Draft: 29 November 2002

The New Basel Accord and Capital Concessions

Christine Brown and Kevin Davis

Department of Finance
The University of Melbourne
Victoria 3010
Australia

christine.brown@unimelb.edu.au
kevin.davis@unimelb.edu.au
Fax: 61 3 8344 6914

The New Basel Accord and Capital Concessions

Abstract

The new Basel Accord proposes an incentive, by way of a lower minimum capital ratio, for banks judged to have acceptable advanced risk management systems and which are thus to be regulated under the advanced (internal ratings based) rather than standardised approach. This paper investigates the case for such a proposed capital concession to such banks, and demonstrates circumstances under which it may be warranted. A methodology for estimating the appropriate size of capital concessions, which reflects the cost of implementing advanced risk management systems (in order to qualify for the concessions) and the value of deposit insurance, is presented – and illustrative estimates provided. The paper also considers briefly why capital concessions have been proposed rather than the alternative of adjustment to deposit insurance premiums.

1. Introduction

The Basel Capital Accord introduced in the late 1980s meant that banks have to use relatively more equity (or other capital), and less deposits, in funding assets assigned higher regulatory risk weights. The New Basel Accord (Basel 2) allows for risk weights assigned to various asset classes and customers to vary depending on whether the bank undertaking the lending is regulated under the standardised or the advanced approach. Moreover, Basel 2 proposes the introduction of different minimum capital requirements for banks, with an incentive, by way of a lower minimum capital ratio, for banks judged to have acceptable advanced risk management systems.

This paper focuses upon important issues raised by the proposal for regulatory capital incentives for adoption of advanced risk management techniques. First, we consider the question of why lower capital requirements might be adopted for banks adopting advanced risk management techniques. We note that adopting such techniques is a costly exercise, but with potential competitive advantages. Hence, it would seem necessary to argue that there is some form of market failure which leads to socially suboptimal adoption strategies. Using an option theoretic framework, and an assumption that deposit insurance or government guarantees exist and mean that taxpayers are at risk from bank failures, we illustrate conditions under which such incentives may be justified. Second, drawing on the option theoretic approach, we attempt to provide some (preliminary) quantitative illustrations of what size incentives might be warranted[1]. Third, we consider the question of whether capital requirement concessions are the only method of achieving the goal of inducing more rapid adoption of advanced risk management techniques. We note that similar results could be achieved through appropriate calibration of risk based deposit insurance premia, but note that complications associated with the institutional relationships between regulatory and insurance agencies may preclude such an approach.

In the following section we provide a brief description of the Basel Capital Accord(s) by way of background and to outline the stated motivation behind the proposed

[1] Ongoing work, to be reported in a subsequent version of the paper, attempts to calibrate such estimates to more appropriate figures for the costs associated with implementing such advanced systems.

capital concessions. Then, in section 3, we use a simple option pricing framework to analyse the possible effects on bank and regulatory risk of the introduction of advanced risk management systems, and illustrate circumstances under which capital concessions could be justified. In section 4 we apply the option pricing framework to estimate the size of capital concessions necessary to provide incentives to bank adoption of advanced systems, and consider the potential effects on competitive neutrality. In section 5 we consider the question of why incentives should be provided by way of regulatory capital concessions rather than through adjustments to deposit insurance premiums. Section 6 provides a summary and conclusions.

2. Regulatory Capital and the Basel Accord(s)

Primarily in response to the steady erosion of bank capital ratios, in the mid 1980s the Basel Committee for Banking Supervision, operating under the auspices of the Bank for International Settlements, began establishing a set of capital adequacy requirements for internationally active banks. In 1988 the current accord was established with a focus on regulations governing minimum levels of capital for credit risk. Under this Accord assets (and certain off-balance sheet transactions) are assigned risk weights which are designed to reflect the relative credit risk of those assets (or transactions). Credit risk was the primary focus of the 1988 Accord; a capital requirement for market risk was introduced in an amendment to the Accord in 1998. Nevertheless, it was understood that the resulting capital assessments for credit and market risks contained sufficient buffers to guard against other risks, including operational risk.

However, the existing Accord does not provide for regulatory capital requirements that accurately reflect the risks associated with portfolios or operations of individual banks or the banking system as a whole. In January 2001 the Bank for International Settlements issued a proposal for a new Basel Capital Accord (Basel 2) that is to replace the 1988 Accord. The new framework's focus is primarily on internationally active banks but its broad underlying principles are suitable for banks of varying levels of complexity and sophistication.

Basel 2 consists of three mutually reinforcing pillars: (i) minimum capital requirements, (ii) a supervisory review process and (iii) effective use of market discipline. Minimum capital requirements are set under Pillar 1 for credit risk, market risk and operational risk. Interest rate risk in the banking book is monitored under Pillar 2, the supervisory review process.

