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Risa Palm

Georgia State University, risapalm@gsu.edu

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PUBLIC RESPONSE TO EARTHQUAKE HAZARD INFORMATIONⁱ

RISA I. PALM

ABSTRACT. Consumer protection legislation has been based on the assumptions that people prefer to avoid risks and that they make rational decisions given a bounded field of information. Mandated disclosure of information about environmental hazards in limited areas should therefore result in the avoidance of such areas by homebuyers or the adoption of mitigation measures subsequent to the move. The response of California homebuyers to mandated disclosure of the location of special studies zones or surface fault rupture districts was negligible, both because of the failure of the law to specify rigorous disclosure procedures and also because the law was based on the assumption that the mere provision of information will result in a predictable and rational behavioral response.

Consumer protection legislation has been based on two assumptions about human behavior: first, that individuals are risk-averse, and second, that decisions are generally rational, given only limited knowledge of alternatives and their consequences. The first assumption implies that when given a choice, individuals will prefer less exposure to major losses even if this choice also means less opportunity for large gains.¹ Such risk-averse behavior produces a utility function with a concave form, and is the basis for economic theory predicting the conditions under which insurance is purchased: the individual trades a small, fixed loss (the premium) against protection from larger losses.

ⁱⁱ The research reported here was supported by the National Science Foundation under grant no. PFR78-04775. Any opinions, findings, and conclusions or recommendations expressed herein are those of the author and do not necessarily reflect the views of the National Science Foundation. I am grateful for the work of David Kuntz, Rene DuFort, Vickie Kendrick, and Gladys Bloedow, and for the helpful comments of Gilbert F. White, David Greenland, and Stuart W. Cook.

The second assumption implies that the course of decision-making can be manipulated, to some extent at least, by constricting or expanding the amount of information available to individuals.²

¹ The notion of risk aversion and its relationship to expected utility models was presented in M. Friedman and L. J. Savage, "The Utility Analysis of Choices Involving Risk," *Journal of Political Economy*, Vol. 56 (1948), pp. 279-304; W. Edwards, "The Prediction of Decisions Among Bets," *Journal of Experimental Psychology*, Vol. 50 (1955), pp. 201-14; and F. Mosteller and P. Noguee, "An Experimental Measurement of Utility," *Journal of Political Economy*, Vol. 59 (1951), pp. 371-404. In these papers, decision-making under conditions of uncertainty is examined, and choices are predicted using either the expected utility model or its variant, the subjective expected utility model.

² This postulate is derived from studies of manipulative communication or persuasion which evaluates the impact of

The combination of these ideas provides the framework for such consumer protection legislation as the mandatory inclosure of warnings of side effects associated with particular medications, the publication of the surgeon general's warning on packages of cigarettes, and other forms of mandated disclosure.

There have been several forms of consumer protection legislation as related to residential purchases. For example, federally insured financial institutions are now required to make a complete disclosure of the full costs to be incurred by the borrower when a home mortgage application is filed. Similarly, several laws require that *environmental* information be provided to buyers: the federal government requires that lenders notify prospective buyers that property is located within a flood hazard area as defined by the Federal Insurance Administrator when communities are part of the federally-subsidized flood insurance program; the Department of Housing and Urban Development requires that real estate agents in Boulder and Jefferson counties (Colorado) inform buyers within ten miles of the Rocky Flats Plant that there is an emergency response plan which would go into effect in the event of accidental release of radioactive materials from the plant; and the Santa Clara County California Board of Supervisors requires sellers of property partly or wholly within flood, landslide, and fault-rupture zones to provide a statement of geologic risk to prospective homebuyers.³ The legislation considered in this paper is one of this genera: the California Alquist-Priolo Special Studies Zones Act which requires disclosure to prospective buyers of the location of a property within one-eighth mile of a fault trace. It is argued that the failure of this legislation to change the behavior of homebuyers is the result not only of incomplete compliance with the law, but also and more importantly the incorrect premise linking information provision with "rational" behavior.

the form of the message and the order in which information is presented on attitude change. Influential reviews of this literature include C. I. Hovland, I. L. Janis, and H. H. Kelley, *Communication and Persuasion* (New Haven, Connecticut: Yale University Press, 1953); and M. Sherif and C. I. Hovland, *Social Judgment: Assimilation and Contrast Effects on Communication and Attitude Change* (New Haven, Connecticut: Yale University Press, 1961). A study specifically investigating the ways in which real estate agents manipulate information to achieve desired sales patterns is T. R. Smith and F. Mertz, "An Analysis of the Effects of Information Revision on the Outcome of Housing-Market Search, with Special Reference to the Influence of Realty Agents," *Environment and Planning A*, Vol. 12 (1980), pp. 155-74.

³ For a discussion of the impacts of the federally subsidized insurance program as it has affected the management of floodplains, see D. R. Anderson, "The National Flood Insurance Program-Problems and Potential," *Journal of Risk and Insurance*, Vol. 41 (1974), pp. 579-99; and R. Platt, "The National Flood Insurance Program: Some Midstream Perspectives." *Journal of the American Institute of Planners*, Vol. 42 (1976), pp. 303-13.

