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Pre-Disaster Social Capital and Disaster Recovery in Wenchuan Earthquake-Stricken Rural Communities

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Received: 16 April 2018; Accepted: 12 June 2018; Published: 16 June 2018

Abstract: This study examined the impact of social capital on disaster recovery in the 2008 earthquake-stricken rural communities in Wenchuan, China. The results show that quake-affected households having more social capital recovered more easily and quickly from disasters. A larger network significantly increased the amount of government aid received for housing reconstruction. This indicates that network members assist the quake-affected households to apply for and obtain government aid. These findings imply that social capital, as a kind of non-institutionalized social force, facilitates earthquake-affected households' recovery from disaster in rural China. Based on these results, this study suggests that policymakers should pay special attention to improving the social capital of existing local households to improve disaster recovery.

Keywords: Wenchuan earthquake; social capital; disaster recovery; rural China

1. Introduction

Social capital has become a popular concept in social science. Regardless, no consensus has been reached on the definition and measurement. Bourdieu regarded social capital as the "aggregate of the actual or potential resources" in ones' social network [1]. Coleman defined social capital by function, derived from densely connected social networks as positive social conditions of creation, flow, and the acquisition of human capital [2]. Putnam, following Coleman, emphasized the participation in the civil activities and trust in the government [3]. Lin defined social capital as resources embedded in social relations, suggesting that the resources in the relationships include wealth, power, and reputation of other social actors [4]. Hence, social capital refers to trust, norms, structure, and resources in the social network, from which individuals may gain advantages [5].

Many studies have shown that social capital has a significant effect on job searches and mobility [6–8], incomes [9], development, and innovation [10]. The roles of social capital in disaster recovery have also been highlighted. In the United States, scholars studied how social capital affects individual support provision, resource allocation, and aid availability after Hurricane Andrew in 1992 [11,12]. In Japan and India, scholars examined the role of social capital in post-earthquake rehabilitation and reconstruction programs after the Kobe and Gujarat earthquakes, finding that social capital was one of the most effective elements in both cases at enhancing collective actions and disaster recovery [13]. A study on the recovery after the Tokyo earthquake in Japan also showed that social capital best predicted recovery in the disaster area [14]. The positive role of social capital in recovery was also found after the Great Kanto earthquake in 1923, Asian tsunami in 2004, and Hurricane Katrina in 2005 [15].

In China, social connections with relatives, friends, and neighbors play an important role in social life. As an informal system, personal social networks can supply social support to people [16–18].

In terms of disaster recovery, Zhao [19] found that social capital as social support and social trust helped the reconstruction of the west of the country. Compared with urban areas, the roles of social capital have been highlighted more in rural areas. Urban households can rely on the insurance market or other formal institutions to manage disaster damage [20], but rural households are much more vulnerable and may experience a prolonged recovery as the insurance market is under-developed [21]. As for Wenchuan earthquake, Han [22] found that personal networks were the most prominent sources of social support after the earthquake, and social capital increased during the recovery process. He suggested that stronger and more tightly knit communities could be built in the disaster recovery process [22]. Besides, participation in recovery activities and trust in governments can also help recover from disasters. Residents who participated in disaster risk reduction activities had a perception of higher community resilience [23]. People with higher degrees of trust in government perceive lower consequences of potential earthquakes [24].

In this paper, we focused on the rural survivors' recovery from Wenchuan earthquake in Sichuan, China in 2008. Among the aspects of social recovery to quake-affected households, the house is the most essential for life during the post-disaster period. Thus, we specifically studied how social capital affects the reconstruction of households. We extended the study to examine the channels through which social capital works that would extend our understanding on the role of social capital for the disaster recovery of rural households. The paper is organized as follows. Section 2 provides a brief background of the 2008 Wenchuan earthquake, followed by the data, variables, and model specifications in Section 3. Section 4 provides the results. Finally, the discussion and conclusions are presented and implications are illustrated in Section 5.

2. Research Background

2.1. The Wenchuan Earthquake and Relative Recovery Policies

The 2008 Wenchuan earthquake occurred on 12 May 2008 measuring a magnitude of 8.0 on the Richter scale. The location of the earthquake's epicenter was in a rural area of Wenchuan County, Sichuan, which is 80 km west-northwest of Chengdu. The earthquake caused more than 69,000 deaths, with 18,000 people missing, and about 4.8 million people were rendered homeless. Public infrastructure collapsed and provision of utilities was disrupted for an extended period. The economic losses amounted to 845 billion RMB ($122 billion USD). The government declared 10 counties severely destroyed (Jizhongzaiqu) and 29 counties heavily affected (Zhongzaiqu).

The earthquake is among one of the deadliest in Chinese history. Donations were received from across the country and the world, which amounted to 50 billion RMB. International rescue teams arrived in the affected areas to provide relief support. The central government garnered resources across the country for rescue and rehabilitation efforts. A three-year target was announced, in which all the homeless should have their houses rebuilt within that time frame following the earthquake. To finance the housing reconstruction, the government granted each household 20,000 RMB ($2877 USD in 2008), whose house was destroyed during the earthquake, and the amount varied depending on the size of the household. Homeless people could also apply for loans from financial institutions and an average of 20,000 RMB was disbursed per household. The rest of the construction costs would be self-financed by the household.