A central objective of the new framework is to make regulatory capital requirements more consistent with assessments of economic capital made by banks. In order to calculate capital requirements for credit risk, banks may adopt one of three approaches. The standardised approach is the simplest and closely resembles the approach under the current Accord; the aim was to construct a more risk-sensitive standardised approach that on average broadly left the required minimum capital unchanged for internationally active banks. The other two approaches to calculating regulatory capital for credit risk are based on banks using their own internal risk models to calculate the capital charge. The first of these is the Foundation Internal Rating Based (IRB) approach which requires a probability of default (PD) to be calculated for each grade from the bank's internal rating system. IRB risk weights are then derived to achieve adequate coverage of both expected and unexpected credit losses, taking into account a loss given default (LGD) factor, which is standardised for the Foundation IRB Approach. A maturity adjustment factor (M) and a granularity adjustment factor (G) modify the calculated risk weights.[2] Finally the capital charge is calculated using exposure at default (EAD) and the derived risk weights. The main difference between the Foundation and Advanced IRB Approaches is that the Advanced Approach allows the bank to used internally derived LGD factors.

It is anticipated that the IRB framework will produce a closer alignment of regulatory and bank assessments of economic capital across different customers. The lower capital charges that will likely result from use of the IRB framework provide an incentive for banks to improve systems and modelling for credit risk measurement. Indeed, the argument advanced for capital incentives for banks with systems which qualify for use of the IRB approach is one of "incentive compatability". This does,

[2] The maturity adjustments reflect the fact that longer maturity loans require greater economic capital. The granularity adjustment reflects the fact that idiosyncratic credit risk diminishes as the loan portfolio becomes more diversified or 'finer-grained".

however, raise the question of why capital incentives are needed. If banks, by adopting such systems, are better able to assess the risk of customers they will be able to more accurately price loans and capture “good” business. Intuitively, it could be expected that market forces will drive banks to optimally adopt advanced systems where the perceived benefits exceed the costs. It may be that regulators perceive that banks are myopic and do not adopt improved techniques rapidly enough, or that there are social benefits (such as lower risk of systemic failure) from adoption which are not considered in the private cost benefit calculations of bankers. The validity of these largely subjective judgements are difficult to assess. However, as we demonstrate later, there is one more objective consideration: some part of the benefit from adoption may accrue to the regulator/taxpayer because of the existence of deposit insurance or guarantees of bank deposits.

Supervisors in all member countries expect banks to operate above the minimum capital ratios laid down in the 1988 Accord.[3] Jackson, Perraudin and Saporta (2001) consider what current levels of capital imply for financial stability and to what extent they form binding constraints on banks. They conclude that minimum capital requirements under the current Accord imply a one-year survival probability of between 99.0% and 99.9% (depending on the quality of the corporate loan book used in the calculation). However internationally active banks maintain economic capital at a level that implies a solvency rate that is higher than 99.9%. The authors conclude that maintaining minimum regulatory capital levels at the same standard as under the 1988 Accord will not impose constraints on banks as they already operate on higher economic solvency levels than those implicit in the current regulatory minimum.

Using the Advanced or Foundation IRB Approach will lead to regulatory capital for credit risk much more closely aligned to economic capital. However introduction of systems capable of delivering the required output for the bank to qualify for IRB status will require a substantial one-off cost, even if the bank already has in place internal ratings based systems for calculating economic capital. Clearly, the system and technology requirements for running a head-office internal ratings based system for loan

[3] Basel Committee on Banking Supervision, Pillar 2 (Supervisory Review Process), Consultative Document, January 2001.

pricing, management reporting and measurement of risk-adjusted profitability is far less onerous than a credit VaR system that must be able to be audited by regulators, and presented to the public under disclosure requirements. For banks in this position there will be little marginal benefit from changing to the IRB approach. The number of banks in this category may not be insignificant. In the next sections we examine the capital incentives that may be required for banks to move to the IRB Approaches.

3. Advanced Risk Management Systems and Capital Incentives

To consider the arguments for providing capital incentives for banks adopting advanced risk management systems, we find it useful to adopt an option pricing framework. Depositors at an uninsured bank can be viewed as having made a risk free investment and written a put option giving the bank owners the right (exercised when the bank is insolvent) to put the bank's assets to the depositors at a strike price equal to the deposit obligations (including interest due). Where an insurance or guarantee scheme operates, the insurer or government has, in effect written that put option, so that depositors have a risk free claim.

For ease of exposition, consider a bank engaged in lending to only one homogeneous group of borrowers over a one year horizon. It has no operating costs and no need to hold liquid assets. It raises \$D of deposits and \$E of owner's equity (capital) and can make A=D+E of loans. In book value terms:

$A_{BV} = D_{BV} + E_{BV}$.

If loans are priced at the RAROC required rate, such that they have a zero NPV, then

$A_{BV} = A_{MV}$.

