stand out as missing during manual checks for data completeness.

We next consider the average annual total loss reported by participating institutions, scaled to the same three factors: Total Assets, Tier 1 Capital, and Gross Income. Results are presented in Table 9. The first entry in column 1 indicates that for firms in Group 1, the median ratio of the average annual loss to Total Assets is 0.06%. That is, the typical institution in this group has an average loss of $600 per year for every million dollars of assets.

Table 9 also reports interquartile ranges for the ratios of average annual loss to the three scaling factors. These results suggest that there is considerable variability across firms. For example, the Group 1 interquartile range for the average annual loss to Gross Income ratio is 0.5% to 2.86% – so that firms on the high end of the range have ratios approximately six times greater than firms on the low end of this range. One potential source of this variability is that the calculations reported in column 1 are based on data using different reporting thresholds across

[20] More precisely, the interquartile range is defined as the difference between the 25th percentile of a distribution and the 75th percentile.

firms. To correct for this possibility, we consider in Column 2 calculations the average annual loss using only losses of $20,000 or more for all firms. By construction, all of the ratios are lower for Column 2 than for Column 1. For this standardized sample, the interquartile ranges do not appear to be materially narrower in Column 2. This suggests that the variation in the average annual loss is not attributable to different data thresholds. More broadly, one might view the cross-firm variability in the average annual loss as analogous to the variation in loss severity results seen in Tables 3-4 and Figures 1-4. That is, while the relative frequency of operational losses appears to be relatively stable across firms, total loss amounts (and thus average loss amounts) tend to be driven by a few very severe events, and can thus vary significantly across firms with otherwise similar characteristics.

IV. Summary of QIS-4 Operational Risk Questionnaires

This section provides a range of practices for operational risk measurement methodologies, focusing on the Advanced Measurement Approaches (AMA), based on questionnaire responses for those institutions providing an estimate of operational risk exposure in QIS-4. The AMA is one of three operational risk measurement methodologies outlined in the Basel II framework, but the only methodology that is available to U.S. banking institutions.[21] There are four basic elements of an AMA: internal loss data, external loss data, scenario analysis, and business environment and internal control factors.

[21] Non-U.S. institutions can choose to use the AMA or one of the other two approaches, the Basic Indicator Approach or the Standardized Approach. The capital charge under the Basic Indicator Approach is calculated as the average over the previous three years of a fixed percentage (alpha) of consolidated positive annual gross income. The capital charge under the Standardized Approach is calculated as a three-year average of the sum of individual business line charges where the business lines are the eight Basel business lines and capital for each is calculated by multiplying business line gross income by a business line percentage (Beta). Both Alpha and Beta are set by the Basel Committee.

Twenty-four U.S. financial institutions provided estimates of their operational risk exposure in their response to QIS-4. Fourteen of these institutions reported that their capital estimates were derived using an AMA framework based on a stand-alone Loss Distribution Approach (LDA). The remaining ten used a variety of methods, including use of the Basel II Basic Indicator approach. The remainder of this section focuses on those fourteen institutions that reported using an AMA framework, and these institutions are referred to as AMA framework institutions. It is important to stress that the fourteen AMA framework institutions are thus classified only because they reported using an AMA framework to derive their QIS4 operational risk exposure estimates. The classification of these firms (and of the ten other firms as well) should not be interpreted as either a formal or informal supervisory determination regarding AMA compliance.

Most of the AMA framework institutions perform estimation and simulation by the Basel-defined "business lines" (the number of business lines used ranged from less than 10 to greater than 80) and/or risk "event types" (the number of event types used was generally less than 10). In all the number of "units of measurement" (business lines by event type), or cells, ranged from less than 10 to greater than 100.[22] Some of these institutions also performed estimation and simulation by pooling all their loss data together into a single "firm-wide" cell, making the implicit assumption of zero correlation across business lines and event types. Potentially, such assumptions could have a significant impact on the risk exposure calculations. About half of the fourteen AMA framework institutions have developed at least part of their model internally, while some have contracted with specialized vendors for model development and/or analytics.[23]

[22] The unit of measurement refers to the level at which frequency and severity distributions are estimated and simulated. For example, if an institution estimates a separate LDA for each of the seven Basel II event types within each of eight standard Basel II business lines, it will have 56 units of measurement or "cells."

[23] Some information was derived from responses to the LDCE and from the operational risk benchmarking exercise.

Most of the AMA framework institutions utilized internal loss data as a direct input into their quantification model, while a few either used internal data as an indirect input (e.g., using internal data to inform scenario analysis), or did not use internal data. Of the four elements (internal loss data, external loss data, scenario analysis, and business environment and internal control factors), institutions used internal loss data most often. This may reflect a view by management that internal data are the most relevant to their institution's particular business and internal control environment. Management may also hold the view that they have better control over the integrity, accuracy and completeness of internal data, as compared to external loss data for which they must rely upon external sources or vendors.

Most of the AMA framework institutions employed external loss data in their AMA framework. External data were typically included in the model when a specific event type or business line did not have sufficient internal losses in the database to model low frequency, high severity "tail events." About half of the institutions used external data directly in the model, while some used it indirectly, thus influencing the capital calculation via its effect on another element (e.g., scenario analysis), while two institutions did not utilize external data.

Less than half of the AMA framework institutions used data derived from scenario analysis as a direct input to their models. As in the case of external data, scenarios were typically included in the model when internal data for a particular event type or business line were not deemed sufficient. A few institutions that employed scenario analysis for capital estimation also found the process to be useful for operational risk management purposes, as it raised the awareness of operational risk in the institution by drawing information and experience from the other four elements, as well as from subject matter experts.[24]

[24] See footnote 23.

