

Does flood risk affect development?

Evidence from Irish planning permissions

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Extended Abstract

This paper focusses on the supply-side effects of flood risk. We ask – Is development policy giving enough consideration to flood risk? Is housing delivery being prioritized over scientifically assessed risk in the context of a increased population and no recent major flood events? A unique dataset of individual planning permissions and detailed flood risk maps allows us to explore this issue. Preliminary results suggest that the rate of development in flood risk zones is almost the same as outside risk zones – 2.5% of applications inside risk zones vs 3.1% of Eircodes. Further data work will allow deeper analysis into the reason for these developments

Introduction

Floods are the leading cause of natural disaster deaths worldwide. They are the most costly and pervasive natural hazard globally. Over the period from 1985-2014, according to the Dartmouth Flood Observatory archive, floods worldwide killed >500,000 people, displaced >650,000,000 people, and caused damages >USD800 billion (2000 prices). In Ireland, floods caused roughly EUR1 billion, or EUR800 per household, in insured losses 2000-2014 (Insurance Ireland, n.d.). Flood defences of EUR227 million are now in place, with an additional EUR1 billion in planned expenditure over next 10 years (OPW, 2018).

Why study flooding?

Climate change means increasing hazard (sea level rise, and more intense rainfall). It is an economically interesting problem due to tendency towards over-exposure: Moral hazard (Kydland and Prescott, 1978); Information problems and behavioural biases (e.g. Burningham et al. 2008; Pryce et al. 2011); Historical lock-in: persistence in spatial development patterns; agglomeration forces (Kocornik-Mina et al. 2020; Lin et al. 2022).

Flood risk is now a significant policy issue. Is the development policy in Ireland heeding the warnings?

Most of the existing literature on flood risk and housing has tended to focus on prices.

However, there is a long literature using hedonic house price models to estimate flood risk

discounts (see e.g. Beltran et al. 2018 for a review). The focus of recent literature is on risk preferences, and updating of risk perceptions (e.g. following shocks and/or new information about risk) – Gibson et al. 2018, Timar et al. 2018, Ortega & Taspinar 2018, Beltran et al. 2019, Hino and Burke 2020, Gibson and Mullins 2020. There is also some attention on selection into risk / inequalities etc. -- e.g. Bakkensen and Ma 2020, Bakkensen and Barrage 2022. Few papers have studied quantities (exposure) (Barrage and Furst, 2019). Where exposure has been assessed, the focus has still tended to be on demand side explanations – preferences of residents, trade-offs between amenities and risk etc. – e.g. Lin, McDermott and Michaels 2022.

This paper focusses on the supply-side effects of flood risk. We ask – Is development policy giving enough consideration to flood risk? Is housing delivery being prioritized over scientifically assessed risk in the context of a increased population and no recent major flood events? A unique dataset of individual planning permissions and detailed flood risk maps allows us to explore this issue. Preliminary results suggest that the rate of development in flood risk zones is almost the same as outside risk zones – 2.8% of applications inside risk zones vs 3.1% of Eircodes. Further data work will allow deeper analysis into the reason for these developments.

Irish Context

Planning legislation in Ireland is designed “in the interests of the common good, the proper planning and sustainable development of urban and rural areas” (Office of the Planning Regulator, 2020). Local authorities use development plans as their main policy document in relation to planning and designating zones for various development purposes. This is overseen by the Office of the Planning Regulator (OPR). Most forms of development require planning permission from a Local Authority. Decision-making on individual planning applications is an executive function within the local authority. An Bord Pleanála (ABP) is an independent national planning body that deals with appeals of decisions made by city and county councils in respect of planning applications which have been lodged with them. In 2009 “The Planning System and Flood Risk Management: Guidelines for Planning Authorities” was published and outlines comprehensive mechanisms for the incorporation of flood risk identification, assessment and management into the planning process: Avoid development in areas at risk of flooding, particularly floodplains, unless there are proven wider sustainability grounds that justify appropriate development and where the flood risk can be reduced or managed to an acceptable level without increasing flood risk elsewhere; Adopt a sequential approach to flood risk management when assessing the location for new development based on avoidance, reduction and mitigation of flood risk; and incorporate flood risk assessment into the process of making decisions on planning applications and planning appeals. A site-specific flood risk assessment is required if a proposed development is within a flood risk zone. These are generally undertaken by external consultants (paid for by developer), depending on the scale of the development. Are these guidelines enough to prevent development in flood risk zones?

