HEARTBEAT IN THE FOG

PARAMETRIC INSURANCE OF INTANGIBLE ASSETS

John Donald
john.donald@axiscapital.com

AXIS

Contents

Introduction

London 1888. Fog again. You are standing in the backstreets of Whitechapel. The wind from the river is roiling the mist in front of your eyes. You can't see anything, it's a real pea souper. In the distance, you faintly hear the clacking of the rigging of the tea clippers in St Katharine Docks. An aural point of orientation. A sonic lighthouse. A signal to guide you home. But the mist is so disorientating that you can't really tell which direction it's coming from. Moving your head and straining your ears, you try to get a proper bearing. And then you hear it. A heartbeat. Very close. A heartbeat in the fog.

A wave of relief and then a frisson of fear. It's very close by. There must be someone else out there. A friend? Or Jack the Ripper? Or maybe it is just the fevered beating of your own heart...

Economists neatly divide activity into three categories: primary industry, which is the extraction of resources; secondary industry, which is manufacturing; and tertiary industry, which is services. As economies develop, they tend to move up this scale and become dominated by the service sector. They grow less concerned with physical goods and more concerned with knowledge; a segue from tangible to intangible. This change is clearly visible at the corporate level too. Examining the balance sheets of the S&P 500, some 83% of their value now stems from intangible assets, up from only 20% or so forty years ago. These intangibles are a heterogeneous collection of items such as service contracts, intellectual property, goodwill, software, trademarks, data, rights of use and other non-physical goods. Unlike property or machinery, they are hard to classify and even harder to value. This is the fog.

Traditional insurance is inadequate in several ways. One of which is the growing coverage gap; the difference between the damage inflicted by events and the amount of insurance cover. In tangible assets, like property, this has ballooned in recent years and now stands at $136bn. But if tangible asset insurance with its 400-year history still falls short of the mark, try glancing across to the intangible side of the balance sheet. These assets are hardly insured at all. We are still at the starting line.

Traditional insurance is based on the concept of indemnity. There must be a demonstrable and calculable loss that can then be used to justify a payment, in compensation for that amount.

The challenge is that in the slippery fog of intangibles, financial values, and indeed damage, is hard to pin down. This is where parametric insurance comes in. The beauty of parametric insurance is that it is free from the concept of demonstrable asset damage, so you don't need to figure out what a particular asset is worth. Parametric insurance is as simple as an if-then statement: if this, then pay that. All that is needed is a trigger and a pay-out mechanism. That is the heartbeat in the fog.

Part A:

Problems with the Status Quo

The coverage gap

How much insurance does the world need? An underwriter might glibly answer 'as much as possible'. A more considered way of answering the question would be to examine the current value of the assets that require protecting, and the scale of losses that might be expected to occur. In this way, two indicators can be calculated: the penetration rate and the coverage gap.

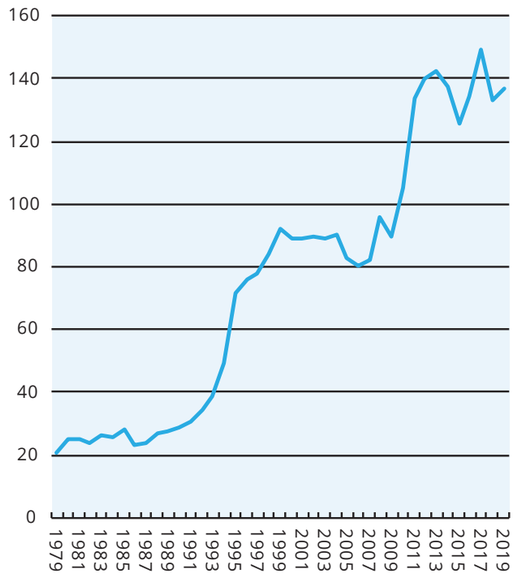
The first could be a comparison between the total value of assets and the total value of insurance cover. But since it is hard to calculate the total value of all assets that exist in the world, the insurance penetration rate is normally expressed as the ratio of premiums paid to GDP. For the last decade or so, this has typically been around 3% for non-life insurance according to the Swiss Re Institute [1]. That means that if you viewed the whole earth as if it was a single economic entity – Global Inc, if you will – then that company would be spending 3% of its revenues on insurance.

The coverage gap approach tries to be a bit more precise than this. Taking the specific case of property for example, the Swiss Re Institute calculates the total value of property damage worldwide year by year caused by natural catastrophes and man-made disasters. In 2019 (according to their calculations) this was US$133bn [2]. Of this, only US$50bn was insured meaning a coverage gap of US$83bn. Given the unpredictable nature of earthquakes and hurricanes, this coverage gap can vary quite dramatically year by year.

For instance, in 2017 it was $207bn because of the extensive damage caused by hurricanes Harvey and Irma. So, to smooth out this volatility, the coverage gap is normally expressed as a ten-year moving average as shown in Fig 1. As you can see, this has grown from $20bn in 1979 to $136bn in 2019.

The coverage gap also varies quite markedly by geographic location. While North America and Europe are mature economies with a reasonable level of cover, other parts of the world are significantly underinsured. In Asia in 2017, for example, out of total losses of $31bn, only $5bn was insured. The developing world is growing faster than the West. This, coupled with climate change which makes extreme weather events more likely, means that the coverage gap is likely to continue to worsen for the foreseeable future.

Figure 1 – Coverage Gap ($bn)



Source: Swiss Re/Sigma

Tangibles vs. intangibles

The previous discussion was focused only on property insurance, a product that is well established and with a comprehensive historic data set. Property is a tangible asset that can be readily valued and traded but it still has issues with adequate insurance cover. However, if we turn our attention to intangible assets, we will see that the situation there is far worse. In fact, in key areas there is no cover at all. A 2019 study by Ponemon Institute [3] estimates that tangible assets are 60% covered but intangibles only 16%.

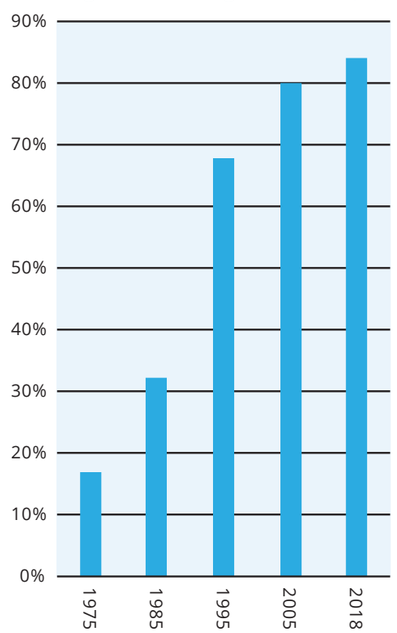
As a quick reminder, tangible assets are physical objects such as houses, cars, machinery and the like. Intangible assets are things like service contracts, intellectual property, goodwill, software, trademarks, data, rights of use and other non-physical goods. Intangibles have grown at a phenomenal rate in corporate balance sheets.

A study by Ocean Tomo in 2015 [4] showed how the components of value of the S&P 500 have changed dramatically over the last 40 years. As we mentioned in the introduction, in 1975, 83% of the value of the S&P 500 was accounted for by tangible assets. By 2015 this had completely reversed, with 84% of the value coming from intangible assets giving a total value of these intangibles of $25tr (See Fig 2).

We should note that the methodology behind this study is slightly dubious since it involves simply subtracting the value of tangible assets from the market capitalisation. There are conceptually two different ways of valuing a company – what the accountants say and what investors say. The accountants record their valuation of assets on a particular day in an audited balance sheet report.

Investors are looking at future earnings from those assets and expressing that in a share price. In essence, it's the difference between a stock view and a flow view. If they were the same, then a company would always trade on 1x book value which is rarely the case. Just for the record, the S&P 500 is currently trading on 3.7x book value, and briefly reached as high as 5x in the dotcom bubble of 2000. Having said that, it is clear that intangible assets are playing a much bigger part in the value of a company than previously.

Figure 2 – Intangible Assets (%)



Source: Ocean Tomo/Ponemon

So, what do these $25tr of intangible assets consist of? We can break it down into several main categories:

- Contracted rights
- Capitalised R&D spending
- Goodwill
- Brand value

Amongst these, contracted rights are the easiest category to establish financial value. Contracted rights include franchise and royalty agreements, licensing arrangements, mineral extractions rights, import quotas and other negotiated agreements. They have been legally established, they are protected by contract terms and have a clear monetary value that was established by the transaction.

This concept of a third-party validation is a common theme. After all, the value of something, in the end, is whatever someone else is willing to pay for it. In the contest between what you think it is worth and what someone else is willing to pay for it, the latter always wins. This is key when we examine the other categories of goodwill and R&D spending.

Companies need to spend on research and development in order to come up with improved products that the market will want. The question is should spending in this area be treated as an expense or as an investment? The purpose of this spending is to develop something for the future which would imply it is an investment and so capitalised and then depreciated in a similar way to investment in plant and machinery.

But, on the other hand, what if the research proves fruitless or the development does not result in a marketable product? In that case it would be wrong to think of dud R&D as an asset.

Unfortunately, the accounting profession does not have a single view on this issue and there is inconsistency between different accounting standards. Broadly speaking international accounting standards (IFRS) allow R&D expenses to be capitalised while US accounting standards (US GAAP) require them to be expensed. These inconsistencies make valuing R&D overly subjective, adding to the fog of intangibles.

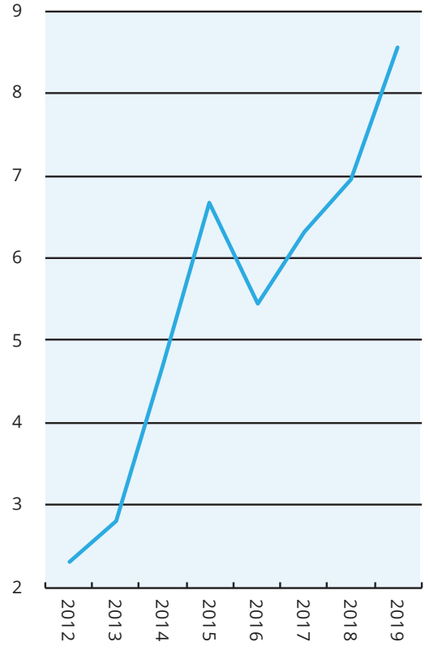
Turning to goodwill, since this is based on a market transaction there is a bit more clarity. When one company buys another, it normally has to pay over the odds. They bid at higher than the current market price and, as noted before, most companies trade at above book value. So, after the acquisition the acquired company's assets are incorporated into the balance sheet and the excess amount paid beyond book value is put into the balance sheet as goodwill. The argument is that since you paid money for it, it must be worth that much but since you can't ascribe the excess to any particular item it becomes just a generalised intangible asset called goodwill.

You will spot the problem here immediately. What if it's not worth the money you paid for it? That would mean that the goodwill value was spurious.

Given that the value of global M&A has been around $3tr a year for the last 5 years [5], and using a conservative 2x book value for these transactions, that would suggest that $3tr of goodwill is being added to corporate balance sheets globally each year. That is one driving factor behind the extraordinary growth of intangibles on corporate balance sheets, and a factor that is probably overstated (see Fig 3).

Goodwill is a strange type of asset in that it cannot be sold, transferred or exchanged. There is no replacement cost for goodwill as there is for machinery. It is an economic fudge factor to make sure the books balance. It also introduces a potential error through double counting. The difference between the price paid and the book value of the assets theoretically reflects the value of future earnings streams.