The Alquist-Priolo Special Studies Zones Act

The California state legislature has several times been spurred to action on seismic legislation by major damaging earthquakes.⁴ The most recent impetus was the earthquake in San Fernando-Sylmar in February, 1971. The legislative response to this earthquake was the passage, eleven months later, of the Alquist-Priolo Geologic Hazards Zones Act which directed the state geologist to delineate by the end of 1973 “appropriate wide special studies zones to encompass all potentially and recently active traces of the San Andreas, Calaveras, Hayward, and San Jacinto Faults,” as well as any other faults which were “a potential hazard to structures from surface faulting or fault creep.”⁵ These zones were to be one-quarter mile in width or less. City or county approval was required for all new real estate development or structures for human occupancy in the original legislation, although this language was later modified to exempt single-family frame dwellings not a part of large developments.

In 1975 the act was amended; the names of the zones were changed from "geologic hazard zones" to "special studies zones" and the new act provided for disclosure to purchasers that property was within the special studies zones.⁶ The disclosure amendment stated that “a person who is acting as an agent for a seller of real property which is located within a delineated special studies zone, or the seller if he is acting without an agent, shall disclose to any prospective purchaser the fact that the property is located within a delineated special studies zone.”⁷ Enforcements included the threat of revocation of license by the State Department of Real Estate, as well as a legal precedent proscribing misrepresentations and requiring "the fullest disclosure of all material facts concerning the transaction.”⁸ Specific directions, such as the type of

⁴ A summary of the pre-1975 legislation is presented in Joint Committee on Seismic Safety, Meeting the Earthquake Challenge: Final Report to the Legislature of the State of California (Sacramento: Joint Committee on Seismic Safety, 1974).

⁵ California Public Resources Code, Section 2621.1.

⁶ Given the strength of the real estate lobby in California, it might have been expected that this amendment would have generated public controversy; instead, the act passed virtually unopposed in the legislature after a few amendments were modified in the assembly and unnoticed in the general press. Part of the reason for the absence of controversy and the acquiescence to disclosure on the part of the California Association of Realtors was the package of amendments of which the disclosure provision was a part. Along with disclosure, several changes were added which were favorable to real estate developers and agents including the exemption of new single-family frame dwellings not part of large developments from geologic reports, the exemption of mobile homes and condominium conversions from reports, and the exemption of alterations and additions to structures not exceeding fifty percent of the value of the structure. The California Association of Realtors would have preferred that disclosure be the responsibility of the seller, but they agreed to the language given the rest of the package. The name change was favored not only by real estate interests, but also by state geologists. It was felt that the term "geologic hazards zones" might be misinterpreted, since the zones delimited in the legislation did not include many of the areas susceptible to geologic hazards. The scientists preferred a term implying that the identified areas were targeted for future special study, and therefore the change of terminology was seen as an improvement in precision. Proponents of the disclosure provision viewed the final package of amendments as a compromise in which they had traded the exemption of single-family dwellings for the disclosure provision.

⁷ California Public Resources Code, Section 2621.9.

⁸ 98 Ca. Repr. 242, 20 C.A. 3d 785.

materials to be used in the disclosure or when in the sales process disclosure was to take place, were not specified in the law.

The legislation was met with a great deal of apprehension. Real estate agents were uncertain as to how mortgage lenders would respond to the zonation, and therefore its impact on sales. These apprehensions were soon laid to rest, however, when it was learned that mortgage lenders took almost no account of special studies zones location.

A standardization of disclosure practice soon took place. This standardization was assisted by the publication in 1977 of a manual on special studies zone disclosure by the California Association of Realtors, the development of a contract addendum to the deposit receipt which was made available to California Realtors, and the production of colored maps by several local boards of Realtors.⁹ As far as the regulatory department and the USGS were concerned, the disclosure legislation seemed to be "working."¹⁰ But the important issue, of whether homebuyers were being "informed" by the disclosure, and whether this information was being translated into behavior which would mitigate their exposure to risk, had not been determined.

Theories of Information Provision and Behavior Change

The assumption that the provision of information may result in behavior change is based on the postulate that because most behavior is risk-averse, the individual should respond to seismic risk information either by attempting to avoid location within the area or lessening the potential hazard by mitigation measures. These measures might include the purchase of earthquake insurance, structural changes in the house, or even self-insurance in the form of bargaining for a lower price which is in effect "traded" for the willingness to assume the risk of major structural damage. There have been many experimental tests directed at the notion of risk aversion, with a surprising number of results which suggest that individuals may prefer risks rather than avoid them.¹¹ A number of suggestions have been made to account for this seeming preference risk assumption. Three are particularly applicable to earthquake hazard response: the existence of a probability threshold, the difficulty of analyzing individual aspects of a complex decision, and

⁹ California Association of Realtors, *Disclosure of Geologic Hazards* (Los Angeles: California Association of Realtors, 1977).

