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RESIDENTIAL EARTHQUAKE RECOVERY:

Improving California's Post-Disaster Rebuilding Policies and Programs

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In the five-year period between 1989 and 1994, earthquakes, hurricanes, and floods took a heavy toll on America's housing stock. Two hurricanes, Hugo and Andrew; two earthquakes, Loma Prieta and Northridge; and one 100-500-year flood in the Midwest, caused \$75 billion in damage, half of it in residential structures. More than 200,000 housing units were completely destroyed or substantially damaged. An additional 600,000 housing units required significant repairs.

Between 1989 and 1994 California alone suffered 13 federally declared disasters. On January 17, 1994, California's streak of bad luck culminated in the 6.8 magnitude Northridge earthquake. Northridge would quickly become the most expensive earthquake ever to strike the United States. It would also change the way California planners and policymakers would look at natural disasters, shifting their emphasis from preparation and relief issues, to those concerning recovery. Many of the lessons of Northridge were immediate; others are only now being learned and applied.

This report examines the current state of earthquake recovery practice in California, with special emphasis on housing recovery. Public and private payments for residential rebuilding in the aftermath of Northridge have so far totaled \$12-13 billion, or about 50-60% of the total recovery cost.¹ In this report, we consider the complementary and overlapping roles of different federal, state, private, and nonprofit recovery and rebuilding institutions. We look at what has been learned since the Loma Prieta earthquake of 1989 regarding residential response and recovery policy. And we take a new and closer look at the distribution of post-Northridge rebuilding funds.

We draw two fundamental lessons from our analyses. The first is that while California state and local officials and federal disaster response agencies have made improvements in preparing themselves to provide emergency relief in large urban disasters, no equivalent level of preparation has gone into the much bigger task of coordinating and paying for post-disaster rebuilding. Second, even though scientists are confident that another disaster of the same magnitude as the Northridge earthquake will occur in the reasonable future, *we cannot expect that private insurers or federal agencies will be willing or able to compensate victims with a comparable level of rebuilding assistance.*

State policymakers and agencies must give much more attention than they have in the past to the challenge of paying for earthquake recovery. The recently enacted law establishing the California Earthquake Authority is a welcome step in this direction, but it is only a start. We believe that a

reorganized and refocused system of providing public and private rebuilding assistance, linked to improved incentives for earthquake mitigation (particularly residential retrofitting), holds the most potential for significantly reducing public and private post-disaster rebuilding costs.

STATE AND FEDERAL DISASTER RESPONSE AND RECOVERY PROGRAMS

California has a tradition of strong home rule that guides all state policy including disaster preparedness and response. When a disaster strikes, local police, fire, and emergency management entities respond to the needs of the jurisdiction, using local resources. If an emergency exhausts the resources of local governments, assistance is requested through a system of mutual aid coordinated by the California Governor's Office of Emergency Services (OES). In the event of a catastrophe, the state may request assistance from the Federal Emergency Management Agency (FEMA) and other federal agencies. Federal funding for relief and recovery activities is officially triggered by a presidential declaration of disaster.

In the event of a major earthquake or other large disaster, the focus of the first 24-48 hours is exclusively on emergency response and relief: controlling fires, rescuing victims, providing medical assistance, and securing food and shelter for displaced victims. These activities are largely in the domain of the local government and charitable relief organizations such as the Red Cross.

Representatives of federal agencies typically arrive on the scene to provide assistance several days after the event itself. Whereas OES acts as California's coordinator of disaster response, FEMA serves that role among federal agencies and departments. FEMA also provides funds for public as well as individual assistance. For property owners, businesses, or households lacking disaster insurance,² the Small Business Administration (SBA) provides rebuilding loans at below-market rates. In some circumstances, the U.S. Department of Housing and Urban Development (HUD) may be asked to provide special financial assistance for housing. Depending on what is damaged and what services are required, dozens of other federal agencies (e.g., the departments of Agriculture, Education, Health and Human Services, Transportation, Veterans Affairs) may also step in to provide funding and assistance.

This system of disaster response and recovery has evolved over time. It was initially developed to provide federal funding for restoration of public functions and repair of public buildings and infrastructure--a tradition that culminated in the modern creation of FEMA in 1979. Since the 1950s, the provision of rebuilding assistance to private citizens and businesses has been the responsibility of the Small Business Administration through its various low-interest loan programs.

