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# HOME MORTGAGE LENDERS AND EARTHQUAKE HAZARDS

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**ABSTRACT:** A survey of major home mortgage lenders and real -property appraisers in California and the Puget Sound region shows a general inattention to earthquake hazards in appraisal and lending policy. This inattention is demonstrated not only in responses to survey questions, but also in a lack of differentiation in lending decisions between properties within and outside surface-fault rupture zones. As posited by organizational theory however, important variants exist in this overall policy, almost always resulting from the efforts of individuals within large lending organizations.

## I. INTRODUCTION

In the United States, few homeowners are insured for earthquake-related damage. As a result, homeowners in earthquake-prone areas are particularly susceptible to serious financial losses. In California, for example, less than 10 percent of the homeowners are insured for earthquake-related damage (Kunreuther et al. 1978; Palm 1981a; Steinbrugge 1982; Turner et al. 1979). Most of the homeowners' equity in such property, which is frequently the major source of savings for the individual household, could thus be lost in a single major event.

Contrary to popularly held views, all of California is not equally susceptible to seismic-related damage. Even within individual metropolitan areas, it has been possible to develop microzonation maps to show regions likely to experience "no significant damage" in contrast to those likely to experience "extremely strong shock with partial or total destruction of some buildings" or "high ground water with high potential for ground failure (liquefaction)" (Figure 1). Such information could be made available to prospective home buyers in some systematic fashion or could be contained "in the market," in the sense that housing in more hazardous would carry a lower price. Neither of these conditions, however, obtain at present. Although the Alquist-Priolo legislation in California requires real estate agents to inform home buyers if a property is within a surface-fault rupture zone (a "special studies zone"), this disclosure has been shown to be ineffective as a means of transmitting environmental information (Palm 1981a). Furthermore, house prices do not reflect location in such zones (Palm 1981b). Finally, the special studies zones themselves never were intended to approximate the area particularly liable to earthquake damage; because they are based solely on distance from a surface-fault trace and do not take into account bedrock conditions, areas susceptible to liquefaction and ground failure are excluded.

