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The recent pervasive external effects of residential home foreclosure

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The recent pervasive external effects of residential home foreclosure

Robert W. Wassmer*

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The United States faced an ongoing foreclosure crisis in the late 2000s. Federal and state governments responded with public policies designed to reduce foreclosures. Such policies are economically appropriate if the cost to implement them is less than the negative private and public external effects of mortgage foreclosure. A hedonic home price regression calculates the value of these external effects for a large United States area (Sacramento, CA) hit particularly hard by the crisis over the period between January 2008 and June 2009.

The selling price of an average non-real estate owned homes, due to the presence of real estate owned sales of neighboring homes, fell by $48,827 or 31.9 percent. This estimate of the external neighborhood effect far exceeds similar estimates from previous regression studies using data from before the late 2000s foreclosure crisis and likely justifies public intervention into the curtailment of a regional foreclosure crisis of this magnitude.

Keywords: foreclosure; housing; neighborhood; policy

The quickest way to end up underwater is to live in a neighborhood that is plagued by foreclosures… As homes go into foreclosure, they create a domino effect, lowering home values throughout a neighborhood in a cascade beyond homeowner’s control.

Anna Maries Andriotis (2009) in Smart Money

But by making these investments in foreclosure prevention today, we will save ourselves the costs of foreclosure tomorrow – costs that are borne not just by families with troubled loans, but by their neighbors and communities and by our economy as a whole.

President Obama (2009) introducing his Making Home Affordable Plan

Introduction

During the last half of the first decade of the twenty-first century, the United States faced an ongoing foreclosure crisis that resulted in an unprecedented number of families losing their homes (Nelson 2010). In 2006, about 7 percent of United States
homeowners owed more on a single-family residential mortgage than what the property could have sold for (Calculated Risk 2007). By 2010, estimates of those “underwater” on their home mortgage had risen to between 20 and 25 percent (Streitfield 2010; The Economist 2010). Haughwout and Okah (2009) calculate this percentage to be even larger in some United States metropolitan areas. This severe loss in homeowner equity arose from a combination of factors (Immergluck 2008). The price of homes and home ownership rates in the first half of the 2000s rose due to low mortgage interest rates, growth in secondary mortgage markets, and expansionary mortgage access policies. Concurrent with a tightening of credit and employment markets between 2006 and 2009, housing prices then drastically fell. Many homeowners found themselves in the difficult situation of both owing more on their home than it was worth and not being able to meet their scheduled mortgage payments. Such homeowners faced involuntary foreclosure, or sometimes defaulted on their home mortgage as a strategic financial decision.\footnote{Guiso, Sapienza, and Zingales (2009) use United States survey data from the late 2000s and report that 26 percent of defaults during this period are best classified as such a strategic financial decision.} Federal and state governments responded with direct aid and policy reforms designed to reduce this wave of foreclosures; however, such policies came under attack from both those who viewed them as public dollars inappropriately spent and from others who wanted even greater public resources devoted to curtailing the crisis.

If the effects of a home foreclosure extend beyond the two parties involved in the decision to foreclose, economic theory indicates that there may be a role for greater government involvement in the foreclosure process. Economists define the hurt that a foreclosure can place on neighbors as a “negative externality” whose cost is not considered by the mortgage recipient or mortgage holder when deciding whether foreclosure is the appropriate course of action. Using a simple benefit cost assessment of whether a residential property should go into foreclosure, foreclosure rationally occurs if the benefits to the private parties involved exceed their private costs.\footnote{Aee Ambrose and Capone (1996) for a technical treatment of this decision.} The private parties in the foreclosure decision ignore the additional public cost that a foreclosure can impose upon neighboring properties. If such an external cost is present, a greater than socially optimal number of homes will enter foreclosure. Moreover, if the magnitude of this negative externality is large enough, micro-economic theory suggests a role for government in getting the private parties to internalize this public cost into the private parties’ decision to foreclose upon a mortgage.

The statements that opened this paper reflect this economic way of thinking. Both Smart Money and President Obama recognize that a foreclosure can exert a negative neighborhood influence that extends beyond the foreclosed property itself. What they and most others claiming this negative neighborhood effect as justification for government intervention often fail to do is to quantify its magnitude. By not doing this, those opposed to greater government involvement in foreclosure decisions can claim that such effects are nonexistent or very small, and thus not greater than the cost to the taxpayer of further public involvement.

Empirical evidence exists on the direct influence that mortgage foreclosure has on the selling price of a home undergoing it and the indirect influence it has on the selling price of homes near a foreclosure. However, the derivation of this evidence
predates the most recent foreclosure crisis. This is important since the severity of foreclosures in this current crisis, especially in certain regions of the US, far exceeds that observed in the past. Therefore, an extrapolation of the indirect effects of foreclosure from past studies, applied to the current crisis, may not be appropriate. Offered here is an updated empirical estimate of the neighborhood effects of foreclosure derived from a January 2008 to June 2009 data set on single-family home sales in the Sacramento (CA) Area. This region, with about 70 percent of home sales in the first quarter of 2009 resulting from foreclosure, is definitely above the average of a similar figure of about 37 percent calculated for the entire United States in the same quarter. However, the region is not such an outlier when considering that Arizona’s and California’s total home sales during this same quarter were also around 70 percent foreclosure based, and Nevada led the nation with about three fourths of its sales due to foreclosure at the same time (National Mortgage Professional 2010a).

