TEXAS A&M UNIVERSITY
Hazard Reduction & Recovery Center

Did Residents Move Away from Hazards? The Consequences of a Landslide and Landslide Risk Mapping for Housing Prices

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Overview

Introduction:
- Real estate transactions can be influenced by disasters and hazard maps. By analyzing changes in housing prices, planners could gain a deeper understanding of hazard information.
- Information on disaster impacts, proximity to hazards, and environmental cues are potentially associated with home-buying behaviors.
- However, disaster Hazard impacts on perception and prices fade over time, leading to price recovery.

Aim: Understand the individual and combined effects of explicit (maps) and experiential (events) landslide risk information on housing prices.

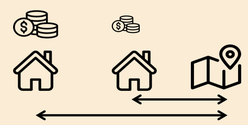
Methods:
- **Area:** Xizhi District, New Taipei City, Taiwan.
- **Data:** 39,836 housing transactions and their structural attribute data (2012-2024).
- **Data Sources:** Ministry of the Interior and Ministry of Agriculture, Taiwan.
- **Network Analysis:** To capture environmental attributes by route distance.
- **Model:** Hedonic Models and Difference-in-Differences Models.

Key Findings:
- **Maps:** Proximity to mapped risky streams negatively impacted prices (e.g., 37.64% drop within 100m).
- **Actual Event:** 2022 Landslide caused immediate and significant price drops (57.16%), but only on the older and weaker-structure house type (AB5F).
- **No Ripple Effect:** The landslide did not evoke further awareness and led to a price decrease near risky streams.
- **Temporal:** 2022 Landslide impact was short-lived (9 months), suggesting disaster myopia may exist.

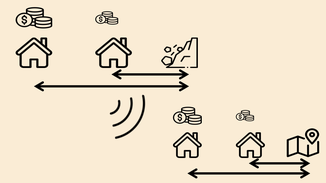
Conclusion:
- Hazard maps can be effective guides and hence influence transactions. They can serve as mitigation information tools and , in combination with other measures (e.g., land-use, insurance), leverage development toward urban resilience.
- Disaster events can have severe but short-lived declines, indicating risk myopia.
- Windows of opportunity after disasters should be exploited to promote resilience, especially in the risky stream areas.

Research Hypotheses

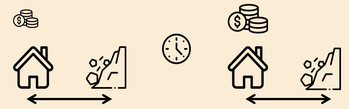
H1:
Landslide hazard maps negatively affect the housing market; proximity to map-indicated risky areas is negatively associated with housing prices.



H2:
Actual landslide events cause additional declines in housing prices and amplify the negative effects in hazardous areas indicated on maps.



H3:
Housing prices begin to recover over one year after landslide events.



Models

Model 1: Map Impact
$\ln\_AdPrice = \beta_0 + \beta_1 S + \beta_2 E + \beta_3 HR$
Tests hazard map effects on housing prices

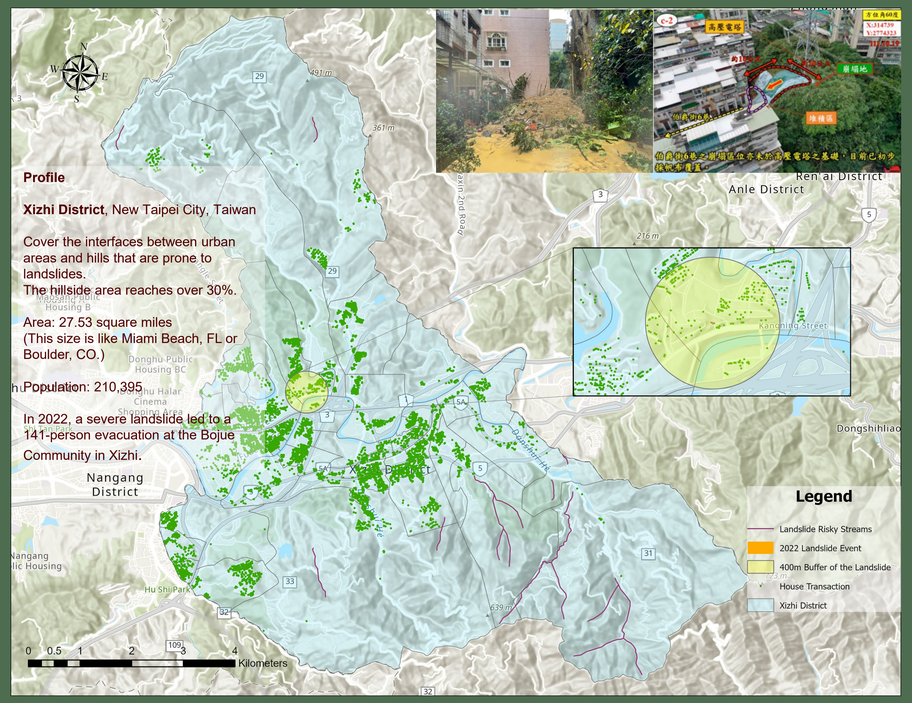
Model 2: Event Impact
$\ln\_AdPrice = \beta_0 + \beta_1 S + \beta_2 E + \beta_3 Treat*Post + \alpha_i + \gamma_t$
Tests landslide event effects

Modified Model 2: Event Impact with Housing Types
$\ln\_AdPrice = \beta_0 + \beta_1 S + \beta_2 E + \beta_3 Treat*Post + \beta_4 h\_type + \beta_5 Treat*Post*h\_type + \alpha_i + \gamma_t$
Tests event effects controlling for housing types

Model 3: Map-Event Interaction
$\ln\_AdPrice = \beta_0 + \beta_1 S + \beta_2 E + \beta_3 MTreat*Post + \alpha_i + \gamma_t$
Tests interaction between map and event

