

## Flood risk insurance, mitigation and commercial property valuation

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**Flood risk insurance, mitigation and commercial property valuation**

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## 1 2 3 **Flooding and commercial property: valuation, insurance and mitigation** 4 5

6 **Purpose:** To understand how Built Environment professionals approach the valuation  
7 of flood risk in commercial property markets and whether insurance promotes  
8 mitigation in different insurance and risk management regimes, draw common  
9 conclusions, and highlight opportunities to transfer learning.  
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13 **Design/methodology/approach:** An illustrative case study approach involving  
14 literature search and 72 interviews with Built Environment professionals, across five  
15 countries in four continents.  
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19 **Findings:** Common difficulties arise in availability, reliability and interpretation of risk  
20 information, and in evaluating the impact of mitigation. These factors, coupled with the  
21 heterogeneous nature of commercial property, lack of transactional data, and remote  
22 investors, make valuation of risk particularly challenging in the sector. Insurance  
23 incentives for risk mitigation are somewhat effective where employed and could be  
24 further developed, however the influence of insurance is hampered by lack of insurance  
25 penetration and underinsurance.  
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31 **Research limitations/implications:** Further investigation of the means to improve  
32 uptake of insurance and to develop insurance incentives for mitigation is  
33 recommended.  
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37 **Practical implications:** Flood risk is inconsistently reflected in commercial property  
38 values leading to lack of mitigation and vulnerability of investments to future flooding.  
39 Improvements are needed in: access to adequate risk information; professional skills in  
40 valuing risk; guidance on valuation of flood risk; and regulation to ensure adequate  
41 consideration of risk and mitigation options.  
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46 **Originality/value:** The research addresses a global issue that threatens local, and  
47 regional economies through loss of utility, business profitability and commercial  
48 property value. It is unique in consulting professionals across international markets.  
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51 **KEYWORDS:** Flood, valuation, insurance, mitigation, international, commercial  
52 property, adaption  
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### 56 **Introduction**

57  
58 The commercial property sector is an important economic engine that suffers loss and  
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3 disruption as a result of flooding and may be at increased risk in the future (Committee on  
4 Climate Change, 2015). Commercial property transactions are an important part of a national  
5 investment portfolio (Savills, 2016) and any risk to these asset values can threaten local or  
6 even national economic stability. Furthermore, businesses operating within commercial  
7 property are a vital part of local economies and are integral to community recovery.

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10 Therefore understanding the impact of flooding on commercial property value and the  
11 potential to mitigate this impact through risk transfer and loss reduction measures for existing  
12 property can support sustainable property markets in areas at risk, as well as the communities  
13 they support (Tobin, 1979).

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16 However property investment, and in particular non-domestic property investment  
17 form part of global investment markets and investment funds that may be at threat from flood  
18 risk (London Climate Change Partnership, 2009), there are also businesses operating trans-  
19 nationally with real estate portfolios to match. Investment managers' performance would be  
20 enhanced if understanding of risk pricing was developed on a consistent basis internationally.

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23 Research on the value of property at risk of flooding or having been flooded has  
24 generally focussed on the residential property market. The majority of empirical studies,  
25 spread internationally, are transactional analyses of observed market price for example  
26 (Montz, 1993, Eves, 2004, Sirmans *et al.*, 2005, Bin *et al.*, 2008, Lamond *et al.*, 2010, Pryce  
27 *et al.*, 2011, Beltrán Hernández, 2016, Hirsch and Hahn, 2017). Studies have also used expert  
28 consultation to explore the process, rationale and causes of discounted valuation (Eves,  
29 2004). Findings from these studies show large variation in the scale of impact observed on  
30 market price. Differences in value estimates for different national markets relate to  
31 information and perception of risk fostered through different regulatory and insurance  
32 contexts (Yeo, 2002, Lamond *et al.*, 2005). However there are also temporal variations in  
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3 market price within national and sub-national markets that reflect the point in time value  
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5 including economic conditions and saliency of risk (Eves, 2002).  
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8 Based on rational choice theory, studies in the USA have explored price differentials  
9  
10 in relation to the extra cost of insuring against flood damage and loss (Skantz and Strickland,  
11  
12 1987, Bin *et al.*, 2006). Theory also predicts impacts on market value proportionate to  
13  
14 expected cost of damage repair where insurance is not available or not taken up (Tobin and  
15  
16 Newton, 1986). Imperfect information, denial and heightened risk perception are expected to  
17  
18 hamper market behaviour (Pryce *et al.*, 2011) whereby value is based on perceived rather  
19  
20 than actual risk or supported artificially through subsidised insurance. New information such  
21  
22 as a flood event can therefore cause large and undesirable temporary adjustments in value  
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24 that have the potential to become embedded into blight (Pryce *et al.*, 2011).  
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28  
29 Notwithstanding this, there is far less evidence in the commercial property market. It  
30  
31 is not appropriate to assume that findings can be extended directly from the residential sector,  
32  
33 although the same concepts are relevant to explore. Commercial property transactions are  
34  
35 more likely to be for investment purposes and the proportion of non-domestic buildings that  
36  
37 are owner occupied is much smaller. Thereby the purchase decision may often be arms  
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39 length, influenced by different factors. As pointed out by the Investment Property Forum  
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41 (Investment Property Forum, 2015) valuation points and rental transfers may be more  
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43 frequent whilst sales transactions are less frequent and transparent. Studies of the value of  
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45 commercial properties at risk in the UK, in the absence of high quality transactional data,  
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47 have canvassed expert views and gauged market perception from commercial property  
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49 owners and occupiers. (Kenney *et al.*, 2006, Bhattacharya *et al.*, 2013). Kenney *et al.* (2006)  
50  
51 noted the importance of insurance and complexity with respect to physical aspects of  
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53 potential damage given the heterogeneity of non-domestic construction. Bhattacharya-Mis &  
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55 Lamond (2016) demonstrated that use class (such as retail vs industrial property), is a key  
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3 factor in the vulnerability of property utility and value. They both point to a vulnerability in  
4 the UK market that is not yet realised in market price but has the potential to cause serious  
5 impact in the future if mitigation is not undertaken (Pottinger and Tanton, 2011). Recent  
6 work in the USA on hurricane risk by Eichholtz *et al* (Eichholtz *et al.*, 2018) suggests a  
7 measured impact of floodplain location on property price in the aftermath of Sandy around  
8 11% and a study in St. Louis Missouri found similar effects, albeit not statistically significant,  
9 due to absence or presence of flood protection levees (Fell and Kousky, 2015). An Australian  
10 study also including some commercial property (Rajapaksa *et al.*, 2016) found flood events  
11 were more important than the release of flood risk maps in changing property value. Authors  
12 also highlight the duty of the valuation professional to consider flood risk thereby avoiding  
13 claims of negligence (Craddock, 2016).  
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28 Insurance is seen as important since it provides, amongst other things, reliable  
29 compensation and as such supports recovery and reconstruction. Available research also  
30 suggests that insurance and regulation regimes influence the uptake of risk mitigation  
31 measures (Kreibich *et al.*, 2007) and that the regimes vary across different international  
32 markets (Lamond and Penning-Rowsell, 2014). In contrast, government compensation  
33 independent of prior actions is assumed to discourage individual precaution and preparedness  
34 (Keskitalo *et al.*, 2014).  
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45 Therefore the dual aims of the research were to develop an understanding of how  
46 different international insurance and regulatory regimes promote effective flood risk  
47 mitigation for commercial property; and to explore the consistency of international  
48 approaches to the valuation of commercial property at risk from flooding.  
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## 55 **Research Methods**

