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Housing Reconstruction After Two Major Earthquakes: The 1994 Northridge Earthquake in the United States and the 1999 Chi-Chi Earthquake in Taiwan

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The idea of pre-impact recovery planning has recently been promoted by researchers and practitioners, but very little research has been done to evaluate its effects on disaster recovery. This study compared two jurisdictions — the city of Los Angeles, California and Taichung county in Taiwan — in their recovery from earthquakes. Although the two cases also differ with respect to variables other than the presence of pre-impact recovery plans, the available data suggest that having a pre-impact recovery plan facilitates housing reconstruction and allows local officials to make more effective use of the window of opportunity after disaster to integrate hazard mitigation into the recovery process.

Keywords: China, US, disaster recovery, pre-impact planning, earthquakes.

The disaster recovery period is a time with immense potential for confusion and conflict as different stakeholders pressure government to take action directed towards divergent purposes. Such conflicts can produce major difficulties for the local government, including failure in recovery leadership (Rubin, 1985; Spangle Associates, 1997), ad-hoc decision-making (Rubin, 1995) and poor coordination between departments (Rolfe and Britton, 1995). Moreover, many reconstruction finance programmes neglect the needs of the poorest victims (Comerio, 1998; Bolin and Stanford, 1998) and a rush to restore the community to its pre-impact pattern of social and economic functioning tends to reproduce its vulnerability to disaster (Schwab et al., 1998).

To overcome these problems, many observers have advocated that communities engage in pre-impact recovery planning. According to Wilson (1991), preparation of pre-impact recovery plans provides local officials with time to consider how activities undertaken during the immediate aftermath will affect long-term recovery. Similarly, Geis (1996) suggested that the more recovery issues can be thought through in advance, perhaps by means of disaster scenarios, the greater will be the efficiency and quality of post-impact decision-making (see also Haas et al., 1977; Olson et al., 1998).

Pre-impact planning for post-disaster recovery has been minimal in the US (Mileti, 1999), but it has become more common in the past decade. Recovery training courses and handbooks are provided by the UN,[1] the Organization of American States (OAS),[2] the Federal Emergency Management Agency's (FEMA) Emergency

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Management Institute[3] and state governments. Nonetheless, pre-impact recovery planning is not a very common idea at the local level. Most communities, except a few in California, Florida and North Carolina, are unprepared for the most basic challenges of disaster recovery, such as restoring infrastructure and immediate housing needs (Petterson, 1999). So far, only Florida requires local plans for post-disaster recovery and that mandate applies only to coastal counties.

Despite the apparent promise of pre-impact recovery planning, only one study has been published that evaluates its effectiveness. Spangle Associates (1997) studied disaster recovery after the Northridge earthquake by interviewing city officials in Los Angeles, which had developed a long-term recovery and reconstruction (R&R) plan before the earthquake. The researchers found that few local officials referred directly to the R&R plan after the earthquake, but the planning process was very helpful. Many officials mentioned that they knew what their responsibilities were and what needed to be done after the earthquake because they had resolved these issues during the planning process. Similar to the findings on emergency response planning (e.g., Kartez and Lindell, 1987, 1990; Kreps, 1991), the greatest benefit of disaster recovery planning was not the written plan itself but the planning process.

Despite the promising evidence from the Spangle Associates (1997) study, more work is needed to determine if pre-impact recovery planning has a significant effect on disaster recovery. Two very important questions concern whether such plans accelerate housing recovery as well as whether they enhance hazard mitigation.

Accelerating housing recovery

Housing recovery passes through four stages in the aftermath of disaster: emergency shelter; temporary shelter; temporary housing; and permanent housing (Quarantelli, 1982). Emergency shelter is usually established after a disaster at the instigation of individuals and households based on chance availability, convenience, proximity and perceived safety (Bolin, 1993a). Temporary shelter is often sought in the homes of friends and relatives, but mass care facilities are also used (Tierney et al., 2001). Temporary housing is sometimes available in vacant housing units within commuting distance of the stricken neighbourhood but, in the US, FEMA provides mobile homes when local housing stocks are insufficient (Bolin, 1993b). The last stage of housing reconstruction is permanent housing, which can be rebuilt on the same site or elsewhere after the disaster.

Many factors contribute to a community's capacity to make rapid progress through these stages of housing recovery — the availability of undamaged housing in the community, economic conditions, the disaster management system, local land use and building practices and, especially, the availability of financing. Comerio's (1998) study of housing reconstruction after the Mexico City earthquake, the Northridge earthquake and the Kobe earthquake in Japan concluded that, in developing countries, most of the funds for housing reconstruction come from international aid. In developed countries, however, financing for recovery comes from a diverse set of domestic sources including insurance, savings and borrowing from commercial sources. Unfortunately, housing reconstruction cannot rely exclusively on market forces because some segments of the victim population, especially ethnic minorities, lack savings, insurance or information about where to get government loans (Peacock and Girard, 1997). Consequently, national treasuries are tapped for grants and loans.

Although financing is a critical influence, local jurisdictions have little control over this aspect of housing recovery. Nonetheless, there are a number of tasks that they can perform that affect the speed of housing recovery. First, local jurisdictions can plan the location of temporary housing because resolving this issue can cause conflicts that can delay consideration of longer term issues of permanent housing and distract policymakers altogether from hazard mitigation (Bolin and Trainer, 1978; Bolin, 1982). Second, local jurisdictions can plan how they will accomplish essential tasks such as damage assessment, condemnation, debris removal and disposal, re-zoning, infrastructure restoration, temporary repair permits, development moratoria and permit processing because all of these tasks must be addressed before the reconstruction of permanent housing can begin (Schwab et al., 1998).