Consider now the introduction of advanced risk management systems. There are two potential effects arising from this. First the bank can better select borrowers and make loans which have a positive NPV. Then $A_{MV} > A_{BV}$ and $E_{MV} > E_{BV}$. In the latter case, depositors with claims of $D(1+r_D)$ on an uninsured bank, have greater safety, since the market value of the bank's assets is greater and there would need to be larger unexpected losses before insolvency occurs. Where there is a deposit insurance scheme in operation, the insurance fund benefits since the value of the put option (insurance) written has declined. Bank owners benefit from the introduction of the new risk management techniques, but some part of the total benefit accrues to depositors.

A second possible effect occurs if the introduction of advanced risk management systems reduces the volatility of total repayments by borrowers. This could arise from better loan portfolio composition, or through use of credit derivatives, such that the expected loss on the total portfolio is unchanged, but the variance of losses is reduced. Suppose, to take an extreme case, that there were no effect on borrower selection ability such that $A_{MV} = A_{BV}$. Then, unless the reduction in volatility of returns is reflected in lower required rates of return, or the bank's capital ratio reduced, the entire benefit is captured by depositors in the case of an uninsured bank, or by the deposit insurer / government when insurance/guarantees exist. With a lower volatility of returns, and no change in equity capital, there is less chance of the bank becoming insolvent through large unexpected losses occurring which exceed the capital base.

These arguments are summarised in the option pricing diagram below. Initially, the bank has deposit repayment obligations at the end of the period of $D(1+r_D)$, contributed equity of E and has invested the funds raised (D+E) in assets (loans) with a zero NPV such that the market value of assets (A_{MV}^0) equals the book value (A_{BV} = D+E). Given the volatility of end of period asset value, s_0, (which reflects the losses experienced on the loan portfolio) the value of the put option written by the deposit insurer is P_0, which is derived from an option pricing model using strike price of $D(1+r_D)$, volatility s_0, and where the underlying variable is the current market value of the bank's assets. P_0 is the put option value at the asset value of A_{MV}^0 = (D+E).

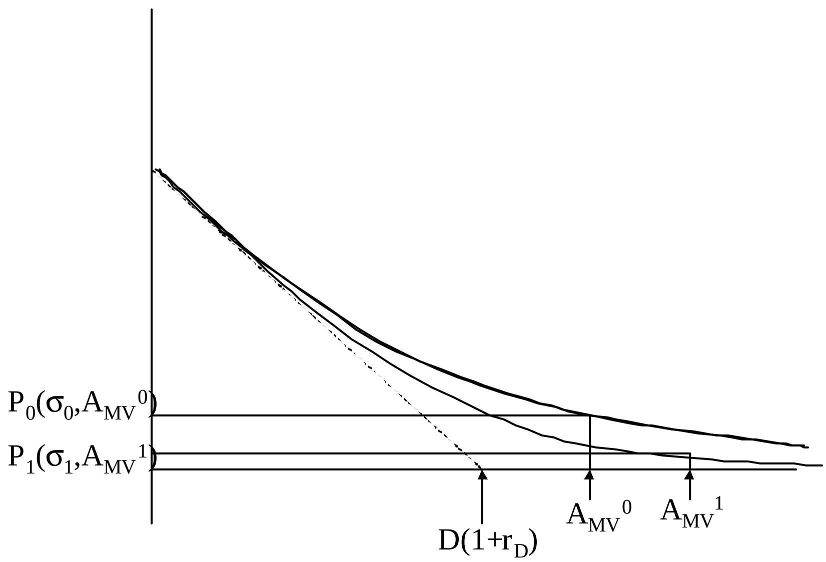

Figure 1: The value of the put option for varying volatility and asset levels.

Introduction of the advanced risk management system has two effects as outlined above. First, the option pricing curve is shifted down because of the lower volatility of end of period asset value, here denoted by s_1. Second, the asset value at which the option is now valued is shifted to the right to A_{MV}^1, where $A_{MV}^1 > A_{MV}^0$, reflecting the fact that the bank is now undertaking positive NPV loans. P_1 is the put option value after the change.

Since some part of the benefit arising from the introduction of the advanced risk management system accrues to the put option writer, there would appear to be an argument for some recognition of this effect. Note that this could occur in two ways. One is by reducing the option premium (insurance fee) charged to the bank to reflect the lower put option value. The other is by allowing the bank to increase its leverage (reduce its capital ratio) such that the value of the put option remains unchanged.