Until Hurricane Hugo and the Loma Prieta earthquake struck in 1989, large-scale property losses were the exception, not the rule. The dramatic 8.4 magnitude Alaska earthquake of 1964, and the 6.6 magnitude 1971 San Fernando earthquake, each damaged fewer than 2,000 housing units. With a very few exceptions (Hurricane Camille in 1969), natural disasters almost never seemed to strike major cities or suburban areas. This kept damage estimates, private insurance payouts, and overall public reconstruction costs fairly low--typically less than \$1 billion.

Hurricane Hugo and the Loma Prieta earthquake were quickly followed by a series of "urban" disasters of unprecedented scale: the 1991 Oakland hills fire, Hurricane Andrew in 1993, the midwestern floods of 1993, and the 1994 Northridge earthquake. These disasters tested state and local disaster response agencies, while at the same time significantly raising the costs of recovery. Government disaster response agencies adapted to the heightened demands made on them primarily by increasing the scale of their existing services. The realization that the response and recovery needs associated with large-scale urban disasters differed fundamentally from those associated with localized floods, tornadoes, and small earthquakes came much more slowly.

For many agencies, one approach to improving responsiveness was to begin relief and recovery services even as they were undertaking their initial damage assessment. Especially in the case of large disasters, these attempts to combine expedited relief and recovery services often ended up at cross purposes. The overworked volunteers and government employees who staff Disaster Application Centers (DACs) simply could not handle all of the needs of all of the victims at the same time. Victims who had lost every-thing required a wide array of financial assistance and social services to help reestablish their lives; others with only minimal losses were ready to apply for simple home repair loans. Too often, both groups found at the DAC that they had to stand in line to obtain application forms for a mystifying array of grant and loan programs, each with different eligibility criteria, specialized forms, and bureaucratic procedures.

For victims, the process of finding assistance that would meet their needs was confusing and slow. For agencies, the pressure to provide help quickly meant that they had to initiate programs before they had a complete understanding of the scope of the losses. Moreover, agencies often applied their full arrays of disaster relief and recovery programs, even when particular programs were not entirely applicable to the circumstances.

In the wake of so many disasters, there was little time for careful analysis and review of policies and programs. Institutional learning was directed instead toward answering the question, "What can we do to avoid the problems of the last disaster?"

Nonetheless, each disaster brought about important improvements in procedures and practices. The most significant of these came in the areas of emergency response. Emergency communication problems after the Loma Prieta earthquake led to the development of a statewide satellite communications system. Lessons learned in the Oakland hills fire led to the development of standardized emergency response procedures. Agency and volunteer staff received training in cultural sensitivity and language in response to criticisms of uneven services for minority victims. Oakland's one-stop-shop service center, established so that fire victims could do everything from collecting mail to applying for assistance and building permits, became a state model for expediting government services.

Temporary housing assistance was also improved. FEMA worked to develop procedures that would expedite funds for temporary housing. HUD was brought in after Hurricane Andrew and the Northridge earthquake to ex-pand temporary housing assistance with Section 8 housing vouchers. After

Northridge, the federal government committed tremendous resources to all its disaster assistance programs.

Even as disaster relief programs were being expanded and improved, the media were personalizing the victims--bringing the suffering and tragedy into America's living rooms. With cameras rolling, politicians rushed to deliver more dollars and services than ever before. They quickly became lobbyists for their local constituencies, thereby raising expectations among citizens and local governments. It is not surprising, therefore, that disaster assistance has come to be perceived as something of a boundless entitlement program.

Despite the extra federal funding available, there were fewer innovations in the area of reconstruction finance. The various federal programs providing small grants and low-interest loans gave out more money, but because these programs were designed to assist homeowners they provided little help to the many owners of damaged multifamily structures. Recognizing this gap in the immediate aftermath of the Loma Prieta earthquake, California quickly created its own California Disaster Assistance Program (CALDAP) to serve as a reconstruction lender of last resort for homeowners and rental property owners. Unfortunately, CALDAP soon ran out of money and was not recapitalized. Even in the aftermath of the Northridge earthquake, voters rejected bond measures to restart the program.

