"The Quantification and Trading of Credit Risk"

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Session III: The Value of Diversification in Credit Portfolios

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Note: The views expressed are those of the speaker and do not necessarily reflect those of the Federal Reserve Bank of San Francisco or of the Federal Reserve System.

What is the value of diversification in credit portfolios?

Quite clear from finance theory and actual practice that diversification within credit portfolios is valuable

Questions:

- How valuable?
- What is the marginal benefit of diversifying?
- How can we measure this value?

Where might this be relevant?

- credit portfolio management

- model selection: When is our modeling good enough?

  GARP (1999) response document: (http://www.garp.com)

  "Sometimes very simple [credit] models can be as successful as sophisticated models. The selection of the model depends on the particular problem and the various constraints of the environment in which the model will operate."

- regulatory capital requirements: How comprehensive?

  Current BIS capital proposal:

  (http://www.bis.org/publ/index.htm) (Doc. #50: A new capital adequacy framework)

  "The trade-off between the current straightforward, but simplistic, approach and the potentially greater accuracy and coverage that could result from the use of internal ratings systems has to be carefully evaluated..."

What factors impact the value of diversification?

We generally know that:

- Debt portfolios are harder to diversify than equity portfolios.

- Marginal benefit of one more asset to a well-diversified portfolio is much less than to a concentrated portfolio.

So, the degree of diversification for a credit portfolio will depend on several factors:
(Carey (2000); http://www.nber.org/papers/w7629)

- size of the portfolio
- number of obligors in the portfolio
- loan size distribution / concentration in specific obligors
- concentration by country
- concentration by industry
- issues of maturity

- variation over time

Campbell *et al.* (2000): (http://www.nber.org/papers/w7590)
From 1962, a noticeable increase in firm-level volatility relative to market volatility; accordingly, correlations among stocks have declined; number of stocks needed for given level of diversification has increased.

Bottom line: It is a challenge to measure credit diversification.

How might we start to measure the value of diversification?

Discussion here is focused on structural models because of the intuitions derived from equity portfolio diversification; reduced form models should follow similar thinking

Benchmarks of portfolio value for comparison:
- no correlation (i.e., all credits are independent)
- perfect correlation (worst case scenario; no diversification)

We can begin by varying the correlations within our model and comparing the results with the benchmarks.

Qualitative comparison:
ISDA on contingent credit risk: (http://www.isda.org/baselcaf.pdf)

low/medium/high designation of correlation based on country and industry; round numbers like 30%, 50% and 100%

Quantitative comparison:
More realistic assessment and used widely in actual practice

See the 1998 Federal Reserve study & the 1999 BIS study on current practices in credit risk modeling
(http://www.federalreserve.gov:80/boarddocs/press/General/1998/19980529/study.pdf)
(Document #49; http://www.bis.org/publ/index.htm)

See also the 2000 joint study by IIF & ISDA

How might we conduct quantitative comparisons?

- comparison of alternative models' output to actual outcomes

  Sobehart *et al.* (2000): measures for individual assets
  (http://www.moodysqra.com/research/crm/53621.asp)

  Lopez & Saidenberg (2000): methods for evaluating models' forecasts of credit loss distributions
  (http://www.frbsf.org/econrsrch/workingp/wp99-06.pdf)

  Caveat: these "backtesting" methods perform best with more time-series data than is usually available for individual bank analysis.

- stress tests = evaluate models' output under extreme unfavorable changes; provides insight and evidence on the model's internal consistency and realism

- scenario analysis = evaluate models' output under previously experienced or plausible scenarios

- sensitivity analysis = explore how models perform in response to incremental changes in risk factors, assumptions, parameters, etc.

Bottom line: Firm's value depends on management decisions

It is up to management to decide how much effort to put in, how complex a model they want, to what purposes will it be use (internal pricing, risk management purposes, etc.)

What is the regulatory challenge?

Individual firms can decide that they want to do internally, but the regulators have a more difficult challenge.

Regulators' concerns:

- comparability of results across banks
- consistency of capital charges across banks
- systemic risk concerns

What do we find in practice across banks? Heterogeneity.

IIF/ISDA study: "[T]he magnitude of the change in outputs based on a change in correlation assumptions demonstrates that these models are highly sensitive to this factor. This indicates that banks should take great care when estimating correlation for credit risk measurement purposes."

