No. 08-08
April 2008

WORKING PAPER

QUALITY ASSURANCE BY THE PUBLIC SECTOR: An Analysis of Building Code Enforcement

By Daniel Sutter

MERCATUS CENTER
GEORGE MASON UNIVERSITY

Quality Assurance by the Public Sector: An Analysis of Building Code Enforcement

Daniel Sutter

Department of Economics & Finance
University of Texas - Pan American
1201 W. University Drive
Edinburg, TX 78539-2999
Phone: (956) 381-2494
dssutter@utpa.edu

This research was supported by the Mercatus Center's Global Prosperity Initiative.

Quality Assurance by the Public Sector: An Analysis of Building Code Enforcement

Abstract

Building codes have been stressed as a measure to reduce vulnerability to hurricanes and other natural hazards. Almost all U. S. states have adopted a building code, but building codes do not enforce themselves. This paper explores the determinants of building code enforcement across states using ratings from the Insurance Services Office. Overall enforcement is not outstanding, as only five communities have the best rating of 1 and less than 7% have one of the three top ratings. Although proposed as a means to reduce damage from natural hazards, enforcement is not on average better in states vulnerable to hurricanes and earthquakes; enforcement is actually lower in states vulnerable to earthquakes. Enforcement generally improves with a larger state and local government, while political corruption reduces enforcement for personal insurance lines. Building codes are better enforced in more urban states, consistent with beneficial competition between local governments, although this result might be an effect of income. Greater inequality does not affect enforcement.

Keywords: Building codes, hurricanes, earthquakes, quality assurance

1. Introduction

The quality of the built environment is a major determinant of property damage from extreme weather and natural hazards (Ryland 2006). Buildings can be designed and constructed to withstand stronger winds with less damage, or withstand groundshaking in an earthquake. In the limiting case, "saferooms" can survive even the strongest tornadic winds. Strengthened building codes have been highlighted as an important means to reduce damages from natural hazards, and particularly catastrophic events (Kunreuther 1996).

Economic examinations of building codes have focused on information asymmetries and externalities. Verification of many elements of quality in construction is difficult for home buyers or even building experts after completion of construction. Some features which are difficult to verify but important for structural integrity include the number of nails and direction of nailing, the proper attachment of hurricane straps to the roof, and the anchoring of walls to the foundation. Construction deficiencies may not be revealed until engineers perform a damage assessment after the next hurricane or tornado or earthquake. In the meantime, home owners, businesses and insurance companies all might have thought the buildings were well constructed. Asymmetric information provides one of the economic rationales for building codes (Oster and Quigley 1977). Building code inspectors observe the construction process through inspections and certify the quality of construction. Poorly constructed buildings can generate damage as well; debris from a poorly constructed structure can become windblown debris damaging nearby buildings, or the collapse of a building in an earthquake can damage adjacent structures. Externalities provide a second economic rationale for building codes (Cohen and Noll 1981). Engineering studies suggest that the adoption of current International Building and Residential Codes could reduce wind damage by up to 50% relative to no building codes or poor enforcement (Shimberg Center 2003, Levitan et al. 2006).

Building codes, however, do not enforce themselves. Construction standards might be codified in a code, but if builders do not build to the code and inspectors do not enforce the provisions, the resulting buildings will not actually be any more resistant to hurricanes, tornadoes or earthquakes. Poor enforcement of the existing South Florida Building Code was responsible for approximately 25% of the insured losses in Hurricane Andrew (a then record $16 billion) in 1992 and the Northridge Earthquake in 1994.[1] Ultimately quality assurance problems do not disappear simply because a public agency assumes the quality assurance task through regulation and inspection. Whether the public sector assures quality more effectively than the private sector through reputation mechanisms is an open question. A government agency does not have a reputation and potential financial stake when certifying quality. The lack of a financial penalty for failure to reject low quality can lead to lower quality through public sector certification than with market based quality certification (Holcombe 1997). Building inspectors might end up being captured by the building industry.

In light of the revelations of poor code enforcement after Hurricane Andrew and the Northridge Earthquake, insurers through the Insurance Services Office (ISO) began evaluating the building code enforcement efforts of communities across the country. Knowledge of where building codes where being enforced rigorously and where code enforcement was lax could be used by insurers to adjust premiums to expected losses. The resulting program is the Building Code Effectiveness Grading Schedule (BCEGS), in which the ISO conducts evaluation and markets the information to insurance companies. Building code enforcement is an example of

---

[1] The Insurance Services Office claims that poor code enforcement might have

quality assurance by the public sector. Government effectively promises home buyers, businesses, bankers and insurers when enacting a building code that buildings will be built to the stated provisions of the code. The knowledge that building codes exist and the presumption of effective enforcement might lull the public into a false sense of security and ironically lead to a deterioration of the quality of the built environment. Thus the quality of building code enforcement is of relevance in society's vulnerability to natural hazards, and provides evidence on quality certification by the local public sector generally.