¹⁰ W. J. Kockelman, "Examples of the Use of Earth-science Information by Decision-makers in the San Francisco Bay Region, California," *USGS Open File Report* No. 80-124, 1980.

¹¹ Experimental findings running counter to strictly risk aversion are presented in A. Tversky, "Elimination by Aspects: A Theory of Choice," *Psychological Review*, Vol. 79 (1972), pp. 281-99; S. Lichtenstein and P. Slovic, "Reversals of Preference Between Bids and Choices in Gambling Decisions," *Journal of Experimental Psychology*, Vol. 89 (1971), pp. 46-55; H. R. Lindman, "Inconsistent Preferences Among Gambles," *Journal of Experimental Psychology*, Vol. 89 (1971), pp. 390-97; P. Slovic, "Choice Between Equally Valued Alternatives," *Journal of Experimental Psychology: Human Perception and Performance*, Vol. 1 (1975), pp. 280-87; and D. M. Grether and C. R. Plott, "Economic Theory of Choice and the Preference Reversal Phenomenon," *American Economic Review*, Vol. 69 (1979), pp. 623-38. The implications of these findings for expected hazards response are outlined in Kunreuther et al., op. cit., footnote I; and P. Slovic, H. Kunreuther, and G. F. White, "Decision Processes, Rationality and Adjustment to Natural Hazards," in G. F. White, ed., *Natural Hazards: Local, National and Global* (New York: Oxford University Press, 1974).

the role of the information agent.

The existence of a probability threshold has been suggested by several authors studying the purchase of hazards insurance.¹² This concept refers to the observation that if the probability of a hazard is very low, it seems to be treated as if it were zero. One suggested explanation for this phenomenon is the fact that people face a multitude of hazards and problems in their everyday lives, and give their attention to those which recur most frequently. There have been few time-specific predictions of seismic risk for localized areas within California, but it is likely that even where such probabilities are estimated and widely publicized, they fall below a critical threshold at which they would be taken into account.

In any complex decision, it is very difficult to analyze the impacts of a single element. To the researcher, a portion of that decision, such as the refusal to respond to seismic risk warnings, may seem as if it were risk-taking behavior. However, when the complex decision is viewed as an entirety, the conjunction of all of the related decisions may fit the risk avoidance or utility maximization model.¹³ In short, what is observed and labeled as risk-taking behavior for a portion of the decision, would actually be perceived by the decision-maker as risk-averse behavior given all of the elements which made up the final decision. It is difficult to analyze portions of the home purchase decision, particularly that portion of it dealing with environmental hazards, apart from the other constraints and utilities of the household, a fact which must constantly be kept in mind when labeling the migration behavior as risk-averse or risk-taking in nature.

The third factor which may account for the observation of risk-taking behavior is the role of the information agent. A great deal of research has been addressed to the general topic of the impact of the change agent on behavior modification. In the field of earthquake and flood insurance adoption, some research has found that it was not so much the objective nature of the risk as the institutional structure of the insurance industry which affected the likelihood that insurance would be adopted. Specifically, the commission structure for the sale of insurance had as great an effect on the purchase of insurance as any determination of utility functions by homeowners.¹⁴

The information agent may also affect the way in which a message is received by the techniques used to communicate the information and also the agent's personal and role characteristics. The timing and materials used in the presentation of new information will greatly affect the extent to which they are understood and heeded, as well as the presence or absence of behavior-relevant information or practical suggestions for responses incorporated into the message. In addition, the information will have more impact if the information agent has high credibility, a function of

¹² Kunreuther et al., op. cit., footnote 1; and Slovic et al., op. cit., footnote 1.

¹³ B. P. Pashigian, L. L. Schkade, and G. Menefee, "The Selection of an Optimal Deductible for a Given Insurance Policy," *Journal of Business*, Vol. 39 (1966), pp. 35-44.

¹⁴ Kunreuther et al., op. cit., footnote 1.

one's trustworthiness and ability to provide knowledge on the subject at hand.¹⁵

Previous research also suggests that new information has greater impact if the information is perceived as important and instrumental to the attainment of the goals of the recipient and if there is institutional support for the suggested behavior change.¹⁶ If information concerning special studies zones is seen as an important aspect in the drive to acquire safe and secure housing, it will be attended to and included within the decision-making process. Similarly, if other societal institutions, such as the mass media, mortgage lenders, or employers reinforce the notion that special studies zones are significant residential considerations, any information about their existence will seem more important to the homebuyers.

Finally, individual and cultural factors have an effect on the impact of any new information. Individuals may vary in the extent to which they can comprehend the significance of the disclosure, and their awareness of alternative responses. In addition, "external attitudes" or beliefs, not directly related to the decision at hand, may affect the response to information.¹⁷ For example, if one generally believes that there is little an individual can or should do to prevent injury or damage from "an act of God," then no amount of information will produce mitigation behavior. These external attitudes are very difficult to assess without lengthy observations or field interviews, but may affect the process of response to new information.

