

Measuring LGD on Commercial Loans: An 18-Year Internal Study

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This article presents findings of and highlights issues associated with an extensive internal loss severity study for the JPMorgan Chase (JPMC) wholesale bank. The recently completed loss given default (LGD) study draws upon 18 years of loan loss history at JPMC for 3,761 defaulted borrowers at its several heritage organizations.

Estimates of LGD are key parameters in a bank's risk-rating system that impact facility ratings, approval levels, and the setting of loss reserves, as well as developing credit capital underlying risk and profitability calculations. LGD can be measured as either the net charge-off rate (accounting LGD), or the present value of cash losses (economic LGD), with respect to the initial book value of a defaulted obligation. Analysis of JPMC's loss history entailed compilation of quarter-end book balances, charge-offs, recoveries of charge-offs, and cash flows for all customers that defaulted in the period 1982-99, with losses determined through 2002. LGD was computed for JPMC as a whole

and was differentiated by business unit, industry group, geographic region, cohort year, and collateral type. Some findings of the study are as follows:

- Overall, the average accounting and economic LGD was found to be 27.0% and 39.8%, respectively. An annual discount rate of 15% was used to compute the economic LGD.
- Differentiation by business unit revealed that while the JPMC Investment Bank (IB) unit's borrowers had an economic LGD of 40.4%, the Middle Market (MM) and Private Bank (PBG) organizations' borrowers had lower economic LGDs of 38.7% and 34.5%, respectively.
- The distribution of LGD was seen to be bimodal, with large concentrations at 0% and 100% and with a high standard deviation (on the order of the mean).
- Economic LGD was found to be lower for secured (40.9%) as compared to unsecured facilities (50.5%) for a large subset of the population.
- The average time to final resolution and the average time a loan remained in a nonaccrual status were computed to be 2.4 years and 1.8 years, respectively, again with significant variability.
- Results by industry and geographic region showed wide variation in LGDs but were deemed not statistically sig-

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nificant enough to be of use other than as rough guidance.

- LGDs for unsecured credits were shown to be well correlated with the economic cycle, while LGDs for secured credits were not.

There have been a number of LGD studies by ratings agencies and academics, but these have been principally focused on large syndicated bank loans, often in the high-yield market. The last comprehensive study describing a bank's internal experience was that of Asarnow and Edwards [3], covering 831 defaults over a 24-year period ending in 1993 and resulting in an LGD of 34.8%.¹

Measurement Issues

Most banks, including JPMC, place loans on a nonaccrual status either on a discretionary basis when payment default is likely or automatically after the loans are 90 days past due principal or interest payment. In a number of cases, this automatic designation resulted from operational errors that needed to be corrected. On occasion, loan payments were credited to the wrong account or loans were renewed without updating maturity indicators. Care was thus taken to cleanse the data to eliminate these operational errors. For example, all “short-lived” nonaccruals (defined as six months or less on nonaccrual with no charge-off) with a subsequent return to accrual status were carefully reviewed. This procedure, which was designed to eliminate spurious defaults, has been consistently applied for all related historical studies, such as the evaluation of loan equivalents and prob-

abilities of default.

Another measurement issue is the treatment of borrowers who default on facilities to lenders other than JPMC. In these relatively few cases, payments to JPMC continued, even when borrowers were in bankruptcy. For the purposes of this study these were not counted as defaults. Since the LGDs of these facilities are zero, including them would result in a lower overall LGD, but a higher probability of default estimate.

Issues of determining exposure amount also arise in the computation of LGD. The aggregation of all defaulted facilities to an obligor was chosen as the unit of observation for the practical reason that in many cases neither the workout process nor JPMC's historical nonaccrual systems allocated charge-offs and recoveries to individual facilities. In addition, all forms of cash flows attributable to a given initial exposure at default—such as payment of back interest, liquidation of collateral, or payments of principal—were included and were not treated differentially. At the same time, all forms of cash outflows, such as additional facilities defaulting and additional advances to a defaulted customer under an existing facility, were incorporated. In these instances the exposure profile during default could be an increasing one, possibly resulting in a discounted LGD being greater than 100%. A size cutoff of \$100,000 in initial balance was imposed to filter out observations of a more retail character.

