THE DYNAMICS OF FINANCIAL ANALYSIS

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Introduction

Dynamic Financial Analysis, or DFA, is now on everybody's lips in the insurance and reinsurance industry.

DFA is one of those insurance terms that is used by many but with no one agreed definition. In purest terms, it represents a whole company asset and liability model, but in common usage it is any probabilistic or stochastic model.

Building a multi-year, multi-risk model (for example, asset and reserving risk) is a more difficult task, a task that most insurers have avoided, unless forced. But what are the practical implications of building and implementing such a multi-year, multi-risk DFA model in an insurance company? Are there any benefits to offset the pain of the process?

Many insurance markets round the world are moving towards more risk based regulatory regimes. Within Africa, the South African Financial Services Board is encouraging the use of internal financial models in its new capital regime proposals. These follow the developments by the Australian Prudential Regulatory Authority (APRA) in the Australian market but represent a global trend, perhaps the most notable being Solvency II, a European wide risk-based solvency system, which is currently being finalised and expected to be in place by 2010. These regulatory developments are being complemented by Enterprise Risk Management (ERM) being given significant focus by rating agencies, in particular Standard & Poor's. A key element of ERM is the development and, more importantly, the use of internal models.

Fortunately for the global insurance industry, one part of the world has, albeit reluctantly, pioneered the development of whole company, multi-year asset and liability models. Virtually every UK company now either has a DFA model of their business, or is building one, driven in part by the expectations of the UK Financial Services Authority. Demand for DFA software and for actuaries and analysts with DFA experience is rocketing.

But why is this? What was the motivation for UK companies (or the UK regulator) to invest so quickly and so heavily in DFA modelling? Are there lessons in the successes and failures experienced by UK insurers?

What is DFA?

DFA is now often used as a catch-all term for any stochastic financial model. A stochastic model does not just seek to present the most likely result, or a worst case, but rather the whole range of possible outcomes, each with its associated probability. It does this by describing each key variable in a system as a probability distribution rather than just a single value. Some distributions may depend upon others, while others will be independent. Thousands of simulations will be run, perhaps one hundred thousand, each a different version of the following year or years. From the model, it is possible to see not only the most likely outcome (the median) but also the average (the mean) or the extremes (e.g. the 1 in 200th worst year).

The early days of DFA

Stochastic modelling really started to be used in re/insurance in the 1990s, as computer power increased and software tools became available. Typical initial analyses were limited to specific tasks, for example optimisation of the reinsurance programme for a single class of business. But by the late 1990s whole company DFA models were being attempted, particularly in the USA. The concept was captivating, a single model encompassing all the risks to which the company was exposed. Strategic decisions could be compared based upon their impact on the whole company: for example, would reinsurance strategy A deliver a higher return

and lower the risk of company failure than strategy B? Or is the company investment policy consistent with its underwriting risk appetite?

Unfortunately, most of the early projects failed; they tried to do too much, too soon. The software was slow and not very robust, the models became too complicated and impossible to interpret or audit. Whole company DFA models got a very bad name.

Stochastic modelling comes of age

Through the late 1990s and early 2000s stochastic analysis became common-place. The modelling was often used by reinsurance brokers to determine "optimal" reinsurance arrangements and prove to their customers the value of their reinsurance purchase. Similarly, the output was often used to demonstrate the economics of a deal to reinsurers, particularly for non-traditional reinsurances where the behaviour of the contract may not be readily clear.

In parallel, probabilistic catastrophe peril models were growing in use and influence. A peril model is essentially a specific purpose DFA model, though often, particularly in the early days, with little transparency about the assumptions used to generate the catastrophe events themselves or the damage they cause. People became familiar with the concept of a "1 in 100" event or "1 in 100" aggregate year for catastrophic risk and sought equivalent information for other classes of business.

At the same time, computers were getting faster and DFA software becoming readily available, either as add-in to Microsoft Excel or as a stand-alone product. At the end of 1999, the first component based, flexible DFA tool ReMetrica™ was launched. There was now no theoretical barrier to building a stochastic financial model appropriate to each task.