56 An illustrative case study design was used to develop a cross country comparison. Five  
57 countries (Australia, China, Germany, the USA and the UK) were chosen to represent  
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3 different insurance and regulatory regimes as understood from previous studies of insurance  
4 systems (Lamond and Penning-Rowell, 2014) and regulation (Defra, 2015). The research  
5 team included local researchers in each country with expertise in flood risk management and  
6 building pathology, and a common approach was adopted across the case studies to allow for  
7 cross comparison and synthesis of findings.  
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12 A qualitative approach was chosen to illuminate the complexity of the interactions  
13 between practice and governance of this rapidly evolving issue (Robson, 1993). The methods  
14 employed were: a systematic scoping review of literature and grey literature to understand the  
15 prevailing regimes and opinions at a national level; and interviews with Built Environment  
16 professionals operating in the case study countries to understand their experiences and  
17 perspectives as practitioners with differing opportunities and constraints.  
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22 The systematic scoping included databases of academic literature and industry  
23 sources, as well as generic search websites. A PICO search query (Collins *et al.*, 2015) was  
24 developed on the ISI web of science using terms related to commercial property, flooding,  
25 insurance and valuation that was used to search international databases with country  
26 delimiters. Websites of specialist organisations and local language journals and databases  
27 were also scoped by the country specialists.  
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32 A semi-structured interview approach allowed common themes to be explored across  
33 case studies, with the necessary flexibility (given different roles and responsibilities of  
34 interviewees) within, and across, case studies. A common set of interview questions was  
35 developed to explore themes identified through the literature review. Two of these themes  
36 focussed on the role of flood insurance in the mitigation of flooding and the impact of  
37 flooding on commercial property value.  
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42 Experts with knowledge and experience of advising on flood risk were targeted in  
43 order to gain the most informed view from a small sample size (Silverman, 2013).  
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3 Interviewees were therefore purposively selected through a combination of recruitment  
4 methods including social media, known experts, emails from the RICS (a global professional  
5 body for surveyors) to their commercial members and snowball techniques. Such a strategy  
6 was necessary given the expected diversity of roles and professionals involved and the rarity  
7 of individuals with specific flood expertise. A target sample of fifteen (15) semi-structured  
8 interviews in each case study was considered to be appropriate in advance as the point of  
9 theoretical saturation. As interviews proceeded, the number of interviewees per country was  
10 adjusted as the local researchers judged understanding of the critical context had been  
11 achieved. Data was obtained from interviews with 72 Built Environment professionals from  
12 the five countries. The roles and division of the experts is shown in table 1.  
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26 INSERT TABLE 1 here  
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28 The interviews were coded in suitable software (NVIVO and MAXQDA) under a  
29 common set of initial and emerging themes and a thematic content approach to analysis was  
30 employed, nationally and then cross nationally.  
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## 35 **Results**

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37 The results of the literature review and interviews are combined below to provide a summary  
38 of the insurance regime in each country. This is followed by a thematic evaluation of the  
39 interview findings in relation to risk mitigation, through insurance and property valuation.  
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### 46 ***Insurance and risk management regimes***

#### 47 *Australia*

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49 Australian insurance policy-making originated from the policies of UK companies, prior to  
50 the 1968 'Gentlemen's Agreement' (Huber, 2004). Within a typical policy, 'flood' events  
51 were covered, even though the term itself was not defined (Australian Government, 2016). In  
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3 1984 the Insurance Council of Australia (ICA) provided a definition of flood<sup>1</sup> that was not  
4 covered by default enabling partial, or fuller, add on 'flood' cover. However the definition is  
5 not clear as multiple interpretations have been applied over the three subsequent decades.  
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10 Following extensive flooding in Queensland in 2011, the Federal Government  
11 considered adopting a system of mandatory flood insurance. A National Disaster Insurance  
12 Review (National Disaster Insurance Review Panel, 2011) was undertaken; however, the  
13 government decided not to legislate, with the result that the definition of flood is still  
14 questioned and debated, and the lack of understanding of the difference between a flood and  
15 storm event remains (Australian Government, 2016).  
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24 Participants noted that insurance cover varies from state to state, with each having  
25 different risk profiles. Insurers in more flood prone areas request that mitigation measures are  
26 adopted or, they impose penalties when mitigation measures are not adopted. An interviewee  
27 commented: *'Brisbane insurers are likely to be red hot on this, whereas in Sydney they  
28 wouldn't be because they've not had a lot of flooding here'*.  
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### 37 *China*

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39 National government in China encourages companies and citizens to participate in insurance  
40 programs according to the *'Emergency Response Law of the PRC'* (2007). However, Shi and  
41 Liu (2013) have criticised this system because it lacks any legally binding incentive  
42 mechanisms.  
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49 Commercial property owners, landlords or property management companies are  
50 required to purchase property insurance (Li *et al.*, 2015) that covers a limited set of water  
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57 <sup>1</sup> Described as 'the inundation of normally dry land by water escaping from the normal confines of  
58 any natural watercourse or lake whether or not altered or modified, or any reservoir, canal or dam'.  
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3 damage problems such as rainwater leakage, blocked drainage, escape of water from pipes  
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5 and surface water flooding. Fluvial and coastal flooding are not included.  
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8 Gaschen *et al.* (1998) stated that around 80% of property flood insurance schemes are  
9  
10 purchased by large and medium sized commercial enterprises. According to interviews in the  
11  
12 Greater China region, having property insurance is a common practice among land and  
13  
14 property owners. However, they confirmed the limitations of cover:  
15

16  
17 *...as far as I know most of commercial properties are required to purchase the property*  
18 *insurance and it is combined with flood disaster, fire and other hazards ..... So, I*  
19 *understand the property insurance that my clients purchase normally can cover the cost*  
20 *from surface water flooding includes fixing the lifts or escalators or the flood from pipe*  
21 *leakages and seepages, etc.*  
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26 Insurance coverage for fluvial, coastal or combined flooding is available from private  
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28 insurers but is not compulsory. Commentators have noted that the availability of, and demand  
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30 for, both bundled property insurance and extra flood cover may be enhanced if urban  
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32 provincial and local governments support the private insurers with the required risk  
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34 information and financial support (Wang *et al.*, 2012, Li *et al.*, 2015).  
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### 39 *Germany*