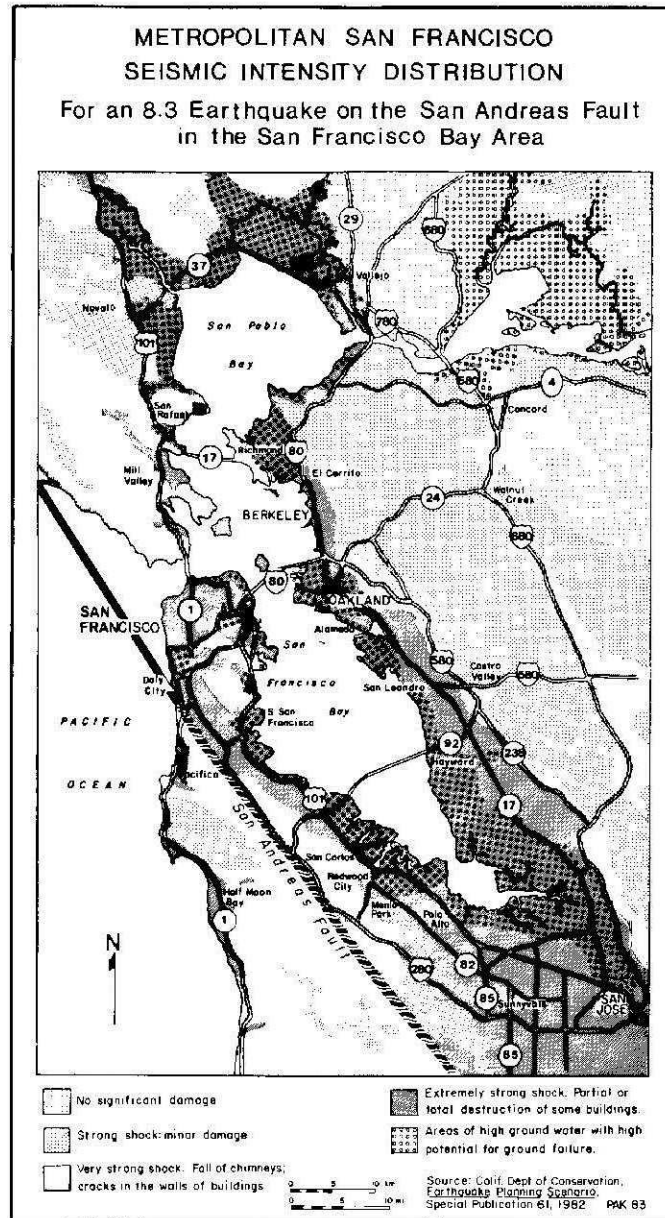


FIGURE 1. Microzonation of Earthquake Hazards

The purchase of housing takes place in a highly credit-dependent environment: most housing involves some form of mortgage financing, and, as a result, the willingness of the mortgage lender to grant a loan on favorable terms has a major influence on the purchase decision. What this means is that the lender has a major impact on the maximum price that can be obtained on a property. Although the actual final price is the product of “the market,” in which a buyer and seller reach an agreement, some consensus among appraisers and lenders about the market value of a class of housing affects the price range within which final negotiations take place. Thus, the ways in which home mortgage lenders estimate property value and make loan approvals set major limitations to individual locational decision making by prospective home buyers.

The purpose of the research reported here was to study the responses of home mortgage lenders and real property appraisers to earthquake hazards. The study was designed to describe the practices of lenders and appraisers in incorporating earthquake hazards in their portfolio analysis and lending behavior. Its other purpose was to explore the applicability of recent organizational theory to an empirical setting in which individuals in very large organizations must respond to a highly complex and ambiguous environmental situation.

## 2. DECISION MAKING BY LENDERS AND APPRAISERS

The valuation of property by real-estate appraisers and the decision to grant or deny a loan application by home mortgage lenders are conceptualized as highly rational processes. Investment in a particular set of locations can be seen as comparable to the so-called “locational rationalization” process used to describe the behavior of multilocal or multinational corporations (Clarke 1982; Taylor and Thrift 1981). In this system of analysis, operations are continuously checked against one another for relative profitability, and capital is moved rapidly to the most profitable locations (Clarke 1982; Taylor and Thrift 1981). The financial and operational performance of firms can be monitored, and performance is compared to normative indices (McConnell 1982).

While the relatively longer-term investment in home mortgage loans is not perfectly captured by the locational rationalization system, lending and valuation decisions can be understood as part of an overall investment strategy. Furthermore, valuation procedures and loan decision-making skills are frequently taught in university courses and described in textbooks (Bloom and Harrison 1978). These idealized decision models can be used as a standard against which the actual behavior of appraisers and lenders can be measured.

### *Models of Appraiser Behavior*

Real-estate appraisers are taught to use three methods to assess the value of single-family residences: the market-data or comparable approach, the cost method, and the income approach. The market-data approach, in which the subject property is compared to “comparable” property that has recently been sold, is used most commonly for single-family residential property. The appraisal report for this approach should include information on the house itself; its local environment, and neighborhood characteristics. In courses in real-estate appraisal, students are reminded that various hazards may affect the value of the property.

Sometimes hazards exist in the neighborhood that reduce the value of a property. The most common hazard is heavy traffic, and the market will definitely recognize and penalize this problem. The awareness of flood hazards has become quite important in many parts of the country . . . [and the effect of flooding and mandatory flood insurance] on value must also be considered and reported in the appraisal. Other hazards that should be investigated include potential slides, earthquakes, dangerous ravines and bodies of water, or any unusual fire danger (Bloom and Harrison 1978, pp. 124-25).

There are two significant points in this quotation; first, the notion that it is not the appraiser who is taking an active role in valuation, but rather, “the market,” which in this text is reified to

enable it to “recognize” and “penalize” a problem; and second, the admonishment to take flooding and other natural hazards into account in the appraisal.

Although appraisers may include descriptions of any number of variables in their reports, the final estimated value they report is based on probable market activity—the agreement reached between a seller and a buyer. In some ways, then, the appraiser simply reflects the workings of the market in attempting to estimate the probable selling price. In other ways, however, the appraiser influences the market, insofar as appraisal reports are used to make decisions concerning the amount of mortgage financing to be made available. The influence of appraisers is conservative: the appraisal report reflects past market behavior that, in the process of being reported and estimated for the current transaction, influences present financing decisions as well as perceptions of current market value.