Both accounting and economic LGD values were determined for each obligor. Accounting LGD is

defined as the net charge-off rate (the sum of charge-offs minus recoveries), while economic LGD is defined as the present value of cash losses. These are both determined relative to the initial book balance. In principle, losses should include all workout costs, and cash recoveries should include any non-cash payments (e.g., equity, warrants, and property). Workout costs were not tracked in this study, but a previous study determined that they add approximately 1% to the Economic LGD. Noncash payments were captured to the extent that they were recorded as recoveries of charge-offs. Economic cash flows are measured based on changes in book balance, coupled with accounting charge-offs and recoveries. A “vulture” discount rate is used to discount these cash flows, as opposed to the original contract rate on the loan or a cost-of-funds rate. The rationale for using a vulture rate is that it appropriately accounts for the riskiness of distressed-instrument cash flows. An alternative to discounted cash flow analysis is to measure the trading value of distressed debt shortly after default [1,4]. However, except for relatively few large corporates, most of the defaulted customers do not have debt that is traded publicly, and even if they did the use of such prices is predicated upon the efficiency of the market for such debt.

Determination of when the workout is finally resolved and no further payment in cash or in kind is received also presents difficult measurement issues. In some cases this period could be rather lengthy. Excluding those observations that were not determined to

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be finally resolved would reduce the number of observations and also result in lagged LGD estimates. Only those customers who defaulted no later than the fourth quarter of 1999 were included as observations in this study. This allowed up to three years, i.e., through the fourth quarter of 2002, for additional charge-offs and recoveries to manifest themselves. Recoveries as well as additional charge-offs likely to be recorded beyond this three-year period needed to be estimated. These adjustments were made based on benchmark profiles of cumulative recoveries and charge-offs over different periods following default.²

There were also a small number of observations with LGDs below 0% (0.5% of observations), partly as a result of gains in asset sales. This feature of the LGD distribution, with a relatively large amount of outliers on both ends of the domain, results in statistical difficulties—in particular, the variance of the LGD blows up. “Windsorizing” the data, or effectively capping and flooring the LGD distribution at appropriately chosen quantiles,³ addressed this problem.

To further analyze the determinants of loss severity, observations were segmented along line of business (LOB), borrower

industry, geographic region, cohort date, and type of primary collateral. The main LOBs were Investment Bank (or “large corporate”), Middle Market (or “regional / small business”), and Private Bank (private high net worth). As there had been a number of reorganizations over this period, historical LOBs were remapped to these designations. A separate LOB presenting special issues is Emerging Markets. Nonaccrual information for Emerging Markets was on occasion incomplete—in some cases loans appeared to be paid off, but in fact the asset was moved elsewhere on the bank’s books, resulting in a possible understatement of LGD.

Recoveries following country-rescheduling events were often arbitrarily allocated to individual loans. In other cases, it was not

Table 1
Summary of Overall LGD Study Results JPMC Resolved Defaults (1Q82-4Q99)

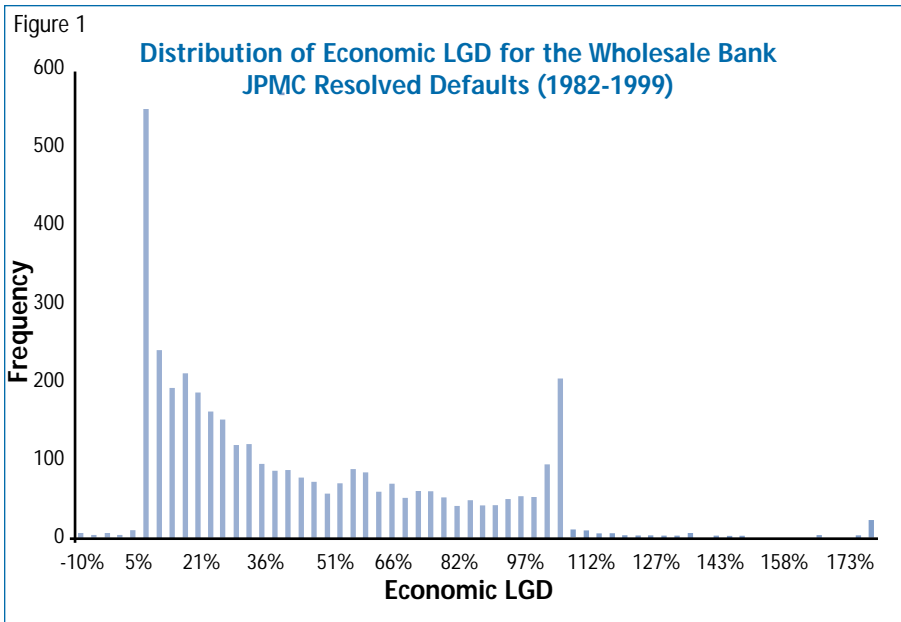
Description	Mean	Standard Deviation
Net Charge-Offs	27.0%	37.9%
Discounted LGD @15%	39.8%	35.4%
Gross Charge-Off Rate	30.8%	37.7%
Time to Final Resolution [Yrs]	2.4	2.3
Time-to-Zero Book Value [Yrs]	1.8	1.6