The purpose of this paper is to explore the impact of foreclosure on surrounding home sales prices when it rises to the historically high levels observed in urban neighborhoods in Arizona, California, and Nevada during the late 2000s foreclosure crisis. I proceed with a background description on the foreclosure process, foreclosure activity in the Sacramento Area during the period under consideration, and a summary of the housing data used in this study. In addition, I review the previous empirical literature of how foreclosure affects the own selling price of a home, and the selling price of homes in proximity to a foreclosed home. This literature reveals the previous magnitudes calculated of external foreclosure effects in a neighborhood, and the appropriate regression technique to calculate similar magnitudes for the more recent data set used here. A description of the regression model and the results of the regression analysis follow. I conclude with a section describing policy interventions designed to assist mortgage holders threatened with default.

**Background**

**Foreclosure process**

Foreclosure is the procedure that a mortgage lender must follow to take possession of a home whose owner has not satisfied the requirements of her mortgage contract. In most states, foreclosure is a multi-stage process that begins with a homeowner missing a scheduled loan payment. After a set period (that varies by state) that the mortgage loan is in default, the lender in a “Judicial Foreclosure” state may file a legal intent (Lis Pendens) to foreclose upon the mortgage and offer the home for sale. In a “Non-Judicial Foreclosure” state, the homeowner just receives a default letter in the mail. In the next stage of foreclosure, the mortgage lender can negotiate the possibility of either a restructured loan or a “short sale” by which the property is sold for less than the amount owed on the mortgage and with terms on who is responsible for the difference. If these negotiations fail, the property goes to the final stage of foreclosure, which in a Judicial Foreclosure state is an auction requiring a minimum bid set to cover the distressed mortgage’s loan balance and fees. If the highest auction bid does not meet the minimum, the property reverts to the lender and is considered real estate owned (REO). In a Non-Judicial Foreclosure state, the bank takes possession of the home without the formal requirement of a minimum bid auction and the property is then REO. California, the state from which data for this study is drawn, is a Non-Judicial Foreclosure state.
REO activity in a neighborhood measures only the worst-case outcome of the foreclosure process just described. An REO home – as opposed to one in *Lis Pendens*, or one having received a default letter, or one involved in a foreclosure sale – is likely to have faced the greatest neglect, vandalism, and subsequent physical deterioration. Thus, if looking to measure the greatest expected external effects of foreclosure on a neighborhood, it is reasonable to use a measure of the degree of REO activity in a neighborhood.

**US, California, and Sacramento Area foreclosure activity**

Kingsley, Smith, and Price (2009) believe that the first decade of the twenty-first century is likely to be the most tumultuous to date in the history of United States Housing Markets. As reported by the National Mortgage Professional (2010b) 2.21 percent of all the United States single-family housing units received a *Lis Pendens* or similar letter of mortgage default in 2009. This was up from 1.84 percent in 2008, 1.03 percent in 2007, and just 0.58 percent in 2006. Nevada led the states in 2009 with just over 10 percent of its housing units receiving a default notice. Arizona and Florida ranked next with around six percent of their housing units receiving these notices, while California followed at 4.75 percent. Regarding California, the Federal Housing Finance Agency (2009, 3) notes that between the first quarter of 2000 and the fourth quarter of 2006, around five percent of all residential real estate sales in the state were distressed sales (ones that had proceeded within a year of foreclosure notice). By the first quarter of 2009, this percentage had risen astoundingly to nearly half. For the nation’s 100 largest metropolitan areas, Immergluck (2008, 10) notes that the Sacramento Area produced the fourth largest increase (at 162 percent) in foreclosure filings between mid-2006 and mid-2007. And in 2009, the Sacramento Area still remained in the top 20 such areas in the United States for housing foreclosure notices with 5.6 percent of the area’s homeowners receiving them (Market Watch 2010).

**Sacramento housing data**

Single family, residential home sales from the Sacramento Area represent a reasonable sample to use in a hedonic regression study designed to produce a more contemporary measure of the negative neighborhood effects of foreclosure in an urban area affected relatively hard by the recent foreclosure crisis. For this study, the Sacramento Area consists of El Dorado, Nevada, Placer, Sacramento, Yolo, and Yuba Counties. The Multiple Listing Service data from all zip codes in these six counties that had more than 50 sales for each of the six quarters under consideration yielded home specific data on sales price and characteristics. The result being information from 35,822 single-family homes sales, for the period between January 2008 and June 2009, for 61 different zip codes, and for six different counties. Sacramento County contained 73 percent of the observed home sales. A black dot in Figure 1 represents each of these individual home sales.

The average selling price of a Sacramento Area home between 2008 and mid-2009 was $255,908. Foreclosure activity is accounted for here by a dummy variable that records as a one if a home was real estate owned (REO) when sold. In the first

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3See http://www.mlslistings.com for a general description of Multiple Listing Service data.
The effects of residential foreclosure

The effect of foreclosure status on own home price

Holding other characteristics constant, there are at least two theoretical reasons for why a home in foreclosure sells for less. First, the previous homeowner is likely to anticipate the foreclosure of her mortgage, spend less on maintenance, and relinquish to the lender of her foreclosed mortgage a lower maintained house. Second,
lender holding a foreclosed house faces the stigma of buyers knowing that the
incentive for them to sell the house is greater than that for an owner-occupied house.
Specifically, Campbell, Giglio, and Pathak (2009, 3) attribute a lender’s desire to sell
at a lower price as related to the increased cost of protecting an unoccupied asset.
While Clauretie and Daneshvary (2009, 47) point to a lender’s desire for a shorter
marketing time and a greater need for liquidity. Previous studies of the influence of
mortgage foreclosure on a home’s selling price have calculated the combined
influence of the two just described effects, while some have calculated the magnitude
of these two effects separately.

As summarized by Clauretie and Daneshvary (2009, Table 1, 45), previous
studies found the impact of a home anywhere in the foreclosure process on its sales
price in the low- to mid-20 percent range. Rogers (2008) controls for the influence of
neighboring homes in foreclosure and finds this own-price foreclosure discount to be
27 percent. Using a similar control of neighboring homes in foreclosure, Campbell,
Giglio, and Pathak (2008) report a foreclosure discount of 28 percent. Clauretie and
Danshevary (2009) control for the influence of neighboring homes in foreclosure, but
also add measures of property condition as explanatory variables in their hedonic
home price regression. After doing this, they obtain a distressed sale discount that is
about one-third less.

