

Chapter 14 – Insurance and flood risk

14.1 Aims

Flood insurance is a major and legitimate activity in managing flood risk. For those insured, flood insurance provides a mechanism for them to transfer part of their risk and reduce their vulnerability to flooding; to those providing the insurance (and re-insurance) it provides a commercially viable means of generating income.

Flood insurance, when seen as part of a portfolio of measures to reduce or manage flood risk, has four main roles:

- **Reimbursing** those who suffer damage, and thereby restoring them to their pre-flood financial situation.
- **Spreading** the costs of flooding across communities (and clients) , given that floods may affect only some communities at a time; and for individuals through time by spreading the potential costs of flood damage over many years in relatively small payments rather than having a single large cost if and when a flood actually occurs.
- **Reducing** the costs to the government of post-event recovery since the insured will receive insurance funds (note: where a private insurance sector exists only)
- Promoting a **change of behaviour** with regard to exposure to flood risk, by giving a signal of the hazard that people face and providing incentives for “good behaviour” - joining automated warning schemes, flood proofing properties etc.

Only the fourth of the roles listed above seeks to reduce risk, the first two simply transfer the risk from the insured to the insurer and the third reduces government expenditures.

The way in which each of these roles are approached determines the nature of the flood insurance arrangements that are effective and commercially viable. In descending order of general incidence, insurance policies can be bought for:

- **Property damage loss**, when floods cause damage that requires the repair or replacement of buildings and their contents
- **Loss of business income and profits**; for example when operational days occur or stock is lost
- **Loss of agricultural production**, for example when crops are destroyed
- **Loss of life and injury during floods** (“life insurance”)

Insurance against flood damage provides a central component as part of a well considered portfolio of flood risk management measures, but there are dangers. Many private insurance companies failed in the United States in the early parts of the 20th century when confronted with massive claims during major floods. This failure occurred because of a number of reasons:

- Few legitimate insurance companies in the early part of the 20th century underwrote flood losses; as few considered catastrophe natural hazards. (In part this was because the insurer had limited ability to properly access the catastrophic risk - i.e those affecting many insured at once - in terms of frequency and severity and hence premium levels and reserves were often

insufficient.

- Many illegitimate insurance companies existed at the turn of the 20th century as insurance products became increasingly popular. Due to the lack of associated regulation fraud, scandal and mismanagement were commonplace. As such many of the issuing companies did not actually have the capital to pay claims whether these claims were due to flood, fire or life.
- Many companies went bankrupt and the claimants did not receive their compensation.

In response the US government had to intervene to make many of these payments, so as to restore faith in insurance generally. A much tighter and more regulated industry followed to try and curb future problems.

14.2 State or private? A key decision

Any organisation promoting flood insurance must be large, as claims totals can be substantial. There are basically two alternatives:

- Flood insurance provided by the **state/government**, and sold to communities or individuals.
- Flood insurance provided by large **private companies**, and sold as profit-making services just like motor and other typical insurance.

Each has advantages and disadvantages. For example, a state system requires a long term commitment which may not fit with changing political agendas. It also requires a commitment by the government to periodic large claims which have to be funded. Private companies may fail, or may withdraw cover when it becomes unprofitable. Governments should decide for their country where the balance of advantage lies, or decide (like most of the Netherlands) to have no flood insurance at all.

14.3 Necessary conditions for successful insurance

There are **five conditions** that need to be in place to ensure the sustainability of **any** insurance scheme, **not** just flood insurance (Arnell, 2000). These are:

1. It must be possible to estimate the **likelihood and magnitude of possible losses**, so that premiums can be calculated that reflect this loss potential. If this is not possible, the premiums become arbitrary and the insurance agency (private or governmental) is at risk;
2. Losses from individual claims must be **independent**, and no single event such as a major flood should affect the majority (or even a large number) of those insured. If this is not the case, then the insurance agency might be faced with an overwhelming claims total, and fail.
3. The occurrence of any event leading to claims **must not be predictable** in deterministic terms (i.e. the dam will failure tomorrow and my house will be lost), or else those purchasing policies will only do so when they know that a claim is certain / likely.
4. There must be sufficient **demand** for insurance coverage to make a large enough market whereby a single event such as major flood does not lead to claims that exhaust the insurance agencies' resources
5. The **premium** charged to the insured must be acceptable such that coverage is purchased.