Pre-impact recovery plans also should address the licensing and monitoring of contractors and retail price controls to ensure that victims are not exploited and also should address the jurisdiction's administrative powers and resources, especially the level of staffing that is available. It is almost inevitable that local government will not have sufficient staff to perform critical recovery tasks such as damage assessment and building permit processing, so arrangements can be made to borrow staff from other jurisdictions (via pre-existing Memoranda of Agreement) and to use trained volunteers such as local engineers, architects and planners. Finally, these plans also need to address the ways in which recovery tasks will be implemented at historical sites (Spennemann and Look, 1998).

Integrating mitigation policies into recovery

The recovery period is a unique time to enact policies for hazard mitigation, which can be defined as advance action taken to reduce or eliminate the long-term risk to human life and property from hazards (Berke and Beatley, 1997; Godschalk et al., 1999). These mitigation measures can be classified into three categories: community-protection works, land-use practices and building-construction practices (Lindell and Prater, 2003). Community protection works include dams, levees and drainage systems that protect an entire area from hazard impact. Land-use practices include land-use regulation (zoning), and comprehensive plans that limit the amount of property in vulnerable areas. Building-construction practices include structural designs and construction materials that reduce the vulnerability of the structures that are located in the hazardous areas.

Whatever mitigation measures planners seek to adopt, they must recognise that the time period immediately after impact is the window of opportunity (Kingdon, 1995) to enact mitigation policies, because policymakers can use a disaster as a 'focusing event' to be exploited to force desired policy changes (Birkland, 1997). But the opening of the policy window does not automatically result in policy change. The public needs to pay attention to the problem, and make sure new groups participate in public debate on the mitigation issue in order to produce policy change (Prater and Lindell, 2000). Nor will the window remain open indefinitely; Schwab et al. contend that planners have only 'about a 30-day window of opportunity to incorporate a planning framework into the disaster recovery effort' (1998: 85). Kingdon has offered five reasons for the closing of a policy window. First, the window may close without action if no policy options are available for action at the appropriate time. Second, action on the problem may be taken and the problem resolved. Third, attempts may be thwarted, leading to a decrease in attention and finally a shift in political resources to

other issues. Fourth, agency personnel may change and new personnel may be unwilling to back any proposed change. Finally, the events that caused the crisis eventually will fade from public awareness, allowing attention to shift to fresh issues. To take advantage of the window of opportunity that opens after a disaster, policy activists must ensure that it closes because of the second reason (action taken and the problem resolved). Development of a pre-impact recovery plan can ensure that this happens by conducting community hazard/vulnerability analyses, examining alternative mitigation measures (community-protection works, land-use practices and building-construction practices) and identifying the appropriate financial and management tools for implementing the selected mitigation measures (Schwab et al., 1998).

Essential elements of pre-impact recovery plans

The available research on recovery planning provides some general guidance on the elements that should be contained in pre-impact recovery plans. Based upon 14 case studies, Rubin (1985) concluded that personal leadership, ability to act and knowing what to do are three necessary elements to ensure an efficient community recovery. Wilson (1991) in his study on the Loma Prieta earthquake emphasised that recovery planning should be a continuing organisation-wide process that has the full support and involvement of top officials. Schwab and his colleagues (1998) considered that the purpose of planning for post-disaster recovery and reconstruction is to provide a vision for decision-makers and a framework within which decisions will be made. The plan can provide decision-makers with some general guidance and principles that they should follow to achieve long-term recovery goals. Comerio (1998) concluded that an ideal recovery policy would minimise the potential for damage by incorporating mitigation programmes and, when damage occurs, link property owners to reliable sources of financial capital.

Schwab et al. (1998) propose that four basic functions be addressed in a community-recovery plan: organisation and authority; short-term rehabilitative functions; land use; and regional coordination. The OAS (2001) proposes a broadly similar programme of pre-impact recovery planning for the islands in the Caribbean and recommended the following four categories of activities: construction standards; household preparation; construction-sector preparation; and policy development. If one combines these concepts, a good pre-impact recovery plan can be defined as one that establishes a recovery task force and leading agency, lets stakeholders know their roles in disaster recovery and identifies the recovery-financing programmes for which different classes of residents are eligible. In addition, it informs people where recovery resources can be obtained, establishes agreement about long-term recovery goals and integrates mitigation policy into the recovery process.

Research hypotheses

To examine how pre-impact recovery planning affects housing reconstruction activities, this study will examine the following two hypotheses:

- The first hypothesis is that having a pre-impact recovery plan will increase the speed of housing reconstruction. The rationale for this hypothesis is that pre-

impact recovery planning will shorten implementation time after disaster by developing policies and procedures and by acquiring implementation resources before they are needed. Furthermore, pre-existing recovery financing programmes will provide victims with more rapid access to reconstruction loans and grants.

- The second hypothesis is that having a pre-impact recovery plan will increase the extent to which hazard mitigation is integrated into the recovery process. The rationale for this hypothesis is that if mitigation is formulated as a long-term recovery goal during pre-impact recovery planning, it should increase the opportunity for integrating mitigation into housing reconstruction. One of Kingdon's (1995) explanations for the closing of the window of opportunity is that policy-change attempts may be thwarted, leading a decrease in attention and a shift in political resource to other issues. Moreover, mitigation is likely to be overlooked due to competing demands that arise immediately after a disaster if it has not been integrated into pre-impact recovery planning.