The effect of proximity to residential foreclosure on home price
As summarized by Lee (2008), a home in foreclosure can exert at least three different
forms of negative external effects on the selling price of nearby homes: blight,
valuation, and supply. A bank-owned home is more likely to suffer physical neglect
before and after repossession. Such home-specific blight in a neighborhood is likely
to send a negative signal to potential buyers about the quality of life and social
control in the neighborhood. Such neglect can also encourage nearby homeowners to
ignore the upkeep of their own homes; the result being further neighborhood blight
and perhaps greater crime. The second effect of valuation arises because of the
comparable prices taken by a real estate agent to set the sales price of home and/or
an appraiser seeking to qualify a new mortgage. Foreclosure lowers the own-price of
a home undergoing it, and through comparable pricing, can lower the appraised
prices of nearby homes. Finally, foreclosure is usually a forced act and thus
“unnaturally” raises the supply of homes in a neighborhood. Since prospective
homebuyers usually shop by neighborhood, this supply increase lowers the
prospective selling price of all homes in a neighborhood due to the expansion of
choices available to the same buyers shopping that neighborhood.

Immergluck and Smith (2006) are widely cited as one of the first to use hedonic
regression analysis to estimate the external costs of foreclosure on surrounding
property sales. By means of a 1999 data set from 9,600 single-family property
transactions in Chicago (IL), they found that a foreclosed property within one-
eighth of a mile of home reduces its selling price by 1.1 percent, while foreclosed
properties between one-eighth and one-quarter mile reduce it by 0.3 percent. Lin,
Rosenblatt, and Yao (2007) offer a greater accounting of the influence of time on the
effect that foreclosure proximity has on selling price. Using a United States sample of
nearly 30,000 home sales drawn from both 2003 and 2006, they find a statistically
significant effect of a foreclosure on nearby home prices within a radius of a half mile
and up to five years after the liquidation. Using the 2006 housing data, the most
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (Minimum Maximum)</th>
<th>Variable</th>
<th>Mean (Minimum Maximum)</th>
<th>Variable</th>
<th>Mean (Minimum Maximum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Square Feet 1000s</td>
<td>1.78 (0.40 10.61)</td>
<td>Tile Roof Dummy</td>
<td>0.3960</td>
<td>Neighborhood Assoc. Dummy</td>
<td>0.1455</td>
</tr>
<tr>
<td>Lot Square Feet 1000s</td>
<td>186.53 (0 866,408)</td>
<td>Metal Roof Dummy</td>
<td>0.0034</td>
<td>Neighborhood Assoc. Dues</td>
<td>24.06 (0 9.999)</td>
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<tr>
<td>One Story Dummy</td>
<td>0.6748</td>
<td>Slate Roof Dummy</td>
<td>0.0021</td>
<td>Tenth Mile REOs in Quar.</td>
<td>8.78 (1 60)</td>
</tr>
<tr>
<td>No Garage Dummy</td>
<td>0.0220</td>
<td>Shake Roof Dummy</td>
<td>0.0535</td>
<td>Quarter Mile REOs in Quar.</td>
<td>27.41 (0 120)</td>
</tr>
<tr>
<td>No Fireplace Dummy</td>
<td>0.2177</td>
<td>Contemporary Dummy</td>
<td>0.2322</td>
<td>One Mile REOS in Quar.</td>
<td>313.44 (0 1,012)</td>
</tr>
<tr>
<td>Bedrooms</td>
<td>3.3842(0 9)</td>
<td>Mediterranean Dummy</td>
<td>0.0301</td>
<td>Fraction Zip REO in Quar.</td>
<td>0.6125 (0 1)</td>
</tr>
<tr>
<td>Full Baths</td>
<td>2.0804(0 7)</td>
<td>Victorian Dummy</td>
<td>0.0014</td>
<td>Own REO Dummy</td>
<td>0.6235</td>
</tr>
<tr>
<td>Half Baths</td>
<td>0.2172(0 5)</td>
<td>Years Old</td>
<td>27.28(0 134)</td>
<td>Days on Market 100s</td>
<td>1.01(0 7.6)</td>
</tr>
<tr>
<td>Sewer Dummy</td>
<td>0.9899</td>
<td>Years Old Squared</td>
<td>1,214.46(0 17,956)</td>
<td>Quarter Two Dummy</td>
<td>0.185</td>
</tr>
<tr>
<td>Wood Ext Dummy</td>
<td>0.1673</td>
<td>Years Since Remodeled</td>
<td>25.88(0 133)</td>
<td>Quarter Three Dummy</td>
<td>0.218</td>
</tr>
<tr>
<td>Brick Ext Dummy</td>
<td>0.0039</td>
<td>Horse Prop Dummy</td>
<td>0.0136</td>
<td>Quarter Four Dummy</td>
<td>0.175</td>
</tr>
<tr>
<td>Lap Ext Dummy</td>
<td>0.0355</td>
<td>Comm. Serv. Dist. Dummy</td>
<td>0.0600</td>
<td>Quarter Five Dummy</td>
<td>0.160</td>
</tr>
<tr>
<td>Vinyl Ext Dummy</td>
<td>0.0188</td>
<td>Covenant Rest. Dummy</td>
<td>0.8330</td>
<td>Quarter Six Dummy</td>
<td>0.160</td>
</tr>
</tbody>
</table>
severe impact is an 8.7 percent discount for each current foreclosure. This foreclosure effect declined to 1.7 percent for foreclosures measured as occurring five years in the past. Lin, Rosenblatt and Yaos calculated external foreclosure discounts when using housing data from the 2003 boom year, as compared to the 2006 bust year, were half the magnitude. Based upon 130,000 home sales in St. Louis County (MO) for 2000 to 2002, Rogers (2008) finds that one foreclosure within a tenth of a mile reduces a residential property’s sales price by 0.9 percent. Campbell, Giglio, and Pathak (2009), using a 1987 to 2008 data set of nearly 1.8 million Massachusetts home sales, finds a residential foreclosure within a twentieth of a mile of a home reducing its sales price by about one percent.

