Climate risks and their implications for commercial property valuations

Article

Accepted Version

Climate risks and their implications for commercial property valuations

Abstract

Purpose

We outline a framework that captures the channels through which physical climate risks could affect cash flows and pricing of income-producing real estate. This facilitates detailed consideration of how the future performance of real estate investments could be affected by such risks.

Design/methodology/approach

This is a literature-based investigation that draws on work commissioned by UNEP-FI (Clayton *et al*. 2021a; 2021b). It extends this work to consider in more detail the channels through which climate risks may impact property performance and the implications for the valuation community.

Findings

Recent empirical studies have identified more instances where pricing is reflecting both current and anticipated climate risks. Market valuations cannot properly incorporate climate risk without clear evidence that it is priced by market participants, but valuers can advise clients on the potential for future impacts.

Research limitations / implications

While inferences can be made from studies of residential real estate, more research on commercial real estate pricing and climate risk is required to assist valuers and their clients, as well as other stakeholders in the real estate market.

Practical implications

Differences between a Market Value and an Investment Value context are considered, and how valuers could and should account for climate risk in each setting is discussed with reference to existing professional standards and guidance.

Originality

The article synthesises a wide range of literature to produce a framework for the channels by which real estate values could be influenced by climate risk.

Keywords

Appraisal; Climate change; Climate risk; Sustainability; Valuation

1. Introduction

The effects of climate change and the resulting risks to human life and habitation are increasingly visible. There has been longstanding interest around the impact of weather-related events and other natural catastrophes on property values and property market outcomes. Attention in the literature has shifted from analysing just the current risks of floods, fires, or storms to the implications of climate change for future risks, either because of rising sea-levels or changing weather patterns. Notably, the devastation caused by Hurricane Sandy in the United States sparked a renewed interest in the subject and led to a more explicit climate change / climate risk focus in residential and commercial real estate research.

A summary for policymakers of Working Group I's contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (IPCC, 2021) presented a set of five new illustrative emissions scenarios to explore the climate response to greenhouse gas, land use and air pollutant futures. These scenarios are grounded in an evaluation of underlying evidence to express a level of confidence of the assessed likelihood of an outcome or result. The summary states that, for every additional increment of global warming, extremes in weather and temperature will increase:

> *For example, every additional 0.5°C of global warming causes clearly discernible increases in the intensity and frequency of hot extremes, including heatwaves (very likely), and heavy precipitation (high confidence), as well as agricultural and ecological droughts in some regions (high confidence). (IPCC, 2021: 20)*

Scenario modelling has been applied in real estate appraisal to investigate the impact of different economic scenarios on values rather than the impact of climate events. However, the future for real estate faces increased uncertainty given climate change scenarios of various likelihoods. This will test the resilience of buildings and infrastructure that were designed and constructed to withstand specific climatic conditions, but which now must withstand changes beyond their original parameters [1]. While uncertainty remains around the precise impacts of climate change, an acceleration in major climate events is expected, with the following impacts on specific locations:

- Frequency of event – events more likely to occur
- Intensity of event – can be more extreme
- Scale of event – larger area affected
- Type of event – did not previously occur in location

Extreme weather events expose owners and occupiers of buildings to what may have been hitherto unforeseen risks. Aside from the costs of any physical damage that might occur, recognition of such risks will feed into the short- and long-term financial performance of buildings. Roberts *et al*. (2015) state that an increased likelihood of extreme climatic events can be a major driver for depreciation in property values. The drivers for this could include an increased reluctance of occupiers to locate in an area and an increased reluctance of investors to hold assets with exposure to such risk, with effects on pricing and liquidity as a result. Related concerns surround securing insurance or mortgage finance for properties with increased exposure to events such as storms or floods. Investor acquisition and disposal decisions may therefore depend on the ability of individual buildings to meet the changing requirements of tenants, insurers, and lenders in the face of climate change.

This paper is essentially a theoretical and perspectives paper based on existing literature. It draws on work commissioned and published by UNEP-FI (Clayton *et al*., 2021a; 2021b) and it extends this work to consider the channels through which climate risks may impact property performance as well as the implications for the valuation community, with a focus on real estate investment markets in

developed economies. It also builds on the Sustainable Property Appraisal Project (Ellison and Sayce, 2006), which identified how the emergence of more resilient green buildings could impact on factors such rental growth, depreciation, duration to sale and duration to let.

This study is focused on climate risk, and it examines the effects on real estate performance from climate change-driven changes in weather patterns as well as more gradual processes such as sea level rise. Implications for valuation are then considered, distinguishing market valuations, which rely on price signals generated by market participants, from investment appraisals where clients and advisers have more freedom to adopt different assumptions. Attention is paid to the channels through which climate risks can affect cash flows and pricing, illustrating possible impacts through a framework that is based on an explicit discounted cash flow approach to appraisal.

2. Professional standards, guidance, and regulation

Valuers may be engaged to estimate the Market Value of properties for purposes such as financial reporting, performance measurement, loan underwriting, and decision making. Since Market Value is fundamentally an assessment of the likely exchange price for a property in a normal transaction situation, valuers provide an opinion of value based on signals of market pricing as at the valuation date that include recent transactions and other evidence of market conditions. Valuers may also be asked to estimate the Investment Value (or worth) of a property, or clients may undertake such assessments themselves. This represents the value to a specific owner or prospective owner of that property, and it can differ from the likely exchange price. Estimates of Investment Value are crucial to decision making around acquisition, asset management and disposal.

How do valuation standards recommend that climate risks are addressed in either type of valuation? International Valuation Standards (IVS) are set by the International Valuation Standards Council (IVSC) [2]. IVS do not explicitly mention any requirement for valuers to consider climate change during valuations, and only mention sustainability in relation to valuation of development schemes (IVSC, 2021a). However, the IVSC identified ESG (including matters of climate change) as a major area for consultation ahead of revisions to IVS due in 2023 (see IVSC, 2020). Their consultation document noted that, while there was good qualitative information, there was little quantitative information to guide valuers on how to reflect ESG in the valuation process (IVSC, 2020: 13).

