

Estimating the Effect of FORTIFIED Home™ Construction on Home Resale Value¹

Sebastain Awondo, PhD – University of Alabama

Harris Hollans, PhD – Auburn University

Lawrence Powell, PhD – University of Alabama

Chip Wade, PhD – University of Mississippi



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INTRODUCTION

The Insurance Institute for Business and Home Safety (IBHS) created the FORTIFIED Home™ (henceforth “*Fortified*”) program to promote construction of homes that are resilient to natural disasters. *Fortified* is a set of engineering and building standards designed to help strengthen new and existing homes through system-specific building upgrades to minimum building code requirements that will reduce damage from specific natural hazards. While there is growing evidence that *Fortified* construction is resilient to windstorms and reduces insurance premiums, little is known about its impact on home resale value. This information, if available, could help homeowners, insurance companies, and policy makers better adopt and promote specific home mitigation features under different scenarios.

This study seeks to investigate the effect of *Fortified* designation on resale value in the U.S. Specifically, we investigate homes built or retrofitted following standards approved by the IBHS in Mobile and Baldwin counties in Alabama. Alabama currently leads the country with more than 2,000 *Fortified* designations; therefore, the coastal counties in Alabama are an appropriate venue for our analysis. We use data on homes sold during the last 15 years in Alabama, some of which have achieved the *Fortified* designations.

METHODS

We employ a hedonic regression model (MacDonald, Murdoch and White, 1987) to estimate the marginal effect of fortified home construction standards on home resale value while controlling for other housing characteristics (lot size, building square footage, age, number of rooms, full baths, fireplaces, and distance of property from the coast, and market conditions (year during which the house was sold). Our estimation process involves several steps to ensure the selection of a parsimonious model that best fits the data and is robust under alternative specifications. First, we estimate the regression model using ordinary least squares and clustering the standard errors around subdivisions. We estimate several models and explanatory variables entering the model are selected based on model fitness measures and existing literature. We test for spatial correlation in the data using Moran’s I test (Moran, 1950) and Geary’s C statistic (Geary, 1954) and the results indicate a statistically significant presence at the 1 percent level. To account for spatial correlation in our estimation, we use a heteroscedasticity-corrected Spatial Error Model (SEM) in estimating the final hedonic model. We choose this model as opposed the spatial lag model due to our inclusion of sufficient controls in the model, enabling the spatial correlation to be adequately modeled through the error component as opposed to a lagged dependent variable.

DATA

We purchased data on house characteristics and sale prices for all houses sold from 2004 through first quarter of 2016 in Alabama from CoreLogic. These data include property addresses, characteristics, sale prices and dates, sub division name, and geographic coordinates of block in which the property is located. IBHS provided address and designation date for all *Fortified* designations. The two data sets were merged

and observations (unfortified houses) within a subdivision including a fortified property were also retained, yielding a mixed sample of both fortified and unfortified properties.² Using the coordinates, the distance from the block in which each property is located to the beach was calculated in ESRI ArcGIS.³ After dropping outliers, and observations with zero building square footage, number of bedrooms, and lot size, our final sample includes 321 observations.

Table 1 describes the variables used in the estimation while Table 2 presents a summary of the data. Twenty-two percent of the sample is made up of fortified properties. On average, houses in the sample are six years old, with four bedrooms, two baths, 2,531 square feet, lot size of 0.45 acres, about 1.8 miles from the coast, and \$293,332 in sale price. Most of the properties in the sample were sold within the last three years.

Table 1: Variable Definitions

Variable	Definition
<i>Ln(Sale Price)</i>	Natural log of sale price (dependent variable)
<i>Fortified</i>	Indicator variable for fortified home, Fortified=1, and 0 otherwise
<i>Age</i>	Age of house at the time of sale
<i>Lot size</i>	Size of the lot on which the house is built in square feet
<i>Bsqft</i>	Square footage of the house
<i>Bedrooms</i>	Number of bedrooms
<i>Baths</i>	Number of bath rooms
<i>Fireplace</i>	Indicator variable for presence of fireplace, Fireplace=1, and 0 otherwise
<i>Ln(DistCoast)</i>	Natural log of the distance (in meters) from the house block to the coast
<i>Sale_year</i>	Year during which the house was sold (2004 – 2016)

² We also clustered the data around residential blocks but the resulting sample is too small to be use for estimation.

³ See www.arcgis.com.

