Housing Recovery Pathways and Progress After Two Earthquakes in Taiwan

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Introduction

Permanent housing recovery remains inconsistent. Exploring the critical factors driving this recovery allows researchers to better predict its progress and assists decision-makers in formulating effective post-disaster strategies.

While existing studies often focus on structure-level damage or neighborhood proxies, applying these models to Taiwan poses unique challenges. A high proportion of multi-family buildings (condominiums) and the lack of public property appraisal records require alternative approaches to explore housing recovery dynamics.

- Scale Shift: Structure-level analysis → Household-level dynamics.
- Geographical Expansion: Adds empirical evidence from Taiwan, expanding disaster recovery literature beyond the US and other countries to identify cross-national characteristics.

Objectives

By leveraging household-level recovery progress, multilevel socioeconomic data, housing types, and recovery pathways, this study aims to:

- Delineate diverse housing recovery progress across two major Taiwanese earthquakes (2016 Meinong & 2022 Taitung).
- Identify critical factors (including building types, household/ neighborhood socioeconomic characteristics, and recovery pathways) influencing the recovery timeline.
- Enable proactive pre-disaster preparedness and predictable, resource-customized post-disaster interventions to reduce inequality.

Materials and methods

This study utilizes empirical survey data collected in 2024 and 2026, tracking households residing in "red- or yellow-tagged" housing from two major seismic events in Taiwan:

- 2016 Meinong earthquake
- 2022 Taitung earthquake.

Methodology & Survey Design

Based on a comprehensive literature review and qualitative interviews, a structured questionnaire was developed to investigate critical dimensions including recovery progress (timeline), recovery pathways, housing types, and socioeconomic characteristics at both the household and neighborhood levels.

Sampling & Data Collection

Out of 945 questionnaires sent to "red- or yellow-tagged" households, 210 valid responses were retained for analysis after careful screening and data cleaning.

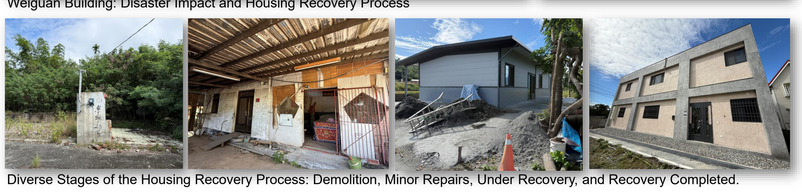
Research team preparing and sorting questionnaires for mailing

Event	Survey Targets	Valid Addr.	2024 Collected	2026 Collected	Response Rate	Recovered (No.)	Recovery Rate
Meinong	741	702	150	0	21.4%	140	93.3%
Taitung	204	198	24	70	47.5%	70	74.5%
Total	945	900	244		27.1%	210	86.1%

Statistical Analysis

OLS multiple regression analysis was conducted, utilizing the recovery timeline as the dependent variable to evaluate the quantitative impacts of various factors on housing recovery progress.

Weiguan Building: Disaster Impact and Housing Recovery Process



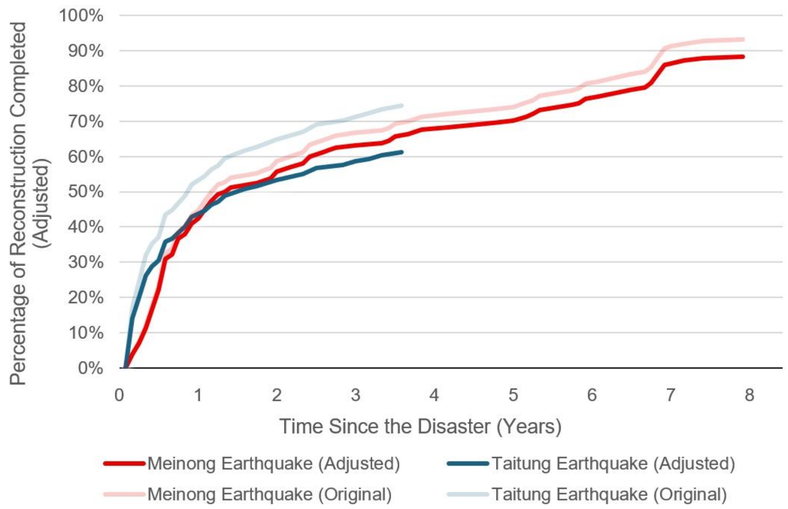
Diverse Stages of the Housing Recovery Process: Demolition, Minor Repairs, Under Recovery, and Recovery Completed.