The central government set out a clear guideline on the amount of disaster aid disbursed and which households should be prioritized to receive the aid. The province, county, and village officials were required to adhere to the policy. Take housing reconstruction as an example. According to the official document of the Sichuan government [25], the provincial government, together with prefecture-level city governments and county governments, provided a house reconstruction subsidy to every rural household requiring the reconstruction of a permanent house. The object of house reconstruction subsidy in the rural was for the households whose house was destroyed or severely damaged due to the earthquake.

However, given that the earthquake caused substantial damage with extensive coverage, the aid policy was not strictly enforced in every affected village. Furthermore, communication with the public media was disrupted after the earthquake, so households may have relied on private information from relatives and close friends for information about the government relief program, such as the method of application, the government organization to contact for the application, and eligibility requirements, which were crucial to obtain the subsidy. In addition, the more vulnerable groups, such as the female-headed households, the left-behind elderly, and the ethnic minorities, may have needed someone to apply for the government aid on their behalf. Hence, a household with a larger social network could approach more people for support in obtaining government aid.

2.2. Social Capital in China

Existing literature has formed various conceptions and measurements in different social contexts, emphasizing generalized trust, civic participation, engagement, associational membership, security and crime, and family stability and integrity [26–28]. Woolcock defined three categories of social capital: (1) bonding social capital; (2) bridging social capital; and (3) linking social capital [29].

Social capital theory proposed by Lin [4] has occupied a prominent place in China. Lin [4] measured social capital in four dimensions based on his social resource theory: structural position, heterogeneity, extensity, and upper reachability. Following Lin, Bian developed the Spring Festival network to measure social capital of Chinese households [30]. Spring Festival marks the beginning of the Chinese calendar, starting in the second half of January or the first half of February, when relatives, friends, and acquaintances interact with each other. The Spring Festival can be regarded as the most important time for reunions and interactions. People having migrated to different parts of China return to their hometowns to prepare for Spring Festival. Families visit each other and exchange gifts, which has substantial importance for maintaining and expanding social networks. The significance of the Spring Festival is similar to that of Christmas and New Year in Western society. Given the significance of the Spring Festival, the size and structure of the Spring Festival network can be a proxy for the social capital possessed by a household. This measure is now commonly adopted in Chinese sociological studies. Another important measure of social capital is connections with government officials, which enable households to have better access to information and public resources. Finally, China is a communist state, and affiliation with the communist party can be beneficial for rural households to obtain special privileges [30–34].

As for existing studies on the Wenchuan earthquake, Zhao performed a series of sociological studies on the role of social capital. Zhao investigated the impacts of the structure of the Spring Festival network on funding receipt for housing reconstruction from various sources, including own financial assets, loans from banks, borrowing from relatives and friends, and government disaster aid. The structure of the network was quantified by computing the proportion of non-relatives visiting the household during the Spring Festival. The occupations of the network members were considered and factor analysis was used to compose a network score [35–37].

This study focused on an alternative measure, the size of the Spring Festival network, and investigated the impact of network size on housing reconstruction aid received. We also considered network structure in our analysis. Similar to the findings of Zhao's study, we did not find any significant effect. Afterwards, we explored contribution of network size to the amount of government aid received.

3. Method

3.1. Research Framework

Our research involved three steps. In Step 1, we estimated the effect of social capital on housing reconstruction. In Step 2, we used the same set of control variables and examined how social capital

affects some plausible channel variables. In Step 3, we re-estimated the effect on housing reconstruction as in Step 1, but added the channel variables to our specification.

3.2. Data Sources and Sample

The data used in this study were obtained from a survey conducted by Tsinghua University. Survey teams commissioned by the University were dispatched in 2009 to conduct interviews in 17 villages in Deyang and Mianyang, that were classified by the government as the most heavily damaged (Jizhongzaiqu). The 17 villages were selected based on convenient sampling. As transportation was heavily affected after the earthquake, the survey teams could only visit the villages that were accessible by car. The survey was conducted between January and July 2009, with most of the households interviewed in July.

Forty households in each village were randomly selected based on a full list of households from the village committees. Hence, 680 households were sampled in this survey. A questionnaire was designed to collect the data. Information on the degree of earthquake damage, amount of aid received, a variety of post-earthquake assistance, and household socio-economic status were recorded in the survey.

Face-to-face interviews were conducted with every respondent by the survey team members who had been trained before the interviews. The respondent was randomly selected based on the Kish Table. Finally, 558 of the 680 households were interviewed successfully, meaning that the response rate of valid samples was 82.06%.