### *Home Mortgage Lending Practices*

Ideally, lending decisions are made in two steps. The first is a general portfolio analysis, including a decision about what percentage of assets to invest in housing. This decision is made in response to regulatory and tax constraints, liquidity needs, and the computation of the current ratio of profit-to-risk in residential loans. The second decision is made by loan officers or loan committees concerning particular applications for financing. Two factors are considered: characteristics of the borrower (the likelihood that the borrower will repay the loan in a timely fashion), and characteristics of the security property (the likelihood that in the event of a foreclosure, the costs of foreclosure and the balance of the loan outstanding will be covered). Studies have also shown that lending decisions are affected by the risk-taking inclinations of the loan officer, the perceived career advantage of particular risk-taking strategies (Schweig 1977), the dynamics of the decision-making process in the loan committee (Chalos 1982), and the previous relationship between the borrower and the loan officer.

The rational decision-making model posits that lenders formulate an expected profit function which is used to evaluate any given loan application. For example, Shear and Yezer (1983) conceptualized a rational decision-making model:

$$E(\pi) = \Lambda(1 + r)L + (1 - \Lambda)OV - (1 + i)L$$

Where

- $E(\pi)$  = expected profit
- $\Lambda$  = expected probability of borrower not defaulting
- $R$  = mortgage interest rate
- $L$  = mortgage amount
- $O$  = share of house value not captured by collection costs when default occurs
- $V$  = expected value of house conditional on foreclosure occurring
- $I$  = opportunity cost of capital

Expected profit from a mortgage loan is equal to revenue from the loan (based on interest rate and resale value in the event of a default) minus the cost of making the loan (what the capital could return to the investor if placed in alternative investments). The mortgage's interest rate should be higher if the loan officer's perception of the possibility of default is higher, if opportunity costs are higher, or if collection costs when a default occurs are higher. The lender integrates earthquake hazards through a calculation of the probability that an earthquake will occur which will cause the loan to go into default, or that earthquake damage will impair the ability of the lender to recoup the investment in the event of a default. On this point, empirical evidence (Anderson and Weinrode 1981) suggests that moderate-intensity earthquakes have induced fairly high foreclosure and delinquency rates.

This study posited that if lenders feared major potential financial losses associated with foreclosure proceedings or, in a period of weak or declining house values, anticipated negative net equities in the event of a major earthquake, then they might take measures to ensure the safety of their mortgage investments. It should be noted that even if only a few lenders refuse to grant conventional loans, require higher down payments, or require the purchase of earthquake insurance in areas particularly susceptible to seismic-related damage, the result would be some reduction in the flow of mortgage funds and a relatively higher cost of obtaining mortgage financing, thereby depressing property values.

### 3. ORGANIZATIONAL THEORY

In the preceding discussion, a model of decision making and valuation by appraisers and lenders was presented which was based largely on "rational" calculations. Little consideration was given to the fact that organizations, including major lending institutions, are complex, inconsistent, and constantly changing. Decision theory that ignores such circumstances is clearly insufficient to capture the complexity involved in the actual valuation of hazards and the integration of this valuation in lending behavior. It is important, therefore, to review those aspects of organization theory that contribute to the understanding of the response of lending institutions to uncertainty in the physical environment.

Recent work in organizational theory has diverged from the classic models describing communication and decision making within large organizations (Putnam 1982). Putnam and Cheney (1985) have concluded that recent studies of organizational communication have emphasized the ways in which *meaning* is *created*. Organizations are seen increasingly as simple aggregates of persons arranged in patterned relationships, rather than as formal and permanent structures. In addition, more attention has been paid to intraorganizational conflict in studies focusing on resource control or power, and the influence of "gatekeepers" on decision making (DuBrin 1972; Kanter 1977).

Thompson (1983) has argued that the objectives of firms are often ambiguous and contradictory. In the firm, there are conflicting interests, continuing negotiations, and alliances continuously being renegotiated, reformed, and dissolved. The organizational management "charts an always compromised course through an always changing series of constraints and obstacles where an

always shifting series of partial objectives are in play in that negotiation” (Thompson 1983, p. 237). Similar arguments have been made by Salaman (1978) and Heydebrand (1977).

Another perspective has been provided by communication theorists influenced by an anthropological approach to organizations (Pacanowsky and O'Donnel-Trujillo 1982). This line of argument promotes attention to “organizational culture.” Within this framework, studies would focus on the use of “relevant constructs” (shared vocabulary which indicates the ways in which individuals affiliated with the organization structure their experiences), “facts” (shared social knowledge within the organization), “practices” (methods of performing particular functions), “metaphors” (specific phrases or symbols used to structure the reality of the organization), “stories” (narratives about real and ideal organizational life), and “rites and rituals” to orient and share reality with other organizational members.