Figure 3 – Goodwill Added ($tr)



Source: Refinitiv/AXIS

But over time these earnings streams are realised without goodwill necessarily being reduced to reflect this. Though it used to be depreciated over a 40-year period, this is no longer the case after the accounting rules changed in 2001 (FASB statement 142). So, goodwill is hanging around for longer, although the current practice is to evaluate it each year with an annual impairment test which could result in write-offs. Management has two reasons to avoid doing this: less borrowing capacity and lower profits. A smaller asset base reduces borrowing ability and a goodwill write-off hits the P&L.

Also note there is a slightly anomalous situation that if you buy another company's R&D you can put it on your balance sheet as an asset (goodwill), but if you develop it yourself you cannot.

Share buybacks

Another factor that is driving the rise in share of intangibles on the balance sheet is the growth in popularity of share buybacks. Prior to 1982, it was illegal for a company to purchase its own shares on the stock market because it was seen as form of stock manipulation. However, the rules were changed as share buybacks were recognised to be an efficient way of returning excess cash to shareholders. It has since become extremely popular with an estimated $800bn spent on share buybacks by US listed companies in 2019 according to Forbes Magazine [6]. Take IBM as an example. Ten years ago, in 2009, it had 1.3bn common shares outstanding, but today after an extended program of share buybacks this has shrunk by 30% to 892m. Another example is Apple, which has spent $319bn buying back its own stock over the last 7 years. The balance sheet effect of this is to convert tangible assets (cash) into contra equity account otherwise known as treasury stock. By shrinking tangible assets, the intangible to tangible ratio increases.

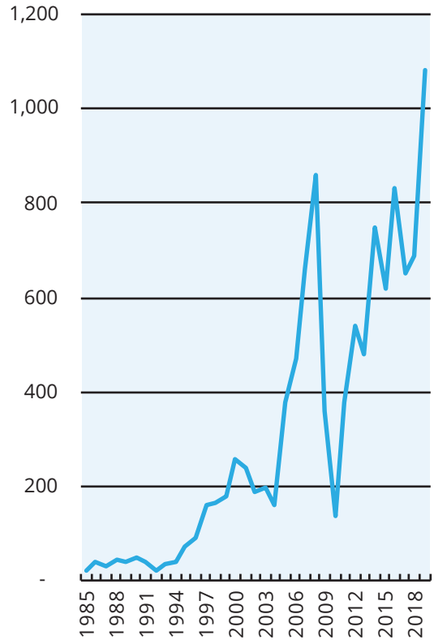
Share buybacks are popular with CEOs because it boosts the share price and improves earnings per share. Since a large part of senior management's pay is based on share options, the temptation to massage the share price upwards at particular times is evident. The US market's extraordinary bull run for the last 10 years has been partly driven by these share buybacks (see Fig 4).

There are a few other points to make when considering how share buybacks have impacted corporate balance sheets. First, in the past, excess cash was used to reinvest in productive capacity – plant and equipment to generate future revenues. But this tangible asset investment has since been diverted into shrinking outstanding equity. Second, in 2018 30% of share buybacks were funded by debt issuance rather than cash.

Borrowing money to buy back shares weakens the balance sheet further. Debt to equity ratios rise as debt swells and equity shrinks. Lastly, we need to consider the price paid for the share. Buying back your own shares make good sense if they are being substantially undervalued by the market. But buying them back after a 10-year bull run has stretched valuation measures to the very top of their historic range is more questionable.

Buying a company at above book value increases goodwill on the balance sheet. Buying back your own equity at inflated prices converts assets into treasury stock. Both have the effect of increasing the intangible proportion of the balance sheet.

Figure 4 – Share buybacks ($bn)



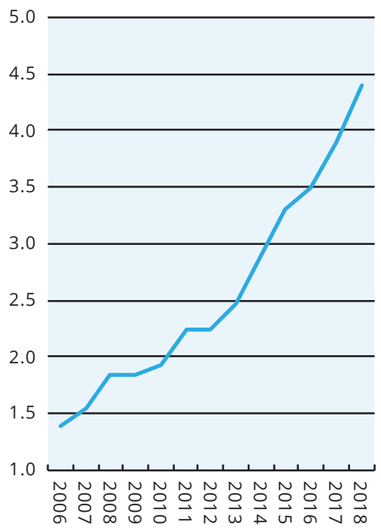
Source: Visual Capitalist

The value of brands

The appropriate value of brands has generated much debate. The value of a brand will be part of the goodwill equation. Take this example. In 1988 Nestle bought Rowntree, the UK confectionary company famous for its fruit gums and jelly babies. It paid £2.5bn which was three times more than the market thought it was worth. Nestle then had a big problem with its accounts.

Traditionally, accountants would only look at the value of tangible assets; physical things like equipment and buildings. The difference between what you paid for a company and its tangible assets was called goodwill and had to be written off. Rowntree at the time had tangible assets of £0.5bn. So according to the accounting principles of the day, Nestle had just blown £2bn on intangible assets that had no true recognised value. It faced having to declare a huge loss.

Figure 5 – Brand Value ($tr)



Source: WPP/BrandZ

Nestle argued this was nonsense. The intangible assets were not worthless, in fact they were very valuable. They were Rowntree's consumer brand names that had cost many millions in advertising investment to build up. Moreover, they were more valuable than physical equipment. Machinery wears out and breaks down in the end; it depreciates in value. Brand names don't. They last a lifetime.

This debate about accounting policies ran on for over a decade. The proper accounting treatment of brands was not settled until 1999 in the UK and 2002 in the US. Nestle's view won out. Brands do have financial value and don't necessarily depreciate. That value has grown dramatically in recent years as shown in Fig 5.

A brand is a set of perceptions and feelings that a company owns in the mind of a consumer. When a company brands its products, it is attempting to establish a set of emotional responses that the target consumer will feel. Turning these subjective feelings into an objective financial value is tricky but that does not stop many from trying. Forbes Magazine publishes an annual survey of US brands ranked by value [7]. The top five are shown in the table below.

Forbes Magazine Brand Survey 2019

Apple	$205bn
Google	$167bn
Microsoft	$125bn
Amazon	$97bn
Facebook	$88bn

Top of the list is Apple with an estimated brand value of $205bn. That is around $26 for every person on the planet. In other words, somewhere in the basement of your brain, alongside your fears and your childhood memories, is a little bit that is worth $26 and owned by Apple. How does that feel? Did you ask them to put it there?

That was just a light-hearted way of illustrating how the problem of valuing emotions in someone's head can seem bizarre at times. That said, there are three different approaches that are commonly used:

1. Cost based approach

This method examines how much money has been spent on building the brand through advertising, promotional expenditure and trademark fees. Calculating the brand value is then simply a case of adding up all that previous spending. The problem with this approach is that it is backward looking, assumes the money has been well spent and that there was no multiplier effect: a dollar spent on advertising created only a dollar of value.

2. Income based approach

This views a brand as an asset capable of generating revenues in the future. The advertising spend is thus an investment which will pay off in the long term. Its value can then be determined by the future expected revenue stream discounted by an appropriate rate of interest. Happily, the stock market is valuing future revenue streams for every listed company on a daily basis and expressing it in the price to earnings (PE) ratio. So, applying that PE ratio to, say, a three-year average of earnings from the brand will give you a value. The Forbes survey uses a methodology similar to this.

The advantage is that this is a forward-looking methodology which assumes a handsome return on brand investment. However, it is hostage to the vicissitudes of the stock market and can be distorted by investors' fear and greed.

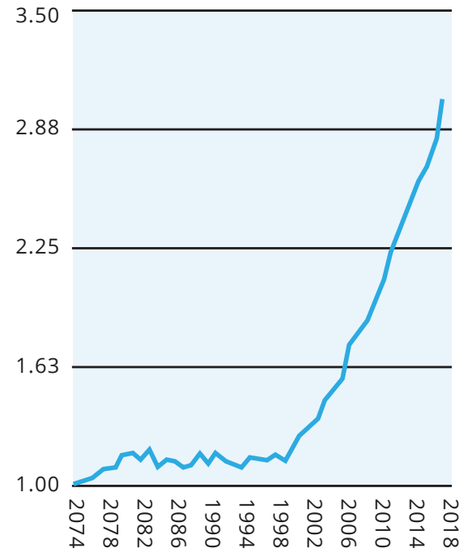
3. Consumer based survey approaches

A third methodology is based on directly surveyed consumer sentiment. After all, it is the consumers in the end who make the critical purchasing decision. The brand value is assessed through questionnaires asking consumers to rank their brand preferences and indicate how big a brand premium they might be willing to pay, and whether they would recommend it to a friend. In this way, the degree to which the brand is differentiated from a generic product can be established. From this, 'brand earnings' can be estimated – earnings purely due to the brand strength and not other factors. Applying an appropriate future earnings multiple will then give a current asset value. This approach is used by marketing organisations such as Nielson and WPP BrandZ [8].

Intellectual Property

A brand is clearly an asset and can be legally defined as such through the use of trademarks. Likewise, other types of intellectual property can gain legal status through the use of patents. Patents typically last 20 years before expiring but new ones are being added all the time.
The inception and expiration of patents was roughly in balance in the past, with the number of patents in force in the USA hovering at around 1.1m for over 25 years throughout the period from 1974 to 2000. But since 2000, they have grown dramatically in number as shown in Fig 6.

Figure 6 – USA Patents in Force (m)



Source: Patentlyo

There are now 3m patents in force in USA, but this still understates the situation. Widening the view to look at global figures, there were 3m patent applications globally in just one year (2018). Of these, only 1.4m were actually granted but it's still safe to say that there has been an explosion in the number of patents.

A lot of the growth comes from China where the number of patent applications has grown fivefold in the past 10 years.

An expansion in the number of patents is exactly what you would expect as the global economy becomes more knowledge based. But the growth in patent applications is also driven by a less wholesome factor: the emergence of patent trolls. These are specialist operators who build up portfolios of old patents (often bought from bankrupt companies) and then try to enforce patent rights beyond their original remit, through hardball legal tactics.

Patent trolls cost the US economy around $29bn each year in terms of lawyers' bills and license fees according to a study by Boston University [9]. The aggressive and vexatious tactics used by patent trolls has made corporations review their existing intellectual property portfolios, re-evaluating their worth and ensuring they are properly categorised and protected. Hence, an increase in patent applications.

Intellectual property infringement claims would not typically be covered under a standard commercial general liability (CGL) policy. But specialist Intellectual property insurance is available and currently exists in two flavours:

- Defensive policies which cover settlements resulting from lawsuits against the policyholder
- Enforcement policies which allow the policy holder to sue intellectual property infringers

However, you will notice the compensation that these policies offer is based on the legal costs, not the commercial costs of lost revenues from your ideas being stolen. Those will presumably be covered by the damages awarded in the lawsuit.

It's also worth remembering that you can't patent everything. A patent cannot protect an abstract idea on its own. It needs to be embodied in a machine, tool or process of some sort. Also, the invention must be novel, useful and not obvious. This makes patenting software quite difficult at times. If the software is deemed to improve a computer's functionality it is patentable. But if the software performs a more generalised function and only uses the computer for execution then it is deemed an 'abstract idea' and therefore not patentable. Typically, mathematical algorithms are not patentable because of this.

A common view amongst developers is that most software is neither novel, nor non-obvious since any decent coder could probably write it. For both these reasons, patenting software is tricky and requires careful wording in the application process.

Despite the growth in patent applications described earlier, many tech companies don't bother applying for patents. This is partly because the wording proves tricky but more because it broadcasts to your competitors, and indeed the whole world, what you are trying to do.

Start-ups prefer to keep their ideas secret and, besides, they often pivot to a different business model in the early years. For example, Instagram was originally designed to be a location-based check-in service before it pivoted to become a social media behemoth. Had they applied for a patent when they started out, they would have protected the wrong thing.