Table 1 presents the description of the sample. In Table 1, most of household heads were male, accounting for 95.10% of the sample. The average age of the household head was 50.81 in 2009, and they had 6 years of schooling on average, having finished only elementary education. In terms of marriage, 87.07% of the household heads were married. The mean of household size was 3.20. A total of 5% of the sample households were classified by government as impoverished, and 6% were under the protection of wubao/dibao, a form of income protection.

Table 1. Sample description.

Variable	No.	Mean/Frequency	Std. Dev./%	Level of Measurement
Gender: Household Head	556	0.951	0.215	Nominal: Male = 1, Female = 0
Age: Household Head	557	50.81	12.81	Continuous
Years of Schooling: Household Head	552	6.04	3.48	Continuous
Marital Status: Household Head	557			
Never married		26	4.67	Nominal: Never married = 1; Married = 2; Divorced = 3; Bereft of Spouse = 4
Married		485	87.07	
Divorced		40	7.18	
Bereft of spouse		6	1.08	
Household Size	558	3.20	1.11	Continuous
Impoverished	557	0.048	0.22	Nominal: Yes = 1, No = 0
Wubao/Dibao	558	0.057	0.23	Nominal: Yes = 1, No = 0

Notes: Impoverished means if the household is classified by the government as impoverished before the earthquake; Wubao/Dibao identifies if the household was classified by the government as Wubao/Dibao Households, in which "Wubao Households" means those receiving the five guarantees, i.e., childless and infirm old persons who are guaranteed food, clothing, medical care, housing, and burial expenses by the governments and "Dibao Households" means those receiving the minimum living guarantee.

3.3. Variables and Measurements

3.3.1. Dependent Variable

The dependent variable was house reconstruction. Among all the elements of disaster recovery, a house is a basic need for survivors and most important to a survivor's life; thus, house reconstruction was selected as the dependent variable. In the questionnaire, the respondent was asked whether their

house had been reconstructed successfully when the survey was conducted. This variable was treated as a dummy variable with yes = 1 and no = 0.

3.3.2. Independent Variable

We focused on social capital as the independent variable in this paper. Our study used three different measures of social capital:

(1) Social network: Size of Spring Festival network, defined as the number of people with whom a household interacted during Spring Festival in 2008. Spring Festival marks the beginning of the Chinese calendar and in 2008, the Spring Festival started on 7 February 2008, which is before the occurrence of Sichuan earthquake. Note here that those who lost their lives in the Wenchuan earthquake were not included in the network to reflect the social capital after earthquake. This variable is continuous.
(2) Government officials: Number of town government officials and village cadres with whom the households have close connections, which is also a continuous variable
(3) Party Membership: Communist party membership of the household head, which is a dummy variable with Party membership = 1 and otherwise = 0.

3.3.3. Variables as Channels

Four variables were treated as channels: (1) the amount of government aid received for housing reconstruction, which is continuous; (2) knowledge of the government aid program, which is an ordinal variable with no knowledge = 1, almost have no knowledge = 2, some knowledge = 3, and considerable knowledge = 4; (3) a dummy with yes = 1 and no = 0 indicating whether the households received support to build temporary housing; and (4) a continuous variable showing number of people providing monetary and material support.

Among all four channels, government aid obtained was the most important contributing factor to housing recovery. To further investigate how social capital channels increased government aid to the household, we examined how the monetary and material support received, and the knowledge about the government aid program, were correlated with the government aid obtained.

3.3.4. Control Variables

The control variables can be broadly classified into four categories: (1) Human capital was measured by years of schooling of the household head and number of household members possessing technical licenses, such as chef, plumber, or electrician licenses, which are both continuous. (2) Household wealth was estimated by the size of farmland which is a continuous variable and orchard ownership which is a dummy with yes = 1 and no = 0. Ideally, we could have been able to control for pre-earthquake annual household income and total household asset, which can be highly correlated with both social capital and status of housing reconstruction. Unfortunately, this information was not collected in the survey. (3) Socio-economic status, a dummy, was valued 1 if household was impoverished as classified by the government. Another measure of socio-economic status is a dummy of safety net protection (wubao/dibao), which was assigned a value of 1 if the household is under the protection of the safety net. (4) Some other control variables are considered, such as the size of household, gender, age, age-squared, marital status of household head, and status of residential registration (hukou). The survey also asked the households about the degree of housing damage and any incidence of mortality, which allowed us to estimate the effect of earthquake damage on housing reconstruction.

3.4. Model Specification

To begin, we only retained the households that reported the need to rebuild houses after the earthquake (95% of the overall sample). After refining our sample, we assigned a value of 1 if a household has a house reconstructed by the time of the interview, or 0 otherwise.

We used the simple ordinary least squares (OLS) model in all of our specifications and the primary dependent variable was a housing reconstruction dummy. Normally, as the dependent variable was a 0 or 1 dummy, the logit/probit estimation was warranted. However, we used the OLS model instead, mainly based on the considerations as follows.

