An approach to economic capital for financial services firms

What is economic capital, and how can it be both used and calculated? Bruce Porteous, Louise McCulloch and Pradip Tapadar have the answers

A precise definition of economic capital is hard to find, even though it is often referred to in risk and finance literature, including the new Basel capital Accord (Basel II) and the UK Financial Services Authority's (FSA) consultation papers. Under Basel II, it is broadly considered to be the amount of capital a financial services firm's own internal risk assessment determines it should hold. This appears to leave the determination of economic capital to the discretion of the firm, but this determination will be subject to regulatory scrutiny.

We believe economic capital should satisfy the following criteria:

☐ It should represent the amount of capital a firm requires to remain solvent following events that might be considered as unexpected, yet not so unlikely that they might never occur in practice.

☐ If a firm's reserves cover unexpected, as well as expected, events – for example, the resilience reserve, an asset/liability mismatch reserve occasionally prescribed by the FSA, that UK life assurance companies must set up (although under current FSA proposals, this may soon become a capital charge rather than a reserve) – this extra amount should be counted as economic capital.

☐ Solvency should be based on a firm's realistic market value balance sheet, rather than its statutory or book balance sheet. In other words, both assets and liabilities should be valued as realistically as possible, usually by discounting asset and liability future cashflows at risk discount rates reflecting the underlying risks inherent in the assets and liabilities. This is the approach we have taken here. In this sense, economic capital should contain no additional safety margins that might normally be included in a regulatory capital charge.

We therefore believe economic capital should represent the amount of capital a firm needs to hold under a genuinely realistic risk assessment. So, for the purposes of this article, we define economic capital as 'the amount of capital a firm should hold to keep its realistic balance sheet solvent following a series of events that might be considered as unexpected, yet still reasonably likely to occur in practice'.

From a probabilistic point of view, this definition is imprecise. But at this stage we will resist prescribing 'unexpected' in precise probability terms because, as is described later, this may not always be possible or helpful in practice.

Unexpected events

We believe the term 'unexpected event' should cover any unlikely event that could threaten the realistic solvency and ongoing economic viability of a firm. For example, a firm may lose a major distribution channel, resulting in a drop-off in both new and existing business volumes. If the firm cannot reduce its expenses in line with the fall in business volumes, it may no longer be able to operate profitably. If the problem persists, the firm will ultimately erode its capital base below the level required by the regulators and will cease trading or require recapitalisation.

Table A, taken from Porteous (2002), lists the types of risks financial services firms typically collect.

A firm's economic capital calculation should take into account the amount of capital it needs to survive an unexpected event concerning any appropriate combination of at least the above risks.

For example, for a life assurance firm, one component of its economic capital calculation might comprise the amount of capital it needs to hold if future improvements in annuitant mortality are greater than has been priced into its annuity rates.

For a retail mortgage bank, for example, one component of its economic capital calculation might comprise the amount of capital it needs to hold in case customer retention is poorer than has been assumed in its mortgage pricing.

The current UK approach of setting regulatory capital for financial services firms has evolved over many years somewhat arbitrarily, and with perhaps little attention to the nature and extent of the underlying risks firms carry on their balance sheets. For example, in a speech given to a City and Financial conference Clive Briault (2002), director of prudential standards at the FSA, stated that in connection with insurance regulatory capital: "The current minimum EU standards are certainly out of date and seriously flawed."

Similarly, banks in most jurisdictions around the world set their regulatory

A. Types of financial risk

Type of risk	Collector
Mortality/morbidity	Life assurance, health insurance, pension funds, reversion companies
Business retention	All
Expense	All
Market risk (for example, equity investment)	Life assurance, asset management, pension funds, investment banks
House price inflation	Life assurance, retail banks, reversion companies
Credit	Life assurance, asset management, pension funds, retail/wholesale/investment banks
Interest rate	Life assurance, retail/wholesale/investment banks
Currency	Life assurance, pension funds, wholesale/investment banks
Retail price or earnings inflation	Life assurance, pension funds
Liquidity	All
Claims experience risk	General insurance, health insurance companies
Operational	All

B. Life assurance example stresses

Stress	Fixed expenses	Mortality improvements	Corporate bond yields
1	Base + 15%	Base	Base
2	Base	Twice as fast as base	Base
3	Base	Base	Fall from 5% to 3%
4	Base + 15%	Twice as fast as base	Fall from 5% to 3%

capital charge according to a local variant of the current Basel capital Accord (Basel I). In a speech to the British Bankers' Association, Howard Davies (2002), the chairman of the FSA, stated that in relation to Basel I, "… the somewhat by-and-large approach to capital under the 1988 Accord does have considerable theoretical and practical weaknesses. There is little doubt that regulatory and economic capital have become significantly misaligned."