Table 2
Sensitivity Analysis of Overall LGD JPMC Resolved Defaults (1Q82-4Q99)

Discount Rate	Economic LGD
5%	31.9%
10%	36.2%
15%	39.8%

Table 3
LGD by Business Unit JPMC Resolved Defaults (1Q82-4Q99)

Business Units	Obligor Count	Average Time-to-Resolution (Years)	Net Charge-Offs		Discounted LGD	
			Mean	Standard Deviation	Mean	Standard Deviation
Large Corporates (U.S.)	676	3.33	23.8%	34.2%	41.6%	30.9%
Large Corporates (non-U.S.)	268	2.58	22.9%	33.8%	37.3%	33.2%
Real Estate	719	2.23	29.8%	36.6%	42.0%	33.7%
Emerging Markets	394	3.04	25.8%	39.5%	42.2%	35.6%
Middle Market	1,264	2.15	30.0%	40.4%	40.3%	38.4%
Private Banking	310	1.66	25.4%	40.9%	34.5%	38.3%
Total	3,761	2.43	27.0%	37.9%	39.8%	35.4%



time to zero book value are 2.4 and 1.8 years, with standard deviations of 2.3 and 1.6 years, respectively. The economic LGD was computed using a 15% annual discount rate. Table 2 shows a sensitivity analysis of overall average economic LGD—using a discount rate of 10% or 5% yields averages of 36.2% or 31.9%, respectively. A good argument can be made to vary the discount rate to reflect varying investor yield requirements during different parts of the economic cycle. Figure 1 shows the

distribution of economic LGD to be bimodal, with 0.5% (8%) of observations at 0% (100%) and below (above), highly abnormal with a pronounced positive skew.

Table 3 breaks the results out by business unit, though given the high standard deviations of LGD, these results should be interpreted with care. The highest economic LGDs are seen in Real Estate and Emerging Markets, with respective averages of 42.0% and 42.2%, and the lowest in the Private Bank, 34.5%. The LGD results for Large Corporate (U.S.) and Middle Market are 41.6% and 38.7%, and the average time to resolution is 3.03 years and 2.07 years, respectively.

Table 4 summarizes the differentiation of LGD by industry type. Among those groups having reasonably large numbers of observations, Manufacturing Wholesale (46.8%), Consumer Products (43.7%), and Retail (43.3%) have mean economic LGDs notably above the overall

possible to track loans to resolution, so missing observations added to the thinness of data. For this reason, Emerging Markets data was broken out separately.

Determining whether collateral was received and the categorization of such collateral also raised measurement issues. Our analysis was developed at the obligor level. Collateral, however, is obtained at the facility level. It is thus possible that some facilities to the same borrower were secured with collateral while other facilities were unsecured or had different types of collateral.

JPMC Credit Surveillance Reports (CSRs), prepared when customers near a criticized status (“B”), were consulted to determine whether the exposure was secured and, if secured, the primary collateral designation. CSRs were not available for all defaulted borrowers, as historically they were generally prepared for larger exposures and for those borrowers with more problematic workout

issues. A sub-sample of 1,705 obligors with CSR or collateral information at the time of default was used to differentiate secured vs. unsecured LGD.

It should be noted that management of bank loans is a dynamic process. At origination, the loan may have been unsecured, but somewhere along the workout process collateral is often obtained. To improve the distinction between secured and unsecured LGDs it would be highly desirable to determine when collateral was received.