Harding, Rosenblatt, and Yao (2009) extend this line of empirical research by using a 1989 to 2007 data set of over 400,000 repeat housing sales covering 37 different metropolitan statistical areas from 13 states. The use of repeat sales allows for a finding of the influence of foreclosure proximity on the sales price trend of the same home. They find a 1.3 percent discount per foreclosure within a twentieth of a mile, which falls to 0.6 percent for between a twentieth and a tenth of a mile. These negative external effects linger for up to a year after the foreclosure sale. Leonard and Murdoch (2009), observing 23,000 plus homes sales in 2006 for Dallas County (TX) record a 0.5 selling price discount for a home within 0.14 mile of a foreclosure; and 0.1 percent discount for each home within 0.28 to 0.57 miles; and the same 0.1 percent foreclosure discount for between 0.57 to 0.85 miles. Schuetz, Been, and Ellen (2008) differ from previous studies in its calculation of the effect of a notice of intent (as opposed to a full foreclosure sale) to begin foreclosure being given to a property on surrounding properties. They use threshold levels as opposed to a continuous measure of this notice. Using a 2000 to 2005 data set of around 57,000 home sales in New York City, they find that one or more of these notices within a twentieth of a mile of a property reduce its sales price by 1.8 percent. While within a twentieth to tenth (tenth to fifth) of a mile, six (11) or more notices reduce selling price by 4.7 (3.5) percent.

Regression analysis

The appropriate regression technique

Immergluck and Smith’s (2006) research on the external costs of foreclosure offers an excellent example of the appropriate statistical technique to determine the direct and indirect effect of residential foreclosure on the selling price of homes. They use a hedonic regression model to estimate the impact of foreclosures of conventional single-family loans on the selling price of single-family properties in Chicago (IL) while holding other causal factors constant. The hedonic regression model assumes that housing is a composite product and typically uses a log-lin functional form where the dependent variable (selling price of a home) is in natural log form and the explanatory variables are unaltered. Regressing the attributes of a house against its selling price results in an estimation of the marginal contribution of each attribute to its selling price. The categories of explanatory variables expected to influence the selling price of a home include property characteristics (measures of home and lot square footage, bedrooms, bathrooms, construction, etc.), location characteristics (measures of neighborhood density, income, race, etc.; and/or a set of neighborhood dummy variables), and sales environment characteristics (measures of time on the market, date sold, real estate agent experience, etc.). The foreclosure status of the
home and its proximity to other homes in foreclosure, respectively fall in the sales and location characteristics that can theoretically influence selling price.

A concern increasingly raised in the estimation of hedonic regression models of housing price is the possibility of spatial autocorrelation. This occurs when observations in a regression’s data set that are physically close to each other produce correlated error terms and thus violate a necessary assumption regarding the validity of this statistical technique (Anselin 2002). As noted by Lochl (2007), this is of particular concern in a housing data set drawn from a region because of the geographic, governance, and economic factors that are more likely to be similar the closer that one home sale is to another. If not fully accounted for in the choice of explanatory variables, shared location characteristics are likely to produce positively correlated error terms based upon proximity. Few of the previous regression-based studies of the effect of foreclosure on housing price have corrected for spatial autocorrelation. However, Rogers (2008) does find the presence of spatial autocorrelation in his study of neighborhood foreclosure effects using a 1996 to 2007 data set from St. Louis County (MO). After correcting for it, both the magnitude and statistical significance of some of his regression estimates change. Clauretie and Daneshvary (2009), and Leonard and Murdoch (2009), find the same for regression based tests of neighborhood foreclosure effects for housing data sets respectively drawn from 2004 to 2007 home sales in two Sun Cities in the Las Vegas (NV) Area, and 2006 home sales in Dallas County (TX).

**Regression model**

Since the purpose of this study is to produce estimates of the influence of foreclosure activity on surrounding home sales comparable to estimates produced earlier, the regression model used here is similar to that used previously. By means of the hedonic pricing model, the natural log of a home’s selling price is a function of its property, location, sales environment, and real estate owned characteristics. I account for each of these characteristics through a choice of variables available in the Multiple Listing Service for residential home sales in the Sacramento Area. The general formulation of the regression model is:

\[
\log (\text{Selling Price}) = f (\text{Property Characteristics, Location Characteristics, Selling Environment Characteristics, Real Estate Owned Characteristics}),
\]

where

**Property Characteristics** = \(f (\text{Home Sq Feet 1000s, Lot Sq Feet 1000s, One Story Dummy, No Garage Dummy, No Fireplace Dummy, Bedrooms, Full Baths, Half Baths, Sewer Dummy, Wood Ext Dummy, Brick Ext Dummy, Lap Ext Dummy, Vinyl Ext Dummy, Tile Roof Dummy, Metal Roof Dummy, Slate Roof Dummy, Shake Roof Dummy, Contemporary Dummy, Mediterranean Dummy, Victorian Dummy, Years Old, Years Old Squared, Years Since Remodeled})\),

\(\text{(2)}\)

**Location Characteristics** = \(f (\text{Horse Property Dummy, Community Service District Dummy, Covenant Restriction Dummy, Neighborhood Association Dummy, Neighborhood Association Dues, Set of 60 Zip Code Dummies})\),

\(\text{(3)}\)
Selling Environment Characteristics = f (Days on Market 100s, Quarter Two Dummy, Quarter Three Dummy, Quarter Four Dummy, Quarter Five Dummy, Quarter Six Dummy), (4)

Real Estate Owned Characteristics = f (Own REO Dummy, Tenth Mile REOs in Quarter, Quarter Mile REOs in Quarter, One Mile REOs in Quarter, Fraction Zip REO in Quarter). (5)

The property characteristics included in the regression model take full advantage of the richness of the Multiple Listing Service data. The excluded exterior, roof material, and architectural style characteristics are respectively stucco, composite shingle, and ranch. The squared value of years old is included in anticipation that at some age a home’s value stops declining based upon consumer preference for older preserved homes.

