There's No Place Like Home:
Housing Reconstruction and Assistance after the 2004 Indian Ocean Tsunami

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On December 26, 2004 a 9.2 earthquake off the west coast of the island of Sumatra in Indonesia spawned a tsunami that affected countries around the entire Indian Ocean. Aceh, on the northern end of Sumatra, was hardest hit where over 5% of the population of 4.3 million was killed and over 15% of the population was displaced because of the massive destruction to housing, roads and infrastructure. It is estimated that the area sustained about $4.5 billion worth of damage.

The tsunami was followed by an unprecedented humanitarian and reconstruction effort. Initially, the effort centered on the provision of food and shelter to those who had lived in the most damaged areas. As camps were built and people found shelter, aid extended to provide improved access to education, health care and markets. Once primary needs were met, the focus of assistance programs turned to reconstruction, which brought new roads, infrastructure and, importantly, new housing. “Build back better” is estimated to have spent over $7 billion on reconstruction with funding from domestic and international sources.

This project examines the impact of the tsunami and subsequent reconstruction on housing, an important dimension of population well-being. Not only is housing a source of shelter, it is also a major component of wealth. Moreover, housing or residential location, has been shown to play a central role in outcomes related to, for example, work, schooling and social interactions. The project will provide evidence on three key questions. First, who was affected by the tsunami with respect to loss of -or damage- to housing? Second, who received housing-related aid and how well-targeted was that aid? Third, what are the longer-term impacts of housing damage in the tsunami on well-being and how did housing aid mediate those effects?

We begin by providing evidence on the characteristics of those individuals and households whose housing was damaged by the earthquake and tsunami and also identify those whose homes were completely destroyed. In parallel, we identify the communities where damage to housing and to other assets or livelihoods was widespread.

The second step in this research identifies those individuals, households and communities who benefited from the “Build back better” reconstruction effort and distinguishes those who benefited directly - from housing assistance - from those who benefited indirectly - from local area investments in infrastructure and roads. We also examine the timing of this assistance.

Linking the individual, household and community recipients of assistance to those that suffered damage provides direct evidence on the nature of targeting of the assistance. We exploit these linkages to then address a set of related questions that have been widely discussed in the literature on aid. First, we determine whether targeting was based on individual, household or community characteristics and use the evidence to identify those who are likely to have benefited differentially from the reconstruction, conditional on their experience of the tsunami. These analyses provide direct evidence on the actual beneficiaries of the program and determine whether housing aid served to assist people in communities that were better organized, were richer, or were less unequal prior to the tsunami. They will also examine whether beneficiaries of housing aid included not only those that lost their house but also those that lost other assets or sources of livelihoods.

Second, we explore whether receipt of housing assistance was related to other sources of public or private assistance and determine whether this assistance was associated with crowding out of alternative sources of aid or whether, conditional on levels of damage, housing assistance served as a magnet for aid and resulted in crowding *in* of alternative sources of aid.

Third, we examine the relationship between housing damage, housing assistance, and well-being over the longer-run. Specifically, we examine housing and non-housing wealth, labor market outcomes, living arrangements and health status of those people who suffered damaged or destroyed houses in the tsunami, and we compare these individuals to others who lived in neighboring communities but did not lose their homes. It has been claimed that the force of the tsunami as it came ashore varied idiosyncratically as a function of factors such as slope of the beach and aspect of the shoreline relative to the open ocean. If that is true, then communities on the coast that were damaged are likely to be very similar to (exchangeable with) communities that are not damaged. As noted above, the first step in this research will provide direct evidence on this question and explicitly test this hypothesis. To the extent that the hypothesis of exchangeability is not rejected by the data, it is possible to assign a causal interpretation to differences in outcomes of those who lost their homes relative to those, in the same or neighboring communities who did not.

Fourth, we assess whether longer-run outcomes are modified by receipt of housing aid. Since receipt of housing aid is not likely to be random, we will draw on results from the second step in this research to identify characteristics of communities that are predictive of assistance that are not likely to have had a direct impact on well-being over the longer term. One potential candidate is the type of aid organization that provided assistance in the community. Soon after the tsunami, aid organizations carved up the *kecamatan* (sub-districts) and *desa* (villages and neighborhoods) in Aceh and North Sumatra in order to minimize overlap in service provision.

Data for this research are drawn from the Study of the Tsunami Aftermath and Recovery (STAR) a large-scale population-representative longitudinal survey data that was designed to address our three key questions. The STAR baseline was conducted 10 months prior to the tsunami in February/March 2004 and is representative of the population at the *kabupaten* (district) level at that time. STAR follow-ups were conducted annually for five years starting in May, 2005, five months after the tsunami, and a 10 year follow-up will be completed in early 2015. The STAR sample includes over 30,000 survivors of the tsunami who were living in over 400 communities spread across the *kabupaten* that lie along west and north-facing coastlines of the provinces of Aceh and North Sumatra.