The organization of this paper is as follows. Section 2 discusses hypotheses regarding the determinants of building code enforcement across states. Section 3 describes the provisions of the BCEGS and the distribution of the ratings across states. Section 4 offers variable definitions, while Section 5 presents the empirical results. Section 6 offers a brief conclusion.

2. Hypotheses Regarding Building Code Enforcement

A number of factors might affect the enforcement of buildings codes across states. A first factor is vulnerability to natural hazards. Building codes are considered crucial in improving the quality of the built environment and reducing vulnerability to natural hazards. Indeed, the ISO states that the BCEGS is explicitly designed to address vulnerability to hurricanes and earthquakes. Consequently the value of code enforcement and strengthened construction is higher in states with substantial natural hazard vulnerability. All states, though, face vulnerability to natural hazards of various sorts, including tornadoes, severe thunderstorms, floods, hail, and some seismic risk. I will focus on earthquakes and hurricanes to identify high vulnerability states. States along the Gulf of Mexico and Atlantic coasts face a clearly defined

---

been responsible for as much as 30% to 40% of losses in Andrew.

vulnerability to hurricanes compared with inland states. For seismic risk, I will restrict attention to states identified as high risk by the U.S. Geological Survey.

Competition between local governments could also affect code enforcement. Cities enforce state building codes, making decisions about the number of inspectors and setting a tone for the rigor of inspection. States with numerous cities in close proximity with each other will have more vigorous competition between local governments. Competition between governments, however, could be beneficial or harmful for code enforcement. Competition could spur communities to better enforce building codes in order to attract or avoid losing residents, who could vote with their feet and move to a community which enforces building codes (Tiebout 1956, Hirschman 1970). On the other hand, competition between local governments could produce a race to the bottom in code enforcement. Communities seeking growth might relax code enforcement, instructing inspectors to conduct pro forma inspections or allowing variances to building practices to lower construction costs. A lower cost of construction would then reduce new home prices and increase housing or business growth. Neighboring communities might be forced to similarly relax code enforcement to prevent the diversion of new building. In the limit, although all communities might wish for codes to be enforced, no one community might want to strictly enforce codes when other communities do not enforce codes. Burby et al. (2000) examine the role that inefficient building code enforcement (long lags for inspections and frequent fines) has played in shifting growth out of central cities and to suburbs. They suggest that more "business-friendly" enforcement could spur considerable new building without compromising the enforcement of codes.

The overall growth rate of a state could affect building code enforcement as well. Building codes apply to new construction and remodeling of existing structures. The increase in the number of structures built provides a good measure of the demands on the local building code enforcement office. In fast growing states, the demands on inspectors are greater, if the number of inspectors does not increase with building stock growth. As inspectors become overwhelmed, the rigor of inspections may well decline. For example, in Miami-Dade county in 1992, there were 60 building inspectors on staff, while 20,000 new buildings were built in the county each year. The average inspector would have to conduct 35 inspections per day (due to multiple inspections on the same structure), and thus inspections could not have been very rigorous (Mileti 1999, p.31). Note that causality might run in the opposite direction, with poor enforcement being a local economic development strategy. Population growth may not affect enforcement if communities in fast growing states expand their code enforcement efforts proportionally. Bulding inspection offices in states which have experienced an increase in growth may be particularly likely to be overwhelmed by new construction and see enforcement deteriorate.

Failure to ensure that structures meet existing codes can be considered a type of political corruption, and thus enforcement may be related to the general level of corruption in a state. Government promises to home buyers, bankers, and insurers that new construction meets the standards in the code, and then reneging on the promise. Explicit corruption can also weaken code enforcement if building inspectors accept or solicit bribes to approve construction which is not meeting the code. The overall level of political corruption in a state could affect building code enforcement, either directly as in the case of a corrupt inspector, or indirectly as reflecting general attitudes in a state toward performance of public sector duties. Note that Leeson and Sobel (2008) have established a link between disasters and corruption. States vulnerable to natural hazards may have higher corruption due to disaster relief, and if empirical measures of corruption across states are imperfect, hazard vulnerability may capture some of the impact of corruption.