The problem with flood insurance (compared, say, with motor insurance) is that not all the conditions are met. In particular, flood losses are not independent; a major flood affects hundreds or thousands of adjacent properties, all of whom may claim at once. Regional floods may affect properties across different catchments, or even in different countries. Equally a flood event may be coincide with an earthquake and /or hurricane and wind damage. Although there always will be some correlation between risks, for the most part one flood event will not affect everyone. Flood is not alone in this, brush fire, windstorm, freeze and all other natural perils have some degree of dependence and can impact multiple policy holders. A regional company may have greater exposure to dependent risks than a well-diversified international / national insurer. The potential for such large, single event, claims however puts insurance companies or even governments at risk. This pressure has led to the development of active re-insurance market for natural perils that seeks to further transfer this risk – see below.

How best to meet the five conditions

Failure to meet the above conditions is liable to render any insurance system fragile and for it periodically to fail. This is to be avoided, by careful attention to information on flood risk and the nature of the insurance scheme, as discussed below:

Having adequate information on which to base premiums.

What is required here are flood maps and flood probabilities. This in turn will require a hydrological database of past floods, from which to predict future flood probabilities for locations where insurance premiums are to be sold, as these premiums should ideally be related to the risk of flooding and hence of claims. This database should extend back as far as possible (say 50 years) and is likely to include, for each catchment or locations within catchments:

- Rainfall records
- Runoff characteristics
- River flow records
- Coastal tidal gauge and surge records
- Historical flood extents (for model calibration)
- Structure elevations
- Adequate topographic information,

The simplest way of presenting information from the analysis of this data is as so-called insurance “rate maps”, showing where properties are located, and the extent of the 10, 20, 50 and 100 year floods is also depicted. With climate change the behaviour of the flood system and hence probabilities, this can be a complex operation, and modelling is usually required to produce the flood extent data, rather than rely on historical records.

Insurance premiums should reflect risk, although they do not always do so. Risk incorporates the probability of flooding, and the consequences of that flooding. This means that the insurer must also know the susceptibility of the insured to flood damage, as compensation will obviously be a function of that damage. For this, data needs to be collected on:

- The nature of the property insured (domestic; industrial; commercial; etc);
- The size of that property or group of properties;
- The potential damage that would result from a range of flood events (to establish an expected annual loss).

In this way the insurer can calculate an appropriate annual **premium** to charge which, over the long term will compensate the insured for the flood losses they will incur and create sufficient profit (and hence reserves) for the insurer to be safe from failure.

Assessing exposure of individual premium payers, communities and hence total portfolios

Given the data collected as above, the insurance company needs to set the premium to charge. If undertaken correctly total claims should not exceed total premium income, over the long term.

But the exposure of the insured to risks changes over time. This may result from increased runoff from an urbanising catchment, or increased flood flows resulting from climate change. It may also result from the property characteristics changing, when the owners extend their buildings or purchase more valuable contents. This means that exposure needs to be monitored continuously, and premiums recalculated on a regular basis (say, every year).

Any insurance company will also need at the same time to assess its total exposure to risk, by cumulating all possible simultaneous claims within its portfolio of policies. This is necessary to ensure that the company can meet its obligations of paying compensation totals that cover its entire portfolio; it will also alert the company to excessive risk and encourage it to spread its portfolio of cover over many communities and/or catchments.

In this way it makes it very less likely that all policy holders will claim at the same time, and thus threaten the company, by ensuring that claims to the insurance company are matched by (or at least paid partly from) income from others who are not making these claims either at that time or at all.

Having adequate financial reserves to meet all claims

In a properly run flood insurance scheme total claims should not exceed total premium income, over the long term. But the scheme might be faced with many claims early in its life, or claims in any one year that far exceed its annual premium income.

This means that the scheme must have reserves (reinsurance, capital market securities, or be backed by the country's government as the "insurer of last resort"). The extent of these reserves will depend on the nature of the portfolio of policies that it has "written" (i.e. sold) and the chance that premiums in any one period will exceed income, and by how much. There are no simple rules here, but insurers at Lloyds of London (a marketplace within which insurance is traded) are required by UK government to be able to cover all the claims from a one-in-two-hundred (1:200) year event.

These reserves also need to be "liquid". That is to say they need to be available at short notice, to respond to a flood event and the claims that rapidly follow, so they cannot include valuable property that could not be sold easily or quickly. Generally they comprise government bonds that are regularly traded and are relatively risk-free investments. Holding these liquid reserves – which generally yield a low income - is an expense that the insurers must be able to cover.

Promoting a sufficiently large market to ensure the safety of the insurers

Any small market in flood insurance is liable to suffer from claims that overwhelm its income and reserves. Therefore the market for flood insurance needs to be large, so as to include at any one time far fewer claimants than the numbers that are insured. Ideally any insurance scheme will, say, have many thousands (or millions) of premium payers but only a few hundred or a few thousand claims in any one year (or any other such period).