At the beginning, we found that, in three of the sample villages, none of the households interviewed managed to reconstruct a new house, which means the responses to the dependent variable were all 0 in the three villages. Under this circumstance, logit/probit estimation would eliminate all the sample households in those three villages from the estimation after controlling for the village fixed effect, which would result in sample loss. As the number of respondents in those three sample villages was 90, reaching 16.13% of all the respondents, directly omitting such a large proportion of respondents would be inappropriate. Secondly, the effect of village on the dependent variable was quite significant. As a result, the village fixed effect should be controlled. Thus, comparing the disadvantages with the advantages, we finally decided to use the OLS model.

In our study, the measures of the Spring Festival network in 2008 and status of communist party membership of the household head were established before the earthquake. In addition, not all but most of the connections with the government officials were formed before the earthquake. Given that the interview occurred after the earthquake, our data could be subject to recall error. However, assuming the recall error should be random is reasonable, which will mitigate the magnitude of the estimated effects.

The regression estimates the impact of pre-earthquake social capital on post-earthquake recovery. Some confounding factors that can affect both household social capital and housing reconstruction may exist, e.g., household wealth and socio-economic status. To address this issue, we controlled for a list of control variables as shown above. Finally, we included the village fixed effect to account for any time-invariant village unobserved characteristics.

Since the application and allocation of housing subsidies and all other disaster recovery programs were administered at the village level, it is highly plausible that the error term in our specification was subject to arbitrary correlation within a village. Clustering errors at the village level did not work well as the samples only included 17 villages. Hence, we used block bootstrapping as suggested by Bertrand et al. [38] to address the small cluster number issue. Standard robust clustering provides similar results, though the significance of the effects of social network on housing reconstruction and government aid dropped from 5% to 10%. Without clustering, the robust standard errors were even larger, which made the effect of social network on housing reconstruction insignificant, but the impact on housing subsidies received remained significant. The results suggest that, once controlling for the village fixed effect and other covariates, a negative intra-correlation existed among households in the same village for housing recovery. This may suggest that competition exists among village households for government resources for housing reconstruction. The results based on standard robust, both with and without clustering, are available upon request. Block bootstrapping may still lead to inconsistent estimates of standard error given the small cluster number. We also used wild bootstrapping method suggested by Cameron et al. [39]. However, we needed to drop the village fixed effect from the regression equation as the method does not allow for fixed effect estimation. The overall results obtained were similar, even though the correlation between housing aid obtained and monetary support received from the social network became insignificant. The results are available upon request.

4. Results

4.1. Descriptive Statistics

In Table 2, about 82% of households reported that their houses were destroyed or heavily damaged, meaning the home was no longer habitable. Among the respondent households, 528 reported they needed to rebuild the house, accounting for about 95% of the overall sample. Notably, some households were still habitable but claimed that they need to build a new house (14% of the total sample). Some households were inhabitable but reported that they did not need to rebuild a new house (2% of the total sample). For the 528 households who reported that their houses were no longer habitable, about 48% had permanent houses rebuilt by the time of interview in 2009.

Table 2. Descriptive statistics.

Variable	No.	Mean/Frequency	Std. Dev./%	Min	Max	Levels of Measurement
Housing Reconstruction	528	0.48	0.50	0	1	Nominal. Yes = 1; No = 0
Social Network	539	23.44	18.65	0	108	Continuous
Government Officials	558	3.06	3.76	0	50	Continuous
Communist Party	558	0.082	0.28	0	1	Nominal. Yes = 1; No = 0
House Rebuilding Subsidy	558	0.79	0.41	0	1	Nominal. Yes = 1; No = 0
House Subsidy Amount (*yuan*)	440	20,600	6800	1000	52,000	Continuous
Total Government Aid (*yuan*)	558	24,440	14,000	0	126,800	Continuous
Knowledge of Subsidy						
No knowledge		31	5.58			Ordinal. totally have no knowledge = 1, almost have no knowledge = 2, some knowledge = 3 and considerable knowledge = 4
Almost no knowledge		134	24.1			
Some knowledge		342	61.51			
Considerable knowledge		49	8.81			
Money and Material Support	557	4.43	6.07	0	70	Continuous, indicating the number of people offering monetary and material support after the earthquake
Temp. House Rebuilding	558	0.61	0.49	0	1	Nominal. Whether household received support for building temporary housing after the earthquake. Yes = 1; No = 0
House Damage						Ordinal. Degree of house damage. House intact = 1; house slightly damaged = 2; house damaged = 3; house destroyed = 4
House Intact		12	2.17			
House Slightly Damaged		85	15.34			
House Damaged		135	24.37			
House Destroyed		322	58.12			
Death	558	0.059	0.24	0	1	Nominal; indicating whether Household has members deceased during the earthquake; Yes = 1; No = 0
License Holding	558	0.14	0.39	0	2	Continuous; number of household members possessing technical licenses
Female Headed	556	0.049	0.22	0	1	Nominal. Household head is a female = 1; otherwise = 0
Farmland (hectares)	555	2.47	1.4	0	7	Continuous
Orchard Ownership	555	0.17	0.38	0	1	Nominal; Yes = 1, No = 0

For the measure of social capital, the average size of the social network was 23.44. Only 8.2% of household heads belonged to the communist party. In addition, a household had close connections with 3.1 government officials on average.

