PUBLIC RESPONSE TO MANDATED EARTHQUAKE HAZARD DISCLOSURE BY REAL ESTATE AGENTS

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Among the legislative responses to the damaging Sylmar earthquake in California (1971) was the Alquist-Priolo Special Studies Zone Act. In addition to requiring the delineation of zones encompassing potentially and recently active fault traces, an amendment to the act (1975) required that prospective buyers of property within the surface fault rupture zone be informed of this potential hazard. The responsibility for disclosure was placed on the real estate agent, unless the sale was consumated without an agent. The response of the California Association of Realtors (the professional and lobbying organization representing approximately half of the licensed real estate agents in California) was that the legislation would "not only insure that buyers and potential buyers of property are aware that their land may be subject to fault displacement, but also to actually reduce projected geologic losses" through the banning or modification of construction itself [Gillies, 1976, p. 2]. Few complaints of non-disclosure were registered with the Department of Real Estate which has the power to issue or revoke real estate licenses, [Liberator, 1979], and it was assumed that the legislation was trasmitting "complex hydrologic, seismic, and other geological information...to real-estate buyers before the sale [Kockelman, 1980, p. 71]. In addition, analysis of house price trends in Los Angeles seemed to show that the legislation had "created a restructuring of demand for housing," resulting in a systematic drop in house prices within the zones [Brookshire and Schulze, 1980, p. 67].

What is interesting about this legislation to the non-Californian is the question of whether such practices are effective means of disseminating natural hazards information to the general public. The policy issue is whether legislation requiring disclosure by real estate agents of natural or human-made hazards associated with the residential environment should be adopted elsewhere. This question is of importance because of the interest shown in mandating disclosure by real estate agents in other states (such as efforts in Texas to disclose storm surge hazard areas) and by federal agencies (such as the current HUD regulations requiring the disclosure of proximity to a nuclear weapons plant). Such legislation may be considered or even adopted with only vague notions about the effects it does or does not have on the homebuying public.

In addition to the policy issue, the legislation poses an interesting theoretical question: does the mere provision of environmental information result in a measurable change in the behavior of homebuyers? To posit an affirmative answer to this theoretical question requires a review of previous research on the conversion of information into behavioral responses.

The adjustment of individuals and societies to natural hazards has been linked to theories of decision-making, such as the maximization of expected utility, bounded rationality and the principle of "satisficing," and probabilistic information processing by human beings (such as over-generalization from a small number of cases, inaccurate perceptions of randomness, misperceptions of correlation and causality, and the use of the "anchoring and adjustment" heuristic problems of varying availability in information, and problems of integrating information obtained from multiple sources [Slovic, Kunreuther and White, 1974]. In addition, it has been suggested that research within social psychology and communications on "fear appeals" are directly related to responses to natural hazards [McClelland, 1981]. In this section, the relationships between response to disclosure of surface fault rupture zones and two of these research themes is suggested.

Research within the framework of "expected utility theory" [Von Neumann and Morgenstern, 1947] and its less deterministic and rationalistic variants provides a set of expectations which can be applied to the response of homebuyers to mandated hazards disclosure. In brief, this framework postulates that under conditions of uncertainty, the decision to take or to avoid risk can be understood as utility functions derived from combining the sets of possible outcomes with the probabilities that various outcomes will occur. People are assumed to be risk-averse, preferring a known but smaller pay-off or loss to the possibility of either a large loss or a large pay-off. However, in the case of response to low probability events such as natural disasters, several studies have observed risk-taking behavior (or seemingly convex utility functions). This anomaly may be explained by the existence of a probability threshold below which risks are not taken into account [Kunreuther, 1978; Slovic, et al., 1977], or the possibility that homebuyers do not have full and accurate information about factors such as fixed losses and pay-offs essential to decision-making resulting in risk behavior [Kunreuther, et al., 1978]. In addition, since the home purchase decision is made in the context of a larger set of decisions, it is possible that while portions of the total decision may not fit the utility maximization model, the overall decision does; in other words, environmental uncertainties may not be amenable to analysis apart from the total set of constraints and utilities influencing the household [Pashigian, et al., 1966]. This complex decision environment suggests the need to understand the context of the decision, particularly where probabilities and outcomes are uncertain [Schoemaker and Kunreuther, 1979; Hershey and Schoemaker, 1980].