Finally attitudes in a state toward the role of government may affect building code enforcement. In states with political attitudes favoring large government, home buyers, businesses and builders may be more accepting of the inspection process, more willing to work with inspectors, and more willing to allocate adequate resources for code enforcement. On the other hand, where public attitudes favor a smaller role for government, the public and builders might perceive codes as infringing on contractual freedom and seek actively to conceal substandard construction from inspectors or otherwise subvert the inspection process. In addition, insufficient resources might be allocated to the code inspection process, to help ensure that inspectors cannot do a good job. If these attitudes are sufficiently pervasive, a state may not have adopted a building code, but conditional on a building code being adopted, they could lead to poorer enforcement. The size of state and local government, and by implication attitudes about government, might affect building code enforcement by an alternative mechanism. As the extent of government increases, the performance of tasks might deteriorate, particularly for traditional functions of government. That is, government officials might have adopted building codes to receive credit from citizens for ensuring a safe built environment. Once a building code is adopted and credit has been taken, government officials might move on to try to deliver new regulations and programs and services to citizens to win votes in an upcoming election. Government might become over committed and fail to actually deliver on the promised services. By contrast, a more limited government might focus better on delivering its smaller number of promises and services.

3. The BCEGS System and the Building Code Enforcement Variables

The BCEGS is a program of evaluating a community's enforcement of building codes developed by the Insurance Services Office (ISO) in the 1990s. The program is modeled on the Public Protection Classification Program rating system for the fire fighting capabilities of communities established by insurers in 1909 and now also administered by ISO. Insurance companies pay the cost of the building code program through subscriptions with ISO. Communities face no monetary cost of participating, which requires relatively modest effort: completion of a questionnaire and assistance with an interview by program evaluators. States can and sometimes do encourage participation in the BCEGS ratings by communities; Florida, for example, has approved a 1% surcharge on insurance policies in communities not participating in the program, and provides information about the BCEGS on the state Department of Insurance website.

The BCEGS is a ten point scale, from 1, described as "exemplary enforcement of a model building code," to 10.[2] Not all communities participate in the program, and some communities do not have a code enforcement program, so no rating is also a possibility. The score for a community is based on points for 21 different factors including: the administration of codes, the review of plans, and field inspections, including staffing levels and staff qualifications, the building code in effect, any local modification of the codes, contractor and builder licensing and bonding requirements, and public awareness programs. Staffing levels are evaluated relative to the number of permits issued, as larger or faster growing communities with more new construction must have more inspectors to maintain the integrity of the process. Personal and

---

[2] This description of the program is based on information available on the ISO website at

commercial construction code enforcement are independently evaluated, and the score assigned may differ. Insurers generally offer discounts for a better score, with no discount offered for a score of 10; the program is intended to offer reductions for enforcement, not penalties for a failure to enforce codes. The program rates community enforcement, but an independent inspection process also exists for individual properties which might be built to more rigorous standards than those in place in their local community. Ratings are reviewed by ISO every five years, while a community can request a new review if they have undertaken steps to strengthen enforcement since their last evaluation. Ratings apply to new construction in a community, not construction which predates the current rating.

Nationally over 8600 communities have ratings for personal lines and over 9600 are rated for commercial lines. To put this total in perspective, the Census Bureau reports data for over 25,000 communities, and over 44,000 different fire departments are rated by the Public Protection Classification Program. Table 1 displays the distribution of the ratings of communities by BCEGS score for personal and commercial lines as of early 2008, based on the state summaries of community ratings.[3] A first fact about enforcement is the paucity of communities receiving a rating of 1; only 5 communities for commercial lines and 4 for personal lines received this rating, out of over 25,000 communities nationally. According to ISO, communities with ratings of 1 to 3 receive the highest credit, which suggests that there may be little marginal benefit from taking steps necessary to improve a score from 2 or 3 to 1. If so, the relevant measure for outstanding enforcement might be ratings of 1, 2 and 3 as a group. A total

---

http://www.isomitigation.com/bcegs.

[3] The summaries by state are available at http://www.isomitigation.com/becgs/1000/bcegs1001.html.

of 1690 communities have a score of 3 or better for commercial lines and 1445 have a score of 3 or better for personal lines, or about represent 7% and 6% of communities nationally. The mean score for rated communities was 4.84 for commercial lines and 4.91 for residential lines, virtually equal, but 1,000 more communities were rated for commercial lines. The modal rating is 4 for both personal and commercial lines, with ratings of 3 and 5 the next most common; 71% and 73% of rated communities for personal and commercial lines respectively have a score between 3 and 5. Overall the provision of quality certification by the local public sector cannot be characterized as exemplary.