Location characteristics include all zoning, taxing, and neighborhood association characteristics included in the Multiple Listing Service data. A Community Service District taxes residential property for local infrastructure projects outside of the restrictive property tax system of post-Proposition 13 California. Sixty zip code dummy variables control for neighborhood characteristics not otherwise accounted for. Without the zip code dummies, the findings attributed here to foreclosure activity could instead be due to a positive correlation between higher foreclosures occurring in less desirable zip codes. Of course, this control is contingent on the zip code being the appropriate geographic accounting of what constitutes a neighborhood.

The environment within which a home sale occurs also influences its sales price. The number of days in hundreds that a home is on the market can influence its selling price. Particularly important for the period under consideration are the controls for which quarter the home sold in. Since the first quarter (Jan–Feb–March 2008) is the excluded dummy category, and the economy was in continual recession over the following 18-month period observed, the signs on the included time dummies will likely be negative.

The explanatory variables of utmost importance to this research are categorized above as real estate owned characteristics. Whether the home itself was bank owned is an important determinant of the environment that generates its selling price. I account for it here by an explanatory variable (Own REO Dummy) that takes on a value of one if the home was real estate owned at the time of sales, and zero if not. The number of REO sales at various distances measures the influence of nearby properties that sold while bank owned and calculated for the quarterly period that the property under consideration sold. Distance choices follow previous conventions and measure REO home sales occurring within a tenth of a mile, a tenth to quarter mile, and a quarter mile to one mile. Unique to this analysis, I include a broad measure of the percentage of REO home sale for a quarterly period in the entire zip code that is the location of the home.

Since the functional form of the hedonic regression is log-lin, a simple transformation of a regression coefficient yields the percentage change in the selling price of a home following a one-unit change in the respective explanatory variable.
The necessary transformation is the natural exponent of the log-lin regression coefficient, less one, all multiplied by 100.\(^4\)

Two other econometric concerns that arise in a regression of this sort are heteroskedasticity and spatial autocorrelation. Heteroskedasticity occurs when the residual values calculated from the regression are codependent. In predicting home prices, this is likely to occur in relation to the size variables for either the structure or lot, and if present result in biased regression estimates. In the earlier literature review, I raised the issue of the likelihood of spatial autocorrelation and the need to account for it. Both heteroskedasticity and spatial autocorrelation are present in the estimation of this regression model and appropriately corrected.

**Data and regression results**

Table 1 contains the descriptive statistics calculated for all variables in the regression analysis. GEODASpace produced the log-lin hedonic regression estimates.\(^5\) This software estimates robust standard errors in the presence of heteroskedasticity for both an ordinary least squares (OLS) estimation and a two-stage least squares regression method that accounts for spatial autocorrelation. For comparison purposes, both results are in Table 2. As summarized in Lochl (2007), the incorporation of spatial effects into regression estimation involves either a spatial lag or a spatial error model. As stated by Anselin (2002), the spatial lag model assumes that a spatially weighted value of surrounding home prices is a factor in the determination of home price. While the spatial error model assumes that spatial dependence in the regression estimation is present in the error term in the form of the price of a home being a function of the omitted variables at neighboring locations. To use either of these models, a weight matrix must specify the method of inclusion of neighboring properties. Either a k-nearest neighbor or Euclidian distance approach is possible. In previous research, Lochl (2007) chose the k-nearest neighbor approach with two neighbors, Clauretie and Daneshvary (2009) used eight neighbors, and Leonard and Murdoch (2009) included all neighbors within 2000 feet because this gave every house sale in their data set at least one neighbor.

For the spatial regression results recorded in Table 2, I ran both the spatial lag and spatial error model. The Akaike Information Criterion and the log likelihood statistic calculated for these models, indicates that the spatial error model is the more appropriate and thus reported here.\(^6\) Regarding the suitable number of neighbors to include in the weight matrix when running the spatial error model, I allowed k to vary from one to 12 neighbors. The Moran’s I statistic, calculated for each regression that used a different value of k, identified the most appropriate number of neighboring houses for inclusion as one.

The statistical significance of the Lamda regression coefficient in the spatial error model indicates the presence of spatial autocorrelation in the ordinary least squares estimation.\(^7\) Its positive sign indicates that errors made in the prediction of neighboring home prices, positively influence the error made in the prediction of a

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\(^5\)Available from the GEODA Center at Arizona State University (see [http://geodacenter.asu.edu/software](http://geodacenter.asu.edu/software)).

\(^6\)Lochl (2007) also found the spatial error model more appropriate.

\(^7\)Statistical significance is always at the 90 percent or better confidence level in a two-tailed test.
### Table 2. Heteroskedasticity corrected ordinary least squares and spatial error model regression results. (Dependent variable: natural log of home selling price).

