Assessing the Price Effects of Flood Hazard Disclosure Under the California Natural Hazard Disclosure Law (AB 1195)

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Submitted to the Journal of Environmental Planning and Management
February 2003

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A. ABSTRACT

This study uses hedonic analysis to estimate the effects of flood hazard disclosure under the 1998 California Natural Hazard Disclosure Law (AB 1195) on property values throughout California. It finds that the average floodplain home sold for 4.3 % less than a comparable non-floodplain home following AB 1195 while before that law there was no significant price differential. The introduction of interaction terms indicates that the magnitude of the price reduction due to AB 1195 varies positively with Hispanic population share. An average floodplain home in a half-Hispanic neighborhood saw an $11,305 negative capitalization due to AB 1195, while that amount was only $2,210 for a neighborhood with 10% Hispanic residents. Results suggest that, in particular, homebuyers in Hispanic communities are better disclosed to under AB 1195 than they were under the National Flood Insurance Program (NFIP), which was the primary policy regulating flood disclosure in California prior to passage of AB 1195.

B. INTRODUCTION

While considerable research has looked at the effects of floodplain location on housing values (see Shilling *et al.* 1985, MacDonald *et al.* 1987, Donnelly 1989, Tobin and Montz 1994, Fridgen and Schultz 1999, Harrison *et al.* 2001, among others), the role of information asymmetries in floodplain property transactions has received considerably less attention. This study looks at the price effects of flood disclosure in real estate transactions under the California Natural Hazard Disclosure Law of 1998 (AB 1195) and compares them to price effects under the National Flood Insurance Program (NFIP), which regulated flood disclosure in California prior to AB 1195. The study has three purposes. The first is to determine the extent to which information is better disseminated under AB 1195 relative to the NFIP.[i] The second is to determine whether biases existed in the disclosure mechanisms of the NFIP that may have systematically resulted in lower levels of information dissemination to certain income or ethnic groups, and, if so, whether AB 1195 has helped to correct those biases. The third is to determine whether the pre-AB 1195 floodplain price differential found in this study differs significantly from differentials found in the literature.

The last point is of importance because most previous studies were confined to the US Midwest and Southeast, which is hydrologically and climatically different from the American West. Federal policy does not require an avoided damages approach in determining cost-benefit ratios for non-structural flood hazard mitigation measures because it is assumed that the value of the land already fully capitalizes the flood risk (PWRC 1983). For this reason the federal government has expressed strong interest in determining whether empirical evidence can be found that flood risks are not capitalized into property values (USACE 1998). If flood risks are capitalized differently into property values in different parts of the country, this could have important implications for the government's flood mitigation policy.

C. POLICY BACKGROUND

The National Flood Insurance Program (NFIP)[ii] requires transfer disclosure and flood insurance purchase for houses in Special Flood Hazard Areas (SFHA's)[iii]. The inconsistency of flood disclosures and designations under the NFIP has resulted in estimated program participation rates of as low as 20% in flood prone areas (Beneson 1993), although participation rates have increased somewhat since the early 1990s. Low participation relates in part to the mechanisms of designation and disclosure. When Congress amended the National Flood Insurance Act in 1974, they made flood designations mandatory for all properties with mortgages originated through federally regulated institutions (i.e. S&L's or commercial banks) and for those properties whose mortgage were resold on the secondary market to Government Sponsored Enterprises (GSEs) such as the Federal National Mortgage Association (FNMA, or "Fannie Mae") or the Federal Home Loan Mortgage Corporation (FHMC, or "Freddie Mac"). This arrangement left many homebuyers and some sectors of the mortgage industry unregulated by the NFIP, and hence not subject to determinations and disclosure.

In addition to those who self-financed, or financed through informal sources, those who financed through less heavily regulated sectors of the mortgage industry, especially subprime mortgage companies, were likely subject to lower rates of disclosure. While some mortgage companies do disclose in a timely manner, others do not undertake flood determinations until they sell a mortgage portfolio to a larger federally regulated lending institution, or to a GSE, like FHMC or FNMA, all of whom require a federally compliant mortgage contract that must include proof of flood determinations. If any determinations in the portfolio indicate floodplain location, those owners are disclosed to and must buy insurance. However, according to John Eldridge, Community Mitigation Program Branch Chief for FEMA Region IX, because of this mechanism, many property owners who finance through mortgage companies frequently do not learn that their house is in a floodplain until long after purchase (personal communications, 2000, 2001). Disclosure after the transaction is essentially meaningless from the perspective of economic efficiency (Chivers and Flores 2003). Since consumers do not know about the flood zone status when they bid on the property, it fails to internalize the costs and risks associated with living in that location.

From the perspective of disclosure, subprime lenders represent a particularly problematic type of mortgage company. They specialize in originating high-interest loans to homebuyers with impaired credit histories. Because of the higher risk of this sector, GSEs and other regulated institutions have traditionally not purchased subprime mortgage portfolios (Temkin and Johnson 2002), and hence subprime originators have been subject to much less regulatory oversight (Canner and Passmore 1999). Moreover, subprime lenders are notorious for pressuring homebuyers without adequately explaining the conditions of a loan. Hence, it seems likely that those originating with subprime lenders would undergo lower rates of flood disclosure under the NFIP.

AB 1195[iv] represents a more comprehensive and rigorous approach to hazard disclosure. It requires sellers of properties within statutorily designated natural hazard zones to show prospective buyers a Natural Hazard Disclosure Statement prior to closing. The statement informs buyers whether the property is located in one or more of six hazard zones[v] (only flood zone effects are examined in this article), including the FEMA 100 year floodplain, also known as the special flood hazards area (SFHA). The Statement, available in multiple languages, informs the consumer of the federal requirement that properties in the SFHA must be covered by NFIP insurance. Its inclusion of FEMA flood zones in the disclosure statement could be thought of as a tacit recognition that flood disclosure provisions are inadequate for consumers under the NFIP system.

AB 1195 also granted a three-day rescission period during which buyers have the right to terminate a transfer after signing a contract if proper disclosure was not made. This provision gives sellers and their agents an incentive to disclose early in the process rather than at the last minute. Finally, in contrast to previous hazard disclosure laws, AB 1195 clearly articulates where sellers and real estate agents are liable for disclosure and where they are not and it protects them from liability exposure due to error, omission or inaccuracy in the disclosure. Under AB 1195, that liability is transferred to a third party[vi] company hired by the seller to conduct the report, usually for a fee of between $50 to $100. This shielding of liability is likely a significant incentive for compliance with the law.

D. Previous Research

One of the few recent studies to look at imperfect information in the National Flood Insurance Program is from Chivers and Flores (2003), who found a market failure stemming from information asymmetries in the NFIP. Using homeowner surveys in Boulder Colorado, they found that homebuyers in the floodplain typically learned of the flood risk very late in the buying process and generally underestimated the costs of flood insurance. The fact that nearly 70% of respondents said they would have reduced their offer price had they known of the need for and cost of insurance is an indication that the allocative efficiency gains that Krutilla (1966) said should arise from a national flood insurance program are not happening, at least in their study area.

Most of the literature has looked at the price effects of flood zone location, independent of information dissemination mechanisms. In theory, the risks and expenses associated with living in a flood hazard zone should be capitalized negatively into housing prices. This negative premium may also include an “option price” or risk aversion premium that compensates for the uncertainty of potential damages and injury in excess of insurance coverage. Most studies have found that floodplain location is capitalized negatively into housing prices, although the magnitudes have varied.