Recent sociological approaches have stressed a historical perspective. Bensen (1977) has argued for increased attention to the historical process from which present-day organizational patterns have been generated and through which relationships are sustained. Similarly, Giddens (1979, 1984) and Abrams (1982) have called for an increased emphasis on the evolution of the organization within broader societal structures; the organization continually emerges as a function the influence of individuals as well as structure.

Regional science has also concerned itself with these theoretical perspectives. Two presidential addresses to the Regional Science Association, by Torsten Hägerstrand (1970) and Allan Pred (1985), have pointed up the importance of the investigation of human agency embedded in a complex organizational structure. In Pred's paper, explicit attention was given to the importance of studying the ways in which situated individuals affect the development of structure -- how human agency produces and maintains places and regions.

A continuing theme in this literature the necessity to focus on diversity within organizational structures, as well as on the specific historic circumstances which have contributed to current organizational structure and practice. When studying the response of financial institutions to the physical environment, diversity of responses within a single industry should be monitored. This would elicit an understanding of conflicts within individual institutions, of their resolution in particular cases, and of the influence on overall organizational policy of individuals with varying professional goals and personal experiences. External constraints to organizational response should also be included explicitly in the analysis.

Both the rational decision-making models and the frameworks suggested by recent work in organizational theory were used to formulate hypotheses for the study reported here. It was hypothesized that the aggregate of lending and appraisal decisions generally follow principles of rational decision making: that, except where forced to respond to low probability events by other legislation, lenders rarely consider the unlikely event of major destruction associated with earthquake in their overall lending decisions, and that little disinvestment occurs in earthquake-

hazard areas. It was also proposed, however, that (1) there are intra-industry variations in this generalization (significant differences in the ways in which earthquake hazards information is incorporated and weighted in lending policy); and (2) certain individuals within financial institutions have had significant impact on the decision to adopt a particular lending policy with respect to earthquake hazards.

#### 4. THE SURVEY OF APPRAISERS

In order to ascertain the practices and attitudes of real estate appraisers to earthquake hazards, a survey of 30 California appraisers was conducted between November 1982 and February 1983. Individuals interviewed were, in all but one case, independent fee-appraisers who were self-employed or employed by appraisal firm, rather than by a financial institution. All had been appraisers for more than 10 years, and most of them did single-family house appraisal primarily for mortgage lenders.

Appraisers were asked how they incorporated information into their property appraisals about a variety of environmental factors, including, landslide hazards, location in a flood plain, location on a surface-fault trace, location in a special studies zone, and evidence of damage to the property from earthquakes or landslides. They were asked if they routinely investigated these factors, if they noted them in their appraisal reports, if they checked comparable properties for these factors, and if they identified a price adjustment for each factor (Table 1). Although appraisers said they almost always investigated whether a property was in a flood plain, only a minority sought information on whether it was on a surface-fault trace, and only 13 percent made any price adjustment for this factor. It was exceptional that comparables were checked for similar hazard conditions, or that any price adjustment was made.

TABLE 1. Appraisals and Environmental Hazards

Percentage of appraisers who:

	Investigate if condition applies	Note in report	Check comparables	Identify price adjustment
Floodplain	93	87	77	23
Special Studies Zone	67	53	57	17
On surface-fault trace	37	37	23	13
Landslide area	57	43	43	33
Evidence of previous damage	63	63	27	17



To elicit another view of the way in which appraisers incorporate earthquake hazards into a property valuation, they were provided with an example of a typical property and asked to make an appropriate price adjustment. They were asked to estimate the 1982 price of a “fifteen-year old, tract or semi-custom house with 1,800 square feet, three bedrooms, and two bathrooms, on a standard-sized lot in an average middle-income and middle-aged neighborhood in this community.” The median price estimated by the California appraisers for such a house was \$160,000, with the estimated price ranging from \$115,000 to \$250,000. When asked, “In your experience, what range of price reduction have you encountered if the property were in a special studies zone or surface-fault rupture zone,” most responded that there was no price reduction at all; the median response was 0.1 percent reduction (Table 2). Most appraisers felt that location in a landslide-prone area, or evidence of actual damage from previous earthquake-related movement, would have a negative effect on price, but that the location of a property within a mapped floodplain or special studies zone would not, by itself, lower the price. This perception is in accord with previous statistical analysis of actual price effects (Palm 1981b).