IIF report: "... differences in the approach to valuation and correlation calculation methods were the key drivers of discrepancies in outputs among the publicly available models."

ISDA report: "It is important to note however that the risk distributions associated with some types of assets are likely to have shorter tails than the distributions associated with corporate assets (reflecting different levels of portfolio diversification)."

GARP response: "Each institution's model should be expected to come up with different results given the difference in underwriting standards, risk appetite and credit culture at each institution. Model results are different because no two banks share the same portfolio constitution."

So, how do regulators value diversification? Very carefully.

First pass: Current BIS capital proposal

Recent work by Gordy (2000) shows that a risk-bucketing approach assumes that the credit risk of all assets in all buckets is driven by a single systematic risk factor.

That is, no diversification benefits.

Second pass? Possibly criteria for modeling diversification.

- correlation between credit changes across obligors
- correlation between credit changes and loss given default
- correlation between credit changes and exposure size
- correlation between recovery rates

In the end, the burden of proof will be with banks; they will need to justify their diversification assumptions based on sensitivity analysis and other empirical work.

Without a doubt, the regulatory response to the value of diversification will rely on the other pillars of the proposed capital framework.

Pillar I: Minimum capital requirements

Pillar II: Supervisory review of capital adequacy and internal assessment processes

"The framework stresses the importance of management developing internal capital assessment processes & setting capital targets that are commensurate with bank's risk profile & control environment."

Beginning to take shape:

"Principles for the Management of Credit Risk" (Doc. #54, 7/99)
"Range of Practice in Banks' Internal Ratings Systems" (Doc. #66, Jan. 2000)
"Assessing Capital Adequacy in Relation to Risk at LCBOs & Others w/ Complex Risk Profiles" (SR99-18)
(http://www.bog.frb.fed.us/boarddocs/SRLETTERS/1999/SR9918.HTM)

Pillar III: Market oversight

"Effective market discipline requires reliable and timely information that enables market participants to make well-founded risk assessments."

Again, beginning to take shape:

"Best Practices for Credit Risk Disclosure" (Doc. #53, 7/99)
"Sound Practices for Loan Accounting and Disclosure" (Doc. #55, July 1999)
"Improving Public Disclosure in Banking" (Federal Reserve Staff Study #173; February 2000)
(http://www.bog.frb.fed.us/pubs/staffstudies/173/ss173.pdf)

Conclusion

That diversification in credit portfolios is of value is accepted.

Now, the next challenges:

- better and clearer measures of the value of diversification

- better and clearer internal practices by firms to clarify and simply their decisions on their desired degree of diversification

- better and clearer guidance from regulators on capital rules and the role of diversification within them

- better and clearer communication between firms, their regulators and the marketplace on this issue

Wharton 2000 conference on "The Quantification and Trading of Credit Risk"

Session III: The Value of Diversification in Credit Portfolios

(15-20 minutes of "distilled wisdom" on backtesting & evaluation of credit risk models)

Pretty clear from theory that diversification is valuable a priori

insights from Duffee memo? as add instruments, overall portfolio variance increases, but less so per unit

But by how much?

How much benefit?

Debt portfolios are much harder to diversify than equity portfolios.

The degree for any particular portfolio will of course depend on things like size, number of obligors, concentration by obligor, country, industry, maturity, etc. (see Carey NBER paper)

We know that the marginal benefit of adding one more asset to a well-diversified portfolio is much less than a concentrated portfolio.

So, important factors in the value of diversification are:
size of the portfolio (see Carey NBER paper?)
previously existing assets
granularity
country concentration
industry concentration

even variation over time

Campbell, Lettau, Malkiel and Xu (2000):

"Over the period 1962-97, there has been a noticeable increase in firm-level volatility relative to market volatility. Accordingly, correlation among individual stocks and the explanatory power of the market model for a typical stock have declined, while the number of stocks needed to achieve a given level of diversification has increased."

GARP response: "Many of the issues Basle raised involve sophisticated mathematics or finance. The cost of greater accuracy is usually more effort and more sophistication. However, one should not misinterpret the discussion of sophisticated mathematics or finance as an endorsement of complicated models. Sometimes very simple models can be as successful as sophisticated models. The selection of the model depends on the particular problem

and the various constraints of the environment in which the model will operate."