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41 Severe floods in the Rhine catchment in 1993 and 1995 initiated a change towards more  
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43 integrated flood risk management in Germany (Bubeck *et al.*, 2017). This was strengthened  
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45 following the 2002 event (Kreibich *et al.*, 2011) through the 5-point action programme for  
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47 improvements in flood risk management, which led to amendments of the Federal Water Act.  
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49 Private precautionary measures are expected from property owners in a floodplain in  
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51 accordance with their resources and capabilities (Wasserhaushaltsgesetz (Federal Water Act),  
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53 2009 ).  
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3 Flood insurance is provided as commercial property insurance and ‘all-risk’ policies,  
4 covering direct damage to assets as well as losses due to business interruption (Jakli, 2003).  
5  
6 Flood insurance penetration in Germany has increased strongly in recent years, but is still low  
7  
8 in comparison with other countries such as the UK (Surminski and Thieken, 2017). There are  
9  
10 large regional differences due to historical compulsory flood insurance in the former German  
11  
12 Democratic Republic and in the federal state of Baden-Wuerttemberg (Schwarze and  
13  
14 Wagner, 2004).  
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19 Decisions about cover for small companies (insured value < 2.5 million Euros)  
20  
21 depend on the ZÜRS flood zoning system German Insurance Association (GDV) (GDV,  
22  
23 2016). Premiums and deductibles increase from zone 1 to zone 4, with properties in flood  
24  
25 zone 4 (more frequent than 1/10 years) considered uninsurable (Schwarze and Wagner,  
26  
27 2004). An expert explained that the GDV has developed several non-binding adaptable  
28  
29 insurance templates for small businesses. However, interviewees recognised that insurance  
30  
31 terms are negotiated on a case by case basis with industrial and large commercial businesses.  
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35 In Germany, triggered by the 2002 flood and again by the 2013 flood, political  
36  
37 debates took place about a compulsory flood insurance scheme. However, both initiatives  
38  
39 failed, mainly due to governmental refusal to provide a guarantee for remaining risks  
40  
41 (Schwarze and Wagner, 2004, Surminski and Thieken, 2017). The GDV together with  
42  
43 engineers and Build Environment professionals developed the building certificate “flood  
44  
45 passport (in German: Hochwasserpas)”, launched in 2014 (Thieken *et al.*, 2016). The impact  
46  
47 in the commercial sector is unknown but there is no evidence of a positive effect on the  
48  
49 implementation of precautionary measures for households (Osberghaus and Philippi, 2016).  
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## 54 55 UK

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57 Commercial property insurance is provided by private companies in the UK and is not  
58  
59 compulsory. Standard policies usually includes cover for flooding of all types, and ‘business  
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3 interruption' insurance can also be purchased to cover flood disruption. Evidence on the  
4  
5 uptake of insurance among business properties from UK Department for Environment, Food  
6  
7 and Rural Affairs (Defra) surveys (Dickman *et al.*, 2015) and the Federation of Small  
8  
9 Businesses (2015) suggests high level of cover (95%) among small businesses with few  
10  
11 problems of availability. Recent developments, that reduce the commitment of insurers to  
12  
13 universal availability of cover and the introduction of the Flood Re re-insurance pool (April  
14  
15 2016) that specifically excludes commercial property, may lead to large increases in  
16  
17 premiums and excesses for small to medium businesses at risk. This may be an important  
18  
19 consideration given that the availability of insurance is a material factor in the valuation of  
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21 commercial assets (Kenney *et al.*, 2005).  
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26  
27         Bhattacharya-Mis and Lamond (2014) supports these findings, larger companies in  
28  
29 their study were more likely to self-insure and they note that even small businesses may  
30  
31 avoid claiming against their policy to avoid increases in premium. Larger commercial  
32  
33 concerns, have long been excluded from guaranteed cover (Huber, 2004).  
34

35  
36         Interviewees had limited knowledge about the details of insurance conditions. As one  
37  
38 expert explained:  
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41         *There is a bit of a gulf really between the technical engineering and property side of the*  
42  
43 *flood problem and the insurance industry. The insurance industry, typically, has been*  
44  
45 *quite black box with regard to flood risk ...*

46  
47         Another interviewee noted:

48  
49         *I suppose most commercial people go through a broker, to get their insurance, rather*  
50  
51 *than just going online and getting insurance.*

52  
53         However, they were aware that some companies that had been flooded were having problems  
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55 obtaining insurance and that this was a serious issue to them.  
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3 *USA*  
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6 Under provisions of the US National Flood Insurance Program (NFIP), both commercial and  
7 residential properties located in the administratively-defined 100-year floodplain are required  
8 to carry flood insurance, with the cost of that insurance dependent on the elevation of the  
9 structures relative to the base flood elevation (BFE) and any mitigation that has been  
10 implemented (Hartwig and Wilkinson, 2005, Federal Emergency Management Agency,  
11 2017). For commercial properties, rates are capped at \$500,000 for both building and  
12 personal property (Federal Emergency Management Agency, 2013). While some of those  
13 interviewed agreed that the program encourages mitigation, the extent to which this  
14 requirement influences mitigation varies depending upon a number of factors including the  
15 age of the building, the size of the operation, and ownership characteristics. With respect to  
16 age, it may be the case that the costs of mitigating older buildings and buildings with  
17 basements are so high that the offset in premium costs is not seen to make mitigation a good  
18 investment. At the same time, new structures must incorporate flood-proofing into their plans  
19 in order to obtain a building permit, typically through elevation above BFE.  
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38 Size of the business affects the willingness to undertake mitigation in several ways.  
39 For larger operations, the NFIP cap on flood insurance is often insufficient so these  
40 businesses may be required as a loan condition to carry both an NFIP policy and a private  
41 commercial policy. The extent to which this encourages mitigation is variable. As one  
42 interviewee put it:  
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50 *my impression is that there is nothing other than a determination to say if you do or do*  
51 *not [need to] buy flood insurance. ... It's not really an appraiser/client relationship*  
52 *where they are giving advice, it's more of a here is what you need for the loan file.*  
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56 Other large operations that are not subject to loan requirements will self-insure, so it is  
57 difficult to obtain information on the extent to which mitigation is used to reduce risk.  
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3 Smaller businesses face different issues. As one professional noted, '*some businesses only*  
4 *have the money to keep the doors open and others have the resources to actually look into*  
5 *making their property safer.*' In many cases, small businesses are renters. Once an  
6 appropriate location is found, they typically do not think about flood risk and are not required  
7 to carry flood insurance. The owner of the building may have insurance but that does not  
8 cover the contents of the businesses, only the building.  
9

### 18 ***Take up and motivation for risk mitigation***

20  
21 There was largely a consensus among the interviewees across countries that the insurance  
22 industry could have a major influence on the motivation of companies to take active steps to  
23 mitigate against flood risk. However, many perceived that this was not currently the situation  
24 with regard to all commercial properties in their markets and that insurers could do more.  
25 This was the case despite differences described above in the regimes under which the  
26 property insurance cover treats flood risk. Reasons offered to explain the perceived failure  
27 included two that were repeated across all five case studies: low take up of insurance cover  
28 and lack of a premium incentive to spend resources on mitigation.  
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#### 41 ***Low take up of insurance***

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43 Low take up of insurance can be a reflection of lack of perceptions that flood risk is a serious  
44 threat to property and business:  
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49 *...normally developers and the government are not foolish, they will not put*  
50 *developments into a high (flood risk areas), normally the drainage system is well*  
51 *equipped...(Chinese interviewee).*  
52  
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54 Alternatively insurance may be unavailable or unaffordable in a particular flood zone  
55 (Germany, Australia). Lack of cover may be more prevalent in large companies because  
56 while smaller companies may be unwilling to bear risks, large companies can self-insure.  
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3 *Supposing they've got, a thousand supermarkets, it'll cost them A\$10 million a year to*  
4 *get .. insurance, they just don't insure, they do a self-insure.... if they lose a supermarket*  
5 *through a flood, they just rebuild/repair it. Each supermarket costs probably less than*  
6 *A\$10 million to rebuild. As long as you don't have more than one flood in your portfolio*  
7 *in a year, you're ahead. (Australian interviewee)*  
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12 Even in the USA where cover is encouraged by the NFIP and mandatory in some  
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14 circumstances, larger concerns may be underinsured. Commercial coverage through the NFIP  
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16 is seen to be too low for many commercial entities, resulting in under insurance. As  
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18 respondents remarked  
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22 *a lot of deals we do blow past the 500,000 dollar statutory max per building (US*  
23 *interviewee)*  
24