In Los Angeles in the days and weeks after Northridge, the City of Los Angeles tried to assume this function. Starting with the mayor, city officials appealed to HUD for supplemental appropriations of Community Development Block Grants and HOME Investment Partnership funds. Ultimately, more than \$200 million in supplemental HUD funds were made available, which the city used to finance repairs on 12,000 units that could not qualify for SBA loans. Whether another city lacking the size and political clout of Los Angeles would have been equally successful in obtaining such funding is an open question.

THE INSURANCE PROBLEM

Although the state began requiring insurance companies to offer earthquake insurance with homeowners' policies in 1985, only 20% of Californians carried earthquake insurance at the time of the Loma Prieta earthquake. Californians neglected to buy insurance for many reasons: it was too expensive; it wouldn't happen to them; the deductible was too high; lenders didn't require it. Most importantly, many people believed that the federal government would ultimately bail them out.

Similarly, the concept of retrofitting (i.e., upgrading existing structures to better withstand earthquake forces) was a relatively novel idea. Efforts to encourage Californians to voluntarily mitigate against earthquake hazards in their homes have largely fallen on deaf ears. In 1991, the legislature passed a bill requiring the installation of foundation anchors in single-family homes at the point of sale, but it was vetoed by then-Governor George Deukmejian. Instead, a much weaker bill was passed the next year requiring "disclosure" of seismic conditions at the point-of-sale. Had the original bill passed, 25% fewer homes in California would now be vulnerable to earthquake damage.

Today, when more Californians have earthquake insurance (40% in urban coastal areas and 30% inland) than ever before, insurance companies are raising legitimate concerns about adequate pricing, about their exposure to risks, and about a lack of reinsurers. Under current circumstances, insurers argue, the only alternative to the state's requirement that all homeowner policies be accompanied by earthquake insurance is for them to cease doing business in California. Geographic concentrations of policies in high-hazard areas, they argue, could easily lead to insolvency.³

The commissioner of the California Department of Insurance has responded to these threats by proposing legislation that was recently enacted to establish the California Earthquake Authority (CEA). The CEA would create a \$12 billion pool of tax-exempt funds that will cover earthquake losses to homeowners who have purchased a CEA "mini-policy" insuring their home and its contents. Significantly, damage to pools, garages, garden walls, and other appurtenant structures will not be covered. The establishment of the CEA begins to address the need to find an actuarially sound and affordable solution to the problem of disaster losses. However, it falls far short of being a policy to fully finance post-disaster residential reconstruction.

NORTHRIDGE REEVALUATED

On January 17, 1994 a 6.8 magnitude earthquake on a blind thrust fault rocked the San Fernando Valley in the City of Los Angeles and changed forever the way Californians would approach earthquakes and other natural disasters. In terms of ground-shaking and duration, the Northridge earthquake--as the event would soon be known--was only a moderate earthquake. In terms of its impact on everyday life in the Los Angeles Basin, it was a much bigger event. Sections of six freeways collapsed and 27 bridges were damaged. Some 450 public buildings (schools, libraries, recreation centers, and offices) suffered significant damage, as did utilities such as water, power, and sewer. Six thousand commercial buildings were damaged. Although Californians remember the dramatic news photos of the collapse of the parking garage at Cal-State Northridge, the Northridge Fashion Mall, and the Kaiser Medical Building, the majority of the damage to public and commercial structures was in one- and two-story wood-frame buildings, mini-malls, and shopping strips.

Most affected was housing. Inspection records, collected by local building departments and organized into a database by the California Governor's Office of Emergency Services, counted serious structural damage to 49,000 housing units in 10,200 buildings (7,500 single-family and mobile homes, and 2,700 multifamily structures). Minor--but not inexpensive--damage was reported in another 388,000 housing units in 85,000 structures. The total value of the damage to houses in Los Angeles County⁴ was estimated to be about \$1.5 billion.