Additional standards may be set by regional and national professional bodies connected with asset valuation. Of these, the body with arguably the biggest global reach is the Royal Institution of Chartered Surveyors (RICS). The RICS has mentioned sustainability in their mandatory standards since 2014, but specific reference to climate change as a subset of the wider sustainability agenda has so far been limited. The latest RICS global standards for valuation (RICS, 2021a) mostly retains the wording present in previous versions, as follows:

> *"Only where existing market evidence would support this, or where in the valuer's judgement market participants would expressly reflect such matters in their bids, should sustainability characteristics directly influence value(s) reported."* (RICS, 2021a: 129)

This stance is moderated when moving from the context of market valuation to that of assessment of worth:

> *"[W]hen preparing valuations on the basis of investment value or worth, sustainability and ESG factors that could influence investment decision-making may properly be incorporated, even though they are not directly evidenced through transactions."* (RICS, 2021a: 129)

It is also recognised that market evidence might not reflect sustainability considerations in full. Historical comparables might have been set in situations where the resilience of buildings to climate-driven changes in weather patterns had not been tested or where market participants had limited awareness of sustainability concerns or climate risks. Yet the potential implications for value in the future from climate risks might already be evident to the valuer. Hence, the Red Book advises that:

> *"While valuers should reflect markets, not lead them, they should be aware of sustainability features and the implications these could have on property values in the short, medium and longer term."* (RICS, 2021a: 129)

Similar guidance is provided by other bodies such as the Australian Property Institute (Warren-Myers and Cradduck, 2021).

Consideration of climate risks could build on existing traditions of reporting environmental matters that might impact value. The UK supplement to the RICS Global Standards (RICS, 2018: 90) instructs valuers to record and, if appropriate, report location-related factors such as flooding or subsidence that may affect value, even if a property does not appear to be immediately affected by such issues. This guidance is accompanied by a reporting template with headings for matters such as flooding, and 'sustainability' [3], but the template does not prescribe what should be included under these headings or show how this information can be presented. Anecdotal evidence suggests that UK valuers do populate these headings but not in a way that is consistent. If this is typical of reporting generally, then it is unsurprising that the IVSC has identified the quality and comparability of ESG information in valuations as a key element of their review (IVSC, 2020: 13).

Minimum Energy Efficiency Standards (MEES) in the UK may provide a precedent for how this could change. These standards specify minimum thresholds for energy efficiency and buildings that do not meet them cannot then be let to occupiers and may need significant capital expenditure to improve their energy efficiency before further lettings can occur. Mandatory Energy Performance Certificates (EPCs) measure buildings against these standards and the UK Red Book supplement stipulates that EPCs must be considered by valuers, if available (RICS, 2018). They are also listed as a factor that can have a material impact on property value. Furthermore, valuers need a view on any likely future shift in MEES and how this would impact on the asset under consideration given its current rating.

A detailed consideration of sustainability-related issues is included in TEGOVA's European valuation standards (TEGOVA, 2020). These single out climate change-related concerns as a factor the market may regard as relevant. The guidance lists a set of factors for valuers to consider, including the risks of natural disasters, and asks valuers to reflect on how any deficiencies might be remedied.

> *"The valuer's task is to understand and interpret these issues, where relevant, and the market's reaction to them, applying professional judgment to the evidence available in finding a property's value at a given time to enable a client to take informed decisions."* (TEGOVA, 2020: 221)

Further guidance on reflecting sustainability in valuations is provided in the third edition of the RICS Guidance Note on this theme, titled *Sustainability and ESG in commercial property valuation and strategic advice* (RICS, 2021b). In contrast to mandatory standards, this provides valuers with non-compulsory recommendations or accepted good practice. The lack of mandatory status has raised questions about the ability of these guidance notes to influence market practice (Sayce, 2018; Le and Warren-Myers, 2019). Nonetheless, on physical risks, the Guidance Note states that:

> *"Valuers should make themselves aware of the likely short- and longer-term use of the property. They should also explicitly consider and reflect upon how physical characteristics of the property and physical risks related to the locality impact resilience […] This may need to include consideration of likely capital expenditure requirements […]" (RICS, 2021b: 21)*

RICS (2021b) acknowledges that physical risks might be heightened going forward, and it highlights flooding, heat, wildfires, and severe storms as examples of issues that could impact the resilience of buildings for occupiers and owners. It also recognises that, alongside valuation, this could impact on investment, lending, insurance, management and redevelopment of buildings and sites. In view of the potential significance of physical risks, it recommends that:

> *"Valuers should ensure that, as far as reasonably possible, up-to-date information on environmental and physical risks is gathered in respect of the subject property and considered when comparing it to others used as part of the evidence base." (RICS, 2021b: 21)*

However, valuers may lack the necessary interdisciplinary skills, specific professional guidance, and underlying evidence base to fully integrate climate risks into valuations or advice. Meins *et al*. (2010) argued that climate change could not be explicitly and sufficiently accounted for by valuers owing to a 'valuation lag' and 'black box' approach to data analysis. Michl *et al*. (2016) found that UK and European valuers routinely collected some environmental data, notably published data on current flood risk, but Lamond *et al*. (2019) found no consistent approach in how professionals in Australia, China, Germany, UK, and US reflected flood risk in their advice. Warren-Myers and Cradduck (2021) concluded that inadequate identification, consideration and reporting of climate change risks could be attributed to a lack of guidance from professional bodies as to what is required, as well as inadequate data sources with which to evaluate the risks. Lamond *et al*. similarly highlighted a lack of guidelines and common practices as reasons for inconsistent adjustments in valuations.

