Assessing Financial Institution Risk

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ABSTRACT

This paper considers the proposition that banking sector risk has increased, and suggest methods by which that hypothesis could be examined. Underpinning those methods is the use of an option theoretic model of banking to identify the interdependencies between exposures of various stakeholders in banks. Finally, various topical public policy issues related to dealing with a perceived increase in risk are analysed.

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In the last few years the Australian financial markets have seen a number of failures of financial institutions as well as increased loan write-offs and doubtful debt provisions among surviving institutions. This experience has prompted a common perception that risk in financial intermediation has increased. Financial deregulation, innovation, and technological advance, are among the factors which have changed the nature of financial intermediation, and which could have contributed to any increased risk - if in fact risk has increased.

The objective of this paper is to address the question of how to measure whether there has been an increase in the risk of financial intermediation, to consider possible causes of change in risk, and to consider alternative public policy responses to changes in financial institution risk. First, however, it is important to clarify the meaning of risk.

1.   The Meaning of Financial Institution Risk

In the literature of economics and finance, risk refers to the dispersion of possible outcomes of economic variables (such as exchange rates and interest rates) around their expected value. Exposure refers to the quantitative effect of that uncertainty about future outcomes upon some economic magnitude of interest, such as firm value. Typically, discussions of banking refer to types of risk (such as interest rate, default, payments system risk etc.), although the focus of interest is

upon the exposure of the institution (or some of its stakeholders) to those factors.

The evidence of an increased number of financial institution failures, loan loss provisions etc., does not of itself indicate increased risk or exposure in financial intermediation. An analogy may help to clarify this assertion. The fact that a family suffers a financial loss as a result of their uninsured house burning down, is not evidence that they have recently increased their risk. They may have been without insurance for many years - their risk may have been unchanged. Nor is the fact that many families simultaneously suffer such a loss evidence of increased risk. They may all have been long-term uninsured, but exposed to a common event - a bushfire in their locality. (There may also have been an increase in the number of families in the locality.) Or, alternatively, fires may be contagious - so that a fire in one house increases the probability of fires in neighbouring houses. In these cases, the outcome we observe is just the chance drawing from a probability distribution of possible outcomes which has not changed through time, i.e. a situation in which there has been no change in risk.

Continuing the analogy, it is of course possible that risk or exposure may have increased. The families may have recently cancelled insurance, thereby increasing their exposure to the unchanging risk of fire. Alternatively, changes in climatic

conditions may have increased the risk of bushfire, and thus the households' exposures. Finally, cutbacks in Government expenditures on fire-risk detection and fire-prevention services may have increased the risk of contagion.

Hopefully, the parallels between this analogy and the case of financial intermediation are sufficiently transparent not to require much elaboration. Financial institution failures may reflect no change in risk, or may relect a change in risk bearing away from direct financing activities towards financial intermediation. Alternatively, failures could stem from changed (risk-taking) behaviour by institutions, unchanged behaviour by institutions in an environment of increased risk, or a downgrading of the mechanisms designed to prevent contagion. It is important that the relative significance of these factors be determined so that the public policy response to the recent Australian financial experience is an appropriate one.

Recognising that risk refers to deviations of outcomes from what is expected still leaves unanswered the question of who among the stakeholders in the institution are subject to this uncertain outcome. Those stakeholders include: depositors and other creditors, equity holders, loan customers, employees, and (in general) government. The activities of financial institutions affect these various stakeholders in the institution in differing ways. They can increase the exposure of the stakeholders (as a group) to some event. In other cases they

3

involve arrangements to share or trade exposures between stakeholder groups. (An example of the former activity would be where a bank loan enables a borrower to invest in property, thereby increasing exposure of the stakeholders, as a group, to property prices. An example of the latter activity is that of writing fixed rate loans while taking floating rate deposits, thereby transferring interest rate risk among stakeholders.)

Recognising the interdependence between stakeholders enables us to classify a number of risk perspectives and decide which it is that warrants attention. In what follows we will disregard employees and focus upon the overall exposure of stakeholders, rather than the source (or type) of risk (such as interest rates). The nature ofthe exposures faced by remaining stakeholders are of the following forms:

Depositors/Creditors: the actual return on their funds may be less than that promised by the financial institution because of insolvency, or access to their funds may be delayed because of liquidity problems.

Loan customers: promised credit facilities may be unavailable when required, or loans prematurely recalled.

Equity holders: the returns on funds invested are unpredictable.