A closer look at the OES inspection database reveals that the damage was both concentrated and dispersed. Although significant damage occurred to homes as far away as 30 miles, two-thirds of the housing units damaged by the earthquake were located within 12 miles of the surface fault-rupture projection line.⁵ (Ninety percent of the damaged units were located within 20 miles of the fault-rupture projection line.) Three-quarters of the dollar value of damage to single-family homes, and 90% of the

dollar value of damage to multifamily structures, occurred within just 10 miles of the fault-rupture line. *Within this 10-mile radius, the number of damaged housing units and the dollar value of damage varied mostly according to the intensity of ground-shaking and the age and design of individual structures.* Ironically, houses in neighborhoods developed prior to 1950 often sustained less damage than houses in areas developed after 1960. Beyond 10 miles, the number of homes damaged and the value of the damage declined with distance to the fault-rupture line.

Our analysis of the OES inspection data--upon which the commonly quoted \$1.5 billion estimate of residential damage is based--reveals them to be seriously incomplete. The OES inspection database appears to be reasonably complete in its counts of significantly damaged apartment buildings (those that include red-tagged and yellow-tagged units) and damaged single-family homes, particularly in Los Angeles County. It is far less reliable in its tabulations of damage to residential structures in Ventura County, and of nonstructural (i.e., "green-tagged") damage to multifamily structures and units. And it is even more unreliable in its estimates of the dollar value of damage.

We note these problems not to criticize the hundreds of building inspectors who carefully and diligently responded to almost a half-million inspection requests. Nor do we wish to criticize the OES for its efforts to gather and tabulate many different inspection forms and records. Rather, we note them to make two related points. The first is that it is nearly impossible to obtain quick *and* reliable estimates of the *value* of damage to dispersed private property from large-scale natural disasters. This is particularly true in the case of housing. The second point is that given this difficulty, public policymakers, disaster response and recovery officials, well-meaning staff of agencies and relief organizations, and private insurers should all refrain from making quick judgments regarding the scale and scope of rebuilding programs, policies, and payments. Disaster response and recovery organizations should focus on quickly providing emergency shelter for those who need it, and on connecting victims with appropriate aid and recovery organizations. These initiatives worked very well in the hours and days immediately after Northridge. Building inspectors should focus on establishing the immediate habitability of damaged structures. *Questions of damage and loss appraisal should wait until the extent of the physical damage has been completely assessed.*

TOTALING THE COST OF RESIDENTIAL REBUILDING

We estimate the actual cost of residential rebuilding from the Northridge earthquake at \$12-\$13 billion. This total includes private insurance settlements; SBA loans; HUD loans and grants administered by the City of Los Angeles; and FEMA Minimum Home Repair grants. It does not include FEMA temporary housing assistance or HUD Section 8 housing vouchers. Nor does it include additional equity provided through private bank refinancing, or private savings.

Between two-thirds and three-quarters of the cost of post-Northridge residential reconstruction--\$8-\$10 billion--has taken the form of private insurance payouts. Because this amount was so large, and because it significantly exceeded the amount collected through premiums, private insurers argue that state laws requiring them to offer earthquake insurance may very well bankrupt them should another earthquake of

Northridge magnitude and impact occur in the foreseeable future.⁶

As part of this research effort, we obtained data covering Northridge insurance claims and coverage for all of the state's major property insurers as of March 1995.⁷ The data covered 160,000 insurance claims in more than 250 zipcodes organized into six policy types: condo-minimum policies, earthquake policies, fire policies, homeowners' policies, mobile home policies, and renters' policies.⁸ Average payouts by policy type ranged from \$5,248 for renters' policies, to \$44,582 for earthquake policies. Payouts under homeowners' policies, which accounted for 65% of total claims, averaged \$23,083.

The insurance data yielded a number of surprising results when analyzed by zipcode and distance from the fault-rupture projection line. First, the number and amount of payouts occurred over a wider area than was apparent from local inspection records. According to those, the vast majority of the damage (whether measured in terms of units or dollars) occurred in zipcodes within 12 miles of the fault-rupture line. By contrast, a significant share of insurance payouts occurred to policyholders in zipcodes beyond 12 miles.

Second, claims rates (defined as the number of claims divided by the number of policyholders), although generally declining with distance, were still fairly high 10 miles from the fault-rupture line. Moreover, claims rates varied widely by policy types. Claims rates for earthquake riders to fire and condominium policies, and to individual earthquake policies, all exceeded 50% in zipcodes as far away as 12 miles from the fault-rupture line. Claims rates for the earthquake riders on homeowners' policies (the most common form of earthquake coverage) were typically much lower. Also higher than expected--regardless of distance and policy type--were claims rates for contents and appurtenant structure losses. Damage loss rates (defined as claimed losses divided by coverage) were also higher than expected, and declined at a slower rate than expected.