Research methods

The method of analysis selected for use in this investigation is a comparative case study because the goal is explanatory, the events are not controllable and the focus is on contemporary events (Yin, 2003). The study design compares two jurisdictions that are as similar as they can be with respect to all other variables save the one being investigated: the existence of a pre-impact recovery plan. To control for the most important rival hypotheses, two urban areas were selected that had experienced earthquakes. Of course, major earthquakes are infrequent events, so it is not possible to identify study sites that have had recent earthquakes and differ only with respect to their level of pre-impact recovery planning. Two recent earthquakes that struck reasonably comparable communities that vary with respect to pre-impact recovery planning are the 1994 Northridge earthquake in southern California and the 1999 Chi-Chi earthquake in Taiwan. The Northridge earthquake had a magnitude of 6.7 on the Richter scale, killed 57 people and caused more than 7,000 injuries. It completely destroyed or substantially damaged over 65,000 housing units in a city with a population of 3.8 million and 1,337,706 housing units (US Census Bureau, 2000). Perkins et al. (1995) report that 13,575 buildings were severely damaged (red tagged[4]) and another 37,711 were moderately damaged (yellow tagged). The direct economic loss was estimated to be at least $25 billion (Office of Emergency Services, 1997).

The Chi-Chi earthquake, also called the 9/21 earthquake because it occurred on September 21, had a magnitude of 7.3 on the Richter scale, killed 2,417 people, and caused 11,305 injuries. The earthquake caused the collapse of 10,366 housing units and damaged another 14,720 (9/21 Earthquake Post-Disaster Recovery Commission, 2003). According to the 2000 data from the Directorate General of Budget, Accounting and Statistics, the overall financial loss caused by the earthquake was about $11.5 billion.[5] One of the most severely stricken jurisdictions, Taichung county, had a population of 1.6 million that suffered 113 deaths and 1,112 injuries during the earthquake. The county also suffered the total collapse of 18,608 buildings with another 18,771 buildings damaged (Taichung County Fire Department, 1999).

Both the Northridge earthquake and the Chi-Chi earthquake were the most destructive earthquakes in their respective countries in the past half-century, so they

provide an opportunity to study how disaster recovery is implemented in one jurisdiction that did have pre-impact recovery planning (the city of Los Angeles) and another jurisdiction that did not (Taichung county). Specifically, Los Angeles had a pre-impact recovery plan that specified local government actions that needed to be taken, identified disaster-recovery programmes at the federal and state levels and formulated actions for integrating mitigation policy into the recovery process. By contrast, Taichung county had no pre-impact recovery planning and very few existing recovery programmes. Thus, comparing these two jurisdictions will help to determine if a pre-impact recovery plan has a significant effect on housing reconstruction.

Approximately 90 official housing recovery-related documents and plans in Los Angeles and Taichung were examined to assess local plans according to the criteria described previously. Specifically, these are the extent to which each jurisdiction had:

- Established a task force and lead agency.
- Let stakeholders know their roles in disaster recovery.
- Identified the recovery financing programmes for which different classes of residents were eligible.
- Informed people where recovery resources could be obtained.
- Established agreement about long-term recovery goals.
- Integrated mitigation policies into the recovery process.

The documentary data on the Northridge earthquake were supplemented with interviews conducted by Spangle Associates in 1995; similar interviews on the Chi-Chi earthquake were conducted with 25 Taiwanese government officers and planners by the first author during 2002. The documents and interviews confirmed that there was a pre-impact recovery plan in Los Angeles, but not in Taichung.

The dependent variable for the first hypothesis, the speed of housing reconstruction, was measured primarily by the time at which rebuilding permits were issued in each of the two jurisdictions. Additional data were gained through interviews with officers in the Department of Building and Regulation, the Department of Public Works and Offices of Emergency Management, as well as articles in local newspapers such as the *Los Angeles Times* and the *Taipei Times*.

The dependent variable for the second hypothesis, the extent to which hazard mitigation is integrated into the recovery process, was measured by the extent to which hazard mitigation was included in housing-recovery-related policies such as disaster-recovery programmes, land-use planning and comprehensive planning. The primary data sources were official documents from different levels of government, supplemented by personal interviews with officers in the departments of Planning, Community Development and Building.

Because there are variables other than the presence of a pre-impact recovery plan that might account for differences in the dependent variables, the study design can only seek to determine if the data are consistent with the hypotheses. Confidence in the validity of the hypotheses could be higher if it is possible to identify and cast doubt on some of the plausible rival hypotheses that could also account for the obtained results. The results section will examine whether the data are consistent with the hypotheses and the discussion section will examine whether plausible rival hypotheses could account for the results.

Results

Housing reconstruction following the 1994 Northridge earthquake

The City of Los Angeles R&R Plan has four central themes: planning, hazard mitigation, short-term recovery and long-term reconstruction (City of Los Angeles, 1993, 1994). The plan assigns lead responsibility for each of 300 implementing actions to one or more departments or agencies within city government. This plan is a project of the Recovery and Reconstruction Division of the Los Angeles Emergency Operations Organization, which launched an innovative planning process for post-earthquake recovery and reconstruction in 1987. This planning process involved representatives from academic fields as well as a number of city departments and took considerable time. At the time of the Northridge earthquake, the R&R plan was on the agenda of the Emergency Operations Board for approval and adopted five days after the earthquake.