Basel II is a response to the broad-brush approach of Basel I. Under Basel II, regulatory capital will better reflect the underlying risks a bank is running, so regulatory capital should be closer to true economic capital. Similarly, the capital rules for insurance companies are also currently subject to both FSA and European review, and we can expect a more risk-based approach to emerge in due course.

Porteous (2001) has shown that, under Basel II, the capital charge for retail mortgage banks is likely to fall substantially. For retail mortgage banks, therefore, regulatory capital may currently be too large relative to the risks such banks are running. Certainly, we might expect regulators to err on the side of caution in setting regulatory capital. But the Bank for International Settlements has implied in its Basel II draft that the amount of regulatory capital supporting the worldwide banking system will not increase as a result of the new Accord. This seems to imply that, for certain business lines, the Basel I regulatory capital charge may not be sufficient to cover the underlying risks banks are running. In other words, it appears that the misalignment referred to by Davies may go either way.

The main uses of economic capital for regulators and financial services firms are described below:

☐ **Regulators.** In setting a risk-based regulatory capital charge, it may be appropriate to base the charge on the corresponding amount of economic capital required to cover such risks, perhaps plus a small margin. The regulatory capital charge will then, rather than being an arbitrary charge, possibly containing either very large positive or negative margins, be based on a genuine risk-assessment of the underlying risk.

This is broadly the approach of the new Basel Accord and it is likely that, in due course, this approach may also be carried over to non-banking financial services firms. See Briault (2002) for a discussion of this point in connection with insurance firms.

As the products offered by financial services firms – and the financial instruments backing such products – become more complex, it is likely that static regulatory capital rules, based on an economic capital justification at a given point in time, will become outdated. This may again result in regulatory capital becoming misaligned with the underlying risks.

The current UK approach of setting regulatory capital for financial services firms has evolved over many years somewhat arbitrarily

Basel II and the UK's FSA (via their consultation paper CP136) are therefore likely to require all firms to regularly compare their internally calculated economic capital with their regulatory capital charge. If the economic capital amount exceeds the regulatory capital amount, then a regulatory capital top-up may be required. Likewise, if economic capital is less than regulatory capital, the FSA might, in certain circumstances, be open to the possibility of a regulatory capital charge reduction (see Briault, 2002).

☐ **Financial services firms.** To assess individual business unit performance, most financial services firms compare return on capital earned versus cost of capital. But this begs the more fundamental question of what is the appropriate amount of capital that should be allocated to support each business unit.

Regulatory capital might be used, but this will penalise business units containing retail mortgages, for example, where the Basel I capital charge is in excess of that required to cover the risks run by that unit. Likewise, business units where regulatory capital is inadequate to cover the underlying risks will be subsidised. For business unit performance assessment to be fair and objective, it seems unavoidable that capital allocation across business units should be based on an economic capital measure. Such an approach should help firms better understand which parts of their businesses are adding or destroying value, bearing in mind the relative risks each unit is running.

Life assurance example

We now look at the example of a life assurance company whose long-term business fund (LTBF) is made up of £1 billion of pension annuities. The LTBF is the internal policyholder fund that contains the assets backing the annuity business and must, at all times, have assets equal to at least the amount of the annuity business mathematical reserves (the reserves actuaries set up to cover life assurance liabilities).

Our approach to determining economic capital is as follows:

☐ We determine the economic value of the life assurance company's LTBF by discounting, at our assumed risk discount rate, all future net cashflows that will emerge from this fund – that is, economic value is essentially the market value of assets less the market value of liabilities for that fund. This is our base case, with all other elements of the life assurance company's balance sheet ignored, for example, the company's equity capital.

☐ The exercise is then repeated, after having stressed the life assurance company's economic value experience assumptions to a combination of unexpected, yet plausible, stresses.

☐ Economic capital is then determined as -min (0, stress 1 economic value, stress 2 economic value, …), that is, the amount of capital required for the LTBF's realistic balance sheet to remain solvent after the worst of the stresses.

The stresses we have used in this example are shown in table B.