A better strategy for tech start-ups is to avoid the legal hassle of patents and just focus on gaining a critical mass of users as fast as possible. Establishing a dominant position in a new market is better protection than a legal patent. It would be tough to dethrone Google from its dominant position in internet search even if you perfectly copied its technology because of the scale advantages of a large user base.

Once established, tech titans protect themselves by simply buying up any young start-ups with fresh ideas that may threaten them. All this would suggest that it is not the idea itself that should be prized but rather the user base that it attracts, and beyond that its associated data. Forget the patent, it's the data that is valuable.

Data is the new oil

The Economist magazine in May 2017 devoted its cover to pointing out the similarities between data and oil. At the beginning of the 20th century, oil was a valuable new commodity that became the engine of economic development, spawning a lucrative and fast-growing industry and eventually prompting the anti-trust regulators to step in. Exactly the same can be said about data at the beginning of the 21st century. To extend the analogy a bit further, the $3bn clean-up costs of the Exxon Valdez disaster in 1989, when a tanker spilt 10m gallons of oil in Alaska, triggered a dramatic change in industry thinking about safety and sped up the introduction of double hulled vessels. In a similar way, data breaches, which represent oil spills in our analogy, are becoming so expensive that cyber security is front and centre on most boards' risk registers. The estimated $1.7bn cost of the 2017 Equifax breach certainly focussed many minds on the topic.

Crude oil needs to be refined to be useful, so does data. In the case of oil, we can define three states: oil reserves in the ground (which may be uneconomic to extract), crude oil that has been extracted and finally refined petroleum products which are commercially useful. In the case of data, we can draw the analogy as shown below:

Oil reserves = Analog data

Crude oil = Digital data

Petroleum products = Information

Data is all around us. The random pattern of leaves on a forest floor is a type of data but it is not in a digital form and it has no meaning. This type of analog data can be thought of as oil reserves under the ground that may not have been discovered yet and may not be economic to extract even if they were.

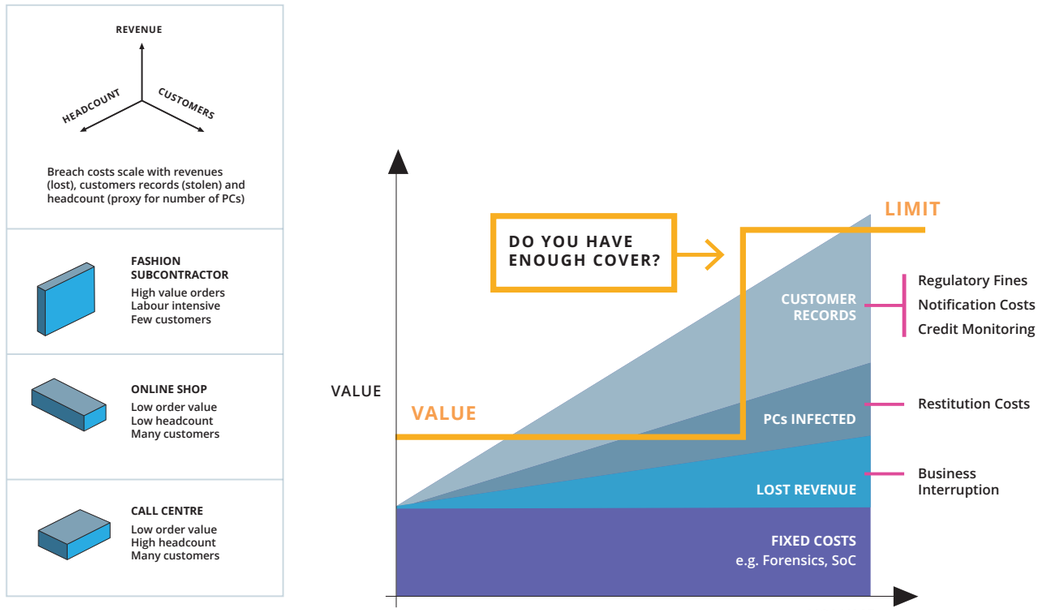
However, once it has been 'extracted' into a digital form it can then be processed into useful information. This processing – gleaning information from data – can be done by humans but it is much more efficient to do it with machines. So, the equivalent of an oil refinery is a machine learning algorithm which sucks input from a large data reserve and produces insights that have commercial value. Large data sets can be mined to reveal previously unknown trends and patterns. This is the 'AI plus big data' revolution which we will discuss in more detail later. Examples include scouring purchasing records to predict consumer behaviour or scanning medical records to predict and diagnose disease.

However, data is an unusual commodity and unlike oil in several important ways. First, data is the only thing you can lose and still keep at the same time. It is perfectly replicable – identical copies can be created at (virtually) no cost and with no damage to the original. So, it can be stolen from you without your knowledge while you remain in possession of the original. Second, data is highly contextual. Oil is a fungible, freely traded commodity whose value is the same everywhere. The value of data is very dependent on who knows it and when. The chemical formula for a particular compound may only be of interest to another chemist. Knowing the details of a corporate announcement before it is made public can be commercially advantageous. After the announcement, it has little value since it is widely known and in the public domain. Third, data in some legal jurisdictions is not recognised as being 'property'. In some court cases, the media on which the data was stored (e.g. the disks) was judged to be property and therefore subject to physical loss but the data content not.

The final point to make is maybe the most important. The Economist article warned of anti-trust regulations. Trust busting regulations in 1911 led to the breakup of Standard Oil into 33 different companies. Likewise, the data monopolies of Facebook and Google are under increasing scrutiny from regulators. If we view data as a resource similar to oil, there is a question as to who actually owns it and who is authorised to mine it.

The new GDPR and CCPA regulations are reasserting the rights of individuals to own and control their own data. There are companies that sit atop a vast data lake that are not highly valued, maybe because the rights to exploit that data resource are unclear. Unlike Facebook which is valued at six times its book value, Deutsche Bank trades at a price to book ratio of only 0.25 despite having colossal amounts of customer financial data. The difference is, of course, that users give Facebook the right to mine their data, but few people would like their bank transactions widely exposed to others.

Figure 7



Source: AXIS

Cyber losses – Fog is clearing?

Let's summarise the discussion so far. Intangibles are an increasingly dominant part of corporate balance sheets, but they are hard to accurately value or define – hence the fog analogy. Concepts such as goodwill and brands have accounting inconsistencies which make it difficult to establish a truly objective financial value. Intellectual property may not be defined legally nor properly crystallised through patents. More valuable than any of the above may be data; this commodity is now recognised as the 'new oil', whose exploitation holds the key to future economic dominance but whose asset value is undetermined by accountants and whose legal status as 'property' is uncertain. In this fog how is it possible to make progress?

The good news is that at least in one corner of the intangibles universe, the fog may be clearing. Much as the value of an object is determined once a financial transaction takes place, the 'value' of data can be said to be demonstrated through a different type of transaction – its loss. Losses from cyber-attacks are material, fast growing and indemnified by a developing cyber insurance market which is beginning to create recognisable financial landmarks in the pervading mist.

Insurable losses from cyber-attacks come in different forms including business interruption, data recovery, regulatory fines, ransom demands, customer monitoring & recompense, PR and communication expenses and other restitution costs required to bring the systems back to normal again. A report by Net Diligence in December 2019 put the average cost of a data breach at $178k for a SME and $5.6m for a large corporate [10].

Cyber security revolves around three data attributes: confidentiality, integrity and availability. We previously discussed the value of intellectual property so clearly this must be kept confidential – you don't want your competitor to get access to it.

But it's not just the theft of valuable data that needs to be protected against. Data integrity is vital as corrupted or unreliable data will cripple corporate activity. Lastly, availability is essential. Your data might be safe and uncorrupted but if you can't access it then it is useless.

Typically, the costs of a cyber-attack scale with three key factors; the employee headcount, the number of clients and the revenues (see Fig 7). Corporate headcount is a good proxy for the size of the IT estate particularly for professional service companies where every employee has a PC. Roughly half of all cyber insurance claims come from the professional services sector. The number of clients a company has is a good indicator for the number of records kept in databases. The Net Diligence report estimates a cyber incident will cost $234 per record on average.

Lastly, a company's monthly revenues are the key to determining business interruption costs; it could take several months for systems to be up and running which means several months of lost revenues. Looking at the historic claims data, Net Diligence puts the median figure for business interruption following a cyber-attack at $45k.

One of the most worrying trends recently is the rise in ransomware attacks. A hacker gains access to the corporate network, maybe through a phishing attack, denying access to essential data by encrypting it. The hacker then demands a ransom payment – normally in anonymous Bitcoin. Once the ransom is paid the hacker will give the encryption key allowing the data to be recovered. The above report puts the average cost of a ransomware demand at $72k and growing at an alarming rate. Indeed, the ransom demands can be much larger than that. They are getting so excessive that it is sometimes cheaper to laboriously reconstruct data from paper files by hand for several weeks rather than pay a six-figure ransom.

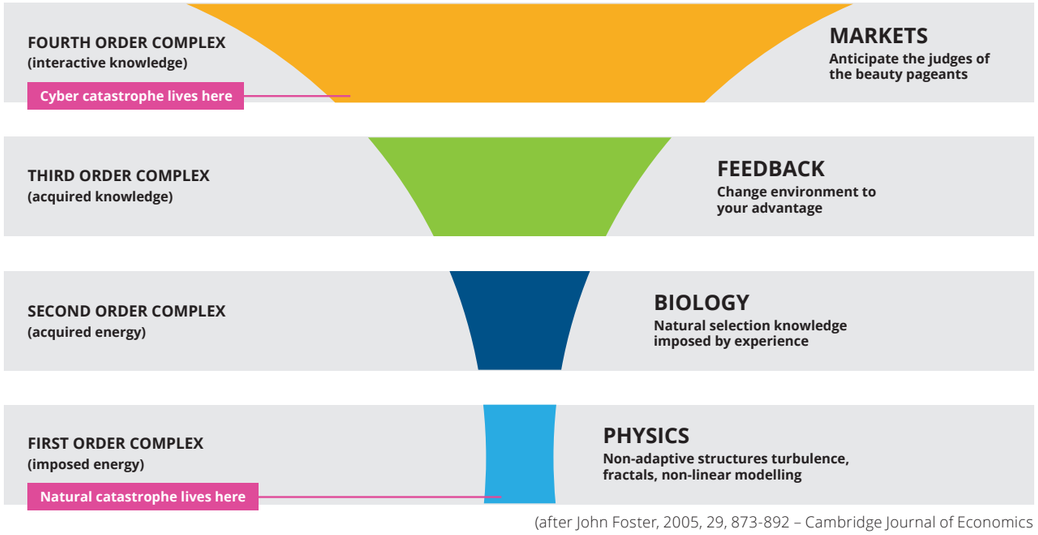
Systemic Risk

At the beginning of this piece we discussed the coverage gap in terms of property insurance, noting that climate change was altering the risk environment (literally!) making modelling risk more difficult. However, when it comes to cyber risk, we enter a whole different level of complexity. Property insurance risk confines itself to the physical world and is only first order complex – a building and a hurricane are both physical objects and their interactions are governed by laws of physics which have been understood since Newton discovered the forces of nature 400 years ago. But once you add biology into the mix you get Darwinian evolution, a feedback loop that means the predator and the prey are constantly evolving in an arms race. Going one step further and adding humans into the mix, means you have a feed forward loop too; an anticipatory intelligence that tries to outsmart the opponent before they have even made their move. This type of system is known as fourth order complex.