The Northridge earthquake emerged as a focal point for political discourse, stimulating claims of disaster needs that were publicly promoted at both the state and national level (Bolin and Stanford, 1998). Because the earthquake occurred during a congressional election year, politicians at the federal and state levels immediately converged on the impact area. The policies that were subsequently announced had many political implications, especially for the Democratic President Clinton and the Republican California Governor Wilson. President Clinton declared the Northridge earthquake a national disaster on the afternoon of 17 January, resulting in very rapid mobilisation at the federal level. James Witt, the FEMA director, Federico Pena, the Transportation Department secretary, and Henry Cisneros, the HUD secretary, all arrived in Los Angeles by the evening of the first day. On 19 January, Pena committed himself to 100 per cent federal coverage of repairs to interstate highways for six months without the usual requirement of 25 per cent matching state funds. Secretary Cisneros also immediately disbursed $129 million in Community Development Block Grants, as well as 20,000 Section 8 housing certificates for low-income victims, without waiting for preliminary loss estimates (Bolin and Stanford, 1998).

Some financial schemes for housing reconstruction were available from government agencies after the earthquake. These included FEMA's Temporary Housing Program, Additional Living Expense Program, Minimum Home Repair Program and Individual and Family Grant Program; HUD's Section 8 Rental Vouchers Program, Community Development Block Grants and Affordable Housing Program (HOME) Grants; SBA's Assistance Loans for Homes and Personal Property and Physical Disaster Loan; the IRS's Tax Disaster Assistance Program; and the City of Los Angeles Housing Department's Rehousing Grants.

In addition, households could rely on private sources such as personal savings, insurance and commercial loans. However, data from the National Income and Product Accounts indicates that the individual savings rate in the US for the period from 1994 to 1997 was in the range of 2–7 per cent. A savings rate this low suggests that personal accounts could not provide a major source for housing reconstruction. Indeed, data provided by the US Office of Management and the Budget, the Governor's Office of Emergency Services and the California Department of Insurance indicated that private insurers paid out almost 65.3 per cent of the major housing reconstruction funds after the Northridge earthquake; SBA loans contributed another 20.7 per cent; and FEMA and HUD grants each contributed 7 per cent (see Figure 1).

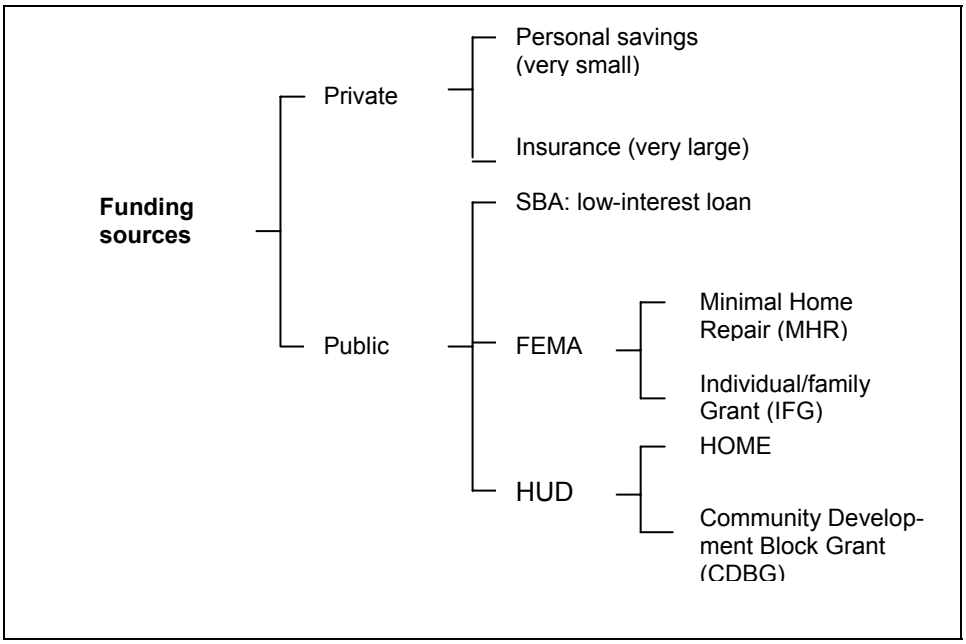

Figure 1 Funding sources for housing reconstruction after the Northridge earthquake

At the time of the earthquake, Los Angeles had a new mayor and a new planning director who were unfamiliar with the R&R plan. Indeed Spangle Associates reported that their interviews with 39 staff members from 11 different departments and the city council revealed that fewer than half of their interviewees claimed to know about the R&R plan at the time of earthquake. Nonetheless, this does not mean that the R&R plan had no impact on housing recovery because departments that participated in the R&R planning process had changed their departmental response plans and, therefore, knew what they needed to do after the earthquake even though they were unaware of the R&R plan itself. Moreover, many departments had deployed recovery-preparedness checklists that could accelerate the speed of housing reconstruction. These recovery-preparedness policies are listed in Table 1.

Among the 19,229 approvals of house-rebuilding permits by the LA Building and Safety Department at the end of November 1996, 95.69 per cent were for single-family dwellings, 1.63 per cent were for apartment buildings and 1.16 per cent were for condominiums. Figure 2 shows the percentage of the building permits during the entire period from January 1994 to January 1997 that were issued during each month. The baseline level of permit issuance can clearly be seen in the period from January 1996 to January 1997, whereas the effects of reconstruction can be seen in the months before then. The rate of reconstruction rose in February and peaked in April (three months after the quake), with a steep decline over the next 13 months. This is followed by another 12 months of shallow decline to an asymptotic level of permit application.