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Ordinary Least Squares Coefficient (Elasticity)</th>
<th>Spatial Error Model Coefficient (Elasticity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>12.9375***</td>
<td>12.972***</td>
</tr>
<tr>
<td><strong>Property Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home Sq Feet 1000s</td>
<td>0.2729**(31.37)</td>
<td>0.2573**(29.34)</td>
</tr>
<tr>
<td>Lot Sq Feet 1000s</td>
<td>0.0000001</td>
<td>0.0000001</td>
</tr>
<tr>
<td>One Story Dummy</td>
<td>0.0564**(5.80)</td>
<td>0.0510**(5.23)</td>
</tr>
<tr>
<td>No Garage Dummy</td>
<td>−0.1776**(−16.27)</td>
<td>−0.1482**(−13.78)</td>
</tr>
<tr>
<td>No Fireplace Dummy</td>
<td>−0.1001**(−9.53)</td>
<td>−0.0820**(−7.88)</td>
</tr>
<tr>
<td>Bedrooms</td>
<td>0.0041</td>
<td>0.0118**(1.18)</td>
</tr>
<tr>
<td>Full Baths</td>
<td>0.0605**(6.24)</td>
<td>0.0569**(5.85)</td>
</tr>
<tr>
<td>Half Baths</td>
<td>0.0492**(5.05)</td>
<td>0.0464**(5.85)</td>
</tr>
<tr>
<td>Sewer Dummy</td>
<td>0.1264**(13.48)</td>
<td>0.1061**(11.19)</td>
</tr>
<tr>
<td>Wood Exterior Dummy</td>
<td>−0.0306**(−3.02)</td>
<td>−0.0291**(−2.87)</td>
</tr>
<tr>
<td>Brick Exterior Dummy</td>
<td>0.0647**(6.68)</td>
<td>0.0877**(9.17)</td>
</tr>
<tr>
<td>Lap Exterior Dummy</td>
<td>−0.0043</td>
<td>0.0002</td>
</tr>
<tr>
<td>Vinyl Exterior Dummy</td>
<td>−0.0084</td>
<td>−0.0053</td>
</tr>
<tr>
<td>Tile Roof Dummy</td>
<td>0.0506**(5.19)</td>
<td>0.0359**(3.66)</td>
</tr>
<tr>
<td>Metal Roof Dummy</td>
<td>0.1014**(10.67)</td>
<td>0.0598**(6.16)</td>
</tr>
<tr>
<td>Slate Roof Dummy</td>
<td>0.0854**(8.91)</td>
<td>0.0655**(6.77)</td>
</tr>
<tr>
<td>Shake Roof Dummy</td>
<td>0.0788**(8.20)</td>
<td>0.0496**(5.09)</td>
</tr>
<tr>
<td>Contemporary Dummy</td>
<td>0.0120**(1.21)</td>
<td>0.0085**(0.85)</td>
</tr>
<tr>
<td>Mediterranean Dummy</td>
<td>0.0011</td>
<td>0.0025</td>
</tr>
<tr>
<td>Victorian Dummy</td>
<td>0.0889**(9.29)</td>
<td>0.0161</td>
</tr>
<tr>
<td>Years Old</td>
<td>−0.0052**(−0.52)</td>
<td>−0.0061**(−0.61)</td>
</tr>
<tr>
<td>Years Old Squared</td>
<td>0.00005**(0.005)</td>
<td>0.00005**(0.005)</td>
</tr>
<tr>
<td>Years Since Remodeled</td>
<td>−0.0039**(−0.39)</td>
<td>−0.0037**(−0.37)</td>
</tr>
<tr>
<td><strong>Location Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horse Property Dummy</td>
<td>0.1671**(18.20)</td>
<td>0.1550**(16.76)</td>
</tr>
<tr>
<td>Community Service District Dummy</td>
<td>−0.0315**(−3.10)</td>
<td>−0.0202**(−2.00)</td>
</tr>
<tr>
<td>Covenant Restriction Dummy</td>
<td>0.0009</td>
<td>0.0002</td>
</tr>
<tr>
<td>Neighborhood Association Dummy</td>
<td>−0.0084**(−0.83)</td>
<td>−0.0034</td>
</tr>
<tr>
<td>Neighborhood Association Dues</td>
<td>0.00003</td>
<td>0.00003**(0.003)</td>
</tr>
<tr>
<td><strong>Selling Environment Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days on Market 100s</td>
<td>−0.0134**(−1.33)</td>
<td>−0.0110**(−1.10)</td>
</tr>
<tr>
<td>Quarter Two Dummy</td>
<td>−0.0468**(−4.57)</td>
<td>−0.0492**(−4.80)</td>
</tr>
<tr>
<td>Quarter Three Dummy</td>
<td>−0.1010**(−9.61)</td>
<td>−0.1029**(−9.78)</td>
</tr>
<tr>
<td>Quarter Four Dummy</td>
<td>−0.1808**(−16.54)</td>
<td>−0.1778**(−16.29)</td>
</tr>
<tr>
<td>Quarter Five Dummy</td>
<td>−0.2830**(−24.65)</td>
<td>−0.2799**(−24.42)</td>
</tr>
<tr>
<td>Quarter Six Dummy</td>
<td>−0.3052**(−26.30)</td>
<td>−0.3023**(−26.09)</td>
</tr>
<tr>
<td><strong>Real Estate Owned Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own REO Dummy</td>
<td>−0.1803**(−16.50)</td>
<td>−0.1574**(−14.56)</td>
</tr>
<tr>
<td>Tenth Mile REOs in Quar.</td>
<td>−0.0059**(−0.59)</td>
<td>−0.0061**(−0.61)</td>
</tr>
<tr>
<td>Quarter Mile REOs in Quarter</td>
<td>−0.0018**(−1.18)</td>
<td>−0.0019**(−0.19)</td>
</tr>
<tr>
<td>One Mile REOS in Quarter</td>
<td>−0.0003**(−0.03)</td>
<td>−0.0003**(−0.03)</td>
</tr>
<tr>
<td>Fraction Zip REO in Quarter</td>
<td>−0.0556**(−5.41)</td>
<td>−0.0431**(−4.22)</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.8725</td>
<td>0.8716</td>
</tr>
<tr>
<td>Lamda</td>
<td>−2.564***</td>
<td></td>
</tr>
</tbody>
</table>

Two-tailed statistical significance: *** > 99th percentile, ** = 95th to 99th percentile, * = 90th to 95th percentile.