For insurance companies, the combination of claims rates and damage loss rates provides a measure of loss exposure. The results of our analysis suggest that many insurance companies may have systematically under-estimated their financial exposure to moderate earthquakes in urban and suburban areas.

After private insurers, the Small Business Administration was the second largest source of residential rebuilding funds. The SBA made nearly 75,000 low-interest loans to homeowners and 8,000 loans to renters, totaling \$2.3 billion and \$147 million, respectively. The average SBA homeowner's loan was for \$30,700.

Other significant sources of funds for residential reconstruction included the Federal Emergency Management Agency (\$841 million in grants under the Minimum Home Repair program to 288,000 recipients, averaging \$2,900 per grant), and the U.S. Department of Housing and Urban Development (\$180 million in loans as of March 1995 to more than 3,500 property owners and renters).

SPATIAL MATCHES AND MISMATCHES

The spatial distribution of insurance claims, SBA loans, FEMA grants, and HUD loans and grants generally followed the spatial distribution of damaged residential structures (based on OES inspection data). Both the number of insurance claims and SBA loans were strongly correlated with ground-shaking and distance from the fault-rupture projection line, and weakly correlated with area income levels and housing values. Curiously, fewer claims and loans were made in areas with high proportions of homes built before 1950. Average claim, grant, and loan amounts were also correlated with ground-shaking and distance, although less so than the number of claims and loans. Taken together, these various indicators suggest that most of the public and private rebuilding funds went where they were needed.

There was also a high level of correlation between the spatial distributions of the number and amount of private insurance payouts and SBA loans to homeowners. This would suggest that there were in fact significant overlaps between private insurance payouts and SBA loan funding. By comparison, SBA loans to renters and HUD grants and loans were not correlated with insurance payouts. This would suggest that these programs served a different clientele than did private insurance.

KEY FINDINGS

Over the years, the term "disaster recovery" has grown to encompass just about every activity that happens in the days, months, and even years after a major natural disaster. In the aftermath of major disasters, government agencies now rush to provide a host of services ranging from temporary shelter, to mental health crisis counseling, to rebuilding assistance through FEMA grants and SBA loans. Thanks to the media, it is this rush to response that occupies our popular attention, as well as the attention of policymakers and planners. Once essential services are restored and people begin returning to their homes, the hardest part of the disaster response and recovery process is often thought to be over. In fact, as the experiences surrounding a number of recent natural disasters show, what is in many ways the hardest part--paying for rebuilding--is just beginning.

As part of this research effort, we reviewed the entire "recovery process" following five recent natural disasters in California, including the Loma Prieta earthquake of 1989, the Oakland hills fire of 1991, the Cape Mendocino earthquakes of 1992, the Landers/Big Bear earthquakes of 1992, and, of course, the Northridge earthquake of 1994. We noted how the process had changed over time, as disaster planners learned from past experiences. We also looked at recurring issues and problems. Among our most significant findings are the following:

- 1. There have been real improvements in the ways federal and state agencies respond to major disasters.*

Most of these improvements have been in the provision of more and better short-term assistance to a wider spectrum of affected populations. Improvement in the coordination of recovery and rebuilding programs lags behind. Most such programs are still oriented toward single-family homeowners.

- 2. As evidenced in several recent large-scale natural disasters, repairs to private homes typically constitute at least 50% of the cost of recovery.*

Private-sector rebuilding, not the repair of public infrastructure, is by far the costliest aspect of the disaster recovery process.

3. The major source of funding for post-disaster rebuilding has been and continues to be private insurance payouts.

Yet one of the things made most clear in the aftermath of the Northridge earthquake is that private insurers do not have a reliable system for estimating their potential exposure to disaster-based risks. To limit future exposure, private insurers pressured for a greater governmental role, resulting in the creation of the California Earthquake Authority. Although this is a useful first step in restoring the ability of private insurers to underwrite earthquake risk, much more can and should be done to expand the role and effectiveness of private insurance.