There was evidence of preparation for hazard mitigation at the local level because, prior to the earthquake, the Department of Building and Safety had drafted an ordinance to require the retrofit of tilt-up buildings. This was submitted to the city council during the window of opportunity immediately after the earthquake and

Table 1 Actions that Los Angeles departments took to increase the speed of housing reconstruction

Department	*Actions increasing the speed of housing reconstruction*
Building and safety	Establish criteria for emergency demolition contracts Establish due process and procedures for demolition Prepare pre-incident agreements Set up a damage assessment system Expedite building permits Establish one-stop processing Create parcel database
Community redevelopment	Review and revise qualifying criteria for the city's neighbourhood revitalisation tools Streamline procedures for redevelopment area expansion or additions
Housing	Prepare emergency regulations Identify staff in other departments who understand loan processing Have procedures to adopt emergency regulations Develop loan guidelines and procedures Obtain pre-approval on loan procedure from federal agencies Develop and implement city loan programme Identify available housing
Planning	Update procedures to expedite permits Insure consistency of R&R Plan with safety element Prepare procedures, forms, list of R&R division members Determine criteria for balancing post-event work priorities
Emergency operations board	Request formation of ad-hoc committee on R&R, assist utilities in restoration, initiate demolition and debris-removal programme
Chief legislative analyst	Lobby for and support the National Earthquake Insurance Program

Sources: Recovery and Reconstruction Plan, City of Los Angeles, California, 1994; Interview data, Spangle Associates, 1995.

enacted. There was also attention to hazard mitigation through federal programmes as well. The city used existing federal recovery finance programs such as HUD's Community Development Block Grant Program to promote hazard mitigation. Moreover, the FEMA Hazard Mitigation Grant Program provided grants to implement long-term hazard mitigation measures after a major disaster declaration. After the Northridge earthquake, this money was mostly used for public buildings such as hospitals and classrooms.

Nonetheless, HUD's Office of Policy Development and Research (1995), which conducted an earthquake mitigation report after the Northridge earthquake, concluded that federal mitigation resources were mismatched with local recovery needs. Almost 80 per cent of the damaged residential units were multi-family housing and low-cost rental housing was particularly affected, unfortunately recovery programmes were designed to serve middle-class owners of single-family dwellings. Moreover, the HUD report also noted that most existing mitigation programmes and

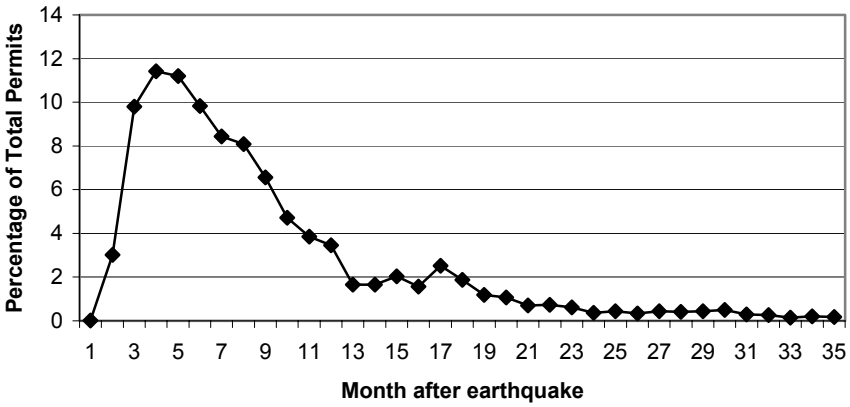

Figure 2 Rate of housing recovery in Los Angeles

resources were designed to address structural mitigation needs. The authors concluded that attention to nonstructural mitigation methods might provide greater safety to risk-area residents.

Housing reconstruction following the 1999 Chi-Chi earthquake

Taiwan is a highly centralised state in which the national government has established a standard building code and standard urban planning procedures for all, but each jurisdiction may add regulations to fit its own needs. The building code is very strict because the entire island of Taiwan is vulnerable to earthquakes, but code implementation is rather lax. Some builders have skimped on work and stinted on material, which has made the buildings weaker than designed. Moreover, Taiwan had not had a catastrophic earthquake in more than 50 years, so all levels of government lacked experience with post-earthquake housing reconstruction and none had a pre-impact recovery plan. Because of the serious damage caused by the earthquake, the central government assigned responsibility for recovery to a new agency called the 9/21 Earthquake Post-disaster Recovery Commission, but this was not done until nine months after the event.

Because Taiwan is so centralised, most of the local governments except Taipei city need a grant from central government to construct infrastructure or implement welfare policies during normal times, not to mention during the post-disaster recovery period. Within a few days to two months following the earthquake, central government developed a series of programmes to help victims. Some of these programmes, which were restricted to earthquake victims, were criticised for being crude and inconsistent — flaws attributable to their rapid development and implementation. These programmes included cash payments for households with deaths, injuries or missing members, or for complete or partial housing collapses. In addition, the Taiwanese government (15 per cent) and private sector (65 per cent) and the Japanese government (20 per cent) provided free prefabricated housing as temporary housing. Victims who did not stay in temporary housing could apply for housing rent relief or a 30 per cent discount on the purchase of public housing. There were also employment programmes, a health-insurance subsidy and subsidised home loans, as well as tax deductions.