Results of the Study

The overall results of the study for 3,761 resolved defaults in the period 1Q82-4Q99 encompassing all JPMC heritage organizations are shown in Table 1. The average net charge-off is 27.0%, with a standard deviation of 37.9%, while the average economic LGD is 39.8%, with a standard deviation of 35.4%. The average time to final resolution and the

Table 4

LGD by Industry
JPMC Resolved Defaults (1Q82-4Q99)

Industry	Obligor Count	Net Charge-Offs		Discounted LGD	
		Mean	Standard Deviation	Mean	Standard Deviation
Automotive	29	37.9%	40.2%	52.5%	39.8%
Utilities	20	36.8%	59.1%	49.0%	50.8%
Finance Companies & Lessors	68	34.5%	38.3%	47.1%	38.1%
Energy	102	31.4%	35.6%	46.8%	35.7%
Mfg Wholesale	246	33.8%	42.5%	46.3%	38.4%
Retail	279	32.2%	37.9%	43.3%	34.8%
Metals & Minerals Mfg	44	26.8%	41.0%	42.4%	39.5%
Construction	104	29.8%	38.8%	41.0%	38.5%
Real Estate	864	26.3%	36.0%	38.6%	34.0%
Transportation	98	23.9%	35.1%	38.2%	31.5%
Consumer Services/Entertainment	86	27.7%	38.5%	38.0%	35.9%
Communications	86	21.5%	29.6%	34.4%	29.3%
Other	1,370	23.8%	37.8%	37.5%	34.9%
Total	3,761	27.0%	37.9%	39.8%	35.4%

mean, while Communications (34.4%) and Business Services (35.5%) are markedly below. Finance Companies and Lessors, while having a relatively low sample representation (68 obligors), seem to be significantly above the overall mean economic LGD (47.1%). Energy, with a mean economic LGD of 46.8%, also has a relatively high loss severity, even without including some of the recent large losses. Communications, another sector in which large loss severities of late are not reflected in this data, has mean economic LGD lower than the overall average of 34.4%. Again, while there is clear variability in

average LGD across industries, potential lack of statistical significance in the averages should be kept in mind.

Table 5 differentiates LGD by presence and type of collateral for a sample of the population having CSRs. This sample of 1,705 borrowers has about 75% of the names coming from the 1990-99 period and the rest from earlier periods. The CSR-based 1,705 observations had somewhat higher overall LGDs of 43.3% vs. the remaining non-CSR-based 2,056 observations that had a 36% LGD. In this context, we observe that about 75% had some form of security associated with their

loans and experienced an economic LGD of 40.3%. Unsecured exposures to obligors had, as expected, a significantly higher economic LGD of 50.5%.

Nine buckets of primary (mutually exclusive) collateral types are shown, with the economic LGD ranging from 35.8% for Cash and Marketable Securities to 53.0% for Other. Accounts Receivables and Inventory lie between these, with economic LGDs of 35.1% and 40.9%, respectively; the latter are not distinguishable from the overall average. Mortgages/Liens on Real Property are between these, with an economic LGD of 39.4%. LGD is higher for unsecured as compared to secured exposures and increases as the quality of the security decreases. The magnitudes of LGD for secured suggest sample selection bias (i.e., it seems to be generally higher than the overall sample) and possibly incomplete characterization of collateral types (e.g., one would expect much lower LGDs for cash collateral).

Another issue of concern is the fact that 75% of the CSR sample consists of secured customers, while most of the loans are unsecured at origination. This points to the difficulty in associating an LGD with an unsecured exposure, as a good portion of them will wind up as secured at the time of default. Estimates of LGDs for unsecured loans should take into consideration the likelihood of obtaining security during the workout process.

Table 6 summarizes the LGD by cohort year. The net charge-off rate and economic LGD for 18

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Table 5

**LGD by Categories of Collateral
JPMC Resolved Defaults (1Q82-4Q99)**

Type of Secured Collateral [Primary]	Obligor Count	Net Charge-Offs		Discounted LGD	
		Mean	Standard Deviation	Mean	Standard Deviation
Cash & Marketable Securities	36	23.7%	37.1%	35.8%	33.8%
Nonmarketable Securities	11	15.8%	29.7%	44.9%	54.7%
Accounts Receivable	126	24.3%	34.6%	35.1%	32.4%
Inventory	60	31.9%	34.5%	40.9%	32.2%
Accounts Receivable & Inventory	66	30.9%	41.6%	41.6%	38.6%
Fixed Assets / Machinery & Equipment	71	32.1%	36.8%	42.3%	34.2%
Mortgages / Liens on Real Property	706	25.0%	32.5%	39.4%	31.2%
Blanket Lien	120	33.2%	34.2%	47.2%	32.7%
Other	83	41.4%	48.8%	53.0%	41.8%
Total Secured	1,279	27.7%	35.3%	40.9%	33.4%
Total Unsecured	426	40.3%	42.5%	50.5%	38.1%
Total	1,705	30.8%	37.2%	43.3%	34.6%

the larger number of defaulted obligors in recession years. Note that the volatility of LGD also has a negative correlation with the rate of economic growth. This further implies that the positive correlation of LGD with default rates is accentuated during bad years.