With regard to the receipt of government aid, 79% of the full sample received a subsidy for building permanent housing and the average amount granted was about 20,600 RMB. However, 18.37% of the 528 households who need to rebuild houses did not receive any housing subsidy from the government.

4.2. Inferential Statistics

4.2.1. Regressions of Housing Reconstruction on Social Capital

Table 3 shows the effects of social capital on housing reconstruction based on the OLS estimation and Model 4 provides the results using the full specification. The size of the social network had a significantly positive impact on housing reconstruction at the 5% level of significance in every specification. Holding the other variables constant, increasing the network size by 10 raised the probability of housing reconstruction by 0.014, as shown in Model 4, whereas connection with government officials did not significantly contribute to housing reconstruction. The communist party membership of household head even lowers the probability. However, the negative significance was marginal at 10%, and disappeared in the full specification, as shown in Model 4. Among the three measures of social capital, the size of the social network was the only significant factor contributing to house reconstruction.

Table 3 shows that the role of human capital was limited. Specifically, both years of schooling of household heads and amount of household members possessing a technical license did not have a significant effect on housing reconstruction in any specification. The lack of significant effects may be due to multi-collinearity. We separately estimated the effects of the two variables of human capital and obtained similar results. Compared with Model 1, the increase in R^2 in Model 2 was minimal when the two variables were included.

Furthermore, in Table 3, household wealth, proxied by the size of farmland, had positive effects, which highlights the positive relationship between household wealth and housing reconstruction.

Generally, except for social capital and household wealth, all other factors including household size, age, and gender of household head, and status of being impoverished, do not affect housing reconstruction. Additionally, the degree of housing damage and mortality were not correlated with housing reconstruction.

4.2.2. Analysis of Channels

We then examined the effects of social capital on various channel variables. Table 4 shows the results for government subsidies. Controlling for the other variables, expanding the network size by 10 increased the chance of receiving housing subsidy by 0.013, and increased the amount of housing subsidy received by 14%. The increase in total government was also significant but only marginally, as shown in Model 7. Social network primarily affected the housing aid received by the households, but it had a much smaller impact on other kinds of aid, such as mortality compensation and living assistantship. However, connections with government officials did not significantly contribute to the amount of government aid received when controlling for the other variables, which was the same as for communist party membership.

Table 3. Housing reconstruction and social capital, ordinary least squares (OLS).

	Model 1	Model 2	Model 3	Model 4
	House Reconstruct	House Reconstruct	House Reconstruct	House Reconstruct
Social Network	0.00175 **	0.00182 **	0.00157 **	0.00137 **
	(0.000787)	(0.000765)	(0.000704)	(0.000687)
Government Officials	0.00743	0.00718	0.00498	0.00288
	(0.00944)	(0.00986)	(0.00916)	(0.00925)
Communist Party	−0.107 *	−0.105 *	−0.107 *	−0.0707
	(0.0559)	(0.0572)	(0.0630)	(0.0602)
Schooling: Household Head		−0.0011	−0.00101	−0.00753
		(0.00618)	(0.00626)	(0.00695)
License Holding		0.027	0.0334	0.0421
		(0.0378)	(0.0355)	(0.0362)
Farmland			0.0430 **	0.0426 **
			(0.0176)	(0.0180)
Orchard Ownership			−0.0997 *	−0.0858
			(0.0532)	(0.0626)
Household Size				−0.0209
				(0.0182)
Impoverished				0.0430
				(0.0917)
Wubao/Dibao				−0.0237
				(0.102)
Female Headed				0.0450
				(0.139)
House Damage (Ref. = House Intact)				
House Slightly Damaged	0.100	0.0937	0.101	0.128
	(0.256)	(0.256)	(0.269)	(0.304)
House Damaged	0.252	0.239	0.252	0.259
	(0.271)	(0.268)	(0.282)	(0.325)
House Destroyed	0.421	0.414	0.412	0.426
	(0.269)	(0.267)	(0.278)	(0.317)
Death	0.0163	0.0218	0.0209	0.0539
	(0.0672)	(0.0658)	(0.0737)	(0.0777)
Observations	506	500	497	492
AIC	508.5648	509.0508	501.6353	509.3041
R^2	0.088	0.089	0.103	0.122
Number of village	17	17	17	17

Notes: (1) OLS coefficients are reported with robust standard errors in parentheses, bootstrapped at the village level. (2) All regressions include the village fixed effect. (3) "House Reconstruct" is a dummy: 1 = Household has rebuilt house by the time of interview. For house damage, the base group is the households whose houses remained intact. (4) All control variables including gender, age, age-squared, marital status of household head, and status of residential registration (hukou) are included in Model 4. (** $p < 0.05$, * $p < 0.1$).

