Draft: 6 December 2002

Prudential Regulation and Competition

Christine Brown and Kevin Davis

Department of Finance

The University of Melbourne

Email: christine.brown@unimelb.edu.au

kevin.davis@unimelb.edu.au

Fax: 61 3 8344 6914

1. Introduction

Should Prudential Regulation be competitively neutral? The architects of Australian financial deregulation, the Campbell Committee, certainly were of that view: "…the relevant principle is clear – investor protection arrangements ….. should aim to involve minimum disturbance to competitive neutrality" (Campbell, 1981, p289). Similarly, the Wallis Committee noted that "[c]ompetitive neutrality requires that the regulatory burden applying to a particular financial commitment or promise apply equally to all who make such commitments" (Wallis, 1997, p196).

However, the current (risk weighted capital requirement) approach to prudential regulation has implicitly, if not explicitly, rejected that view, and the "three pillars" approach of the proposed new Basel Accord goes even further down this line. 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. Given the conventional wisdom that deposits are cheaper than equity, this means that returns required by banks vary across asset classes in a manner influenced by the somewhat arbitrarily determined risk weights. Competitive neutrality in terms of pricing and flows of funds to particular asset classes and sectors would thus not hold unless, by chance, the regulatory risk weights either mimicked the risk assessments made by banks of their borrowers or were ineffective.

More recently, the New Basel Accord appears to take this rejection of the principle of competitive neutrality even further, even though an objective of the changes is to make regulatory risk weights better aligned with market- and bank-based risk weights. Under the current proposals, risk weights assigned to various asset classes and

customers may vary depending on whether the bank undertaking the lending is regulated under the standardised or the advanced approach.[1] 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.

In these respects, Basel 2 has significant potential to affect structure, conduct and performance in three distinct areas or the economy. First, it may alter the industrial structure of the banking industry if capital incentives do provide a competitive advantage to banks using advanced risk management techniques. Second, distortions to the cost of bank participation in certain activities may alter the attractiveness and thus use of capital market financing relative to bank based intermediation for certain types of activities. Third, certain types of borrowers may suffer an unwarranted cost disadvantage if inappropriate risk weights affect bank pricing of credit facilities.

This paper examines these issues and addresses the question of whether the provision of regulatory capital incentives for adoption of advanced risk management techniques is warranted. Since the issues revolve around the determinants of bank pricing of credit, it is first useful to briefly review bank pricing practices and the role of capital in the absence of regulatory capital requirements. We then provide a brief description of the Basel Capital Accord(s), illustrate how Basel 2 may affect bank credit pricing, and discuss the potential effects upon structure, conduct, and performance as outlined above.

Finally we turn to the question of the possible justification for lower capital

[1] APRA (2002, p4) notes a very large difference between the capital requirements for housing loans for banks using the standardised approach and those using the advanced approach under the proposed New Basel Accord, and comments that it "will need to exercise its national discretion to …reduce competitive inequalities that might otherwise arise".

requirements 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. Under the assumption that deposit insurance or government guarantees exist and mean that taxpayers are at risk from bank failures, an option theoretic framework is utilised to illustrate conditions under which such incentives may be justified.

2. Bank Pricing and Capital

For ease of exposition, consider initially 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. It can make N loans each of the same size (\$N/A), and each of which has a probability of default of (1-p) per cent, in which case only the promised interest amount is recovered. If the interest rate charged on the loans is r%, the promised repayment is R^p = \$A(1+r) million, and the expected repayment is

$$R^e = (1-p)rA + pA(1+r) = rA + pA. \quad (1)$$

Denote the difference between promised repayment and expected repayment, which may be thought of as general provisions,[2] as:

$$Prov = R^p - R^e = A(1+r) - rA - pA = (1-p)A. \quad (2)$$

[2] Borio and Lowe (2001) discuss issues associated with measurement and accounting treatment of general provisions, and argue that if the loan is priced to have a non-negative NPV, there is no case for any such provision, since the book value of the loan equals its "fair value". Our treatment accords more closely with

Assume that deposits pay an interest rate of r_d % p.a., that there are no operating costs, that the bank raises D of deposits (for promised repayment of $D(1+r_d)$ and owners provide equity of E = A-D. The expected rate of return to owners (r_e) is determined from:

$(1+r_e)E = A(1+r) – Prov - (1+r_d)D = (D+E)(1+r) – (1+r_d)D - Prov$

If the owner's required rate of return on equity is known, the loan rate which must be quoted is determined as:

$$1 + r = \frac{E}{(D+E)}(1+r_e) + \frac{D}{(D+E)}(1+r_d) + \frac{\text{Pr}\,ov}{(D+E)}$$

or

$$r = \frac{E}{(D+E)}r_e + \frac{D}{(D+E)}r_d + (1-p) \qquad (3)$$

which is known as the RAROC (Risk Adjusted Return on Capital) required loan rate. It can be seen as a standard weighted average cost of capital equation plus an adjustment to reflect the difference between the quoted loan interest rate and the expected return on loans. (Incorporation of operating costs as an additional cost component is, in principle, straightforward).

Within this framework, incentives for banks regarding capital ratios and adoption of improved risk management systems can be easily seen.

First, if equity is a more costly form of finance than deposits (including operating costs associated with such deposits), banks have an incentive to maximise "leverage" (use of deposits), ie to minimise owner's equity investment. That, however, comes at the risk

---

market practice, and regulatory standards which require general provisions at least equal to 0.5 per cent of risk weighted assets.

of insolvency – should loan repayments not meet deposit obligations.

Second, if banks are better able to assess the risk of customers (here reflected in the default probability term (1-p)) they will be able to more accurately price loans and capture "good" business. Consider, for example, the case where borrowers differ in terms of default probability and one bank, having installed a costly credit risk management system, can accurately identify the different probabilities, while another bank cannot. The latter bank will charge all borrowers the same loan rate, while the former bank will offer high (low) quality borrowers a lower (higher) loan rate and attract good borrowers and deter bad borrowers. Over time, the non-discriminating bank will lose money through attracting high risk borrowers but pricing as if they were of average risk. The discriminating bank may recoup the costs of installing improved risk management systems if it can price loans to good customers above the minimum required rate (or equivalently if market competition conditions permit it incorporating such costs into its loan pricing system).

Also relevant is the possibility that such improved risk management systems may not alter the average probability of customer default and thus expected repayments, but may reduce the variance of actual repayments. This could occur, for example, if a loan portfolio with better diversification characteristics (such as lower correlation between repayment outcomes of individual borrowers) was achieved. If so, the bank would be able to operate with higher leverage (less equity and more deposits) without increasing the probability of insolvency. If, as generally presumed, equity is more costly than deposits, the bank could gain from operating with a lower capital ratio.

How, in practice and absent regulation do banks determine an appropriate capital

ratio? Current banking practice typically involves banks determining an amount of "economic capital" appropriate for activities of certain risk. The method used is a variant of the "value at risk" approach and involves calculation of "capital at risk" arising from unexpected losses.

Consider the example used above, and note that with a large number (N) of independent loans, the probability distribution of actual losses on the loan portfolio can be approximated by a normal distribution. The mean of the distribution is the expected loss calculated earlier and denoted by "Prov", which corresponds, in our framework, to the general provisions made by banks upon writing a loan. The standard deviation of the probability distribution of actual losses can be readily calculated, and we denote it here by σ. Under the capital at risk approach, bank management makes a judgement about the probability of insolvency which it is willing to tolerate. If, for example, it were willing to tolerate a one in forty probability of insolvency, this would (using the properties of the normal distribution) be consistent with having equity capital:

$$E = Prov + 1.96\sigma$$

In this case, one time in forty, actual losses would exceed the equity capital contributed and the bank would be insolvent.

The equity capital contributed in excess of Prov is referred to as "capital at risk" or economic capital and is the buffer to absorb unexpected losses. In practice, banks typically operate their internal capital management systems with a calculation of economic capital involving a probability of insolvency, within a one year horizon, in the order of one in one thousand (or greater).

The apparent simplicity of this approach, as described above, masks a number of

major complexities. First, note that "capital at risk" in this context relates not to the expected default probability of the borrower (since this is catered for by Prov) but to the standard deviation of the losses on the portfolio. The correlation between individual loan outcomes is thus crucial to the result. Using the example given above, the standard deviation σ would be much greater in the case where repayment outcomes on the N loans were perfectly correlated than if they were uncorrelated. A higher capital at risk would be necessary (for the same insolvency probability) in the case of an undiversified portfolio. Second (and implicit in the previous point), note that capital at risk cannot be simply added up across asset categories to give a total capital at risk for the organization, since the correlations across asset groups are the critical determinant for the bank as a whole. Equivalently aggregate capital at risk can be calculated for the bank (by incorporating correlations across assets) but there is no unique algorithm available for allocating this across activities for use in product pricing (as required in the RAROC example given above).