A stock market is fourth order complex because buyers and sellers are trying to anticipate each other's actions before they trade. It is the same with cyber, attackers and defenders trying to outsmart each other without revealing their hands (see Fig 8).

Not only is cyber fourth order complex, it is also rife with systemic risk. Systemic risk is undiversifiable risk; risk that cannot be mitigated through a diversification strategy. In property insurance, geographic diversification is the primary method of risk reduction. This is best summed up with the old adage 'don't put all your eggs in one basket'. The likelihood of a building collapsing in London, Tokyo and New York at the same time is effectively zero. However, the likelihood of a computer crashing in those three cities at the same time is certainly not zero, and if they are on the same network then it is actually quite high. Geographic diversification does not work in cyber space, and although network segregation strategies help, the fact the internet connects every device in the world to every other means systemic risk is theoretically inescapable. In cyber, all eggs are in one big basket called the internet.

Figure 8



(after John Foster, 2005, 29, 873-892 – Cambridge Journal of Economics

Source: AXIS

It is also worth remembering that internet, and software in general, is not designed for security. In industries such as aerospace or pharmaceuticals new products are put through extensive tests and costly trials before being released to the public. Understandably so, because a mistake in these types of products can result in deaths.

The software industry plays by different rules. One rule of good engineering practice is not to over specify. A well-engineered bridge should never collapse, but it would be equally wrong to build it from titanium which is unnecessarily expensive. The bridge just needs to perform its function adequately; to get cars from one side of the bridge to the other. So, building it from steel is fine.

The replicability of data noted earlier means that software upgrades are easy to perform. Software just needs to perform its job adequately in the expectation that you can fix things later in version 2. This casual attitude to product reliability is reflected in Facebook's famous motto to 'move fast and break things'. In the race to achieve a critical mass of users, it's better to put out a half decent product as soon as possible rather than obsess about perfection. As a result, software is generally full of errors and security vulnerabilities that will be fixed sometime in the future with patches and upgrades. The problem is with the dawning of the internet of Things (IoT) the risk of death from bad software is increasing. Computerised medical devices, home thermostats and driverless cars could be lethal if software malfunctions; thus, the software industry may need to become more like the aerospace or pharmaceuticals industries in the future.

Growing Complexity

Another factor to consider is the growing complexity of IT systems. Complexity is the enemy of security because it increases the potential attack surface and thus the vulnerability of the system overall. Think of it this way. Imagine a long fence – maybe 10 miles long – over rough uneven ground with only one guard to police it on foot. Are there any breaks in the fence? That would be a software vulnerability. Is the fence erected in the right place? Any overhanging trees or hillocks? Those would be configuration issues – a good fence that has been set up wrong. The length of the fence corresponds to the attack surface.

This fence is growing in length rapidly. As each new device is added to a network the number of connections grows dramatically because that device is connected to all the others on the network. So, where devices grow in a linear fashion, connections grow exponentially. That means the fence is growing exponentially too in our analogy. If it grew to 100 miles long, a single guard on foot would be totally inadequate. With five billion new IoT devices due to be added to the internet this year, the potential attack surface is scaling up massively.

Eric Clapton's magic glove

Let's switch perspective to view things as an attacker rather than a defender. Imagine if Eric Clapton started to sell a magic glove that meant you could play the guitar as well as him when you put it on, and it only cost $5. You would immediately acquire all the skill and technique that a musical maestro had learned in his lifetime for a pittance. Who would not want to buy that?

That's what hacking tools can do. You can buy hacking toolkits online for as little as $100. This is cheap, incredibly powerful software that makes you as good as the best criminal hackers in the world. Risk evaluations often hinge around constructing an intent and capability matrix. You identify different threat actors; those who may intend to harm you but don't have the skill and those who have the skill but don't wish you ill. Cheap hacking tools shred this conventional matrix. Software transfers skill, so you must assume that anyone who has bad intentions now also has the skill to cause you harm. Also, in the past, physical location was a constraint – someone in Iran might hate you but they were on the other side of the world. In cyber space, there are no geographic barriers. Malefactors are now no longer physically constrained nor held back by lack of skill.

All these factors, the underlying systemic risk, the growing attack surface with IoT and the criminal hackers' improving expertise combine together to escalate the severity of cyber risk. So, while the good news is that cyber insurance is growing fast at maybe 30% per annum, a pertinent question might be why is it not growing faster?

Why don't people buy more insurance?

The coverage gap in property insurance, the even larger absence of cover for intangible assets and the looming cyber risk all beg the question: why don't people buy more insurance?

There are many reasons, but the three main ones can be summed up as knowledge, trust and price:

a) Knowledge

Customers may be unaware of the risk or believe it will never happen to them, particularly in the cyber domain. However, this is becoming less likely as newspaper headlines report major cyber incidents regularly and extreme weather events raise awareness of flood, fire and hurricane risks. It could also be argued that when it comes to knowledge the customer actually has an advantage: an information asymmetry. They will have a much better knowledge of their assets than an insurer does. The underwriter, on the other hand, will have deeper understanding of the risks.

b) Trust

Customers often fear that their insurance policies will not pay out on a claim because of some technical details in the small print. This is partly because smooth pay-outs on claims go unreported while disputed ones are highly visible in the courts and the press. It is interesting to note that the very first insurance policy in London on the life of William Gibbons in 1583 had a dispute over the claim. He died almost a year after the policy incepted. The underwriters tried to argue that if a month was defined as 28 days then Gibbons had lived 12 months and therefore the claim did not need to be paid. This goes to show that disputed claims are as old as the insurance industry itself.

c) Price

The third reason, and maybe the most rational one, is that customers know the risks and trust that the policy will pay out but do not buy insurance because it is not priced correctly: the cost of peace of mind is too expensive. Business owners face many uncertainties: Will their new product sell well? Is the government going to change the goal posts? Will the economy grow next year? What is the competition doing? Businesses take calculated risks all the time, many of which are uninsurable. Indeed, running a business is a process of learning to live with uncertainty where prudent penny pinching is rewarded. So, sensitivity to the price of insurance is only to be expected.

Modelling the unknown

From an underwriter's perspective, the problems of pricing stem from the problems of modelling. There is a 'Catch 22' at the heart of the insurance market. For any new insurance product to be introduced, historic data is required so that an appropriate model of risks can be created. Without this data, insurance cannot be offered. But with no insurance offered, how is it possible to get the data? This is why government agencies are often needed to get the ball rolling.
The satellite market is a good example. In the early years of space exploration, launching satellites was an expensive and risky business and so government agencies effectively self-insured; but later a commercial market gradually evolved at Lloyds based on 20 years of historic data. Likewise, after the IRA bombing of the Baltic exchange in 1993, the Pool Reinsurance Company was set up in 1993 with UK government in a public/private partnership to offer insurance against acts of terrorism.

It is interesting to note that the development of the insurance industry has been a slow and measured process: tentative steps into the unknown and a gradual clothing of the darkness with numbers. The first insurance products in the 16th century were life policies. The advantage of this type of insurance is that the event is certain, only the timing is unknown. Similarly, early was marine hull insurance where the maximum loss was certain (the value of the ship) but the event and timing uncertain. It was not until the 19th century and the development of P&I Clubs that third-party liability cover was available for shipping (loss amount set by policy limit, uncertain event and uncertain timing). Comprehensive general liability (CGL) insurance started in the 1950's providing blanket coverage for a whole range of uncertainties.

By that time statistical science was developed enough, and 150 years of industrial history was long enough, to create models that could enable risk to be priced effectively.

Over the last 400 years, the insurance industry has developed in a bottom up fashion, responding to demand and reacting to particular risks and perils to create a fragmented patchwork of classes and lines. The different types of insurance product on offer are based around the type of asset that needs protection (e.g. property or car) or the type of peril that needs defending against (e.g. cyber, kidnap or terrorism). For underwriters this makes sense because it speaks to their special areas of expertise. For clients, less so. The multi-siloed nature of insurance adds to the confusion.

Clients, when they have had a damaging event, just want prompt compensation. For them, they don't really care where the coverage sits, the types of assets damaged or the cause of the event – they just want money and help to put things right again.

What is needed is an insurance solution that can cover the damage to assets, whether tangible or intangible, that will quickly and reliably pay out and that does not cost too much. Luckily, such a solution is at hand.

Part B:

Parametric solutions

Parametric Solutions

Traditional insurance is based on the principle of indemnification: a demonstrable loss against an asset. Take home insurance, for example. A house will be in a particular location of a known size and built from specific materials which makes its asset value fairly easy to establish. If the house burns down, a loss adjuster can estimate the damage, and this can be used as the trigger for the claim payment. With parametric insurance, the pay-out is not linked to identified damage but instead to an index or set of parameters that gauge the severity of the event.

A loss adjuster will ask many questions in the claims process such as:

- What caused the damage?
- When did it happen?
- What items were damaged?
- Can the insured prove a loss?

Parametric insurance does not require any questions like this. The simple fact that an index reached a specified level is enough to trigger the claims payment. Examples of parameters that can be used as triggers are rainfall volume or seismic intensity. So, for flood insurance, if the rainfall volume in a particular area exceeds a defined number a pay-out will be made without having to demonstrate that any flood damage has occurred. Likewise, in an earthquake scenario, if the seismic intensity exceeds, say, seven on the Richter scale a parametric insurance contract will pay out even if there is no loss to compensate.

A claim is the moment of consummation in an insurance relationship. After all, that is the real product that is being sold. Parametric insurance has the ability to improve this relationship by avoiding arguments about causality and valuation and delivering a speedy payment. Knowledge, trust and price were identified earlier as three reasons why customers might not be buying traditional insurance. Parametric insurance can deliver improvements in all three:

Knowledge – parametric insurance is more transparent as it is based on a single identified numerical value equally understood by both parties.

Trust – no tricky 'small print' or obfuscation around exclusions, causes or damage. Pay-outs are streamlined and much faster.

Price – by eliminating underwriting and claims settlement costs, these savings can be passed on to customers in lower prices.

In addition to these, there are other benefits to parametric insurance. There is a greater time flexibility as the contracts can be tailored for specific scenarios and do not have to be renewed annually. Typically, a parametric contract is multi-year, of three to five years duration. The normal insurance annual cycle requires exposures and asset values to be changed every year based on accountants reports and the like, whereas parametric insurance has no such limitations because it is not linked to underlying assets. Contracts can also be shorter than one year, for example, just covering the Christmas shopping season or summer holiday periods.

Parametric insurance is based on inclusion rather than exclusion. A traditional insurance wording starts with a base premise and then carves parts out through detailed exclusions, deductibles and limits. The parametric approach remains at a high level. All that is required to be demonstrated is simply that the event happened, not what caused it nor what harm resulted.