25  
26 *We calculate the amount of insurance a business needs to comply with federal law.*  
27 *Example...\$200,000 loan but building worth \$500,000 – bank only requires \$200,000 ....*  
28 *Can get more but typically only get what is required. No one has ever asked what can I*  
29 *do to lessen my risk. (US interviewee)*  
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34 Regardless of underlying causes, from a practical perspective, low levels of cover  
35  
36 subvert the influencing potential of the insurance mechanism. Consequently, some  
37  
38 professionals called for more regulation that includes mandatory flood insurance.  
39  
40

#### 41 *Lack of premium incentives*

42  
43  
44 There was a perception in countries where insurance is widely available that property owners  
45  
46 and occupiers would regard insurance as an alternative to other mitigating action unless they  
47  
48 were able to offset the cost of other mitigation via lower insurance costs. There are market  
49  
50 specific considerations about the practicality of introducing premium incentives. In some  
51  
52 markets, such as the UK, where premium for flood risk is concealed within an all risks  
53  
54 policy, insurers may not be accurately or transparently pricing flood risk. In other countries,  
55  
56 for example the USA, premiums have historically been subsidised, though there is some  
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3 movement aimed at reducing or eliminating subsidies.  
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5  
6 *The pricing of flood insurance sends a signal to do mitigation and if you have a*  
7 *subsidized pricing structure then you aren't sending the mitigation message but if you*  
8 *have more actuarially rated policies then you are sending the message that if you*  
9 *mitigate it can reduce your insurance premium. (US interviewee).*  
10

11  
12 Interviewees recognised that this might be challenging to achieve given the level of  
13 understanding of the impact of mitigation on risk. Although there are several initiatives that  
14 exist or are emerging that could help in the process, currently no professional could identify  
15 such a neutral body and interviewees reflected on a lack of guidance available that insurers  
16 could use to price mitigation efforts.  
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#### 26 *Flood experience and reinstatement*

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28 A commonly mentioned route to influence mitigation occurs during the reinstatement of a  
29 property following flood. The reinstatement period is seen as a cost effective opportunity to  
30 install mitigation that is also linked to the widely acknowledged effect of flood experience on  
31 mitigation. One valuation expert in the US pointed out that a number of commercial entities  
32 are retrofitting types of mitigation after Hurricane Sandy. Similarly, following significant  
33 flooding in South Carolina in 2015, According to an interviewee:  
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43 *I think that is why a lot of people are doing this [mitigation] right now, not so much the*  
44 *insurance side but more the disruption and the down time associated with it. (US*  
45 *interviewee).*  
46  
47

48 In such circumstances insurers may influence mitigation through information or  
49 encouragement of resilient reinstatement. However they may or may not have a role in  
50 planning and implementing recovery, particularly within commercial insurance markets  
51 where there may be a high degree of financial settlement: *'when I did work in Hull in 2007,*  
52 *people got a flood and never bothered doing any work, they just took the cash'* (UK  
53 interviewee).  
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3 In any case the costs of risk mitigation are not generally borne by insurers, because  
4 terms in insurance generally preclude “betterment”, which is defined as the enhanced value of  
5 real property arising from local improvements.  
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9  
10 *They won't pay for risk mitigation, no. You'll find, with insurance companies, they'll*  
11 *repair what's already there, but if you want to put an improvement scheme in, they won't*  
12 *pay for it. (UK interviewee)*  
13  
14

15  
16 Insurers may still have the potential to inform policyholders about resilience or to insist on  
17 physical resilience measures being installed as a condition of future cover.  
18

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20  
21 *They push back on us saying; “Well what are you doing about mitigating the risk?”*  
22 *Premiums go up, deductibles increase. There's a big focus on what we're doing; to*  
23 *mitigate the cost to the insurer. (Australian interviewee).*  
24  
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26  
27 With the property owner paying for mitigation an increased interest in undertaking benefit  
28 cost analyses with respect to mitigation of flood risk and insurance has taken place following  
29 flood events in the USA, with an emphasis on how best to reduce future risk. Requirements  
30 for flood insurance have been influential in encouraging mitigation, but the results have been  
31 very context-specific with respect to different business characteristics.  
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### 40 ***Impact on property value***

41 Interviewees generally concurred that the value of commercial property should be affected by  
42 the level of flood risk. As one commented: *'there has to be a difference in value between a*  
43 *property that floods and one that doesn't'* (UK interviewee). UK valuers also recognised it  
44 was part of their due diligence obligation to consider flood risk:  
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50  
51 *...So yeah, it is a key consideration for investors and therefore, as valuers, we need to*  
52 *put ourselves in the shoes of those investors and to consider the situation as we would*  
53 *expect them to consider the situation. (UK interviewee).*  
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56  
57 However, interviewees from all countries felt that the realisation of this discount in market  
58 value is inconsistent due to: lack of awareness or low perception of flood risk; the perception  
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3 among multiple stakeholders that flood risk is less important than other property  
4 characteristics; and a lack of guidelines or common practices that allow valuers to factor  
5 flood risk into property value, as described below.  
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### 10 11 *Risk awareness and perception*

12  
13 Interviewees noted that businesses at risk, but not recently flooded, can have low spontaneous  
14 awareness of risk or perceive that the risk is not something they need to be concerned about.  
15 They pointed out that lack of awareness of risk is reinforced if property searches do not result  
16 in disclosure and insurance is available regardless of risk. For investment and for business  
17 occupation, valuers' due diligence should result in risk discovery, however a lack of hazard  
18 maps (in China) and shortcomings of accessible hazard information (low resolution and lack  
19 of depth information in UK) as well as difficulties in interpretation (Germany) mean that this  
20 is not always meaningful discovery. In the USA one respondent remarked:  
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33 *Real estate disclosure laws do more harm than good. People put too much faith in them.*  
34 *Hugely unreliable – usually tailored that only the previous owners' experience*  
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36

### 37 38 *Other demand factors*

39  
40 Other demand factors were highlighted by interviewees particularly for the case of central  
41 business districts where locational desirability is the dominant consideration.  
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45 *...I have to mention one thing, because the current office and commercial property are*  
46 *very demanding in Chinese cities like Hong Kong and Shanghai, you can see the*  
47 *commercial property offices emptiness rate is very low especially the grade A and B*  
48 *offices, I believe even if the landlord were to put up the rent because of the insurance and*  
49 *other costs. This will not affect the situation (rental) too much. (Chinese interviewee).*  
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54 In high risk, high reward locations, no matter what the country, the demand for  
55 property remains strong:  
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3 *You could have a property that does have an elevated level of risk, but if every other*  
4 *factor is a big tick and there's very few, other options in the vicinity, well you're gonna*  
5 *find a deal that gets done despite the flood risk issue. (UK interviewee).*  
6  
7