Note three implications which follow from this. First, the policy towards determination of insurance premia is important to assessing the arguments for capital incentives. If insurance premia accurately reflect the risk changes, there would seem to be no argument for differential capital ratios. In what follows we assume risk-insensitive insurance premia, but return to this issue in section 5. Second, the appropriate reduction in the capital ratio, to keep the value of the put option unchanged can, in principle, be calculated – although in practice it is difficult to determine. Nevertheless, it would seem appropriate to attempt to quantify an appropriate change, because of the third implication of our analysis. That is, that banks examining the introduction of new systems will compare the largely sunk, one off, cost of such an action, which is also largely independent of size, with the benefits which follow. Since some of the benefits accrue to the deposit insurer, private decisions regarding introduction will not be socially optimal unless the bank is compensated for the reduction in the put option value. In the subsequent section we attempt to compare the one-off sunk costs against the potential flow of benefits from a lower capital ratio (which will depend on bank size) to assess the minimum size of bank for which capital incentives of various amounts might make it worthwhile introducing new systems.

Before proceeding to that analysis, we advance one speculative comment, prompted by recognition that introduction of such systems is an investment project which involves largely sunk costs. As explained by the real options literature, it may be optimal to defer undertaking such a project, even though it has a positive NPV, if the passage of time involves resolution of some elements of uncertainty associated with such a project. In this case, the pace of technological progress in the development of risk management systems, the potential for lower cost systems, and the uncertainty about the effectiveness of extant systems, may create some "real option" characteristics. If so, adoption of advanced risk management systems, while optimal from the private perspective of bank owners, may be slower than is viewed as optimal from a social perspective. Whether this constitutes an additional argument for capital incentives is a question we pose for consideration by others.

4. Estimating Required Capital Incentives

Black and Scholes (1973) and Merton (1974) (BSM) were the first authors to introduce a contingent claims approach to value corporate risky debt.[4] In the BSM model, the holder of corporate risky debt with price (B_T) equivalently holds one unit of risk free (or default free) bond with face value (F) and a short position in a put option on the firm's value (V_T) with strike price equal to the face value of the debt:

$$B_T = F - Max[F - V_T, 0]$$

The price of the put option (which is granted by the bondholders to the shareholders) with payoff of $max(F\text{-}V_t, 0)$ is given by the Black-Scholes (1973) option pricing formula.

$$p(T) = Fe^{-rT}N(-d_1 + s\sqrt{T}) - VN(-d_1), \qquad (4)$$

[4] The assumptions of the BSM model are: constant risk-free rate; a single zero coupon bond liability maturing at time T; absence of arbitrage and transaction costs; zero bankruptcy costs and enforced

with $d_1 = \dfrac{\ln \dfrac{V}{F} + (r + \dfrac{1}{2} s^{2})T}{s_V \sqrt{T}}$ (5)

where p(T) is the put option price; T is the maturity date of the bond and put option; r is the risk-free rate; V is current market value of the firm; F is the face value of the debt; F(t,T) is the current market value of the risk-free debt, so that F(t,T) = $Fe^{-r(T-t)}$; s is the instantaneous variance of the return on the firm's assets; N(.) is the univariate cumulative normal distribution function.

Where there is a third party guarantee of the payment to the bondholders (and there is no uncertainty regarding the guarantee being met), then management has the right to sell the assets of the firm for F dollars on the maturity date of the debt. Thus management has been granted a put option over the assets of the firm, with a strike price equal to F, and the price of the put option is given by equation (4). Merton (1974) notes that when the firm is a bank the debt issue corresponds to deposits where both principal and interest are guaranteed, then the current value of deposits D can be written as

$D = Fe^{-rT}$. (6)

If we write the cost of the guarantee per dollar of insured deposits as g = p(T)/D, then equation (4) can be written as

$$g(d,T) = N(h_2) - \frac{1}{d} N(h_1), \qquad (7)$$

where

$$h_1 = \frac{\ln d - \frac{1}{2} s_V^2 T}{s \sqrt{T}}, and\, h_2 = h_1 + s \sqrt{T} . \qquad (8)$$

d º D/A is the current deposit-to-asset ratio. Providing the deposit-to-asset ratio and the volatility of the underlying assets remains fixed, the cost of deposit insurance per dollar of deposits is constant.

In countries such as the US where there is an explicit deposit insurance the cost of such insurance is the insurance premium charged. However even where an explicit deposit insurance scheme exists not all deposit claims are insured. For example, in the US

---

protection of priority in bankruptcy; rational wealth maximizing shareholders; assets of the firm follow foreign deposits and that portion of deposits above the insurance ceiling remain uninsured. In countries such as Australia where the government is unlikely to jeopardise the safety of the banking system by allowing one of the large banks to fail, there is an implicit deposit insurance, ultimately paid for by the taxpayers. We ignore these complexities and assume that *all* deposits are insured. The cost of the deposit insurance is the value of the put option granted by the insurer (or the government) to management, and (per dollar of insured deposits) is given by equation (7).

In what follows we use this framework to provide some idea of appropriate reductions in minimum capital requirements in response to use of advanced risk management techniques which would otherwise reduce the value of the deposit insurance put option.