About half of the AMA framework institutions used business environment and internal control factors. Some of them used qualitatively derived assessments such as Control Self-Assessment (CSA) results, scorecards, key risk indicators (KRI), and audit scores as a direct input into the model to adjust their base operational risk capital, while others used these factors indirectly through scenario analysis. More than half of all respondents also used CSA to identify, mitigate and manage operational risk. Not all institutions are currently employing all four elements of the AMA framework, and only a few reported an explicit weighting of the elements that they used.[25]

Most AMA framework institutions reported using the Poisson distribution to model loss frequency, while a few use the Negative Binomial distribution. About half of the institutions use the lognormal or a variation thereof to model the body of the loss severity distribution (typically populated with internal loss data points). The most common choices for modeling the tail of the severity distribution are the Generalized Pareto distribution (GPD) and the Transformed Beta distribution.

Most of the respondents did not report adjustments or scaling of internal or external loss data. A few institutions scale internal loss data for inflation, while some of the institutions that utilize external data directly in the model adjust for inflation, reporting bias, scope, and size.[26] A few of the institutions that employ scenarios scale external data indirectly for size, scope of the business, and control environment. These adjustments are based on expert judgment, although how such expert judgment is applied was not fully described. Scaling the external data used in scenarios could have a significant effect on risk exposure calculations.

[25] For many institutions, combination of the four elements took place as an integral part of their modeling process. Although these processes do implicitly assign weights to each element, it may not always be possible to summarize the weight of each element in a simple manner (e.g., "internal data are given a 50 percent weight").

Most of the AMA framework institutions adjusted their AMA capital for diversification. About half of the institutions stated their correlation assumptions, while some estimated only one loss distribution at the firm-wide level, thus implying a zero correlation assumption. Institutions did not provide empirical support for their chosen diversification/correlation assumptions, as correlation assumptions relied primarily on expert judgment. Potentially, these correlation/diversification assumptions could have a significant impact in the risk exposure calculations.

Most of AMA framework institutions calculated their AMA capital as the sum of Expected Losses (EL) and Unexpected Losses (UL). A few institutions calculated AMA capital on a UL-only basis. These institutions indicated that EL is covered in a variety of ways including: reserves and provisions, pricing, margin income, and budgeting. These institutions also provided numerical estimates of EL, which was calculated as the statistical mean of the loss distribution.[27]

The most common loss data collection threshold reported was $10,000. However, a wide variety of thresholds was observed, with some institutions not applying any data collection thresholds and others applying thresholds in excess of $10,000. For some institutions, the data collection threshold may have been lower than the threshold for the data used as direct input to the quantification model. The lower threshold may have been used by the business units to better manage their processes or to manage at a more granular level.

About half of the AMA framework institutions incorporated capital-reducing effects of insurance coverage in their AMA calculations. However, a significant number of the institutions

[26] Some firms used a reporting bias adjustment to correct for the tendency of external data sets based on news reports to overstate the relative frequency of large operational losses.
[27] A few institutions that reported AMA capital as the sum of EL and UL also provided estimates of expected losses.

that incorporated insurance benefits did so via an *ex-post* adjustment to AMA capital based on broad assumptions, rather than by embedding the effects of insurance into the AMA model itself.

In summary, progress has been made by large, complex institutions in converging towards an AMA framework, particularly in the implementation of an LDA based approach and the requisite four data elements. However, much work remains to be done in ensuring that all the four elements, including relevant credible and objective adjustments, are integrated within the framework. Because of the considerable flexibility that the AMA framework affords institutions in estimating operational risk exposure to meet their specific business and control environments, it becomes very important to achieve transparency by documenting the rationale for assumptions that may have a significant impact on capital calculations such as: loss data threshold(s), correlation, diversification, insurance coverage, and expected losses.

V. Conclusion

In conclusion, we discuss some of the challenges that remain in the quantification of operational risk, and highlight some areas where progress has been made. Overall, half of the institutions submitting an estimate of operational risk exposure reported using an AMA framework, while the other half reported using placeholder methods such as the basic indicator approach.

The QIS-4 questionnaire responses indicate that those institutions that reported using an AMA are still working towards incorporating all of the four data elements into their framework. In particular, significant work remains to incorporate scenario analysis, as less than half of the AMA framework institutions are currently including scenarios in their AMA process. Additional efforts are also needed with respect to incorporating qualitative factors and scaling external and

internal data. And while almost all are using internal data in their AMA, some institutions indicated that they are still working towards collecting a complete operational loss data set. A final and overarching issue of concern is the weight applied to the four data elements within the AMA framework. Wide variation was observed in the weight given to each of the elements, with institutions finding it difficult to describe both the derivation of their weighting scheme and the precise weight given to each element.

Other aspects of the AMA differ across institutions as well, and the impact of these differences needs to be better understood by both the industry and supervisors. Some institutions are calculating their operational risk exposure at a firm-wide level, while others are aggregating exposure estimates that are calculated separately by business line and/or event type. Estimates of diversification benefits are derived from varying methodologies, and there is not yet an industry consensus on either the level of dependence across business lines and event types, or on the appropriate way to model such dependence. Questions also remain about the appropriate method for incorporating an insurance benefit into AMA capital estimates.