### 8 9 Similarly in Germany

10  
11 *In Germany there are companies located next to a large river. Despite this, the topic of*  
12 *flooding only plays only a minor role (also for the economic valuation). This is because*  
13 *the markets are so strong, that they consider these risks as unimportant. (German*  
14 *interviewee)*  
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18  
19 Locational factors cited in the USA included water dependent businesses and the high  
20 amenity associated with some areas at risk such as coastal areas. As one professional said:  
21 *'coastal development is already so rampant here so it's not like they are going shy away from*  
22 *a project because they are in a flood zone.'* (US interviewee).  
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27  
28 However interviewees also noted that where choices were available between property  
29 with high risk and low risk, the higher flood risk property would be less popular and valued  
30 lower: *' This means demand for properties in a flood zone is lower than for those behind a*  
31 *flood protection wall. With an appropriate reduction in price.'* (German interviewee).  
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37 Different sectors were also regarded as more or less vulnerable to flooding:

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39 *The government reclaim some land, they create sort of data centre area, where allocated*  
40 *land for data centre operator, now, that's interesting because if those data centres are at*  
41 *risk of the coastal foundation of water, ... reducing its value ... massively, because the*  
42 *one you want for the data centre is a safe secure location. If it so close to the water, I*  
43 *think it's a major major issue. (Chinese interviewee)*  
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### 48 *Temporal variability*

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51 Lack of a structured way to price risk was reflected in the disproportionate reaction to an  
52 actual flood event and the impact of experiencing a flood. For example, one German  
53 interviewee noted that after floods in Germany, *"suddenly disproportionately high value*  
54 *markdowns occur, which are probably not risk appropriate"*. Similarly in Australia after the  
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3 2011 Brisbane floods, one interviewee observed that; *“commercial investment slowed in*  
4 *Brisbane after floods, focus was on getting buildings back into operation not sale and*  
5 *acquisition, but people tend to ‘forget’.*  
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10 A flood event raises general awareness and, more importantly, perception that the risk  
11 is “real” and that the impacts can be severe. This effect was also seen in New York following  
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*If market participants believe there is a risk then it affects value. For example a shopping centre could be in a flood zone since say 1973 but has never flooded no matter what the risk is, so value isn't affected but one flood can change that. (US interviewee).*

Professionals interviewed also indicated that such over reactions can be driven by sharp increases in property insurance premiums after flooding, especially if some relatively expensive facilities or equipment are damaged causing unexpectedly high claims:

*As far as I know in many cases, if it is needed to repair or fixing a lift/escalator in a commercial building (with 30<sup>th</sup> to 40<sup>th</sup> floors/levels - common height in the Greater China region) will approximately cost at least with \$1 million (or more) Hong Kong Dollars (HKD) (equivalent to £100,000)....(Chinese interviewee).*

Disproportionate reaction causes volatility and could potentially lead to blight in less desirable locations. However, in general the market will return to equilibrium as was reported in Queensland where a rebound effect occurred, with an economic boost from rebuilding of 0.5% GDP, and also in Germany:

*The evaluator will compare the property with comparable transactions in the surrounding area. If there has been a flooding event in the wider area, then the prices will be accordingly low. But if there has not been a flooding event for a longer period, then the prices will go up. (German interviewee)*

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3 The consensus is that valuers base their market valuations on the available market  
4 intelligence and that may not reflect actual flood risk.  
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6  
7 *Appraisers reading the market. Putting together all the data and making judgment of the*  
8 *situation. Not appraiser judging, it is market judging – emphasis on present. If market*  
9 *not concerned, won't be reflected in appraisal. Stigma or not – no stigma, no impact (US*  
10 *Interviewee)*  
11  
12

### 13 14 15 *Risk information and interpretation*

16 From the investment valuation' perspective, a more risk based approach to valuation of  
17 property at risk would be preferred but is dependent on the ability to assess risk accurately.  
18  
19 As one valuer described it '*I think the cost of flood insurance in additional costs (affects*  
20 *value), so capitalized insurance costs gets factored into property value'. (US Interviewee).*  
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26 Availability and cost of insurance are important risk signals but, although insurance is  
27 important in order to facilitate sales and support property value (Kenney *et al.*, 2006), it is not  
28 always rigorously evaluated during property transactions. Evaluation of risk by other means  
29 can be dependent on the impact of regulation and the provision of information about flood  
30 risk, for example in the form of flood zone maps. However there may be lack of trust in the  
31 maps.  
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41 *I just ran into a situation where one flood service said the property was not in a special*  
42 *flood hazard zone and another service said it was located in a special flood hazard zone.*  
43 *Data not consistent. And flood zones change. (US interviewee)*  
44  
45

46 Future risk is also important in valuation for investment, however significant uncertainties  
47 surround such estimates. Without reliable and accurate data and projections of risk, some  
48 interviewees are reluctant to disclose flood risk to buyers through concerns of prejudicing  
49 sales. Flood hazard maps, have the potential to depress values in areas at risk as in Germany  
50 where one participant observed such an effect after the first round of flood risk management  
51 plans was produced towards the end of 2015 (European Flood Directive 2007/60/EC) .  
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3 The impact of risk mitigation on value is also unknown with some interviewees  
4 believing a flood event may even have a positive effect on the value of commercial property  
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6 if mitigation measures are put in place after the flood:  
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9  
10 *So if a business, or a commercial property ..could demonstrate that significant flood*  
11 *resistance measures have been adopted. ...., then I'm sure that would have a positive*  
12 *effect on the valuation of the business, or the property itself. (UK interviewee).*  
13  
14

15  
16 However they recognised that the scale and detail of such an uplift are problematic to  
17 estimate in the absence of consensus among the professions or recognition in the form of  
18 insurance discounts. Thus owners and occupiers may be deterred by mixed messages from  
19 different Built Environment professionals, government officials and insurers, and the real  
20 moral hazard where positive action is not recognised by lowering of premiums and inaction is  
21 rewarded through compensation.  
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### 31 **Discussion**

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33 The findings from the study of commercial property value at risk from flooding and  
34 mitigation through insurance broadly confirms many of the findings previously observed in  
35 the residential property market. These findings relate to a general lack of awareness of risk  
36 (Kreibich, 2011), lack of incentives to mitigate risk through insurance (Kreibich *et al.*, 2007),  
37 lack of understanding of the impact of mitigation and lack of consistency in the reflection of  
38 risk in property value (Hirsch and Hahn, 2017). However there are some significant  
39 differences in the commercial market that require careful consideration.  
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49 The lack of risk awareness is not only on the part of property owners and occupiers  
50 but includes many professionals that may advise them. Shared understanding of risk is a pre-  
51 requisite for shared understanding of impact and routes to mitigation. Provision of this  
52 information is generally considered to be the role of Governments, eg the European directive  
53 (European Flood Directive 2007/60/EC). Raising awareness and generating common risk  
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3 perception is also often a Governmental goal often delegated to governmental or non-  
4  
5 governmental agencies. Maintaining this awareness is an acknowledged challenge, however  
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7 annual reminders through insurance renewal has been proposed as one potential way to  
8  
9 increase saliency. This has significant policy relevance such as opportunities for  
10  
11 strengthening the link between insurance and risk reduction measures (Hudson *et al.*, 2017).  
12  
13