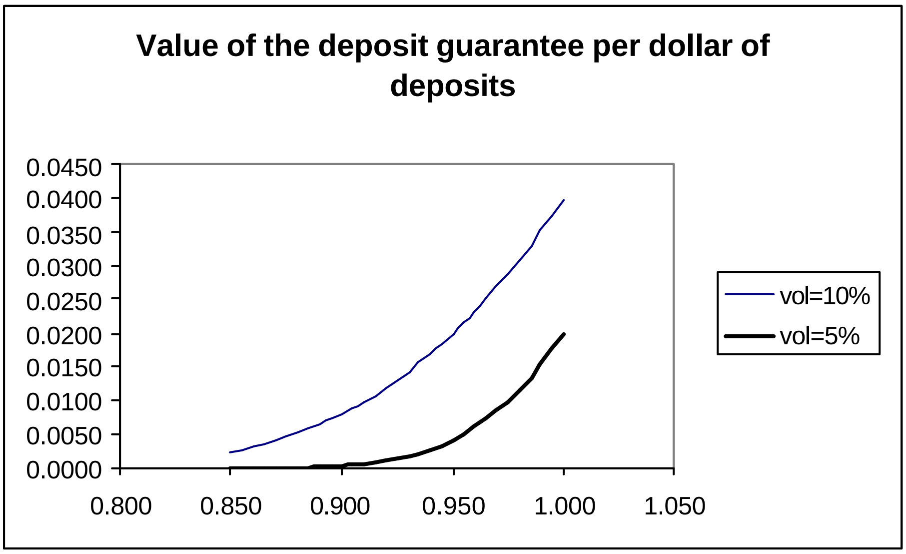

Figure 2: Value of the deposit guarantee per dollar of deposits plotted against $d = D/V$

In Figure 2 the value of the deposit guarantee (per dollar of deposits) is plotted against the deposit-to- asset ratio for different levels of the volatility of assets. Figure 2 illustrates (as did Figure 1) that the value of the option (or in this case deposit guarantee) increases with increasing volatility in the underlying asset. The sensitivity of the deposit

geometric brownian motion.

guarantee to movements in the volatility of assets is given by differentiating equation (4) with respect to volatility.

$$\frac{\partial g}{\partial s} = \frac{n(h_1)\sqrt{T}}{d} where n(h_1) = \frac{1}{\sqrt{2p}} e^{-\frac{1}{2}h_1^2} \tag{9}$$

In Figure 3, $\partial g/\partial \sigma$ has been plotted against d, assuming a constant volatility of assets of 10 percent. Reduction in the value of the deposit insurance guarantee is greater the higher is the deposit-to-asset ratio.

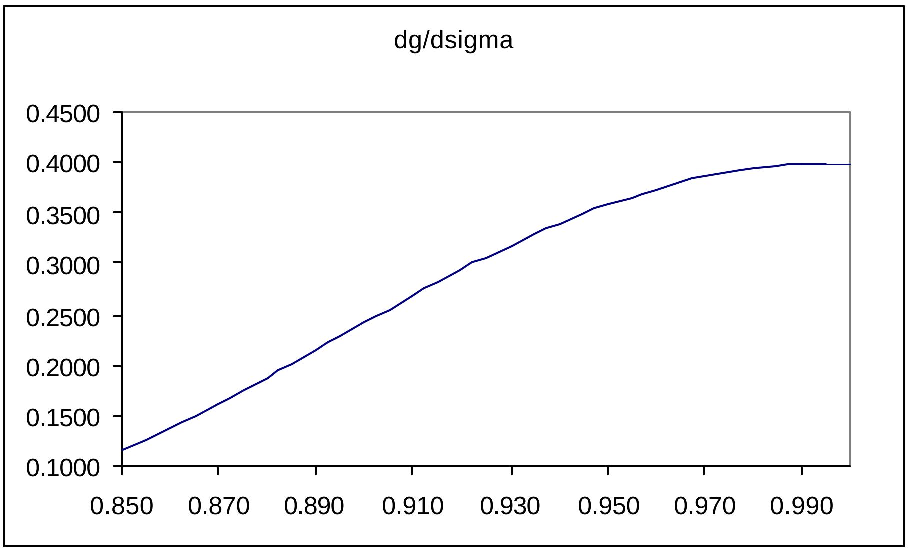

Figure 3: The sensitivity of the deposit guarantee to movements in asset volatility, $\partial g/\partial \sigma$ plotted against d.