Using hedonic analysis of home sales prices in Louisiana, MacDonald *et al.* (1987) found that statutory floodplain homes sell on average for between 6% and 8% less than comparable non-floodplain homes. They found that the differential was equated with the present value of insurance premiums at a 2.8% discount rate but that an "option price" emerged at a higher discount rate. In MacDonald *et al.* (1990), they added that the selling price differential also includes the difference in non-insurable costs. Using similar methods, Shilling *et al.* (1985) found that floodplain location in Louisiana reduced home values on average by 6.4% from comparable houses outside the floodplain and that the reduction in value equaled the present value of insurance costs when calculated at a 5% discount rate. Shilling *et al.* (1989) conducted another hedonic study of a Louisiana housing market, which used both a dummy variable for presence in flood zone and a continuous variable for the amount of insurance premiums paid. Results were consistent between the two approaches, indicating a $4,500, or 8% negative capitalization. This was found to equate to the present value of insurance premiums at a 4% implicit rate of discount.[vii] Donnelly (1989) conducted a hedonic analysis on sales prices for floodplain and non-floodplain properties in La Crosse Wisconsin and concluded that floodplain location reduced sales price by 12% for the average house in his study area. At a 10% discount rate, he calculated that this results in a 6% risk aversion premium. Harrison *et al.* (2001) used hedonic analysis to look at floodplain properties in Florida and found a smaller differential. Prior to the 1994 National Flood Insurance Reform Act, that differential was roughly $985 for the average house while it rose to $2,126 thereafter. Fridgen and Schultz (1999) found that floodplain location in Fargo, North Dakota and Moorehead, Minnesota lowered values on average by $8,990, while after a major flood that negative premium rose to $10,241.

Bartosova et al. (1999) used hedonic analysis to study the price impacts of flood risk on property values in Wisconsin. Unlike the previous studies, however, they came up with a continuous measure of flood risk, related to the flood return frequency, which was mapped as a surface and assigned to overlaying properties. They found a significant but small positive relationship between reduced flood risk and property values, indicating that price effects are not uniform within the floodplain, ranging from a 7.8% loss in value for houses at the river's edge to no loss at locations with a flood return frequency of less than once in 33 years. USACE (1998) took a somewhat similar continuous approach to the flood variable and found a 0.157% reduction in property value for each 1% increase in flood probability in Frankfort, Kentucky.

Most of these studies focus on a single, or just a few linked markets, limiting their ability to explain how price effects vary with socio-economic factors. The one study that covered several heterogeneous areas, by Tobin and Montz (1994), found that recent occurrence of a flood reduced transacted property values in their study sites in Pennsylvania, California and Illinois. The magnitude of the relationship between flooding and home value was found to be a function of flood severity as well as of several local factors not related to flooding. Two factors of importance were the demand for housing and the availability of flood free land. Nevertheless, the results must be taken with caution, given that the R squared values for the hedonic equation ranged only from .17 to .56.

Only a few studies found either no effect or a positive effect from flood zone location.[viii] One of the few studies located in the US West, conducted by Muckleston (1983), found that regulations for floodplain homes in Oregon did not serve to depress property values, as hypothesized, but rather tended to be associated with an increase in value. However, the author cautioned that those conclusions were tentative and offered the caveat that study areas were not uniform due to heavy development just before the implementation of the floodplain regulations.[ix]

Our study contributes to the literature in several ways. First, it looks at the inadequacies of information dissemination under the NFIP, using AB 1195 as a yardstick of comparison. It is different from Chivers and Flores (2003) not only in that it uses hedonic analysis rather than surveys, but also in that we look at the entire population of homebuyers, rather than just those who were disclosed to, allowing us to investigate the mechanisms behind non-disclosure. Second, it looks at the distributional consequences of disclosure under the NFIP and AB 1195, across income and racial groups. Third, it is among very few studies to address the question of floodplain price effects in California or the American Far West (most of the literature has focused on the Midwest and Southeast), where the different nature of the hydrology and climate may result in differences in consumer perception of and market behavior towards flood hazard.

E. METHODS

This study uses hedonic analysis to isolate the price effects of disclosure under AB 1195. Economists including Rosen (1974), Quigley and Kain (1970) and Griliches (1971) developed the concept of hedonic price analysis, in which the observed price of a good is econometrically disaggregated into a schedule of implicit marginal attribute prices. The first step hedonic equation is estimated by regressing observed market price on vectors of neighborhood, locational and structural attributes and, in this case, dummy variables for flood zone location (FLOOD), for transaction before or after the law (AFTER) and an interaction term representing disclosure (FLOOD:AFTER). This model can be expressed as:

$$P_{it} = \beta_0 + \beta_1 S_i + \beta_2 L_i + \beta_3 N_{it} + \beta_4 M_{it} + \beta_5 F_i + \beta_6 A_{it} + \beta_7 FA_{it} + \upsilon_{it}$$

Where:

P_{it}= Sales price of house *i* at time of transaction, *t*
S_i= structural characteristics of house *i*
L_i= locational characteristics of house *i*
N_{it}= characteristics of house *i's* neighborhood at time *t*
M_{it}= housing market characteristics house *i's* neighborhood at time *t*
F_i= dummy variable indicating house *i's* location in the flood zone
A_{it}= dummy variable indicating house *i's* transaction after the law at time *t*
FA_{it}=interaction dummy variable indicating house *i*'s transaction after the law at time *t* within the flood zone

β_0 = intercept

$\beta_{1...n}$ = regression coefficients

υ_{it} = regression error term

A two-tier cluster sample method was used to get a representative sample of housing transactions from across California. In the first sampling tier, zip codes from across the state were stratified by 3 categories of population density and three categories of median 1999 housing price, subsetting only zip codes meeting minimum threshold values for percentage of the land area occupied by statutory hazard zone.[x] A proportional random sample (11% sampling rate) was taken from each stratum, yielding 63 tier 1 sampling units (zip codes). Figure 1 shows the location of sample zip codes.

Individual property transaction records from the sampled zip codes were obtained for the period starting 18 months before the implementation of AB 1195 to 19 months after it. Both vacant and developed parcel transactions were obtained[xi], but only the results of regressions on developed properties are discussed here.[xii] These property points were address geocoded and a variety of structural, locational, demographic, school and market variables were assigned for each property point as control variables.[xiii] A price adjustment factor, varying by quarter was also included. Variable names, descriptions, count proportions and mean values are given in Table 1.

For tier two sampling, property transaction records were stratified by zip code and by hazard (or no-hazard) zone. A sampling algorithm was created that oversampled cells (i.e. groups of properties of a given hazard status within a given zip code) with low populations and undersampled cells with high populations. Since non-hazard zone properties are over five times as prevalent as combined hazard zone properties[xiv] within the 63 zip codes, this served to oversample hazard zone properties, especially those in zip codes where there were relatively few hazard zone properties. Samples were assigned a different sampling weight by cell, for use in weighted least square estimation, equal to the inverse of the sampling rate for that cell. The sample included 2,880 records in flood zones (about 62% of all flood zone records from the sampling population), 4,289 from fire zones (54%) and 14,524 from no-hazard zones (38%), all of which were randomly sampled by stratum and assigned sampling weights. Separate models were then specified to look at fire and flood effects. Only the portion of the study looking at floodplain price effects is discussed here. The effects of fire hazard disclosure will be discussed in subsequent papers.