14 Findings emphasised the importance of insurance, in keeping with theoretical stances  
15  
16 of insurance as a societal good that covers residual risks and enables recovery (Association of  
17  
18 British Insurers, 2005, Lo *et al.*, 2015). Insurance is also a pre-requisite for due diligence and  
19  
20 therefore a material factor in investment valuations. Interviewees also called for insurers to  
21  
22 do more to incentivise mitigation and this has been discussed in the literature as a way to  
23  
24 avoid increase in societal risk from moral hazard (Kunreuther, 2006). However, while  
25  
26 anecdotal evidence of moral hazard exists in the UK recent empirical results from Germany  
27  
28 and the US question the prevalence of such attitudes in the residential sector (Hudson *et al.*,  
29  
30 2017).  
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34  
35 Interviews indicated that in comparison to the residential sector, penetration of cover  
36  
37 is lower and commercial property is less likely to have comprehensive cover for flood risk,  
38  
39 and is more likely to self-insure. This concurs with recent observations in Missouri (Fell and  
40  
41 Kousky, 2015), it follows that the tendency for moral hazard is lower but also that adverse  
42  
43 risk selection may be more likely in commercial premises. Therefore the relevance of calls  
44  
45 for incentives for mitigation through insurance mechanisms in the commercial property  
46  
47 market may currently be seen to be lower than that in the residential sector. Yet, in the USA,  
48  
49 mandatory flood insurance has been seen by some interviewed to have a positive impact on  
50  
51 implementation of mitigation measures despite some limitations in the specific types of risk  
52  
53 mitigation they incentivise. Institutional investors and lenders could have a strong influence  
54  
55 where they are involved (Ball *et al.*, 2002, Teicher, 2018). Therefore while there is evidence  
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3 that insurance can play a significant role in encouraging anticipatory flood risk management,  
4  
5 more research is needed in context to understand the way this might provide incentives for  
6  
7 commercial property owners and investors.  
8  
9

10 Lack of consistency is evidenced in valuation of properties at risk within and across  
11  
12 countries and over time. In this respect the commercial property market is similar to the  
13  
14 findings within the residential sector in the UK and Australia (Eves, 2004). The findings also  
15  
16 support studies in the UK regarding commercial property (Bhattacharya-Mis and Lamond,  
17  
18 2015, Bhattacharya-Mis and Lamond, 2016). While the quality of risk information available  
19  
20 to valuers varies, the difficulties previously reported in the UK appear across all countries  
21  
22 studied in terms of understanding how to interpret risk information in order to apply flood  
23  
24 discounts. Sector specific considerations are highlighted with risk largely ignored in the high  
25  
26 demand for premium commercial real estate. Different locational factors are offsetting risk in  
27  
28 the commercial sector (eg high street position) than in the residential sector (waterfront  
29  
30 location), although waterfront location is important, indeed vital, for some commercial  
31  
32 sectors. Heterogeneity in the commercial sector adds to the complications in valuation and  
33  
34 mitigation advice. Many interviewees recognised the need to explore mitigation for  
35  
36 commercial property, perhaps as an alternative to insurance or as a means to keep insurance  
37  
38 costs low. This finding sets commercial property apart from studies of the residential market  
39  
40 where insurance or compensation is the more expected approach. The potential to treat  
41  
42 properties on a case by case basis, scale of investment, increased involvement of advisers and  
43  
44 property professionals in the commercial property world may explain this difference.  
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51 There were differences in the attitudes expressed in regard to valuation for sale or for  
52  
53 investment, more pragmatism is seen on the ground where specific locational or operational  
54  
55 advantages offset risk. The study therefore reveals heterogeneity in the approach to valuation  
56  
57 due to purpose of the valuation and client goals, as well as in sector and scale of business that  
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3 the limitations of this study do not allow us to unpick. However the study points to the need  
4  
5 to harmonise approaches and increase consistency in order to incentivise mitigation.  
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## 8 9 **Conclusions**

10  
11 The research has highlighted that understanding the link between flood risk, insurance, flood  
12  
13 mitigation and property value is important in the maintenance of commercial property value  
14  
15 and business prosperity. This is therefore of value to businesses and economies that are  
16  
17 threatened by flood risk. It is also of value to investors and their support network of Built  
18  
19 Environment professionals in managing sustainable investment portfolios.  
20  
21

22  
23 While discounting due to flooding, or flood risk, is sometimes observed it is far from  
24  
25 universally applied and is often time limited as market value relies on risk perception that  
26  
27 varies due to saliency of recent flood experience. Heterogeneity in the commercial property  
28  
29 sector and the primacy of business location in certain sectors adds to the difficulties faced by  
30  
31 Built Environment professionals in taking a unified view of risk. There is no consistent  
32  
33 approach that valuation professionals use to reflect flood risk within or across national  
34  
35 markets and therefore investors may need to recognise volatility associated with such  
36  
37 valuations. The use of a cost based approach (estimated damage and loss/cost of  
38  
39 insurance/cost of compliance with codes) may be appropriate, but guidance is needed and  
40  
41 caution needs to be observed in the application of valuation based on rapidly changing risk  
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43 designations. The adoption of such guidance may need to be supported by changes in  
44  
45 government regulations on risk disclosure and transparency in insurance regimes.  
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50  
51 Uptake of flood mitigation measures by property owners and occupiers could limit the  
52  
53 loss and disruption caused by flooding. Furthermore, flood insurance conditions in some  
54  
55 markets were found to be effective in incentivising prescribed measures. However across the  
56  
57 five countries studied, no example was found that provided sufficient incentive for a coherent  
58  
59 programme of risk mitigation for all properties at risk. Government regulations that increase  
60

the uptake of flood insurance or other appropriate risk transfer mechanisms could help to maintain property value through ensuring adequate funds during recovery and incentivising mitigation.

Lack of risk awareness of professionals and lack of appropriately detailed information on risk are two further critical barriers that need to be addressed. There are large differences in the amount and level of detail of risk information available across the countries studied. Government investment in improved provision and precision of hazard maps would not only benefit commercial property markets but also flood risk management as a whole. However Built Environment professionals will need to invest in their own professional development to interpret and advise on risk.

## References

- ASSOCIATION OF BRITISH INSURERS 2005. The social value of general insurance. London: Association of British Insurers.
- AUSTRALIAN GOVERNMENT 2016. Australian Flood Risk Information Portal. Retrieved on 2nd February 2016 from <http://www.ga.gov.au/flood-study-web/#/search>
- BALL, M., LIZIERI, C. & MACGREGOR, D. G. 2002. *THE ECONOMICS OF COMMERCIAL PROPERTY MARKETS*, London and New York, Routledge.
- BELTRÁN HERNÁNDEZ, A. I. 2016. *Essays on the economic valuation of flood risk* PhD, Birmingham.
- BHATTACHARYA-MIS, N. & LAMOND, J. 2014. An investigation of patterns of response and recovery among flood affected businesses in the UK: Case study in Sheffield and Wakefield *Flood Recovery Innovation and Response*. Poznan, Poland: WIT Press.
- BHATTACHARYA-MIS, N. & LAMOND, J. Flood risk vs property value: A sector specific market perception study of commercial properties. International Conference on Building Resilience, 2015 Newcastle, Australia.
- BHATTACHARYA-MIS, N. & LAMOND, J. 2016. Risk perception and vulnerability of value: a study in the context of commercial property sector. *International Journal of Strategic Property Management*, 20, 252-264.
- BHATTACHARYA, N., LAMOND, J., PROVERBS, D. & HAMMOND, F. 2013. Development of conceptual framework for understanding vulnerability of commercial property values towards flooding. *International Journal of Disaster Resilience in the Built Environment*, 4, 334 - 351.
- BIN, O., CRAWFORD, T. W., KRUSE, J. B. & LANDRY, C. E. 2008. Viewscapes and flood hazard: coastal housing market response to amenities and risk. *Land Economics*, 84, 434-448.
- BIN, O., KRUSE, J. B. & LANDRY, C. E. 2006. Flood hazards, insurance rates and amenities: evidence from the coastal housing market. East Carolina University.