Results

Variables and Descriptive Statistics

Variable	N	Min.	Max.	Mean	Std. Dev.	Skew.
Recovery duration (months)	210	.50	94.0	21.06	25.19	1.448
Reconstruction cost (TWD $10K)	244	.0	1200.0	186.47	273.67	2.135
Education below university	244	0	1	.43	.50	.283
Household income (TWD $10K/month)	244	.50	25.0	5.29	5.20	2.392
Existing loan (TWD $10K)	244	.0	700.0	31.11	79.93	3.962
Bank loan (TWD $10K)	244	.0	1200.0	98.69	220.63	2.742
Earthquake insurance (TWD $10K)	244	.0	200.0	11.07	37.62	3.893
Own funds (TWD $10K)	244	.0	1200.0	99.25	190.00	3.226
Government financial aid (TWD $10K)	244	.0	700.0	43.16	102.01	4.356
Charitable assistance (TWD $10K)	244	.0	375.0	9.21	29.31	8.679
Assistance from relatives/friends (TWD $10K)	244	.0	375.0	6.19	30.25	8.760
Neighborhood income (TWD $10K/year)	244	31.60	90.6	50.25	9.82	.031
Population density (1,000 persons/km²)	244	.01	35.24	3.94	6.23	2.393
Neighborhood housing price (TWD $10K/ping)	244	.68	65.94	18.13	14.25	2.328
Building structure (non-RC)	244	0	1	.46	.50	.149
Housing type (multifamily home)	244	0	1	.13	.33	2.254
Housing type (detached house)	244	0	1	.40	.49	.404
Recovery pathway of on-site recon.	244	0	1	.27	.44	1.063
Recovery pathway of off-site home purch.	244	0	1	.03	.18	5.280
Non-primary residence	244	0	1	.12	.32	2.370
Valid N (listwise)	210					

Housing Recovery Progress



Note. Adjusted Trajectory: This includes households with returned mail and those confirmed as not rebuilt during field visits. Therefore, the overall recovery rate is lower than if we only counted the analyzed questionnaires.

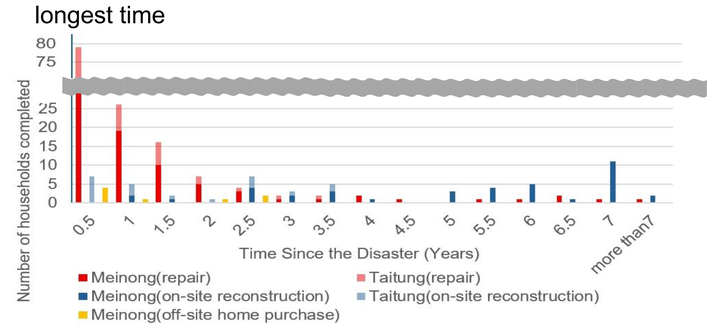
- Recovery Trajectory: Across both earthquakes, the comprehensive housing recovery rate approached 50% at 2 years after disaster and reached nearly 90% by year 7.
- Trajectory Comparison: While the two events shared a similar timeline, the 2022 Taitung earthquake showed faster initial recovery—driven by charitable organizations providing free housing repairs for vulnerable households—but experienced a slight lag in the later stages.