Information about housing ownership and housing characteristics along with detailed demographic and socio-economic information are collected in the baseline. Follow-up surveys collect extensive information on experience of the tsunami and damage to or loss of housing, other assets and livelihoods, loss of family in the tsunami, psycho-social well-being, measured and self-assessed health, economic well-being including income and wealth, as well as detailed information about demographic and social characteristics of individuals and their co-resident and non-co-resident family members. Information about aid, including housing aid and the sources of all aid, is collected in each wave. A specially designed community-level survey provides information about the land topography and extent of damage (drawing on high resolution satellite imagery) as well as aid and assistance at the community level.

The results of this research will inform questions regarding the nature of the benefits of a major housing reconstruction program in the aftermath of a disaster. In addition to the questions of what types of individuals experience destruction and who is most likely to receive housing

assistance, the research will provide evidence on the intermediate and longer-term benefits of investing reconstruction funds into replenishing housing assets.

We provide preliminary evidence related to the first and second stages of the analysis. Figure 1 shows the relationship between tsunami damage at the community level and percent of individuals that experienced total or partial damage to their house. The pattern is as expected, and communities that had higher exposure to tsunami damage had also larger shares of their population reporting housing losses. While most of the affected individuals live in medium- and high-damage communities, individuals in low-damage communities also experienced damages to housing, most likely because of the impact of the earthquake. In terms of housing assistance, Figure 2 shows percent of the population that benefited from any form of housing aid by level of community damage. As expected, people living in heavily damaged communities received a large share of housing aid.

We estimated models of the likelihood of receiving housing assistance. We restricted the sample to individuals who were household heads at baseline. Results for these models appear in Table 1. A simple linear model to predict housing aid (Model 1) shows that measures that capture the extent of tsunami damage to one's baseline community, such as living in a location that was heavily damaged or in which 10% or more of the population was killed, location near the coast, , damage to housing, and death of the pre-tsunami household head are all strong predictors of receipt of housing aid. In terms household measures, home ownership (at baseline) is predictive of benefits from housing programs, while SES and household size are negatively correlated with receipt of assistance. These results, for the most part, are robust to the inclusion of community fixed effects (Model 2).

We next restrict the analysis to communities that experienced heavy damage. Model 3 shows that most of the measures that capture effects of the tsunami, with the exception of death of the household head, remain good predictors of receipt of housing aid. For household measures, SES remains negatively correlated with housing assistance, while other measures such as home ownership (at baseline) and household size no longer appear to be good predictors of aid in this case. These patterns persist after adding community fixed effects, although significance is only at the 10 percent level.

For the next stage of the analysis, these models will be refined and extended to test for effects of housing aid on outcomes relevant to household well-being.