Although the research reviewed here suggests that the relationship between information provision and behavior change is extremely complex, legislation has been adopted as if there were a simple and straightforward connection between new information and behavior change. Assuming for a moment that the complexities can be ignored, one might expect that disclosure legislation would have an immediate and measurable effect. In this case, knowledge of the risks associated with living in a particular area would result in responses including the bargaining for a lower sales price, the avoidance of house purchase within the special studies zone, or the adoption of mitigation measures in the new residence. Any such change in behavior should be noted in a reduction in average house prices, since demand would be weakened and the cost of mitigation measures should enter in the estimation of the cost of living in the surface fault rupture environment.

Organization of the Study

Two California housing submarkets were selected for intensive surveys of recent homebuyers, associated real estate salespersons, and housing market behavior. These areas, Berkeley and

¹⁵ W. J. McGuire, "The Nature of Attitudes and Attitude Change," in G. Lindzey and E. Aronson, eds., *The Handbook of Social Psychology*, 2nd ed., vol. 3 (Reading, Massachusetts: Addison-Wesley, 1969), pp. 136-314; and P. Zimbardo and E. B. Ebbesen, *Influencing Attitudes and Changing Behavior* (Reading, Massachusetts: Addison-Wesley, 1970).

¹⁶R. H. Weigel and L. S. Newman, "Increasing Attitude-behavior Correspondence by Broadening the Scope of the Behavioral Measure," *Journal of Personality and Social Psychology*, Vol. 33 (1976), pp. 793-802.

¹⁷ Weigel and Newman, op. cit., footnote 16

central Contra Costa County, were chosen to minimize the social and economic contrasts of the study areas while varying the physical appearance and geologic characteristics of the areas, as well as the organization of the board of Realtors (Figs. 1 and 2). Although both are East Bay communities suburban to San Francisco, they function as separate housing sub-markets. Both are generally inhabited by white, upper-middle class households in single-family, detached dwellings. They differ in that Berkeley is located on the Hayward fault and has more visible damage from fault creep to the retaining walls, houses and curbs, while central Contra Costa County is located primarily on the Calaveras fault, and visible signs of fault creep are difficult to find.

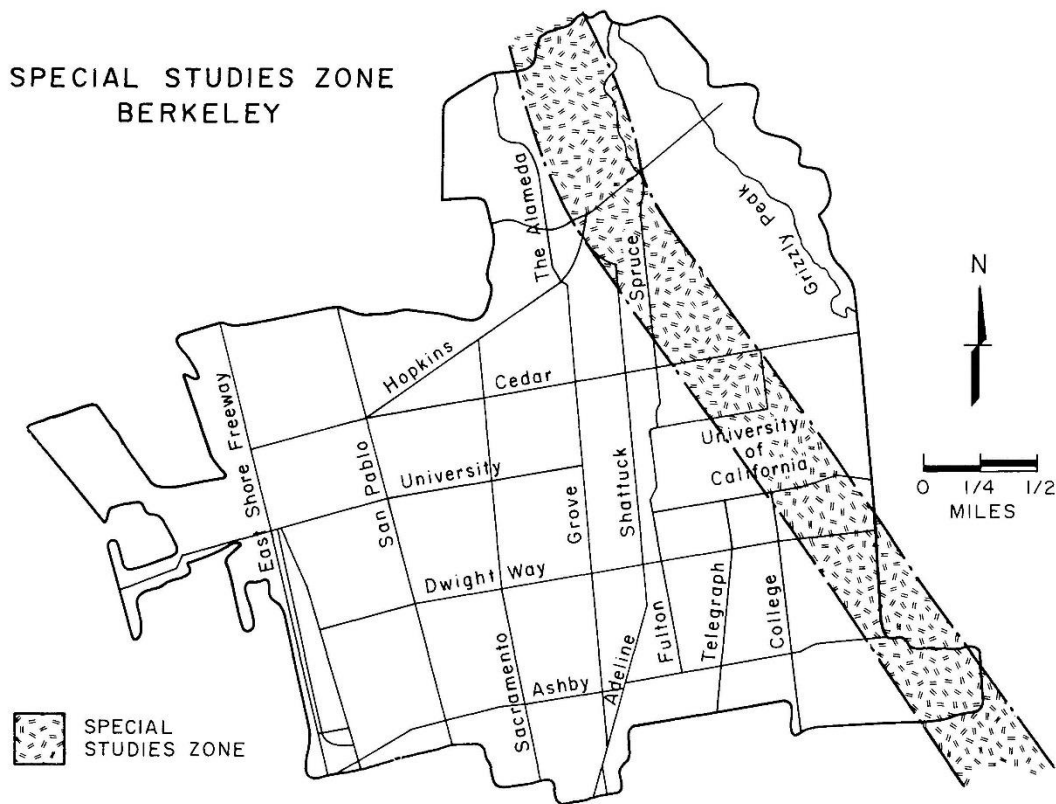


Figure 1: The special studies zones in Berkeley along the Hayward fault.