Hence, while standards and guidance encourage valuers to consider climate change impacts, they are less clear on how valuers should approach this. There would appear to be more scope for this in investment appraisals than in market valuations. The process of establishing Market Value normally involves looking for recent transaction evidence involving comparable buildings and then distilling this through a process of interpretation. Valuers are asked to be aware of risks and to collect data, but they cannot reflect these factors in the valuation figure if the comparable evidence does not support it. In contrast, the process of estimating Investment Value involves establishing likely future cash flows and this allows valuers to adjust inputs accordingly even if these adjustments have yet to enter the evidence base (Sayce, 2018). The following sections examine these differences in detail.

3. Evidence on market pricing

Whether market pricing reflects either current or future climate risks adequately depends on the market participants driving transaction activity. Market participants differ in the information that they hold, beliefs they have about the future, and attitudes to risk (Bakkensen and Barrage, 2021). Such factors may influence pricing alongside the cash flow or utility generating attributes that a building possesses. Yet while heterogeneity exists among individual buyers and sellers, whether it can systematically influence pricing depends on the typical market participants active in a specific location (Bernstein *et al*., 2019; Baldauf *et al*., 2020). This is shaped by the type and quality of the properties traded (including residential versus commercial) and the nature of the local real estate market.

Research has focused on residential real estate pricing, though research on commercial real estate pricing has emerged more recently (Fisher and Rutledge, 2021; Addoum *et al*., 2021). Many studies have examined the short-term and longer-term impacts on (residential) property prices from specific climate events such as floods or storms. Some studies have tested whether the risk of a specified event affects prices without that event having necessarily occurred. Examples of the latter include papers that examine the impact on transaction prices from flood map designations or from potential sea level rises in coastal areas.

Studies of floods, storms, and wildfires have shown that there is typically a marked short-term price impact in affected areas, as might be expected. Yet property prices have been observed to recover reasonably quickly. Below *et al*. (2017) studied the effect of hurricanes on house prices in North Carolina and found a discount in affected areas for only 60 days following a storm and not afterwards. However, other studies have found that price discounts last for several years. Following major wildfires, McCoy and Walsh (2018) found a 2 to 3-year impact on house prices in high-risk areas in Colorado, while Bin and Landry (2013) found that house price effects from large floods in North Carolina lasted 5-6 years. Meanwhile, Fisher and Rutledge (2021) studied the effect from hurricanes on US commercial real estate appraisals. They observed that the impact on capital values of assets in affected metro areas lasted for up to 5 years.

It can be difficult to establish the exact reasons that drive a bounce back in prices following a climate event. One explanation in areas that are used to events such as hurricanes or wildfires is that the risk is already capitalised (though not necessarily accurately) and so a short-term price drop just reflects the immediate impact of damage and disruption in that area. A more lasting discount would only be observed if the event had changed perceptions of the risks or, alternatively, the extent of protection from risks in the form of available and affordable insurance. Likewise, in locations not used to climate events, a flood or storm might be written off as a freak event rather than one that causes risks to be re-evaluated. Some locations prone to climate events are also areas with high amenity values resulting from adjacency to water or forest (see Miller *et al*., 2019). This is especially applicable in residential real estate, and the benefits from such amenities might continue to offset any climate-related risks in the views of market participants.

However, studies of pricing following Hurricane Sandy in the US suggest that this event led to a re-evaluation of climate risks by market participants. Ortega and Taspinar (2018) found that prices of damaged residential properties in New York City only partially recovered after the storm, and a lasting discount emerged in prices of at risk but undamaged properties. This suggests that buyers revised their beliefs about climate risks following this storm. Cohen *et al*. (2021) reported lasting price effects for undamaged homes based on their proximity to the actual storm surge. Gibson and Mullins (2020) found price effects from the storm itself and from proposed revisions to FEMA flood maps, especially for homes that were not flooded but then added to the floodplain. Addoum *et al*. (2021) found a lasting price discount post-Sandy for office buildings exposed to flood risk in New York City, which was directly affected, and Boston, which was not. Results for Boston suggested that investors changed their perceptions of flood risk for cities further up the US Atlantic coastline, but this discount had shrunk by the end of their study period.

Several other studies have indicated that differences in current climate risks between locations are at least partially reflected in residential pricing. Beltrán et al. (2018) reviewed 37 published papers on flood risks, of which 32 related to the US. Their analysis of these studies suggested that homes located on a 100-year floodplain sold at a discount of 4.6% to those in less susceptible areas. Atreya and Czajkowski (2019) noted that discounts vary within the floodplain based on degree of risk and distance from amenities. Price differences can also vary depending on available information about

risks (Hino and Burke, 2021), whether flooding has been directly experienced (Atreya and Ferreira, 2015; Yi and Choi, 2020), and the location of any mitigation measures (Fell and Kousky, 2015). This does not mean that discounts accurately price potential losses from flooding or the costs of being insured against such losses (Hino and Burke, 2021). Yet these findings suggest that valuers must be aware of the nuances that can influence pricing in areas where climate risks are present.

Evidence for whether pricing reflects projected climate risks is more mixed. Bernstein *et al*. (2019) reported a 6.6% overall discount for US residential properties at risk from sea level rise, with higher discounts for the most exposed houses, and that the discount had risen over time. Keenan *et al*. (2018) reported divergent residential price trends based on elevation from circa 2000 in the highly exposed location of Miami-Dade County, Florida. In contrast, Murfin and Spiegel (2020) did not find statistically significant price discounts for residential properties at risk in US coastal states, and nor did Fuerst and Warren-Myers (2021) for their study area in Melbourne, Australia. Results for the US in Baldauf *et al*. (2020) indicated that the size of any discount depended on beliefs about sea level rise in that neighbourhood. Baldauf *et al*. also contended that beliefs should be less important for commercial real estate given more sophisticated market participants, while Addoum *et al*. (2021), highlighted the skills and resources possessed by professional investors for pricing investment risks.