Financing was as important a factor influencing housing reconstruction after the Chi-Chi earthquake as it was with the Northridge earthquake. Because only about 2 per cent of the population had earthquake insurance, victims' major funding sources were personal savings and public relief/loans (see Figure 3). In Asian societies, the saving rate is usually very high — as high as 26.2 per cent at the time of earthquake (Taiwan Directorate General of Budget, Accounting and Statistics, 2000). Therefore, most victims used their savings — as well as government payments for death, injury or housing collapse — for housing reconstruction. They also could apply for a low-interest housing reconstruction loan from the central bank through commercial banks, but many people complained that it was difficult to get these low-interest loans because of stringent conditions attached.

The factors that influenced housing reconstruction in Taichung were very similar to those in Los Angeles except for two unique conditions. First, the quake caused a shift in the geodetic survey reference points that delayed the rebuilding of some collapsed buildings until new cadastral maps could be prepared. Second, there was a complicated pattern of land ownership because some parcels, especially in rural areas, had been occupied without title for many years. Reconstruction of these properties was delayed until clear titles could be established.

In total, the central government announced 61 special ordinances and programmes to speed housing reconstruction after the Chi-Chi earthquake. These ordinances can be classified into three types: streamlined procedures for housing reconstruction; housing reconstruction financial programmes; and incentive mechanisms to encourage housing reconstruction (see Table 2). The policies of streamlining procedures for housing reconstruction included expediting building codes, and urban planning and renewal procedures. In addition to the Housing Collapse Relief and Housing Reconstruction Loans that the central bank provided through commercial banks, central government also established some policies for housing

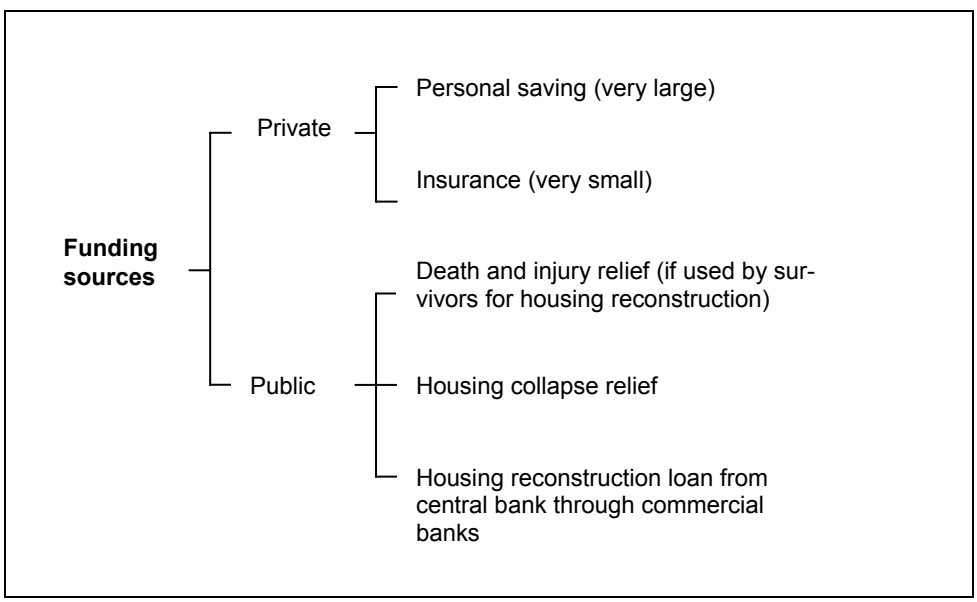

Figure 3 Funding sources for housing reconstruction after Chi-Chi earthquake

Table 2 Major policies for housing reconstruction after the Chi-Chi earthquake

Major policies for housing reconstruction	*Time of adoption*
Procedures for streamlining housing reconstruction	
Expedite building permits	10 days after the earthquake
Streamline procedure for urban planning	55 days after the earthquake
Streamline procedure for urban renewal	66 days after the earthquake
Housing reconstruction financial programmes	
Relief for tearing down totally collapsed buildings	140 days after the earthquake
Relief for housing design fee	183 days after the earthquake
Relief for farmers' housing reconstruction	118 days after the earthquake
Incentives to encourage housing reconstruction	
Procedure for new cadastral maps in the impact area	139 days after the earthquake
Establishment of property ownership conflict-mediation committee	216 days after the earthquake

Sources: Collections of Programs and Ordinances for 9/21 Earthquake Housing Reconstruction, 9/21 Earthquake Post-disaster Recovery Commission, 2002.

reconstruction finance such as relief for demolishing collapsed buildings and relief from housing design fees. Incentive mechanisms that encouraged housing reconstruction included procedures to make new cadastral maps in the impact area and the establishment of a property ownership conflict-mediation committee. In general, these housing reconstruction policies are quite similar to those adopted in Los Angeles, but were adopted significantly later — from 10 days to more than one year after the earthquake. Nonetheless, most of them could have been prepared before the earthquake and adopted at that time or immediately afterwards.

Data from the Taichung County Department of Building Regulation show that the peak period of housing reconstruction was between March and July 2000, about seven to 11 months after the earthquake, with the peak month in May 2000 (see Figure 4). The line in Figure 4 fluctuates during the peak period due to the meeting schedule of the building-permits review panel. For example, some building-permit applications submitted in late April were not reviewed and issued until May.

The reconstruction speed for totally collapsed condominium housing was far slower than other types of buildings because of the difficulty in reaching consensus on reconstruction among condominium owners. Moreover, the longer it took for the owners to reach a consensus, the more difficult it was for them to reach agreement. The old ordinance required two-thirds of the collapsed-condominium owners to agree to rebuild, but it was very difficult to reach this threshold. The central government amended this ordinance to lower the threshold from two-thirds to one-half almost four months after the earthquake. By June 2002, only about 30 per cent of these condominiums were under construction or had been rebuilt.