A full set of 60 zip code dummies included, but results not recorded.

*A unit increase in respective explanatory variable yields this percentage increase in home price. These are recorded for only statistically significant regression coefficients.*
home’s price. Thus, as compared to OLS, the spatial error model results are the more appropriate to consider. As shown in Table 2, they differ from the OLS results in that two explanatory variables (Victorian Dummy and Neighborhood Association Dummy) lost statistical significance, while two other variables (Neighborhood Association Dues and Bedrooms) gained it. Of the explanatory variables found statistically significant in both regression models, the elasticity of the vast majority of these declined in the spatial error model.

The statistically significant elasticities recorded in Table 2 for the spatial error model are all reasonable in sign and magnitude. The calculated effect of a two percent decrease in the price of a home in a community service district is logical if the typical homeowner values the additional services available in such a district, less than the increased fees levied on the home to finance them. While the positive influence of neighborhood association dues – a $100 increase in these yearly dues raising selling price by 0.3 percent – shows that neighborhood associations offer positive value to a home the more they do (as measured by the amount of dues collected to do it). The statistical significance and the respective positive and negative directional effects on Years Old and Years Old Squared, indicate that the vintage of a home has a decreasing negative effect on its selling price until it is around 61 years old. Similar quadratic specifications were tried for the explanatory variables Years Since Remodeled and Days on Market, but in both cases the quadratic variables were statistically insignificant.

The own effect of a home being REO when sold is a 14.6 percent decrease in price from a home with the same characteristics controlled for in the regression specification. This near 15 percent decrease associated with real estate owned is lower than the 20 to 27 percent REO discount calculated in earlier studies. However, it does match the expectation put forward by Claretie and Danshevary (2009) that if controlling for property condition – as at least partially done here with Years Since Remodeled – the REO effect is expected to be about one-third of that if not controlled for.

Getting to the explanatory variables of interest for the primary purpose of this paper, all of the measures of the external neighborhood effects of foreclosure are statistically significant. An additional home within a tenth of a mile, sold by a financial institution that had taken possession of it through mortgage foreclosure, reduced the selling price of a home by 0.61 percent. Between a tenth and a quarter mile, the effect of an additional REO home sale reduced selling price by 0.19 percent. Between a quarter mile and a mile, the neighborhood effect per REO sale fell to a 0.03 percent reduction. This last effect may seem small, but note that the average number of REO sales within a mile of the homes in this data set is 313; thus, on average, this results in a 9.4 percent reduction in selling price.

In comparison, the —0.61 percent external effect of a foreclosed home within a tenth of mile, and the —0.19 effect for between a tenth and quarter mile, are near or slightly below the magnitudes calculated for similar distances in earlier studies. What is unique here is that the third ring of calculated external effects extends to as far as one mile from the home sold. Only Leonard and Murdoch (2009) found a significant effect of neighboring REO sales in a zone that extended to 0.85 miles from a sales location. Most other studies found neighborhood foreclosure effects that only extended as far as a quarter mile. Even more important to the claim of an external effect more pervasive in this sample than in the past is the finding that the neighborhood effect extends throughout a zip code. Never detected before, and over
and above the within one mile external neighborhood effects already discussed, the sales price of a home in the Sacramento Region in the late 2000s is expected to have fallen in percentage terms by the decimal share of homes sold in the same zip code and quarter, multiplied by $-4.22$. Thus, if 0.61 of homes sales in a zip code are REO sales (as was the average observed here), home price on average declined about 2.6 (0.61 * $-4.22$) percent from the influence of the sale of bank-owned homes in a zip code. Since the square mile size of zip codes in the data sample used varies widely (see Figure 1), I suspect this zip code effect is likely due to buyers forming opinions about the desirability of buying a home anywhere in a specific zip code based upon the amount of REO sales activity zip code wide. As compared to earlier studies, calculated here are both a narrower negative neighborhood effect of REO sales within one mile of a home and a much broader overall zip code effect.

Calculating the external effects of residential foreclosure in the Sacramento Area

For the 18-month period from January 2008 through June of 2009, 36,833 single-family homes sold in 61 different Sacramento Area zip codes. The total market value of these transactions added up to $9.09 billion. Only 38 percent of these home sales were non-REO sales. The market value of these non-REO home sales totaled $4.55 billion.

The hedonic regression analysis just described found that the selling price of these non-REO home sales, holding all else constant, were lower due to at least four distinct external effects: (1) each REO sale within a tenth of a mile in the quarter a home sold, reduced its sales price by 0.61 percent, (2) each REO sale between a tenth and quarter of mile in the quarter a home sold, reduced its sales price by 0.19 percent, (3) each REO sale between a quarter and one mile in the quarter the home sold reduced its sales price by 0.03 percent, and (4) each percentage point rise in the percentage of home sales in zip code that are REO reduced sales price by 0.04 percent. Using these statistically significant effects, and the average measures of the prevalence of foreclosure for each residential property by distance or throughout the zip code, the external effect of REO sales is around a $1.10 billion reduction in the price of non-REO sales over the 18-month period observed for the Sacramento Area. This loss in value represents a 31.9 percent drop in market value from what non-REO home sales would have sold for if no REO sales occurred in the same quarter. Since there were 22,553 non-REO homes sold over this period, this price decline averaged $48,827 per home. For comparison sake, this per-home estimate far exceeds the $7,200 per home price decline in the United States (a $14,891 decline for California) due to neighborhood foreclosures that the Center for Responsible Lending (2009) estimated for 2009. The basis of such estimates being effects drawn from an approximation taken from previously described regression studies that utilized data sets from before the late 2000s foreclosure crisis.