Nonetheless, the above challenges should be viewed in the context of significant progress that has been made in quantifying operational risk. With regard to data, the LDCE indicates an increase in the number of institutions collecting internal loss data. Many are building large, comprehensive data sets that could potentially support a meaningful analysis of operational risk exposure. With regard to quantification, a comparison of QIS-4 information with information obtained in last year's operational risk benchmarking exercise suggests a clear increase in the number of institutions with elements of an AMA framework. Overall, the LDCE and QIS-4 should be viewed as important exercises that highlight areas where progress has been made in quantifying operational risk exposure as well as areas where future efforts should focus. The

data collected in these exercises provides additional information that will engender further operational risk discussions between U.S. banking institutions and their supervisors.

Table 1
Loss Data Collection Thresholds Used by 2004 LDCE Participants

Loss Data Collection Threshold	Number of Participants	Percentage of Total Losses	Percentage of Total Loss Value
$0 for most or all business lines	6	96.3%	21.8%
Less than or equal to $1,000 (excluding $0)	4	0.8%	1.0%
$5,000 for all business lines	4	1.3%	3.2%
$10,000 for all business lines	6	0.4%	6.2%
More than $10,000 for some or all business lines	3	1.1%	67.8%
Total	23	100.0%	100.0%

Table 2a
Number of Individual Losses Reported by 2004 LDCE Participants

Number of Losses of $10,000 or More	Number of Participants	Number of Losses of 10,000 or More	Total Number of Losses	Total Loss Amount ($M)	Comprehensiveness of Loss Data[1]		
					Fully Comprehensive	Partially Comprehensive	No Information Provided
0-250	6	640	134,679	212	2	2	2
250-1,000	5	2,253	6,125	283	2	1	2
1,000-2,500	8	13,404	43,814	8,151	5	1	2
2,500+	4	39,469	1,342,147	17,275	1	3	0
Total	23	55,766	1,526,765	25,920	10	7	6

Table 2b
Loss Data by Year (Losses of $10,000 or More)

	Pre-1999	1999	2000	2001	2002	2003	2004[2]
Number of Losses	755	2,079	5,095	7,709	13,653	16,080	10,395
Total Loss Amount ($M)	72	461	341	1,975	5,054	1,960	14,959
Number of Institutions Reporting	3	6	7	13	17	22	21
Number of Losses per Institution	252	347	728	593	803	731	495
Total Loss Amount per Institution ($M)	24	77	49	152	297	89	712

1) An institution's data are considered fully comprehensive if the institution indicated that the loss data above its internal threshold were complete for all business lines for recent years. An institution's data are considered partially comprehensive if the institution indicated that the percentage of losses reported was less than 100% for one or more business lines.

2) 2004 reflects only a partial year as institutions were asked to submit data through June 30, or September 30, 2004.

Table 3
Number of Losses, Annualized
By Business Line and Event Type
Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable

	Internal Fraud	External Fraud	Employ-ment Practices & Workplace Safety	Clients, Products & Business Practices	Damage to Physical Assets	Business Disruption & System Failures	Execution, Delivery & Process Mgmt	Other	Fraud	Total	Percent of Total
Corporate Finance	1.4	2.1	10.9	14.1	0.4		22.6	6.0	1.6	59.1	0.3%
Trading & Sales	4.1	2.5	30.4	35.7	5.8	43.7	**1,204.2**		8.5	1,334.9	7.3%
Retail Banking	***419.8***	**6,218.3**	***690.2***	***810.5***	103.1	39.2	**2,256.7**	126.3	***385.0***	11,049.1	60.1%
Commercial Banking	8.5	***484.1***	31.5	65.4	1.4	5.2	***254.2***	4.0	80.6	934.9	5.1%
Payment & Settlement	96.3	81.4	32.4	6.8	1.8	9.5	***549.3***	1.0	41.7	820.3	4.5%
Agency Services	1.4	6.1	7.0	57.1	1.8	25.8	***829.6***			928.7	5.1%
Asset Management	0.3	47.0	19.2	24.7	0.2	6.6	***335.1***		16.2	449.3	2.4%
Retail Brokerage	11.0	19.0	***254.4***	***606.2***		1.8	***404.1***		36.4	1,333.1	7.3%
Other	76.3	***304.5***	***321.6***	72.6	22.0	3.9	***633.9***	13.0	13.9	1,461.8	8.0%
Total	619.2	7,164.9	1,397.7	1,693.2	136.5	135.6	6,489.7	150.4	583.9	18,371.1	100.0%
Percent of Total	3.4%	39.0%	7.6%	9.2%	0.7%	0.7%	35.3%	0.8%	3.2%	100.0%	

Legend: Cells with more than 1% of losses are bold and italicized. Cells with more than 5% of losses are bold and underlined.

Table 4
Total Loss Amount ($ Millions), Annualized
By Business Line and Event Type
Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable

	Internal Fraud	External Fraud	Employ-ment Practices & Workplace Safety	Clients, Products & Business Practices	Damage to Physical Assets	Business Disruption & System Failures	Execution, Delivery & Process Mgmt	Other	Fraud	Total	Percent of Total
Corporate Finance	11.9	0.2	2.2	25.5	0.0		4.2	0.6	0.0	44.7	0.5%
Trading & Sales	8.5	***100.9***	4.3	***370.9***	0.3	5.0	***238.8***		12.9	741.6	8.6%
Retail Banking	35.9	***237.3***	75.3	***346.8***	8.8	17.8	***316.2***	5.6	22.8	1,066.4	12.3%
Commercial Banking	0.6	60.4	2.8	67.2	0.1	0.2	24.1	0.2	3.5	159.2	1.8%
Payment & Settlement	7.2	10.9	2.1	1.0	0.2	1.9	24.1	0.0	4.1	51.4	0.6%
Agency Services	1.3	0.8	1.6	5.5	0.7	1.5	85.5			97.0	1.1%
Asset Management	0.1	1.6	2.1	***181.4***	0.0	0.7	32.8		0.5	219.3	2.5%
Retail Brokerage	2.2	1.5	28.4	81.0		0.0	22.0		6.0	141.1	1.6%
Other	8.9	25.5	29.6	**5,820.5**	***110.7***	38.1	84.9	3.9	0.5	6,122.5	70.8%
Total	76.6	439.1	148.3	6,899.7	120.8	65.3	832.7	10.2	50.4	8,643.2	100.0%
Percent of Total	0.9%	5.1%	1.7%	79.8%	1.4%	0.8%	9.6%	0.1%	0.6%	100.0%	