A maximum likelihood Box-Cox transformation was run to diagnose the appropriate functional form for the regression model. A Box-Cox transformation is defined as: $z^{(\lambda)} \equiv \dfrac{z^{\lambda} - 1}{\lambda}$, where λ = the Box-Cox parameter. A value of $\lambda = 1$ suggests a linear form is best, while a value of $\lambda = 0$ suggests that a log transformation of the dependent variable is warranted. The latter form (semi-log model) was chosen because the estimated λ of .09 is close to zero and includes zero within its 95% confidence interval. A plot of λ is given in Figure 2. One property of the semi-log functional form is ease of interpretation; coefficients can be interpreted as percentage changes in the response due to a marginal change in an attribute.

Quadratic terms were also included for most distance and size variables, where significant. Both weighted and unweighted least squares regressions were run. While unweighted models fit the data slightly better, core results were robust to inclusion or exclusion of weights, with only slight variations in magnitude. Hence, only results of weighted regressions are given here.

Attempts were also made to estimate separate equations stratified by time before or after AB 1195 as opposed to the pooled approach presented here, where time before or after is coded as a dummy variable (AFTER). Because results were little different and because F-tests indicated insufficient gains to model fit from temporal stratification, those results are not given here.

Three regression models were used to assess the effects of flood disclosure (see Table 2). Model 1 looks at the overall effect of flood disclosure without demographic interaction terms. It includes the terms FLOOD, representing the price effect of flood location before AB 1195, and FLOOD:AFTER, representing the additive effect of flood disclosure following AB 1195. Model 2 looks at the effects of flood zone location and disclosure accounting for interaction with median household income. In addition to FLOOD and FLOOD:AFTER, it includes FLOOD:MHHINC (interaction between median household income and pre-AB 1195 flood zone location). FLOOD:AFTER:MHHINC (additive interaction effect for post-AB 1195 flood zone location) was insignificant at the 95% confidence level and dropped.[xv] Model 3 looks at the effects of flood zone location and disclosure accounting for interaction with the percentage of Hispanics by census tract. In addition to FLOOD, this model includes FLOOD:AFTER:PHISP (interaction effect between percent Hispanic and post-AB 1195 flood zone location). FLOOD:PHISP (interaction between percent Hispanic and pre-AB 1195 flood zone location) and FLOOD:AFTER were dropped from this model because they were not significant at the 90% confidence level. A model including flood interactions with both percent Hispanic and median household income was not undertaken. Doing so would have required such a large number of interaction terms including FLOOD so as to result in losses to parsimony and to make parameter estimates on all interaction terms unstable.

F. ANALYSIS OF SALES PRICES

R-squared values for regression models ranged between .765 and .767 and all control variables were significant and had expected signs. Signs on quadratic terms were as expected as well, all having the opposite sign of the term they squared. Full regression results are given in table 3.

Model 1 (see table 4 for a summary of FLOOD effects for all models) indicates that prior to AB 1195 there was no significant difference in selling price between comparable floodplain and non-floodplain homes. However, disclosure under AB 1195 reduced the price of floodplain homes by 4.3% relative to comparable non-floodplain homes, holding all else constant. FLOOD (representing the floodplain premium before AB 1195) is not significantly different from zero, while FLOOD:AFTER (representing the change in floodplain premium after AB 1195, since interaction terms are additive) is negative and significant at the 99% confidence level, with a value of -.043. Solving the Model 1 equation for the average property in each of the four combinations of FLOOD and AFTER indicates that AB 1195 resulted in an $8,150 negative capitalization for floodplain homes (Table 5). That is, it caused the average floodplain home to sell for $8,150 less than a comparable non-floodplain home selling after the law. Or, put another way, AB 1195 caused the average floodplain home to sell for $8,150 less than it otherwise would have.

AFTER is positive and significant, suggesting that the PADJ variable did not control for all price appreciation[xvi] and that AFTER explains more than just variance in home prices resulting from the law itself since it is unlikely that AB 1195 caused houses to be worth significantly more. Had PADJ successfully controlled for all price appreciation, then AFTER should have been insignificant (although FLOOD:AFTER need not have been) and solving the equation would have yielded an absolute longitudinal decrease in floodplain home price, in addition to the relative decrease shown by these results. Ultimately this is not of great importance from an economic perspective; what matters is that AB 1195 caused homes to sell for less than they otherwise would have. We use two terms interchangeably to refer to this price effect: “relative price decreases” or “negative capitalizations.”

In Model 2, median household income (MHHINC) was tested for interaction with both flood location (FLOOD: MHHINC) and AB 1195 flood disclosure (FLOOD:MHHINC:AFTER).

FLOOD:MHHINC was positive and significant, with a coefficient of .323, indicating that in low-income neighborhoods floodplain properties are worth less than comparable non-floodplain properties (independent of transaction before or after AB 1195), while in high-income neighborhoods, it is the opposite. With FLOOD:MHHINC included, the coefficient on FLOOD becomes highly negative (-.27) and the coefficient on FLOOD:AFTER stays negative, at -.036. Solving Model 2 at mean attribute values results in a $6,633 relative price reduction for floodplain homes (Table 6). That is, while floodplain homes in neighborhoods with the mean income sold for considerably more than comparable non-floodplain homes before the law under this model, AB 1195 served to reduce that positive differential considerably.[xvii] This reduction due to AB 1195 is essentially unchanged by the level of income at which the equation is solved (what slight differences that arise stem from the nonlinearity of the equation), although the cross-sectional differentials between floodplain and non-floodplain prices both before and after the law change significantly when the equation is solved at different median household income levels.

The fact that FLOOD:AFTER:MHHINC is not significant suggests that AB 1195 had no impact on the relationship between the flood zone premium and income. That term was dropped from the model in the interests of parsimony.

Instead of low-income neighborhoods, it is Hispanic neighborhoods that appear to experience a negative price effect due to AB 1195 flood disclosure. Model 3 indicates that the price effects of AB 1195 are strongly conditioned by the racial composition of a neighborhood and that, when this effect is accounted for, FLOOD:AFTER become insignificant. That is, the flood disclosure price effect isolated in Model 1 can be attributed almost entirely to neighborhoods with significant Hispanic populations. The interaction term between pre-AB 1195 flood location and percentage of Hispanics in a census tract (FLOOD:PHISP) was insignificant at the 90% level and dropped. However, the interaction term between AB 1195 disclosure and percentage of Hispanics in a census tract

(FLOOD:AFTER:PHISP) was negative and significant, indicating that the negative capitalization caused by flood disclosure increases with the proportion of Hispanic residents. That term's coefficient of -.0011 indicates that, following AB 1195, every 10% increase in Hispanic population is associated with a 1.1% reduction in floodplain home price relative to comparable non-floodplain homes (the PHISP variable is recorded as integers, not decimals). Hence, holding all else constant, a floodplain home in a neighborhood with 50% Hispanic residents sells for roughly 5.5 % less than a comparable non-floodplain home, after AB 1195, all else equal, while before, it would have sold for the same amount.