The BCEGS ratings are proprietary, and thus the ratings for individual communities are unavailable. ISO constructs the ratings and must charge insurance companies for access to the ratings. The distribution of communities by rating by state for personal and commercial lines, a breakdown similar to Table 1 for each state, is available to the public. Ideally analysis would focus on individual communities and their rating, or at least state variables constructed based on the population of various communities. Considerable variation in ratings across states exists, and despite the imperfections of the state aggregated ratings, an analysis of the determinants of enforcement revealed here in the state aggregates is worthwhile. Note that six states have no communities with BCEGS ratings. These states are Hawaii, Idaho, Kansas, Louisiana, Mississippi, and Washington. Two of these states, Hawaii and Mississippi, do not have statewide building codes, while Louisiana only passed a statewide building code in 2007, and this might explain the lack of BCEGS ratings for communities in these states. I will estimate all regressions both including and excluding the six states with no rated communities.

I construct three sets of measures of enforcement by state, for both personal and commercial lines. The first, *PPct* and *CPct*, are the percentage of communities in a state which are rated in the BCEGS. The number of communities is the number of places in the state tracked by the Census bureau in the 2000 Census. In six states the number of communities rated in the BCEGS exceeds the number of places reported by the Census in the state, and so the percentage in these states is set to 100; rated communities may exceed the number of communities tracked by the Census because the BCEGS lists communities spanning two counties separately. Thus *Pct* is truncated above and below. The averages across states are 32.4% for personal lines *PPct* and 35.4% for commercial lines *CPct.*

The second building code variable is *Pct123*, the percentage of communities in a state which have a rating of 1, 2 or 3 in the BCEGS. This variable would represent very effective building code enforcement, in contrast to the broad measure of *Pct*. The mean *Pct123* across states is 6.0% for personal lines (*PPct123*) and 6.7% for commercial lines (*CPct123*). *Pct123* is not truncated above, as the maximum percentages are 39.0% and 40.4% for personal and commercial lines, both in New Jersey.

The third measure of building code enforcement is *Mean*, the mean BCEGS rating of communities in a state. In constructing this variable, unrated communities must be included with rated communities. To facilitate this, I assign points for rated communities inversely to the rating on the schedule. Thus ten points are assigned to a community with a rating of 1, 9 points for a community rated 2, and so on to 1 point for a community rated 10 and 0 for communities which are not rated. The assignment of points is somewhat arbitrary, as it assumes a one unit improvement in the score of a community has the same marginal contribution whether going from 2 to 1 or 10 to 9. Also it assumes that the difference between unrated communities and rated communities is not too great, that a move from unrated to 9 is comparable to a community improving from 5 to 3. Nonetheless, *Mean* combines communities which are and are not rated, and also makes use of the differences between ratings of communities. The average rating across states is 1.96 for personal lines (*PMean*) and 2.15 for commercial lines (*CMean*), both of which are equivalent to approximately a 9 rating. Michigan has the highest means at 6.92 and 6.99 for personal and commercial lines, the equivalent of a 4 rating. Overall about 98% of Michigan communities are rated, with about 93% of communities rated 5 or better, even though no Michigan communities are rated 1 for personal or commercial lines. Note that as constructed, larger values of all three of these measures of enforcement represent a higher level of enforcement in a state. Consequently interpretation of the direction of a variable on enforcement is similar across all regression specifications.

The BCEGS ratings have not been extensively employed in research to date. Sapat and Birkland (2004) analyzed a measure of enforcement similar to my *PMean* variable in a cross section of states, but mainly focused on state level policy variables like a divided state government and existence of a comprehensive state building code or hazards planning mandate. Since enforcement occurs at the local level, state government variables seem unlikely to be strong determinants of local level decisions. In addition a hazards planning mandate is likely itself endogenous, that is, states where the public is concerned with natural hazards are likely to both enact such a mandate and better enforce building codes. My study links building code enforcement more directly to demographic and economic characteristics of states, as well as controlling with the truncation of the BCEGS ratings using a Tobit regression model.

4. Variable Definitions

I employ a number of control variables to test the various hypotheses regarding building code enforcement discussed in Section 2. The BCEGS was designed to address natural hazards losses, and so I employ two variables to control for vulnerability. *Hurricane* is a dummy variable which equals one for states along the Atlantic and Gulf coasts and Hawaii and zero otherwise. *Earthquake* is a dummy variable which equals one if any part of a state faces a high risk of an earthquake (a ground shaking g value in the 16-24 range or higher) and zero otherwise.[4] Note that these variables control for exposure to hazards and not recent hazard experience. A calculation of the expected value of strengthened construction should use the best available scientific estimate of the probability of the occurrence of an earthquake or hurricane, because recent experience can either over-estimate or under-estimate the likelihood of a loss, depending on recent hazard listing. A major hurricane has not struck Galveston or Corpus Christi in recent decades, but vulnerability exists in these areas. On the other hand, building codes and other mitigation measures are often adopted after a major disaster, so vulnerability based variables may not explain building code enforcement. Overall 19 states face *Hurricane* risk and 16 face *Earthquake* risk; two states, Hawaii and South Carolina, face both hurricane and earthquake risks. Table 2 contains summary statistics for all the variables used in this study.