The preceding discussion has been premised on the absence of regulatory capital requirements for banks, and implicitly on the existence of a cost advantage to deposit financing over equity financing of bank activities. The latter feature stems from either the inability of bank depositors to assess bank risk and thus insensitivity of their required rate of return to bank leverage, or from the existence of deposit insurance or government guarantees of bank deposits which are not priced to fully reflect their value. We return to this issue subsequently when we examine the possible rationales for regulatory capital incentives for banks adopting advanced risk management techniques. In the next sections we focus on bank capital adequacy requirements, particularly those proposed under Basel 2, and their implications for competitive structure in banking, finance and business.

3. 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; capital 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 economic capital requirements. 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. However concern has been expressed that the proposals in aggregate will lead to an increase in regulatory capital,[3] and that the standardised approach for calculating risk weights overestimates the risk of high-quality debt relative to low-quality debt.[4] It is anticipated that many banks in the Asia pacific region will initially adopt the standardised approach.[5]

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,

[3] ANZ submission to the Basel Committee, May 2001.
[4] Altman, Bharath and Saunders (2002)
[5] Indications are that the major banks in Australia could ultimately qualify for advanced IRB approach

which is standardised for the Foundation IRB Approach.[6] A maturity adjustment factor (M) and a granularity adjustment factor (G) modify the calculated risk weights.[7] Finally the capital charge is calculated using exposure at default (EAD) and the derived risk weights.[8] 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 economic capital. 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. Benefits may also be generated if capital assigned on a more economic basis results in a more rational allocation of capital. 'As the Australian major banks move towards advanced IRB status it is clear that the banking system minimum regulatory capital will drop significantly unless a discretionary buffer is maintained.'[9]

There is a general view amongst larger banks which may qualify for Advanced IRB status that the lower capital charges for credit risk do not provide sufficient incentive for banks to adopt the advanced method, because of the additional capital requirements for other risks. For example, Bank of America, in its submission to the Basel Committee, argues that the benefit for introducing a more risk sensitive capital requirement for credit risk may be outweighed by the introduction of the capital requirement for operational risk. The possible application of banking book capital further reinforces these arguments.

---

[6] In the context of the simple example used earlier in this paper, p was the probability of default and the LGD factor in that case was 1 (100 per cent loss).
[7] 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".
[8] Again in the context of the simple example used earlier, the exposure given default is total loans (A).
[9] Charles Litrell, Presentation to ABAC/PECC Symposium on Risk Management, Pricing and Credit Provisioning

Supervisors in all member countries expect banks to operate above the minimum capital ratios laid down in the 1988 Accord.[10] 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 hold economic capital 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 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 section we examine these issues

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

using an option pricing framework.

Before proceeding to that analysis, we note some of the potential competitive / structural effects which Basel 2 may cause.

- The approach can be expected to influence the evolution of individual bank management systems and techniques towards greater sophistication. But at the same time, the competitive advantage provided to more sophisticated banks (through lowering of capital ratios) has the potential to distort the structural development of national banking sectors if the resource costs of achieving such status make that infeasible for currently smaller and less sophisticated banks.

- Basel 2, by providing incentives for more "model based" credit analysis may change the relevance which long term inter-relationships between banks and their customers have for credit decisions, and thus may impact upon the importance of relationship banking.

- The revised "standardised approach", likely to be used initially by most banks assigns different risk weights for different types of business borrowers, based on external credit ratings, or lack thereof. Corporate credit ratings may adequately reflect expected default probabilities, but may not be particularly suitable for assessing "capital at risk" of a portfolio of loans. Potential distortions to pricing of bank loans to the business sector (and particularly for unrated SMEs), and thus differential incentives for capital market funding (including securitisation options), are particularly relevant issues.

- It is not apparent that the standardised approach and the advanced approach will lead to consistency in relative pricing of credit to different types of customers, by banks operating under the alternative approaches. Housing loans are one such area in which this potential effect has already been noted – since historical mortgage default rates used in bank internal models are well below those implied by the standardised approach. That example highlights an important problem, since housing finance would seem to be one area in which relatively unsophisticated financial institutions (which would operate under the standardised approach) could otherwise be expected to operate competitively, safely, and efficiently in the absence of distorting regulation.