TABLE 2. Valuation of an “Average House”

	Median estimated price reduction	Percentage of appraisers who said “no reduction”
The house . . .		
. . . is in a mapped floodplain	0.3%	69.6
. . . is in a landslide-prone area	17.0%	25.0
. . . is in a Special Studies Zone	0.1%	75.0
. . . shows evidence of actual damage from previous earth movement	10.0%	40.0

Appraisers were asked whether they had ever had a client request information concerning seismic hazard. Only three of the respondents (10 percent of the sample) said they were frequently asked about seismic hazards by clients; the others answered that they were rarely or never asked. Appraisers whose clients asked for seismic information were also more likely to say that they routinely investigate whether a property is located on a surface-fault trace or landslide-prone area, to note this in the appraisal report, and to check comparables for both characteristics.

In general, appraisers behaved as hypothesized. They indicated that earthquakes cannot be isolated as an influence on value because they occur only infrequently. In addition, the effect on price is generally small and short-lived.

Appraisers do not feel that earthquake hazards have been incorporated “by the market” into housing prices and, therefore, generally disregard their potential effect on value. Although there

is individual variability in appraisal practice, most appraisers respond to what they perceive as the realities of the market.

## THE RESPONSE OF LENDERS TO EARTHQUAKE HAZARDS

A survey of chief executive officers (or their designates) was conducted in last three months of 1982 among 90 California lending institutions, and 30 similar institutions in the Puget Sound Region. The combined assets in home mortgage loans for the Washington sample accounted for approximately 60 percent of all home mortgages held by commercial banks, savings banks, and savings and loans in the state; the California sample represented about 75 percent of such assets.

An open -ended question asked lenders to list those characteristics of a property that are important in their decision to grant a home mortgage loan. Only 37 percent of the responses included some sort of geophysical hazard, such location in a floodplain, location with respect to a known earthquake fault, or susceptibility to landslides. When asked more directly whether seismic risk was considered when evaluating loans on residential property, the vast majority respondents in both states said that seismic conditions were *not* considered as a basis for setting loan conditions. Overall, only 18 lenders, mostly in California, *did* consider seismic conditions.

The rational lending model suggests that earthquake hazards should be a factor in the lending decision if lenders believe that large numbers of households would default after a major damaging earthquake, and if areas particularly susceptible to earthquake damage can be pinpointed. , Several questions were posed to probe lenders' perceptions of these issues.

First, lenders were asked to rank five possible causes of mortgage default-- unemployment of the head of household, divorce, fire, major flooding, and major earthquake damage. In both California and Washington, lenders evaluated a major earthquake as the least likely cause of mortgage default.

A second perspective was sought with a question designed to elicit the beliefs of lenders concerning the likely outcomes of a major damaging earthquake. The question provided a scenario of probable damage following the maximum intensity earthquake likely to occur in the three areas. Three forms of this question were posed: one for the Puget Sound (based on U.S. Geological Survey 1975), a second for Northern California (based on Davis et al. 1982a), and a third for Southern California (based on Davis et al. 1982b). In Southern California, scenario read:

An earthquake along the southern San Andreas Fault has a high likelihood of occurrence. An 8.3 event would claim \$17 billion in property damage, between 3,000 and 14,000 dead, and between 12,000 and 15, 000 hospitalized, depending upon the time of day the event occurs.

Lenders in the three regions were then asked to speculate on the likely outcomes such an earthquake (Table 3). Lenders do expect mortgage defaulting in the event of a major earthquake and believe that some insurers will be unable to meet their liabilities. When asked what

proportion of their portfolios they expected would be in default, most Washington lenders indicated only a small percentage (less than 10 percent), but California lenders were more pessimistic. Almost one-fourth of the California lenders expect more than 25 percent of their home mortgage portfolios to be in default.

TABLE 3. What Would Be the Likely Results of a Major Earthquake?