What do these findings suggest for valuation practice? In the case of Market Value, the valuer must estimate the likely exchange price at the valuation date given the buyers and sellers that are active in the market in question. Prices paid might include an allowance for climate risks, but those buyers and sellers might not price risks in a manner that accords with the valuer's judgement of their impact on the properties concerned. Nonetheless, it is the perspectives of the buyers and sellers based on current information and current beliefs about risks that shape what properties could sell for in current market conditions, which the valuer must then reflect in their Market Value estimate. There is more evidence that differences in risk between locations are recognised in prices, and that major or repeated climate events have led to a re-evaluation of risks by market participants, but whether and how far climate risks have been priced is still likely to depend on the nature and scale of the exposure as well as the availability of information about the risks involved.

Even if current pricing does not fully reflect climate risks, a valuer must be aware of whether such risks affect a property so that they can raise awareness of how this might affect Market Value in future. For instance, Roberts *et al*. (2015) suggested that UK surveyors should look at the local probability of floods and evolution of flood maps in the vicinity of assets to be valued. However, Lamond *et al*. (2019) found that more reliable and accurate flood data and risk projections were needed to overcome reluctance to disclose flood risk to buyers. Nonetheless, as investors become more conscious of climate risk, and as information about such risks improves, it is likely that it will influence the bids they are prepared to make [4]. Hence, market pricing should shift eventually to reflect the risks affecting assets in different locations as more investors reflect climate risks in their decision making. To do this appropriately, the ways in which climate risks could affect future real estate performance need to be understood. This is considered next.

4. Assessing investment worth

Estimating Investment Value (or worth) differs from the process of market valuation because such assessments reflect an investor's own expectations around future cash flows and their own views or criteria about holding period and target return rate for the asset in question. The output from such an appraisal can therefore differ from an estimate of Market Value, and that difference can inform

investor decision making. If an investor is the potential buyer of an asset, the estimate of Investment Value should guide them as to an appropriate bid. If an investor already owns an asset, the estimate can inform decisions around disposal versus retention, or the nature and timing of refurbishment. In this exercise, the investor can incorporate their views on how climate risk might influence the future performance of a property. To do so, they must be clear on the channels through which climate risks could influence value.

An appraisal of the Investment Value for income producing real estate typically involves an explicit discounted cash flow (DCF) model. The IVSC (2021b) has noted that the DCF approach is well suited for transparently reflecting ESG considerations in valuations and, similarly, it can be used to model climate change impacts on commercial real estate values. Figure 1 shows variables that the investor or a valuer must normally consider, classified according to factors affecting the cash flow projection (divided between income and cost items) and factors affecting the discount rate applied to that cash flow. Moreover, increased exposure to climate risks (or increased awareness of such exposure) might have implications for how acquisitions will be financed, or how loans will be refinanced. While the value of an investment should not be dependent on how it will be financed, financing is often modelled within investment appraisals to gauge the expected returns to the various stakeholders.

INSERT FIGURE 1 HERE

Effects on expected income include reduced rent and occupancy rates resulting from lower demand in the face of disruption to business activity from climate events. The effects may not be immediate and may only be significant once the effects of climate change on a location become marked. Yet, as capital values will reflect current and future cash flows, pricing should respond to expected changes ahead of current occupancy or rents. Hirsch and Hahn (2018) found evidence of this for residential properties in Germany. They found a smaller discount in rents for flood risk than in sale prices. For the US, Bernstein *et al*. (2019) did not find a significant effect on residential rents from projected sea level rise (a future but not yet realised event) but they did establish a statistically significant price discount. A similar comparison by Giglio *et al*. (2021) produced similar results. This is unsurprising since the horizons of investors and tenants differ. Investors have a greater stake in the long-term performance of an asset from either their own intentions to hold or from concerns about resale.

Similar results are anticipated for commercial real estate, with prices affected more by climate risks than rents until climate events become frequent and disruption in an area becomes too great. There is little empirical evidence for this at present, but the findings for office occupancy in Addoum *et al*. (2021) seem to support this contention. Following Hurricane Sandy, they did not find a significant association between flood risk and office vacancy rates in either New York City (directly affected) or Boston. However, Meltzer *et al*. (2021) argued that retail businesses were more likely to be impacted by Hurricane Sandy than non-retail businesses as the former rely more directly on activity (footfall) in the local area. Their analysis indicated that areas of New York City with higher levels of storm surge experienced higher rates of business closure and declines in retail sales that persisted for several years after the hurricane hit.

The possible effects on future costs faced by real estate investors include changes to operating costs (which may or may not be recoverable), repair costs and capital expenditure, as well as the potential for higher insurance premiums and taxes in areas with increased climate risk. Capital expenditure on mitigation is especially interesting as this has the potential to counteract other effects in Figure 1 by

making a building more desirable to potential tenants or to other investors in the event of resale. Yet Teicher (2018) noted reluctance among owners of US commercial real estate to invest in mitigation measures. More generally, Bunten and Kahn (2017) showed that payoffs from capital expenditure decline and investment becomes less likely as the probability of severe damage from climate events increases, leading to greater physical and economic depreciation of affected structures. Therefore, modelling is important to understand the benefits and costs of different actions at different times, but the valuer may require specialist advice about the costs involved (RICS, 2021b). It may also require the investor or valuer to go beyond standard DCF modelling and incorporate a real options perspective.

There are also limits to what can be achieved from asset level expenditure. Investment in mitigation can be undermined if there is not accompanying investment and coordination by public agencies to protect the infrastructure that supports economic activity. The role of public investment is beyond the scope of this article, but it is important since it might attenuate further any rent or price effects. Even without such investment, higher taxes might affect areas with increased exposure to climate risks through the need to restore infrastructure and services in the wake of climate events. Investors are also likely to face increased insurance costs as premiums are revised to account for a higher probability of loss in exposed locations. This might be cushioned by government intervention to ensure continuity of affordable insurance to homes and businesses, a notable example being the National Flood Insurance Program (NFIP) in the US. Nonetheless, rising premiums and changes to the terms of public schemes and private policies may be inevitable, and some property owners might underinsure or self-insure in response to rising costs.

