Insuring versus Self-Insuring Operational Risk: Viewpoints of Depositors and Shareholders

MICHEL CROUHY, DAN GALAI, AND ROBERT MARK

MICHEL CROUHY
is head of research and development at IXIS Corporate & Investment Bank in Paris.
mcrouhy@ixis-cib.com

DAN GALAI
is the Abe Gray professor at the Hebrew University and a principal of Sigma P.C.M. in Jerusalem, Israel.

ROBERT MARK
is chief executive officer of Black Diamond Inc. in La Fayette, CA.

Operational risk refers to low-frequency, high-severity, events that threaten the solvency of a bank and contribute to the tail of its loss distribution. Operational risk is unlike market and credit risk; by assuming more of it, a financial firm cannot expect to generate higher returns. Operational risk destroys value for all claimholders.

To mitigate operational risk, a bank can improve its controls, upgrade its infrastructure and redundancies, or buy insurance against its operational risk exposure. None of these alternatives comes for free. The cost associated with each should be compared to the benefit of reducing the frequency of operational risk events and the loss when an event occurs.

Under what conditions and terms should a bank buy insurance against an operational risk exposure? There are certain issues related to conflicts of interest in a bank between shareholders and depositors, and between them and regulators.

With full implementation of the new Basel Capital Accord, commonly known as Basel II, by 2007, operational risk mitigation will assume considerable importance. Basel II defines operational risk as the potential for loss due to the failure of people, processes, or technology as well as external dependencies.[1]

Some of these risks, such as trading losses due to fraud or losses due to a computer system failure, terrorism, vandalism, earthquakes, fires and floods, can be insured, thus reducing the uncertainty faced by a bank. Other types of operational risk can be reduced by improving internal control processes and implementing redundancies in business recovery plans. Computer breakdowns, for example, can be mitigated by investing in backup computer systems.

We address the fundamental question as to the conditions and terms under which a bank should buy insurance against an operational risk exposure. Insurance is not necessarily good for a bank, as it may destroy value if it is too costly. There is a trade-off between the cost of insurance and capital allocation against such risk. There should also be a concern that the new regulation does not produce an incentive to overinsure if banks are allowed to recognize the risk-mitigating impact of insurance in the measurement of regulatory capital due to operational risk. In the final version of Basel II, the recognition of insurance mitigation is still limited to 20% of the total operational risk capital charge.

Our approach can be applied to much broader operational risk problems than the one we examine here. We specifically ask whether a bank should buy insurance against a loss due to any type of operational event, but the methodology can also address a question such as:

Operational risk from a particular source (e.g., IT failure, rogue trader) creates a probability x of incurring a loss of L_x in the next year. Instituting new controls (e.g., backup computer system, larger surveillance staff) will

reduce this risk to a lower level y or reduce the loss, if it occurs, to some value L_y. Should the bank take that action?

The same kind of conflict of interest between depositors and shareholders arises with this more general risk management problem.

I. WHO BENEFITS FROM INSURING OPERATIONAL RISK?

A major factor distinguishes operational risk from both market risk and credit risk. By assuming more market risk or more credit risk, a bank expects to earn a higher rate of return on its capital—there is a trade-off between risk and expected return.

By assuming more operational risk, however, a bank does not expect to earn higher returns. Operational risk destroys value for all claimholders—the less operational risk in a firm, the better off all claimholders are.

At the same time, trying to reduce the exposure to operational risk is costly. A bank, for example, can install a better IT system with more security devices, and also a backup system. By doing so, it reduces the risk due to system failure but at the cost involved in taking these measures. While there is no economic incentive to increase operational risk, there is a question as to whether the bank should mitigate operational risk, and at what cost. Should it spend resources to reduce its exposure to operational risk?

There is an inherent conflict of interest in a bank between the shareholders and depositors, and between them and the regulators (particularly the deposit insurance authorities). When a bank buys insurance against, say, the failure of a computer system, who is hurt by the payment of the insurance premium, and who benefits from the protection?

The alternative to insurance is self-insurance, which saves the payment of the premium, at the cost of a potential failure with a low probability. The issue is even more complicated when the cost of insurance is taken into consideration, compared to its actuarial benefit.

The issue of optimal insurance against an operational risk event (ORE) is more complex in a bank than in an industrial company. In an industrial company the equityholders' point of view is the dominant factor in making investment decisions. In a bank, the equityholders' interests are not necessarily the dominant ones; the regulators also try to act to protect depositors' interests.

Obviously, depositors benefit the most from a bank's purchase of insurance when deposits are uninsured, but are they willing, ex ante, to bear the cost? Do shareholders have the incentive to buy insurance against an exposure to operational risk whose cost cannot be passed through to the depositors?

Both depositors and shareholders are hurt by the occurrence of an operational risk event. There is no reward to bearing operational risk, so depositors and shareholders both have an incentive to avoid this risk. But if the avoidance of an ORE is costly, there can be a conflict of interest between shareholders and depositors, as the depositors benefit the most from insurance while the shareholders might be better off assuming the risk.