A second general approach to the issue of information provision and behavior change analyzes the impact of the communications process [Zimbardo and Ebbesen, 1970; McGuire, 1968]. Studies of manipulative or persuasive communication suggest that a given source (the real estate agent) has more impact on the receiver (the homebuyer) if he/she has high credibility. Such credibility is a function of both buyer perceptions of the expertise of the agent, and the extent to which the buyers trust that

the agent is providing unbiased information. In addition, the agent has more influence if the information and opinions expressed by the agent are already shared by the buyers.

Other research suggests that attitude change by the homebuyer is maximized if conclusions from the information are unambiguous, if recommendations for action are explicit and feasible, and if buyers' attitudes towards the recommended actions are congruent with the recommended behavior changes. External attitudes or beliefs may also affect response to information. In the case of homebuyers, the perception that there are no alternative locations free from earthquake hazards or the belief that there is little an individual can do to prevent death, injury, or damage from "an act of God" if one is fated to experience a natural disaster would interfere with avoidance or mitigation behavior.

Finally, the information disclosed must be instrumental to the goals of the homebuyer. The existence of surface fault rupture zones would have to be important to the buyer in his attempt to attain housing goals such as a safe and secure property. If other goals are more important in the home purchase decision, such as location in a homogeneous and high-prestige neighborhood as an expression of social status [Perrin, 1977], then information on environmental hazards may be considered to be of little importance.

In short, behavioral response to hazards information can be expected only under very special conditions [Saarinen, 1979;] [Wyner and Mann, 1978];[Saarinen and McPherson, 1977]. Baumann [1980] suggests that the optimum conditions for a message to be heeded are that: first, the information is made personal to the homebuyer; second, information on risks, costs, and benefits be made very specific; third, information should be clear and unambiguous; fourth, mitigation measures should be precisely prescribed; fifth, information must originate from a credible source; sixth, social reinforcement of the information should be present; seventh, multiple and supporting messages should be provided; eighth, fear appeal or positive action appeal should be used appropriately based on an understanding of the intended audience; and last, previous attitudes, values, and beliefs must be considered in designing the message.

This brief review suggests that the relationship between the provision of information and behavior change is extremely complex. Yet legislative decisions have been made as if the relationship were simple and straightforward, and conclusions about market responses have been drawn as if mandated disclosure were obviously and unequivocally linked to the provision of environmental information [Brookshire and Schulze, 1980]. To bring into focus the relationship investigated, one can hypothesize the set of circumstances which would lead the buyer to a measurable response. A measurable response is defined as (1) the avoidance of the purchase of a house in the special studies zone, or (2) an attempt to bargain with the seller for a reduced price in exchange for the buyer's assumption of environmental risks--a form of self-insurance, or (3) the adoption of mitigation measures after the buyer has moved into the house. The circumstances necessary for a measurable response include: (1) the buyer must be motivated to listen to the disclosure--earthquake hazards must be viewed by the buyer as significant in the attainment of housing goals; (2) information about the zones must

be accurate and unambiguous--the real estate agents must know the house is in the zone, must know the definition of the term "special studies zone," and must transmit the importance of this information; and (3) the buyer must believe that it is possible to lessen the risk by either forgoing purchase of a house in a special studies zone or by adopting mitigation measures. Evidence of buyer response would include (1) statements by buyers that disclosure resulted in an attempt to negotiate more favorable sales terms, their avoidance of the zones in favor of similar nearby areas, or their adoption of mitigation measures, (2) statements by real estate agents that they had had clients dissuaded from purchasing homes within the zones as a result of the disclosure, or (3) houses within the zones should command lower selling prices than houses with comparable characteristics in similar neighborhoods outside the zones.

The San Francisco Bay area was the setting for a survey of homebuyers and real estate agents, as well as a study of housing market activity. Two areas were selected for homebuyer and real estate agent surveys: Berkeley and central Contra Costa County. A third was included for analysis of market trends: southern Alameda County. These areas are not a representative sample of residences in all California special studies zones, and therefore the surveys and statistical analyses should be interpreted only as case studies of housing submarkets which may differ markedly from other portions of California. The Berkeley and central Contra Costa County special studies zones lie within housing submarkets [Palm, 1979], and are generally inhabited by white, upper-middle-class households in single-family detached dwellings. Their most notable contrast is that they are located on different fault traces, and that there is far more visible damage from fault creep in Berkeley than in Contra Costa County.