Table 4 shows that the degree of housing damage did not significantly affect the probability of receiving aid for housing reconstruction, which may point to the mistargeting of aid. Mortality due to earthquake did not increase the subsidy received for housing reconstruction, but increased the amount of miscellaneous aid received, which was primarily in the form of mortality compensation. In addition, female-headed households were more disadvantaged in obtaining government aid. As shown in Model 5, holding the other variables constant, these households were 26% less likely to receive a housing subsidy compared with the male-headed households. In addition, human capital had no significant effect on the government aid received. Households with larger farmland did not receive less aid, which suggests poor households were not particularly advantaged in obtaining government subsidies.

We also considered another form of help received by the households after the earthquake, namely help for temporary house rebuilding. As shown in Model 8 of Table 4, the dependent variable was a dummy with a value of 1 if the household received support for building temporary housing, such as tents and compartment houses. With all other variables being constant, the probability of receiving

help in building temporary housing increased by 0.047 if the network size expanded by 10. In addition, household size was negatively correlated with the support received, which could have been due to more abundant labor resources in a larger household, resulting in a requirement for less outside help to rebuild temporary housing.

Table 4. Government house rebuilding aid and social capital, OLS.

	Model 5	**Model 6**	**Model 7**	**Model 8**
	House Rebuilding Subsidy	**House Subsidy Amount**	**Total Aid Amount**	**Temp House Rebuilding**
Social Network	0.00133 **	0.0140 **	0.00266 *	0.00471 ***
	(0.000646)	(0.00647)	(0.00140)	(0.00108)
Government Officials	−0.00795	−0.0781	0.0295	−0.000473
	(0.00547)	(0.0556)	(0.0260)	(0.0119)
Communist Party	0.0482	0.290	0.0418	0.0543
	(0.0584)	(0.560)	(0.0997)	(0.0732)
Schooling: Household Head	0.00198	0.0179	0.00411	0.00591
	(0.00330)	(0.0352)	(0.00915)	(0.00654)
License Holding	0.0334	0.401	0.0560	0.0109
	(0.0420)	(0.410)	(0.0735)	(0.0605)
Farmland	0.000274	−0.00737	0.00874	−0.0219
	(0.00877)	(0.0866)	(0.0249)	(0.0207)
Orchard Ownership	−0.0389	−0.327	−0.115	0.0530
	(0.0575)	(0.554)	(0.103)	(0.0962)
Household Size	−0.0275	−0.263	−0.00725	−0.0386 **
	(0.0209)	(0.206)	(0.0775)	(0.0183)
Impoverished	0.0203	0.0505	0.0576	0.0435
	(0.0950)	(0.864)	(0.159)	(0.169)
Wubao/Dibao	−0.0121	−0.0242	−0.0347	0.178 *
	(0.0995)	(0.899)	(0.173)	(0.0969)
Female Headed	−0.264 **	−2.686 **	−0.456 *	0.0664
	(0.125)	(1.231)	(0.260)	(0.122)
House Damage (Ref. = House Intact)				
House Slightly Damaged	−0.0189	−0.262	−0.454	0.0215
	(0.199)	(2.003)	(0.431)	(0.214)
House Damaged	0.0317	0.233	−0.288	0.126
	(0.194)	(1.977)	(0.437)	(0.209)
House Destroyed	0.156	1.429	−0.174	0.0303
	(0.182)	(1.864)	(0.438)	(0.195)
Death	0.0180	0.121	0.501 ***	0.00571
	(0.0475)	(0.505)	(0.131)	(0.135)
Observations	492	492	492	492
R^2	0.094	0.090	0.123	0.079
Number of village	17	17	17	17

Notes: (1) OLS coefficients are reported with robust standard errors in parentheses, bootstrapped at the village level. (2) All regressions include the village fixed effect. (3) "House Rebuilding Subsidy" is a dummy variable: 1 = household has received house rebuilding subsidy. "House Subsidy Amount" is the logged value of one plus the house rebuilding subsidy received. "Government Aid Amount" is the logged value of one plus the total amount of disaster aid received. "Temp. House Rebuilding" is a dummy variable: 1 = Household received help in building temporary housing. (4) All control variables including gender, age, age-squared, marital status of household head, and status of residential registration (hukou) are included. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Following the above analysis, we investigated how social network channels enabled the receipt of more government aid for the household. We first examined two plausible channels: knowledge on government aid and number of people offering monetary and material support after the earthquake. The result of Model 9 in Table 5 shows that a larger social network did not contribute to better knowledge. However, connection with more government officials did not affect the self-rated knowledge either, but communist party membership significantly increased the knowledge. Furthermore, education of the household head was not significantly associated with the self-rated knowledge of the program, neither was the number of household members in possession of a technical license. However, the response is self-rated, which means the responses were subject to bias and

measurement error. In addition, households with deceased members had more knowledge, which suggests that households suffering mortality may have had a greater need for government support, and hence they received more details about the government relief program, or they put more effort into collecting the information.

Table 5. Channels of social capital for government house rebuilding aid, OLS.