- 1  
2  
3 BUBECK, P., KREIBICH, H., PENNING-ROWSELL, E. C., BOTZEN, W. J. W., MOEL,  
4 H. & KLIJN, F. 2017. Explaining differences in flood management approaches in  
5 Europe and in the USA – a comparative analysis. *Journal of Flood Risk Management*,  
6 10, 436-445.  
7  
8 COLLINS, A., COUGHLIN, D., MILLER, J. & KIRK, S. 2015. The Production of Quick  
9 Scoping Reviews and Rapid Evidence Assessments. A How to Guide.: JWEG.  
10 COMMITTEE ON CLIMATE CHANGE 2015. Progress in preparing for climate change  
11 2015 Report to Parliament. London: Committee on Climate Change.  
12 CRADDUCK, L. 2016. After the rains: water's impact for valuation practices. *Property*  
13 *Management*,, 34, 158-175.  
14 DEFRA 2015. Surveying for Flood Resilience in Individual Properties. London: DEFRA.  
15 DICKMAN, A., LANGLEY, E., SILMAN, T. & HARROLD, P. 2015. Affordability and  
16 Availability of Flood Insurance: Findings from research with Businesses. *Report of*  
17 *the Defra Joint FCERM Research and Development Programme*. London:  
18 Defra/Ipsos MORI.  
19  
20 EICHHOLTZ, P. M. A., STEINER, E. & YÖNDER, E. 2018. No Shelter from the Storm:  
21 Hurricanes and Commercial Real Estate Values.  
22  
23 EVES, C. 2002. The long-term impact of flooding on residential property values. *Property*  
24 *Management*, 20, 214-227.  
25  
26 EVES, C. 2004. The impact of flooding on residential property buyer behaviour: an England  
27 and Australian comparison of flood affected property. *Structural Survey*, 22, 84-94.  
28 FEDERAL EMERGENCY MANAGEMENT AGENCY 2013. National Flood Insurance  
29 Program Summary of Coverage for Commercial Property.  
30 [https://www.fema.gov/media-library-](https://www.fema.gov/media-library-data/6a2ad0291e8d6a5452aa891a6c037039/fema_Summary_508C.pdf)  
31 [data/6a2ad0291e8d6a5452aa891a6c037039/fema\\_Summary\\_508C.pdf](https://www.fema.gov/media-library-data/6a2ad0291e8d6a5452aa891a6c037039/fema_Summary_508C.pdf).  
32 FEDERAL EMERGENCY MANAGEMENT AGENCY 2017. NFIP Flood Insurance  
33 Manual: 01 Contents Section. . [https://www.fema.gov/media-library-](https://www.fema.gov/media-library-data/1503238892702-30b35cc754f462fe2c15d857519a71ec/03_general_rules_508_oct2017.pdf)  
34 [data/1503238892702-](https://www.fema.gov/media-library-data/1503238892702-30b35cc754f462fe2c15d857519a71ec/03_general_rules_508_oct2017.pdf)  
35 [30b35cc754f462fe2c15d857519a71ec/03\\_general\\_rules\\_508\\_oct2017.pdf](https://www.fema.gov/media-library-data/1503238892702-30b35cc754f462fe2c15d857519a71ec/03_general_rules_508_oct2017.pdf).  
36  
37 FEDERATION OF SMALL BUSINESSES 2015. Severe weather: A more resilient small  
38 business community. London: Federation of Small Businesses.  
39  
40 FELL, H. & KOUSKY, C. 2015. The value of levee protection to commercial properties.  
41 *Ecological Economics*, 119, 181-188.  
42  
43 GASCHEN, S., HAUSMANN, P., MENZINGER, I. & SCHAAD, W. 1998. Floods - an  
44 insurable risk? A market survey. Zurich: Swiss Re.  
45  
46 GDV 2016. Naturgefahrenreport 2016. Berlin, [http://www.gdv.de/wp-](http://www.gdv.de/wp-content/uploads/2016/10/Naturgefahrenreport-2016.pdf)  
47 [content/uploads/2016/10/Naturgefahrenreport-2016.pdf](http://www.gdv.de/wp-content/uploads/2016/10/Naturgefahrenreport-2016.pdf) (last accessed 1.11.2017):  
48 GDV.  
49  
50 HARTWIG, R. P. & WILKINSON, C. 2005. The National Flood Insurance Program (NFIP).  
51 New York: Insurance Information Institute.  
52  
53 HIRSCH, J. & HAHN, J. 2017. How flood risk impacts residential rents and property prices:  
54 Empirical analysis of a German property market. *Journal of Property Investment &*  
55 *Finance*, 36, 50-67.  
56  
57 HUBER, M. 2004. reforming the UK flood insurance regime - the breakdown of a  
58 gentlemen's agreement. *Discussion paper*. ESRC centre for analysis of risk and  
59 regulation, London School of Economics.  
60  
61 HUDSON, P., BOTZEN, W. J. W., CZAJKOWSKI, J. & KREIBICH, H. 2017. Moral  
62 Hazard in Natural Disaster Insurance Markets: Empirical Evidence from Germany  
63 and the United States. *Land Economics*, 93, 179-208.