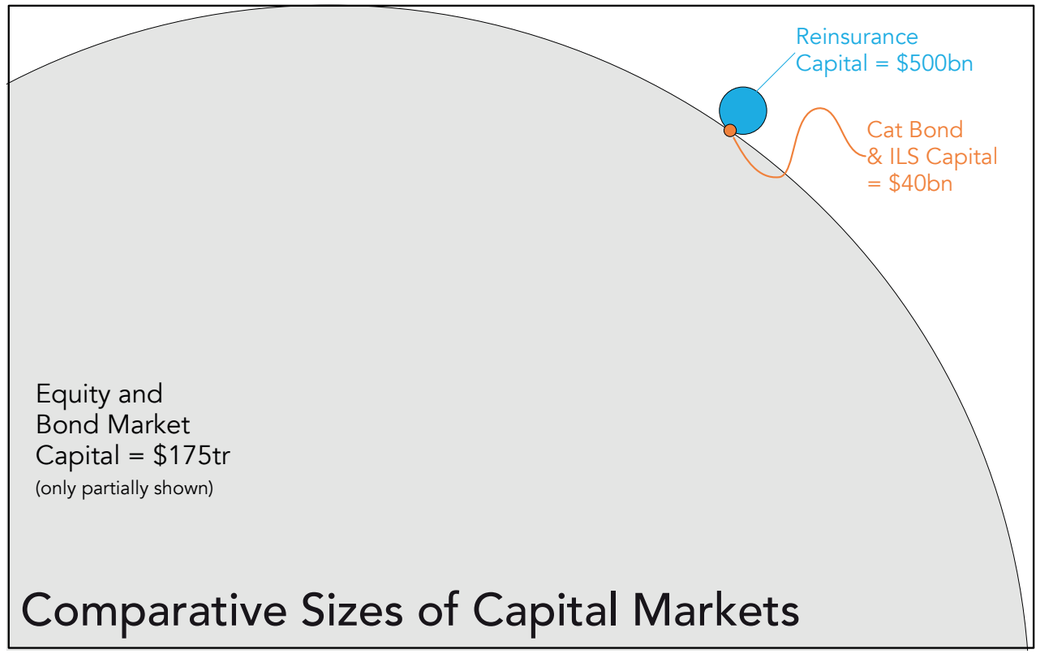
Traditional insurance is well suited to high frequency, low severity events aimed at households and small business.

A multitude of small-scale losses are easier to model and manage due to the richness of historic data and the fact that the law of large numbers will enable accurate macro level predictions. Parametric insurance in the past has been focussed on low frequency, high severity events. It was initially developed in the form of catastrophe bonds to provide extra reinsurance capital for major disasters. Global capital markets dwarf reinsurance markets in terms of capacity. The Aon Reinsurance report 2020 [11] estimates the global pool of reinsurer capital is $532bn. This is tiny when compared to the global equity market of $75tr, a global bond market of $100tr and a global derivatives market with a notional principal value of $700tr (see Fig 9).

Also, bear in mind that the massive derivatives market is very familiar with parametric triggers since that's what drives their options contracts. Capital markets, with much deeper pockets and a long familiarity with the underlying concepts, is a natural bedfellow for parametric insurance products.

There have been many notable successes. A good example is Mexico's FONDEN catastrophe bond which was issued in 2006 and transferred $160m of risk to capital markets. The parametric trigger scheme was created by drawing a map grid over Mexico and defining specific Richter scale measurements in each of those grid boxes. In 2017, a magnitude 8.1 earthquake struck off the coast of Chiapas in Mexico triggering the pay-out of $150m from one of the subsequent bonds in this series.

Figure 9 – Comparative Sizes of Capital Markets



Source: AXIS

Another example, multi-sovereign this time, is the Caribbean Catastrophe Risk Insurance Facility (CCRIF) founded in 2007.

Several Caribbean nations all clubbed together to issue a $140m bond with parametric triggers based on wind speed and rainfall, thus transferring disaster risk to the global capital markets. The bond paid out $50m to member countries like Antigua and Dominica after hurricanes Irma and Maria in 2017.

Parametric insurance has also been used to guard against bad harvests. There are typically two types of agricultural index used:

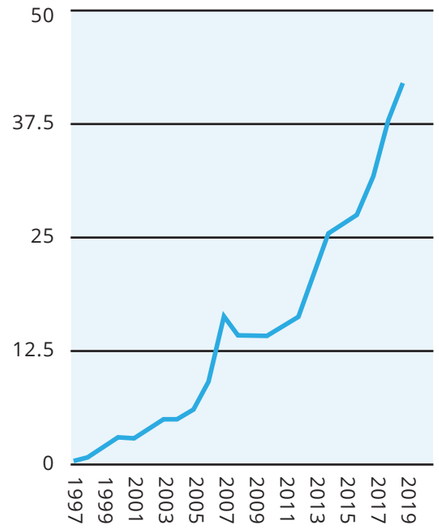
Aggregate Loss – These types of index are based on the area yield for crops in a region. This is the average loss experienced in the whole area rather than looking at things on a farm by farm basis. These were commonly used in early parametric products but require a large amount of detailed data which might not be available in emerging markets.

Indirect Loss – this focuses on the proximate cause of crop failure, for example, rainfall or wind measures rather than a direct read of actual production. These are easier to construct but introduce more basis risk: the gap between the damage predicted by the model and the actual damage in the real world. Indirect loss indexes assume a high degree of confidence in modelling skills.

The African Risk Capacity (ARC) Insurance Company provides parametric cover for African member states based on agricultural indirect loss indices. Mauritania got a $6m pay-out in 2015 from ARC after a dry rainy season threatened a humanitarian crisis from widespread crop failure. This went a long way towards paying for emergency food and water relief bill.

Catastrophe bonds are very well suited to disaster scenarios because the fast pay-outs give a rapid injection of capital when it is needed most, for immediate disaster relief. There are also well established and trusted meteorological agencies that can provide data for constructing parametric indices. Acts of God are often not covered by traditional insurance policies, so the costs are normally borne by governments. Notice also that these types of disasters are caused by global issues. Pollution, overfishing, and climate change which causes flooding, droughts and bushfires are problems that are too large to be fixed by any one country on its own. Concerted action on a global scale is required but this is cumbersome and prone to failure. Smaller countries with little global clout can at least use catastrophe bonds to return the problem to its proper global context by using capital markets. The Pacific Catastrophe Risk Facility (PCRAFI) set up by the World Bank to cover climate change risk for five small Pacific Island nations is a good example of this. In that sense, Insurance Linked Securities (ILS) like catastrophe bonds represent a local solution to a global predicament.

Figure 10 – ILS outstanding $bn



Source: Artemis

They are growing in popularity too. In 2019, some $11bn of ILS risk capital was issued bringing the total outstanding value of ILS funds to $40bn according to Artemis (see Fig 10). The average annual return on ILS investments over the last 15 years has been 4.3% according to the Eurekahedge ILS index [12] although performance has suffered in the last few years due to hurricanes, bushfires and other extreme weather events.

What about the use of parametric insurance for intangibles? All the examples given above are large scale government backed schemes to fill in the gaps in traditional insurance cover.

For large scale catastrophes there is scarce capacity, as few underwriters would want to carry that level of risk and so parametric insurance has stepped in. Coverage of intangibles is another gap in the market that begs to be filled.
The problems of establishing accurate asset values for intangibles were covered earlier – that is the fog. But the beauty of parametric insurance is that it is free from the concept of demonstrable asset damage, so you don't need to figure out what a particular asset is worth. Parametric insurance is as simple as an if-then statement: if this, then pay that. All that is needed is a trigger and a pay-out mechanism. That is the heartbeat in the fog.

The trigger must be an objective parameter or index that is related to the insured's exposure. It must be consistent, in other words, calculated in the same way over time so as to be fair and accurate. It must also be independently verifiable and so unable to be influenced by the risk taker or the insured. Lastly, it needs to be regularly reported. If these three criteria are met and a pay-out mechanism pre-agreed, then there is nothing stopping the use of parametric insurance to cover any type of asset, tangible or intangible. In fact, several recent developments in technology have made this process much easier and therefore open the door to far more widespread use. It is to these technology factors that we turn our attention to next.

Factor 1: AI + Big Data

The first important technological development to examine is the use of artificial intelligence (AI) algorithms to mine large data sets, known as 'big data'. We touched on this in the discussion about data being seen as the new oil. But we need to step back a bit and get some historical perspective to properly recognise how significant this technological revolution really is.

The scientific method was developed in the 17th century, powered the startling advances of the Enlightenment in the 18th and still underpins most academic reasoning today. The method has three steps: abstraction, modelling and reapplication. When a scientist is faced with a messy, complex real-world problem their first step is to simplify or generalise it through abstraction. By making certain assumptions, omitting minor variables and ignoring feedback effects, the problem can be modelled in a simplified form and captured in a theoretical construct with mathematical notation. The specifics of the situation are replaced by x's and y's to make a general model.

Once the model is constructed it can be used to make predictions. Putting in different values for x and y will illustrate the range of possible outcomes. So, reapplying this to the real-world problem, some useful conclusions can be drawn, policies implemented, and inferences made.

To summarise, the traditional scientific method involves a trip from the specific to the general, followed by some theoretical number crunching and then a reapplication from the general to the specific. There are problems with this approach. An often heard complaint is "That's ok in theory but it does not work in practice". The problem normally lies in the first step: the abstraction. Once you move from the specific to the general you intentionally leave the context behind. But the context is sometimes the most interesting part. Things taken out of context will often be misleading. That's often a reason why models fail – the contextual detail left behind in the abstraction phase was very important. There is an alternative approach one that is now commonly used in Artificial Intelligence (AI) algorithms. Instead of ignoring the context, the algorithmic approach is focussed on it. It effectively reduces the three steps of the scientific method to a single step – from problem direct to solution.

A good example is Google Translate service. Linguistics experts have been working on the problem of machine translation for years. The traditional approach was to start by programming a model of that language's grammar, which the computer could then use to comprehend the meaning of each statement. Google's approach was radically different. It simply fed the algorithm with millions of examples of translated texts and got the software to teach itself. The machine in this case was not trying to understand the meaning of the text but simply trying to match patterns. Fairly soon, having scanned the vast numbers of translated texts available on the internet, Google's Translate service was outperforming all other machine translation services without ever understanding what the texts actually said.

So large amounts of data coupled with a machine learning algorithm offer an alternative to the traditional modelling process. Though there is a risk of overfitting, where the algorithm models the noise and not the important data, it does help to solve the 'Catch 22' problem. To launch any new insurance product, you need claims data in order to model risk. Without data you cannot offer insurance, but with no insurance offered you cannot get data. The 'AI + Big Data' approach gets around this conundrum by using data scientists to create an index from non-traditional sources, thus obviating the need for historic claims datasets. What type of alternative data sets can we mine for the coverage of intangibles? See Part C: The Way Forward for a discussion of this.

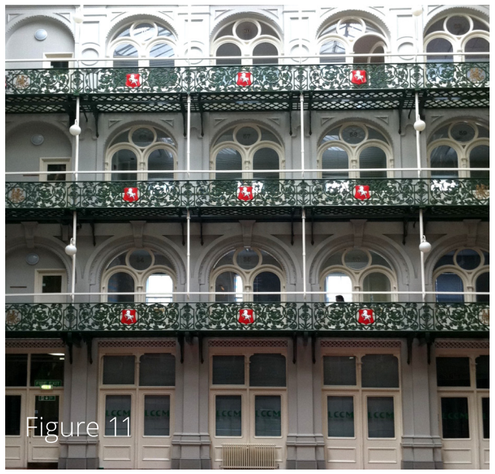
The end of reason

There is one drawback, however, with algorithmic data mining and that is that AI cannot explain its reasoning. Since it does not use a theoretical framework, its processes are incomprehensible to humans. An algorithm can only show its answers, not its working. So, we only know it works because it does. We do not know why. This can be a potential problem as there may be biases in the process that we are unaware of. Why did the algorithm pick that candidate? Why did it diagnose that medical condition? These are questions we cannot answer. A lot of legislation is based on the concepts of reasoning and intent. But with AI output, there is no accountability and no contestability so it is hard to know how such decisions may play out in court. With machine learning algorithms there is no intent. They are the heralds of the end of reason.

Factor 2: The platform business model

The second technological development is the platform business model. The titans of the internet are all 'platform' businesses; Apple, Facebook, Google, eBay, Uber and Airbnb have all been remarkably successful in exploiting this type of business model. It took new technologies such as mobile phones, social media and the cloud to properly unlock the full potential of this approach, but the underlying concept of a platform business is actually quite ancient.