	Percentage of lenders who said "yes" or "maybe"	
	California sample	Washington sample
Increased mortgage defaults	98	94
Fire insurance more expensive	76	77
Changes in the building code	75	87
Local recession	71	57
Insurers unable to meet liabilities	53	35
Adequate government aid	41	43
Earthquake insurance unavailable	40	21
State-wide recession	35	30
Fire insurance unavailable	16	10

### *Market Impacts of Lender Perceptions*

The survey research indicates a lack of attention to earthquake hazards. To investigate the market impact of this attitude to earthquake hazards, loan applications in California were analyzed. Economic theory would posit that the market should reflect the response of even a minority of lenders (Brookshire and Schulze 1980, 1982; Rosen 1974): Although explicit incorporation of earthquake hazards is done by only a minority of lenders, their actions should result in a weakening of house prices within special studies zones.

To test this hypothesis, data from the *California Loan Register Report* were analyzed. This publication contains detailed information on home loan applications from all California state-licensed savings and loans over the period of 1976 to 1981. The second and third quarters of 1979 and 1980 were selected to draw a sample. This period contained a large number of property transfers and immediately preceded a very rapid rise in interest rates which weakened the market.

The specific hypothesis was that the decision to grant a loan would be systematically related to the ratio of sales price to income, the age of housing, whether the property was owner- or renter-occupied, the race or ethnicity of the borrower and whether or not the census tract in which the house was located was included in a special studies zone. Variables reflecting the borrower's credit history, the more detailed attributes of each property and information on the immediately

surrounding neighborhoods also *should* be included. Such information is not available in the *Loan Register Report*; the model, therefore, uses age of housing and proposed tenure status of the borrower as general indicators of neighborhood quality, and race or ethnicity of the borrower to control for possible discrimination factors. Weak evidence of discrimination was found by Schafer and Ladd (1981) and Goebel (1982) in their analyses of the same data set.

Data analysis was conducted for the state as a whole, as well as for smaller housing submarkets. The statewide calculations were performed to get a very general outline of the characteristics of lending decisions. Submarket approximations give a more detailed and accurate picture of the contributions of individual variables to the lending decisions, since it can be argued that various submarkets operate independently (Straszheim 1974). Ideally, submarket areas should be defined by patterns of information exchange, an area which is best approximated by Board of Realtors territories (Bourne 1976; Palm 1976, 1978); counties within SMSAs were used to approximate Board of Realtors Districts.

For the state as a whole, and for ten counties within the major SMSAs, determinant functions were calculated, as well as t-tests on the individual variables to determine their relationship to the lending decision (Table 4). Location in a special studies zone entered only the discriminant functions for Riverside, San Bernardino, and Santa Clara Counties. T-tests on this variable showed that there was a significant difference between loan applications granted and denied in special studies zones versus other areas only in Alameda and Riverside Counties. Both of these cases are interesting because the relationship was exactly the *opposite* of what would have been expected: loans on property located in the special studies zones (surface-fault rupture zones) were *more likely* to be granted than loans on property located in other areas. The explanation is not a perverse preference of residents of these counties for earthquake hazards zones; rather, it is probable that special studies zones do not contribute in any way to the lending decisions, and other amenities associated with these zones make them attractive to lenders. In Alameda County the special studies zones are associated with architecturally unique properties in the hills of Oakland and Berkeley along the Hayward Fault. In Riverside County, the special studies zone runs through a set of rapidly developing desert communities, including Morongo Valley, Desert Hot Springs and North Palm Springs. In both cases the special studies zone is in a portion of the county which is desirable for relatively newer, higher-priced housing, and the zone designation has not had a negative impact on loan applications.

In the state taken as a whole, and in the urban submarkets approximated by counties within major SMSAs, only two variables were consistently related to the decision to accept or reject a home mortgage loan application. First, lenders tended to act more favorably on loan application for new housing rather than older housing (except in San Francisco County). Second, ethnicity and race of the borrower had an impact on the lending decision in several of the counties: Hispanic borrowers were less likely to receive a favorable loan decision in Alameda, Los Angeles, Riverside, and Santa Clara Counties than were Anglo borrower, and black borrowers were more likely to receive a negative decision in all but San Bernardino County. The ratio of sales price to income was related to the lending decisions only in Alameda, Los Angeles, San

Bernardino, and San Francisco Counties, contrary to expectations based on the rational decision model.