Very hard to measure.

How might we start to measure it?

Discussion focused on structural models because of similarities to portfolio diversification; reduced form models can follow similar thinking (see IIF/ISDA trial)

Typically, think of diversification as permitting decreased risk/unit as add more instrument, even if overall portfolio risk is increasing; it is increasing at a decreasing rate

Benchmarks:
no correlation (i.e., no diversification because of independent factors)
unit correlation (i.e., no diversification because all perfectly related; worst case scenario)

a). Qualitative assessment

ISDA approach for differentiating levels of correlation (FOR HAIRCUTS):
low/medium/high designation based on country and industry

fixed at round numbers such as 30%, 50% and 100%

b). If enters portfolio diversification through valuation, then can see differences between assuming no correlation (ignoring it), perfect correlation and bank's assumptions.

(see Fed 1998 study)

- long time-series / backtesting:
GARP response: "The difficult in measuring non-independence (i.e., correlation) stems from instability. For example, the correlation matrix usually reflects historical (typical) correlation between risk factors. The conditional correlation might be very different."

- Sobehart et al. from Moody's: measures for individual assets
Marc & my method: resampled portfolios used to evaluate credit loss distribution forecasts

more realistic / actual practice:
Basle Committee on Banking Supervision: Credit Risk Modelling: Current Practices and Applications (#49; April 1999; http://www.bis.org/publ/index.htm)

ISDA document:

Federal Reserve System Task Force on Internal Credit Risk Models, 1998. "Credit Risk Models at Major U.S. Banking Institutions: Current State of the Art and Implications for Assessments of Capital Adequacy." Manuscript, Board of Governors of the Federal Reserve System. (http://www.federalreserve.gov:80/boarddocs/press/General/1998/19980529/study.pdf)

- stress tests = value portfolios under extreme unfavorable changes; provides insight and evidence on the model's internal consistency and realism; how choose?

scenario analysis = value portfolios under experienced scenarios or potential scenarios

- senstivity analysis = process of exploring how a model's predictions change in response to an incremental change in one or more risk factors, assumptions, parameters or input on economic and market conditions; assists with how changes in model assumptions or the variables' values affect the credit losses

Firms' response

and it is up to the firm to decide how much effort to put in and how they want to model and use it for internal pricing and risk management purposes

Correlation first, diversification second:
Pre-specified views on correlation / degree of diversification

Diversification first, correlation second:
"Empirical" or menu-driven choice of diversification / capital charges

Regulators' response

For regulatory purposes, the issue is harder.

Firms can decide that they want to do internally, but systemic risk concerns make the supervisory decision different.

No. 50, A new capital adequacy framework, (E), June 1999 (http://www.bis.org/publ/index.htm)

The Accord should continue to promote safety and soundness in the financial system; continue to enhance competitive equality; constitute a more comprehensive approach to addressing risks; focus on internationally active banks, although its underlying principles should be suitable for application to banks of varying levels of complexity and sophistication

Bev group: "bring as much consistency as possible among the capital charges derived by various institutions; what degree of comparability is necessary to achieve a workable regulatory capital regime and at what cost will this comparability be obtained?"

What is the regulatory line on diversification? see the Basel proposal

Bucketing approach downplays diversification, but only for the sake of simplicity. Accurate modeling of diversification and correlation are highly valued.

IIF report based on studies of multiple modeling systems used by 25 commercial banks from 10 countries for a range of different types of credit risk exposure: "When standardized assumptions are relaxed and banks use their own assumptions in their proprietary models, significant differences in outputs should be expected to, and do, result."

> "Some differences in model outputs also can be attributed to differences in the analytical engines used in models and in versions of the same model. In particular, differences in the approach to valuation and correlation calculation methods were the key drivers of discrepancies in outputs among the publicly available models."

ISDA report: "Significantly, the (index cell for the proposed capital requirements) was created by a small set of ISDA member banks using their internal models on typical portfolios of corporate bonds and loans, reflecting the banks' large size, geographic reach and multiple business lines. The index therefore takes account of diversification, as measured by banks in relation to corporate portfolios. It is important to note however that the risk distributions associated with some types of assets are likely to have shorter tails than the distributions associated with corporate assets (reflecting different levels of portfolio diversification)."