How this is achieved is not easy in flood insurance, as property owners may only seek and therefore buy insurance if they feel that their individual risk of flooding is high (so-called adverse-selection). In the motor insurance sector, for example, most governments make it compulsory for drivers to insure against accidents. This is generally not possible for flood insurance, as the owners of risk-free properties well outside flood plains will justifiably complain, and in a free market they will decline to buy cover or simply refuse to pay. Either incentives for insurance need to be provided (by governments generally) or other ways found whereby insurance is bought by people unlikely to claim, as in the UK (see below). In any case the market must be large, or it is vulnerable to large simultaneous claims which will lead to its collapse.

Governments have an important role here. They can either be the agency of insurance themselves (i.e. act as an insurance company in insuring individuals or communities) or they can promote a private insurance market (see above). If the latter, they will need to regulate it in such a way as to minimise the risk of failure by requiring the companies to hold sufficient reserves to meet multiple claims. Often the critical tension between the regulator and the private insurers is a desire for affordability for all and a fear that regulation will suppress risk based rates to a level where premiums would never cover losses, and hence the private insurance sector would fail to function.

Importantly, the ratio between reserves and the extent to which the companies can write policies (i.e. provide insurance cover) needs to be controlled, using fixed ratios based on modelling of catastrophic floods or by some other means, so as to disallow the companies from writing excessive numbers of policies that could lead to failure if claims all come together (note: rating agencies routinely do this for hurricane and earthquake, and are likely to increasingly do so for flood).

14.4 The nature of re-insurance

Individual insurance companies can become unsafe if condition (2) above is not met: the insurance company is faced with an overwhelming claims total, and fails.

Anticipating these circumstances the company can '**re-insure**' part of their liability, say over a certain sum in \$billions, with a specialist insurer who sells this re-insurance. The premium may be quite small per sum insured, given that the probability of a claim is inherently low, but it means that the insurance company is rendered fit to write more policies than otherwise would be the case.

Re-insurance companies are typically regulated with capital ratios, and to be profitable and safe they tend to be large, to bear the losses when claims are made, and have an international rather than just a national marketplace to realise the benefits of a diversified portfolio covering many disparate circumstances.

As pressure mounts for insurance pay-outs to be delivered as rapidly as possible, some reinsurance products release the insurance compensation payment based on the occurrence of a (precisely defined) catastrophic event - without being linked to the actual damage caused. This allows for speedy processing of insurance claims; the event itself can be verified in a matter of hours, whereas damage assessment can take months or years.

14.5 “Non-stationarity”: a real threat to insurance?

The world is changing, in both its climate and its social and economic fabric. The past is no complete guide to the future. Insurance arrangements and premiums that are based on the past hydrological record may be unsafe, and fail if there is a “run” of serious floods requiring huge insurance payouts.

There are several ways out of this dilemma:

- One solution is for insurers not to offer long term policies, but to restrict them to annual cover. In this way losses one year can be recouped the next (so long as the insured can afford the higher premiums that will probably be required).
- Another strategy is more risk sharing. The insurance policy can require that the insured pays the first “slice” of the flood damage costs (termed an “excess” or a “deductible”), particularly for high risk areas. In this way the liability of the insurance company is reduced.
- Insurance for floods is not offered by the private sector: this is a real option, and can bring dilemmas for the governments of the countries concerned, as they are then liable to pick up a substantial element of the bill for flood damage if they want the areas affected to recovery quickly.

Clearly, insurers need to monitor very carefully indeed the state of flood risk in the areas in which they provide cover, so as to avoid the dangers that come with unanticipated change in risk and hence liability.

14.6 Example insurance regimes

Flood insurance in the UK: insurance for all, irrespective of risk

Flood insurance is **very common** in the UK, for some internationally unique reasons. Based on the government’s Household Expenditure Survey and evidence from its own members, the Association of British Insurers (ABI) estimate that the take-up of insurance in the UK is such that 93% of all homeowners have buildings insurance that covers their home (where this insurance is a standard condition of a UK mortgage), although this falls to 85% of the poorest 10% of households purchasing their own property. Some 75% of all households have home contents insurance, although half of the poorest 10% of households do not have this protection.

This internationally unusual situation is a product of **history**. Following severe floods in the south-west of England in 1960, the insurance industry agreed in 1961 to make flood insurance more widely available to private households and to commercial and industrial properties. Members of the British Insurance Association, the forerunner of the Association of British Insurers, reached a so-called “gentleman's agreement” with government. The agreement was that they would offer flood cover to any domestic residence or small shop in Britain at an additional premium not exceeding 10 shillings (£0.50; \$0.60) per cent on the sum insured. But there was a key condition: This cover they would charge to all properties, **irrespective of risk**, as part of a general household insurance ‘package’.