Legend: Cells with more than 1% of losses are bold and italicized. Cells with more than 5% of losses are bold and underlined.

Figure 1. Loss Frequency by Business Line Across Three LDCEs

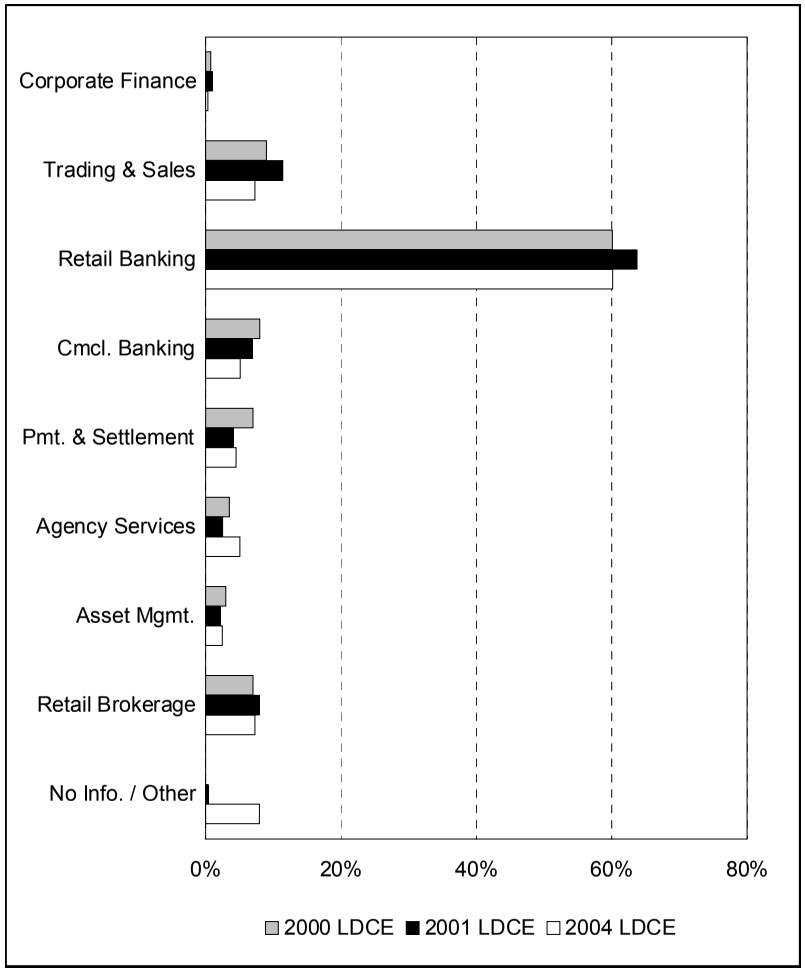
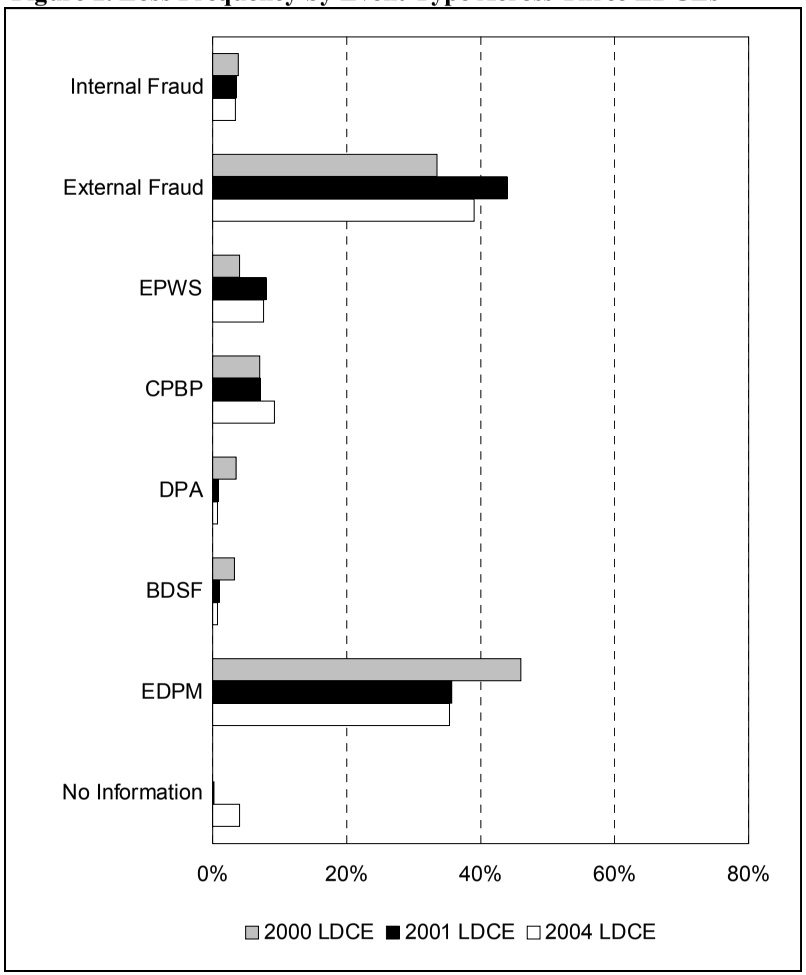


Figure 2. Loss Frequency by Event Type Across Three LDCEs[a]



a) The following abbreviations are used: EPWS denotes Employment Practices and Workplace Safety; CPBP denotes Clients, Products and Business Practices; DPA denotes Damage to Physical Assets; BDSF denotes Business Disruption and System Failures; and EDPM denotes Execution, Delivery and Process Management.

