Floodplain Designation and Property Sale Prices in an Urban Watershed

Noelwah R. Netusil, Reed College
Maya Jarrad, Reed College
Klaus Moeltner, Virginia Tech
J. Alan Yeakley, University of Maryland Baltimore Campus
Jacob Sherman, Portland Housing Bureau

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Source: https://www.portlandoregon.gov/bes/article/117017
Flood Insurance

- 1929: Private insurers stop offering flood insurance citing commercial infeasibility
- 1936: Flood Control Act, focus on “structural” measures like levees, channel improvements, and flood walls
- 1968: Flood Disaster Protection Act, created the National Flood Insurance Program (NFIP), four co-equal parts:
  - Flood mapping
  - Floodplain management to guide development
  - Flood mitigation to reduce risk
  - Flood insurance for properties in high-risk areas

Source: Mississippi State Department of Archives and History
Source: Oregon Historical Society
Flood Insurance

- 1973: National Disaster Protection Act, mandated federally-backed financial institutions require flood insurance for high-risk properties
- 1994: Flood Insurance Reform Act, strengthened the enforcement of mandatory purchases of insurance
- 2012: Biggert-Waters Flood Insurance Reform Act, quickly phased out subsidized rates, eliminated grandfathering
- 2014: Homeowner Flood Insurance Affordability Act (HFIAA), repealed and modified many of the Biggert-Waters reforms, created a reserve fund surcharge

Source: Washington Post, August 28, 2017

Source: NOAA via WikiMedia Commons
National Flood Insurance Program (NFIP)

- Longest standing government-run disaster insurance program in the world; offered to property owners in participating communities.
- Mandatory if you have a federally-backed mortgage and have a structure located in a 100-year floodplain.
- Premiums: Set for each flood zone nationally, and do not vary by state or locality; artificially low rates.
- Coverage limits: Structure up to $250,000, and Contents up to $100,000; private insurance may be available to purchase additional coverage.
- Take-up Rate: 74% of new policies are still in force after 1 year; only 36% are in force after 5 years (Michel-Kerjan and Kunreuther 2011).

Source: FEMA's Map Service Center

“...we need to establish a compulsory insurance scheme in which the premium for which each occupant of the flood plain would be responsible as a condition of flood plain occupation would be proportional to the risk of losses to which he was subjected and to the external diseconomies his occupance occasioned for others in the community.” (page 186)

“It is conceivable that it would not be **politically feasible** to require **present occupants** of the flood plain to enroll in a national flood insurance program in which premiums were equal to the expected damage and associated costs of flooding and its aftermath.” (page 188)

Consider two homes that are identical except that one is in a 100-year floodplain and the other is not. Would you be willing to pay the same amount for the two homes?

Home A: in 100-year floodplain

Home B: Not in a 100-year floodplain
Capitalization Formula

Assume annual flood insurance premium is $1,180 (2014 dollars)

Net Present Value (NPV) = -$1,180 + (-1,180)/(1+r) + (-1,180)/(1+r)^2 + ...

NPV of a perpetuity = -$1,180/r

Estimates can be sensitive to the discount rate “r”:

3% = $39,333
5% = $23,600

Average sale price in the study area is $193,092 (2014 dollars), so we expect homes in a 100-year floodplain with insurance to sell for 20.4% (r=3%) or 12.2% less (r=5%)
Motivating Questions

1. Is a property’s sale price affected from being in a 100-year floodplain?

2. If so, have these effects changed over time?

3. How do the estimated effects compare to the price discount from floodplain insurance capitalization?

4. Is the effect of being in a 100-year floodplain different from the 500-year floodplain?

5. Does how we model a property’s location as being “in a floodplain” matter?
Existing Literature

- Many hedonic studies, but only 3 use a repeat-sales approach
- Focus is on “major” storm events like hurricanes, but not the type of flooding that occurs in our study area
- Studies use a tax lot boundary to create floodplain variables or rely on self-reporting in the Regional Multiple Listing Service (RMLSC) database
- Consensus is that being in a floodplain reduces sale price by 4-12%; major flooding events can cause price declines of over 40%
- Myopia after major flooding events, price declines go away after a few years
- Mixed findings about the capitalization of insurance premiums
Study Area: 5 km buffer from Johnson Creek
Methodology: Repeat Sales

Property sells in 2000 for $160,000

New park opens near the property in 2003

Property sells in 2005 for $180,000
Why include floodplain in a repeat sales model?