Thus, the pattern of compensation for flood damages being the responsibility of individual householders and businesses provided through the market was set: as was the role **of private insurance**. In the 1990s, as data and techniques for mapping and modelling flood risk improved, the insurance industry focused attention upon identifying properties at greatest risk; and thereby on

endeavouring to ensure that the premiums charged reflected that risk and on assessing the overall level of liability it might face in a major flood event.

This provided the industry with an argument for **increased investment** in flood defence. In this way, the ABI began to contribute to the debate about funding for flood and coastal defence. The flood event of 1998 also served to increase the industry's level of concern about the potential frequency, and cost, of floods in the UK, but it was the events of autumn 2000 that confirmed the industry's predictions on inland flooding - that a significant flood event could result in insurance costs of between £1-2 billions (\$1.2bn - 2.4 bn): to them a dangerously large sum.

Following the **autumn 2000 floods**, in January 2001, the industry, through the Association of British Insurers (ABI), agreed voluntarily that it would be their general policy to maintain flood cover for domestic properties and small businesses, but just for a period of two years. During the two years, the ABI was active in putting pressure on the Government, through a variety of means such as direct discussions and responses to the consultation documents, to ensure that sufficient funds were made available to allow flood defences to be improved, thus reducing their potential liabilities.

The ABI was also a key actor in the processes to secure a strengthening of the control of **development** in flood plains through changes to planning policy guidance/statements and the planning system. More recently (2003-10), the Association, in its '**Statement of Principles** on the provision of flooding insurance', indicated that flood cover would be maintained for domestic properties and small businesses where properties were currently protected to Defra's minimum indicative standard or 1 in 75 years, for urban areas, or better where improved defences to at least that standard were planned by 2007.

In other locations, where risks were unacceptably high, and no improvement in defences were planned, flood cover could not be guaranteed but would be considered on a case-by-case basis. The implementation of the principles in the Statement was conditional upon specific actions from Government being carried out, on funding, development control and other matters.

In **summary**, the UK flood insurance arrangements are designed to make the insurers safe and profitable, without which there would be no private market for compensation against loss through flooding. The consequence is that some individuals who are insured, and pay for it, do not need that insurance, and the government is required to spend more on flood defence than it might otherwise do. The merits and demerits of these characteristics continue to be debated.

Flood insurance in the USA: 'carrot and stick'

Standard US homeowners' insurance does not cover flooding. It is therefore important for those at risk to have extra protection from the floods associated with hurricanes, tropical storms, heavy rains and other conditions that impact the U.S.

In 1968, Congress created the National Flood Insurance Program (NFIP) to help provide a means for property owners to financially protect themselves from unaffordable flood damage. The NFIP offers flood insurance to homeowners, renters, and business owners if their community participates in the NFIP. Participating communities agree to adopt and enforce ordinances (zoning of land use) requiring that all new homes built after the community joined the program to have their first floor elevation at or above the 100-year flood elevation. Communities must also meet or exceed other FEMA requirements, such as control of construction in that portion of the floodplain that passes the 100-year flood in order to reduce the community risk.

The NFIP has the following three aims:

1. To provide flood insurance at affordable rates (that are reasonable given the risk faced);
2. To reduce federal disaster aid by replacing such aid with the insurance system;
3. To slow the rate of increases in flood losses through community actions that control development in the 100-year floodplain.

In this respect the NFIP supports local communities in their efforts to reduce the risk and consequences of serious flooding. In order to participate in the NFIP, a community must agree to adopt and enforce sound floodplain management regulations and ordinances. In exchange for these practices, FEMA makes (government subsidised) flood insurance available to homeowners, business owners and renters in these communities. Those who joined the program in its early days and who lived in the 100-year floodplain were offered reduced or subsidized rates. Today, approximately 25% of the FEMA policies are subsidized (i.e. at a rate lower than actuarially expected).

Because relatively few homeowners purchased flood insurance early on, the US Congress established the Mandatory Purchase Requirement (MPR) in 1973. A property owner in an area at high flood risk (defined as having a first floor below the elevation of the 100-year flood) is required to purchase flood insurance if the property is mortgaged with a federally regulated lender. The lender is required to ensure that the property is covered by flood insurance for the term of the loan and to purchase flood insurance on behalf of the property owner if the property owner fails to do so, although this is not frequently done. Homeowners who live in a hazard area that is protected by an levee that provides protection against the 100-year flood and has been recognized by FEMA as providing that level of protection are not required to purchase insurance.