When considering capital value, potential effects from increased climate risk include expectations of greater volatility and of lower growth in future cash flows, which should lead investors to use higher discount rates when pricing assets. Therefore, a price effect should emerge even if current incomes were not markedly different from those of assets in less risky areas. At the extreme, it could include expectations of a total loss of value at some future date, pertinent for properties in low-lying areas exposed to sea level rise. Giglio *et al*. (2021) identify parallels between the pricing of such assets and the discounts applied to long leasehold interests of different lengths. However, research that directly captures how discount rates might vary with climate risk exposure is scant. AEW (2021) published estimates of the risk premium attributable to transition risks and physical climate risks for European commercial real estate based on forward-looking modelling. This suggested relatively small impacts at a market level of only 0-25 bps based on flood risks faced by different property types in different cities, but this does not preclude greater effects for buildings in highly exposed locations [5].

Furthermore, it appears that some institutional investors have begun screening assets and locations based not only on current climate risks but also exposure to future changes in climate (see Kanne *et al*., 2017; ULI/Heitman, 2019; 2020). If the pool of potential buyers in riskier areas starts to shrink as a result, then this should affect prices, though a reaction might not be immediate. Keys and Mulder (2020) found a relative decline in residential sales for coastal communities in Florida that were more exposed to sea level rise, and that this occurred several years before any divergence in pricing. Yet Ortega and Taspinar (2018) found that a fall in sales after Hurricane Sandy for houses in flood zones was only short-lived. Turnbull *et al*. (2013) found longer sales times for houses at a higher risk of flooding. Other studies have suggested a sorting effect where market participants in locations more exposed to climate risk have different perceptions or tolerances of such risk (Bunten and Kahn, 2017; Bakkensen and Barrage, 2021). This might mitigate falls in prices or sale rates in those areas.

Since examination of liquidity effects has been confined to residential real estate, the applicability of the findings for commercial real estate markets is uncertain. It was noted earlier that the cost and

availability of flood insurance is arguably distorted in the US by the NFIP, and such distortions might influence decisions around the ownership and occupation of at-risk properties. Yet, the relevance of the NFIP to high value US commercial real estate is limited and market-based insurance provision is more common, as is the case for commercial real estate in most other nations. ULI/Heitman (2019) noted concerns among institutional investors about the cost and availability of insurance in future that might, in turn, make assets exposed to higher climate risks harder to refinance or to sell. In a discounted cash flow framework where models are typically formulated over an assumed holding period, this could influence assumptions about the future resale price and an appropriate discount rate since the prospect of increased illiquidity should cause the required risk premium to rise.

Finally, effects on pricing and liquidity should also influence lender decisions (and, more generally, the availability of capital) in areas exposed to greater climate risk, as well as the quality of existing loans. This is another aspect on which research is scant. Studies of residential lending suggest that underwriting has been unresponsive to changes in information about climate risks (Garbarino and Guin, 2021; Keys and Mulder, 2020). The different nature of commercial real estate loans, lenders and borrowers make this an area where more research is clearly required.

5. Discussion and conclusion

If greater awareness of climate risk is feeding into market activity and pricing, then this should be evident in transaction data. This review provides some evidence that this is starting to take place, but much of this evidence is based on the more extensively researched residential sector, and the evidence for commercial real estate is still limited. There is anecdotal evidence that climate change risks are affecting the investment policies of some commercial real estate investors, and there has been a rise in the number of climate advisory firms, rating systems and tools to meet this demand. However, if more informed investors are currently in a minority, it will take time for pricing to fully reflect climate risk considerations.

The absence of a conclusive evidence base on pricing means that valuers are limited in their ability to reflect climate risk in market values. This arises from the nature of market valuation because estimates of value must be anchored in evidence, the principal source of which is normally recent transactions of other, similar assets in the location concerned. Owing to the thin trading that characterises real estate markets, it can take time for changes in market behaviour to feed through into transactions and so be reflected in asset valuations. If valuation techniques and valuer heuristics are bound by evidence of pricing that does not account for heightened risks going forward, then how can such risks be signalled by valuations in a timely manner? This supports the contention of Rivera (2020) that climate risk “is not being adequately priced into commercial real estate valuations” and this should be of concern to market participants.

Standards and guidance suggest that consideration of climate risks can still feature in the strategic advice offered to clients either in a market valuation or an investment appraisal setting, but there is a lack of solid guidance on how to signal these risks within valuation reporting. At present, valuation reports may not contain accurate indicators to reflect current climate-related risks, and valuers are not typically asked to identify future sources of risk. If climate-related risks are not communicated effectively, this has the potential to distort investment decision making. Once the effects of climate change on individual assets and locations becomes more apparent, this may then result in sudden adjustments to prices that have a detrimental effect on market stability.

EPCs provide a relatively consistent metric for energy efficiency that, despite some limitations, is widely understood, but such a clearly designated metric is lacking for climate risk. Valuers are not experts on risks relating to climate change and will defer assessment of such risks to third party data providers. A commonly used source of data on flood risk in England are the maps provided by the Environment Agency for land planning purposes [6]. These maps are revised periodically, but data points may not provide an accurate depiction of future flood risk. The FEMA Flood Insurance Rate Maps in the US have also met with criticism (Kousky *et al*., 2020). These maps should be updated every five years, but they tend to be based on much older data or modelling. Lamond *et al*. (2019) suggested that there are continued problems with such information across a range of geographies.