Urban, the percentage of state residents living in urbanized areas as defined by the Census in 2006, controls for the strength of competition between local governments. More local governments are in closer proximity and represent closer substitutes with each other in urbanized areas than in rural areas. A positive coefficient on *Urban* is consistent with Tiebout competition driving superior building code enforcement, while a negative sign on *Urban* would indicate competition driving down enforcement in a race to the bottom. The mean level of urbanization across states is 71%.

---

[4] The classification of states is based on the ground shaking map available at

Pop Change is the percentage change in state population between 2000 and 2007. A fast growing state may have difficulty enforcing codes given the volume of new construction. A positive sign for *Pop Change* would be consistent with growth compromising the enforcement of building codes. The causality between code enforcement and growth could run in the other direction, as mentioned in Section 2. But my use of the state population change instead of community population change should minimize the potential for reverse causality for this variable. The mean across states in the change in population is 6.9%, with a range from -4% to 28% growth.

Corruption is the corruption rate based on Federal corruption convictions per capita between 1976 and 2002, taken from Glaeser and Saks (2006). More convictions indicate greater corruption, and thus a negative sign on *Corruption* in the regressions would indicate that a more corrupt state offers poorer enforcement of building codes. Leeson and Sobel (2008) find evidence that FEMA disaster declarations increase corruption in a state, suggesting a link between the *Hurricane* and *Earthquake* variables and *Corruption*. Note though that because *Hurricane* and *Earthquake* as defined here are the vulnerability of a state to these disasters and not recent disasters. Federal disaster relief would be related to the number of recent hurricanes or earthquakes in a state, and so the potential relationship between *Corruption* and hazards should be minimized. The mean level of *Corruption* across states is .279.

S&L Spending is total spending by state government and all local governments as a percentage of Gross State Product in 2004, and allows a test of the competing hypotheses concerning attitudes toward government and building code enforcement. A positive sign on *S&L Spending* would indicate better building code enforcement in states with larger government. A

---

http://earthquake.usgs.gov/research/hazmaps/product_data/images/nshm.us02.gif.

negative sign on *S&L Spending* would indicate a possible diversion of enforcement due to a larger public sector. The average level of *S&L Spending* across states is 19.6%, ranging from 11.8% to 26.9%.

The regression analyses are Tobit models based on a cross section of U. S. states. Due to the small number of observations, the number of additional control variables must be relatively limited. All of the models estimated here will include the above described variables to test the main hypotheses regarding building code enforcement. Several other variables are included as controls in certain specifications. *Income* is median household income in thousands of dollars, from the 2006 American Community Survey. Generally safety is regarded as a luxury good, and thus with higher incomes, residents should want to secure a safer built environment through superior code enforcement. A positive coefficient for *Income* would be consistent with this hypothesis. *Gini* is the state Gini coefficient based on household incomes. Anbarci, Escaleras and Register (2005) and Kahn (2005) found evidence internationally that natural hazards fatalities increase due to income inequality. Specifically Anbarci et al. consider a political economy model in which greater inequality leads to disagreement over tax shares for mitigation leads the wealthy to protect themselves using private good mitigation measures instead of public good mitigation that benefits the entire community. Building codes represent a type of public good mitigation, and so *Gini* allows a test of this hypothesis across the U. S. A negative sign on *Gini* is consistent with the Anbarci et al. model. Finally *Under18* and *Over65* are the percentages of the state population in 2006 in these two categories. An older population might have less interest in strengthening the built environment and prefer to save on the added cost of construction to a strict code. A larger young population could lead to greater interest in building code enforcement, if parents are concerned about the safety of their children.

5. Regression Results

Table 3 reports the regression results for measures of the BCEGS for personal lines. A parsimonious specification is presented for each of the three measures of enforcement aggregated by state, and then the additional four control variables are included in specifications of *PPct* and *PMean*. The table reports the Tobit coefficients and standard errors; the marginal effects of selected variables will be mentioned in the text.