4. Although well-intended, the current disaster recovery assistance programs administered by FEMA, and particularly by SBA and HUD, are operated in a largely ad hoc and uncoordinated fashion.

These programs can be made more efficient and cost-effective if reorganized to complement a revitalized system of private insurance.

RECOMMENDATIONS

The nation's current system of disaster planning, relief, and recovery has developed through an ad hoc learning process based on experience and a desire to be more responsive to the immediate needs of victims. Overall, the system works well for rural and small disasters, and has improved significantly over time. Agencies such as FEMA at the national level, and OES at the state level, are now much better at coordinating disaster response and relief efforts than they were seven or eight years ago.

Considerably less has been learned about recovery. Indeed, the nation's disaster management structure remains largely focused on response and relief. Missing is the two-part realization that, at least in the case of large disasters, the recovery phase is both bigger and more complicated than the response/relief phase; and disaster recovery issues typically are much more closely related to the financing of reconstruction than to the reconstruction itself. In the absence of such an understanding, agencies have expanded their individual roles and responsibilities without regard to how well the whole system works. The difficult *financial* aftermaths of Hurricane Andrew in 1992, and the Northridge earthquake in 1994, have pointed to the need for a new conceptualization of public and private rebuilding programs.

We offer four recommendations in this regard:

1. That the post-disaster period be seen as consisting of two distinct phases: (a) response and relief; and, (b) recovery and rebuilding.

The response and relief phase should be dominated by activities that provide immediate shelter, food, and medical care to victims, followed by assistance to stabilize the living conditions of displaced victims. The recovery and rebuilding phase should be dominated by activities that funnel appropriate funds and financing to those whose property has been destroyed or damaged (including local infrastructure). Federal agencies such as FEMA and state agencies such as OES should review their current organizational structure, programs, and services so as to best undertake these two key, and mostly distinct, functions. In addition, in a place like California--where some types of disasters can be planned for--publicly funded rebuilding efforts should give priority to buildings whose owners have undertaken hazards mitigation. This means expanding the scope and level of research into the effectiveness of particular mitigation approaches.

2. The primary financial responsibility for funding private post-disaster reconstruction should rest with private insurers.

Thus, the primary goal of post-disaster public policy should be to increase the utilization of private insurance. The more private insurers can do to fairly insure individual homeowners, renters, and commercial property owners, the better. We make this argument not out of admiration for the private insurance industry, or because we have been overly impressed with the post-disaster performance of private insurers, but because *only the private insurance industry has access to the volume of capital required to finance post-disaster reconstruction.*

Achieving this goal means substantially increasing the capacity of the private insurance industry to provide appropriate post-disaster reconstruction financing. Improvements in several areas are essential. First, private insurers must be able to more accurately *underwrite* disaster policies and riders. Building on improved underwriting, private insurers must offer consumers a wide choice of policies and products. Just as auto and homeowners' insurance comes in many different product forms, so too should disaster insurance. Giving consumers more product choices will help foster competition, reduce premiums, and encourage more and more homeowners, renters, and commercial property owners to purchase insurance. Ultimately, this will increase the premium pool available for payouts. A critical step in this direction is for the IRS to allow current reserves (against anticipated claims) to be taxed over multiple years.

3. Increasing the responsibility and capacity of private insurers will mean decreasing the scope of publicly funded rebuilding programs.

We believe the role of government policy and programs in post-disaster reconstruction can and should be narrowed into three areas.

The first role is funding the reconstruction of public infrastructure such as roads, schools, hospitals, government buildings, and selected public utilities. This responsibility currently and appropriately rests with FEMA, the U.S. Department of Transportation and Department of Energy, and a number of other federal agencies.

The second role is to provide reconstruction funding for victims who, by virtue of low incomes or some form of market failure, cannot afford to purchase private insurance.

One such group comprises low-income renters and homeowners--those with incomes that are less than 80% of the median area income. To the extent that HUD is involved at all in post-disaster recovery, its role should be limited to providing short-term "gap" grants to low-income renters to help them find market-rate rental housing, and low-interest loans to cash-poor homeowners to help them make repairs.

