

# How do households perceive flood-risk? The impact of flooding on the cost of accommodation in Dublin, Ireland



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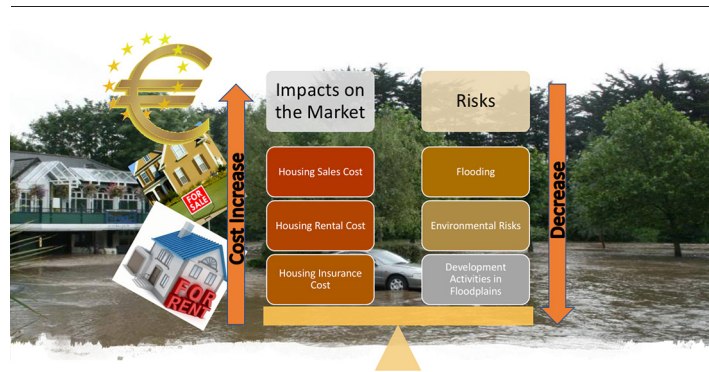
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## HIGHLIGHTS

- Analysis on impact of flood risk on rental and sale costs of residential properties in Dublin
- Quantitative analysis of impact on prices of perceived and actual flood risk
- Use of hedonic regression techniques to account for impacts of amenities on prices
- Higher impact of past flood events than scientific assessments of flood risk
- Important policy implications about communicating flood risk to consumers

## GRAPHICAL ABSTRACT



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## ABSTRACT

Climate change and human behaviour, such as building on floodplains, are increasing the incidence of floods in urban areas. This paper investigates the relationship between flood risk and residential accommodation costs, both sales and rental, using a detailed dataset of over 650,000 sale and rental listings in Dublin, Ireland over the period 2006–2015. These are combined with detailed data for the Dodder river on 1% flood risk and past flooding events. Research to date suggested that the lack of a persistent effect may have an impact on buyers' and sellers' risk perceptions by changing with the prevalence of hazard events and that homebuyers are unaware of flood risks and insurance requirements when bidding on properties. Using hedonic regression techniques, the presented work shows opposite results: flood events are found to have a negative impact, particularly on sale prices, while being at 1% risk has no effect once past flood events are controlled for. For past flood events, however, there is evidence to suggest that this impacts on property values, certainly in the areas affected and up to 200 m away. Before the institutional flood risk maps were published, the assessment was based on existing Ordnance Survey maps which showed areas 'Liable to flooding' generated with land surveys carried out around the 1830. Set against these devices for raising awareness of flooding is the Irish constitution which regards property rights almost the same as human rights, which obvious impacts on the ability of planners to implement development/zoning plans. On the basis of this evidence, it is reasonable to conclude that households pay more attention to past flood events than to scientific assessments of flood risk, has important policy implications about communicating flood risk to consumers.

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## 1. Introduction

The occurrence and consequences of floods is receiving increasing media coverage worldwide as a result of a higher incidence of these natural disasters. Sizeable human and material losses are associated with flooding disasters, making flooding an important question for economists and social scientists. Climate change is a result of the combined impacts of changing natural circumstances and human behavior, causing increases in the frequency and the magnitude of floods (Hirabayashi et al., 2013). Indeed, there is an increased chance of intense precipitation and flooding due to “greater water-holding capacity of a warmer atmosphere”, and it is expected that “such events will continue to become more frequent” (IPCC, 2007): precipitation intensity is estimated to increase almost everywhere, but particularly at mid- and high latitudes where also the mean precipitation is anticipated to increase (Meehl et al., 2005), with a resulting impact on the risk of flash flooding and urban flooding. This is also suggested by other studies specifically relevant to Ireland (Gharbia et al., 2016a, Gharbia et al., 2018, Osman et al., 2013, Alexander et al., 2016). Agricultural interventions by farmers and local communities particularly in the rivers upstream areas can be one of the main causes of floods in many parts of Europe and other continents (Posthumus et al., 2008; Mustafa, 1998). This can happen by intentionally blocking or slowing surface runoff on farmlands. On the other hand, runoff from impermeable surfaces is considered to be one of the biggest contributors to flood risk, in addition to development activities in floodplains. While this is not the case in Dublin, Ireland's capital, this risk exists for other catchments in Ireland. Anthropogenic impacts on river flooding are clearly visible in changed river management practices (McNamara and Keeler, 2013). Construction in floodplains (Guarín et al., 2004), channel straightening and increased presence of impermeable surfaces such as transport infrastructure and residential areas are examples of urbanization that increases the risk of river floods in small catchment areas and small river networks (Berry et al., 2008; Bradford et al., 2012; Daniel et al., 2009; Kron, 2003).