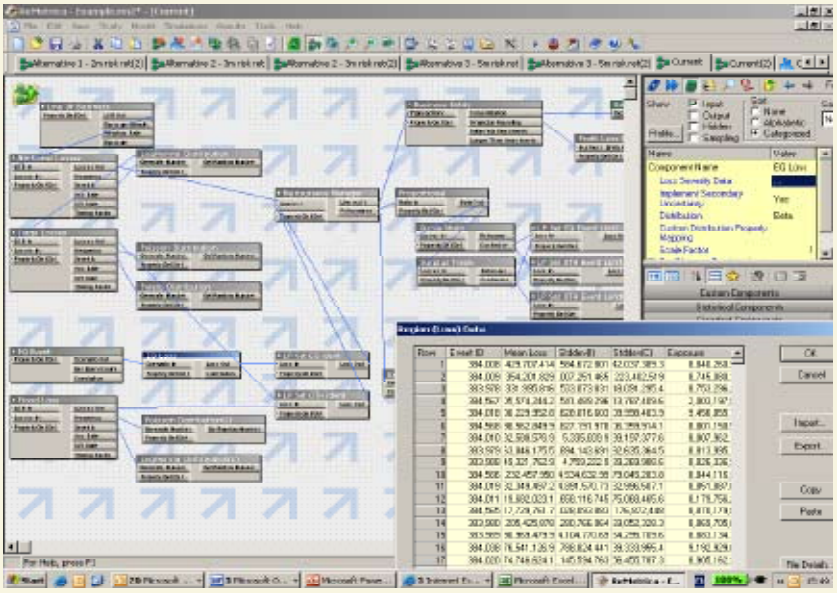

Figure 1: Example Component based DFA model with event by event peril model input

Whole company DFA models

By the early 2000s full company DFA were still a "nice to have" rather than a "need to have". But it had become clear to many that business strategies could not be properly compared on a departmental basis if one measure of success was the capital efficiency of the company as a whole.

How to model capital is a matter for another paper, but typically companies use some form of Value at Risk (VAR) or Tail Value at Risk (TVAR) method to assess and/or allocate the economic capital required to support a line of business. Note that VAR methods look at a chosen percentile, whilst TVAR methods look at the average over a threshold. For example, every 200 years, you may expect an underwriting loss of over USD 100m or more (VAR) with the average such large loss being USD 150m (TVAR).

Consider two companies with identical motor portfolios; one a mono-line motor company, the other a diversified composite company. The capital implication of cancelling a quota share reinsurance arrangement for the mono-line company is likely to be severe: its 1 in 200 number, and so its required capital, could double. But for the diversified company, things are very different. It could be that its capital is driven not by the motor book but by a much larger property book exposed to catastrophe risk. Cancelling the quota share does inject more risk in the motor book, but most of the 1 in 200 year and above scenarios for the company as a whole are driven by the property book. Cancelling the motor quota share thus has little if any capital implication.

An early case study

An example of this is some work done around the turn of the century with a leading UK company. The company was one of the first to attempt a whole company DFA in the UK, but would be the first to acknowledge that in 1999 it was still very crude. Benfield was attempting to show the value of the company's UK catastrophe treaty protections.

1. Benfield's initial analysis looked at the impact of the programme on the company's UK catastrophe losses: the 1 in 100 catastrophe loss, at the time its chosen benchmark, was cut from £500m to under £50m, an excellent result.
2. Benfield then looked at the cover in the context of the company's global catastrophe exposures; it still looked good, reflecting the UK dominance of their portfolio.
3. But when non-catastrophe property losses were included, things began to change. The model probably over-estimated the variability of attritional property losses, but even so the result was unexpected. The gap between the gross and net 1 in 100 result narrowed from £400m to under £200m, as bad attritional loss years dominated the net 1 in 100 number. Whilst still valuable, the catastrophe cover was looking less attractive.
4. Adding in all other underwriting risks, e.g. motor, casualty etc, the impact of the catastrophe cover was becoming negligible – the gap between 1 in 100 gross and net of the catastrophe cover fell to under £50m.
5. When asset risk was added, the gap almost disappeared – the UK catastrophe programme had no measurable effect on the group's 1 in 100 number.