Governments (taxpayers): political pressures may dictate that other stakeholders be protected from loss, or actions perceived necessary for efficient functioning of the financial system may involve governments adopting an exposure.

Most discussion of risk in banking focuses upon the risk faced by depositors, typically assuming that their decisions are

not based upon a fully informed trade-off between risk and expected return. Government protection of depositors, in most of its forms, reflects this assumption. At one level it may be argued that depositors are unable to assess risks, because of insufficient information or expertise, so that caveat emptor is not appropriate. At another level, it can be argued that efficient functioning of the financial system requires some form of depositor protection - or at least some method of preventing unwarranted swings in depositor confidence resulting from imperfect information. One of the significant social products of banking (liquidity production) depends upon depositor confidence (i.e. assessment of risk), and this creates interdependencies between depositors. Individual depositor decision making which ignores these interdependencies can thus be socially sub optimal. (See Diamond and Dybvig, 1983).

Also important, however, is the risk faced by loan customers of banks. A not insignificant part of bank financing involves ongoing access of customers to credit, either by way of overdraft, unused commitments, or remaining tranches of funds to be drawndown under project financing etc. Removal of these facilities, through bank failure for example, can create considerable dislocation - indeed Bernanke (1983) has suggested that this aspect of bank failures in the USA in the 1930s was more significant than the decline in bank liabilities.

In principle, there is little reason (in discussions of

public policy) to pay particular attention to the risk faced by the equity holders in financial institutions. Investors of risk capital, it can be argued, should be expected to bear the risks of their investment. In practice, that is not the case for several reasons. First, for many financial institutions, the line between depositors and providers of equity funds is extremely blurred. Co-operative and mutual financial institutions such as credit unions, building societies, mutual life offices, are owned by their customers - and the distinction between whether funds provided by these customers are debt or equity is often blurred. Second, the major growth sector of the financial system during the 1980s - that of unit trusts - is one in which providers of funds are, in effect, providing equity. The extent to which those contributors of funds are "informed" about risk, and to which the social issues differ from those associated with deposit institutions may be more a matter of degree than of kind. Finally, as the Victorian experience dramatically indicates, public policy issues are undeniably involved when the equity holder in an institution is the public sector.

While the government may bear risk through direct equity investments in financial institutions, it may also be subject to equivalent risk from decisions to protect depositors at privately owned financial institutions. This is amply illustrated by U.S. experience with deposit insurance, and recent Australian experience such as with the Pyramid Building

Society. In circumstances where the government is not adequately compensated for the risk it bears by offering depositor protection to customers of private institutions, the exposure of the government may be little different between private ownership to public ownership.

Identifying all the stakeholders in a financial institution raises the question of the interrelationship between their exposures. Here, the theory of option pricing provides a useful mode of analysis - and helps in our subsequent discussion of possible causes of increased risk, and methods of assessing trends in risk.

2.   Risks in banking - an option theoretic framework

A model which can be used to illustrate the interdependencies between the risks borne by various bank stakeholders is as follows. The bank accepts deposits maturing at time T for a promised amount D_T. (Any implict interest paid to bank depositors is incorporated into the promised return.) The value of the bank's assets at that date is the random variable V_T. The value of the bank's equity at that date is thus

$$E_T = Max [V_T - D_T , 0] \qquad [1]$$

which indicates that the bank equity can be thought of as a long call option position on the bank's assets with an exercise price of D_T. (The owners of the bank have, in effect, the right to purchase the assets of the bank from the depositors by payment

7

of the promised deposit amount.) Thus the current (time 0) value
of the bank's equity is

$$E_0 = C(V_0, D_T, T, r_f, \sigma_V)\qquad\qquad [2]$$

where r_f is the risk free interest rate, σ_V is the volatility
(standard deviation) of the rate of return on the bank's assets,
and C( ) is the call option pricing function appropriate for the
stochastic behaviour of V.

  Using the put-call parity relationship

$$V_0 = D_T.e^{-rfT} + C - P\qquad\qquad [3]$$

where P is a put option with the same parameters as C, as well
as the balance sheet constraint

$$V_0 = D_0 + E_0\qquad\qquad [4]$$

we can obtain an expression for the current value of deposits

$$D_0 = D_T.e^{-rfT} - P(V_0, D_T, T, r_f, \sigma_V).\qquad\qquad [5]$$

The preceding equation indicates two important points.
First, the depositors can be interpreted as having made a risk
free loan to the bank as well as having sold a put option over
the bank's assets to the bank owners. Second, the contractual
return on deposits (the discount rate which makes D_0 the present
value of D_T) exceeds the risk free interest rate as long as P( )
exceeds zero. Similarly, the expected return on deposits will
exceed the risk free interest rate. In the absence of government
guarantees of deposits, deposits can only be risk free if the
stochastic behaviour of V_0 is such that the put option is always
out of the money. This would require that banks voluntarily

maintain an asset mix and capital position such that there is no risk of default on deposits.