This paper investigates behavioral responses to a natural hazard (flooding) by examining the cost of residential accommodation, both sale and rental. This type of research is important for at least two reasons. First, results can be used to develop cost effectiveness studies, which attempt to assess the economic merits of policies that change the likelihood or magnitude of an event (Zerger, 2002). Residential housing markets provide an avenue for estimating these values since the choice of where to live includes, at least implicitly, the choice of risk level. Second, research on the role of natural hazards in urban housing markets is important also because the methodology provides a mechanism for testing consumer behavior under uncertainty. This was shown by Brookshire et al. (1985), who used house price differentials resulting from earthquake risk in Los Angeles and San Francisco to test predictions from the expected utility model. Bin and Polasky (2004) used a hedonic property price function to estimate the effects of flood hazards on 8000 single-family residential homes between 1992 and 2002 in Pitt County, North Carolina; this area experienced significant flooding from Hurricane Floyd in September 1999. The study found that a house located within a floodplain has a lower market value than an equivalent house located outside the floodplain. Furthermore, the price discount from locating within a floodplain was significantly larger after Hurricane Floyd than before.

Bin and Landry (2013) re-examined the findings for Pitt County, North Carolina, using multiple storm events within a difference-in-differences framework, and they compared flood zone price differentials for a more recent sample of property sales. Prior to Hurricane Fran in 1996, they detected no price differential for location within a flood zone but significant price discounts after major flooding events: 5.7% after Hurricane Fran and 8.8% after Hurricane Floyd. Results from a separate model that examined more recent data covering a period without significant storm-related flood impacts indicated a significant

risk premium ranging between 6.0% and 20.2% for homes sold in the flood zone, but this effect diminished over time, essentially disappearing about 5 or 6 years after Hurricane Floyd. The lack of a persistent effect suggested that buyers' and sellers' risk perceptions may change with the prevalence of hazard events and that homebuyers are unaware of flood risks and insurance requirements when bidding on properties.

Bernknopf et al. (1990) explored the effects on investment, recreation, and risk perception after earthquake and volcano hazard notices were issued for the Mammoth Lakes, California area by the U.S. Geological Survey under the authority granted by the Disaster Relief Act of 1974. The hazard notices did not affect recreation visitation, but investment was affected with a perceived loss in the market value of homes; property owners' perceptions of risk were also altered. Hallstrom and Smith (2005) used one of the strongest hurricanes to hit the US, Andrew in 1992, to define a quasi-random experiment that permitted the estimation of the responses of housing values to information about new hurricanes. The test site for this work was Lee County, Florida which did not experience damage from Andrew but was close to the affected areas. The authors hypothesized that Andrew conveyed risk information to homeowners in the county. A difference-in-differences (DND) framework identified the effect of this information on property values in areas likely to experience significant storm damage. The DND findings indicated at least a 19% decline in property values.

Murdoch et al. (1993) examined the effect of the Loma Prieta earthquake on housing prices in the San Francisco Bay area. This relationship was examined while controlling for potential confounding variables, such as location-specific risk and the timing of the earthquake. The results indicated that the Loma Prieta earthquake caused an area-wide reduction in property values. In addition, it seemed that individuals considered other measures of earthquake risk in their housing purchases, yielding a measurable price gradient. Dale et al. (1999) examined the Dallas area housing market before, during, and after the closure and cleanup of a 50-year-old lead smelter west of downtown Dallas, using a pooled time series and cross-sectional data set of over 200,000 observations, covering all single-family homes sold through the Multiple Listing Service (MLS) 1979–1995. Consistent with the existing literature, property values around the smelter were lower before the cleanup. However, after the cleanup, the prices consistently rebounded across all neighborhood types, although the areas that were nearest and poorest did so more slowly.

Simmons and Kruse (2000) explored the value of windstorm mitigation in a Gulf Coast city. Data for the study contained detailed information on the inclusion of storm-blinds, a mitigation feature specific to hurricanes. Results indicated that homes with storm-blinds commanded a premium compared to homes without this feature. This result, however, was limited to homes located on the island portion of the community, indicating that agents differentiated the risk from one area to another. Simmons et al. (2002) further explored the valuation of two measures of windstorm mitigation in a Gulf Coast city. The hypothesis of this study was that since the home owner was not able to reduce the probability that a hurricane or tropical storm would occur at the structure's location, any voluntary mitigation intended to protect the home was a form of self-insurance. Using a unique MLS data set with detailed information on several hurricane mitigation features, the authors constructed two models to test the influence of mitigation on resale price. The results of the hedonic study indicated that individuals place a positive value on a self-insurance type of mitigation.

The study here uses hedonic regression techniques, as is standard in the literature, to estimate the effects of flood hazards on residential property values and rental prices. Hedonic techniques use high-dimension data on housing, such as a dwelling's size, type or energy efficiency and its proximity to location-specific features such as transport facilities or schools, to estimate the value of each characteristic holding other measured characteristics constant. Specifically, this study utilizes data from 158,890 sales listings and 499,147 rental listings in Dublin,

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