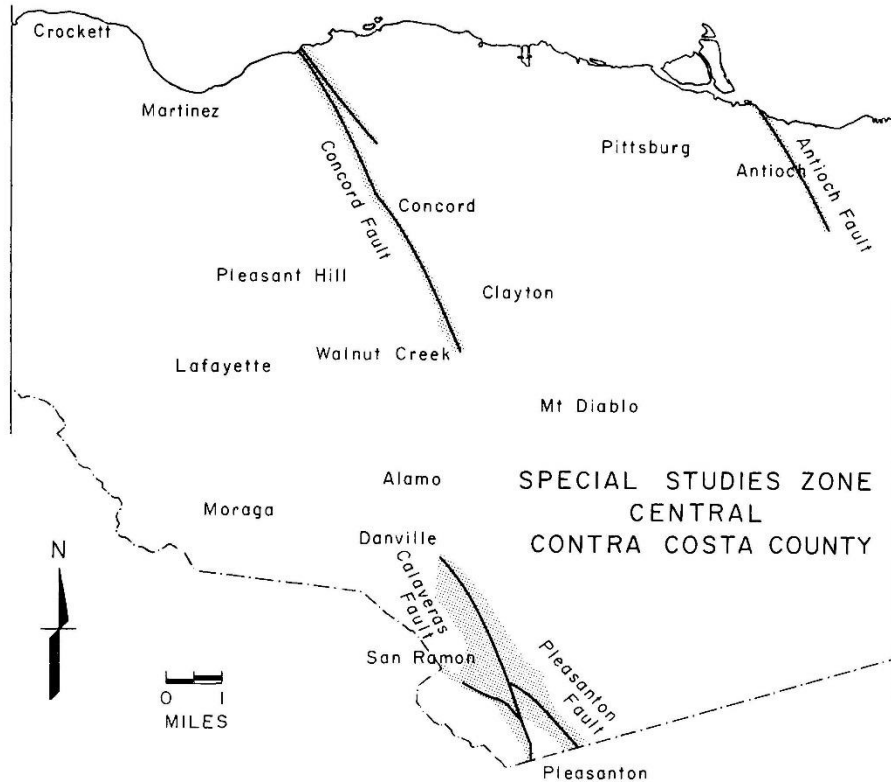


Figure 2. The special studies zones in central Contra Costa County along the Calaveras fault.

Evidence concerning the impacts of mandated disclosure was garnered from three sources: a survey of recent homebuyers, a survey of real estate agents active in special studies zones sales, and a study of house price trends in neighborhoods within and adjacent to the zones. The survey of homebuyers was a set of three surveys conducted throughout 1979. The first was a telephone survey of 207 homebuyers who had purchased houses within the special studies zones within the six months prior to being interviewed. The purpose of this survey was to ascertain whether buyers recalled a disclosure, the impact which disclosure might have had on search and purchase behavior, and general attitudes towards earthquake hazards and special studies zones. The second survey was directed at 100394 households that had purchased homes near but not actually within the special studies zones. It was assumed that these homebuyers might have different attitudes toward earthquake risks, since they might include those who had received a disclosure while looking at a house within the special studies zone and had responded by moving to a similar area outside the zone. The third survey was a mail resurvey of the 96 homebuyers within the zones who had responded that they were aware that their homes were within special studies zones, and seemed to understand the significance of this fact. Its purpose was to ascertain whether disclosure had spurred these buyers to take mitigation measures other than avoiding the area.

The survey of real estate agents was directed at only those salespersons who were identified by recent special studies zones homebuyers as having “helped” them with their home purchase. This

screening limited the sample to licensees actively selling real estate, and to those who should be most familiar with the special studies zones disclosure procedures.¹⁸ The survey attempted to discover the methods used for disclosure, the extent to which the real estate agents understood what it was they were disclosing, and the general response of real estate agents to the legislation.¹⁹

The third portion of the empirical work was a hedonic price analysis based on data describing over 7,000 sales as collected by the Society of Real Estate Appraisers. The independent effects of location within a special studies zone on prices were tested for both before disclosure had been mandated and after it was safely in place.

Responses to Disclosure

Disclosure legislation had little measurable impact on buyer or market behavior. First, surveys of recent homebuyers both within the special studies zones and in nearby similar neighborhoods outside the zones showed that distance from an active earthquake fault has little or no influence on search behavior or the final purchase decision. When recent buyers in both study areas and in both types of neighborhoods were asked to indicate whether each of fifteen factors was “very important,” “some- what important,” “not important” or “did not consider” with respect to the decision to buy the home, the two factors consistently evaluated as most important were investment potential and price; those evaluated as least important were location out of a floodplain and distance from an active earthquake fault. When asked more directly, “Did the location of earthquake hazard zones make any difference in your decision to buy this particular home?” only 18.7 percent of the within zone residents and 20.8 percent of the residents outside the zones said “yes.” The location of a fault trace was not important in the purchase decision, even to those to whom a disclosure had been made.