Depositors are interested mainly in the liquidity and immediacy of service provided by the bank. They are willing to sacrifice some return (compared to the return on short-term default-free bonds) by depositing money in a bank account. In return, they expect to benefit from immediacy so that they can settle transactions right away at low cost.

In many countries, formal deposit insurance is unavailable. And in the United States thousands of banks are uninsured. According to information from the Federal Deposit Insurance Corporation, the FDIC supervises about 5,300 banks and savings banks, just over half of the institutions in the banking system.

Our point remains valid in the case of insured deposits. First, even with deposit insurance the compensation to depositors in failed banks is not necessarily immediate. Second and more important, the conflict is now between the bank's shareholders and the insuring institution. The deposit insurance company obviously benefits from the bank purchasing insurance against operational risk—but who should bear the cost?

II. EXAMPLE OF OPERATIONAL RISK EVENT

To illustrate the problems, we posed a question to groups of bankers, bank directors, and MBA students specializing in finance and banking in France, Israel, South Africa, India, and Switzerland. The question was as follows:

> *A bank has assets valued at \$100 million, expecting to yield 10% with certainty. There is a 1% chance that a computer crash will cause \$50 million of damage (i.e., at the end of the year the bank's assets are \$110 million with 99% probability, and 60 with 1% probability).*[2]
>
> *The bank can purchase insurance against this potential damage at a cost of \$1 million.*

Do you recommend purchasing the insurance?
Yes ☐ *No* ☐

Among bankers and directors of banks, 60% to 80% responded that they would purchase the insurance against such an ORE at a cost of $1 million. (Note that the expected, or actuarial, loss is only half a million dollars.)

How should a bank's managers approach such a question and decide on the maximum premium they will be willing to pay for the insurance? While the question is simple, the answer is much more complicated because it must be related to a clear objective function, to the capital structure of the financial institution, and to economic parameters such as interest rates, which are the basis for determining the alternative cost of self-insurance. A related issue is whose objective should be considered: that of the shareholders or of the depositors?

III. NUMERICAL EXAMPLE

To solve a numerical example we make some assumptions. As in the questionnaire, the bank with initial total assets of A = $100 million expects a yield on its assets R = 10% per year (which can be considered the risk-free equivalent rate of return on its loan portfolio). The risk-free rate on government T-bills is r = 8% per year. Depositors prefer to deposit their money in the bank at a lower yield than T-bills, under the assumption that deposits are (almost) riskless, and provide liquidity, i.e., depositors can convert deposits to cash at will, with no loss of value. In our numerical example, we assume that depositors are willing to receive d = 7% annually with certainty and with perfect liquidity.

Hence, for depositing D = $90 million, with present economic value of $D_{PV} = D\ (1 + d)/(1 + r)$ = $90(1.07/1.08) = $89.17 million, the depositors are willing to pay $D - D_{PV}$ = $90 – $90 (1.07/1.08) = $90 – $89.17 = $0.83 million for immediacy.

The bank promises depositors $D\ (1 + d)$ = $90(1.07) = $96.3 million, and shareholders are expected to have a future value of $S_1 = A\ (1 + R) - D\ (1 + d)$ = $13.7 million after one year.

With a potential loss to the bank of L = $50 million, the issue is what management can do in order to retain the deposits. Exposing depositors to the operational risk event means they have a 1% chance of receiving only $A\ (1 + R) - L$ = $60 million in one year rather than the promised $96.3 million.[3] If the bank opts to self-insure the ORE, this means that depositors, who are now exposed to risk, will require ex ante a higher interest rate, d^*, in order to keep their deposits in the bank.[4]

We denote by Q the risk-neutral probability of no ORE, and by $(1 - Q)$ the risk-neutral probability of the ORE. Using the binomial valuation model, we can then calculate the required rate on deposits, d^*, that fully compensates depositors for the risk they incur when the bank self-insures the ORE.[5] d^* is such that the discounted (risk-neutral) expected value of deposits exposed to operational risk (the right-hand side) is equal to the present value of deposits under conditions of certainty and immediacy:

$$D_{PV} = \frac{D(1 + d^*)Q + (A(1 + R) - L)(1 - Q)}{1 + r}$$

so that:

$$d^* = \frac{D(1 + d) - [A(1 + R) - L](1 - Q)}{DQ} - 1 \qquad (1)$$

For example, if Q = 0.99, then d^* = 7.41%, and the value of equity, S_0^{SI}, for the self-insurance case is:

$$S_0^{SI} = \frac{[A(1 + R) - D(1 + d^*)]Q}{1 + r} \qquad (2)$$

In the numerical example:

$$S_0^{SI} = \frac{[\$100(1.1) - \$90(1.0741)]0.99}{1.08} = \$12.22 \text{ million}$$

Now we can determine whether it makes economic sense for the shareholders to purchase insurance at a cost of I = $1 million. Paying the insurance premium, I, upfront reduces the value of the bank's assets to $A - I$ = $99 million, with expected future value of $(A - I)(1 + R)$ = $99 (1.1) = $108.9 million.