TABLE 4. Statistical Analysis of Home Loan Applications

Sample	SP/I	AGE	OWN	BLACK	HISP	SSZ
State	1.2	1.2	1.2	1.2	2	
Counties						
Alameda		1.2		1.2	1.2	
Contra Costa	1.2	1.2	1.2	1.2	2	
Los Angeles	1.2	1.2	1	1.2	2	
Orange	1.2	1		1.2	1.2	
Riverside	1.2	2			2	1.2
San Bernardino	1.2	2	1.2			2
San Francisco	1.2	1.2		1.2	2	
San Mateo	1.2	2		1.2		
Santa Clara	1.2	1.2	1.2	1.2	1.2	2
Ventura		2	2	1.2		

*Symbols*

1 = t - value for difference between loans granted and loans refused significant at .05 for this variable

2 = variable entered into the discriminant function

*Variable Definitions*

- SP/I Ratio of sales price to family income
- AGE Year the house was build
- OWN Owner-occupied housing
- BLACK Borrower was black
- HISP Borrower was Hispanic
- SSZ Property was located in a Special Studies Zone

In sum, location in a special studies zone does not seem to have a negative impact on the lending decision: instead, it has no impact whatsoever. This finding is not surprising given both the size and diversity of the special studies zones, and the survey responses of lenders and appraisers. Both survey data and information on correlates of lending decision provide evidence that location in a surface-fault rupture zone does not affect the evaluation of that property by appraisers and lenders. The mere mapping of special studies zones has not resulted in a change of lender behavior, nor a tendency to avoid investment the zones.

## 6. CHARACTERISTICS OF LENDERS WHO *DO* CONSIDER SEISMIC RISK

Although the general hypothesis of this research project was that lenders would tend to ignore the low probability, locationally unspecific earthquake hazard, the subhypothesis was that there would be intra-industry variation in this response. This variation would be attributable to the organizational structure of lending institutions and the impacts of key individuals within these institutions. To gain further insights on the behavior of the minority of lenders who do consider seismic risk in their lending policies, the responses of California lenders to questions about the incorporation of seismic risk in lending decisions were cross tabulated with other portions of the questionnaire. This tabulation revealed that California lenders who considered seismic risk in residential loans were also more likely to consider seismic risk when evaluating loans on commercial property; were more likely to require earthquake insurance when there was evidence of previous seismic or geologic damage; were more likely to favor lender-required earthquake insurance as an industry-wide policy; were more favorable to instituting earthquake insurance requirements if the cost of such insurance could be reduced; were more likely to require earthquake insurance for property located within a special studies zone; were more likely to refuse loans because of location within a special studies zone or a landslide-prone area or because of evidence of previous damage to the dwelling unit from seismic or geological activity; were more likely to state that it is the lender's responsibility to inform home buyers about earthquake hazards; and were more likely to use geologic or other scientific information in their lending decisions. They were also less likely than other lenders to expect government aid to be adequate to reimburse homeowners for their disaster losses following a major earthquake.

Discriminant functions corroborated these simple cross tabulations. Coefficients were calculated from a stepwise procedure using Wilks' lambda criterion (Rao 1973). The variables entering into the function are shown in the first column of Table 5. These variables correctly classify 83.9 percent of the grouped lenders.

The responses of California lenders who said they required earthquakes insurance for loans on property underlain by a surface-fault trace were similarly classified. Of 62 California lenders, 12 indicated that they have such requirements. The variables shown on the right in Table 5 correctly classify 88.6 percent of lenders grouped in this way.

To gain further insights into the history of the development of an earthquake-sensitive lending policy among the minority of institutions which explicitly considered seismic hazard, a second round of interviews was conducted in the early months of 1984 at institutions that (1) had a policy incorporating seismic risk in residential lending and (2) had a written document outlining this policy. Ten of the 90 institutions contacted in the first round of interviews were included, representing about 18 percent of the total California residential loan portfolio held by the combination of all commercial banks and savings and loan institutions as of 1981.

The sequence of events that permitted a change in lending policy varied among the institutions. Some responded to losses from previous earthquake; such as the 1971 Sylmar/San Francisco earthquake; others said that the Community Reinvestment Act or the Federal Flood Insurance

Program encouraged lenders to reevaluate their entire lending policy; and still others indicated educational seminars influenced them to consider such a policy. Although hazard mitigation policies resulted from various sequences of events, in all cases, one person had been responsible for instituting and promoting a lending policy sensitive to seismic risk. In most of the institutions this individual was a high ranking executive (the president, chief executive officer, or member of the board of directors), although in a few cases the individual was a residential loan officer.