A way forward should be for all stakeholders in the commercial real estate market to work towards more robust and consistent data collection practices. If better quality data are made available, it becomes more feasible for valuers to then identify whether climate risks are contributing to price determination in different market settings. Valuers are uniquely placed to work with data providers of physical and transition risk information to improve the quality of asset valuations for their clients. This can help to create a data feedback loop, to generate broader understanding of the value-related impacts of risks that can benefit the wider community. We suggest that to improve understanding of how climate change events impact on values and prices, more consistent practices are needed in the following areas:

- How valuers understand and define relevant risks
- How valuers attain information on risks and from which sources
- How valuers process risk-related information (heuristics)
- How valuers communicate and report this risk back to clients

The example of MEES-driven EPC data collection in the UK illustrates how consistency in collection, interpretation and reporting of data can create a starting point to help achieve this, and we would advocate adopting a similar approach when reporting on climate risk. This could begin not only with agreed metrics on such risks, but also a systematic consideration of how the attributes of a property or its location make it resilient to such risks in the future. The RICS and other professional bodies could propose more detailed climate risk-related headings that valuers should consider, along with guidance on how to present such information more consistently in valuation reports. Change can also be facilitated through an improved understanding of how real estate investors consider climate risks in their own appraisals and risk assessments, and this is something that future research could investigate.

Endnotes

[1] As an illustration, the Thames Barrier was designed to protect life, land, and property in London, UK, against the highest tides and storm surges. Although it was originally expected to be used 2-3 times per year, it was being used 6-7 times per year by the early 2000s. See also https://whc.unesco.org/en/series/22/.

[2] Such standards are not enforceable by IVSC. It is the bodies who belong to IVSC that have an enforcement role. The IVSC has around 160 member organisations operating in 137 countries. Most are valuation professional bodies, while some are large firms of property advisers and valuers. See www.ivsc.org/about/members/our-members.

[3] At the time of writing, this template was available at https://www.rics.org/globalassets/rics-website/media/upholding-professional-standards/regulation/media/valuation-report-framework2.pdf.

[4] Pottinger and Tanton (2014) found evidence of increased due diligence among UK investors in respect of flood risk when making acquisitions, and that this was driven by tightening regulation and the occurrence of major flood events at that time.

[5] Addoum et al. (2021) analysed capitalisation rates for sales of office buildings in New York and Boston following Hurricane Sandy. Their analysis indicated that capitalisation rates increased for office properties at more risk of flooding, which they associated with revisions to the underlying risk premiums used by investors.

[6] See https://flood-map-for-planning.service.gov.uk/. See CBRE (2019) for further critique of this information.

References

Addoum, J. M., Eichholtz, P., Steiner, E., and Yönder, E, (2021). *Climate Change and Commercial Real Estate: Evidence from Hurricane Sandy*. Available at: dx.doi.org/10.2139/ssrn.3206257.

AEW (2021). *Climate-Informed Real Estate Returns in Europe*. AEW Research. June 2021.

Atreya, A. and Czajkowski, J. (2019). Graduated Flood Risks and Property Prices in Galveston County. *Real Estate Economics*. 47: 807-844.

Atreya, A. and Ferreira, S. (2015). Seeing is Believing? Evidence from Property Prices in Inundated Areas. *Risk Analysis*. 35: 828-848.

Bakkensen, L. and Barrage, L. (2021). Going Underwater? Flood Risk Belief Heterogeneity and Coastal Home Price Dynamics. *The Review of Financial Studies*. Forthcoming: doi.org/10.1093/rfs/hhab122.

Baldauf, M., Garlappi, L. and Yannelis, C. (2020). Does Climate Change Affect Real Estate Prices? Only If You Believe In It. *The Review of Financial Studies*. 33: 1256–1295.

Below, S., Beracha, E. and Skiba, H. (2017). The Impact of Hurricanes on the Selling Price of Coastal Residential Real Estate. *Journal of Housing Research*. 26: 157-178.

Beltrán, A., Maddison, D. and Elliott, R. J. R. (2018). Is Flood Risk Capitalised Into Property Values? *Ecological Economics*, 146: 668-685.

Bernstein, A., Gustafson, M. T. and Lewis, R. (2019). Disaster on the horizon: The price effect of sea level rise. *Journal of Financial Economics*. 134: 253-272.

Bin, O. and Landry, C. E. (2013). Changes in implicit flood risk premiums: Empirical evidence from the housing market. *Journal of Environmental Economics and Management*. 65: 361-376.

Bunten, D. M. and Kahn, M. E. (2017). Optimal real estate capital durability and localized climate change disaster risk. *Journal of Housing Economics*. 36: 1-7.

CBRE (2019). *Understanding flood risk: Unlocking real estate investment potential*. London: CBRE.

Clayton, J., Devaney, S., Sayce, S. and van de Wetering, J. (2021a). *Climate Risk and Commercial Property Values: a review and analysis of the literature*. Geneva: United Nations Environment Programme Finance Initiative.

Clayton, J., Devaney, S., Sayce, S. and van de Wetering, J. (2021b). Climate Risk and Real Estate Prices: What Do We Know? *Journal of Portfolio Management*. 47: 75-90.

Cohen, J. P., Barr, J. and Kim, E. (2021). Storm surges, informational shocks, and the price of urban real estate: An application to the case of Hurricane Sandy. *Regional Science and Urban Economics*. 90: Article 103694.

de Wilde, P. and Coley, D. (2011). The implications of a changing climate for buildings. *Building and Environment*. 55: 1-7.

Ellison, L. and Sayce, S. (2006) *The Sustainable Property Appraisal Project*. Kingston University.

Fell, H. and Kousky, C. (2015). The value of levee protection to commercial properties. *Ecological Economics*. 119: 181-188.

Fisher, J. D. and Rutledge, S. R. (2021). The impact of Hurricanes on the value of commercial real estate. *Business Economics*. 56: 129–145.

Fuerst, F. and Warren-Myers, G. (2021). Pricing climate risk: Are flooding and sea level rise risk capitalised in Australian residential property? *Climate Risk Management*. 34: Article 100361.