Mitigation issues in housing reconstruction

Taiwanese officials do not appear to have considered mitigation to be an important issue during the housing-reconstruction period. In Taichung county, eight townships

completed recovery plans within 6–10 months after the earthquake, but none of them mentioned mitigation issues. Instead, the interviews indicated that reconstruction speed, and especially reconstruction financing, was the major issue. Government officials were under severe pressure from victims who wanted to rebuild their houses as soon as possible and they were especially vulnerable to these demands because a presidential election was scheduled for six months after the earthquake.

Local governments' neglect of hazard mitigation might also have been caused by the central government's Working Guidelines for Post-Earthquake Reconstruction Planning, which mentioned some mitigation activities that the central government would perform before developing a recovery plan (Council for Economic Planning and Development, 1999). This misled members of local governments into believing that central government would take sole responsibility for mitigation, so they did not consider this activity to be a part of their responsibility during recovery.

Two mitigation policies were adopted by the central government. The first was to increase the earthquake-resistant building code standards in the impact area. Taiwan is classified into higher and lower earthquake-risk zones and Taichung county was originally classified as part of the low-risk area, which had a less-stringent earthquake-resistant building code. After the earthquake, central government reclassified the impact area as a high-risk zone and began enforcing the higher standard building code 40 days after the earthquake. Another mitigation-related policy was to prohibit building along the earthquake fault line. Fifty days after the earthquake, the central government announced a building moratorium within 50 metres of the Chi-Chi earthquake fault line for the remainder of the year. A new policy establishing a permanent building prohibition was announced on 31 December 1999, but it narrowed the distance from 50 to 15 metres because mitigation was no longer a high enough priority to overcome political pressure from victims living in the risk area.

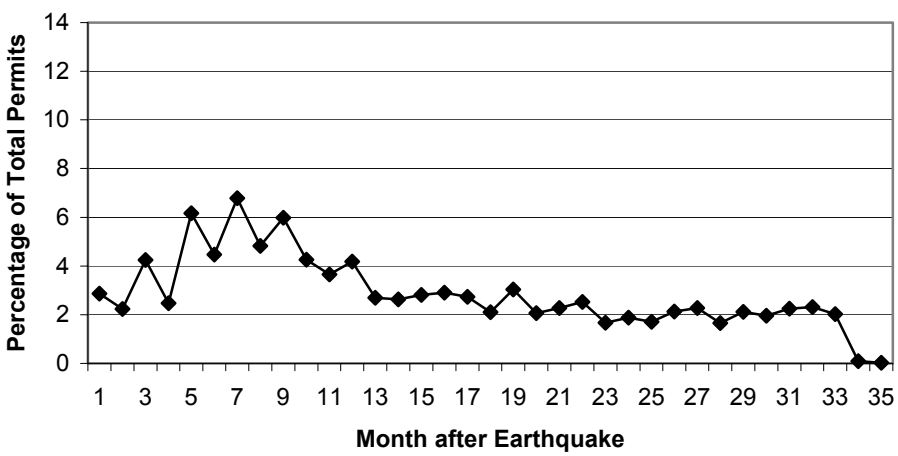

Figure 4 Rate of housing recovery in Taichung

Discussion

The patterns of housing reconstruction in the city of Los Angeles and Taichiung county support a positive answer for the first hypothesis of this study — having a pre-impact recovery plan appears to increase the speed of housing reconstruction. Comparison of Table 1 and Table 2 shows that the central government in Taiwan and the city government in Los Angeles adopted similar policies for housing reconstruction, but the adoption time in Taiwan was one week to two months later than in Los Angeles. Moreover, local government officials in Taiwan took an even longer time to become familiar with the new policies and their implementation procedures. This is consistent with the data in Figure 2 and Figure 4, which show that housing reconstruction in Taichung county peaked about five months later than in Los Angeles despite the similarity between the two jurisdictions in the types of policies they ultimately adopted for housing reconstruction. At six months, the percentage of total permits issued was twice as high in Los Angeles as in Taichung (45 vs 22 per cent, respectively); at 18 months, there was still a significant difference (92 vs 68 per cent, respectively). This supports the contention that the development of a pre-impact recovery plan accelerates housing recovery, but does not indicate whether all, or only some, of the six elements identified in the introduction are essential (or even if the list is complete). Thus, further research is needed to identify the specific mechanisms by which pre-impact recovery plans affect housing recovery.

There also is support for the second hypothesis: having a pre-impact recovery plan appears to increase the extent to which hazard mitigation is integrated into the recovery process. In its pre-impact recovery plan, the Los Angeles Department of Building and Safety had prepared a draft ordinance to require retrofitting of tilt-ups, which was passed by the city council immediately after the Northridge earthquake. By contrast, pressure to address issues of housing restoration in Taiwan seems to have limited the amount of attention given to hazard mitigation in the early stages of the recovery process. By the time an attempt was made to finalise restrictions on building zones around the Chi-Chi earthquake fault line (approximately three months after the earthquake), the window of opportunity had closed. One could argue that other opportunities for hazard mitigation were squandered in Taiwan because of local government's misconception that this would be central government's responsibility, but this supports the hypothesis rather than refutes it. According to the second element in the list of requirements for a good pre-impact recovery plan, a well-written pre-impact recovery plan lets stakeholders know their roles in disaster recovery. Had pre-impact recovery plans been established, local governments would have understood their responsibilities for hazard mitigation.