If we focus, as is commonly done, on the occurrence of bank failure, this corresponds to the instances in which the put option is exercised. The probability of that occurrence depends upon the distribution of V_T relative to D_T, so that the important parameters are the promised deposit repayments relative to current asset value (which are determined by the deposit interest rate and leverage), and the volatility and expected value of asset returns. These, with the exception of the expected return on assets are the key determinants of the put option value as well.

Notably, if we turn to the volatility of returns to bank shareholders, the same factors play the fundamental role. It can be shown (Cox and Rubinstein, 1985) that the volatility of the return on a call option (which here is the bank equity) equals the call option elasticity times the volatility of the underlying item. Thus the variability of stockholder returns depends also on the underlying asset volatility, promised deposit interest rates, and leverage.

The analysis so far has focused only upon two stakeholders, ignoring the role of government. When government guarantees of deposits are in place, they can be interpreted as granting a put option over the bank assets to the depositors of the bank. (See

Flood, 1990). Adding P( ) to equation [5] above gives

$$D_0 = D_T.e^{-rT} \qquad\qquad [6]$$

so that deposits are made at the bank at the risk free rate of interest. From the shareholders' perspective, they have been granted the call option which constitutes their equity by the government - at a zero price. They have an incentive to maximize the value of this free option, which can be done in either of two ways. First, since increases in the current price of the underlying item (here the bank's assets) increase a call option's price by more than equivalent sized increases in the strike price (here the promised deposit repayment) reduce its value, the bank's owners have an incentive to increase bank leverage. Second, since increased volatility increases call option values, the bank's owners have an incentive to select an asset portfolio of increased volatility.

One problem with the option theoretic approach outlined above is that it cannot capture the entire range of factors which contribute to the exposure of stakeholders in financial institutions. These factors can be classified under a number of (not independent) headings (see Lewis and Davis (1987) chapter 3). First, interest rate risk involves variability in income arising from mismatching the repricing intervals of assets and liabilities. Second, liquidity risk involves variability in income arising from unexpected changes in the quantity of particular assets or liabilities. Third, default risk relates to income variability associated with the unpredictability of cash

flows associated with particular assets. Fourth, operations risk
arises from the chance for fraud, errors etc. Fifth, position
risk represents the risk due to holding an open position in some
market (foreign exchange, futures, swaps etc.), or from granting
option type contracts to customers. These factors are the
sources of risk which are summarized in the relationship between
volatility of asset values and level of obligations reflected in
the option model.

3. Has Risk Increased?

As noted in section one of this paper, the mere fact of an
increase in financial institution failures and loan loss
provisions is not of itself evidence of increased risk in
financial intermediation. However, if we are not to use ex post
realizations as indicators of change in risk, what measures are
appropriate? Here, the option pricing perspective on the
interaction of stakeholder risks, outlined above, becomes
useful, since it indicates the variables which need to be
examined.

<u>Relative deposit interest rates</u>

One possible approach is to look at whether the yields
required by depositors have increased vis a vis risk free rates,
representing the development of a premium for increased risk.
This was illustrated in equation [5] above, where the expected

return on deposits increased with increases in the value of the put option granted by depositors. Since the quoted deposit rate represents the maximum return, movements in this rate vis a vis government yields could provide evidence of changing risk perceptions. Unfortunately, the changes in bank regulation which have altered the attractiveness of various types of financing over time, make this comparison uninformative. Even more important, the existence of "implicit government guarantees" over bank deposits has, as explained previously, prevented this mechanism from operating.

Returns on bank equity

A second approach involves examining the returns required by shareholders. The option pricing framework utilised above indicates that the volatility of returns on bank assets is a key ingredient in any meure of risk, and that this volatility (in association with bank leverage) will be reflected in the volatility of equity returns. Consequently, one method of testing for increased risk in banking would be to examine the extent to which risk to equity holders has changed over time. Various measures such as the total variability of returns or systematic risk (with respect to a market equity index or interest rates) could be used (Saunders, Strock and Travlos, 1990) . While for equity holders it may be the undiversifiable systematic risks which matter, it is total risk which matters in considering depositor risk. However, if it is found that total risk has increased, it is also important to ask the extent to

which it can be attributed to systematic or bank-specific features.