Owners of multifamily apartment buildings are another such group. Many apartment owners do not carry earthquake insurance for the simple reason that they are unable to recover its cost through higher rents. That is, tenants are unable or unwilling to pay higher rents for units in earthquake-insured buildings. If and when a disaster strikes, the tenants lose their homes and the owner walks away from the property. We believe that one of the primary post-disaster functions of the Small Business Administration should be to provide low-interest loans to these owners.

Conversely, we do not think the SBA should make low-interest loans to middle-income homeowners except for the purpose of covering insurance deductibles. The current system of providing low-interest SBA loans to all homeowners (regardless of income) serves to discourage many homeowners who could afford private insurance from buying it.

In a similar vein, we think FEMA should consolidate and simplify its own separate, small-scale recovery and rebuilding grant and loan programs (including the Minimum Home Repair and Individual Family Grant programs) into one or two income-tested multipurpose grant programs.

A final role for government is to sponsor and undertake applied research on disaster risk-underwriting. The results of our research indicate it is possible to develop analytic models that predict with reasonable accuracy the likelihood that an individual home will be damaged in a given earthquake, as well as the order of magnitude of the damage. Developing such models requires having access to information on the complete portfolios of multiple insurance companies. Since individual insurers regard such information as proprietary, only an independent public agency can develop such models and disseminate their results. The California Department of Insurance, the Governor's Office of Emergency Services, and the California Seismic Safety Commission should jointly establish an independent advisory group whose responsibility it is to develop such models and freely disseminate their results.

The three primary determinants of earthquake damage are the level of ground-shaking, local soil quality, and the ability of the individual building to withstand damage. The U.S. Geological Survey and the California Department of Mines and Geology should cooperate on the further development and dissemination of high-quality, hectare-scale maps and digital databases for use in risk-assessment and underwriting.

Engineers and architects have a reasonably good idea of the general susceptibility of different building technologies (e.g., steel frame, unreinforced masonry, concrete, wood-frame) to earthquake damage.

They are less certain of the susceptibility of particular designs. This is particularly true in the case of wood-frame residential structures. The Northridge earthquake caused substantial damage to many wood frame buildings that were thought to be earthquake resistant, while sparing many older homes thought to be more damage-prone. Clearly, there is still much to be learned about the role of particular building designs and construction techniques. The California Seismic Safety Commission, together with the Governor's Office of Planning and Research and OES, should sponsor and fund such research.

4. The best way to reduce the cost of post-disaster rebuilding, particularly post-earthquake rebuilding, is through mitigation.

Improved mitigation will benefit insurance companies through lower payouts, taxpayers through lower program costs, and, most importantly, renters and homeowners through reduced damage. We have learned three things about earthquake mitigation in the seven years since Loma Prieta: 1) that mitigation works; 2) that the private real estate market in general and the housing market in particular do not reward homeowners who undertake mitigation with higher resale values, or apartment owners who make their buildings safer with higher rents; and 3) that for political reasons the public sector is unable to require appropriate levels of mitigation. Putting these three lessons together leads to the realization that we must refocus our efforts toward providing financial incentives to promote mitigation. We can think of three such incentives:

Institute a \$2,000-per-year state income tax credit for homeowners' earthquake mitigation, and a similar \$2,000-per-unit-per year tax deduction for owners of rental property. Tax credits and deductions would carry over from year to year, subject to a total cap (e.g., \$10,000 over 20 years). While such a program would clearly have a negative short-term effect on state revenues, it is likely to be outweighed by its positive impacts. In the short- and medium-run, it would reduce the state's financial exposure through the newly established California Earthquake Authority. In the longer-term, it would serve to reduce the cost of earthquake insurance, as well as make it more attractive for private insurers to offer diverse products. The ultimate benefit, of course, would be improved life-safety and significantly reduced rebuilding costs.

Require private insurers to offer discounts on earthquake insurance to policyholders who have undertaken significant mitigation.

Provide incentives to private insurers to train their agents (and underwriters) to conduct earthquake hazard and mitigation inspections, or pay independent inspectors for the same service. To better distribute the costs of training and/or inspection, private insurers should be permitted to write multiyear earthquake policies and riders. Insurers would benefit by having a more stable stream of premiums, and policyholders would benefit by having a multiyear guaranteed premium.

All three of these proposals make sense only to the extent that specific mitigation measures can be shown to be effective. This is an appropriate subject for government-sponsored research.