The one consistent result across all specifications in Table 3 is the negative and significant effect of *Earthquake*, which attains significance at the .10 or .05 level in each specification. *Earthquake* risk does not lead to greater code enforcement, as hypothesized; indeed, codes are less well enforced in states facing a serious risk of earthquakes. The impact of earthquake vulnerability is sizable, the percentage of rated communities is about 17 points lower, the percentage of communities rated 1, 2 or 3 is almost 5 percentage points lower, and the mean rating is reduced by just over one full point. *Hurricane* attains significance once, increasing code enforcement in the parsimonious specification of the percentage of rated communities. The impact of *Hurricane* is sizable in this specification, increasing the percentage of rated communities by 19 points. But the magnitude of the hurricane vulnerability variable is much lower in the remaining specifications in addition to failing to attain statistical significance, except for the parsimonious *PMean* specification, where the rating is increase by nearly .9 points. Exposure to natural hazards does not increase building code enforcement. *Corruption* is associated with poorer building code enforcement, and this variable attains significance in three specifications at the .10 level. A one standard deviation (1 s.d.) increase in *Corruption* decreases the percentage of rated communities in a state by 7.3 points in the parsimonious specification and 5.8 points in the full specification, and reduces the mean rating by .4 in the parsimonious specification. This could be evidence that attitudes toward the enforcement of laws and regulations differ in more corrupt states. A larger state and local government, however, is associated with stricter enforcement, attaining significance in four cases. A 1 s.d. increase in *S&L Spending* increases the percentage of rated communities by 7.3 points in the full specification and the mean rating by over a half a point in each of these regressions. This might reflect different attitudes on the part of the public toward government activity and regulation, or might reflect an overall more efficient public sector, but states with larger state and local governments appear to enforce building codes more effectively.[5] State population growth does not affect building code enforcement, as *Pop Change* never attained significance, and the point estimates are of modest magnitude as well.[6] Thus I find no evidence that rapid growth overwhelms inspection capacity. Among the other control variables, *Income* attained significance in the two specifications in which it is included, and inclusion of *Income* led to a reduction in magnitude and loss of significance for *Urban*. The impact of *Income* is sizable as well, with a 1 s.d. increase increasing the percentage of rated communities by 16 points and the average rating by .8. Thus building code enforcement would seem to be a normal good, consistent with safety generally. *Gini* fails to attain significance in either specification, although the point estimates indicate that a 1 s.d. increase in inequality raised the percentage of rated communities by 8 points and the mean rating by .3. No support is found, however, far Anbarci et al.'s (2005) substitution of private protection for public protection in the face of greater

---

[5] The regressions were estimated with the state's rating on the Economic Freedom of North America as an alternative measure of the size of the public sector, but this variable never attained significance.

[6] The regressions were also estimated with *Pop Change* computed over the period 1990

inequality, since this would have predicted a negative sign for *Gini*. The two age variables *Under18* and *Over65* fail to attain significance and have very modest point estimates.

Table 4 presents the same five regression models for state totals of BCEGS ratings for commercial lines. Generally the results follow those for personal lines, only with fewer variables attaining statistical significance. For each significant variable in the personal lines regressions, the sign of the same variable in the comparable commercial lines specification is the same. Thus in terms of the direction of effect of the independent variables, the same discussion applies for commercial lines. Poorer enforcement in earthquake prone states is again observed, with *Earthquake* attaining significance in every specification except for the percentage of communities rated 1, 2 or 3. *Corruption* now fails to attain significance in any specification, although the point estimates indicate an impact of about 75% of the magnitude of that for personal lines. Thus although not significant, the data suggests there may be a link between political corruption and efforts to enforce building codes. *Urban* is significant at the .05 level or better in each of the parsimonious specifications, but fails to attain significance when *Income* is included as before, and *Income* now fails to attain significance when included in specifications for commercial lines. Again neither *Pop Change* or *Gini* attain significance.

Six states have no rated communities, which might indicate a potential reason for exclusion such as the lack of a statewide building code. If so, the zero values for these states may not accurately reflect the quality of construction in these states. Counting these states as zeros may be influencing the results. To test the robustness of my findings, I reestimated the parsimonious models in Tables 3 and 4 excluding the six states with no rated communities. Several results differ. *Hurricane* is now positive and significant and *Pop Change* is negative and

---

to 2007, and this alternative construction of the variable similarly failed to attain significance.

significant in all of the specifications except for *PPct123* and *CPct123*, while *Earthquake* is no longer significant (although the point estimates remain negative). Hawaii, Louisiana and Mississippi were the hurricane exposed states and Hawaii, Idaho and Washington were the earthquake exposed states with no rated communities. Thus the increase in ratings for *Hurricane* and *Earthquake* is perhaps not surprising. The result that hazard risks did not increase building code enforcement must consequently be qualified. *S&L Spending* and *Urban* remain positive and significant with the six states excluded, while *Corruption* fails to attain significance but retains its negative point estimates. The loss of significance for *Corruption* is perhaps not surprising because Louisiana and Mississippi are two of the most corrupt states in Glaeser and Saks' (2006) sample.