The difference in the fates of the tilt-up retrofit ordinance in Los Angeles and the earthquake fault building restrictions in Taiwan suggests that having a pre-impact recovery plan makes more effective use of the window of opportunity (Kingdon, 1995; Prater and Lindell, 2000). Nevertheless, the Los Angeles recovery plan did not solve all problems. The city was unable to pass ordinances to reduce other sources of vulnerability (for example, soft-storey apartment buildings). Thus, further study is needed to examine the length of time that the window of opportunity remains open after different disasters. Lindell and Perry (2000) have reported that studies of risk-area residents show that concern about disasters decreases relatively rapidly, but additional research is needed to determine whether the 30-day window postulated by Schwab et al. (1998) is true for the political elites involved in passing legislation.

This study also calls attention to the need for planners to understand the disaster demands for which they need to plan. As noted by HUD's Office of Policy Development and Research (1999), most of the federal resources for hazard mitigation were used for public buildings or single-family buildings, but those hardest hit were the lower income residents living in multi-family buildings. Clearly, plans should be responsive to victim needs that actually arise in disasters.

This study is a comparative case analysis, so the results must be interpreted cautiously because the observed differences in the speed of policy adoption and housing reconstruction might be because of unmeasured relevant variables (James et al., 1982). One obvious difference between the two events is that Taichung county is a subdivision of a significantly more centralised national government than is Los Angeles. However, existing research suggests that a centralised government would facilitate emergency response, and perhaps disaster recovery (Prater and Wu, 2002). However, Taiwan — the more centralised government — had a slower response and recovery. This suggests that centralisation facilitates the implementation of policies that have already been adopted, but has no advantage if policies need first to be formulated. Indeed, centralisation might delay formulation of policies because it is easier to establish agreement in smaller jurisdictions (lower levels of government) than at national level.

Another plausible rival hypothesis is that housing recovery was initiated more rapidly in Los Angeles because victims of the Northridge earthquake had more rapid access to the funds needed to pay contractors. Contrary to this, the Taiwanese relied heavily on personal savings whereas the Americans financed recovery mostly with insurance. One would expect that the personal savings could be accessed more rapidly than insurance, so access to financing also cannot account for the differences in the speed of recovery after the two events.

Another possible explanation for the difference between Los Angeles and Taichung in the rate of housing recovery is that the city of Los Angeles had learned from previous earthquakes that had taken place in or near the city (namely, San Fernando, 1971; Coalinga, 1983; Whittier Narrows, 1987; Loma Prieta, 1989). It is possible that this previous experience with earthquakes added to the pre-impact recovery planning process and, indeed, might have motivated it. It seems unlikely, however, that previous earthquake experience substituted for such planning.

The evidence supporting positive effects of pre-impact recovery planning on housing recovery and adoption of hazard-mitigation measures suggests that communities should begin to develop such plans. Indeed, the motivation to develop a pre-impact recovery plan is likely to lead to measures that have the effect of enhancing housing recovery and increasing the adoption of hazard-mitigation measures. Unfortunately, the development of pre-impact recovery plans could be impeded by a low level of local capacity. Prater and Wu (2002) reported that Taiwanese counties are heavily dependent on funding from central government and, consequently, have only a small number of county employees per 1,000 residents. Such low administrative intensities, which also exist in some parts of the US, make it difficult for local planners to invest the time needed to develop pre-impact recovery plans. One way of overcoming this limitation is for land-use planners to establish links with their counterparts in emergency management. Such collaboration would benefit land-use planners by allowing them to coordinate their pre-impact recovery planning more closely with the communities' emergency response plans. It would also benefit emergency management coordinators because Lindell et al. (2002) found that land-use planners had higher skill levels than emergency management coordinators in most

forms of emergency management information technology ranging from word processing to hazard modelling. Thus, land-use planners could help emergency management coordinators to improve their information technology skills significantly, while at the same time developing closer links between emergency-response planning and disaster-recovery planning.

One way for land-use planners to forge these ties with emergency managers would be to become involved in their jurisdictions' Local Emergency Planning Committees (LEPCs) (Lindell and Meier, 1994; Lindell et al., 1996). LEPCs were established in the US by federal law to develop multi-agency plans for toxic chemical emergency responses, but their functioning is similar to disaster-planning committees that have been organised informally by emergency-management coordinators to prepare their communities for a wide range of hazards (Drabek, 1987). Existing research indicates that land-use planners rarely participate in LEPCs, but increasing their involvement could help these organisations to expand their roles beyond statutory obligations by addressing disaster recovery and hazard mitigation as well as emergency preparedness and response (Lindell et al., 1996). In turn, this would achieve the important goal of developing horizontal links in the community that are needed to ensure an effective disaster recovery (Berke, 1995; Berke et al., 1993).

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Notes

1. UN Office for the Coordination of Humanitarian Affairs coordinated a series of training courses regarding rehabilitation and reconstruction. For more information see http://www.reliefweb.int/ocha_ol/index.html.
2. The Organization of American States (OAS) promoted recovery planning after Hurricane Georges struck the eastern Caribbean. For more information see http://www.oas.org/pgdm/.
3. FEMA provides training courses such as course E-210: Recovery from Disaster, course E-376: State Public Assistance Operations, etc. For more information, see http://www.fema.gov/emi.
4. A red tag means the building was rendered entirely uninhabitable. A yellow tag means the building needs further evaluation. A green tag means the building experienced nonstructural damage and remains habitable.
5. All amounts reported here have been converted to US dollars at the 1999 currency exchange of US$1=32NT.

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