We believe these stresses represent a reasonable compromise between events that are unexpected, yet could still con-

ceivably occur in practice, and that these stress variables are the most important variables to consider for pensions annuity business. With a deterministic approach, the choice of which stresses to use will always involve a certain amount of judgement.

We have priced our annuities to achieve a rate of return on capital according to the following two definitions of pricing capital:

☐ Pricing capital 1: the initial capital required to ensure the LTBF contains sufficient assets to cover its mathematical reserves.

☐ Pricing capital 2: pricing capital 1 plus the additional capital required to cover the LTBF's resilience reserve and solvency margin requirements.

Three annuity prices have been calculated as follows:

☐ Price 1: to achieve a post-tax rate of return on pricing capital 1 of 5%.

☐ Price 2: to achieve a post-tax rate of return on pricing capital 1 of 10%.

☐ Price 3: to achieve a post-tax rate of return on pricing capital 2 of 10%.

As the price 1 rate of return on capital < the price 2 rate of return on capital and pricing capital 1 < pricing capital 2, it follows that annuity price 1 < annuity price 2 < annuity price 3. Our economic value results are shown in table C.

We compare the resultant economic capital amounts with the corresponding regulatory capital amounts in table D.

In table D, we have taken regulatory capital as the excess amount of the annuity mathematical reserves over the realistic reserves plus the resilience reserve and the solvency margin. It can be seen from this table that, for this particular example, the regulatory capital charge is comfortably in excess of the economic capital amount, particularly for the more expensively priced annuities.

Likewise it can be seen that, as the annuity price becomes cheaper, the economic capital amount moves closer to the regulatory capital charge. It is clear that, if annuities are priced cheaply enough, eventually the economic capital amount will exceed the regulatory capital charge. In fact, based on preliminary work we have done on the cheapest priced annuities in the highly competitive UK market, this point may already have been reached.

Retail mortgage bank example

Here, we assume that the bank's balance sheet comprises £500 million of floating-rate residential mortgages, funded 100% by floating-rate instant access deposit accounts.

Our approach to determining economic capital is as follows:

☐ We determine the economic value of the bank's balance sheet by discounting, at our assumed risk discount rate, all future net cashflows that will emerge from the current mortgage/savings books; that is, economic value is the market value of assets less the market value of liabilities. This is our base-case, with other elements of the balance sheet, such as the bank's equity capital, ignored.

☐ The exercise is then repeated, after having stressed the bank's economic value experience assumptions to a combination of unexpected, yet plausible, stresses.

☐ Economic capital is then determined as -min (0, stress 1 economic value, stress 2 economic value, …), that is, the amount of capital required for the bank's realistic balance sheet to remain solvent after the worst of the stresses.

The stresses in this example are presented in table E. We believe they represent a reasonable compromise between events that are unexpected, yet could conceivably occur in practice, and that these stress variables are the most important variables for a mortgage bank. With a deterministic approach, choosing which stresses to use will again always involve a certain amount of judgement.

We have priced our mortgages according to the following two pricing criteria.

☐ Pricing 1: to achieve a 12% post-tax rate of return on capital assuming a Basel I risk weight of 50%.

☐ Pricing 2: to achieve a 16% post-tax rate of return on capital assuming a Basel I risk weight of 50%.

The corresponding economic value results are shown in table F:

So, the economic capital for this example is £11.1 million under-pricing 1 and £8.0 million under-pricing 2.

This compares with a Basel I regulatory charge of £20 million and a Basel II charge of £11 million (see paragraph 288 of the Basel Committee's Technical Guidance on Quantitative Impact Study 3), but excluding the Basel II operational risk charge.

In our approach to economic capital we have not explicitly allowed for the extra

C. Life assurance example economic value results

	Economic value (£ million)	Economic value (£ million)	Economic value (£ million)
Stress	**Pricing 1**	**Pricing 2**	**Pricing 3**
Base	0	5.2	32.0
1	(0.2)	5.0	31.8
2	(32.4)	(27.1)	0.9
3	(55.6)	(49.3)	(16.2)
4	(103.7)	(97.1)	(62.4)

D. Life assurance example economic capital results

	Pricing 1	Pricing 2	Pricing 3
Economic capital	103.7	97.1	62.4
Regulatory capital {(mathematical reserve - realistic reserve) + resilience reserve + solvency margin}	135.1	134.2	129.2