6. Conclusions

This paper has undertaken an analysis of state level aggregates of BCEGS ratings and tested a number of hypotheses regarding building code enforcement. A desire to reduce the costs of natural hazards is an important motivator for building codes and the BCEGS ratings, but overall the link between measures of hazard vulnerability and enforcement is weak. The link is stronger for hurricanes than earthquakes, which may indicate a lack of perception among the public in earthquake vulnerable states which have not had a recent significant earthquake. A larger state and local government generally is associated with better enforcement, and thus more favorable attitudes toward government (or more efficient government) leads to better enforcement. Enforcement is markedly better in more urbanized states, consistent with competition between local governments producing improved enforcement, but the effect disappears when state income is controlled for. I find some evidence that corruption reduces enforcement, but faster growing states have little effect on building code enforcement. I find no relationship between inequality and building code enforcement.

Perhaps the most salient feature of building code enforcement is the seemingly poor enforcement of codes across the U.S. Only 4 and 5 communities for personal and commercial lines attain the best rating of “1" in ISO’s BCEGS; less than 7% of communities receive the top ratings of 1, 2 or 3, and fewer than 40% of communities are even rated. Home buyers, insurance companies and mortgage lenders may well be presuming that the building codes codified into law in most states are being enforced, but overall this is not generally the case. I have attempted to explore some possible hypotheses regarding differences in code enforcement using admittedly imperfect state level summaries of building code effectiveness ratings. The results here should be considered no more than a first cut at the issue of building code enforcement. The low level of enforcement observed should however raise questions about the overall effectiveness of assurance of the quality of the built environment by the public sector. Construction has long been a very decentralized industry in the U.S., but with the emergence of regional or national home builders, conceivably home buyers and insurers could rely on a market based reputation mechanism in place of building codes and public sector quality assurance.

References

Anbarci, Nejat., Monica Escaleras, and Charles A. Register. 2005. "Earthquake Fatalities: The Interaction of Nature and Political Economy." *Journal of Public Economics*, 89:1907-1933.

Burby, Raymond J., Peter J. May, Emil E. Malizia, and Joyce Levine. 2000. "Building Code Enforcement Burdens and Central City Decline." *Journal of the American Planning Association*, 66(2):143-161.

Cohen, Linda, and Roger G. Noll. 1981. "The Economics of Building Codes to Resist Seismic Structures." *Public Policy*, 29:1-29.

Glaeser, Edward L., and Raven E. Saks. 2006. "Corruption in America." *Quarterly Journal of Economics*, 90:1053-1072.

Hirschman, Albert O. 1970. *Exit, Voice and Loyalty*. Cambridge: Harvard University Press.

Holcombe, Randall G. 1995. *Public Policy and the Quality of Life*. Westport CT: Greenwood Press.

Kahn, Matthew E. 2005. "The Death Toll From Natural Disasters: The Role of Income, Geography, and Institutions." *Review of Economics and Statistics*, 87:271-284.

Kunreuther, Howard. 1996. "Mitigating Disaster Losses through Insurance." *Journal of Risk and Uncertainty*, 12: 171-187.

Leeson, Peter T., and Russell S. Sobel. 2008. "Weathering Corruption." *Journal of Law and Economics*, forthcoming.

Levitan, Marc L., Carol Hill Friedland, and T. Eric Stafford. 2006. *Residential Wind Damage in Mississippi: Potential Hurricane Damage Reduction Through Improved Building Codes and Building Practices*. LSU Hurricane Center and T. Eric Stafford & Associates.

Mileti, Dennis. 1999. *Disasters by Design*. Washington: Joseph Henry Press.

Oster, Sharon M., and John M. Quigley. 1977. "Regulatory Barriers to the Diffusion of Innovation: Some Evidence from Building Codes." *Bell Journal of Economics*, 8(2):361-377.

Ryland, Harvey G. 2006. "Providing Economic Incentives to Build Disaster Resistant Structures." In R.J. Daniels, D.F. Kettl, and H. Kunreuther (eds.) *On Risk and Disaster: Lessons from Hurricane Katrina*. Philadelphia: University of Pennsylvania Press.

Sapat, Alka, and Thomas Birkland. 2004. "Influences on State Level Building Code

Effectiveness." Paper presented at 2004 Association for Public Policy Analysis and Management.

Shimberg Center for Affordable Housing and Applied Research Associates. 2002. *Florida Building Code Cost and Lost Reduction Benefit Comparison Study*. Tallahassee FL: Florida Department of Community Affairs.

Tiebout, Charles M. "A Pure Theory of Local Expenditure." *Journal of Political Economy*, 64(5):416-424.