The Response of Homebuyers to Disclosure

Surveys of recent homebuyers were taken in 1979. All homebuyers who had purchased properties within the Berkeley and central Contra Costa special studies zones within the six months preceeding the interviews, and a sample of those in areas outside the zones but within three miles were interviewed.

Respondents within the special studies zones indicated that they placed a low priority on environmental factors in their purchase decisions. In a structured question asking the buyers to evaluate fifteen factors which might have influenced their decision, "location out of floodplain" and "distance from an active earthquake fault" were appraised as "not important" or "not considered" in the purchase decision. A comparison of the responses of buyers in nearby areas outside the zones showed a similar disregard for environmental factors--there was no significant difference in attitudes to "distance from active earthquake fault" in the two settings.

Although the survey was done within six months after change of title was recorded, a majority of the homebuyers were unaware that their house was within a special studies zone. Households in the zones were asked "is your present homein a special studies zone?" or "as far as you know is your home located in a specially designated earthquake-prone area as defined by state or federal law?" or "when you first signed a contract offering to buy the house you are living in, do you recall the real

estate agent providing you with a form or an addendum to the contract indicating anything special or particular about the location of the house?" If the buyers answered all of these questions negatively, it was assumed that they did not recall the term, the concept, or the process by which disclosure took place. Of the 207 respondents, only 94 answered one of these questions affirmatively; Berkeley homebuyers were far more likely to be aware their homes were within a zone than those in Contra Costa County. It is interesting to note that there was no significant difference in the proportion of recent buyers within and outside the zones who were aware of the term "special studies zone": mandated disclosure did not increase the likelihood that residents were familiar with the designated environmental area within which they lived.

Not surprisingly, most of the within-zone homebuyers said that the location of the house within a special studies zone made no difference in their purchase decision. Perhaps more suprising was the fact that a similar percentage of residents outside the zones indicated that the location of the zones made no differences in the home purchase decision--for both groups in both study areas, the zones affected the decisions of only a small minority of homebuyers.

When asked whether people living in the zones are more susceptible to losses from earthquakes compared to those who live elsewhere in the Bay Area, the majority of the zone residents said the zones made no difference. On this question, residents of nearby areas differed: they were more likely to believe that living near a fault makes one more susceptible to losses, and were also more pessimistic about the likelihood of a major damaging earthquake occurring in the area while they were living there. Despite this, the overwhelming majority of zone residents feel that zones will affect neither the price or the house of their ability to sell it when they decide to move again.

Berkeley residents were more likely to purchase earthquake insurance, but only a small minority in either area indicated they had earthquake insurance. In addition, there was no significant difference in the percentage of those within and outside the zones that had purchased earthquake insurance--in no case did the percentage rise above 38 percent (for the Berkeley special studies zones respondents), and the lowest percentage was for the within-zone Contra Costa residents--only 2 percent had earthquake insurance.

When residents of the zones were asked about the adoption of a series of mitigation measures, most responded that they had not adopted the measures nor did they intend to do so. In comparison with a random sample of Los Angleles County residents surveyed by Turner in 1977-78 [Turner et al., 1979], Bay Area special studies zones residents were less likely to have instructed children about what to do in an earthquake, to have established emergency procedures at residence, to have made plans for a reunion after an earthquake, to have such items as a working battery radio, flashlight, first-aid kit, food, and water particularly because of an earthquake threat, or to have set neighborhood responsibility plans. Bay Area special studies zones residents exceeded the general population of Los Angeles County only in insurance inquiries and purchase, structural reinforcements, and the replacement of cupboard latches.

In short, recent homebuyers whether within the zones or outside the zones were generally unconcerned with hazards associated with surface fault rupture. The existence of the zones made little difference in the home purchase process, even when homebuyers were aware of their significance. Few had used the zones to attempt to negotiate a lower price from the sellers (less than 5 percent), only a small minority had purchased earthquake insurance, and almost no one felt that the location of the house within the zone would impair its future price or salability. Disclosure had neither dissuaded buyers from purchasing homes within the zones, nor encouraged them to adopt mitigation measures after moving in.