Figure 1

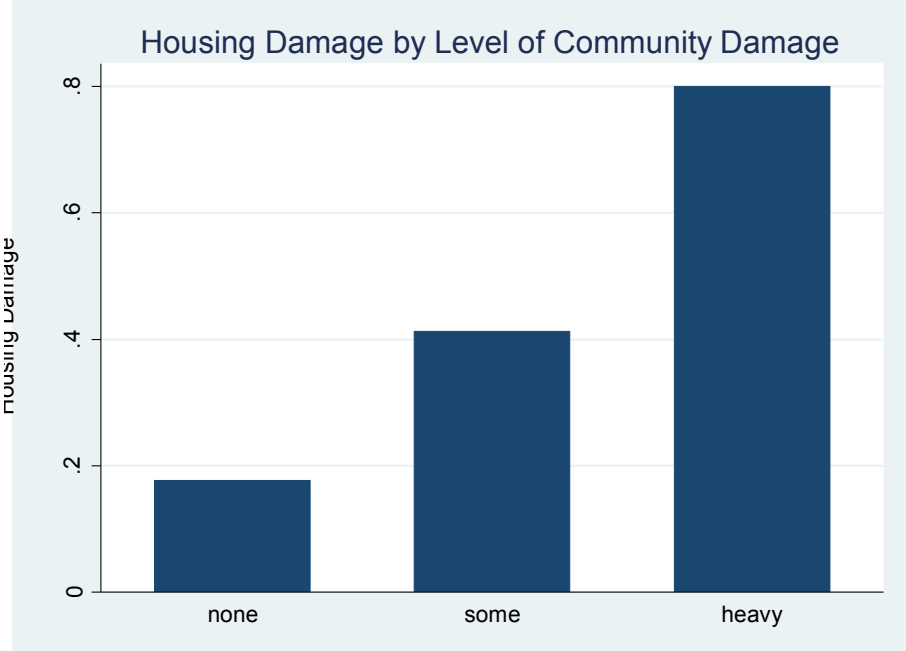

Figure 2

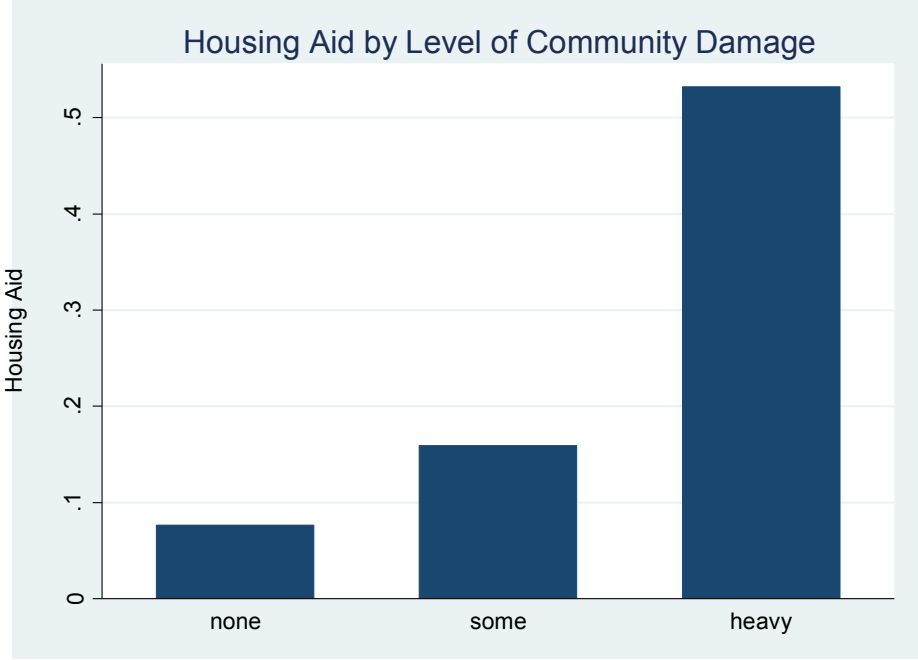

Table 1: Preliminary models

	Model 1: All communities	Model 2: All communities	Model 3: Heavy damage communities	Model 4: Heavy damage communities
Community had heavy damage	0.223**			
	(0.0430)			
Community has moderate damage	0.00787			
	(0.0197)			
Distance to coast less than 3km	0.0583*			
	(0.0229)			
Distance to coast between 4 and 6km	0.0637			
	(0.0329)			
Percent dead in community >= 10%	0.286**		0.376**	
	(0.0484)		(0.0514)	
House damaged in disaster	0.239**	0.108**	0.396**	0.174**
	(0.0211)	(0.0113)	(0.0500)	(0.0396)
Family-owned home (wave a)	0.0543**	-0.00189	0.0899	0.00248
	(0.0182)	(0.0141)	(0.0516)	(0.0360)
Household head died in tsunami	0.124**	0.0885**	0.0479	0.0742
	(0.0339)	(0.0259)	(0.0309)	(0.0388)
ln per capita expenditures Rp (wave a)	-0.0377**	-0.0417**	-0.0895**	-0.0512
	(0.0121)	(0.0108)	(0.0325)	(0.0310)
Household size (wave a)	-0.0120**	-0.00449	-0.00725	0.00760
	(0.00307)	(0.00251)	(0.00763)	(0.00696)
Household head male (wave a)	0.00394	-0.0207	-0.00462	-0.0432
	(0.0139)	(0.0119)	(0.0416)	(0.0358)
Age between 25 – 34 (wave a)	0.0901*	0.0212	0.144*	0.108
	(0.0370)	(0.0304)	(0.0722)	(0.0648)
Age between 35 – 54 (wave a)	0.0642	0.00799	0.0524	0.0257
	(0.0357)	(0.0301)	(0.0557)	(0.0627)
Age 55 plus (wave a)	0.0267	-0.00882	0.0212	0.0576
	(0.0377)	(0.0308)	(0.0726)	(0.0658)
Constant	0.443**	0.731**	1.185*	1.047*
	(0.160)	(0.144)	(0.455)	(0.416)
Observations	6,226	6,226	1,034	1,034
R-squared	0.307	0.022	0.379	0.037
Community FE		YES		YES

Robust standard errors in parentheses
** p<0.01, * p<0.05