Did that company stop buying catastrophe cover on the basis of that analysis? No, for two reasons: firstly the model was known to be flawed, so it would be unwise to base a decision solely on the result of that model; secondly the company was well aware that catastrophe reinsurance is not only bought for capital protection. Should there be a large catastrophe tomorrow and the company reported a larger net loss proportionate to size than its peers, it would appear ill-managed, its share price would fall and management might lose their jobs.

But the company did at last have the beginnings of a framework to judge the value of its reinsurances objectively. It became aware that these models can be used to educate stakeholders about why decisions were made, managing expectation.

The same company continued to develop its DFA model, achieving by 2005 a "state of the art" regulatory capital model. Interestingly, the model showed that for regulatory capital purposes, catastrophe reinsurance was important, but capital requirements were dominated by reserving and asset risk.

Current drivers of demand

The spur for UK companies though was not internal but external. The European Union has long been edging towards a uniform risk-based regulatory capital regime called Solvency II, but the UK regulator, the Financial Services Authority (FSA), decided to go it alone. In 2005, the FSA introduced a risk-based capital regime with a commitment to it being "super-equivalent" to that likely to emerge from European discussion. Essentially the capital assessment element has three components:

1. Minimum Solvency Requirement (MSR): the current "Solvency I" EU minimum capital. Regulatory capital must be at least at this level.
2. Economic Capital Required (ECR): an enhanced

ratio with separate varying charges based on premiums, reserves and asset classes.

3. Individual Capital Assessment (ICA): the company's own view of its capital requirement – with the probability threshold set at 1 in 200. Many UK companies have used DFA models to derive this number.

From these three the FSA impose Individual Capital Guidance (ICG). Normally, this is at least the higher of the MSR, ECR and ICA, perhaps with an additional margin, although the FSA has offered the carrot that it may be willing to accept the ICA number even if lower than the ECR if it is convinced by the model.

Contrary to FSA expectation, the vast majority of UK companies decided to use a DFA model to estimate their ICA; the FSA expected most initially to use stress-test methods. This caused the FSA a problem, as it did not have enough actuaries to validate the DFA models built. But in truth, the FSA is more interested in seeing that there is a robust risk management process in place. The DFA model is part of the evidence that a company has thought through the risks it faces and how they inter-relate.

But interestingly, aside from official regulatory developments, the methodology is now being championed by those that many would call the real regulators of the insurance industry, the rating agencies.

Rating Agency Pressure

In late 2005, Standard & Poor's (S&P) announced two initiatives that could have profound implications for many insurers and reinsurers. Firstly, the catastrophe element of its capital adequacy calculation was no longer to be a flat premium charge but rather a modelled 1 in 250 worst case aggregate net catastrophe loss year. In many cases, this has caused a leap in capital requirement. S&P makes no recommendation about which peril model to use. The agency is aware of the risk of "peril model shopping", i.e. companies picking the most benign model in the market. It seeks to ameliorate this risk by expecting the same model to be used in internal decision making, i.e. the same model should be used to determine reinsurance policy and perhaps be included in the corporate DFA.

The second S&P initiative is a more formal consideration of a company's Enterprise Risk Management (ERM). Just like the UK regulator, S&P wants to see that risks are properly managed and that robust risk control policies and procedures are in place. Again there is no immediate requirement for a DFA model, but it is expected that most re/insurers will feel that they have a greater chance of demonstrating an efficient ERM policy if a corporate DFA is the result of such a process, i.e. risks are not only identified, but also quantified.

However, the position is becoming more interesting. For example, in November 2006, Standard and Poor's published a consultation paper about their proposed capital modelling changes. They indicated in an accompanying brief paper that they will take into account the results of a company's internal "ERM modelling" in their capital assessment. Like their announcement in the previous year about using peril model results to assess catastrophe capital, it is suspected that the exact methodology is yet to be fully thought through. Clearly the key to whether they accept internal modelling will be the credibility of:

1. **The modelling approach:** How are key risks identified, assessed and captured in the internal model, including risk inter-dependencies? Also what risks fall outside the main probabilistic model and how are allowances made for these?
2. **The software used:** Benfield's ReMetrica™ is the market's leading DFA software, used by over 50 companies worldwide and recently selected by the world's largest, AXA, for all their global insurance, reinsurance, asset and capital modelling. Within Africa, ReMetrica is now used by Africa Re and the three largest South African insurance companies.
3. **The model's use:** Do management fully understand the model, and can they demonstrate the model is used to make key business decisions?