The sensitivity of the deposit guarantee to changes in the deposit-to-asset ratio is positive and is given by

$$\frac{\partial g}{\partial d} = \frac{N(h_1)}{d^2} \tag{10}$$

Table 1 gives sensitivities of the deposit guarantee to changes in the volatility of assets and the leverage ratio, assuming a volatility of 5%. For example, for d = 0.90 the value of the deposit guarantee is \$0.000334 per dollar of deposits. Reading off the sensitivities in the table, a 0.1% decrease in the volatility from 5% to 4.9% implies a decrease in the deposit guarantee of 0.0457×0.001 = \$0.0000457. A 0.1% increase in the leverage ratio from 0.90 to 0.901 implies an increase in the deposit guarantee of 0.0204×0.001 = \$0.0000204. Using the sensitivities given in equations (9) and (10) to predict changes in the cost of the deposit guarantee for movements in volatility or leverage will be accurate only for small changes, because of the convexity in the pricing relationships. If, as a result of the introduction of new risk management systems the volatility of assets were reduced by 0.1%, then in order to maintain the same cost of the deposit insurance the leverage ratio can be increased from 0.90 to 0.9022. In a \$100 million asset institution, this implies an increase in deposits of \$220,000, without raising the overall level of risk borne by insurers or the government.

d	g	¶g/¶s	¶g/¶d
0.85	0.000008	0.0022	0.0007
0.86	0.000019	0.0045	0.0016
0.87	0.000043	0.0088	0.0033
0.88	0.000089	0.0162	0.0063
0.89	0.000177	0.0280	0.0117
0.90	0.000334	0.0457	0.0204
0.91	0.000600	0.0706	0.0338
0.92	0.001031	0.1035	0.0535
0.93	0.001696	0.1442	0.0808
0.94	0.002677	0.1913	0.1170
0.95	0.004067	0.2418	0.1625

Table 1: Sensitivity of deposit guarantee to movements in asset volatility ($\partial g/\partial \sigma$) and leverage ($\partial g/\partial d$) when the volatility of assets is 5%.

More generally if the only effect of the introduction of advanced risk management systems is a decrease in the volatility of assets, then the value of the put option granted by the insurer or the government decreases. There is an overall benefit if the reduction in value of the put option is greater than the cost, $C, of introducing the risk management system. This was illustrated in Figures 1 and 2 as a reduction in the value of the put option or the deposit guarantee. Now the change in the value of the put option for a given change in volatility of assets is given by

$$\Delta P = A\sqrt{T}n(h_1)\Delta s \tag{11}$$

where A is the size of the institution (asset size) and P is the value of the put option. We can calculate the present value of the change in the value of the put option as a perpetuity, assuming the change in volatility is permanent.

$$PV(\Delta P) = \frac{1}{r}A\sqrt{T}n(h_1)\Delta s \tag{12}$$

where r is the appropriate discount rate.

Then the reduction in the put value for a given decrease in the volatility of assets is greater than the costs involved in implementing the risk management system if

$$A > \frac{rC}{n(h_1)\sqrt{T}\Delta s} \tag{13}$$

Equation (13) can be used to estimate the minimum size of the institution for which the benefits of a reduction in the value of the put option outweigh the costs of introduction of the risk management system. The minimum size depends on the discount rate, the initial volatility of assets (refer to equations (8) and (9) where it can be seen that h_1 is a function of volatility), the leverage ratio and the size of the change in volatility ($\Delta\sigma$). Table 2 gives the minimum size for a discount rate of 15% (assumed to be the cost of equity capital), a deposit-to-asset ratio of 0.9, and assumed initial asset volatilities of 10% (panel A), 8% (panel B) and 5% (panel C).

Panel A: Initial asset volatility = 10% (0.10)											
Costs ($m)		1	2	3	4	5	6	7	8	9	10
Change in volatility	0.01	69.1	138.3	207.4	276.5	345.6	414.8	483.9	553.0	622.2	691.3
	0.02	34.6	69.1	103.7	138.3	172.8	207.4	241.9	276.5	311.1	345.6
	0.03	23.0	46.1	69.1	92.2	115.2	138.3	161.3	184.3	207.4	230.4
	0.04	17.3	34.6	51.8	69.1	86.4	103.7	121.0	138.3	155.5	172.8
	0.05	13.8	27.7	41.5	55.3	69.1	83.0	96.8	110.6	124.4	138.3
Panel B: Initial asset volatility = 8% (0.08)											
Costs ($m)		1	2	3	4	5	6	7	8	9	10
Change in volatility	0.01	94.4	188.8	283.3	377.7	472.1	566.5	660.9	755.3	849.8	944.2
	0.02	47.2	94.4	141.6	188.8	236.0	283.3	330.5	377.7	424.9	472.1
	0.03	31.5	62.9	94.4	125.9	157.4	188.8	220.3	251.8	283.3	314.7
	0.04	23.6	47.2	70.8	94.4	118.0	141.6	165.2	188.8	212.4	236.0
Panel C: Initial asset volatility = 5% (0.05)											
Costs ($m)		1	2	3	4	5	6	7	8	9	10
Change in volatility	0.01	365.1	730.2	1095	1460	1825	2191	2556	2921	3286	3651
	0.02	182.5	365.1	547.6	730.2	912.7	1095	1278	1460	1643	1825
	0.03	121.7	243.4	365.1	486.8	608.5	730.2	851.9	973.6	1095	1217

Table 2: Minimum size required ($m) for the reduction in the value of the deposit guarantee to be greater than the costs of implementing risk management system, for a range of assumed costs ($m).