Implied volatility estimates

A third approach involves recognizing that using actual returns as above, involves the problem of discerning ex ante risk from ex post outcomes. An alternative source of data lies in the market prices for options on the shares in the three large private banks. Those prices imply market estimates of future volatility, which can be compared to market estimates of implied volatility of the share price index to assess whether banking sector risk has increased relative to other sectors of the economy.

Market valuation of banks

A fourth approach is to look at the Tobin q-ratio for banks (Keeley, 1989). This ratio expresses the market valuation of banks (equity and deposits/debt) as a proportion of the replacement value of assets, which in the case of banks may be approximated by the book value of assets. Since the market valuation reflects expected future cash flows discounted at an appropriately risk adjusted discount rate, a high q value ratio can be interpreted as indicating relatively low risk. Conversely, a low q ratio might indicate a high risk position, perhaps because the book valuation of assets overstates their

real worth, or because of concerns about the quality of management.

Indicators of potential failure

A fifth approach is to examine changes in the factors creating banking sector risk. At the bank asset level, such factors include the nature of loans, interest rate mismatching etc.. At the depositor level, the bank capital ratio plays a crucial role. Demirguc-Kunt (1989) has summarized the results of a number of US studies which endeavour to find variables which are statistically significant predictors of financial institution failure. Measures of capital adequacy are typically found to be relevant, as are measures of earnings. The other category of influences which are regularly found to be significant are measures of asset quality. The other components of the CAMEL classification scheme, management and liquidity, appear to play no significant role.

Casual examination of the Australian situation might suggest that the potential for increased bank risk has increased markedly - with the removal of regulations which prevented banks from various activities. At the same time however, markets and instruments have developed which should tend to limit banking risk.

If we look at the types of problems which have arisen in the Australian financial sector, there appears to be support for

the role of the CAMEL type of factors.

Problems in the unit trust area, particularly property trusts, have arisen because of the attempt by trust managers to provide liquidity to unit holders - even though the market for the assets of the trust is not liquid.

Concerns with some life assurance institutions has arisen because they have offered capital guaranteed liabilitites while investing in assets with uncertain capital values but not having an equity base to provide the buffer needed for making such a guarantee.

Much of the loan loss provisioning of banks appears to reflect inadequate loan assessment procedures.

A shift from net interest income to fee income has altered the reliability of reported income figures as indicators of the health of institutions.

Changes in the Banking Environment

A final approach lies in examining those changes in the environment in which financial institutions operate which may have contributed to change risk. A number of such changes can be identified.

Increased economic volatility: Where economic conditions become more volatile, the returns obtained by banks on the loan portfolio may become more variable.

Increased interest rate and exchange rate volatility: Unless asset-liability and market positions are appropriately altered, increased risk could occur from this source.

Less official control on bank competition and risk taking: deregulation has allowed increased competition among financial institutions and the possibility of increased risk. Also, the disincentive to take on risk, because of the loss of monopolistic rents if bank failure occurs, may have declined.

Increased position risk arising from technological change in areas such as payments services.

Lowering of official impediments to contagion.

Unfortunately, identifying such potential causes of increased bank risk, does not imply that banking risk has increased. Concurrent with these external developments, there have been the emergence of new technology, new financial markets, new financial instruments. Some examples are relevant:

The interbank cash market: provides a mechanism for transfers of liquidity between banks which supplements the traditional role of the official short term money market.

Repurchase agreements: also provide a source of short term liquidity

Financial futures markets: enable banks to hedge interest rate risk arising from mismatching of deposit and asset maturities.

Swap markets: also enable banks to hedge interest rate risk

4. Public Policy and Risk in Banking

The preceding section has indicated ways in which the proposition that banking sector risk has increased could be tested. This section considers some issues involved in public policy responses to perceived increases in banking risk.

[a] Small Institutions and Risk

One response to a perceived increase in banking sector risk has been the emergence of proposals that smaller institutions need to be merged. The notion appears to be that there is increased safety in size. Three types of argument can underpin

this view. The first argument is that the evidence indicates a greater propensity for small institutions to fail. The second argument is that there are economies of either scale or scope which cannot be exploited by small institutions. Faced with subsequent cost disadvantages, such institutions may be inclined to take greater risks. The third argument is that the expertise to operate in the more risky financial environment requires a larger scale operation.