Table 2: Summary of Data (N=321)

Variable	Mean	SD	Min.	Max.
<i>Sale Price</i>	293,322	129,699	67,500	930,000
<i>Ln(Sale Price)</i>	12.508	0.395	11.12	13.743
<i>Fortified</i>	0.22	0.42	0	1
<i>Age</i>	6.23	14.08	0	115
<i>Lot size</i>	18,699	15,735	4,791	130,662
<i>Building sqft</i>	2,531	702	800	5,268
<i>Bedrooms</i>	3.61	0.75	2	6
<i>Baths</i>	2.39	0.7	1	5
<i>Fireplace</i>	0.42	0.49	0	1
<i>Ln(DistCoast)</i>	7.99	1.19	3.58	9.44
<i>Year2004</i>	0.02		0	1
<i>Year2005</i>	0.04		0	1
<i>Year2006</i>	0.02		0	1
<i>Year2007</i>	0.02		0	1
<i>Year2008</i>	0.03		0	1
<i>Year2009</i>	0.08		0	1
<i>Year2010</i>	0.06		0	1
<i>Year2011</i>	0.01		0	1
<i>Year2012</i>	0.01		0	1
<i>Year2013</i>	0.16		0	1
<i>Year2014</i>	0.27		0	1
<i>Year2015</i>	0.26		0	1
<i>Year2016</i>	0.02		0	1

RESULTS AND DISCUSSION

Table 3 reports estimates of the spatial regression model. The results show that the coefficient on *Fortified* is positive and statistically significant at the 5 percent level, indicating that switching from a conventional construction standard to a fortified designation increases the resale value of home by 6.8%,⁴ holding all other variables constant. Coefficient estimates for our control variables are intuitive, bolstering confidence in our methodology and results. Square footage and the presence of a fireplace in the house have a significant positive effect on house sale price, while distance of house from the coast has a significant negative effect. Also note *Lambda* is greater than zero and statistically significant at the 1-percent level, indicating the presence of spatial correlation in the data, and thus validating the use of spatial regression.

⁴ The conversion of coefficient estimates from the log-linear model is $e^{0.066031} - 1 = 0.068 = 6.8\%$.

Table 3: Estimates of Spatial Regression Model

Variable	Estimate	Std. Error	z-value	Pr (> z)
<i>Intercept</i>	11.860	0.299	39.66	< 0.0001 ***
<i>Fortified</i>	0.066	0.034	1.97	0.0493 **
<i>Age</i>	0.001	0.001	0.47	0.6371
<i>Lot size</i>	0.000	0.000	1.62	0.1042
<i>Building sqft</i>	0.000	0.000	8.86	< 0.0001 ***
<i>Bedrooms</i>	-0.017	0.026	-0.64	0.5215
<i>Baths</i>	0.029	0.030	0.96	0.3374
<i>Fireplace</i>	0.059	0.032	1.84	0.0655*
<i>Ln(DistCoast)</i>	-0.075	0.019	-3.98	< 0.0001 ***
<i>Year2005</i>	0.399	0.251	1.59	0.1112
<i>Year2006</i>	0.229	0.281	0.81	0.4153
<i>Year2007</i>	0.439	0.243	1.81	0.0708*
<i>Year2008</i>	0.514	0.241	2.13	0.0329 **
<i>Year2009</i>	0.497	0.248	2.01	0.0447 **
<i>Year2010</i>	0.294	0.253	1.16	0.2456
<i>Year2011</i>	-0.007	0.283	-0.02	0.9811
<i>Year2012</i>	0.196	0.249	0.79	0.43
<i>Year2013</i>	0.241	0.245	0.98	0.3251
<i>Year2014</i>	0.289	0.245	1.18	0.2369
<i>Year2015</i>	0.265	0.245	1.08	0.2797
<i>Year2016</i>	0.482	0.262	1.84	0.0663*
<i>Lambda</i>	0.281	0.093	3.01	0.0013***
<i>N</i>	321			
<i>Log-likelihood</i>	5.2583			

Dependent variable is the natural logarithm of home sale price.

***= 1% level of significance; ** = 5% level of significance; *=10% level of significance

CONCLUSION AND POLICY IMPLICATIONS

In this study, we estimate the effect of IBHS FORTIFIED Home™ designation on home value in Mobile and Baldwin counties in Alabama. Results show that switching from a conventional construction standard to a *Fortified* designation increases the value of a home by nearly 7% holding all other variables constant.

Our findings suggests that building *Fortified* houses or retrofitting houses to meet *Fortified* standards is an economically sound investment. The additional cost of building or retrofitting is frequently is less than 7% of home value; therefore, the benefit of *Fortified* designation is very likely to outweigh cost.

This is without considering other direct benefits such as insurance premium discounts, potential uninsured rebuilding costs, and the inconvenience of temporary housing following a disaster.

In addition, given the robustness of statistical results, we believe it is appropriate for appraisers and financial institutions to reflect *Fortified* designation in appraisals for use in the mortgage process.

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