In sum, lenders generally behaved as hypothesized. Overall, lenders ignore low-probability earthquake hazard, despite a recognition of its potentially disastrous effect on the economic well-being of the institution. In the minority of cases where lending policy has adjusted to the presence of earthquake hazards, it was the efforts of a single individual motivated by specific circumstances that effected the institution's response.

TABLE 5. Characteristics of Lenders Who Consider Earthquake Hazards

Lenders Including Seismic Risk in Loan Policy		Lenders Requiring Earthquake Insurance for Property on a Surface-Fault Trace	
Variable Entering Canonical Discriminant Function	Standardized Coefficient*	Variable Entering Canonical Discriminant Function	Standardized Coefficient*
Lender's responsibility to inform buyers of hazards	.55	Percentage of loans that would be in default	.64
Commercial bank (vs. S and L)	.55	Consider seismic risk on personal residence	.58
Consider seismic hazard on personal residence	.51	Lender's responsibility to inform buyers of hazards	.53
Have earthquake insurance on personal residence	.40	Rank earthquake as cause of default	.51
Have attended earthquake seminar	.31	Location in San Francisco	.36
Years as a loan officer	-.29	Volume vs. safety as criteria of success as lender	-.36
Percentage of loans that would be in default	.21	Have attended earthquake seminar	.22

\*Wilks' Lambda for all coefficients significant beyond the .01 confidence level

## 7. DISCUSSION AND CONCLUSIONS

This study has shown that, in the aggregate, home mortgage lenders and real-property appraisers respond only passively to earthquake hazards. Most lenders do not believe that a major damaging earthquake is a likely cause of large-scale defaulting. They cite several justifications for this belief. First, at present, earthquakes cannot be precisely predicted either in time or location. Second, they believe that even in the event of a major earthquake, their portfolios are relatively insulated from major losses -- large homeowner equity would insure the lenders of an eventual continuation of mortgage repayments. Third, they feel that other events, including unanticipated unemployment of principle wage earners, or dissolution of the family, are far more likely to impair repayment of mortgage loans. Lenders are, therefore, responding to a low-probability event in a way they see as rational: they accept the small risk of loss that might accompany a major damaging earthquake. Lenders depend on "the market" to help them with lending decisions, except when actually forced by legislation or regulation to heed low-probability natural hazards.

A significant exception to this overall conclusion is the finding that nine major home mortgage lenders, with combined residential loan portfolios accounting for 18 percent of loans held by California savings and loans and commercial banks, do have written statements incorporating earthquake hazards into residential lending policies. In every case, these institutions adopted such evaluation procedures as the result of the influence of a particular individual. In some cases, this person had been influenced by state or federally supported earthquake education seminars, or by experience in dealing with the impairment of mortgage repayment associated with previous earthquakes. This finding should be noted by agencies that have sponsored earthquake education seminars for corporate officers, such as the California Seismic Safety Commission, the Federal Emergency Management Agency, and the U.S. Geological Survey, since it indicates that their efforts have borne some fruit. Another important finding is that those lenders who explicitly consider earthquake hazards do not feel that such stipulations have, in any way, resulted in a decline of loan applications or lost business. On the contrary, lenders testified that they gained increased security in their own portfolios, as well as the thanks of loan applicants for informing them about the need to reduce the susceptibility of the household to equity losses.

The study also demonstrates the ways in which structuring theory can provide a framework for better understanding the response to a complex, ever- changing environment. Theories of organizational communication point up the significance of individual influence in corporate policy, and the extent to which variability can exist within a single institution. Structuring theory calls attention to the combination of the influence of individuals (agents) and structural constraints in placing individuals and aggregates of individuals in a particular action context. In the case of lending institutions, the primary environmental constraint is not that of the geophysical setting, but rather the shorter-term set of economic conditions, state and federal banking regulations, and competitive strategies adopted by other similar institutions. Attention to these constraints permits a better understanding of the seeming non-response of lenders to serious environmental hazards.



The synthesis of theoretical perspectives suggested in structuration theory (Giddens 1984) permits and promotes a more revealing analysis of a highly complex human-environmental situation. It is from such an approach that insights into the nature of the human-environmental system may be obtained, and strategies for intervention and mitigation may best be formulated.

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