Table 1: Distribution of BCEGS Ratings

Classification	Personal Lines	Commercial Lines
1	4	5
2	140	160
3	1301	1525
4	3113	3344
5	1703	2160
6	824	918
7	630	633
8	347	365
9	484	451
10	67	58

Table 2

Summary Statistics

	Mean	Standard Deviation	Minimum	Maximum
PPct	32.4	33.5	0	100
PPct123	6.05	9.41	0	39.0
PMean	1.96	2.07	0	6.93
CPct	35.4	33.5	0	100
CPct123	6.66	9.48	0	40.4
CMean	2.15	2.08	0	6.99
Hurricane	.380	.490	0	1
Earthquake	.320	.471	0	1
Urban	71.7	14.9	38.2	94.4
Pop Change	6.90	6.17	-3.93	28.4
Corruption	.279	.133	.0740	.643
S & L Spending	19.6	3.49	11.8	26.9
Income	58.2	8.78	42.8	78.2
Gini	.446	.0213	.402	.499
Under18	24.3	1.74	21.3	31.0
Over65	12.7	1.69	6.80	16.8

Table 3

Regression Analysis of BCEGS Ratings for Personal Lines

	PPct	*PPct*	*PPct123*	*PMean*	*PMean*
Constant	-55.6	-351	-46.3***	-4.61*	-15.1
	(55.6)	(282)	(14.0)	(2.71)	(14.3)
Hurricane	24.6**	7.60	-.638	1.01	.255
	(11.7)	(12.2)	(3.00)	(.605)	(.659)
Earthquake	-22.2**	-21.2**	-5.33*	-1.35**	-1.30*
	(11.3)	(11.6)	(3.13)	(.627)	(.664)
Urban	.997**	.150	.449***	.0661***	.0321
	(.403)	(.648)	(.119)	(.0197)	(.0312)
Pop Change	-1.20	.460	.275	-.0361	.0390
	(.898)	(.904)	(.266)	(.0482)	(.0545)
Corruption	-72.2*	-57.6*	-5.74	-3.59*	-2.62
	(38.6)	(30.1)	(7.74)	(1.89)	(1.64)
S&L Spending	2.12	2.77*	1.03***	.153*	.184**
	(1.65)	(1.49)	(.397)	(.0816)	(.0800)
Income		2.42**			.105*
		(1.20)			(.0565)
Gini Coefficient		490			17.9
		(16.9)			(16.9)
Under18		-1.99			-.139
		(5.15)			(.282)
Over65		1.87			.0892
		(4.04)			(.225)
Log Likelihood	-199.3	-195.3	-149.9	-94.2	-91.2
Proportion Censored Obs.	.24	.24	.12	.12	.12

Number of Observations = 50. Tobit regressions; regression coefficients reported in table. Robust standard errors in parentheses. ***, ** and * indicate significance at the .01, ,05 and .10 levels.

Table 4

Regression Analysis of BCEGS Ratings for Commercial Lines

	CPct	*CPct*	*CPct123*	*CMean*	*CMean*
Constant	-42.9	-234	-40.4***	-3.92	-8.50
	(57.0)	(308)	(13.2)	(2.74)	(15.7)
Hurricane	21.7*	5.49	-1.42	.826	.109
	(12.2)	(13.1)	(3.01)	(.648)	(.718)
Earthquake	-24.8**	-24.2**	-4.70	-1.51**	-1.47**
	(11.7)	(12.1)	(2.98)	(.659)	(.696)
Urban	.931**	.259	.428***	.0617***	.0375
	(.413)	(.696)	(.116)	(.0202)	(.0328)
Pop Change	-1.04	.388	.254	-.0289	.0395
	(.917)	(.994)	(.269)	(.0498)	(.0593)
Corruption	-55.7	-42.5	-2.52	-2.43	-1.54
	(39.4)	(31.9)	(7.51)	(1.94)	(1.77)
S&L Spending	1.72	2.21	.816**	.131	.151*
	(1.71)	(1.59)	(.381)	(.0842)	(.0857)
Income		1.96			.0779
		(1.30)			(.0616)
Gini Coefficient		460			16.3
		(368)			(17.8)
Under18		-4.02			-.256
		(5.71)			(.317)
Over65		.0060			-.0104
		(4.46)			(.249)
Log Likelihood	-200.5	-197.1	-153.6	-96.1	-93.5
Proportion Censored Obs.	.24	.24	.12	.12	.12

Number of Observations = 50. Tobit regressions; regression coefficients reported in table. Robust standard errors in parentheses. ***, ** and * indicate significance at the .01, ,05 and .10 levels.