When the mean value of PHISP (19%) was plugged into the Model 3 equation, AB 1195 was found to result in a $4,220 relative price decrease for floodplain homes (Table 7). However, Table 8 shows how this reduction increases in magnitude as the percentage of Hispanics per tract increases. A tract with 50% Hispanic population sees a relative price decrease in excess of $11,300, while a tract with only 1% Hispanic population sees a reduction of only $200. A tract with 30% Hispanic population, which is roughly the mean neighborhood Hispanic percentage for floodplain properties, sees a negative capitalization of $6,705, which is close to the results of Model 2.

G. DISCUSSION

These results suggest that the costs and risks associated with floodplain location are better internalized under AB 1195 than previously, likely because information is better disseminated under its disclosure mechanisms. The amount of the negative capitalization when solved at mean attribute values varies from $4,220 to $8,150 depending on the interaction model used. Model 1, which is the most parsimonious, and hence is probably the trustworthiest model, indicates a plausible negative capitalization of $8,150.

Model 3 indicates that most of the negative capitalization effect due to AB 1195 is accounted for by neighborhoods with a significant Hispanic population. As Table 8 shows, tracts with low Hispanic populations (<5%) see a very minor price effect, while that effect grows to -$13,644 for a tract with 60% Hispanic population. AB 1195 appears to have caused floodplain homes in highly Hispanic neighborhoods to be worth less than they otherwise would be, while having relatively little effect on floodplain properties in neighborhoods where the percentage of Hispanics is low.

We hypothesize two explanations for this result. First, Hispanics have a disproportionately large population share in floodplains in the state of California relative to other racial groups. The histograms in Figures 3-4 show that the distribution for the percent Hispanic variable is skewed to the left for the non-flood group, but is much less so for the flood group. Moreover, the average non-floodplain property in the data set belongs to a census tract that is 17% Hispanic, while the average floodplain property belongs to a tract that is 30% Hispanic. This suggests that the sample populations of flood zone properties are located disproportionately in neighborhoods with a high percentage of Hispanic residents. Their large population share in floodplains partially explains why any increase in rates of disclosure to Hispanics would have a significant impact on the post-AB 1195 floodplain premium.

Second, we hypothesize that flood disclosure under AB 1195 is correcting discrepancies in transfer disclosure between Hispanics and whites[xviii] that existed previously in California when disclosure was regulated under the NFIP. This discrepancy is due potentially to biases in NFIP's triggering mechanisms for disclosure. NFIP disclosure is regulated through the mortgage process, and Hispanics are significantly more likely that whites to originate their mortgage through less-regulated mortgage sectors. While black homebuyers are also more likely than whites to originate mortgages through this sector, their population share within floodplains in California is small enough that no statistically significant effect is seen from such an interaction.[xix]

The NFIP requires federally regulated lenders (banks, S&Ls, credit unions, etc.) to make flood determinations prior to issuing a mortgage. Our analysis of the Federal Financial Institutions Examination Council's (FFIEC) Home Mortgage Disclosure Act (HMDA) data, as well sub-prime mortgage origination data from the Department of Housing and Urban Development (HUD) suggest that Hispanic homebuyers disproportionately obtain home financing from less regulated sources, including subprime lenders. As described earlier, subprime lenders specialize in originating to borrowers with impaired credit and are notorious for not adequately describing the terms of a loan. Moreover, they are subject to less regulatory oversight because GSE's have traditionally not purchased subprime mortgage portfolios (Canner and Passmore 1999, Temkin and Johnson 2002). Given this, it seems plausible that these institutions also are lax in requiring designations and disclosure of flood hazard. Using a list of subprime lenders obtained from HUD, in conjunction with the FFIEC's Home Mortgage Disclosure Act (HMDA) database from 1998, we found that, in 8 sample Metropolitan Statistical Areas (MSA) in California, Hispanics were nearly twice as likely as whites to originate their mortgage with a subprime lender. Results, broken down by Metropolitan Statistical Area are given in Table 9. These results are consistent with a recent study (Bradford 2002) which found a great disparity between whites and Hispanics in rates of subprime borrowing and found that some of the MSAs of highest disparity were in California, including Fresno (included in this study), which was in the top three for the nation. Hence, Hispanics' disproportionate presence in floodplains and use of subprime lenders, may explain why the negative price effect from AB 1195 interacts significantly with the variable for percentage of Hispanics.

If the post AB 1195 negative floodplain premium in Hispanic neighborhoods is an indication that AB 1195 corrected information discrepancies between Hispanics and whites under NFIP, that would suggest that the price of floodplain homes in largely white neighborhoods should have negatively capitalized the negative floodplain premium prior to AB 1195. Why then, do results show this not be the case (i.e. FLOOD is insignificant in models 1 or 3)?[xx]. If AB 1195 had corrected these information discrepancies, should there not have been at least a slight negative premium on floodplain location prior to AB 1195 after adjusting for the Hispanic flood interaction? In theory, there should have been, but it is reasonable to suggest that the statistics would not have picked this up. A literal interpretation of the statistical results would suggest that nobody was disclosed to prior to the law, and that after the law only those in relatively heavy Hispanic neighborhoods were disclosed to, which is clearly unrealistic.

We posit instead that disclosure was occurring in largely white neighborhoods prior to AB 1195 and that the lack of a statistically perceptible effect was the result of two things. First, it is because of Hispanics' large population share within the floodplain. The lack of a negative pre-AB 1195 floodplain premium in Hispanic neighborhoods might have statistically "swamped out" the negative effect from existing price differentials in predominantly white neighborhoods, for which there were fewer observations in the floodplain. Second, there might have been an unmeasured positive amenity value associated with location in certain types of floodplains, which cancelled out the negative effect of pre-AB 1195 floodplain location. It is a strong possibility that the aesthetic beauty of living in a canyon bottom, on a riverside or by a wetland positively impacts prices. This is at least partially supported by the findings of Mahan et al. (2000), who found that proximity to urban wetlands, and size of nearest wetland, were positively associated with property value in Portland, Oregon. If, prior to AB 1195, the "natural" amenity value was strong enough, and the negative floodplain premium was weak enough, then the two would cancel each other out. In other words, before AB 1195, properties in highly white floodplain neighborhoods did capitalize the negative price effect, but that effect was masked by the omitted aesthetic effect and by the extremely large number of floodplain observations in Hispanic neighborhoods, where no floodplain effect was seen. Only when the large population of Hispanic floodplain households started to be subject to AB 1195 disclosure did that overall negative premium become perceptible.

Determining whether the post AB 1195 price differential fully capitalizes the costs of flood insurance and other expenses is difficult to do given the variability of results under the various models and the variability in flood insurance costs. Nevertheless, we offer a rough estimate of the present value of insurance costs of the average home for comparison to our results. Given the mean assessed structure value for houses in the data set of $115,393, assuming full coverage of the structure, no structure elevation or basement, construction before issuance of the Flood Insurance Rate Map (FIRM) and $20,000 in contents coverage, the premium on this house would be approximately $646 per year.[xxi] At a 6% discount rate (which is fairly realistic for the late nineties), the present value of these payments would be $10,769, which is slightly more than the $8,150 loss in floodplain property value under Model 1. The two equate at a 7.9% discount rate. This further suggests the presence of an unmeasured positive amenity that is slightly downwardly biasing the reported magnitude of the negative price effect.

Finally, the results of the second model, controlling for the interaction of income, indicate that median household income level does not condition the price effects of disclosure under AB 1195. While it appears that it is a critical factor in determining the price effects of floodplain location, AB 1195 had absolutely no effect on that relationship. That is, AB 1195 did not correct any discrepancies in disclosure based on income level. An exploration of why income was an important determinant of the price effect prior to the law is beyond this paper's scope.