Garbarino, N. and Guin, B. (2021). High water, no marks? Biased lending after extreme weather. *Journal of Financial Stability*. 54: Article 100874.

Gibson, M. and Mullins, J. T. (2020). Climate Risk and Beliefs in New York Floodplains. *Journal of the Association of Environmental and Resource Economists*. 7: 1069-1111.

Giglio, S., Maggiori, M., Rao, K., Stroebel, J. and Weber, A. (2021). Climate Change and Long-Run Discount Rates: Evidence from Real Estate. *The Review of Financial Studies*. 34: 3527-3571.

Hino, M. and Burke, M. (2021). The effect of information about climate risk on property values. *Proceedings of the National Academy of Sciences*. 118: Article e2003374118.

Hirsch, J. and Hahn, J. (2018). How flood risk impacts residential rents and property prices: Empirical analysis of a German property market. *Journal of Property Investment & Finance*. 36: 50- 67.

IPCC (2021). *Climate Change 2021, The Physical Science Basis, Summary for Policymakers*. Intergovernmental Panel on Climate Change. Available at: https://report.ipcc.ch/ar6wg1/pdf/IPCC_AR6_WGI_SPM.pdf.

IVSC (2020). *IVS Agenda Consultation 2020: Invitation to Comment*. International Valuation Standards Council. Available at https://www.ivsc.org/wp-content/uploads/2021/10/AgendaConsultation2020InvitationtoComment.pdf.

IVSC (2021a). *International Valuation Standards (IVS) – Effective 31 January 2022*. International Valuation Standards Council. Available at https://www.rics.org/uk/upholding-professional-standards/sector-standards/valuation/red-book/international-valuation-standards/.

IVSC (2021b). *Perspectives Paper: ESG and Real Estate Valuation*. International Valuation Standards Council. Available at https://www.ivsc.org/wp-content/uploads/2021/10/PerspectivesPaperESGandRealEstateValuation.pdf.

Kanne, J., Malek-Madani, D. and Bendix, S. (2017). Climate change and commercial real estate: How resilient is your portfolio? *Institutional Real Estate Americas*. 29 (6): June 1, 2017.

Keenan, J. M., Hill, T. and Gumber, A. (2018). Climate gentrification: from theory to empiricism in Miami-Dade County, Florida. *Environmental Research Letters*. 13: 1-11.

Keys, B. J. and Mulder, P. (2020). *Neglected No More: Housing Markets, Mortgage Lending, and Sea Level Rise*. NBER Working Paper No. 27930. National Bureau of Economic Research, Cambridge MA.

Kousky, C., Kunreuther, H., LaCour-Little, M. and Wachter, S. (2020). Flood Risk and the U.S. Housing Market. *Journal of Housing Research*. 29: S3-S24.

Lamond, J. E., Bhattacharya-Mis, N., Chan, F. K. S., Kreibich, H., Montz, B., Proverbs, D. G. and Wilkinson, S. (2019). Flood risk insurance, mitigation and commercial property valuation. *Property Management*. 37: 512-528.

Le, T. T. and Warren-Myers, G. (2019). An examination of sustainability reporting in valuation practice – A case study of Melbourne, Australia. *Property Management*. 37 (1): 136-153.

McCoy, S. J. and Walsh, R. P. (2018). Wildfire risk, salience and housing demand. *Journal of Environmental Economics and Management*. 91: 203-228.

Meins, E., Wallbaum, H., Hardziewski, R. and Feige, A. (2010). Sustainability and property valuation: a risk-based approach. *Building Research & Information*. 38 (3): 280–300.

Meltzer, R., Ellen, I. G. and Li, X. (2021). Localized commercial effects from natural disasters: The case of Hurricane Sandy and New York City. *Regional Science and Urban Economics*. 86: Article 103608.

Michl, P., Lorenz, D., Lützkendorf, T. and Sayce, S. (2016). Reflecting sustainability in property valuation—a progress report. *Journal of Property Investment & Finance*. 34 (6): 552–577.

Miller, N. G., Gabe, J. and Sklarz, M. (2019). The Impact of Waterfront Location on Residential Home Values Considering Flood Risks. *Journal of Sustainable Real Estate*. 11: 84-107.

Murfin, J. and Spiegel, M. (2020). Is the Risk of Sea Level Rise Capitalized in Residential Real Estate? *The Review of Financial Studies*. 33: 1217–1255.

Ortega, F. and Taspinar, S. (2018). Rising sea levels and sinking property values: Hurricane Sandy and New York's housing market. *Journal of Urban Economics*. 106: 81-100.

Pottinger, G. and Tanton, A. (2014). Flooding and UK commercial property investment: what is the risk? *Qualitative Research in Financial Markets*. 6: 211–226.

RICS (2018). *RICS Valuation - Global Standards 2017: UK national supplement*. Royal Institution of Chartered Surveyors. Available at: https://www.rics.org/globalassets/rics-website/media/upholding-professional-standards/sector-standards/valuation/red-book-uk-supplement-rics.pdf

RICS (2021a). *RICS Valuation – Global Standards*. Royal Institution of Chartered Surveyors. Available at: https://www.rics.org/globalassets/rics-website/media/upholding-professional-standards/sector-standards/valuation/2021-11-25_rics-valuation--global-standards-effective-2022.pdf.

RICS (2021b). *Sustainability and ESG in commercial property valuation and strategic advice, Global, 3rd edition*. Royal Institution of Chartered Surveyors. Available at: https://www.rics.org/globalassets/rics-website/media/upholding-professional-standards/regulation/valuation/sustainability-and-esg-guidance-note_january2022.pdf.

Rivera, J. (2020). *The Impact of Climate Change on Real Estate Valuations and Decisions*. Available at: https://www.capright.com/the-impact-of-climate-change-on-real-estate-valuations-and-decisions-2/.