This response by buyers was corroborated by the experience of real estate agents. When asked if they had ever had a client decide not to buy a home after being informed that it was in a special studies zone, only twelve agents said they had had such a refusal. Of these, only four could recall more than one client balking at the special studies zone designation.

Most homebuyers, whether located within or outside the special studies zones, were not aware that such districts existed. Even more significantly there was no difference in the likelihood that individuals would know of the existence of the zones by neighborhood; those living within the zones usually had never heard the term “special studies zones, nor were they aware their house was in any type of designated seismic hazard district. Although the survey could not gather direct evidence that disclosures were not being made, responses clearly indicate that the disclosure is

¹⁸ Only about fifty percent of those persons holding licenses in California actively sell real estate according to the President of the California Association of Realtors, Clark Wallace (personal communication, 1979).

¹⁹ A more complete version of the survey results is available from the author.

not remembered, even only six months after it is made. It should be noted that although real estate agents are charged by law to make a disclosure, not even all of the real estate agents could associate the term “special studies zone” with seismic risks or earthquake faults; a full 16 percent of the real estate agents interviewed defined special studies zones as flood hazard areas or even as areas in which transportation planning surveys were slated.

There was a difference in the interpretation of the special studies zones by those who lived inside as opposed to outside. Those who lived within the zones said that they were no more susceptible to damage than those who lived elsewhere in the Bay Area (65 percent), but those who lived outside disagreed (62 percent said such residents were more susceptible to losses). Neither group, however, felt that location in a special studies zone would impair either the ability to sell the house or its selling price.

Objective evidence for this belief was reflected in the analysis of house prices. Data on sales prices, housing, and neighborhood characteristics for 1972 and 1977 in the two study areas were analyzed. In addition, a third study area, southern Alameda County, was added to further generalize the impacts of zonation on house prices. Hedonic price indices were calculated for square footage of dwelling space, age of the house, quality of the house, condition of the house, size of the lot, the presence of a swimming pool, fireplace, or “view lot,” the economic status of the area, and housing stock composition. Location with respect to the special studies zone was coded as a dummy variable: property was classified as within the zone, adjacent to the zone (within one mile), or outside the zone (beyond one mile).²⁰

The research hypothesis stated that in 1972 the special studies zone was unrelated to house price (the coefficient was zero), but in 1977 was negatively related. In addition, in 1977 location near the special studies zone should have a positive regression coefficient because of a build-up of demand for housing near but not actually in the zones, and location outside the zones should continue to have no effect on house prices. The results of a set of single-step ordinary least squares equations for the three study areas are complex (Table 1). For central Contra Costa County, the results are nearly as hypothesized, suggesting that even the very few people who were aware of, and concerned with, proximity to an active fault trace may have been a sufficient force in the marketplace to weaken prices within the zones. However, house prices in the other two areas did not perform as hypothesized. In southern Alameda County, special studies zones locations had no independent effect on house prices, and in Berkeley, location in the zones had a

²⁰ The use of hedonic price indexes to assess the impacts of individual environmental variables has been widespread in economics. This literature has focused on the impacts of air quality on land values, as summarized in A. M. Freeman, “Hedonic Prices, Property Values and Measuring Environmental Benefits: A Survey of the Issues,” *Scandinavian Journal of Economics*, Vol. 81 (1979), pp. 154-73. A hedonic price study of the impacts of special studies zones on land values is D. S. Brookshire and W. D. Schulze, *Methods Development for Valuing Hazards Information* (Laramie, Wyoming: University of Wyoming, Institute for Policy Research, October 1980). In this study of Los Angeles County, special studies zones were found to have had a negative impact on sales price, reducing home value by an average of \$6,140 in 1978-79.

positive impact on house prices. The Berkeley results should not be interpreted as reflecting a preference for the special studies zones, but rather show the continued demand for houses in the lower portions of the Berkeley hills. Because of the great variation in the effects of zonation on house prices, it is probable that it is not the zonation disclosure but rather some correlated neighborhood characteristics omitted from the equation that have affected prices. On the basis of the price equations for two of the three study areas, one may conclude that disclosure has not had a negative impact on house price levels.