The last point is key, it is likely that S&P staff will be more comfortable auditing the softer elements of the ERM process, i.e. risk registers and risk control procedures, than the DFA. But, the DFA must be credible, transparent and intuitive.

Lessons learnt from the UK

It is certainly true that the UK experience over the last

two years has been painful: painful for the companies, painful for the regulators and painful (if profitable) for the actuaries and modellers. But there have been positive lessons learnt and potential traps identified. These include:

1. **Do not under-estimate the time that the process will take.** This is not only time for actuaries and modellers, but also time for business managers and ultimately the board. The FSA does not want to see a model owned by actuaries used once a year to keep it happy. It wants to see a model embedded in the risk management and decision making culture of the company. A senior FSA spokesman said in 2005 "We expect the senior management team to "own" the ICA and to understand what it means for the way in which they manage the business"; other regulators and rating agencies will have similar expectations. This is not just a model, it is a cultural change. So start early, don't wait until you have to do it.
2. **Do not expect it to be easy.** The FSA require a multi-year model, normally 3-5 years. They expect the model to behave realistically, e.g. if there is a big loss in year 1 of a simulation, what will happen to reinsurance pricing? It expects companies to think through the impact of business and pricing cycles on their business and their volatility. Companies are expected to identify and model dependency and correlation explicitly. All this must be expressed in a way that is not only technical, but also measurable and understandable to non-mathematicians.
3. **Do expect some surprises.** It is rare for a model not to come up with unexpected results. But it is also rare for a truly unexpected result to not be either due to a mistake or an over-simplified assumption. Checking the model will probably take as long as building it.
4. **Keep it simple.** It is far better to have a simple model which is understood, with its flaws identified and known, than an over-complicated model which produces results nobody understands. One leading UK company was forced to scrap its ICA model as it produced results far worse than any of its competitors for reasons that were not fully understood. If a flexible DFA tool is used, it is possible to add complexity back in where required once a working, believable, base model is built.
5. **Don't build a DFA just because you feel you have to have one.** Build a DFA for a purpose. If there is no immediate regulatory pressure, then pick a pilot study – perhaps a simple whole company capital model, or a detailed model of one line of business for reinsurance optimisation purposes.
6. **Have clear responsibilities and deliverables.** Every DFA project must have a senior management champion, a strong project leader, buy-in from all levels of management and clear, measurable deliverables. If even one of these is not there, the chance of failure is high. If possible, phase the project such that the first real value is delivered in weeks, not months or years.
7. **Choose your software carefully.** In the final reckoning, cost of software is but a small part of the cost of a DFA exercise. The software must be flexible, fit for purpose, robust and fast. This will include having the necessary sophisticated business logic and operating functionality in terms of both model building and result management and reporting. Even then, the software must be robust enough to run over 100,000 simulations, otherwise, as many UK companies have found, the results are vulnerable to sampling error. And finally, the most important lesson:
8. **Remember models advise, models do not decide.** Even the most sophisticated model must be used wisely. Every model requires interpretation; it must be a guide to decision making not the decision maker. A company that lets a model decide its future is dead. But, used intelligently, a DFA model is a superb management tool that can help management determine optimal policy, test the sensitivity of that policy to changes in assumptions, demonstrate risk management competence and explain decisions to others, be they colleagues, superiors, regulators, rating agencies, shareholders, parent company, analysts or reinsurers.

Embarking on a DFA process is not trivial, but within

three years every major company, in Africa or elsewhere, will either have a whole company DFA model or be desperately building one. But building a model is the easy part; embedding it in the culture of the company, and so getting the full benefit without damaging but rather improving the efficiency of the company, is the real challenge.