Data

The principal data source is the National Planning Application Database (NPAD), which is publicly available on myplan.ie. Dataset comprises of site outlines (polygons) for each planning application in the state from 2010 – current day. Most local authorities start their data from 2014 (some from before 2010). Over 440,000 unique planning applications in dataset from 2014 – 2022. Included in the dataset are:

1. Description of proposed development – text field
2. Application type – permission, retention, extension of duration, etc
3. Decision – Granted(unconditional/conditional), refused, invalid, withdrawn, other
4. The date the application was received and the decision date
5. The number of residential units proposed
6. Floor area/site area

LandUseCode	Number of Applications	% of Total
DOMESTIC EXTENSION	11,437	45.7%
SINGLE HOUSE : NEW	3,033	12.1%
DOMESTIC EXTENSION RETENTION	1,260	5.0%
HOUSING : NEW	1,035	4.1%
ENTRANCE : NEW	734	2.9%
APARTMENTS : NEW	539	2.2%
DOMESTIC EXTENSION REVISION	337	1.3%
SINGLE HOUSE : REVISION	306	1.2%
ADVERTISING : NEW	243	1.0%
HOUSING : REVISION	183	0.7%
SHOP up to 2,000 sq. m NEW	182	0.7%
Retail Distribution and Servicing Minor	171	0.7%
PROTECTED BUILDING : EXTENSION	169	0.7%
ENTRANCE : RETENTION	149	0.6%
APARTMENTS : REVISION	148	0.6%
RESTAURANT : NEW	147	0.6%
POST PRIMARY : EXTENSION	122	0.5%
SINGLE HOUSE : RETENTION	121	0.5%
FENCING / WALLS : RETENTION	121	0.5%

ADVERTISING : RETENTION	107	0.4%
ENTRANCE : EXTENSION	104	0.4%
SHOPPING CTR 2,000 sq.m.+ EXTNSN	103	0.4%
...295 More Categories (remanining 17% of applications)		
Total	25,013	

What are most of the planning permissions for?

A categorical variable describing the type of development is not explicitly available in the data. With the one exception is Dun Laoghaire/Rathdown County Council, which gives a preliminary insights into the distribution of development types. Domestic extensions makes up 45.7% of applications, followed by a new single house (12.1%). However, for the rest of the local authorities the description field can be analysed using Natural Language Processing (NLP) techniques to create a variable similar to the table opposite.

Applications can be for permission to develop, but also other categories such as:

1. Retention (asking for forgiveness)
2. Extension of duration (delayed development)
3. Outline permission (asking if a site is open to being developed – pre formal application)

The decision variable can generally be simplified into granted, refused, or other

	Application Type	
PERMISSION	365,104	82.2%
RETENTION	51,302	11.6%
EXTENSION OF DURATION	11,606	2.6%
OUTLINE PERMISSION	11,191	2.5%
OTHER	4,763	1.1%
Total	443,966	

	Decision	
GRANT PERMISSION	307,071	69.2%
OTHER (invalid, withdrawn, etc)	92,200	20.8%
REFUSE	44,695	10.1%
Total	443,966	

Natural Language Processing

The research is focussed on residential developments. As there is no consistent category variable available in the dataset (with the exception of Dun Laoighre – Rathdown, as explained above), machine learning techniques were used to create a category variable from the text field of each application. For this analysis the ~25,000 applications in Dun Laoighre – Rathdown were used to train the NLP model. The algorithm had approximately 90% accuracy when tested. It was then applied to the applications in the rest of the dataset.