GARP response to credit risk modeling paper: “Each institution’s model should be expected to come up with different results given the difference in underwriting standards, risk appetite and credit culture at each institution. Model results are different because no two banks share the same portfolio constitution.”

IIF/ISDA study: “[T]he magnitude of the change in outputs based on a change in correlation assumptions demonstrates that these models are highly sensitive to this factor. This indicates that banks should take great care when estimating correlation for credit risk measurement purposes.”

“For example, industry classifications differ across countries and the correlation between equity returns for specific industry segments differ as well. Specifically, KMV and CreditMetrics each derive correlations from industry classifications based on asset or equity returns as well as specific risk factors. Thus, the modeling results varied in the exercise due to differences in industry definitions in different models.”

How can regulators measure the value of diversification? Why should they permit this for a specific bank? Can they measure it? What would it take for regulators to feel comfortable with diversification modeling? Allude to Bev's working group

How handle correlation across default, LGD and LEQ, for example?

Bev group: "accounting for variance in and correlation between state-transition probabilities, credit exposures in a given state (ex., linked to common risk factor such as oil price) and asset valuations (ex., recovery rates may be correlated across credits; correlated credit spreads) in a given state as well as correlations between these factors (ex., credit quality and exposure,)."

"In the end, the burden of proof must clearly be placed on banks to justify their parameter assumptions. Simple assertions that 'correlations are assumed to be zero' or that 'the impact of this assumption is minimal on the final result' must be backed by sensitivity analysis and other empirical work"

"a bank would be expected to demonstrate that its approach is theoretically sound, empirically supported and is appropriate for its business lines"

6. Correlations between Credit Events

B. Cross-Correlations between Different types of Credit Events

At least in theory, across different bank customers, one might expect to observe significant correlations among

(a) default events/rating migrations,
(b) LGDs and
(c) exposures.

For example, the financial condition of firms in the same industry or within the same country may reflect similar factors, and so may improve or deteriorate in a correlated fashion.

Similarly, for firms within the same industry, LGDs, as well as exposures due to drawdowns of credit lines, may tend to increase (decrease) relative to their long-run averages in periods when the average condition of firms in that sector is deteriorating (improving).

Specifically, correlations between defaults/rating migrations and LGDs, between defaults/rating migrations and exposures and between LGDs and exposures are typically assumed to equal zero.

According to the Task Force's findings in virtually all credit risk models the only correlation effects considered at present are the correlations between defaults/rating migrations of different customers.

D. Key Issues

The assumptions and approximations used in estimating default correlations highlight various conceptual and empirical questions, including:

(a) whether the choice of risk factor distribution functions, e.g. normality or gamma, makes a material difference to model output;

(b) whether the technical approximations introduced have a material impact; and

(c) whether the default correlations generated by the different models are within the same range, result in a correct correlation structure, and are stable over the planning period.

No. 50, A new capital adequacy framework, (E), June 1999 (http://www.bis.org/publ/index.htm)

No. 55, Sound Practices for Loan Accounting and Disclosure, (E), July 1999
No. 54, Principles for the Management of Credit Risk, (E), July 1999
No. 53, Best Practices for Credit Risk Disclosure, (E), July 1999

Link to regulatory pillars, especially 2 on supervision and 3 on market oversight; see ISDA document

Pillar 2: supervisory review of an institution's capital adequacy and internal assessment process. "The second pillar of the framework, the supervisory review of capital adequacy, will seek to ensure that a bank's capital position and strategy is consistent with it overall risk profile and strategy and, as such, will encourage early supervisory intervention if capital does not provide a sufficient buffer against risk." "The new framework stresses the importance of bank management developing an internal capital assessment process and setting targets for capital that are commensurate with the bank's specific risk profile and control environment."

Pillar 3: "Effective market discipline requires reliable and timely information that enables market participants to make well-founded risk assessments."

Conclusion

better and clearer risk measures to permit easier determination of the value of diversification

better and clearer decision process by firms; provide consistency of practice; better determination of the value of diversification and facilitate decision-making

better and clearer decision by regulators on purposes of capital regulation

better and clearer communication between firms, regulators and the marketplace to facilitate individual and aggregate value of diversification