- Hybrid repeat sales/hedonic models (Case et al. 2006)
- Included as a control in a paper on restoration projects and property values (Jarrad et al. 2018)
  - Changes in the National Flood Insurance Program
  - Changes in the risk of flooding due to urbanization (see work by Chang)
  - Knowledge about the risks of flooding in the study area
  - Investments to reduce flooding by city agencies
Restoration Projects: 1990-2014
Restoration Projects by Primary Goal

Source: Jarrad et al. (2018)
## Property Transactions: 1988-2014

<table>
<thead>
<tr>
<th>Number of Times a Property Transacts</th>
<th>Properties</th>
<th>Number of Transactions</th>
<th>Transaction Pairs</th>
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<tbody>
<tr>
<td>1 (unusable)</td>
<td>37,353</td>
<td>37,353</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>21,263</td>
<td>42,526</td>
<td>21,263</td>
</tr>
<tr>
<td>3</td>
<td>9,599</td>
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<tr>
<td>4</td>
<td>3,400</td>
<td>13,600</td>
<td>10,200</td>
</tr>
<tr>
<td>5</td>
<td>940</td>
<td>4,700</td>
<td>3,760</td>
</tr>
<tr>
<td>6</td>
<td>216</td>
<td>1,296</td>
<td>1,080</td>
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<tr>
<td>7</td>
<td>36</td>
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<tr>
<td>8</td>
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<tr>
<td><strong>Unusable Total</strong></td>
<td>37,353</td>
<td>37,353</td>
<td>//</td>
</tr>
<tr>
<td><strong>Usable Total</strong></td>
<td>35,461</td>
<td>91,227</td>
<td>55,766</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>72,814</td>
<td>128,580</td>
<td>55,766</td>
</tr>
</tbody>
</table>
Transaction Pairs by Property

Property Sales Near Johnson Creek
Portland, Oregon

Sales per Property

Cartographer: Maya Juradi
Background Layers: Portland OULS Discovery
Sales Data: DataQuick
Floodplain Variables

- Existing literature counts a property as being in a 100-year floodplain if the tax lot boundary is inside or intersects the floodplain.
- Both properties are counted using tax lot.
- Only the property on the left is counted using building footprint.
- This matters because properties with a federally-backed mortgage are required to have insurance if the residence, or a structure attached to the residence, is inside or intersects the 100-year floodplain.

Included in Building Footprint and Tax Lot Variables

Included only in Tax Lot Variable
Repeat-Sales Equation

\[
\ln \left( \frac{P_{t,t'}}{P_{i,t^0}} \right) = \beta_0 + \sum_{t=2}^{T} \phi_t 100FZ_i * d_t + \sum_{t=2}^{T} \psi_t 500FZ_i * d_t + \sum_{t=2}^{T} \gamma_t dist\_CBD_i * d_t + \sum_{STP=1}^{60} \alpha_{STP} R_{STP} \\
+ \beta_1 Age_{i,(t,t^0)} + \beta_2 UGB_i + \sum_{t=2}^{T} \tau_t * d_t + \epsilon_{i,(t,t^0)} \tag{equation 1}
\]

Where,

\[d_t = -1 \text{ if } t = t^0, d_t = -1 \text{ if } t = t', d_t = 0 \text{ if } t = \text{ neither}\]

- \(P_i\): property’s sale price
- \(t^0\): is the first transaction and \(t'\) the second transaction in a sale pair
- \(\beta_0\): captures non-temporal changes in housing appreciation
- \(100FZ\): 100-year floodplain
- \(500FZ\): 500-year floodplain
- \(dist\_CBD\): distance to Portland’s central business district
- \(R_{STP}\): spatial-temporal-restoration project variables
- \(Age_{i,(t,t^0)}\): change in a property’s age between transactions
- \(UGB\): if a property was brought inside the Portland metro UGB between transactions
- \(\tau_t * d_t\): captures temporal changes in the study area
Repeat-Sales Equation

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\ln \left( \frac{P_{t,t'}}{P_{t,t^0}} \right) = \beta_0 + \sum_{t=2}^{T} \phi_t 100FZ_i * d_t + \sum_{t=2}^{T} \psi_t 500FZ_i * d_t + \sum_{t=2}^{T} \gamma_t \text{dist} \_\text{CBD}_i * d_t + \sum_{STP=1}^{60} \alpha_{STP} R_{STP} \\
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Repeat-Sales Equation

\[
\ln \left( \frac{P_{t,t'}}{P_{t,t''}} \right) = \beta_0 + \sum_{t=2}^{T} \phi_t 100FZ_i * d_t + \sum_{t=2}^{T} \psi_t 500FZ_i * d_t + \sum_{t=2}^{T} \gamma_t \text{dist}_CBD_i * d_t + \sum_{STP=1}^{60} \alpha_{STP} R_{STP} \\
+ \beta_1 \text{Age}_{t,(t',t'')} + \beta_2 \text{UGB}_i + \sum_{t=2}^{T} \tau_t * d_t + \epsilon_{t,(t',t'')} \quad \text{(equation 1)}
\]