	Model 9	Model 10	Model 11	Model 12
	Subsidy Knowledge	Money and Material	House Subsidy	House Subsidy
Money and Material				0.0515 **
				(0.0220)
Subsidy Knowledge				0.259
				(0.220)
Social Network	0.00215	0.0522 ***	0.0140 **	0.0109 *
	(0.00134)	(0.0185)	(0.00647)	(0.00599)
Government Officials	0.0130	0.193	−0.0781	−0.0830
	(0.0141)	(0.187)	(0.0556)	(0.0587)
Communist Party	0.281 ***	0.442	0.290	0.214
	(0.0873)	(1.143)	(0.560)	(0.527)
Schooling: Head	0.00698	0.212 ***	0.0179	0.00352
	(0.00978)	(0.0539)	(0.0352)	(0.0393)
License Holding	0.0856	0.413	0.401	0.360
	(0.0907)	(0.802)	(0.410)	(0.423)
Farmland	−0.0133	−0.109	−0.00737	−0.0143
	(0.0289)	(0.190)	(0.0866)	(0.0848)
Household Size	0.000675	−0.191	−0.263	−0.232
	(0.0331)	(0.249)	(0.206)	(0.210)
Impoverished	−0.0730	−0.122	0.0505	0.0724
	(0.175)	(1.570)	(0.864)	(0.881)
Wubao/Dibao	−0.0852	1.322	−0.0242	−0.0790
	(0.148)	(1.298)	(0.899)	(0.918)
Female Headed	−0.00533	2.419	−2.686 **	−2.614 **
	(0.178)	(1.565)	(1.231)	(1.196)
House Damage (Ref. = House Intact)				
House Slightly Damaged	0.0990	1.870 ***	−0.262	−0.415
	(0.212)	(0.661)	(2.003)	(2.024)
House Damaged	0.178	2.753 ***	0.233	0.0418
	(0.236)	(0.875)	(1.977)	(2.000)
House Destroyed	0.213	2.869 ***	1.429	1.198
	(0.224)	(0.782)	(1.864)	(1.884)
Death	0.267 **	1.561	0.121	−0.0156
	(0.122)	(2.166)	(0.505)	(0.484)
Observations	490	491	492	489
AIC	–	–	2502.431	2484.952
R^2	0.076	0.102	0.090	0.097
Number of village	17	17	17	17

Notes: (1) OLS coefficients are reported with robust standard errors in parentheses, bootstrapped at the village level. (2) All regressions include the village fixed effect. (3) House subsidy measures the logged value of one plus the amount of housing subsidy received. "Subsidy Knowledge" is an ordinal variable recording the self-rated awareness of house rebuilding subsidy. "Money and Material" counts the number of people offering monetary and material support after the earthquake. (4) All control variables including gender, age, age-squared, marital status of household head, and status of residential registration (hukou) are included. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Next, we considered the effect of social capital on the monetary and material support received. The dependent variable in Model 10 counts the number of people offering monetary and material support to the households after the earthquake. The results of Model 10 indicate that a larger social network led to significantly more help received after the earthquake, which suggests that the social network provided direct monetary and material support to the affected households. The larger the social network, the higher the likelihood some people in the network would offer help after the

earthquake. However, connections with government officials and community party membership did not lead to help received from more people.

Finally, we re-estimated the effect of social network on the house subsidy received by adding the above two channel variables, as shown in Model 12. For comparison, we included Model 11 in Table 5 to show the results from the specifications without the two channel variables, which was the same as Model 6 in Table 4. In Model 12, money and material support received were significantly associated with the housing subsidy obtained, which suggests people offering monetary and material support may also assist the household in applying for government aid. However, such significant correlation was not observed between knowledge of subsidy and government aid received. This points to the fact that self-rated knowledge may not truly reflect the household knowledge on the government relief program. With regards to the effect of social network upon including the channel variables, the magnitude and the significance decreased. Hence, the above results suggest that a larger social network led to the household receiving support from more network members, who could also help the earthquake-affected households apply for and obtain government aid. The role of social network in facilitating the flow of information on government aid program was not significant, thereby enhancing the subsidy knowledge of the households.

In our final step, we included the channel variables to re-estimate the impacts of social capital on housing recovery, as shown in Table 6. For comparison, we also show the results from the specification without the channel variables. In Model 15, the specification does not include knowledge of subsidy since we controlled for the amount of government aid. However, we retained the monetary and material support variable as monetary and material support received after the earthquake may have directly impacted housing reconstruction independent of government aid obtained. The results show that the effect of network size decreased substantially and the significance was eliminated after including the channel variables. The receipt of government aid was strongly correlated with housing reconstruction. Other channel variables, including help received to build temporary housing, monetary and material support received, and knowledge of government subsidy program, were positively correlated with housing reconstruction, but not significantly. These findings show that a social network can help households obtain a larger housing subsidy, which was crucial for housing reconstruction.

Table 6. Social capital and housing reconstruction with channel variables included, OLS.

