Effects of Flood Hazard on Property Prices in Cape Town, South Africa

In many rapidly growing cities in the Developing South, an increasing proportion of households live in areas prone to flooding. In this paper's case study of Cape Town (South Africa), the impact of rapid formal and informal urban development on flood risk is amplified by pre-existing economic vulnerabilities. Mitigating the impact of flood risk on households presents an allocative problem for a fiscally constrained city government facing pressing economic, infrastructural, and social challenges. The purpose of this paper is to (a) present information regarding the local property market; (b) present an analysis estimating the impact of flood risk on residential property value; and (c) present two case studies estimating what proportion of flood mitigation project costs will likely be recoverable through property tax increments.

Cape Town is a rapidly growing, low density, middle-income city of 4.7 million inhabitants, sprawled across a broad plain connecting a mountainous Cape Peninsula to the mainland. It has a warm Mediterranean climate, with mild, moderately wet winters and dry, warm summers. Annual winter storms and heavy rains, steep mountainous slopes and long coastlines renders much of Cape Town at risk of flooding. Winter sees a succession of South Atlantic cold fronts buffeting the city with intense rainfall and strong winds, bringing widespread fluvial and pluvial flooding. The frequency and intensity of extreme weather events in Cape Town are changing and likely to increase, resulting in increased flood risk (Ziervogel & Smit 2009).

Fluvial flooding is episodic and localized along Cape Town's four perennial rivers: the Black, Liesbeek, Kuils, and Lourens Rivers. Whereas generous setbacks have limited the flood risk of the Black and Liesbeek Rivers, the Kuils and Lourens River have been partially canalized and encroached upon by formal townships over the course of the 20th century. Major fluvial flood events occurred along their banks in 2013, 2018 and 2022.

To estimate the local impact of flood risk on property value we create a general hedonic price model (HPM) for the region, including all properties. The model residuals, the difference between the expected price and the actual property price, represent the effect on property price of un-modelled factors, which include location of the house within the 100-year flood lines. This measure of discount is then applied to all homes and the distributions of discounts compared between homes within the flood regions (FR) and homes outside of it (non-FR).

Several datasets were combined to produce the intrinsic and extrinsic parameters required by the HPM. These included the municipally assessed general valuation dataset for the region; a dataset of property SALES; intrinsic property parameters such as number of bathrooms and bedrooms; qualitative data regarding the view and quality of the property; neighborhood data regarding occupancy, education and income; and geographical data indicating elevation and distance from the CBD, the ocean and any river.

The datasets were filtered to only include single residential conventional properties, and to size and value limits so as to produce a subsample that could be modelled accurately. The final dataset used to predict the municipally assessed value (AV) included 154,000 properties, of which 2,600 were within the flood region. The same process was repeated to produce an HPM for predicted sale prices (SALES) including 36,500 properties in total, of which 670 were within the floor region.

The results indicate that for AV the model expected the properties within the FR to have higher values than records indicate. A similar result is shown for the SALES dataset This indicates that the properties are valued at a mean discount of approximately 3.2 percent in the case of AV and 2.3 percent in the case of SALE. This relationship was even stronger for median property value (~5 percent discount).

The model results are applied to two neighborhoods identified as fluvial flooding hotspots: Lourens River and Macassar. Of the 6807 formal properties located citywide within the 2007 100-year flood plain, 2643 are located along the Lourens River and 1150 are located in Macassar. Lourens River Phase 2 and Macassar Flood Alleviation account of 24 percent and 18 percent respectively of the U.S.$141 million (U.S.$348 million at PPP) capital cost of the City of Cape Town's long-term flood mitigation capital programme (City of Cape Town 2021).

We estimate land value potential in our local case studies by comparing the present value of the capital cost of projects for respective neighborhoods with the present value of property tax increments over fifty years. The latter is estimated by applying the estimated discount of 3.2 percent calculated using the AV data set to the aggregate municipally-assessed value of properties within the expanded 2020 floodplain for the two project areas, and applying the social discount rate of 2.5 percent over fifty years of expected additional tax revenue.

For Lourens River, applying the discount to both residential and business properties over fifty years allows for a recoverable portion of 10 percent of project cost. Macassar, with lower property values and few business properties, is unlikely to recover more than 2 percent of the capital cost of flood attenuation projects through land value increments on existing properties.

With the above under consideration, we find that only a fraction of floodwater mitigation project costs can be accounted for through aggregate property tax increment expected over 50 years.

This finding does raise a number of important questions that merit further research: First. Does the property discount estimated in this study accurately reflect perceived flood risk by property owners? Second. Which factors not considered in this study influence the relationship between perceived flood risk and observed property value discounts (e.g., property submarkets, household preferences, land value densities, dwelling typologies, existing property owners vs. prospective buyers, flood insurance)? Third. To what extent is the limited recovery of mitigation costs reflective of over-specified flood mitigation measures? How would the estimation of recoverability differ were an incremental rather than maximalist solution to flood risk reduction followed? Fourth. To what degree does perceived flood risk by homeowners differ from actual flood risk, particularly in light of the anticipated effects of climate change on flood intensity? A corollary to this last point is the potential impact of improved information regarding flood risk on perceptions of flood risk, and – by extension – the extent to flood mitigation measures is recoverable through land value capture instruments.

The practical objective of this study was to draw on observed property market data in order to arrive at a 'rule-of-thumb' which local governments in data-poor, resource-constrained contexts may apply in order to appraise in situ capital projects aimed at reducing flood risk in formally developed, low-density residential suburbs. Due to the limitations described above, the findings of this study are not applicable to the appraisal of flood mitigation projects associated with greenfield development or brownfield intensification.

From a policy perspective, the findings do suggest that the empirical estimation of property discounts associated with flood risk may not itself be sufficient to justify large-scale flood mitigation projects in low-density residential suburbs. Factors other than property tax increments may need to be considered as part of future project appraisals.

References:

Ziervogel, G., and Smit, W. (2009). *Learning to swim: Strengthening flooding governance in the City of Cape Town*. https://idl-bnc-idrc.dspacedirect.org/handle/10625/50690