Where,

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100FZ: 100-year floodplain
500FZ: 500-year floodplain
\(\text{dist}_CBD_i\): distance to Portland’s central business district
\(R_{STP}\): spatial-temporal-restoration project variables
\(\text{Age}_{t,(t',t'')}\): change in a property’s age between transactions
\(\text{UGB}_i\): if a property was brought inside the Portland metro UGB between transactions
\(\tau_t \ast d_t\): captures temporal changes in the study area
Repeat-Sales Equation

\[
\ln \left( \frac{P_{t,t'}}{P_{i,t^0}} \right) = \beta_0 + \sum_{t=2}^{T} \phi_t 100FZ_i \ast d_t + \sum_{t=2}^{T} \psi_t 500FZ_i \ast d_t + \sum_{t=2}^{T} \gamma_t \text{dist}_\text{CBD}_i \ast d_t + \sum_{STP=1}^{60} \alpha_{STP} R_{STP} \\
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500-year Floodplain Price Index
Building versus Tax Lot Models
100-Year and 500-Year Floodplains
Difference in Sale Price

- Difference in Sale Price Between Study Area and 100-Year Floodplain Properties (Tax Lot, Model 1a)
- Difference in Sale Price Between Study Area and 100-Year Floodplain Properties (Building Footprint, Model 1b)
- Difference in Sale Price Between Study Area and 100-Year Floodplain Properties (Tax Lot, Model 1a)
- Difference in Sale Price Between Study Area and 100-Year Floodplain Properties (Building Footprint, Model 1b)
Summary of Results

- Mean sale price is $193,092 (2014 dollars)
- Average annual flood insurance premium is around $1,180 (2014 dollars)
- Capitalization using a 3% discount rate predicts a 20.4% price discount
  - Estimated decline of 21.5% using the building footprint model
  - Estimated decline of 8.6% using the tax lot model
- Large difference between estimates using building footprint or tax lot
- No difference between the 500-year and study area price index
- Myopia?
Questions to Ponder: Imperfect Information?

Do people know they’re in a floodplain when they purchase a property?

- Mandatory disclosure in Oregon
- Discussions with property owners tell a different story
- Literature finds evidence of a market failure (Chivers and Flores 2002)
- Comparables? County assessor’s calculation of real market value?
BPS analysis of Regional Multiple Listing Service Sales

- 10% of our property sales in the sample area disclosed
- Between 2015-2017 the disclosure rate increased to 29%
- Observed disclosure for an early sale and no disclosure for a later sale. Why?
- Studies that have relied on the RMLS floodplain disclosure may be flawed
- Raises many interesting research questions
Questions to Ponder: Location?

Properties in the 100-year floodplain are near Johnson Creek

- Model incorporates age, type, and distance to restoration projects including floodplain restoration
- Listed as water quality limited for bacteria, temperature, DDT, dieldrin, PCBs, and PAHs; TMDL standards approved in 2006
- Netusil, Kincaid and Chang (2013) found that poor water quality is capitalized into property sale prices in Johnson Creek
- Species listed under the Endangered Species Act
Questions to Ponder: Differences in Properties?

- Remember this is a repeat sales model, so immutable characteristics drop out of the specification.

- Using building footprint, properties in the 100-year floodplain are older (year built 1948) than properties in the 500-year floodplain (1961) or properties in the rest of the study area (1952).

- Using building footprint, properties in the 100-year floodplain have a smaller lot size (7,036 square feet) than properties in the 500-year floodplain (9,408), but are not different from properties in the rest of the study area (6,095).

- Properties in the 100-year floodplain are not transacting more or less frequently.
Next Steps

- Initiatives underway in the Lents Area, which is included in the study area: Lents Collaborative and Flood Insurance Savings Program

- Future restrictions due to Biological Opinion on floodplain development
  - “external diseconomies his occupance occasioned for others in the community.” (Krutilla 1966, 188)

- Modeling changes in floodplains over time

Source: Portland Housing Bureau
Thanks to….

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Marie Walkiewicz, Bureau of Environmental Services
Jacob Sherman, Portland Housing Bureau

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Recommended Literature


Websites

Lents Stabilization and Job Creation Collaborative

Portland Housing Bureau:  [Flood Insurance Saving Program](#)

Bureau of Environmental Services:  [Flood Information](#)

Bureau of Emergency Management:  [Floods](#)

Bureau of Development Services:  [Flood Hazard Areas](#)

FEMA:  [Flood Map Service Center](#)
Noelwah Netusil, Reed College, Department of Economics: netusil@reed.edu

Jacob Sherman, Portland Housing Bureau: Jacob.Sherman@portlandoregon.gov