Figure 3. Loss Severity by Business Line Across Three LDCEs

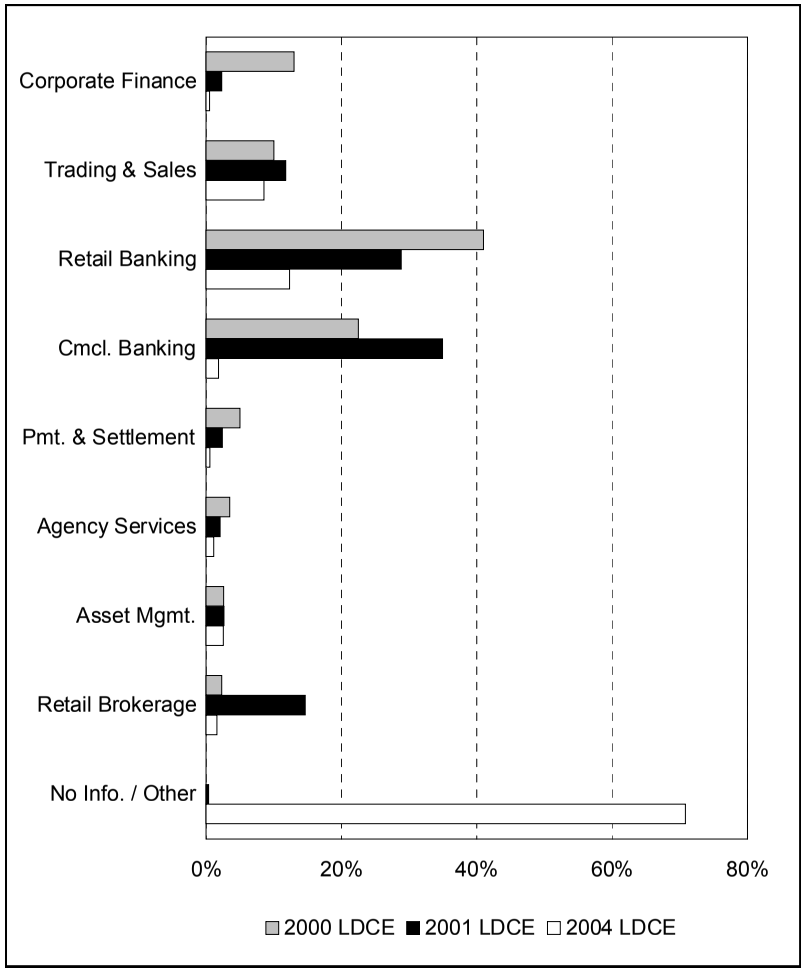
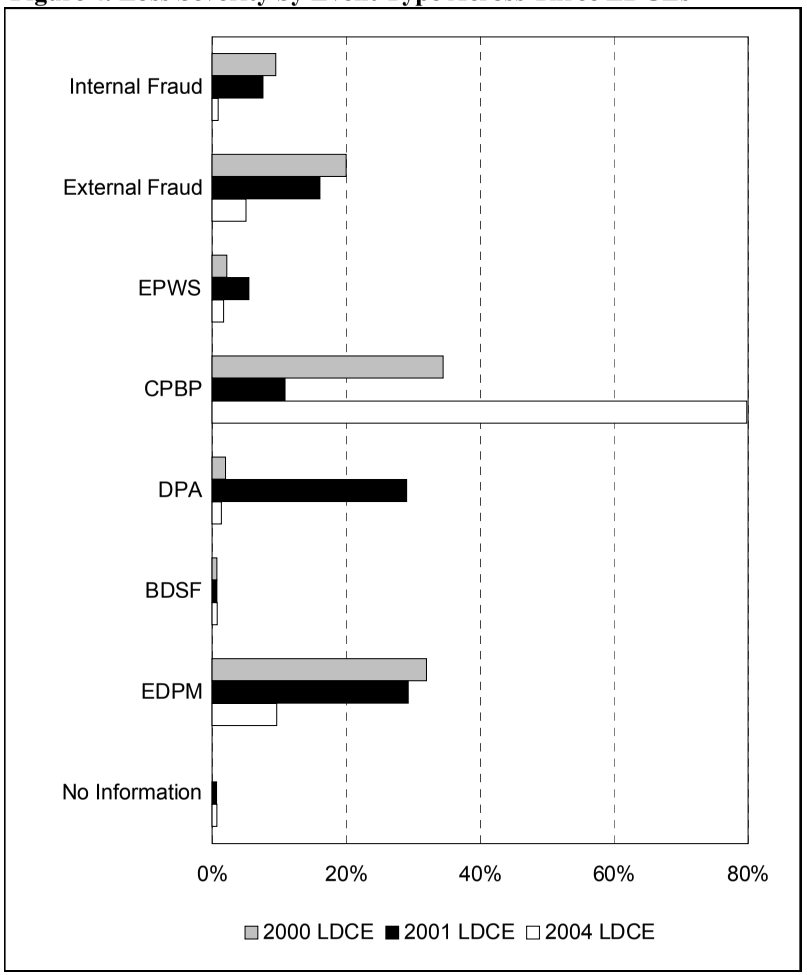


Figure 4. Loss Severity by Event Type Across Three LDCEs[a]



a) The following abbreviations are used: EPWS denotes Employment Practices and Workplace Safety; CPBP denotes Clients, Products and Business Practices; DPA denotes Damage to Physical Assets; BDSF denotes Business Disruption and System Failures; and EDPM denotes Execution, Delivery and Process Management.