Preliminary results

The preliminary analysis is a cross-sectional observation of the number of applications (and their corresponding residential units) submitted in flood risk zones, and the rate of granted vs refused for those applications.

Centroid points of application polygons were used to link spatial data – polygon analysis planned for main analysis.

The following restrictions were applied to the sample:

1. Only applications received between the years 2014 – 2022
2. Only looking at new residential units (single or multiple)
3. Only permission type applications that were either granted or refused (no withdrawn or retention applications)
4. Only Local authorities that had sufficient data (number of residential units)
5. Final sample size of just over 40,000 applications

Stock of housing

Using a dataset of Eircodes we can see the national distribution of flood risk. This is a useful comparison when looking at the % of planning applications in flood risk zones compared to outside flood risk zones. 3.1% of the stock of addresses in Ireland are in a low risk zone

(1/1000) while 1.3% are in a medium/high risk zone (1/100 or 1/10) – highest in Cork City (6%).

	Total	No Risk	Low Risk	Medium Risk	% Medium Risk	
					% Low Risk	% High Risk
Carlow County Council	1,748	1,722	62	20	3.5%	1.1%
Cavan County Council	2,038	2,032	8	5	0.4%	0.2%
Clare County Council	4,687	4,620	109	47	2.3%	1.0%
Cork City Council	209	198	12	9	5.7%	4.3%
Cork County Council						
Donegal County Council	6,005	5,924	122	60	2.0%	1.0%
Dublin City Council	6,945	6,387	754	622	10.9%	9.0%
Dun Laoghaire Rathdown County Council						
Fingal County Council						
Galway City Council						
Galway County Council	7,707	7,650	76	40	1.0%	0.5%
Kerry County Council	5,145	5,031	185	105	3.6%	2.0%
Kildare County Council	13,903	13,721	303	68	2.2%	0.5%
Kilkenny County Council	4,254	4,191	176	75	4.1%	1.8%
Laois County Council	5,207	5,169	90	54	1.7%	1.0%
Leitrim County Council	478	474	5	4	1.0%	0.8%
Limerick County Council	7,189	7,005	203	155	2.8%	2.2%
Longford County Council						
Louth County Council	9,013	8,649	447	252	5.0%	2.8%
Mayo County Council	2,887	2,874	23	13	0.8%	0.5%
Meath County Council	16,926	16,858	99	54	0.6%	0.3%
Monaghan County Council	1,206	1,200	9	5	0.7%	0.4%
Offaly County Council	1,962	1,954	10	4	0.5%	0.2%
Roscommon County Council	1,564	1,553	11	8	0.7%	0.5%
Sligo County Council	614	613	1		0.2%	
South Dublin County Council	8,647	8,586	624	536	7.2%	6.2%
Tipperary County Council	2,293	2,277	43	7	1.9%	0.3%
Waterford City and County Council	5,225	5,213	52	13	1.0%	0.2%
Westmeath County Council	3,443	3,437	35	31	1.0%	0.9%
Wexford County Council	6,445	6,432	23	10	0.4%	0.2%
Wicklow County Council						
Total	125,740	123,770	3,482	2,197	2.8%	1.7%

When we scale up the applications by the number of residential units, the distribution is higher than the Eircode distribution – (1.7% compared to 1.4%). This suggests that flood risk is not a deterrent to housing investment. Application level analysis suggests that there is very little difference in the ratio of granted to refused in flood risk zones nationally – 85.5% nationally vs 79.5% in flood risk zones.

Conclusion

Preliminary analysis suggests that flood risk is not a sufficient deterrent to development in Ireland, despite policy outlined in “The Planning System and Flood Risk Management: Guidelines for Planning Authorities”. We plan to investigate the drivers of residential development in flood risky areas using a measure of housing demand. This measure is a mix-adjusted (dwelling attributes only) Electoral District level list price index comparing 2013 to 2016 (just before the beginning of the complete planning applications dataset. Each ED assigned a % price change from 2013 to 2016.