Surveys of real estate agents confirmed the views expressed by homebuyers. The survey was limited to agents named by the homebuyers as having helped them in their recent home purchase. This sampling method was decided upon to ensure that only those agents actively involved in selling property and presently doing business within the zones would be contacted, and so that the responses of buyers and real estate agents could be matched.

Five notable results emerged from the real estate agent survey. First, most of the real estate agents could recall that "special studies zones" refer to earthquake fault areas, although a full 12 percent incorrectly identified the term (indicated that the special studies zone was either a floodplain or an area in which transportation surveys would be taken). Second, most real estate agents used the contract addendum developed by the California Association of Realtors as the means of disclosing special studies zone location. This means that disclosure takes place at the time the purchase contract is signed, after the buyer is fairly committed to purchasing that particular property. Third, few real estate agents had ever had a client decide not to buy a home after being informed that the property was within a special studies zone. Only 16 percent had ever had such a refusal, and only 4 percent had more than three such refusals. Fourth, most real estate agents do not believe that people who live in special studies zones are more likely to suffer financial losses or physical injuries in the event of an earthquake compared to people who live elsewhere in the Bay Area. What this indicates is that even when real estate agents make the disclosure in good faith, they are not themselves convinced that what they are dislosing has any major significance for the safety or economic security of the buyers. Finally, about 96 percent answered that real estate agents should be required by law to make the disclosure of special studies zones. When their answers were probed, they indicated that this requirement provides them with a form of insurance against future lawsuits if a future major earthquake should damage the properties they sold.

Real estate agents seemed resigned to the existence of a disclosure regulation, and although they indicated they would prefer more information on the meaning of the zones, they accept the contract addendum as proof that they have not misrepresented "material facts concerning the transaction" [Smith v. Zak]. The most common disclosure procedure follows the ideal sales practice: disclosure takes place at the time it is least likely to jeopardize the sale of the house. Since few sales were adversely affected by the disclosures, the agents are relatively content with the existence of the regulation.

Finally, house price levels for houses within, adjacent to, and outside the special studies zones were analyzed for Berkeley, central Contra Costa County, and a third submarket, southern Alameda County. Hedonic price indicies [Griliches, 1967] were calculated for house price levels in 1972 (before the dislosure legislation had been passed) and in 1977 (two years after the legislation was in effect). Data on properties sold in the three study areas were obtained from the appraisal reports of the Society of Real Estate Appraisers. Equations included data on square footage of dwelling space, age of the house, quality of the house, condition of the house, size of the lot, and presence of such elements contributing to price levels as a swimming pool, fireplace, or a "view lot." Data on the general economic status of the area (percentage of professional-managerial employees among residents of the census tract), and housing stock composition (percentage of single-family dwelling units in the census tract) were added based on data from the 1970 Census of Population. It should be stressed that since these three areas were previously established as separate housing submarkets [Palm, 1979], equations were run for each of the study areas individually rather than aggregating them into a whole for the metropolitan area. It is believed that this is an important step to reduce biased estimates which may be due to submarket variations [Straszheim, 1975].

Location with respect to the special studies zone was coded as a dummy variable, and three equations were run for each study area for each year: one for houses within the special studies zone, a second for houses within one mile of the zone, and a third for houses beyond a mile of the zone. The research hypotheses were that in 1972 location in the special studies zone was unrelated to house price (the coefficient should be near zero), but in 1977 location in the zone should be negatively related to house price. In addition, it is possible that in 1977, location near the zone would have a positive coefficient because of an increased demand for houses near, but not actually in, the zones. Location outside the zones should continue to have no effect on house prices.

The results of the set of ordinary least squares equations are complex (Table 1). The study area which best approximated the research hypotheses was Contra Costa County. There, the negative effect of the special studies zones on house price level was strengthened between 1972 and 1977, the effect of adjacent areas was reversed from negative to positive between 1972 and 1977, and the effect of distant areas reversed from a weak negative to a significant positive. Location in the zones remained a negative influence on house price throughout the period, but increased in effect from -$912 in 1972 to -$4182 by 1977. Most of the research hypotheses were confirmed in this example: although the within-zone 1972 effect was negative, the coefficient was not significantly different from zero at .05; by 1977 this variable had increased to a significant negative effect. This statistical finding is somewhat surprising in light of the general lack of awareness of the existence of special studies zones on the part of recent homebuyers within and outside the zones, and the lack of salience which proximity to an earthquake fault had for all homebuyers. However it could be argued that the small effect of the few buyers concerned with proximity to fault traces might have been sufficient to weaken overall demand within the zones, resulting in a decline in prices there.