No discussion of such a study would be complete without acknowledging assumptions and potential sources of error. We used a spatial-temporal proxy variable (FLOOD:AFTER) to infer the effects of flood disclosure because it represented the best available means for addressing this question on a wide-scale without undergoing the costly process of comprehensive surveys.[xxii] This means that, while we can say that floodplain prices are lower after AB 1195, we may only infer that the mechanism of that reduction is AB 1195. Moreover, we assume that, beyond our stated interaction effects, the effect of disclosure on homebuyers is constant. There is a strong possibility that other factors, such as personal or local experience with floods, condition those effects. Finally, errors in measurement may have biased some results. Potential sources of error include positional inaccuracy in the streets layers upon which address geocoding was based and the lack of available parcel maps for overlay with flood maps. Because a geocoded address point is merely an abstraction representing a property's estimated centroid, this approach increases the chance for errors in overlay analysis. Despite these cautions, we feel that this study strikes an adequate balance between model realism and practicality of implementation.

I. POLICY IMPLICATIONS

Across California today, flood disclosure is happening with more frequency and with more effectiveness than prior to AB 1195, when only the National Flood Insurance Program regulated it. One likely reason for the success of AB 1195 is that it allows sellers and agents to transfer liability to third parties. This approach to disclosure could serve as a useful example for other states that wish to enact similar legislation.

If the racially selective effect of AB 1195 is due to biases in the disclosure triggering mechanisms of the NFIP, then AB 1195 represents an important step forward towards more equitable and unbiased dissemination of information in property transactions. Addressing the problem of unequal disclosure on a national level will require that Congress amend the National Flood Insurance Act so that disclosure nationwide occurs through mechanisms similar to those of AB 1195—namely written disclosure by the seller and their agent prior to closing—rather than through the mortgage origination process. Given that such a major change in policy is unlikely any time soon, a more immediate recommendation is that researchers conduct audits to determine whether subprime lenders have lower rates of flood hazard determinations and disclosures prior to transaction than other types of lenders.

This study found that floodplain location had no impact on prices prior to AB 1195, adjusting for other variables. The fact that any potential pre-AB 1195 negative floodplain effect, if it existed, was small enough to be statistically disguised, suggests that it was likely of small magnitude. This contrasts with the previous literature, most of which found a fairly significant negative price differential under the NFIP. This difference may relate to the fact that almost all studies were done in either the Southeast or Midwest, where different climatic and hydrologic patterns likely result in different consumer perceptions of flood hazard. Because California (and the West in general) has highly seasonal precipitation patterns, many of its statutory floodplains are situated around intermittent and "flashy" watercourses that may appear misleadingly dry or anemic much of the year, especially in the context of a semi-arid surrounding environment. Hence, Californian homebuyers probably perceive the same statistical flooding hazard differently than homebuyers in the markets addressed in the literature, since they get fewer and less interpretable visual cues. This is of particular policy relevance because in its cost benefit analyses for flood hazard mitigation, the federal government assumes that the value of land already capitalizes any flood risk. While previous studies have found this to be true in other, wetter parts of the country, this study provides evidence that this assumption may not apply equally to all parts of the country. If Western properties are less likely to negatively capitalize flood risk, federal flood mitigation policy should recognize this, since it could alter the cost-benefit ratios upon which many non-structural flood hazard mitigation decisions are made. It is recommended that further studies address these potential geographical differences in consumer perception and behavior.

I. ENDNOTES

[i] Since disclosure is assumed to be complete under NFIP, any price effect from AB 1195 is an indication both that NFIP disclosure is inadequate and that AB 1195 is a more effective approach.

[ii] To participate in the NFIP, communities agree to adopt and enforce floodplain management ordinances to reduce the probability of future flood damage to new buildings in Special Flood Hazard Areas. In return, the community becomes eligible for federal disaster assistance and homeowners become eligible for flood insurance.

[iii] The SFHA is defined as an area that has a one percent or greater chance in any given year of flooding. The 100 year floodplain, or class A zone, falls under this designation.

[iv] Information given here on AB 1195 was obtained from personal communications in 1998 and 1999 with Peter Detwiler (Staff Director CA Senate local government committee), and communications in 1999 with Julie Snyder (aid to state representative Hannah Beth Jackson), both of whom who were involved in drafting the law. Information also came from Detwiler's 1998 article.

[v] Those zones include: Special Flood Hazard Areas (SFHAs), corresponding with the 100 year flood plain; Areas of Potential Flooding in the Event of Dam Failure; Very High Fire Hazard Severity Zones (VHFHSZs); Wildland Fire Areas; Earthquake Fault Zones; and Seismic Hazard Zones. This study looked at the effects of flood and wildfire disclosure, but only the effects of flood disclosure are discussed in this paper.

[vi]The third party designator is defined by section §1102.4(a) of the California Civil Code as "a licensed engineer, land surveyor, geologist....or other expert, dealing with matters within the scope of the professional's license."

[vii] This result applied to homes in the subsidized "Emergency" NFIP program. For those in the actuarially based "regular program" the negative capitalization was increased to $6,500.

[viii]Two older studies not mentioned in the main text are Babcock and Mitchell (1980) and Zimmerman (1979), both of which found no significant difference between flood zone and comparable non-flood zone properties. Their results must be taken with some caution, however, because rather than using hedonic, they employed simple tests of difference. The former, which took place in Ontario, Canada, also defined its own low and high risk flood zones, based on the extent of the maximum observed floodline. The latter, which took place in New Jersey, used assessed property values from tax records and from the census of housing, rather than transacted sales price.

[ix] He also cautioned that at the time of the study, regulations were in the "emergency" phase, meaning they were less stringently enforced and less likely to impact property values.

[x] Fire and flood zones were included. The larger study of which this paper is a part was intended to assess the price effects of both flood and fire disclosure under AB 1195. Hence, the sampling strategy was designed to be representative of properties in flood prone and fire prone areas. However, only the effects of the flood portion of the study are discussed here. The hazard categories used in tier 1 sampling were: only flood zones present, only fire zones present, both present and neither present. Threshold values for considering flood and urban fire zones (VHFHSZs) as being "present" were 5% of the land area of a zip code occupied by statutory hazard zone (it was 25% for wildland fire hazard areas because of sparser population in these zones). There was a separate 9 cell matrix representing population density and median home price for each of the four categories, yielding 32 strata, but the "no hazard present" category was dropped, leaving 27 cells from which the population of zip codes was sampled.

[xi] Property transaction records were downloaded from Metroscan, an online property transaction database.

[xii] The results given here are for developed property only. While separate regressions were run on transactions for vacant land, significant results about how hazard disclosure is affecting those parcels were not derived. The data were too poor and too few, with few hazard zone observations and not enough records from both before and after the law. Analysis of vacant parcels is also confounded by the fact that many are large and include both flood-prone and flood-free land.

[xiii] Properties were address geocoded using Cenus TIGER streets data from 1990 and GDT streets data from 2000. Flood maps came from FEMA's Q3 data set. Demographic data were obtained from the 1990 Census and from Claritas' 1997 projections of that data, while market data came from a variety of sources, included the California Association REALTORS® and the Rand Corporation. Demographic data was at the tract level, while market data were at both the zip code and city level. Market data varied by time period, in some cases by quarter and in some cases by year.