Commuters passing London Bridge station in a train will see out of the window, just after they pass the Shard, a handsome, Grade II listed building called the Hop Exchange. The hop trade was once a major industry in Southwark, the name for this part of London. Back when there was only one bridge over the Thames (London Bridge) everyone passed through Southwark. Its coaching inns and breweries have been famous since Chaucer's time; this is where the pilgrims gathered before setting off for Canterbury. There was plenty of traffic up the other way too. Kentish hops, grown in the Garden of England, came up the A2 and the Old Kent Road to the hop traders and factors in Southwark Street, around the corner from Borough Market.



Source: photo by author

The Hop Exchange opened in 1867 (see Fig 11). It has a vast open atrium with three tiers of balconies overlooking it designed to allow 'open outcry'; traders on the floor and merchants on the balconies shouting their orders to each other (the Lloyds Insurance building in London has a similar atrium and balcony design). Victorian developers built it in a burst of progressive optimism hoping to capture and consolidate the hop trade inside its walls. But the hop factors and merchants already had their own various premises and saw no reason why they should move. The Hop Exchange was an attempt to cast economic activity in an architectural form. Sadly, it did not work. This building, designed to house speculators, was itself a speculative failure. Not a single hop was ever traded there. It is now a partially filled general office building. Sometimes if you build it, they won't come.

The Hop Exchange was a Victorian version of a platform business. These aim is to create an environment in which buyers and sellers can meet and conduct business. Normal businesses design and build a product and then try to sell it. With platform businesses, the products are created by the users and only the rules and the tools of exchange are controlled by the platform owner. Competitors for normal businesses are those companies who have similar products, and so product differentiation is a key goal. For platforms, competitors are those who have the same pool of users as you. So, the competitive race is to grab as many users as you can, as fast as possible, to achieve critical mass. The dominant platform then gets major economies of scale due to network effects, which is why a company like Google has a 90% market share of the internet search market.

Platforms have oversight but they don't have foresight – they don't know what content will be put on the platform, but they do define how it is put there. Traditional insurance policies try to use foresight to anticipate possible future events and then exclude them or draw causal chains in anticipation of particular types of damage. But parametric insurance does not need to establish chains of causality. The only thing that is important is that the event happened not what caused it. So, there is no foresight needed. That makes a platform style business ideal for parametric insurance.

How to get to critical mass? The Hop Exchange failed because there were no clear benefits for the merchants over using their own premises. In order to attract business to a new platform there must be clear advantages over the traditional way of doing business. A platform that allows risk holders to trade insurance linked securities (ILS) has two of these: it is cheaper due to the cost savings in the claims process, and it is easier because of the third technological revolution.

Factor 3: Blockchain Ledgers

The third important development in technology is blockchain style distributed ledgers – which is the enabling technology behind smart contracts. Traditionally, financial transactions require a trusted third party to facilitate the exchange of payments and securities. This financial clearing house acts as a central counterparty between the buyers and sellers, acting as a guarantor for the transaction. The counterparty risk is transferred from each of the participants to a trusted and highly regulated central authority. Often the actual assets in question, like stocks and shares, are held in a central securities depository. Trading shares then just becomes a book entry change rather than a physical transfer of certificates. Identity and ownership are verified by a centralised database owned and controlled by this trusted middleman.

A smart contract does away with the central database and uses a distributed database on a decentralised peer-to-peer network instead. This transfers the trust element from a central counterparty to the cryptography behind the technology. Bitcoin was the first example of this distributed ledger technology, known as blockchain, but there have been many other blockchain variants since then such as Ethereum, Cardano and Litecoin. While Bitcoin's main appeal was in the anonymity of its transactions, Ethereum is designed for commercial use as an enabling technology to support smart contracts which can be settled in 'Ether' currency. The public and private identifying keys that are required for Ether transactions are stored in a cryptocurrency wallet. The audit trail of these transactions is embedded in the blocks in the chain as a permanent, tamperproof record.

The type of information that is stored in this blockchain ledger can be items, actions and permissions. As an example, the items can be the clauses of a contract, the actions can then specify how a transfer of funds will take place and the permissions will work as the trigger for that transfer to occur. So, a smart contract can be set up to automatically make a pay-out if a certain event occurs. No muss, no fuss. There is no need for verification by a human third party. This makes it the perfect underlying technology for parametric insurance. Since the pay-out terms and criteria are baked into the code you have fast, secure and transparent system which should both help rebuild trust and also be much cheaper as processing costs are dramatically reduced.

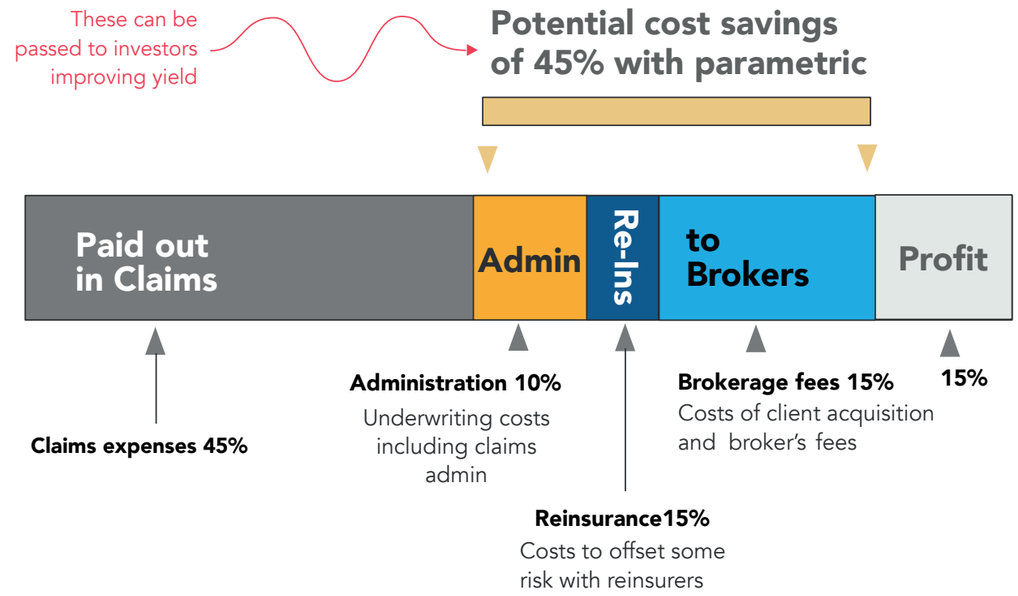
The Convergent Trifecta

These three technologies are converging to create a very exciting opportunity for blockchain based parametric insurance with AI derived triggers, such as that offered by Ryskex. Let's recapitulate the argument so far. The insurance market is falling short in protecting against risks as the coverage gap is growing. For tangible assets the situation is bad, but for intangible assets it is much worse. Intangible assets dominate the balance sheets of large corporates but they are largely uninsured because traditional indemnity-based insurance struggles to place an accurate value on them and lacks a reliable mechanism for calculating damage. The one success story so far is cyber insurance, which indemnifies damage to data caused by cyber-attacks. Data, the new oil, is the underlying commodity for most of the intangible assets that sit above it and the source of the value of those assets.

However, parametric insurance, which is not indemnity based, offers a neat solution to the intangible challenge since it is not necessary to precisely calculate damage to asset values. The pay-out is based on a parametric trigger instead. Though parametric products have been around for a decade or more, three new technologies are converging to catapult these products forward. First, machine learning algorithms enable the construction of sophisticated triggers based on non-traditional data sets. Second, platform business models make the trading of risk friction free and the marketplace much more efficient at matching buyers and sellers. Third, distributed ledgers based on blockchain technology make pay-outs faster and more transparent thus resolving some of the trust issues that restrain the purchase of traditional insurance. A solution that combines all these features into a convergent trifecta is likely to be enthusiastically received.

The most telling argument for the rapid advance in insurance of new types of assets through new parametric mechanisms is based on price. The efficiency gains as illustrated in Fig 12 mean that moving to this new model could achieve cost savings of around 40%. These savings can be partly passed on to the customer to encourage uptake, and partly retained to create an attractive yielding product which will stand out in a bond market where other yields have been driven down below zero.

Figure 12



Source: AXIS

Part C:

The Way Forward

The parametric insurance of intangibles is protean; it is in the process of becoming and struggling towards inception to be born. There are still a number of unresolved issues that need to be addressed, and innovative solutions to be found, in order to have a clear way forward. In this section we address some of these.

Basis Risk

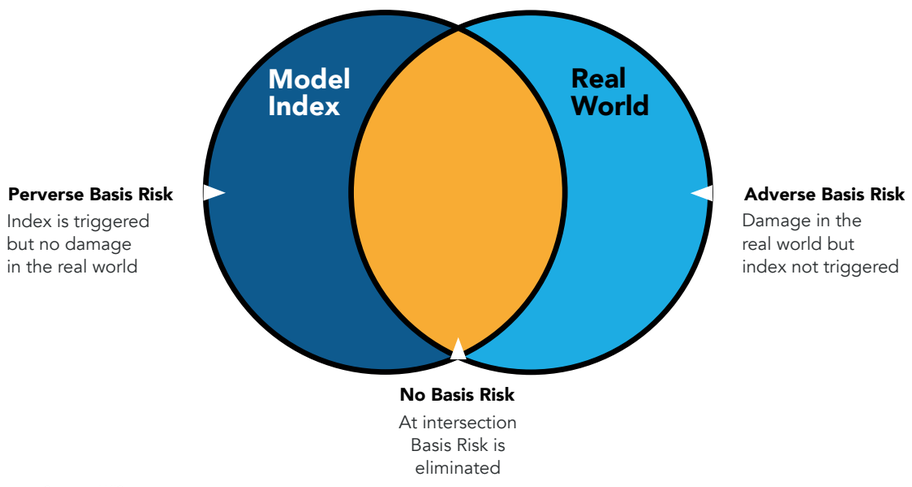
The parametric approach removes the need for human judgement, investigation and debate in the claims process and replaces it with an index-based trigger. While this gives many advantages in speed, validation and transparency it also has a potential disadvantage: what if the index does not properly match the risk being insured? This gap between customer expectations and eventual outcome is known as basis risk. It is an imperfect correlation between the risk and the index. If the parametric product is poorly designed, the trigger level in the contract and the damage suffered by the client will be discrepant. There are two types of basis risk as shown in Fig 13:

- Adverse basis risk – damage occurs but index is not triggered
- Perverse basis risk – a false positive pay-out – index triggered but no damage

If there is too much perverse basis risk, then the product should not really be called insurance and acts more like a derivative. Strictly speaking, insurance should not offer any upside reward. This balance of risk and reward is critical. A key principal of insurance is that insurers should offer premiums that are proportional to a customer's risk. High premiums will attract only the riskiest customers, leading to greater pay-outs thus reinforcing a vicious spiral leading to market collapse. This effect is known as adverse selection by insurers.

A major consideration in balancing these risks is granularity. If the product is pitched at a macro level, such as blanket country wide coverage, then mismatches at a local level are very likely. Conversely, reducing scale to only encompass small localities is costly, cumbersome and hampered by scarce and patchy data. So, finding the correct level of granularity at which to construct the models is critical to success.

Figure 13 – Basis Risk



Source: AXIS

Index independence and moral hazard

A second key consideration is the independence of the index trigger. The index must be detached from any potential influence by either the insurer or the insured. There are two reasons for this. It eliminates any subjectivity over the pay-outs and also removes the risk of moral hazard. This is related to the concept of adverse selection, but where the latter addresses the type of product, moral hazard is concerned with actions. If the insured, through their actions, can manipulate the index so that it rises above the trigger level that would constitute moral hazard.