- To the extent that capital requirements are effective, they impose a cost on banks and other financial institutions. Is the relative cost disadvantage of capital (and thus the burden of capital requirements and competitive effect) constant across countries or across different types of institutions within a country? Across countries, tax systems, structure of deposit insurance premiums, disclosure / transparency and depositor awareness of risk are relevant considerations. Within countries, there can be differential costs – such as in the case of mutual/cooperative institutions and joint stock companies in Australia where mutuals and cooperatives find it difficult to distribute dividend imputation tax credits.

4. 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.

Consider the case of the example bank outlined earlier, which uses deposits (D) and equity (E) to purchase assets (make loans) of A. 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 $E_{MV} > E_{BV}$. Compared to the case where zero NPV loans are made, 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

positive NPV effect of the introduction of the new risk management techniques, but some part of the total benefit is shared with depositors (in the uninsured case) or the deposit insurer.

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 ability to use 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 on bank equity, 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, Figure 1. 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, σ_0, (which reflects the potential variability in 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 a strike price of $D(1+r_D)$, volatility σ_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).[11]

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 σ_1. Second, the underlying 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.

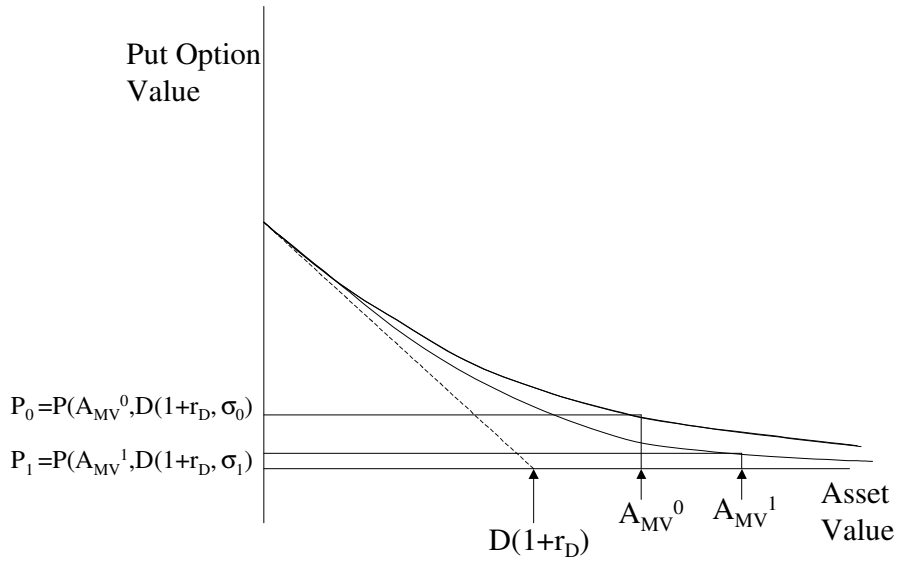

Figure 1: The value of the put option for varying volatility and asset levels.

[11] Black and Scholes (1973) and Merton (1974) were the first to demonstrate that a put option could be exactly valued as a specific function of five variables: the underlying asset value (here, A_{MV}), strike price (here $D(1+r_D)$), volatility (σ), time to expiry (T), and the level of interest rates (r). We suppress T and r for convenience and write the put option value as $P(A_{MV}, D(1+r_D), \sigma)$.

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, and some compensation for, 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.[12]

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. 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 third implication 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.

We have applied the Black and Scholes (1973) option pricing model to derive illustrative examples of the magnitude of several of the effects discussed above. First, we

[12] In the context of Figure 1, this corresponds to finding the higher strike price represented by a higher deposit (repayment) level $D^1(1+r_D)$ such that $P(A_{MV}^1, D^1(1+r_D), \sigma_1) = P(A_{MV}^0, D(1+r_D), \sigma_0)$.

examine the reduction in the capital ratio which would offset the impact of a lower volatility of assets on the value of the deposit insurance provided. In the context of the preceding analysis this is equivalent to finding the change in D which ensures that

$$P(A_{MV}^{0}, D^{1}(1+r_D), \sigma_1) = P(A_{MV}^{0}, D(1+r_D), \sigma_0)$$

and expressing this in terms of a change in the capital ratio.