E. Retail mortgage bank example stresses.

	Mortgage				Savings	
Stress	**Prepayment rates**	**Fixed expenses**	**Interest rate margin**	**Bad debt cost**	**Withdrawal**	**Fixed expenses**
1	Base	Base	Base − 50bp	Base	Base − 50%	Base + 15%
2	Base + 50%	Base	Base	Base	Base − 50%	Base + 15%
3	Base	Base + 15%	Base	Base	Base − 50%	Base + 15%
4	Base	Base	Base	Base + 5bp	Base − 50%	Base + 15%
5	Base + 50%	Base + 15%	Base − 50bp	Base + 5bp	Base − 50%	Base + 15%

capital that may be required for the bank's realistic balance sheet to survive an additional operational risk event (that is, as defined in the Basel Committee's Technical Guidance on Quantitative Impact Study 3, "… the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. This definition includes legal risk, but excludes strategic and reputational risk").

Our example implicitly assumes that the stresses are not the result of an operational risk event, so we need to increase our economic capital estimate to include a component in respect of operational risk.

On average, the Basel Committee expects the new Basel II operational risk capital charge to be around 12% of the Basel I charge (see paragraph 592 of the Basel Committee's Technical Guidance on Quantitative Impact Study 3), so equalling £2.5 million in this example. Table G summarises our results, having added in the average Basel II operational risk capital charge, where appropriate.

As expected for our simple retail mortgage bank, the Basel I capital charge appears to be too high relative to the risks the bank is running, and the Basel II charge appears to better reflect the underlying risks. But as with our life assurance example, economic capital increases as the price of the mortgage falls, and may eventually exceed the Basel I or II capital charge if the pricing is cheap enough.

Deterministic or stochastic approach?

In this article, we have adopted a deterministic stress-based approach to setting economic capital. A stochastic approach (using the estimated probability distribution of the variables under consideration to generate outcomes for those variables) is, at least theoretically, to be preferred:

☐ It allows the firm's realistic balance sheet to be stochastically generated. One advantage of this is that economic capital can then be set to ensure the firm's realistic balance sheet becomes insolvent only with a small specified probability. We can then make broad statements about the likelihood of the firm becoming insolvent.

☐ Correlations between the stress variables can be modelled formally rather than by simply assuming that the deterministic stresses are 100% correlated. For example, in our retail mortgage bank example, we have assumed that mortgage prepayment rates increase by 50% at the same time as the bank's interest rate margin contracts by 50 basis points (for example, in a low interest rate scenario, banks' interest rate margins contract and customer churning increases). Although this might be conservative, it may not occur in practice. Formal modelling of the circumstances in which a bank's interest rate margin contracts by 50bp may provide a more reliable indication of the associated mortgage prepayment rate movement.

With a deterministic approach, the choice of which stresses to use will always involve a certain amount of judgement

The main difficulties with the stochastic approach are as follows:

☐ Implementation involves estimating the multivariate probability distribution of the variables under consideration. This is likely to be difficult due to data paucity, the very large number of variables that could be considered and the identification of which variables are responses and which are explanatory – that is, identifying the direction of any causal relationships between variables.

☐ The stochastic approach is much more challenging to communicate. For example, to the board of directors of the firm, or to the regulator.

In this article we have introduced and discussed an approach to economic capital for financial services firms. We have considered two real examples, one based on a UK life assurance company and the other on a UK mortgage bank. Our main conclusions are as follows:

☐ UK life assurance regulatory capital appears to be more than adequate to cover our pension annuity economic capital. But there is one proviso, which is that, if the annuities are substantially under-priced, regulatory capital may not be sufficient.

☐ For UK mortgage banks, the Basel II capital charge appears broadly in line with our economic capital amount, whereas for Basel I, it appears to be too large. Similarly, if mortgages are significantly underpriced, the regulatory capital charge may not be sufficient.

☐ Stress-based economic capital is a very useful tool in quantifying the size of financial services firms' risks.

☐ With very significant product underpricing, financial services regulatory capital may not be sufficient to cover economic capital. ■

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A summary of the detailed base-case assumptions that underlie our examples are available on request from

F. Retail mortgage bank example economic value results

	Economic value (£ million)	Economic value (£ million)
Stress	Pricing 1	Pricing 2
Base	2.1	5.6
1	(9.3)	(5.5)
2	(4.9)	(2.2)
3	(2.5)	0.9
4	(3.0)	0.4
5	(11.1)	(8.0)

G. Retail mortgage bank example economic capital results

Method	Charge (£ million)
Economic capital: pricing 1	13.6
Economic capital: pricing 2	10.5
Basel II	13.5
Basel I	20.0

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