[xiv] This includes fire zone properties, which are not covered in this paper.

[xv] Insignificant flood interaction terms were dropped because leaving them in the model biased other terms with FLOOD, resulting in a biased assessment of changes in price differentials.

[xvi] Note that when the regression equations are solved using different mean values for PADJ and other time-variant variables for the before and after groups, the results change little. Hence we only present the results from solving PADJ and other time-variant variables at their global means.

[xvii] This counter-intuitive result is due to the fact that, while FLOOD was negative, FLOOD:MHHINC was positive and at a greater magnitude; since MHHINC is normalizaed with a mean of 1, they are comparable.

[xviii] Whites are the only other racial group that has a major presence in the floodplain.

[xix] A variable for percentage of blacks per tract was initially included in all models, but no interaction effect was found; as it added little explanatory power, it was dropped in the interests of model parsimony.

[xx] While Model 2 does yield a positive and highly negative coefficient for FLOOD, it should be noted that FLOOD:MHHINC is positive and has greater magnitude (MHHINC has a mean value of 1, so the two are comparable), canceling out the effect of FLOOD.

[xxi] The yearly rate was determined by multiplying the Pre-FIRM (built before the Flood Insurance Rate Map was created) rate of 68 cents per $100 of basic coverage by the basic coverage limit of $50,000, plus the rate of 23 cents per additional $100 coverage times $40,000 of additional coverage, plus the contents coverage rate of 79 cents per $100 times $20,000 of contents coverage. These rates assume a house in the A zone with no basement or structural elevation and construction before the creation of the FIRM.

[xxii] A preliminary mail survey of 1,200 households was undertaken, but the low response rate of 17% limits that survey's validity. It did find that an overwhelming percentage (75%) of homebuyers did remember seeing the Natural Hazard Disclosure Statement. That statement made 40% of the people "think twice" before buying and affected the bids of 17% of respondents.

J. ACKNOWLEDGEMENTS

Great thanks are due to the California Policy Research Center and the Lincoln Institute of Land Policy for funding the study upon which this paper is based. The authors would also like to thank Drs. David Dowall, Keith Gilless, John Quigley, and John Landis, at U.C. Berkeley, as well as Drs. Jon Erickson and Curtis Ventriss at the University of Vermont, and Dr. Raymond Burby at the University of North Carolina who gave useful advice on this paper. Thanks are also due to interviewees, including Peter Detwiler, Julie Snyder and Melissa Frago, all at the State of California, Jack Eldridge at the Federal Emergency Management Agency, and Stan Wieg at the California Association of REALTORS®.

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L. TABLES AND FIGURES

Table 1. Variable names, descriptions, means and count proportions

Variable	**Description**	**Mean***	**count proportions**
PRICE	Transacted selling price of property	$234,474	
FLOOD	1= in the FEMA Class A Flood Zone; 0= not in that zone		0.133
AFTER	1= transacted after June 1998; 0= Jan 1997 to June 1998		0.543
PHISP	Projected 1997 percentage Hispanic population by tract, based on 1990 census	19%	
ASSDSTCT	Assessed value of structure, normalized by mean	1.00 ($115,393)	
BATH	Number of bathrooms	2.10	
BED	Number of bedrooms	3.11	
SIZE	Total structure square meters	151.89	
LOT	Lot size, hectares	0.16	
NEW	1=house less than 10 years old		0.081
OLD	1=house older than 75 years		.03
D2STAR	Distance (km) to nearest Starbucks ™ coffee shop	10.00	
AVG.RANK	Ranking of district schools by statewide 1-10 standard, normalized by mean	1.00 (6.36)	
AGE	Projected 1997 median age by tract	35.00	
PUNEMP	Projected 1997 percentage unemployment by tract	5.05%	
MHHINC	Projected 1997 median household income by tract, normalized by mean	1.00 ($56,366)	
CBDIND2	logged Central Business District Index**	1.65	
D2HIWAY	Distance (km) to nearest highway or major arterial road	1.82	
SDIND1	Number of transaction by zip code over the population by year	0.02	
PRRATIO	Ratio of median zip code price to median state price	1.13	
PADJ	Percentage change in MEDPRCTY by quarter from first quarter price	1.15	
NRCOAST	1=Within 1 km of coast	0.02	
COAST5K	1=Between 1 and 5 km of coast	0.075	
COAST15K	1=Between 10 and 15 km of coast	0.125	
WEIGHT	Regression weights	3.35	
FLOOD:AFTER	Homes in floodplain that transacted after AB 1195		0.073
Quadratic terms used: LOTSQFT, TOTALSF, BEDROOMS, D2HIWAY, D2STAR and BATHTOT			
TOTAL SAMPLES: 21693			
*Non-normalized means of normalized variables are given in parentheses. **The Central Business District Index was derived by dividing up the business districts within commuting distance of the sample zip codes into A, B, and C districts, based on density of employment and amount of revenue produced by companies in those districts, with A districts representing the highest density relative to revenue. CBDIND2= log(Ra/Da+Rb/Db+Rc/Dc), where Ra = revenue of nearest A district and Da= distance to the nearest A district, Rb= revenue of nearest B district, etc.			

Table 2. List of regression models

Model	**Interaction terms**
1	No interaction terms except for overall disclosure effect (FLOOD:AFTER)
2	Disclosure effect (FLOOD:AFTER), interaction between income and flood location (FLOOD:MHHINC) and additive interaction effect between income and AB 1195 flood disclosure (FLOOD:MHHINC:AFTER); FLOOD:MHHINC:AFTER dropped due to insignificance
3	Disclosure effect (FLOOD:AFTER), interaction between percent Hispanic and flood location (FLOOD:PHISP) and additive interaction effect between percent Hispanic and flood disclosure under AB 1195 (FLOOD:PHISP:AFTER); FLOOD:AFTER and FLOOD:PHISP dropped due to insignificance