Empirical Analysis of LGD and Default Rates

The preponderance of the theoretical arguments and empirical evidence supports the hypothesis that LGDs, on either individual instruments or for segments of the market, should increase with some measure of the default rate [1,2,5]. In this study, a more refined analysis of the relationship between

years follow the expected pattern with respect to the trend in business cycles over the last two decades. LGDs are higher during recessions (53.5%, 48.0% and

38.7% in the respective years 1989-91) and lower during the expansion periods (24.2%, 21.4%, and 23.2% in the respective years 1995-97). The credit cycle is also reflected in

LGD and the business cycle is presented for bank loan LGDs. Figure 2 shows the average annual LGD for unsecured U.S. large corporate borrowers plotted against the average Moody's All-Corporate default rate for the period 1984-99. Given this segmentation, acceptable correlations between LGD and the state of the economy can be derived, as shown by the following estimated regressions for these 15 data points:

$$LGD = 0.35 + 7.18 \times \text{Default Rate} \quad (0.0001) \quad (0.0556)$$

$$R^2 = 0.25 \quad \text{Adjusted } R^2 = 0.20$$

$$LGD = 1.16 + 0.16 \times \ln(\text{Default Rate}) \quad (0.0001) \quad (0.0069)$$

$$R^2 = 0.44 \quad \text{Adjusted } R^2 = 0.40$$

The coefficients on either the default rate or its logarithm are

Figure 2

JPMC Large Corporate Unsecured LGD vs. Moody's All-Corporate Default Rate (Resolved Defaults 1Q85-4Q99 Annual Averages)

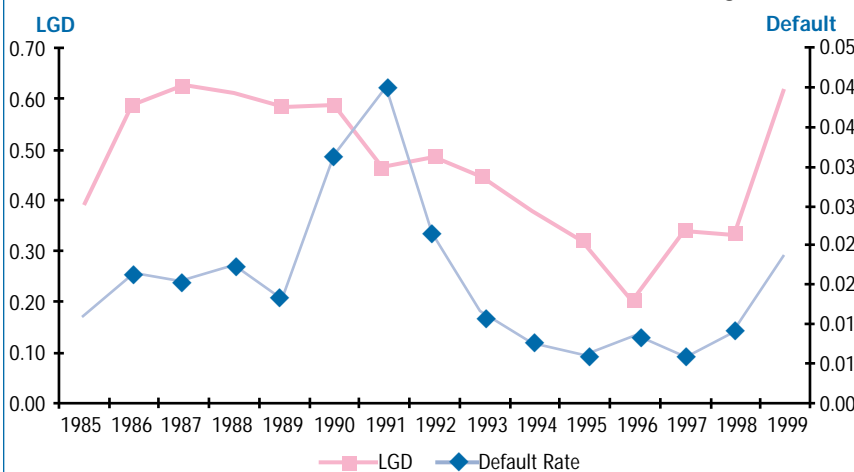


Table 6

LGD by Cohort Year
JPMC Resolved Defaults (1Q82-4Q99)

Year	Count	Net Charge-Offs		Discounted LGD	
		Mean	Standard Deviation	Mean	Standard Deviation
1982	223	34.2%	38.2%	53.3%	30.5%
1983	181	22.0%	35.4%	43.5%	31.3%
1984	144	22.0%	35.0%	41.9%	29.1%
1985	134	26.8%	37.2%	46.0%	33.6%
1986	446	28.1%	42.3%	42.2%	39.4%
1987	281	26.4%	38.8%	39.4%	37.3%
1988	214	31.0%	40.6%	41.9%	37.6%
1989	268	40.3%	40.8%	53.5%	37.5%
1990	352	37.7%	41.5%	48.0%	36.5%
1991	439	27.3%	38.1%	38.7%	35.3%
1992	255	23.0%	32.2%	33.3%	31.9%
1993	167	24.3%	33.5%	33.1%	31.4%
1994	101	11.6%	25.6%	22.7%	25.0%
1995	54	15.0%	29.3%	24.2%	27.4%
1996	131	12.7%	26.4%	21.4%	26.5%
1997	124	14.3%	27.7%	23.2%	26.7%
1998	131	19.7%	32.4%	28.2%	33.3%
1999	116	23.3%	37.6%	30.4%	37.1%
Total	3,761	27.0%	37.9%	39.8%	35.4%