To illustrate, using the Black-Scholes model, 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. Thus, if introduction of the advanced risk management system by a bank with an initial capital ratio (E/A) of 12.2% involved a fifty percent reduction in the volatility of assets from 6 to 4 per cent (and no other effect), a reduction in the capital ratio (E/A) of 4.4% could be warranted.

Second, we illustrate the issues involved in determining whether an institution of a particular size will view the introduction of costly advanced risk management systems to be a value adding project. This will depend upon the fixed costs of introduction (C), the NPV added through better loan selection, and the extent to which regulatory changes in capital ratios allow the bank to achieve tax-related gains from higher leverage and also affect the share of gains which accrue to the deposit insurer.

We consider the illustrative case of a bank with $7 billion assets for which we assume that initially the deposit-to-asset ratio is 0.9, $\sigma = 5\%$, and the fixed cost of introduction of a risk management system is $20m. The assumed effect on volatility of assets is a decrease to 4.5%. Using the Black-Scholes model, an increase in the deposit-to-asset ratio to 0.9112 would leave the value of the insurance put option unchanged, and we assume

an allowed increase in the deposit-to-asset ratio to 0.91, such that the value of the deposit guarantee has decreased from $2,338,000 to $2,160,300

How does the bank gain from the expenditure on the advanced risk management system. The first possibility is the gain from leverage arising from the lower capital requirement (the allowed increase in the deposit-to-asset ratio). [13] The second is the possibility that banks may benefit from now taking on positive NPV loans.[14]

There is an overall gain to the bank if

$$-C + \text{gain from leverage} + \text{gain from positive NPV loans} > 0 \qquad (4)$$

Using the assumed allowed change in leverage of 0.01 and assuming that leverage gains reflect the interest tax shield arising from debt/deposits, the maximum gain from leverage is 0.01 × $7 bill × (bank tax rate) or $21m. From the bank's perspective, the capital incentive is sufficient without incorporating the gain from positive NPV loans. In addition, the insurer or government benefits because the value of the deposit insurance guarantee is lower.

While it is possible to estimate appropriate reductions in capital ratios under varying assumptions about costs and benefits, inertia on the part of bank management to make the initial investment in development of the risk management systems may prevail. Recognising that investment in advanced risk management systems is largely a sunk cost, the real options literature explains why, even if such an investment is a positive NPV project, it may be optimal to defer the decision. Whenever there is uncertainty in the operating environment, it may be optimal to defer investment if the passage of time

[13] 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. We assume in the calculation that the tax rate is 30%.

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, uncertainty about the effectiveness of extant systems, and ultimately uncertainty about the actual size of the capital reduction 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.

Conclusion

The new Basel Accord involves two potential types of distortions to bank pricing and credit decisions, and thus to financial market competition. One effect arises from the potential differences between regulatory capital requirements and bank based economic capital calculations for various types of borrowers. This may affect the cost of bank funding for financing certain types of customers. Changes in the relative importance of capital market versus intermediation-based financing could thus be expected, and changes in the relative cost of finance to certain types of borrowers. The second effect, with potentially significant consequences for competition in banking, arises 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

[14] This creates a further benefit for the deposit insurer which we do not consider here.

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. We have argued that option pricing models can quantify 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.

A crucial issue that remains to be addressed 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 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. In this regard the value of the real option that management hold may give incentives to defer investment if the passage of time resolves some of the operating environment uncertainty. Regulatory uncertainty could also be a key determinant of the value of this real option.

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.

APRA (2002) "APRA's Views On Basel II: Managing The Transition" *APRA Insight*, 2nd Quarter 2002, 3-6, http://www.apra.gov.au/Insight/loader.cfm?url=/commonspot/security/getfile.cfm&PageID=4811

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

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

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

Borio, C. and P. Lowe "To provision or not to provision" *BIS Quarterly Review*, September 2001, 36-48.

Campbell (1981), *Australian Financial System: Final Report of the Committee of Inquiry* (Committee of Inquiry into the Australian Financial System. K. Campbell, Chairman), AGPS, Canberra.

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

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

Wallis (1997) *Final Report*, (Committee of Inquiry into the Australian Financial System S. Wallis, Chairman), Australian Information Service, Canberra http://www.treasury.gov.au/publications/FinancialSystemInquiry(WallisReport)/index.asp