Table 3: Full regression results

	Model 1			**Model 2**			**Model 3**		
	Value	t value		Value	t value		Value	t value	
(Intercept)	9.598	237.81	**	9.641	238.861	**	9.5944	237.53	**
FLOOD	0.013	1.0411		-0.267	-10.507	**	0.0047	0.4762	
AFTER	0.059	10.619	**	0.057	10.392	**	0.0582	10.649	**
ASSDSTC	0.284	57.405	**	0.282	57.083	**	0.2846	57.424	**
BATH	0.025	5.308	**	0.025	5.291	**	0.0249	5.3304	**
BED	0.051	13.837	**	0.050	13.519	**	0.0509	13.786	**
SIZE	0.002	26.71	**	0.002	27.368	**	0.0017	26.696	**
LOT	0.019	10.493	**	0.019	10.451	**	0.0195	10.494	**
NEW	0.043	5.417	**	0.037	4.726	**	0.0429	5.4253	**
OLD	-0.095	-7.221	**	-0.086	-6.590	**	-0.0946	-7.2013	**
D2STAR	-0.005	-10.09	**	-0.005	-10.594	**	-0.0046	-10.042	**
AVG.RANK	0.205	18.257	**	0.202	18.098	**	0.2051	18.291	**
AGE	0.019	26.361	**	0.019	25.949	**	0.0193	26.373	**
PHISP	9E-04	3.1234	**	0.001	3.677	**	0.0011	3.7599	**
PUNEMP	-0.018	-18.62	**	-0.018	-19.563	**	-0.0177	-18.734	**
MHHINC	0.082	7.6473	**	0.056	5.119	**	0.0825	7.7096	**
CBDIND2	0.029	13.548	**	0.026	12.016	**	0.0295	13.631	**
D2HIWAY	0.007	2.3664	*	0.007	2.398	**	0.0071	2.4632	**
SDIND1	-4.937	-11.77	**	-4.874	-11.664	**	-5.0096	-11.933	*
PRRATIO	0.266	38.139	**	0.273	39.120	**	0.2660	38.129	**
PADJ	0.549	25.183	**	0.550	25.332	**	0.5492	25.188	**
NRCOAST	0.118	7.1319	**	0.121	7.338	**	0.1186	7.1532	**
COAST5K	0.095	9.9941	**	0.094	9.936	**	0.0946	9.9664	**
COAST15K	0.071	9.1346	**	0.064	8.257	**	0.0731	9.3373	**
I(SIZE^2)	-2E-07	-35.89	**	-2E-07	-36.479	**	-2E-07	-35.888	**
I(BATH^2)	-0.003	-8.686	**	-0.003	-8.783	**	-0.003	-8.6918	**
I(BED^2)	-1E-03	-6.073	**	-0.001	-5.934	**	-0.001	-6.056	**
I(D2STAR^2)	6E-05	8.1905	**	5.85E-05	8.308	**	5.76E-05	8.1457	**
I(D2HIWAY^2)	-0.002	-5.644	**	-0.002	-5.717	**	-0.002	-5.7163	**
FLOOD:AFTER	-0.043	-2.738	**	-0.036	-2.267	*	X		
FLOOD:MHHINC	NA			0.323	12.492	**	NA		
FLOOD:MHHINC: AFTER	NA			X			NA		
FLOOD:PHISP	NA			NA			X		
FLOOD:PHISP: AFTER	NA			NA			-0.00114	-3.0407	**
R^2		.765			.767			.765	

* significant at the 95% confidence level
** significant at the 99% confidence level
NA: Not applicable; terms that were not tested in the given model
X: terms that were tested in the model and dropped because they were insignificant at the 95% confidence level

Table 4. Major results summary

Term	M1	M2	M3
FLOOD	0.013 (1.041)	-0.267(-10.507)**	0.005 (.476)
AFTER	0.059 (10.619)**	0.057(10.392)**	0.058 (10.649)**
FLOOD:AFTER	-.0431 (-2.738)**	-0.036(-2.267)*	X
FLOOD:MHHINC	NA	0.323(12.492)**	NA
FLOOD:MHHINC:AFTER	NA	x	NA
FLOOD:PHISP	NA	NA	x
FLOOD:PHISP:AFTER	NA	NA	-0.00114 (-3.041)**

* Significant at the 95% confidence level; **Significant at the 99% confidence level. T statistics in parentheses. Cells in gray represent terms that were not included in the model; NA: terms that were not included in the given model
X: terms that were tested in the model and dropped because they were insignificant at the 90% confidence level

Table 5. Mean price differentials between comparable flood zone and non-flood zone properties before and after AB 1195 (Model 1)

Time	zone	price	floodplain differential-before
before	flood	$182,125	$ -
before	no-flood	$182,125	
			floodplain differential-after
after	flood	$185,004	($8,150)
after	no-flood	$193,154	
Reduction in differentials due to AB 1195:			**($8,150)**

Parentheses = negative values

Table 6. Mean price differentials between comparable flood zone and non-flood zone properties before and after AB 1195 when controlling for the interaction between median household income and flood location (Model 2)

Time	zone	price	floodplain differential-before
before	flood	$196,068	$ 10,626
before	no-flood	$185,443	
			floodplain differential-after
after	flood	$200,380	$3,993
after	no-flood	$196,388	
Reduction in differentials due to AB 1195:			**($6,633)**

Parentheses = negative values

Table 7. Mean price differentials between comparable flood zone and non-flood zone properties before and after AB 1195 when controlling for the interaction between percentage Hispanic and flood disclosure (Model 3)

Time	zone	price	floodplain differential-before
before	flood	$185,519	$ -
before	no-flood	$185,519	
			floodplain differential-after
after	flood	$192,410	($4,220)
after	no-flood	$196,629	
Reduction in differentials due to AB 1195:			**($4,220)**

Parentheses = negative values

Table 8. Sensitivity analysis of price reduction due to AB 1195 disclosure as a function of percentage Hispanics by tract (Model 3)

Percent Hispanic by Tract	**1%**	**5%**	**10%**	**19%**	**25%**	**30%**	**40%**	**50%**	**60%**
Negative Capitalization	**($200)**	**($1,102)**	**($2,210)**	**($4,220)**	**($5,572)**	**($6,705)**	**($8,992)**	**($11,305)**	**($13,644)**

Parentheses = negative values

Table 9. Percentage of subprime mortgages originated by race in selected California Metropolitan Statistical Areas for 1998

Metropolitan Area	**Hispanic mortgage originations**			**White mortgage originations**		
	# subprime	total #	% subprime	# subprime	total #	% subprime
Bakersfield	1944	8161	24%	4311	21043	20%
Fresno	3103	11097	28%	4126	24071	17%
Modesto-Merced	1945	7281	27%	4134	20718	20%
Sacramento*	430	3664	12%	2558	35109	7%
Solano County	417	2372	18%	1913	16251	12%
Salinas	1720	5210	33%	1974	13140	15%
Santa Cruz-Watsonville	487	1833	27%	2359	17593	13%
Santa Barbara	584	3396	17%	1699	18001	9%
TOTAL	10630	43014	**25%**	23074	165926	**14%**