Table 1. – Effects of Location in Special Studies Zones on House Prices

	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)	-1,062 (.101)	positive	none
Outside	-422 (.234)	1,121 (.078)	none	positive at .10
R ² =	.74	.75		
Berkeley				
Inzone	2,617 (.000)	9,618 (.092)	negative	positive at .10
Adjacent	1,162 (.061)	9,118 (.092)	positive	
Outside	-3,121 (.000)	-1,315 (.004)	none	negative at .01
R ² =	.84	.74		
Central Contra Costa County				
Inzone	-912 (.307)	-4,182 (.000)	negative	negative at .01
Adjacent	-473 (.620)	1,500 (.048)	positive	positive at .05
Outside	-623 (.377)	1,705 (.007)	none	positive at .01
R ² =	.55	.67		

Finally, disclosure has resulted in little measurable increase in mitigation measures. Because the Bay Area respondents were higher in income and education than the general population, and because they had recently received information that their homes were located within one-eighth mile of an active fault trace, they should have been more likely than the general Los Angeles population to adopt mitigation measures. This expectation was not borne out by the survey findings (Table 2). A comparison of the 96 Berkeley and Contra Costa special studies zones

residents with 1,450 randomly sampled Los Angeles County households showed that only a minority of the residents of either area has taken any of the mitigation measures, the only exceptions being the possession of a working flashlight, battery radio, and first aid kit.²¹ Residents of the special studies zones were more likely than the Los Angeles respondents to purchase earthquake insurance, to structurally reinforce their homes, and to replace cupboard latches, but most other measures were more frequently adopted by Los Angeles residents. A possible explanation for the greater frequency of adoption by the general Los Angeles population of measures such as emergency procedures at residence and family plans for reunion after an earthquake may be the combination of a fairly recent earthquake experience in 1971 and the widespread discussion surrounding the so-called Palmdale bulge as a precursor of major movement along the southern portion of the San Andreas fault running through Los Angeles. But whatever the explanation, one must conclude that special studies zones disclosure, even when understood and remembered, was not associated with increased adoption of mitigation measures.

Table 2. - Mitigation Measures

	Have done primarily because of earthquake threat		Total percentage who have done	
	Bay Area	L.A.	Bay Area	L.A.
Inquired about earthquake insurance	41.4%*	23.1%	41.4*	23.1
Bought earthquake insurance	24.1*	12.8	24.1*	12.8
Instruct children what to do in an	20.0	47.6	22.2	50.4
Emergency procedures at residence	15.6	26.1	25.4	34.1
Family plans for reunion after earthquake	14.0	19.9	16.0	22.1
Replace cupboard latches	13.8*	4.5	22.4*	10.2
Have a working battery radio	8.6	11.1	53.4	54.6
Structurally reinforce home	8.6*	4.7	13.8*	11.1
Have a working flashlight	6.9	10.8	86.2*	71.5
Rearrange cupboard contents	5.2	9.7	12.1	16.3
Contacted neighbors for information	3.4	9.8	15.5	19.5
Have first aid kit	3.4	6.0	68.9	50.1
Store food	1.7	8.0	20.7	26.8
Store water	1.7	8.0	5.1	17.1
Set up neighborhood responsibility plans	1.7	4.0	12.0	12.2

* Bay Area respondents exceed Los Angeles respondents.

Discussion

The empirical study of homebuyers within the special studies zones, homebuyers in nearby areas outside the zones, real estate agents, and housing market behavior demonstrates that mandated disclosure has had little effect on buyer behavior or market performance. Although we have no direct information on the probabilities assigned to earthquakes by recent homebuyers and the existence of a probability threshold, it is apparent that seismic risks are given a very low priority in the home purchase decision. In addition, when some of the many factors considered within the purchase decision are considered individually, it is apparent that respondents give little weight to earthquake hazards or other environmental disamenities in their priority system. Instead, the primary motivation for a given home purchase decision is the minimization of the price paid for a dwelling unit of given characteristics and the maximization of its potential resale value. This motivation is very clear from the priority assigned to price and resale value by buyers in both study areas, both within and outside the zones. The house is treated as an economic investment, rather than a locus for family activity for a ten- to twenty-year period. Given this motivation, buyers may not hesitate to buy a home in the special studies zone as long as it is believed to have good potential resale value, and will not adopt costly hazard mitigation measures which cannot be recouped in the subsequent sales price. Information provided by the mandated disclosure is simply treated as irrelevant to the decision at hand.²²

The role of the information agent also interferes with the translation of disclosure into measurable behavior. To be effective, the real estate salesperson should have a generally high credibility to the buyers; yet it is well documented that buyers do not place their trust in real estate agents as a source of information about all aspects of the house purchase process, a wariness which may be partly attributed to the uncertainty concerning which party the real estate agent is representing in the sales process.²³ A related problem is the fact that real estate agents might provide misinformation concerning the special studies zones or may reinforce wishful thinking on the part of the buyer that the zones are not meaningful. Misinformation may be attributed to the simple lack of understanding of the meaning of special studies zones. The reinforcement of wishful thinking may come about from the desire of the real estate agent to close the sale, and the sincere belief on the part of the agent that the zones are not particularly important or meaningful, an attitude held by two-thirds of the real estate agents surveyed.

The nature of the zones themselves has also proved confusing. The maps provided by the office of the state geologist were not at a scale at which the location of individual properties could be located. This problem of accurate portrayal of individual parcels has become so severe that boards of realtors have urged their members not to make assessments of questionable parcels, but rather to recommend seeking the advice of a consulting geologist. Even more serious is the fact

²² J. C. Hershey and P. Schoemaker, "Risk Taking and Problem Context in the Domain of Losses: An Expected Utility Analysis," *Journal of Risk and Insurance*, Vol. 47 (1980), pp. 111-32.