Roberts, G., Lafuente, J. J. and Darviris, T. (2015). *Climatic Risk Toolkit: The impact of climate change in the Non-Domestic Real Estate sector of eight European countries*. London: RICS.

Sayce, S. (2018) 'Chapter 9: Building sustainability into valuation and worth', in Wilkinson, S., Dixon, T., Miller, N. and Sayce S. (eds) *Routledge Handbook of Sustainable Real Estate – 1st Edition*, London, Routledge, pp. 132–146.

TEGOVA (2020). *European Valuation Standards – 2020.* 9th edition. The European Group of Valuers' Associations. Available at: https://tegova.org/static/72fa037473e198cbd428e465158bcfdb/a6048c931cdc93_TEGOVA_EVS_2020_digital.pdf.

Teicher, H. M. (2018). Practices and pitfalls of competitive resilience: Urban adaptation as real estate firms turn climate risk to competitive advantage. *Urban Climate*. 25: 9-21.

Turnbull, G. K., Zahirovic-Herbert, V. and Mothorpe, C. (2013). Flooding and Liquidity on the Bayou: The Capitalization of Flood Risk into House Value and Ease-of-Sale. *Real Estate Economics*. 41: 103-129.

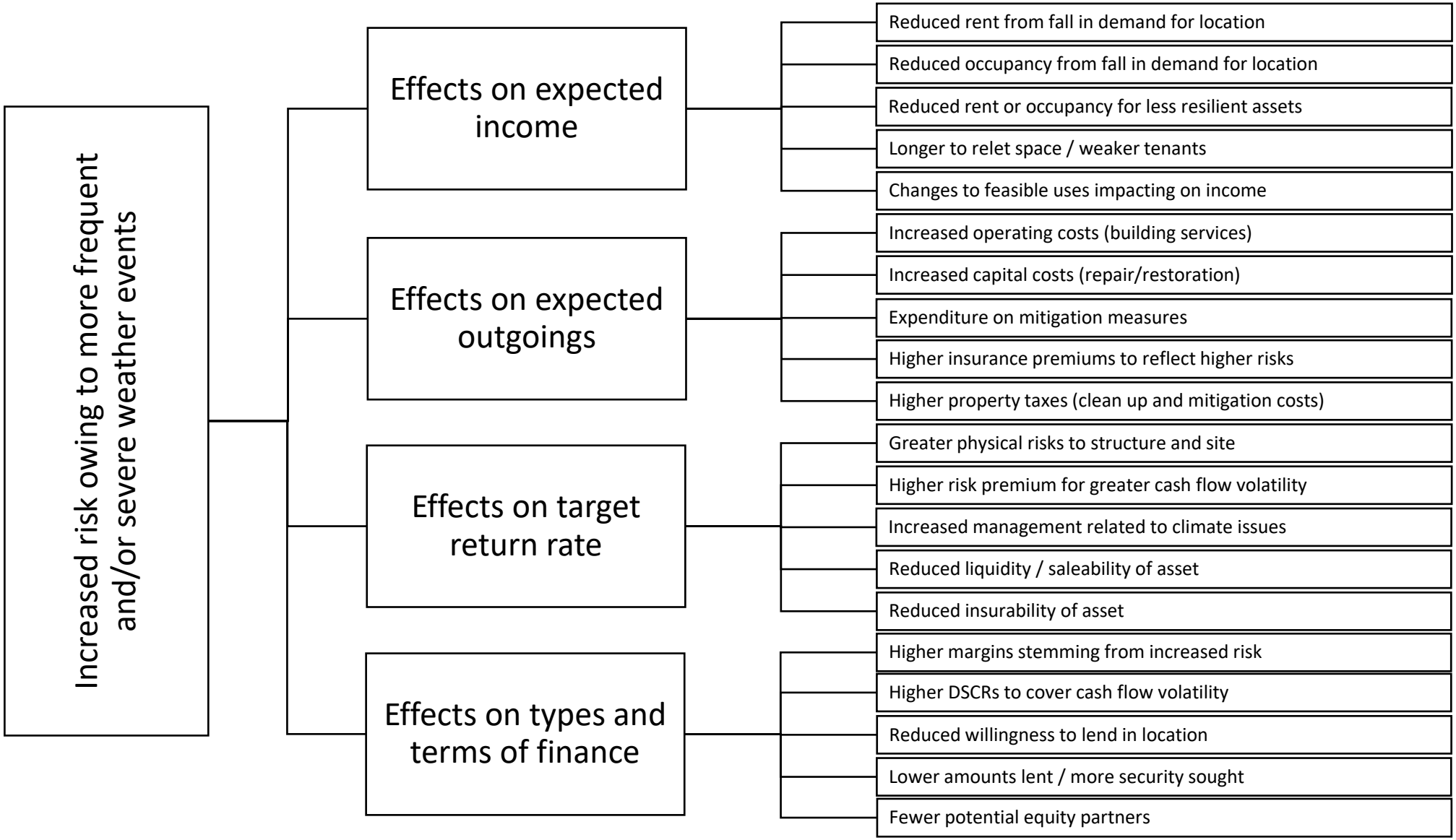
ULI / Heitmann (2019). *Climate Risk and Real Estate Investment Decision-Making*. Washington, D.C.: Urban Land Institute.

ULI / Heitmann (2020). *Climate Risk and Real Estate: Emerging Practices for Market Assessment*. Washington, D.C.: Urban Land Institute.

Yi, D. and Choi, H. (2020). Housing Market Response to New Flood Risk Information and the Impact on Poor Tenant. *Journal of Real Estate Finance and Economics*. 61: 55-79.

Warren-Myers, G. and Cradduck, L. (2021). Physical and climate change-related risk identification in valuation practice: an Australian perspective. *Journal of Property Investment & Finance*. 40: 14-37.

Figure 1: Expected performance of commercial real estate investments with increased exposure to climate risk



Developed with reference to de Wilde and Coley (2011) and Clayton *et al*. (2021a).