The first argument can be dismissed fairly easily. While small institutions may fail more often than larger institutions, it is not clear that the number of institutional failures is the variable which should be of concern. If the value of depositor losses is the variable of social concern, two institutional failures of $0.5m should be regarded as equivalent to one failure of $1.0m. The question to be addressed becomes that of how the probability of failure changes as institutional size increases.

Reducing the number of institutions by merger clearly reduces the number of institutions which can fail, but it is not clear what social objective is achieved by this. Shaffer (1989) shows that combining two depository institutions has the following effects. First, the probability that the combined institution will fail is less than the probability that at least one of the separate institutions will fail. Second, however, the probability of the merged institution's failure is greater than

17

that of both institutions simultaneously failing. Where both institutions would fail because of a common systemic factor to which they were both exposed, so also would the pooled institution. If mergers are to be advocated, it is not to reduce systemic exposures, but because pooling might reduce the number of failures due to idiosyncratic factors. The case for merger must then be based on one of the other arguments about cost economies or management, not on reducing systemic risk in banking. (The exception to this argument is if the stability of depositor confidence is changed, but there are alternatives to merger to achieving this.)

The second argument relating to economies of scale or scope is not supported by recent empirical evidence. Lawrence (1989) is one of the latest in a series of papers presenting evidence that the average cost curve in banking is U-shaped, although he does suggest economies of scope arising from computer technology.

The third argument, relating to expertise, requires that necessary risk management skills are too expensive for small institutions to acquire. That view involves particluar assumptions about the nature of the labour market for personnel with risk management skills, which may or may not be valid, and warrant further examination.

[b] Risk based regulation

Recent years have seen the development of the risk weighted assets approach to bank capital regulation, and suggestions that this be extended to other institutions. While this is generally viewed as an improvement upon the imposition of a simple minimum capital requirement, there are some who have argued instead for alternatives such as "appropriately priced" deposit insurance. Often, the view that underpins this approach is that the capital requirements impose arbitrary constraints on bank activity, and involve a reregulation of banking.

What is sometimes not appreciated is that in a world of perfect information, risk based pricing of deposit insurance and risk based capital ratios are operationally equivalent. To see this, note that the motivation for both approaches is to prevent bank management from exploiting the put option over bank assets which has been granted by the authorities when they provide depositor protection. Under a risk based deposit insurance scheme, the authorities charge insurance premiums which equal the value of the put option granted - the key parameters in which are the volatility of bank asset values and leverage (reflecting the option strike price). If the authorities are concerned about the number of potential failures of insured institutions, they can structure the insurance schedule such that the premiums are only attractive (i.e. actuarally fair) for options with a low probability of exercise. Under a risk based capital requirement, the authorities can set a fixed insurance

premium (such as a license fee) and by altering the capital requirement as asset value volatility changes, ensure that banks choose the put options corresponding to the fixed premium.

This argument applies, of course, to a world of perfect information - but has implications for real world choices. First, it indicates something about the way in which a risk based capital requirement should be structured. The current scheme does not meet that requirement. Second, it indictes that the choice between or combination of a priced insurance scheme and a capital requirements scheme needs to be made on the basis of the real world imperfections which make the two approaches less than perfect substitutes. Flannery (1989) provides an illustration of this point.

[c]   Market Discipline

Some proponents of deregulated banking assert that market monitoring and discipline will limit the risk taking behaviour of banks - and that many problems of bank failure reflect the usurping of these functions by governments. Were there no government insurance or perceived guarantees of deposits, the effects of bank asset quality and leverage would show up in the cost of funds to banks - thereby signalling to the market the risk status of that institution. Even uninformed depositors would be able to assess bank risk by, for example, credit ratings which reflect current market assessments.

Such signalling effects could occur through changes in explicit or implicit ratings of bank debt instruments or through movements in the price of bank equity in response to bank risk parameters. Gilbert (1990) summarizes the results of a large number of U.S. studies in this area. In general the market for bank equity appears to respond to information about measures of bank risk, supporting a role for market discipline. On the other hand, there is less evidence that uninsured deposit and debt markets respond to similar information.

Given the economic function performed by banks of overcoming information imperfections in the evaluation and monitoring of borrowers, it is not surprising that market discipline is less than perfect. Nevertheless, the development of market based mechanisms such as ratings of bank bond issues can provide a useful complement to official supervision and monitoring.

6. Conclusion

This paper has outlined various ways in which the proposition that banking sector risk has increased could be examined. Underpinning those approaches was the use of an option theoretic model of banking to identify the interdependencies between exposures of various stakeholders in banks. Finally, various topical public policy issues related to dealing with a

perceived increase in risk were analysed.

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