In the Berkeley area in which there was generally greater awareness and concern with proximity to a fault trace, the opposite effect on house prices is observed. Rather than weakening house prices, location in the special studies zones seemed to boost prices. Again, "view" and "social status of the area," as well as quality and condition of the dwelling unit were taken into account in the equation. Yet location in the special studies zone had a positive impact on house prices in both 1972 and 1977, increasing the overall price by $2617 in 1972 and $9618 in 1977. Location in nearby areas also had a positive impact on house prices in both years, and location outside the zones had a statistically significant negative impact on house prices in both years. Although the Berkeley equations should not be interpreted as indicating a positive preference for residence along fault traces, it can be said with some confidence that the disclosure legislation was not translated into a weakening of demand or lowering of house prices within the Berkeley zones.

The results of a third set of equations, for southern Alameda County, differed from those obtained for Contra Costa and Berkeley. Location in the special studies zone showed a weak but insignificant negative relationship with house price, a relationship which became weaker over the 1972-77 period. Location in adjacent areas had the opposite effect on house prices than that hypothesized: from a significant positive effect to a fairly weak negative effect. Location beyond the zones had no significant effect on house prices in 1972 and a weak positive effect in 1977.

To summarize the results of the hedonic analysis, the submarket effect was consistent. In areas in which buyers showed most concern for earthquake fault location, the effect of the zones on prices was positive; conversely where buyers were least informed or concerned with the zones, the zones seemed to have a negative effect.

Despite the relatively high overall explanatory power of the equations (coefficients of determination of .74 for Berkeley, .67 for central Contra Costa County, and .75 for southern Alameda County in 1970, it is likely that some unspecified variable or set of relationships affects house price levels, an effect which seems spatially correlated with the special studies zones . It is suggested that it is not the zonation itself that has had a positive or negative impact on house prices, but some other correlated neighborhood characteristics omitted from the equation.

Discussion

The combination of survey evidence and market behavior provides little indication that buyers had responded in any measurable way to special studies zones disclosure. Several of the reasons for non-response are derived from theoretical literature linking information provision with behavior change.

The seemingly risk-taking behavior may be explained by a combination of threshold effect (the probability of a major damaging earthquake over a short time-span is too low to be considered a serious threat), and the likelihood that homebuyers do not have sufficient information concerning fixed losses and pay-offs. In addition, the home purchase decision involves a complexity of factors of which environmental hazards play only

Table 1

Effects of Location in Special Studies Zones on House Prices

Location	1972 Beta for price impact in dollars (significance)	1977 Beta for price impact in dollars (significance)	Hypothesized effect	Observed effect
Southern Alameda County				
Inzone	-741 (.166)	-243 (.807)	negative	none
Adjacent	807 (.030	-1062 (.101)	positive	none
Outside	-422 (.234)	1121 (.078)	none	positive at .10
Multiple r^2 =	.74	.75		
Berkeley				
Inzone	2617 (.000)	9618 (.092)	negative	positive at .10
Adjacent	1162 (.061)	9118 (.092)	positive	positive at .10
Outside	-3121 (.000)	-1315 (.004)	none	negative at .01
Multiple r^2 =	.84	.74		
Central Contra Costa Country				
Inzone	-912 (.307)	-4182 (.000)	negative	negative at .00
Adjacent	-473 (.620)	1500 (.048)	positive	positive at .05
Outside	-623 (.377)	1705 (.007)	none	positive at .01
Multiple r^2 =	.55	.67		

Variables used: square footage of dwelling unit, lot size, condition of the dwelling unit, quality of the dwelling unit, age of house, "view," presence of fireplace, presence of swimming pool, type of mortgage, percentage of professional and managerial in census tract, percentage of single family dwellings in census tract.

a small part; while the overall purchase decision might be evaluated as maximizing subjective expected utility, the environmental component of the decision is overwhelmed by other effects.