These recommendations must be considered against the backdrop of the recently established California Earthquake Authority, about which we have mixed opinions. On the one hand, we view it (or some program like it) as absolutely essential to keeping private insurers active in California. We also think the CEA (through its programs) will encourage more people to purchase some level of earthquake insurance. On the other hand, we worry that the occurrence of a Northridge-scale earthquake in the very near future would exhaust CEA resources, and put additional financial burdens on the state and federal governments (although this would happen with or without a CEA).

These benefits aside, we worry that the CEA will come to be seen as the final step in addressing California's disaster insurance problems--and not as the intermediate step it is. The ultimate goal of the CEA should be to increase the technical and financial capacity of private insurers to generate the broadest range of privately structured products and risk-based fund pools.

In this sense, the model for the CEA should be the Federal Housing Administration. Established in the 1930s to provide government-underwritten home mortgage insurance, the FHA was also supposed to serve as a demonstration to private insurers of the long-term profitability of insuring homes. As part of its mandate, the FHA developed and published underwriting procedures that could be used by public and private insurers alike to accurately assess insurance risk. Through these innovations, the FHA hoped to reduce the risk associated with mortgage lending, increase the supply of mortgage capital, and ultimately reduce the cost of mortgage insurance. It was successful in all three of these efforts. Today, the FHA is still in business, but its role on the national housing scene is much smaller and more indirect. The primary responsibility for issuing mortgage insurance has devolved to a large, healthy, and competitive private insurance industry.

The great majority of California's population--rich and poor--now lives within 20 miles of a major earthquake fault. Recognizing this reality, many California cities already have or are bolstering their building codes and infrastructure standards in anticipation of a major earthquake. Building codes stipulate minimum life-safety requirements for new construction, and the payoff to improved building codes was evident in the aftermath of both Loma Prieta and Northridge--two major urban earthquakes that killed or injured far fewer people than anticipated. What was greater than anticipated, much greater, was the cost of rebuilding, particularly the cost of residential rebuilding. The federal government stepped in after the Northridge earthquake to assume a significant share of this cost, but there is no guarantee that this will happen next time.

California cannot afford a future in which there are no sources of funding to recover from a major urban earthquake. Even following the best building practices and pursuing a strategy of mitigating hazards in existing buildings, there will be substantial damage in moderate-to-large earthquakes in urban settings. The state must take a stand for more intelligent use of federal funds, for smarter and smaller subsidies to private citizens for recovery, and for encouraging cost-saving mitigation. Even more importantly, California must take the initiative in creating a functioning (mostly private) insurance system by which citizens can protect themselves from hazards and finance repairs in the event of damage.

Notes

1. Estimates of the total cost of the Northridge earthquake vary from a low of about \$25 billion, to more than \$35 billion. The low estimate includes losses to public and private property, but not business inventory or economic losses. The latter estimate includes business inventory, lost business, and traveler delay costs.
2. The extent of disaster insurance coverage varies by disaster type as well as location. Fewer than half of California homeowners, for example, carry earthquake insurance. Among homeowners in the Southeast, the proportion with some form of hurricane damage insurance is typically much higher.
3. These concerns are not unfounded. Hurricane Andrew's insured losses were \$16.3 billion and Northridge losses were \$12.5 billion. In both cases approximately two-thirds were residential claims.
4. The OES inspection database includes inspections but no damage estimates for residential structures in Ventura County.
5. The intensity of earthquake damage has traditionally been correlated to distance from the earthquake epicenter. More recently, geologists have begun correlating damage intensity to distance from the surface fault-rupture projection line. This is the intersection of the vertical plane formed by the subsurface fault-rupture with the plane of the ground. In the case of Northridge, this projection took the form of a 15 km east-west line, located just north of the epicenter.
6. Missing from this argument is an acknowledgment that basic homeowners' insurance has been and remains extremely profitable, and that the combination of homeowner and earthquake premiums more than covered total payouts.
7. As of March 1995, private insurance payouts to Northridge policyholders totaled \$6.1 billion. Subsequent payouts have totaled \$2-\$4 billion.
8. Earthquake coverage can be purchased as a stand-alone policy, or as a rider on an existing homeowner, condominium, fire, renter, or mobile-home policy.

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