The relationships depicted in Table 2 are as expected. The higher the volatility of the institution (implying a more valuable deposit guarantee), the smaller the size at which the reduction in the put option value will exceed the costs of implementing the risk management system. Or, for a given cost and initial asset volatility, the greater the reduction in volatility the smaller the minimum size of the institution.

If a reduction in volatility reduces the value of the put option because the bank is inherently less risky, then if the same level of risk is to be maintained the capital ratio must increase. The option pricing framework can then be used to estimate the size of the capital reduction warranted that leaves the overall risk unchanged, by calculating the change in capital ratio (leverage) that results in no change in the value of the put option. Assume that introduction of the risk management system results only in a reduction in volatility of assets. Then the relationship between volatility (s) and leverage (d) that leaves the value of the put option invariant is depicted in Figure 4 (holding all other inputs to equation (4) constant), with values given in Table 3. For example Figure 4 is plotted assuming a volatility of 5% and a leverage ratio of 0.9 and then plotting other (s,d) pairs that leave the value of the deposit guarantee invariant.[5] Clearly there are other curves for different values of the deposit guarantee.

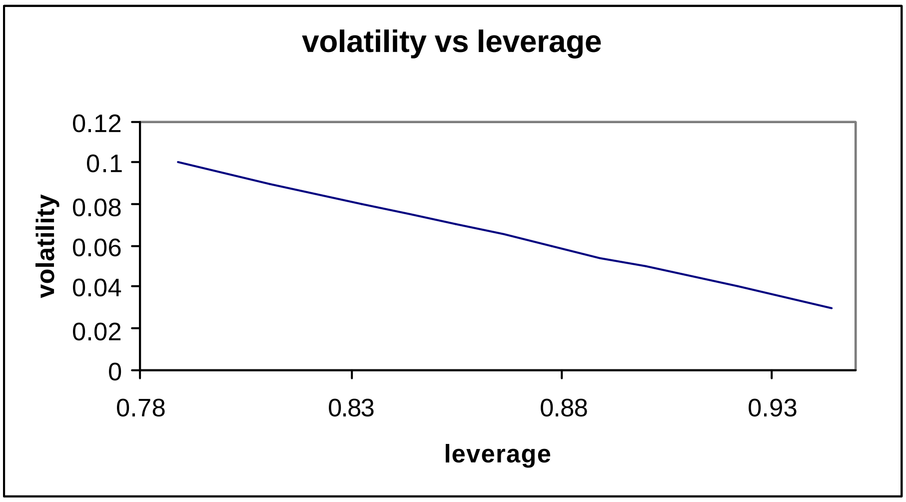

Figure 4: The relationship between volatility and leverage holding risk constant (g=$0.000334).

d	0.789	0.811	0.833	0.855	0.878	0.9	0.922	0.944
σ	0.1	0.09	0.08	0.07	0.06	0.05	0.04	0.03

Table 3: The relationship between volatility and leverage holding risk constant (g=$0.000334).

From Table 3, a volatility of assets of 6% and a leverage ratio (D/A) of 0.878 (87.8%) is equivalent to a volatility of assets of 4% and a leverage ratio of 92.2%, in the sense that the overall risk measured in terms of the deposit insurance guarantee (or subsidy) has not changed. These results can be utilised to investigate the appropriate change in capital ratio as an incentive for the bank to outlay the fixed costs, $C, of introducing risk management systems. Assume that incurring the one off cost $C results in a reduction in volatility, and that the bank is provided with capital relief via an increase in deposit-to-asset ratio. Consequently there may be some gain to the bank from increased leverage.[6] In addition assume that advanced risk management systems provide a competitive advantage which results in a gain to the bank from positive NPV loans. Then there is an overall gain to the bank if

[5] From Table 1 the deposit guarantee is equal to $0.000334 per dollar of deposits.

$$-C + \text{gain from leverage} + \text{gain from positive NPV loans} \quad (14)$$

is positive. As a simple illustration, assume that initially d = 0.9, $\sigma = 5\%$, and the fixed cost of introduction of a risk management system for a $700 million institution is $2m, with a resulting decrease in volatility of assets to 4.5% and an allowed increase in the deposit-to-asset ratio to 0.91. The maximum gain from leverage is 0.01 × $700m× (bank tax rate) or $2.1m. From the bank's perspective, the capital incentive is sufficient after incorporating the gain from positive NPV loans. In addition, the insurer or government benefits because the value of the deposit guarantee has decreased from $233,800 to $216,042.