Table 5

Percent of Losses ≥ $10,000 that are also ≥ $1Million, Annualized

Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable

	Internal Fraud	External Fraud	Employ-ment Practices & Workplace Safety	Clients, Products & Business Practices	Damage to Physical Assets	Business Disruption & System Failures	Execution, Delivery & Process Manage-ment	Other	Fraud	All Event Types	Number of Losses ≥ $1 Million, Annualized
Corporate Finance	19.1%			21.5%			5.7%			7.8%	4.6
Trading & Sales	16.2%	25.6%		10.7%		2.4%	2.6%		14.1%	2.9%	39.2
Retail Banking	0.7%	0.1%	0.7%	3.0%	2.2%	3.3%	1.5%		0.3%	0.7%	78.7
Commercial Banking		1.2%	1.7%	10.3%			1.5%			1.8%	16.6
Payment & Settlement	0.3%	1.6%				2.8%	0.4%		2.7%	0.6%	5.3
Agency Services	38.2%	5.7%	2.4%	0.6%	10.3%	0.6%	1.3%			1.4%	12.7
Asset Management			0.9%	7.9%			0.9%			1.1%	5.1
Retail Brokerage	2.4%		1.4%	1.2%			0.5%		4.4%	1.1%	15.1
Other	1.4%	0.7%	0.9%	16.7%	3.6%	4.3%	0.9%	2.8%		1.7%	25.1
All Business Lines	1.0%	0.2%	0.9%	3.6%	2.4%	2.2%	1.5%	0.2%	0.8%	1.1%	202.5

Table 6a
Insurance Recoveries, Not Annualized
All Institutions Reporting Recoveries

	Number of Losses with Recoveries as a Percentage of All Losses	Recovery Rate for Losses with Recoveries[1]	Amount Recovered as a Percentage of Total Loss Amount[2]
All Losses	8.4%	59.5%	5.0%
All Losses ≥ $10,000	2.2%	63.8%	5.4%

Table 6b
Insurance Recoveries by Business Line, Not Annualized
Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable
All Institutions Reporting Recoveries

	Number of Losses with Recoveries as a Percentage of All Losses	Recovery Rate for Losses with Recoveries[1]	Amount Recovered as a Percentage of Total Loss Amount[2]
Corporate Finance			
Trading & Sales	0.1%	39.9%	13.6%
Retail Banking	2.9%	68.4%	2.3%
Commercial Banking	4.0%	59.8%	0.5%
Payment & Settlement	0.2%	29.5%	0.2%
Agency Services	0.2%	50.6%	5.0%
Asset Management			
Retail Brokerage	0.0%	52.3%	0.0%
Other	2.1%	77.0%	5.8%

1) The Recovery Rate is the dollar amount recovered as a percentage of the loss amount for all losses with an associated recovery.
2) The Amount Recovered as a Percentage of Total Loss Amount is the dollar amount recovered as a percentage of the total loss amount for all losses in the sample.

Table 6c
Insurance Recoveries by Event Type, Not Annualized
Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable
All Institutions Reporting Recoveries

	Number of Losses with Recoveries as a Percentage of All Losses	Recovery Rate for Losses with Recoveries[1]	Amount Recovered as a Percentage of Total Loss Amount[2]
Internal Fraud	0.9%	62.4%	1.0%
External Fraud	4.2%	72.7%	2.5%
Employment Practices & Workplace Safety	1.9%	79.2%	5.5%
Clients, Products & Business Practices	0.2%	40.5%	1.5%
Damage to Physical Assets	20.8%	75.0%	72.7%
Business Disruption & System Failures	0.3%	82.8%	69.0%
Execution, Delivery & Process Management	0.1%	39.8%	0.8%
Other			
Fraud	0.7%	99.8%	0.0%

1) The Recovery Rate is the dollar amount recovered as a percentage of the loss amount for all losses with an associated recovery.
2) The Amount Recovered as a Percentage of Total Loss Amount is the dollar amount recovered as a percentage of the total loss amount for all losses in the sample.

Table 7a
Loss Severity ($), Not Annualized
Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable
Results Reported as Cross-Firm Medians

	Number of Observations	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Group 1: Institutions Reporting ≥ 1,000 Losses	2,102	13,436	21,277	42,155	206,492
Group 2: Institutions Reporting < 1,000 Losses	169	14,250	20,542	43,614	221,271
All Groups	1,120	13,549	20,738	43,574	221,271

Table 7b
Loss Severity ($), Not Annualized
Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable [1]
Results Reported as Cross-Firm Medians

Business Line	Number of Observations	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Corporate Finance	34	19,176	40,676	167,338	730,909
Trading & Sales	45	14,398	24,505	69,998	245,000
Retail Banking	258	13,568	20,379	39,939	134,356
Commercial Banking	88	13,993	21,906	57,096	332,927
Payment & Settlement	207	14,197	22,118	44,618	183,196
Agency Services	562	14,271	23,142	53,375	279,299
Asset Management	131	14,059	24,756	55,259	248,853
Retail Brokerage	130	17,000	33,356	76,946	207,755
Other	107	13,575	22,588	50,839	169,869

1) Includes all instititions with at least 20 losses in a business line. The data for institutions with cutoffs greater than $10k are adjusted to include an estimated number of losses from $10k-$20k.