Box 14.1 Floodplain Development and flood insurance in the USA

- US Federal policy has not prevented development in high risk areas -e.g. since 1980 coastal county population growth rate (at 28%) is consistent with the nation's average rate of increase, but the density is much greater (17% percent of the land area holds 53% of the total population). However, only about three percent of the US population lives in a coastal flood hazard area.
- Flood insurance is available in over 21,000 participating communities nationwide. There are over 1100 communities participating in the financially incentive based Community Rating System implementing "higher standards", and accounting for 66% of policies in force.
- There are over 80,000 insured repetitive loss properties (and growing) and over 8,000 severe repetitive loss properties (and growing). There is \$1.2 trillion in insurance cover, and 5.6 million flood policies, in force. About 25% of the 5.6 million policies are rated at less than actuarial rates
- Outstanding Treasury borrowing (debt) is \$18.7 billion

Source: Federal Emergency Management Administration, **December 1 2011**, Washington DC, USA.

Rather than purchase insurance through the NFIP, lenders and homeowners can purchase flood insurance from private insurers. In contrast to the NFIP market, in which the private sector sells the policies but the federal government underwrites them, in private sector market, insurers both sell and underwrite the policies. Such policies must meet or exceed the coverage provided by NFIP policies to satisfy the MPR.

At present, coverage of residences under the NFIP is limited to \$250,000 and \$500,000 for businesses. Those seeking coverage above the FEMA maximum must turn to the private market.

Flood insurance arrangements in France: 'bundled' with fire cover

In France, a different model of compulsion has been developed. Since 1982 the French government has required communities to produce plans to reduce risk – not just from floods – in the form of *Plans d'Exposition aux Risques* (PER), termed *Plan de Prevention aux Risques* (PPR) since 1995. The insurance element is provided by requiring all those insuring against fire to pay a compulsory levy of 9% of their premium for flood insurance. Insurance companies can buy re-insurance from the state's *Caisse Central de Reassurance*.

At the same time, mitigation was incorporated in the arrangements. A commune has to produce a plan of its flood plain areas, and divide this into zones with different levels of risk. New development is subject to conditions that are designed to reduce the build-up of risk, and existing developments must be adapted to minimise risk, paid for by the owners. Reimbursement for flood damage is only paid if the property affected is meeting the requirement of the PPR: new development in contravention to the plan would not be covered, nor would property that had not been adapted as above.

There are similarities with the US NFIP, but suited to French circumstances. There is no need to incentivise compliance with zoning and mitigation measures, as in the US through subsidised flood insurance, because in France these plans and measures are required by law. This more *dirigiste* regime does have its own limitations, in that enforcement of the mitigation measures has not always been straightforward, and this threatens to undermine the whole arrangement.

Insuring those responding to flood events

As well as those directly impact by floods, local governments can incur significant additional expenditure in responding to floods events. Various "insurance" mechanisms exist to reimburse local governments for this additional expenditure from central funds. For example the Belwin Scheme in the UK, provides a central government fund that local authorities can apply to for emergency financial assistance following a major emergency in their area. If a local authority incurs costs from responding to a major incident, they can apply for a grant to recoup up to 85% of the costs (over a given threshold).

The scheme is applicable where an emergency or disaster results in destruction of or danger to life or property and a local authority incurs expenditure on, or in connection with, taking action to safeguard life or property or preventing suffering or severe inconvenience in their area. Local authorities are not automatically entitled to this financial assistance and the grant does not cover insurable or capital costs. The decision to award a grant is taken by Central Government after deliberating on the disaster circumstances.

14.7 A summary - The key components of an effective flood risk insurance sector

For flood insurance to form a component of the flood risk management it must:

- Have access to sufficient financial reserves (either directly or through reinsurance) -- reflecting an good understanding of the inter-connectivity and the spatial and temporal coherence of the major flood events (and associated perils) to which a country is exposed.

- Form part of a more comprehensive and large private insurance industry, or be run by the state
- Compel individuals and businesses to take insurance (or at least in part)
- Be well regulated to ensure substantial financial reserves are maintained (particularly if operated through private companies)
- Set premiums that are affordable (to promote take-up) yet commercially reasonable given good data on risks faced
- Promote and regulate reinsurance arrangements; ensuring providers have appropriately diversified their exposure.
- Promote “good behaviour” but building flood risk mitigation actions into the conditions for cover to be provided
- Link private and government funding with individuals and business financing to promote betterment of reinstated properties (to be flood resilience)
- Provide access to central government emergency funds to insure the additional costs incurred by local governments in responding to flood events.