5. Deposit Insurance and Capital Incentives

As we have noted earlier, introduction of advanced risk management systems by banks can be interpreted within the option pricing framework as leading to either, or both, an increase in the market (relative to book) value of the bank's assets (from superior loan selection), or a reduction in the volatility of asset values. Both of these effects correspond, for a given level of deposits, to a decrease in the value of the put option implicitly (or explicitly) written by deposit insurance agencies or by government/taxpayers. A reduction in the minimum capital requirement can then be viewed as a complementary adjustment which restores the value of the put option back towards its initial value, and maintains the pre-existing relativity between the value of deposit insurance provided and the insurance premiums (if any) charged.

An alternative approach is to reduce the cost of the deposit insurance premium charged by the deposit insurance fund, without adjusting the minimum capital requirement. Again, the pre-existing relativity between the value of deposit insurance provided and the insurance premiums (if any) charged can be maintained. Indeed, while potentially equivalent in terms of the net subsidy provided by deposit insurance, it might be argued that the latter approach would be preferable, since the combination of

[6] Gain from leverage arises as a result of the tax deductibility of debt, or perhaps because funding with deposits is 'cheaper' than funding with equity. Assume in the calculation that the tax rate is 30%.

unchanged capital and lower risk would involve lower probability of bank insolvency than the alternative of lower capital and lower risk.

Why has such an approach not been advocated? We suggest four reasons. First, there are relatively few countries in which a deposit insurance scheme with risk based premiums can be found, and most of those link premiums to coarse indicators of risk such as non-performing loans ratios (Word Bank, 2000). Second, even if risk based deposit insurance were in place, it may be difficult to quantify the appropriate reduction in premiums for adoption of advanced standards. Third, deposit insurance and bank supervision are often undertaken by different regulatory agencies. Despite this, there has been relatively little analysis of the optimal allocation of responsibilities between regulatory agencies and the appropriate interaction between them. (See, however, Khan and Santos, 2001). The allocation of responsibility for rewarding banks for implementing advanced risk management systems to the regulator which supervises them, in a form (capital concessions) which that regulator can implement reflects that bias towards separation of duties. Finally, and reflecting the problems of regulatory coordination and interaction, a separate deposit insurer could be expected to be hesitant to alter deposit insurance premiums based on the assessment of a bank's internal systems by a separate regulatory agency.

6. Conclusion

The new Basel Accord has potentially significant consequences for competition in banking, arising from the provision of capital incentives for banks which expend resources on implementing advanced risk management systems.

There has been relatively little discussion of the justification for such capital incentives, nor of what magnitude they should be. We have considered the case for such incentives and illustrated how bank expenditures on advanced risk management systems may reduce the value of the put option extended by deposit insurers or government guarantees. While capital incentives may be one way of compensating banks for that benefit, we noted that an alternative would be to adjust the cost of deposit insurance. Finally, we attempted to provide some quantitative insights into the amount of capital incentive appropriate to compensate banks for the fixed cost of implementing new systems and the size of banks for which incurring such costs might be worthwhile. In doing so we noted that a crucial issue is the division of benefits from such systems between private benefits to the bank (through better ability to price loans and make economic profits) and "social" benefits (otherwise accruing to the deposit insurer) in the form of lower risk of bank insolvency. Capital incentives would appear to be based on the latter form of benefit, unless it is believed that there is some reason why banks are unduly slow in adopting value-adding changes in risk management technology. Quantifying the appropriate magnitude of such capital incentives, such that undue distortions to banking sector competition are not induced, is a task commenced in this paper, but in need of further analysis.

References

Altman, E., S. Bharath and A. Saunders (2002). Credit ratings and the BIS capital adequacy reform agenda, *Journal of Banking and Finance* 26, 909-921.

Basel Committee on Banking Supervision, Consultative Document Overview of The New Basel Capital Accord January 2001 http://www.bis.org/publ/bcbsca02.pdf

The New Basel Capital Accord: Comments Received on the Second Consultative Package http://www.bis.org/bcbs/cacomments.htm

Black, F. and M. Scholes (1973), The pricing of options and corporate liabilities, *Journal of Political Economy*, 81, 637-659.

Jackson, P., W. Perraudin and V. Saporta (2001). Regulatory and 'economic' solvency standards for internationally active banks. Bank of England Working Paper Series.

Kahn C M and J A C Santos (2001) "Allocating bank regulatory powers: lender of last resort, deposit insurance and supervision" *BIS Working Papers*, 102, August.

Merton, R.C. (1974), On the pricing of corporate debt: The risk structure of interest rates, *Journal of Finance*, 29, 449-470.

Merton, R.C. (1977). An analytic derivation of the cost of deposit insurance and loan guarantees, An application of modern option pricing theory, *Journal of Banking and Finance*, 1, 3-11.

World Bank (2000) *Deposit Insurance Database* http://www.worldbank.org/research/interest/confs/upcoming/deposit_insurance/dataset2.xls