Table 8

Annualized Loss Frequencies as a Percentage of Total Assets, Tier 1 Capital, and Gross Income [1]

Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable

		losses ≥ $20k per year	losses ≥ $100k per year	losses ≥ $1M per year
Loss Frequency Divided by Total Assets in $Billions				
Group 1: Institutions Reporting ≥ 1,000 Losses	Cross-firm median	1.76	0.35	0.035
	Interquartile range [2]	(1.53-2.18)	(0.31-0.40)	(0.022-0.046)
Group 2: Institutions Reporting < 1,000 Losses	Cross-firm median	1.23	0.37	0.033
	Interquartile range	(0.91-2.10)	(0.10-0.44)	(0.000-0.038)
Loss Frequency Divided by Tier 1 Capital in $Billions				
Group 1: Institutions Reporting ≥ 1,000 Losses	Cross-firm median	31.19	6.11	0.58
	Interquartile range	(24.58-39.90)	(4.20-7.56)	(0.37-0.74)
Group 2: Institutions Reporting < 1,000 Losses	Cross-firm median	14.31	2.45	0.32
	Interquartile range	(8.40-18.43)	(2.10-4.10)	(0.19-0.48)
Loss Frequency Divided by Gross Income in $Billions				
Group 1: Institutions Reporting ≥ 1,000 Losses	Cross-firm median	37.53	7.17	0.576
	Interquartile range	(28.35-49.90)	(5.27-8.44)	(0.303-0.978)
Group 2: Institutions Reporting < 1,000 Losses	Cross-firm median	26.19	2.74	0.513
	Interquartile range	(13.91-34.98)	(2.16-8.86)	(0.063-0.682)

1) Total Assets, Tier 1 Capital, and Gross Income as of 12/31/04. Gross Income is calculated as the sum of Net Interest Income and Total Non Interest Income, minus Insurance and Reinsurance Underwriting Income and Income from other Insurance and Reinsurance. Due to data limitations for thrifts, Gross Income is calculated as the sum of Net Interest Income and Total Non Interest Income.

2) The interquartile range is defined as the difference between the 25th percentile of a distribution and the 75th percentile. The interquartile range is that range of values containing half the firms in the sample, with one quarter of the firms lying below the range and one quarter lying above the range.

Table 9

Average Annual Loss (AAL) as a Percentage of Total Assets, Tier 1 Capital, and Gross Income[1]

Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable

		AAL Calculated Using All Losses	AAL Calculated Using Losses ≥ $20k
AAL Divided by Total Assets			
Group 1: Institutions Reporting ≥ 1,000 Losses	Cross-firm median	0.06%	0.05%
	Interquartile range[2]	(0.03%-0.13%)	(0.02%-0.12%)
Group 2: Institutions Reporting <1,000 Losses	Cross-firm median	0.03%	0.02%
	Interquartile range	(0.02%-0.05%)	(0.01%-0.03%)
All Groups	Cross-firm median	0.04%	0.03%
	Interquartile range	(0.02%-0.09%)	(0.02%-0.06%)
AAL Divided by Tier 1 Capital			
Group 1: Institutions Reporting ≥ 1,000 Losses	Cross-firm median	0.83%	0.68%
	Interquartile range	(0.48%-2.14%)	(0.38%-1.86%)
Group 2: Institutions Reporting <1,000 Losses	Cross-firm median	0.38%	0.23%
	Interquartile range	(0.28%-0.43%)	(0.11%-0.38%)
All Groups	Cross-firm median	0.48%	0.38%
	Interquartile range	(0.31%-1.21%)	(0.23%-0.82%)
AAL Divided by Gross Income			
Group 1: Institutions Reporting ≥ 1,000 Losses	Cross-firm median	1.00%	0.93%
	Interquartile range	(0.50%-2.86%)	(0.36%-2.79%)
Group 2: Institutions Reporting <1,000 Losses	Cross-firm median	0.51%	0.33%
	Interquartile range	(0.36%-0.66%)	(0.15%-0.42%)
All Groups	Cross-firm median	0.58%	0.41%
	Interquartile range	(0.42%-1.83%)	(0.29%-1.68%)

1) Total Assets, Tier 1 Capital, and Gross Income as of 12/31/04. Gross Income is calculated as the sum of Net Interest Income and Total Non Interest Income, minus Insurance and Reinsurance Underwriting Income and Income from other Insurance and Reinsurance. Due to data limitations for thrifts, Gross Income is calculated as the sum of Net Interest Income and Total Non Interest Income.

2) The interquartile range is defined as the difference between the 25th percentile of a distribution and the 75th percentile. The interquartile range is that range of values containing half the firms in the sample, with one quarter of the firms lying below the range and one quarter lying above the range.