	Model 13	**Model 14**	**Model 15**
	House Reconstruct	**House Reconstruct**	**House Reconstruct**
Temp House Building		0.00386	0.00167
		(0.0312)	(0.0324)
Money and Material Support		0.00486	0.00349
		(0.00300)	(0.00243)
Knowledge of Subsidy		0.00699	
		(0.0232)	
House Subsidy Amount			0.0278 ***
			(0.00495)
Social Network	0.00137 **	0.00107	0.000784
	(0.000687)	(0.000792)	(0.000792)
Government Officials	0.00288	0.00243	0.00437
	(0.00925)	(0.00963)	(0.00964)
Communist Party	−0.0707	−0.0714	−0.0804
	(0.0602)	(0.0636)	(0.0647)
Schooling: Household Head	−0.00753	−0.00891	−0.00875
	(0.00695)	(0.00718)	(0.00641)
Farmland	0.0426 **	0.0423 **	0.0432 **
	(0.0180)	(0.0181)	(0.0174)

Table 6. *Cont.*

	Model 13	Model 14	Model 15
	House Reconstruct	**House Reconstruct**	**House Reconstruct**
House Damage (Ref. = House Intact)			
House Slightly Damaged	0.128	0.114	0.128
	(0.304)	(0.308)	(0.337)
House Damaged	0.259	0.24	0.243
	(0.325)	(0.332)	(0.356)
House Destroyed	0.426	0.408	0.376
	(0.317)	(0.321)	(0.346)
Death	0.0539	0.0450	0.0449
	(0.0777)	(0.0769)	(0.0720)
AIC	501.6353	511.2545	491.0779
Observations	492	489	491
R^2	0.122	0.126	0.165
Number of village	17	17	17

Notes: (1) OLS coefficients are reported with robust standard errors in parentheses, bootstrapped at the village level. (2) All regressions include village fixed effect. (3) "Temp. House Building" is a dummy variable: 1 = Household received help in building temporary housing. (4) All control variables including gender, age, age-squared, marital status of household head, and status of residential registration (hukou) are included. *** $p < 0.01$, ** $p < 0.05$.

5. Discussion and Conclusions

5.1. Main Findings of This Study

Our study shows that social capital was important for housing reconstruction after the Wenchuan earthquake in 2008. (1) The size of the social network impacted housing reconstruction. Expanding the size of the social network increased the likelihood of housing reconstruction. (2) A larger network channeled a larger housing subsidy to the household, provided support for building temporary housing, and offered direct monetary and material support after the earthquake, which had positive effects on housing reconstruction. (3) With regards to the impacts of social network channels on the amount of government aid received by the household, the evidence showed that a larger network increased the number of people offering monetary and material support, which was linked to more government aid being received. This suggests that social network members assist the households in applying for and obtaining government aid.

In our study, the social network can be seen as bonding or bridging social capital. Whereas connections with government officials, to some extent, represent one's linking social capital, connections with government officials and communist party membership did not have significant impacts on housing reconstruction. This is a departure from the existing literature. The explanations are as follows. (1) Rural society in China is an "acquaintance society", in which people have broad social connections with each other. (2) Most of the local government officials, especially the village officials, were born and often grew up in the town or village where they took office. (3) Low spatial mobility is a characteristic of Chinese bureaucracy [40]. (4) The recovery and rebuild led to more communication between local officials and villagers. These four factors together allowed most villagers to have social connections with the village even town officials. Our data also supports these explanations.

5.2. Implication of This Study

We found that social capital, as a resource and an informal social force, is of great significance to disaster recovery. With regard to policy makers, implications may include the following.

Firstly, during the recovery and rebuilding period, the integrity and stability of the network should be considered. Survivors re-organized within their original village or community with their familiar social ties, rather than reassembling in different neighborhoods.

Secondly, governments should attempt to help survivors search for their family members and relatives who also survived, and recover their social ties and networks. Hence, information identification and availability are crucial. This should be included in the emergency measures.

5.3. Limitations of This Study

This study examined the link between social capital and disaster recovery. The analysis, however, was based on cross-sectional data, and causal interpretations should be interpreted with caution. We estimated the effect of pre-earthquake social capital on the housing reconstruction after the earthquake, and the estimation should not be subject to reverse causality. The most likely confounding factors are some pre-earthquake unobserved household characteristics, such as the household head's ability to expand the social network, which can also affect housing reconstruction. Longitudinal data collected before and after the earthquake can be useful to establish the causal relationship between social capital and disaster recovery.

Author Contributions: Conceptualization, J.W. Methodology, J.W.; Validation, J.W. and Y.H.; Formal Analysis, J.W. and Y.H. Writing—Original Draft Preparation, J.W.; Writing—Review and Editing, Y.H. Supervision, J.W.

Funding: The research was funded by National Social Science Foundation of China "The Study of Modes of Wenchuan earthquake recovery and sustainable development (2008–2018)" (No. 17ASH007); Beijing Normal University Youth Fund Project (No. 310422108); and Survey on Social Governances in Hundred Villages of China (No. 312231104).

Acknowledgments: I am grateful for Tse Chun-Wing and Wang Yihan for their great help in writing on the early draft.

Conflicts of Interest: The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript and in the decision to publish the results.

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