²³ D. Hempel, *The Role of the Real Estate Broker in the Home Buying Process* (Storrs, Connecticut: Department of Marketing, University of Connecticut, Center for Real Estate and Urban Economic Studies, 1969).

that the zones themselves, while they do include the known fault traces, do not encompass areas most susceptible to earth-quake-associated damage. For example, although the 1906 earthquake in San Francisco is recalled as particularly severe and damaging, no special studies zone runs through the city. The zones do not include areas susceptible to liquefaction, shaking, or ground failure, since these are related to bedrock conditions as well as simple proximity to the fault. Although the special studies zones were relatively easy to define by legislation, they do not necessarily portray the areas of greatest seismic hazard.

Finally, there are problems with the disclosure legislation itself. Because the method of disclosure was not specified within the law, it has been possible to develop methods that minimize the impact of disclosure on buyers. The three standard formats used are the information in the Multiple Listing Service pages (used by thirty percent of the real estate agents interviewed), a map of the area with special studies zones drawn in (used by seventy percent), and a contract addendum (used by ninety-one percent of the respondents). The Multiple Listing Service form presents little information to the buyer. In Berkeley, disclosure on this form is simply a typed line stating "in Alquist-Priolo zone" or "in Alquist-Priolo district." To the uninitiated buyer, such a statement might mean anything. In Contra Costa County, the form includes a line stating "special studies zone" and a box marked "yes" or "no." This disclosure tells the buyer nothing about the meaning of the zones. The map, used particularly in Contra Costa County at the time of the survey, is a detailed street map of the region with the "hundred year floodplain" in blue, the special studies zone in yellow, and areas of combined hazard in green. Terms are not defined on the map, and the districts can be used by the real estate agents to demonstrate to the prospective buyers that many other properties share the same characteristics, and that therefore such a zonation cannot be very important since so many houses are at risk. The third disclosure method is the signing of a contract addendum. This addendum, until recently, stated that "the property is or may be situated in a Special Studies Zone." No definition of the special studies zone is presented, although the form does note that construction for human occupancy on the property may be subject to the findings of a geologic report unless such buildings are single-family, wood-frame dwellings or were in existence prior to May 4, 1975. The words "seismic," "earthquake," or "fault" are nowhere mentioned in the contract addendum. Although the prescription of disclosure methods within the law would not guarantee that the information would be heeded, it is possible that the memorability of the disclosure could be increased. At present, real estate agents are disclosing at the least sensitive time, and using methods which convey a minimum of information, with the result that a majority of those who presumably received a disclosure are unable to remember it.

Conclusions

Mandated provision of information by real estate agents has had little impact on homebuyers. Among the factors diminishing the effectiveness of this method of informing the general public about seismic hazards are the possible poor credibility of the real estate agent as a source of environmental information, the possible role conflict of the real estate agent in both selling

property and protecting prospective buyers from environmental hazards, the differential degree of understanding by real estate agents of the location and meaning of the special studies zones, and the belief held by real estate agents that the zones are unimportant and therefore not worthy of attention. Equally important reasons for the nonresponse of buyers are the emphasis homebuyers place on the house as a financial investment overwhelming most other considerations, and the inadequacies of the zones themselves in outlining areas susceptible to greatest damage in the event of a major earthquake. An additional factor that may have lessened buyer response is the widespread belief that there are few real alternatives: that “all California is earthquake country,” and that in an economic situation in which there is an excess of demand over supply buyers have little choice but to purchase any home they can afford whenever and wherever it becomes available.

The linkage between consumer protection legislation and behavioral response is based on the notion that improved information results in more “rational behavior.” However, when what is “rational” to the individual differs from the assessment of the same situation by the policymaker, the predicted or intended response may not be achieved. In the case of provision of information about special studies zones, flaws within the legislation were compounded because the hazard homebuyers were being warned against generally lies outside the realm of concerns, constraints, and boundaries within which location decisions are made. In such a situation, mandated disclosure was doomed to failure.

A recurring theme in this study has been the attempt by a legislature to protect individuals from environmental hazards. In order to improve their performance, the legislature should realistically deal with the full range of hazards, both natural and human-made, facing state residents. If in such an assessment it is decided that earthquake hazards are more important than some others, and if the legislature truly wishes to take effective action to mitigate these hazards, it must deal with a more comprehensive definition of earthquake risks, and reconsider legislation which would better inform residents both about the hazards and feasible mitigation strategies. It is important that lawmakers recognize that the mere provision of environmental information to homebuyers who are constrained by other aspects of the purchase process is insufficient as a hazard mitigation or consumer-protection measure: mitigation can come only through forceful and direct measures such as zoning, land use regulation, or the compensation of current residents in exchange for the condemnation of dwellings in particularly hazardous environments.