- 1  
2  
3 INVESTMENT PROPERTY FORUM 2015. Understanding UK Commercial Property  
4 Investments: A Guide for Financial Advisers. London: Investment Property Forum.  
5 JAKLI, R. 2003. Zwischen 11. September und Elbehochwasser: Vom Umgang der  
6 Versicherung mit Katastrophen, report. R+V-Versicherung, Wiesbaden, Germany.  
7 KENNEY, S., POTTINGER, G., PLIMMER, F. & YASMIN, P. 2006. Flood risk and  
8 property, impacts on commercial and residential stakeholder's strategies. Reading:  
9 College of Estate Management.  
10 KESKITALO, E. C. H., VULTURIUS, G. & SCHOLTEN, P. 2014. Adaptation to climate  
11 change in the insurance sector: Examples from the UK, Germany and the Netherlands.  
12 *Natural Hazards*, 71 315-334.  
13 KREIBICH, H. 2011. Do perceptions of climate change influence precautionary measures?  
14 *International Journal of Climate Change Strategies and Management*, 3, 189-199.  
15 KREIBICH, H., MULLER, M., THIEKEN, A. H. & MERZ, B. 2007. Flood precaution of  
16 companies and their ability to cope with the flood in August 2002 in Saxony,  
17 Germany. *Water Resources Research*, 43.  
18 KREIBICH, H., SEIFERT, I., THIEKEN, A. H., LINDQUIST, E., WAGNER, K. & MERZ,  
19 B. 2011. Recent changes in flood preparedness of private households and businesses  
20 in Germany. *Regional Environmental Change*, 11, 59-71.  
21 KUNREUTHER, H. 2006. Disaster Mitigation and Insurance: Learning from Katrina. *The*  
22 *ANNALS of the American Academy of Political and Social Science*, 604, 208-227.  
23 LAMOND, J. & PENNING-ROWSELL, E. 2014. The robustness of flood insurance regimes  
24 given increased risk resulting from climate change. *Climate Risk Management*, 2, 1-  
25 10.  
26 LAMOND, J., PROVERBS, D. & ANTWI, A. The effect of floods and floodplain  
27 designation on the value of property: an analysis of past studies. 2nd Probe  
28 Conference, 16-17th November 2005 2005 Glasgow. 797.  
29 LAMOND, J., PROVERBS, D. & HAMMOND, F. 2010. The impact of flooding on the  
30 price of residential property: a transactional analysis for the UK. *Housing Studies*, 25,  
31 335-356.  
32 LI, C., ZHANG, N. & GUO, L. 2015. Flood Insurance: Demand, Supply and Public Policy.  
33 *Li, C., Zhang, N. & Guo, L. (2015) Flood Insurance: Demand, Supply and Public*  
34 *Policy. Insurance Studies*, 5, 006., 5, 006.  
35 LO, A. Y., XU, B., CHAN, F. K. S. & SU, R. 2015. Social capital and community  
36 preparation for urban flooding in China. *Applied Geography*, 64, 1-11.  
37 LONDON CLIMATE CHANGE PARTNERSHIP 2009. London's Commercial Building  
38 Stock and Climate Change Adaptation: Design, Finance and Legal Implications.  
39 London: Greater London Authority.  
40 MONTZ, B. E. 1993. The hazard area disclosure in NZ, the impact on residential property  
41 values in 2 communities. *Applied Geography*, 13, 225-242.  
42 NATIONAL DISASTER INSURANCE REVIEW PANEL 2011. National Disaster  
43 Insurance Review. 2011. Inquiry into flood insurance and related matters Executive  
44 Summary and Recommendations September 2011. Retrieved on 2nd February 2016  
45 from [http://www.ndir.gov.au/content/report/downloads/Exec\\_Summary\\_Recs.pdf](http://www.ndir.gov.au/content/report/downloads/Exec_Summary_Recs.pdf)  
46 OSBERGHAUS, D. & PHILIPPI, A. 2016. Private Hochwasservorsorge und  
47 Elementarschadenversicherung: Moral Hazard, der Effekt von  
48 Informationskampagnen, und eine Versicherungsillusion. *ZVersWiss* 105, 289-306.  
49 POTTINGER, G. & TANTON, A. 2011. waterproof - floodrisk and due diligence for  
50 commercial property investment in the uk. *CEM OCCASIONAL PAPER SERIES*.  
51 College of Estate Management/Marsh.  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 PRYCE, G., CHEN, Y. & GALSTER, G. 2011. The Impact of Floods on House Prices: An  
4 Imperfect Information Approach with Myopia and Amnesia. *Housing Studies*, 26,  
5 259-279.  
6  
7 RAJAPAKSA, D., WILSON, C., MANAGI, S., HOANG, V. A. & LEE, B. 2016. Flood Risk  
8 Information, Actual Floods and Property Values: A Quasi-Experimental Analysis.  
9 *Economic Record*, 92, 52-67.  
10  
11 ROBSON, C. 1993. *Real world research: A resource for social scientists and practitioners-*  
12 *researchers*, Massachusetts, Blackwell.  
13  
14 SAVILLS 2016. Around the world in dollars and cents. Savills.  
15  
16 SCHWARZE, R. & WAGNER, G. G. 2004. In the aftermath of Dresden: new directions in  
17 German flood insurance. *The Geneva Papers on risk and insurance*, 29, 154-168.  
18  
19 SHI, P. & LIU, Y. 2013. Chinese paradigm of catastrophe risk governance. *Integrated Risk*  
20 *Governance*. Springer.  
21  
22 SILVERMAN, D. 2013. *Doing qualitative research: A practical handbook*, Sage  
23 Publications Limited.  
24  
25 SIRMANS, G. S., MACPHERSON, D. A. & ZIETZ, E. N. 2005. The composition of  
26 hedonic pricing models. *Journal of Real Estate Literature*, 13, 3-43.  
27  
28 SKANTZ, T. R. & STRICKLAND, T. H. 1987. House prices and a flood event: an empirical  
29 investigation of market efficiency. *Journal of Real Estate Research*, 2, 75-83.  
30  
31 SURMINSKI, S. & THIEKEN, A., H. 2017. Promoting flood risk reduction: The role of  
32 insurance in Germany and England. *Earth's Future*, 5, 979-1001.  
33  
34 TEICHER, H. M. 2018. Practices and pitfalls of competitive resilience: Urban adaptation as  
35 real estate firms turn climate risk to competitive advantage. *Urban Climate*, 25, 9-21.  
36  
37 THIEKEN, A. H., KIENZLER, S., KREIBICH, H., KUHLCHE, C., KUNZ, M., MUHR, B.,  
38 MULLER, M., OTTO, A., PETROW, T., PISI, S. & SCHROTER, K. 2016. Review  
39 of the flood risk management system in Germany after the major flood in 2013.  
40 *Ecology and Society*, 21.  
41  
42 TOBIN, G. A. 1979. Flood losses: the significance of the commercial sector. *Disasters*, 3,  
43 217-223.  
44  
45 TOBIN, G. A. & NEWTON, T. G. 1986. A theoretical framework of flood induced changes  
46 in urban land values. *Water Resources Bulletin*, 22, 67-71.  
47  
48 WANG, M., LIAO, C., YANG, S., ZHAO, W., LIU, M. & SHI, P. 2012. Are People Willing  
49 to Buy Natural Disaster Insurance in China? Risk Awareness, Insurance Acceptance,  
50 and Willingness to Pay. *Risk Analysis*, 32, 1717-1740.  
51  
52 WASSERHAUSHALTSGESETZ (FEDERAL WATER ACT) 2009 Gesetz zur Ordnung des  
53 Wasserhaushalts (WHG) [http://www.gesetze-im-internet.de/whg\\_2009/WHG.pdf](http://www.gesetze-im-internet.de/whg_2009/WHG.pdf).  
54  
55 YEO, S. 2002. Effects of disclosure of flood-liability on residential property values. Natural  
56 Hazards Research Centre, Macquarie University.  
57  
58  
59  
60

Table 1. Profile of Respondents

Country	Valuation and investment	Risk mitigation (property management)	Reinstatement	Risk mitigation (Property adaptation)	Other	Tot
Australia	2	1	0	0	3	6
China	4	7	0	2	1	14
Germany	3	8	2	2	0	15
UK	5	3	4	3	0	15
US	4	5	5	3	0	17
Overview	2	0	1	1	1	5
<b>Total</b>	20	24	12	11	5	72