Indexes based on climate or geological data are safe from moral hazard as customers are unlikely to be able to make the wind blow harder, the rain last longer or an earthquake more violent. They could, however, tamper with the local measuring equipment so it is important that the reporting body is a trusted, independent entity. Other measurement factors are less robust. Corporate financial figures like revenues and profits, though independently audited, can be quite subjective and rely to a great extent on the honesty of the corporate in question. The huge accounting discrepancies that bankrupted Exxon and Carillion are salutary lessons in this regard. Likewise, cost based measures, where the spending is under the control of the insured, are rife with moral hazard. Why not spend as much as you can, if the insurance company is going to pay for it?

Another consideration to take into account is the risk of index failure. What would happen if the index could not be calculated on a particular day? Maybe the extreme weather has damaged the sensors so no readings can be taken, or a cyber system failure creates a gap in the data record. What interpolation method is specified to patch the void? Are there any backup providers? These types of eventualities need to be appraised and mitigated when defining the parametric trigger.

Brand and IP triggers

We discussed earlier how valuable intangible assets like brands and intellectual property (IP) can be, and how much that value has grown in recent years. What triggers might correlate well with this type of intangible asset? If the IP has legal protection in the form of a patent, then there are existing traditional policies available that will cover legal fees either for defence or prosecution. Legal fees are not a very suitable basis for trigger mechanisms due to moral hazard; the insured could simply make sure they spend up to the target. It might be possible to base a trigger on points of similarity if a competitor were to reverse engineer your product and introduce it to the market. This might prove to be overly subjective and difficult to administer for a mechanical product but might work, say, with pharmaceuticals since a chemical formula is an indisputable fact. On the other hand, small tweaks in chemical formulas can produce compounds that have similar effects, as such circumventing the patent. In the end, there might be little advantage in the parametric approach over the existing legal compensation routes for patent infringement.

How about damage to brand value? The deeper you look into this issue; the more unusual brand assets appear. Take luxury goods, like handbags and couture, where brand management is of paramount importance. Unlike patents, where copying is undeniably bad news, for luxury brands copycat products can sometimes have a positive effect since they increase the desirability of the authentic article. Top fashion brands might worry if there are no cheap lookalikes of their branded goods for sale in dodgy flea markets. That would mean they were not important enough to copy. Some copying is good, just not too much and not too accurate.

With most products, particularly electronics, the aim is to grow as fast as possible and dominate the market. With luxury goods, this is not the case. Rapid growth can be bad since it reduces exclusivity and therefore brand value. Many famous brands (Pierre Cardin springs to mind) have been overexploited until the brand value is depleted to the extent it is almost worthless. Once everyone has got it, then no one wants it. Brand management is all about restraining growth. Again, it's all about not too little and not too much. This 'Goldilocks' conundrum means impediments to growth are not necessarily damaging.

If copying and slow growth are good news, what type of damage should brands be insuring against? History shows that the most harm done to brand value actually stems from the management, or rather, mismanagement. Bad choices by the CEO can destroy a brand faster than any outsider. But management linked parametric triggers would not pass the independence and moral hazard criteria.

The value of the brand is closely linked to the creativity of the head designer and changing the head designer is a dangerous moment in a brand's lifecycle. Sometimes the head designer gets fired, as was the case with John Galiano, who was dumped by Dior after his drunken anti-Semitic remarks were reported in the Sun newspaper. Brands can be badly damaged by the wrong type of association. The Burberry brand was damaged when its iconic check became wildly popular with people of low social standing. Likewise, if high fashion brands are sported by gangsters and criminals it can reduce their desirability. The one thing fashion houses cannot really control is who wears their clothes, and one unfortunate photograph in the press can be extremely damaging.

This type of brand damage through unintended and inappropriate association could form the basis for an innovative trigger mechanism. Sentiment indicators can be created by parsing Twitter feeds or other social media with AI algorithms. Press articles linking brand names to derogatory words or pejorative coverage can be logged and indexed. These are workable methods to measure what the general public thinks, and since brand value resides in the mind of the consumer it is probably the best place to look when measuring damage. There is, however, another sentiment indicator that is readily at hand, easy to access, constantly updated, and available 24 hours a day: the share price.

Share price triggers

An amusing dictum amongst stockbrokers of a certain age is a twist on 'If', the popular Victorian poem by Rudyard Kipling. It goes like this "If you can keep your head while all about you are losing theirs … you haven't heard the bad news yet'. Bad news is quickly reflected in the stock market; good news too. In fact, all news is rapidly assimilated by the market with a resulting change in prices. And since the market is a forward-looking mechanism, it's not just hard news and facts but sentiment too. A continuous, rolling polling engine fuelled by fears, dreams, greed and wild anticipation. All this and more, condensed each millisecond into a single point of data called the share price. The big problem is that it's a one-way function.

Internet cryptography is based around one-way functions. These are easy to compute, but if given only the output it is impossible to decipher what the input variables were. Credit card transactions on the web are secured by one-way functions; the details are scrambled so that the card numbers remain secret. The stock market is the mother of all one-way functions. We know the share price is the output, we just don't know with any certainty what the inputs were. The causal details are lost in the scrambling process. It is like examining a brick in the rubble of a demolished hotel and trying to figure out what the bathroom on the 26th floor looked like.

Pity the poor journalist covering the market for the business section of a newspaper. They are constantly required to explain why the market behaved as it did. They can call different market participants and get a different answer from each. Was it fears of an interest rate hike? Or bad news in China's GDP figures? Or political uncertainty caused by Brexit? It could be none of these, or all of them. No one really knows. As a last resort, they can always just say the market was down because there were more sellers than buyers. But that is as unhelpful as saying that a plane crash was caused by 'gravity'. The market's one-way function makes it impossible to conclusively trace a link back to the ultimate cause.

On the other hand, most of the valuation methods for intangibles involve the share price in some way, from goodwill and share buybacks to future brand earnings based on a price multiple. If you subtract the value of tangible assets on the balance sheet from the market capitalisation then that 'premium' contains the value of intangibles; it's in there somewhere we just don't know how to properly apportion it. What is more, any damage to intangibles will be reflected in the share price whether it is a cyber-attack on data, bad publicity impacting the brand or a costly public patent dispute. So, the share price movements should probably be included in some part of a parametric trigger. What type of movement should we be measuring?

The starting point is the absolute change in share price. Say a car manufacturer's share price was to drop by 5% in a few days. It might have happened because the market as a whole has fallen. We can eliminate the effect of overall market movements by looking at the relative share price movement instead. We calculate this by dividing the stock price change by the market change. Going one step further, what if there has been bad news announced for all auto makers, such as stringent new regulations on emission standards? We can play the same trick by looking at the sector relative price movements. That is price relative to the change in just the auto sector index instead of the whole market. A further thing to consider is whether a 5% fluctuation is unusual or not. How big are the typical daily swings in the share price? We can gauge this by looking at the historic price volatility. So, a good measure on which to base our parametric trigger would be the sector relative price volatility.

If this was to rise beyond a certain figure, then we could assume a specific event has damaged that company in particular. The last thing to take into account would be the timing of special financial events like the announcement of annual results or ex-dividend dates which can create discontinuous changes in share price. In our index, these would have to be excluded or smoothed out in some way.

Then comes the issue of index independence. One problem with individual share prices is that they can be manipulated in the short term. The index trigger needs to be beyond the influence of the insured, but an unscrupulous finance director could judiciously pick the timing of a share buyback announcement or a trading update so as to shift the share price in a desired direction for a few days. This could be mitigated by using moving averages to smooth short-term volatility, but the downside would be a loss in index sensitivity. Maybe a better approach would be to pick a variable that is less easy for an individual to manipulate and shift the granularity up a gear to a macro level. If the index was an aggregate composed of many share prices, the influence of any one price will be substantially diminished. This observation might suggest that parametric insurance is best suited to systemic risk mitigation rather than individual company risk.

Systemic macro triggers

Looking at established parametric products for drought or hurricane insurance, they typically operate at a macro level. Triggers are based on crop yields aggregated across many farms or wind speeds in a defined region rather than single instances. We noted previously that systemic risk is a far greater concern in the cyber realm than in the physical world. There are some parametric products that have been designed to tackle systemic risk head on which are worth studying.

The first is the $320m catastrophe bond that was placed in 2017 by the World Bank to provide coverage against a global pandemic. It is no coincidence that flu viruses and computer viruses share the same name since they act in similar ways but in different domains; one in flesh and the other in silicon. The pandemic catastrophe bonds use World Health Organisation data on infection rates, speed of spread and fatality statistics as the basis for the trigger. The recent Coronavirus outbreak, at the time of writing, looks likely to trigger a pay-out soon. This type of index could be extended to provide cover for, say, declining hotel room occupancy after a pandemic outbreak.

A clear analogy can be drawn between the physical connectivity provided by airlines and public transport and the network connectivity of the internet. In both cases, they are the vector that introduces systemic risk. In transport, every city in the world can be reached within three flights; a convenient vector for viral infections.

Alternatively, train timetable and performance data could be mined to produce a trigger that would pay out if trains were delayed by a rail network failure for longer than 30 minutes. Looking across to the cyber realm, data from a central authority (e.g. the NSA or GCHQ) about computer malware attacks could be used to create a parametric trigger based on the number of systems affected by a particular virus within a defined time window.

A second product of interest was outlined in a whitepaper on Smart Ledgers by the Z/Yen Group in 2018 [13]. It outlined a design for a network availability index created by repeatedly polling a representative sample of web addresses. A 'ping' to confirm if a website is operational is sent out every few minutes to each IP address. Then if, for example, half the websites for the FTSE 100 constituent companies are unavailable for an extended period it would be fair to conclude that some sort of systemic failure had occurred. The length of the downtime and the companies in the sample can be tailored for each specific case.

All these examples have macro level triggers that could respond to business interruption caused by some large-scale systemic failure, be it transport stoppages or cyber incidents, and they are immune from individual level tampering. However, changes in granularity introduce unwanted basis risk. An alternative approach is to remain at the individual company level but couple a share price trigger with another factor like an index based on news reports.

News report triggers

Alert readers will quickly point out that the flow of news, like share prices, is not outside a company's control; after all, what is a PR department for? But the careful selection of reputable news outlets and papers of record helps guarantee objectivity. Corporate spin will only go so far. Also press archives offer a wealth of historic news stories for data mining – The Times online digital archive goes back 200 years.

The *pas de deux* between the news flow and share prices is fascinating, often in unexpected ways. A maverick but successful fund manager of my acquaintance is famous for only ever reading yesterday's papers, not today's. His reasoning? Observing how the market reacts to news is more important than the news itself. So, looking at how today's prices have reacted to yesterday's news gives you the best insight into the mood of the market. If there is bad news but no negative reaction, then sentiment must be bullish.

This concept can be used to some advantage in constructing sophisticated news report triggers that look at both the news and the reaction to the news. In this case, the news derived from broadsheets can be contrasted with the subsequent reactions on social media to create a powerful but objective sentiment indicator. What better way is there to measure the impact of news on brand value?

One warning flag should be raised; public interest fades with time. What was newsworthy last year is boring now, and will be so commonplace next year that it will hardly be worth discussion. The nuclear power industry figured this out back in the 1990's. The nuclear sector was traditionally tight lipped. Its historic links with the military meant it kept much information secret, including any reports of nuclear accidents. It was therefore a target of much investigative journalism in the 70's and 80's and the press delighted in exposing coverups about radioactive leakage, no matter how small and inconsequential, particularly after the Chernobyl disaster in 1986. Then some bright PR spark in the nuclear sector realised that the solution was to overshare. By publishing regular reports, detailing minor infractions in exhaustive, turgid detail every week, the press soon lost interest. Accidental leakage was no longer a story. Public interest had moved on. Is it possible that, within a year or two, cyber-attacks will be so commonplace and overreported that they are no longer newsworthy? If so, news triggered indexes may become less useful in the longer term.