positive and significant in both regressions (at the 10% level at least) and the r-squares are in line with empirical evidence regarding this relationship [1,5]. The relationship is stronger in the log-linear regression as compared to the linear regression with an r-square of 44% versus 25%, respectively. The fitted relationships are illustrated in Figure 3. While these results are broadly in line with

publicly traded corporate bonds at default for the period 1982-2000. The economic variable used in the basic univariate regression is the weighted-average annual default rate in the high-yield market. Used as a regressor, it is able to explain anywhere from 45-60% of the variability in recovery rates, depending upon the model specification. There are several reasons

existing empirical evidence, there are some differences worth noting.

It should be noted that r-squares relating secured exposures to the business cycle for the same period were about 2%, showing virtually no correlation. While values of collateral are expected to rise or fall with economic conditions, this was not observed here.

Altman et al. measure recovery as the market value weighted-average annual recovery of a broad sample of domestic pub-

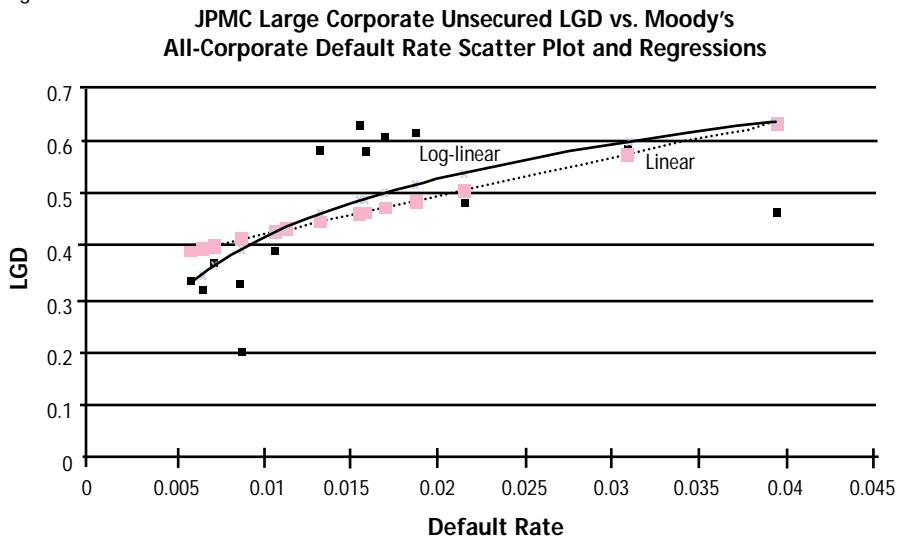
why the relationship here is somewhat weaker. First, bank loan LGDs have greater variability than recovery rates on bonds. Second, there is a more direct connection between the default and recovery rates on bonds in the same high-yield sector, as compared to LGDs for JPMC and the default rate on the entire corporate sector. Finally, it can be argued that discount rates should be more punitive at less favorable points in the cycle, and the absence of such an adjustment serves to reduce the correlation observed in this regression. Hu et al. (2002) perform an analysis of bond recovery and default rates that has greater comparability to what is done here. They look at recoveries on the entire Moody's universe of public bonds, versus the issuer-weighted default rate, at quarterly intervals from 1982-99. The authors obtain correlations ranging between 21% and 31% depending on the model, which is a significantly weaker relationship than recorded here.

Conclusion

Measurement of LGDs for bank loans requires great care in treatment of archival data, particularly if the historical period is to encompass several economic cycles. Consistent definition of default, cleaning up of spurious indicators of default, choice of discount rates, and identification of secured vs. unsecured exposures are critical to the forensic analysis of loss severities. The dynamic character of bank loan management requires tracking of exposure and collateral received throughout the life of a loan. LGDs have high

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Figure 3



volatilities, and LGDs for unsecured loans exhibit relatively high correlation with the economic cycle. These relationships need to be incorporated into the determination of capital requirements for bank portfolios. □

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Notes

- 1 Included in the default definition were loans classified as "doubtful" and the discount rate used was the contractual lending rate.
- 2 Based on the analysis of an early part of the dataset, a charge-off or recovery would be scaled upward by the inverse of the average proportion of total amounts received during the years follow-

ing default. These adjustments were applied to approximately 8% of the observations.

3 This was done at the .01 and 99.99 percentiles, resulting in bounds of -10% and 176%, respectively.

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