Table Appendix 1
Number of Losses, Annualized
By Business Line and Event Type
Sample 2: Losses ≥ $10,000 Occurring in Years 2002-2004 When Data Capture Appears Stable

	Internal Fraud	External Fraud	Employ-ment Practices & Workplace Safety	Clients, Products & Business Practices	Damage to Physical Assets	Business Disruption & System Failures	Execution, Delivery & Process Mgmt	Other	Fraud	Total	Percent of Total
Corporate Finance	1.2	2.1	11.0	15.0	0.4		23.1	6.0	1.6	60.3	0.3%
Trading & Sales	4.3	2.4	32.5	34.6	5.8	41.7	**1,219.6**		8.5	1,349.4	7.5%
Retail Banking	***413.9***	**6,032.1**	***698.0***	***822.6***	100.5	40.7	**2,230.7**	126.3	***385.0***	10,849.9	60.3%
Commercial Banking	5.5	***484.3***	32.8	61.6	1.6	4.9	***246.2***	4.0	80.6	921.4	5.1%
Payment & Settlement	95.9	80.9	31.8	7.3	1.2	11.8	***500.0***	1.0	41.7	771.6	4.3%
Agency Services	2.2	7.0	9.0	67.2	2.5	28.3	***703.1***			819.2	4.6%
Asset Management		47.2	20.2	27.4		7.2	***317.5***		16.2	435.8	2.4%
Retail Brokerage	10.9	18.3	***256.8***	***610.6***		1.8	***404.3***		36.4	1,339.0	7.4%
Other	70.5	***304.7***	***321.7***	65.3	21.6	3.9	***620.2***	13.0	13.9	1,435.0	8.0%
Total	604.5	6,979.0	1,413.8	1,711.5	133.6	140.2	6,264.8	150.4	583.9	17,981.6	100.0%
Percent of Total	3.4%	38.8%	7.9%	9.5%	0.7%	0.8%	34.8%	0.8%	3.2%	100.0%	

Legend: Cells with more than 1% of losses are bold and italicized. Cells with more than 5% of losses are bold and underlined.

Table Appendix 2
Total Loss Amount ($ Millions), Annualized
By Business Line and Event Type
Sample 2: Losses ≥ $10,000 Occurring in Years 2002-2004 When Data Capture Appears Stable

	Internal Fraud	External Fraud	Employ-ment Practices & Workplace Safety	Clients, Products & Business Practices	Damage to Physical Assets	Business Disruption & System Failures	Execution, Delivery & Process Manage-ment	Other	Fraud	Total	Percent of Total
Corporate Finance	0.3	0.2	2.3	32.0	0.0		4.3	0.6	0.0	39.8	0.5%
Trading & Sales	9.6	***130.0***	4.9	***271.6***	0.3	4.4	***241.4***		12.9	675.1	7.9%
Retail Banking	40.0	***240.7***	78.8	***372.2***	7.6	17.8	***340.0***	5.6	22.8	1,125.5	13.1%
Commercial Banking	0.6	60.2	3.5	72.9	0.1	0.2	25.3	0.2	3.5	166.5	1.9%
Payment & Settlement	7.1	12.0	2.4	0.9	0.2	2.4	21.2	0.0	4.1	50.2	0.6%
Agency Services	2.0	0.2	0.9	6.1	1.0	1.1	79.9			91.2	1.1%
Asset Management		1.6	2.7	***246.7***		0.8	31.0		0.5	283.3	3.3%
Retail Brokerage	2.7	1.5	28.5	81.3		0.0	22.1		6.0	142.2	1.7%
Other	8.9	29.2	32.4	**5,861.9**	1.6	0.3	85.1	3.9	0.5	6,023.7	70.1%
Total	71.3	475.6	156.4	6,945.5	10.7	27.0	850.4	10.2	50.4	8,597.6	100.0%
Percent of Total	0.8%	5.5%	1.8%	80.8%	0.1%	0.3%	9.9%	0.1%	0.6%	100.0%	

Legend: Cells with more than 1% of losses are bold and italicized. Cells with more than 5% of losses are bold and underlined.

Table Appendix 3a
Distribution of Losses by Size of Loss (Not Annualized)
Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable
Results Reported as Cross-Firm Medians

Group	Size of Loss				
	$10k-$20k	**$20k-$50k**	**$50k-$100k**	**$100k-$1M**	**$1M +**
Group 1: Institutions Reporting ≥ 1,000 Losses	46.9%	30.3%	11.1%	9.7%	1.0%
Group 2: Institutions Reporting < 1,000 Losses	47.9%	30.2%	10.9%	10.5%	0.5%
All Groups	47.7%	30.2%	10.9%	10.2%	0.9%

Table Appendix 3b
Distribution of Losses by Size of Loss (Not Annualized)
Sample 1: Losses ≥ $10,000 Occurring in Years When Data Capture Appears Stable [1]
Results Reported as Cross-Firm Medians

Business Line	Size of Loss				
	$10k-$20k	**$20k-$50k**	**$50k-$100k**	**$100k-$1M**	**$1M +**
Corporate Finance	32.0%	20.0%	12.0%	24.6%	4.9%
Trading & Sales	45.4%	31.9%	11.3%	15.6%	1.0%
Retail Banking	49.4%	29.7%	11.5%	6.9%	0.1%
Commercial Banking	43.7%	27.3%	14.3%	11.4%	2.3%
Payment & Settlement	47.7%	30.2%	13.7%	9.2%	0.4%
Agency Services	42.5%	31.3%	12.5%	13.1%	1.2%
Asset Management	39.0%	30.1%	11.5%	10.0%	0.8%
Retail Brokerage	29.3%	32.9%	18.0%	15.3%	0.8%
Other	45.8%	28.4%	12.0%	9.4%	1.4%

1) Includes all instititions with at least 20 losses in a business line. The data for institutions with cutoffs greater than $10k are adjusted to include an estimated number of losses from $10k-$20k.