The multi factor double bonus

We can worry about the future later, let's focus back on the present. The good word is that using a two factor trigger of 'share price plus news sentiment' brings two important benefits; it reduces risk and increases granularity. Extra factors mean a more complex trigger mechanism and therefore lower risk to the insurer because more criteria need to be satisfied before pay-out occurs. Lower risk means it can be priced cheaper. But at the same time, more criteria mean a more tailored product, a better fit at the company level and less basis risk. Why stop at two factors? The more factors added the stronger these effects. That is the multi factor double bonus. It is like a tailor telling you that a bespoke suit is cheaper than a generic off-the-peg one. Sartorial heaven and doubles all round, please! Is there any other market you can think of where bespoke products are cheaper?

This also holds the answer to another challenging question. If the trigger was only based on share prices, then the insured could simply cut out the middle man and hedge risk directly through buying share options in the market. There is no need for a complicated parametric vehicle for basic share price protection since that is readily available through a well-established options market. But a multi factor trigger requires structuring. Generic risk such as share price exposure can then be offset with options by the underwriter not the insured, while the bespoke risk from the other factors can be creatively sculpted into a suitable form – a form that may be partly defined by the jurisdictional environment.

Legal issues

As with all new products, there are some legal issues that need clarification. In common law jurisdictions, the case law around parametric insurance is not well established yet. There will need to be a few precedent setting cases conducted before the legal assumptions that have been made are proved to be upheld.

One concern is that insurance products require some 'insurable interest' to be demonstrated. In other words, the indemnity principle is the basis of law in some jurisdictions. If it is not an indemnity product then, legally speaking, it may not be an insurance product. Parametric insurance disposes of the indemnity concept, so can it properly be called insurance?

In UK Law, the main difference between a parametric insurance contract and a derivative is that insurance requires some nominal element of loss before the policy will pay out. Insurance is designed to give protection against losses (insurable interest) but not make payments that would represent a gain. A derivative offers both upside and downside but insurance is only supposed to be a downside safety net.

Consider a case where there is perverse basis risk. The granularity of the parametric trigger was set wrong and a false positive pay-out has been made. The index was triggered but there was no damage. The product has mutated into a derivative and derivatives have a completely different regulatory regime with separate governance bodies.

Much depends on the skilful design of the trigger. We touched on moral hazard and adverse selection risks earlier. Parametric insurance would seem to be quite vulnerable to accusations of mis-selling because the trigger mechanism may not have been properly understood by the insured. Being one step removed from the indemnity principle leaves the door wide open for these types of allegations since there is a larger conceptual gap between product and pay-out. This has proved to be a problem in the agricultural sector, where complex parametric products have been sold to poor, unsophisticated farmers.

Mis-selling risk is minimised by avoiding the consumer market and dealing only with financially savvy corporate counterparties. Also note that some jurisdictions (Vermont is a good example) have made great strides in clarifying the legal landscape to help promote parametric products. So, the best advice is to pick your counterparty and legal residence carefully.

The future outlook

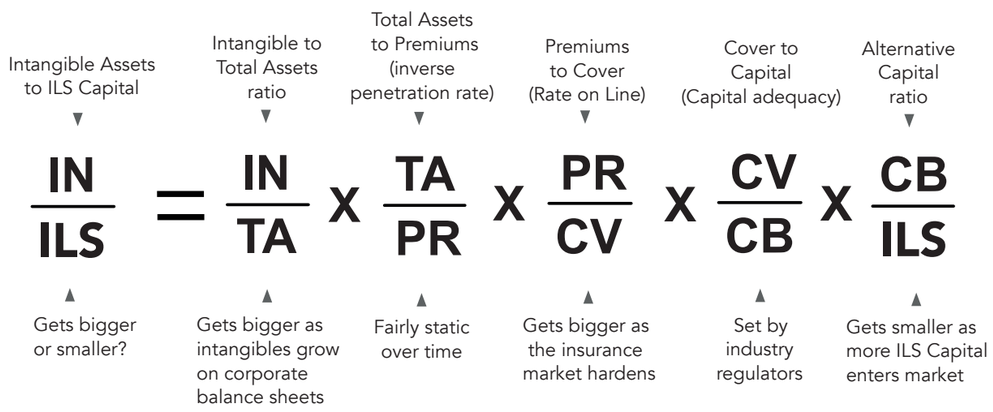
Looking at parametric products from the point of view of an investor, what type of returns might be expected from these products? Yields on catastrophe bonds range from 2% to 20% according to the InsuranceLinked [14] website, while the Eurekahedge ILS index has annualised returns pegged at around 4% which is a more representative figure. In an environment where a quarter of the global bond market is offering negative yields these are attractive rates.
As a guide to thinking about future developments, we have constructed a Dupont style model which is shown in Fig 14 below.

A Dupont model disaggregates a key ratio into a series of other factors, each of which is useful in its own right in explaining how change is occurring. The key ratio to examine in this case is the size of the ILS market relative to the size of the intangible asset pool. This is shown on the left-hand side of the equation, in effect, the heartbeat in relation to the fog.

We then set up a series of factors which, when multiplied together, find the numerators and denominators cancelling each other out to arrive back at the original ratio.

We know that intangible assets have been growing rapidly on corporate balance sheets. We can also anticipate potential growth in the ILS market which is currently tiny in relation to bond and equity markets and offers attractive returns.

Figure 14 – Dupont Style Analysis of ILS Funding for Intangible Asset Coverage



Source: AXIS

So, both the numerator and the denominator are growing but which is growing faster? If ILS capital grows faster than the intangible asset base, then this ratio will get smaller. The point of the Dupont model is to examine the factors on the right-hand side of the model in order to help answer this question. On the right-hand side, we have:

Intangibles to Assets – this has been growing fast (see Fig 2) but since they are already dominant, they may not have much room to grow further.

Assets to Premiums – this is inverse of the insurance penetration rate and stands at around 33 times (a 3% penetration rate inverted).
This reflects the amount of money the corporate sector wants to spend on insuring their assets. Any insurance growth forecasts need to be tempered by the fact that customers only have limited budgets and many spending requirements. Insurance is not often top of that list. The insurance penetration rate has remained fairly steady at around 3% for decades.

Premiums to Cover – also known in insurance circles as 'rate on line'. This is very cyclical as the insurance market hardens and softens. It is currently hardening – the ratio is getting bigger.

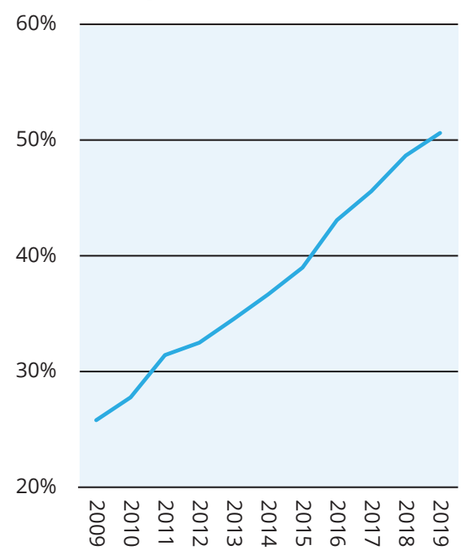
Cover to Capital backing – the amount of capital required to support the cover offered. This is set by industry regulators. Let's assume it is static for now.

Capital backing to ILS – the inverse of the ratio of alternative capital to traditional capital. More ILS funds coming into the market will make the ratio smaller.

To conclude, we have two factors getting bigger, one getting smaller and two probably static. This is a multiplication so each factor is equally weighted, and the precise values matter a lot. That means we can't conclude that the fog is stronger than the heartbeat or vice versa without doing the numbers properly. For now, this model is just a signpost to further research which may prove fruitful in the future.

As another useful indicator of what the future may hold, we can look across to the fund management industry. The cost savings in parametric insurance stem from disintermediation; the removal of the administrative and claims processes. The fund management industry has experienced its own type of disintermediation with the rise of passive funds in the form of ETFs. Traditionally active fund managers charged fees for their stock picking expertise and getting money into their funds was expensive and cumbersome. New technology enabled the creation of ETFs which could track indexes cheaply and could be easily traded, just like stocks, using online platforms. Cost savings and convenience proved a winning combination, with the result that passive funds have grown to represent half the market now (see Fig 15).
As we have seen, new technology is delivering cost savings and convenience in the insurance market too. That might suggest that the disintermediation offered by parametric insurance could also drive things in a similar direction.

Figure 15 – Passive Funds %



Source: AXIS

London 2020. Fog lifting. But the mist still obscures the tops of the newly built skyscrapers in the financial district. To paraphrase T.S. Elliot's poem 'Little Gidding', the end of our exploring will be to arrive where we first started but know that place for the first time. That heartbeat that you heard before was a friend, not Jack the Ripper. The burgeoning cyber insurance market points the way forward in the coverage of intangibles. These are the first steps on a path that still has some challenging obstacles. We may not know all the answers yet, but at least we have identified the questions.

About the Author

John Donald graduated from Exeter University with an Engineering degree in 1983 and spent the next 20 years in Investment Banking both in the Far East and Europe. During that time he worked for Phillips and Drew, Jardine Fleming and ING Barings. He received the Institutional Investor award for No. 1 ranking in Asian Equity Research for five consecutive years.

He left Investment Banking in 2004 and bought a Scotch whisky company which he successfully sold to investors in 2008. For the next 10 years, he ran his own risk consultancy advising on geopolitical and cyber risk. He joined Axis Capital as a Cyber Adviser in February 2019.

John is the author of three books. His first book Catataxis: When More of the Same is Different was published in October 2011 by Quartet Books. His second book Bolt from the Blue: Navigating the New World of Corporate Crises was published by Elliott and Thompson in 2013. The third '35 Views of Cyber Risk' was published by AXIS Capital in 2019.

References

1. *Swiss Re Sigma No. 3/2019*
2. *Coverage Gap: Swiss Re Sigma No. 1/2018 fig 4 Page 5.*
3. *Ponemon Institute: Intangible Assets April 2019*
4. *Ocean Tomo Intangible Assets: https://www.oceantomo.com/insights/ocean-tomo-releases-2015-annual-study-of-intangible-asset-market-value/*
5. *Value of Global M&A: https://www.bcg.com/en-us/publications/2019/mergers-and-acquisitions-report-shows-downturns-are-a-better-time-for-deal-hunting.aspx*
6. *Share Buybacks, Forbes Magazine: https://www.forbes.com/sites/garymishuris/2019/09/10/the-stock-buyback-disaster-and-3-exceptions/*
7. *Forbes Brand Survey: https://www.forbes.com/powerful-brands/list/*
8. *Brand Value: https://www.wpp.com/news/2018/05/brandz-top-100-most-valuable-global-brands-2018*
9. *The Private and Social Costs of Patent Trolls, Boston University School of Law, Winter 2012*
10. *Net Diligence Cyber Claims Study 2019*
11. *Aon Reinsurance Market Outlook Jan 2020*
12. *http://www.eurekahedge.com/Indices/IndexView/Special/635/Eurekahedge_ILS_Advisers_Index*
13. *Cyber-Catastrophe Insurance-Linked Securities On Smart Ledgers – Z/Yen Group Nov 2018*
14. *https://insurancelinked.com/primary-market-pricing/*

0420