The failure of the provision of information to result in behavioral change may be also partly attributed to the fact that the necessary conditions for effective persuasive communication are not present. First, the information source (the real estate agent) may not have sufficient credibility. This may result partly from the economic function of the agent as representing the seller in the house transaction, and partly from the finding that not all real esate agents are well informed concerning the meaning and implications of the special studies zones. Second, disclosure is not accompanied by specific recommendations of purchase avoidance or adoption of mitigation measures; obviously the disclosure is made with a minimum of flourish, and at no time does the real estate agent counsel the buyer to forgo the purchase or to invest in mitigation measures. Finally, the information provided in the disclosure is probably not perceived as instrumental to the attainment of the most important of homebuyer's goals. Since one of the primary factors in the purchase decision is the potential of the house as an economic investment, and because buyers often intend to stay in the house for only a short period of time, long-term environmental safety is of little concern. Since it is relatively unlikely that a major damaging earthquake will occur during the period that the homebuyers are living in the house they have purchased, they do not hesitate to buy a home in the special studies zones as long as they believe the house has a good potential resale value. Similarly, homeowners will not adopt costly mitigation measures, since to the individual these measures are not cost-effective and will not be recouped in a subsequent house sale.

A related issue is that of the significance of the zones. It is important to note that although the special studies zones were defined to outline traces of active faults, they were never intended to include all of the areas susceptible to damage from earthquake. Indeed it has been estimated that the damage from surface fault rupture accounts for only about 10 percent of the total damage potential associated with seismic activity: the remainder is related to liquification, shaking, or ground failure. It is therefore possible that the rare sophisticated buyer who knows his house is near, but not directly on, a fault trace may be correct in an assessment that because of the bedrock conditions underlying the property, location in the special studies zones may be safer than one on an unstable slope or landfill.

Conclusion

The problem of the utilization of land containing traces of active faults is not effectively dealt with by the mere discosure of the existence of surface fault rupture zones to prospective buyers. There has been little response to mandated disclosure for many reasons, including the problems of credibility and role conflict on the part of the information agent (the real estate agent), the emphasis placed on the house as a financial investment rather than a permanent commitment to place by buyers, and the belief by buyers (not contradicted by real estate agents) that there are few real alternatives. When this latter belief is combined with the existence of a "seller's market" with an excess of demand over supply, buyers have little choice but to purchase a home they can afford whenever and wherever it becomes available.

These findings suggest several legislative needs. First, the state legislature should consider dealing with the full range of hazards, natural and human-made, facing residents. If earthquake hazards are deemed more important than some others, and if the legislature wishes to take effective action to mitigate these, it must deal with a more comprehensive definition of earthquake hazards, and reconsider legislation to better inform residents about the hazards and mitigation strategies.

Second, the state should devote resources to multiple dissemination techniques, including public information campaigns concerned not only with emergency procedures but also with the relative likelihood of damage to various portions of the built-up urban area. The distribution of hazards maps in telephone books, public information programs on radio and television, and the periodic news releases could heighten public awareness of the spatial differentiation of areas susceptible to damage from earthquakes and the fact that the mitigation measures can be taken before a damaging earthquake to reduce loss of life and damage to property.

Finally, it has been noted that mortgage lenders seem to vary in their response to earthquake risk. Some banks require earthquake insurance on all properties within the special studies zones, while others require no mitigation measures as a condition for originating loans [Brookshire and Schulze, 1980;] [Bank of America, personal communication, 1981]. In addition, secondary mortgage lenders (such as the FHLMC) have carefully studied the issue of earthquake insurance [Kaplan, Smith and Associates, 1981]. If financial institutions were to decide to require homebuyers in particular areas to invest in earthquake insurance as a condition for a home loan, and if this policy were adopted only for mortgages on homes most susceptible to damage from seismic activity, buyers would be made more aware of the spatial variability of earthquake hazards.

It is clear that the present disclosure law has had little impact on individual homebuyers. Policy-makers at the state and federal level should be aware of the weaknesses inherent in simply assigning the task of disclosure of environmental hazards to the real estate industry and then assuming that homebuyers will, as a result, make more informed decisions. More positive action by government and private industry will be required if homebuyer decisions are to be more effectively influenced.

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