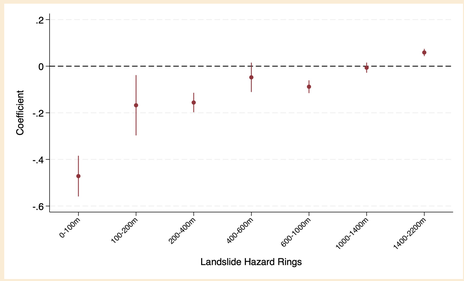
Model 4: Recovery Analysis
$\ln\_AdPrice = \beta_0 + \beta_1 S + \beta_2 E + \beta_3 TS$
Tests temporal price recovery patterns

Variables:
ln_AdPrice: Log Adjusted Price, S: Structural Attributes, E: Environmental Attributes, HR: Extent of Hazard Effect on the Map, h_type: Housing Types, Treat: Interest Area of the Event, Mtreat: Interest Area of the Map, Post: After the Event, and TS: Time Series.



Results

1. Hazard Map Effects on Housing Prices



HR	Log (Price)
0-100m	-0.472***
	(0.045)
100-200m	-0.168*
	(0.066)
200-400m	-0.156***
	(0.021)
400-600m	-0.048
	(0.032)
600-1000m	-0.088***
	(0.014)
1000-1400m	-0.006
	(0.011)
1400-2200m	0.059***
	(0.008)
2200m+	Base Group
Constant	17.252***
	(0.022)
Observations	39839
Adjusted R^2	0.526

- Proximity to the mapped risky streams negatively impacted prices.
- The impact extends to 1,000 meters.
- Within 400-600 meters, there might be a trade-off between natural views and hazards.

Results

2. 2022 Landslide Effects on Housing Prices

	Log (Price)							
$Treat_{600m}*Post_{12mo}$	0.086							
	(0.044)							
$Treat_{600m}*Post_{9mo}$		0.116*						
		(0.054)						
$Treat_{600m}*Post_{6mo}$			0.126**					
			(0.045)					
$Treat_{600m}*Post_{3mo}$				0.053				
				(0.059)				
$Treat_{400m}*Post_{12mo}$					0.084*			
					(0.032)			
$Treat_{400m}*Post_{9mo}$						0.098**		
						(0.031)		
$Treat_{400m}*Post_{6mo}$							0.097**	
							(0.028)	
$Treat_{400m}*Post_{3mo}$								0.071
								(0.057)
Observations	5314	3792	2324	1068	5314	3792	2324	1068
Adjusted R^2	0.472	0.534	0.565	0.551	0.472	0.534	0.565	0.551

- There is no significantly negative result without considering housing types.
- This model couldn't detect impacts on the prices.

3. 2022 Landslide Effects Controlling Housing Types on Housing Prices (β3+ β5)

	Single-family house	Apt. (11+ stories)	Apt. (6-10 stories)	Apt. (5- stories)
$Treat_{600m}*Post_{9mo}$	+***	+	- (nonsignificant)	+***
$Treat_{600m}*Post_{6mo}$	+***	+***	- (nonsignificant)	-(nonsignificant)
$Treat_{600m}*Post_{3mo}$	+***	+	-(nonsignificant)	-(nonsignificant)
$Treat_{400m}*Post_{12mo}$	+***	+*	-(nonsignificant)	-(nonsignificant)
$Treat_{400m}*Post_{9mo}$	+***	+**	+***	-*
$Treat_{400m}*Post_{6mo}$	+***	+***	+***	-***
$Treat_{400m}*Post_{3mo}$	+***	+***	na	-***

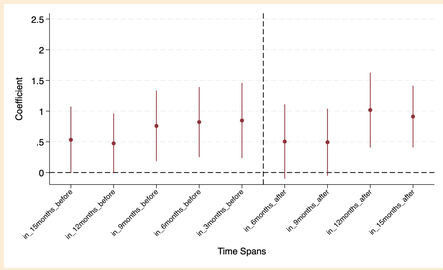
- After controlling housing types, 5-story high apartments (AB5F) received impacts after the landslide.
- The impact sustained 9 months.

4. Interaction between the Map and the Landslide

	Log (Price)			
$MTreat*Post_{12mo}$	0.002			
	(0.028)			
$MTreat*Post_{9mo}$		-0.021		
		(0.022)		
$MTreat*Post_{6mo}$			-0.026	
			(0.031)	
$MTreat*Post_{3mo}$				-0.007
				(0.043)
Constant	18.114***	18.149***	17.088***	16.714***
	(0.553)	(0.551)	(0.598)	(0.595)
Observations	6009	4296	2652	1217
Adjusted R^2	0.439	0.451	0.522	0.577

- There is no significant negative effect on houses near landslide-prone streams after the disaster.

5. Price Recovery Pattern of 2022 Landslide



- The price of AB5F dropped by 57.16% within 3 months after the landslide.
- AB5F took 9 months for housing prices to recover after the disaster.

TS	Log (Price)
15months_before	0.533
	(0.256)
12months_before	0.475
	(0.229)
9months_before	0.759*
	(0.271)
6months_before	0.822**
	(0.269)
3months_before	0.848**
	(0.289)
3months_after	**Base Group**
6months_after	0.505
	(0.286)
9months_after	0.493
	(0.258)
12months_after	1.018**
	(0.288)
15months_after	0.912**
	(0.237)
Constant	1.903
	(4.920)
Observations	35
Adjusted R2	0.609

Implications in Hazard Mitigation Planning

1. Use housing prices to evaluate hazard map effectiveness
2. Implement market-based mitigation instruments based on hazard maps
3. Target interventions during post-disaster risk awareness peaks
4. Maintain accurate, updated hazard mapping systems