OLS Multiple Regression

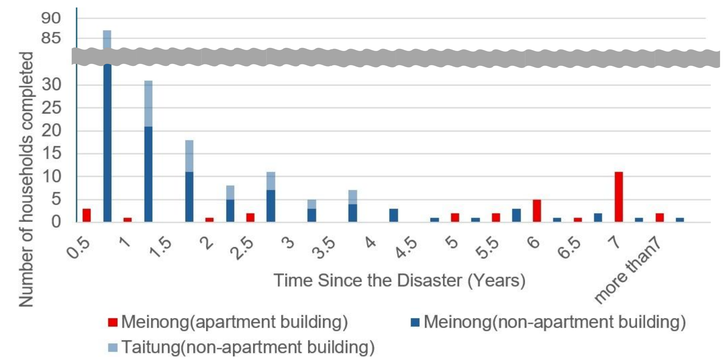
	B	Std. Err.	Std. B	t	Sig.	Tol.	VIF
Reconstruction cost (TWD $10K)	.020	.004	.220	4.572	.000*	.594	1.682
Education below university	.263	2.004	.005	.131	.896	.910	1.099
Household income (TWD $10K)	.565	.187	.123	3.026	.003*	.837	1.195
Existing loan (TWD $10K)	.023	.012	.076	1.834	.068	.811	1.233
Neighborhood income (TWD $10K)	.181	.132	.070	1.366	.173	.519	1.926
Population density (1K persons/km²)	.722	.199	.188	3.633	.000*	.512	1.953
Neighborhood housing price (TWD $10K/ping)	-.164	.081	-.078	-2.022	.045*	.921	1.086
Building structure (non-RC)	-1.317	2.194	-.026	-.600	.549	.730	1.369
Housing type (multifamily)	32.203	4.105	.448	7.845	.000*	.421	2.374
Recovery pathway of on-site reconstruction	9.902	2.926	.175	3.384	.001*	.513	1.948
Recovery pathway of off-site home purchase	-38.606	5.931	-.294	-6.509	.000*	.674	1.483
Non-primary residence	-2.326	3.038	-.029	-.766	.445	.931	1.075
(Constant)	-1.429	7.194		-.199	.843		

R	R Square	Adjusted R Square
.854	.729	.712

- Recovery Pathways Matter: On-site reconstruction takes the longest time



- Housing Types Matter: Condominiums take the longest to recover



- More required funding takes longer to recover.
- Higher household income takes longer to recover: While their decision-making and financing times were not longer, their construction phase took more time, making the overall recovery slower.
- Neighborhood income shows no significant relationship with recovery progress.
- Higher population density takes a longer time to recover.
- Areas with higher housing prices recover faster.

Conclusions

Based on surveys from two Taiwan earthquakes, housing recovery is shaped by damage levels, recovery pathways, housing types, and household/neighborhood characteristics.

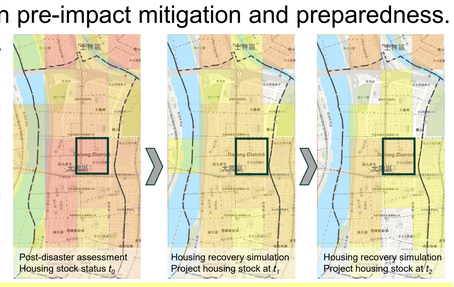
- The Slower Tracks: Larger funding requirements, apartment buildings (condominiums), and on-site reconstruction consistently take the longest time to recover.
- The Income Paradox: Household income did not show the impact predicted by mainstream research. This unexpected gap is likely driven by Taiwan's unique recovery assistance policies and reconstruction practices.

Applications

Integrating with Scenario Models: These findings and parameters can be integrated into scenario models to develop a housing recovery module for progress simulation.

Enhancing Pre-Disaster Preparedness: Decision-makers can utilize these simulations to strengthen pre-impact mitigation and preparedness.

Targeting Post-Disaster Interventions: In the aftermath, they can quickly identify high-priority recovery areas and implement targeted measures to reduce recovery inequality.



Acknowledgements

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