*partial sample of mortgage originations for MSA

Figure 1. Sample zip codes selected for first stage sampling

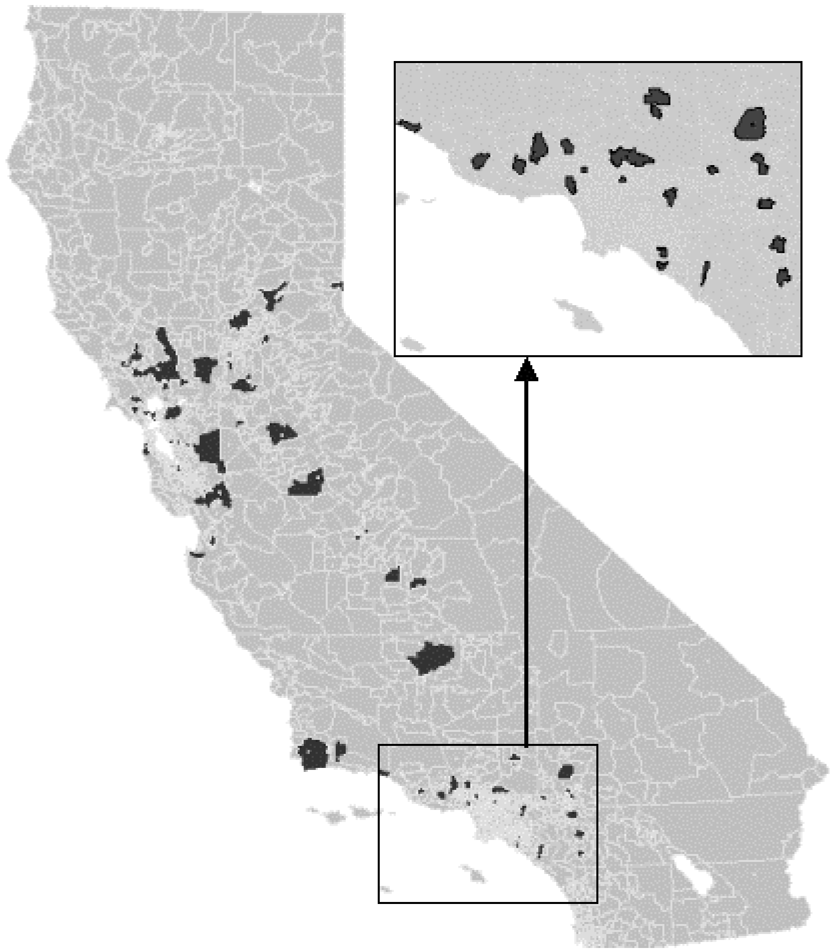


Figure 2. Plot of Lambda from Box-Cox transformation

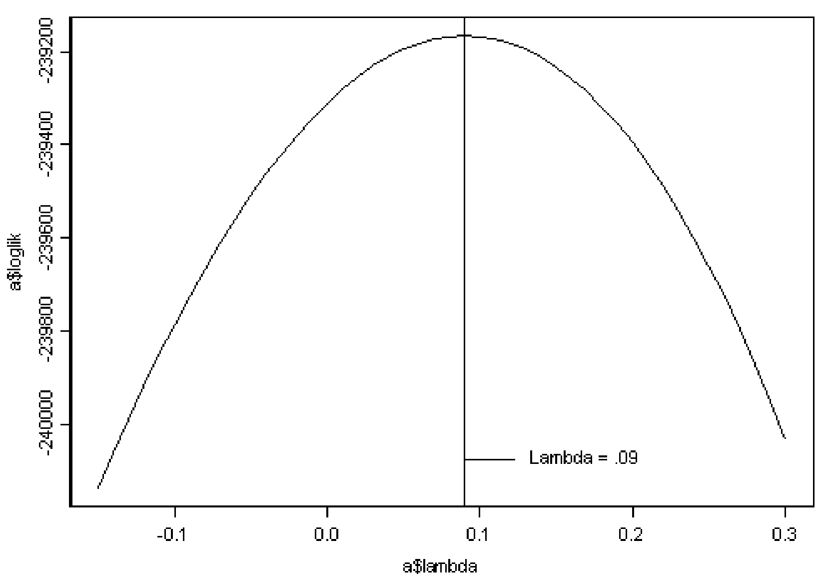


Figure 3. Histogram of frequency of observations by percent Hispanic for non-flood properties

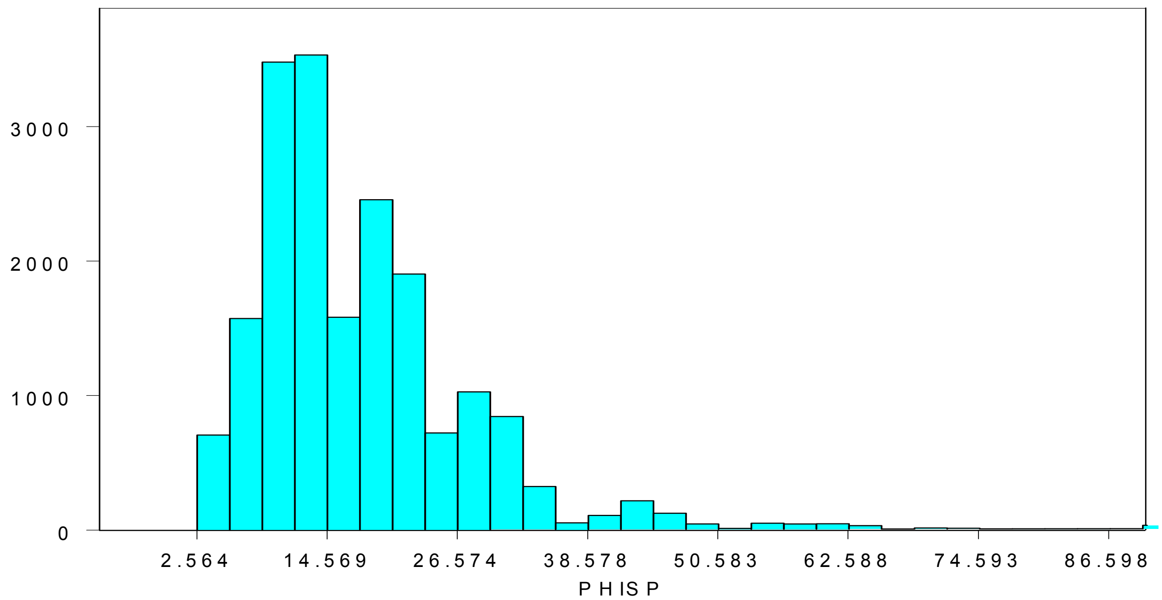
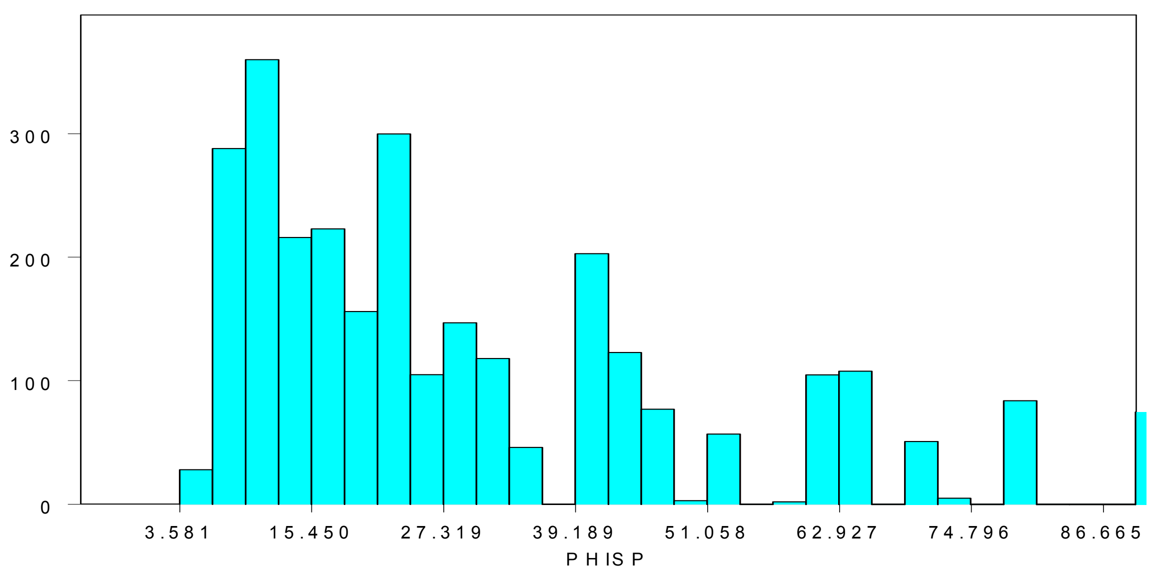


Figure 4. Histogram of frequency of observations by percent Hispanic for flood zone properties



LIST OF TABLE CAPTIONS

LIST OF FIGURE CAPTIONS