By purchasing insurance, depositors are guaranteed to be fully paid $D\ (1 + d)$ = $96.3 million, at a rate d = 7%. The value of equity with insurance at the end of the year is $S_1^I = (A - I)(1 + R) - D(1 + d)$ = $108.9 – $96.3 = $12.6 million with certainty, so the present value of equity is:

$$S_0^I = \frac{S_1^I}{1 + r} = \frac{(A - I)(1 + R) - D(1 + d)}{1 + r} \qquad (3)$$

i.e., $12.6/1.08 = $11.7 million in our numerical example. This value should be compared with the value of equity

EXHIBIT

Required Deposit Rate and Maximum Premium Acceptable to Shareholders

Q	d^* (%)	I^* ($ M)
0.99	7.41	0.4545
0.98	7.82	0.9091
0.97	8.25	1.3636
0.96	8.68	1.8182

for the self-insurance case, which is S_0^{SI} = $12.22 million (for Q = 0.99). Under these conditions, shareholders should prefer self-insurance rather than paying a $1 million insurance premium.

IV. MAKING THE INSURANCE DECISION

The example supports a procedure as follows for making the insurance decision (given Q):

1. Find the required deposit rate d^* such that depositors are indifferent between certainty at rate d, and the uncertain payoff due to the ORE [Equation (1)].
2. Given d^*, calculate the present value of equity for the self-insurance case, S_0^{SI} [Equation (2)], and compare it to the value of equity for the case of purchasing insurance at a premium I, S_0^I [Equation (3)]. If $S_0^{SI} > S_0^I$, the shareholders will opt for self-insurance. If $S_0^{SI} < S_0^I$, the shareholders will buy insurance.
3. We can find the I^* that equates S_0^I to S_0^{SI}. This I^* is the maximum insurance premium acceptable to shareholders, given Q:

$$I^* = \frac{L(1-Q)}{1+R} \tag{4}$$

I^* is such that the expected loss due to the operational risk event is equal to the opportunity cost for the bank of reducing the asset amount by the insurance premium. It is independent of the promised rate on deposits. I^* does not depend on whether depositors are at risk or not. When the loss relative to an ORE is relatively small compared to the equity of the bank and does not affect the amount paid to depositors, I^* is still defined by Equation (4); only the rate paid by the bank on deposits is affected by the operational risk facing depositors. It can be shown that d^* can be written as a function of I^*.

The Exhibit shows the required deposit rate d^* for self-insurance and the maximum premium acceptable to shareholders, as a function of Q.

Given the insurance premium, I, for high values of Q (low probability of the ORE), the shareholders will opt for self-insurance. For low values of Q (high probability of the ORE), the required deposit rate increases, and so does the maximum insurance premium to maintain the indifference between the two alternatives. For Q = 0.99, shareholders are willing to pay no more than $454,500. But if Q = 0.97, the insurance premium can be more than $1.3 million, and still be acceptable to the shareholders.

From observing the differences among deposit rates across banks, particularly the differences between large and small banks with the same credit ratings, one can try to infer $1 - Q$, the risk-neutral probability of the ORE. Loss estimates are derived from both internal loss data and external data (either public data or pool industry data) when relevant. In the next stage one can infer the implied cost of mitigating operational risk.

V. CONCLUSIONS

The question of purchasing insurance for a bank is very important, especially with the introduction of regulatory capital requirements for operational risk in Basel II and the partial recognition of the risk-mitigating impact of insurance. The issue is to avoid purchasing insurance that may destroy equity value (compared to other alternatives such as better controls or self-insurance).

The solution to the problem is non-trivial and requires, among other parameters: information on the capital structure of the bank, the operational risk loss, the expected return on the assets, and the risk-neutral probability of the ORE.

ENDNOTES

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[1]See Crouhy, Galai, and Mark [2003].

[2]This hypothetical is more than fiction. In June 2004, the Royal Bank of Canada (RBC) computer system was paralyzed for a week due to a programming error in a program update. The fallout from the programming error included 10 million RBC customers who couldn't be sure of their account balances for days and a large number of people left waiting for pay deposits and other transfers. RBC had more than 150 people working on the day shift and close to 100 people on the night shift for a week to fix the problem and restore the data. One can see that while the probability of such an event is very low, the cost for RBC and the damage to its reputation is quite great.

[3]Here we assume that the size of the loss is such that when an ORE occurs the depositors will be affected and won't receive the full promised payment.

[4]This example assumes that deposits are not insured as is the case in many countries and for about half of the banks in the U.S. In the U.S., large bank deposits are insured by the FDIC. Interest paid on insured deposits is the risk-free rate less the liquidity premium that depositors are willing to pay for immediacy, i.e., 7% in our numerical example, whatever the risk that the bank will go bankrupt. When deposits are insured, the cost of bankruptcy is shifted from the depositors to the FDIC, and the fair insurance premium, which compensates the deposit insurance company for the risk of default it incurs, is equivalent for the shareholders to the risk premium paid to the depositors when the deposits are not insured (see Crouhy and Galai [1991]). In other words, our conclusions on the economic rationale for insuring operational risk would remain the same if the proposed framework assumed insured deposits.

[5]We assume that the risk-neutral probability of the ORE is given, and it is also assumed to be the same as the real-world probability.

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