Furthermore, the approximate $1.1 billion reduction in the sales price of 22,000 plus Sacramento Area non-REO homes during the 18 months under consideration is

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8Calculated as $[\frac{4.5530}{1 + (0.6125 * -0.0422)}] - 4.5530 + [\frac{4.5530}{1 + (8.78 * -0.0061)}] - 4.5530 + [\frac{4.5530}{1 + (27.41 * -0.0019)}] - 4.5530 + [\frac{4.5530}{1 + (313.44 * -0.0003)}] - 4.5530$.
a low-end estimate of external harm. It does not account for two other external effects that exist, but whose size is impossible to calculate with the empirical methods used here. The first is a similar per-home loss in market value to all other non-REO homes in the area not sold over this period. This is an unrealized loss, but it still is a negative external effect imposed upon those looking to tap into the reduced value of their home’s equity after neighbors’ default on their mortgage. In addition, unrealized losses in market value likely reduce the amount of local property tax revenue collected. In California – in which local governments after Proposition 13 are required to use acquisition value based assessment in the collection of property taxes – this is most likely to affect jurisdictions with a high proportion of homes that sold just before or at the start of the housing downturn. Such homeowners are more likely to be able to appeal successfully their recent acquisition-based property assessment to a lower value. The result being lower local property tax bases, with no ability in post-Proposition 13 California for local jurisdictions to raise the one percent rate applied to them, and subsequently a reduction in locally provided public services that fall upon all homeowners. This is a second external effect on a home under no threat of mortgage foreclosure being in proximity to REO home sales.

After reporting these findings regarding negative neighborhood external effects, a note of caution is in order. It would be inappropriate to assume that these much larger external affects apply equally to all areas of the United States during the late 2000s foreclosure crisis. Though the magnitude of foreclosure sales rose throughout the United States during this foreclosure crisis, the levels seen in the Sacramento Area are most comparable to that seen in urban areas in only a few states (Arizona, California, and Nevada). Thus, before assuming that these affects apply equally throughout the US, it would be necessary to conduct similar research using data from this same period from regions in the United States with less extreme REO concentrations.

Conclusion

Under restrictive assumptions, it is reasonable to argue that the decision to offer and accept a residential mortgage is a private market activity not requiring government interference. However, economists point out that this is only the case if information asymmetry and external effects are insubstantial in the private mortgage market. Information asymmetry exists when one party to the mortgage process knows more about the details and risks of the transaction. As Immergluck (2008) describes, the growth in the proportion of subprime and exotic mortgages held by the poor and less educated is likely, in part at least, due to financial institutions knowing more about the details and risk of these instruments than those using them as a way to finance home ownership. Thus, government intervention in the form of greater third-party counseling to prospective mortgage borrowers on choosing a mortgage form and/or regulation on who can use a particular form of a mortgage is likely in order. Such regulation, in the form of stricter requirements for the underwriting and terms of mortgage loans administered by a new federal Bureau of Consumer Financial Protection has already come through the Dodd-Frank Act signed into law in mid 2010. That said, the intent of this research is not to investigate information asymmetry in mortgage lending, but instead an empirical examination of a second form of market failure
that also justifies government involvement in private mortgage markets. Specifically this research uses regression analysis to document the existence and magnitude of the negative neighborhood effects of mortgage foreclosure for a United States metropolitan area hit particularly hard by it during the crisis of the late 2000s.

If you or your financial institution’s choice of a new mortgage instrument, or decision to foreclose on a mortgage, affects third parties that are not involved in these decisions, then there may be a role for public intervention into private mortgage markets. A personal explanation of this economic logic is that even if your home faces no possible threat of foreclosure, you would rationally support public policies that reduce neighboring foreclosures if the external cost of these foreclosures to you is greater than your cost as a taxpayer to put the policies in place. However, to make such an assessment accurately, you need to know the cost of nearby foreclosures on your home’s value. I have calculated here an estimate of such for a major United States metropolitan area affected disproportionately by the foreclosure crisis that struck the entire country in the second half of the 2000s.

Policy interventions

Others (Immergluck 2008; Kingsley, Smith, and Price 2009; Nelson 2009; Fitzpatrick and Thomson 2010) have already described four different forms that government intervention into single-family mortgage markets could take. The first is trying to slow foreclosures among existing mortgage holders. Government policies of this form include encouragement and/or regulation directed at financial institutions for greater modification of existing mortgage terms, greater short sales, greater allowance for qualified buyers to assume previously classified non-assumable mortgages, and greater forgiveness of debt on properties with underwater mortgages.

The second form of public intervention is reducing the likelihood of future foreclosure for those not yet holding a mortgage. Policy options in this form include greater regulation of subprime, exotic, and even high-risk prime mortgage lending; offering Community Reinvestment Act credit to a financial institution for overall responsible mortgage practices and/or refinancing a previously “predatory” loan, and even reconsidering the previous housing policy push of encouraging home ownership for all. A third form of public intervention after foreclosure occurs is encouraging/requiring the institutional owner of the vacant property to sell it sooner and/or enforcing the accountability of the lender for maintaining an unoccupied property. A reduction in vacancy rates in a neighborhood should reduce the external effects of greater blight and crime that high vacancy rates can spawn. Finally, perhaps the most radical financial reform is the possibility of granting bankruptcy judges the authority to modify primary residential mortgages in a way referred to as a “strip” or “cram down.” In such a procedure, a bankruptcy judge reduces the secured claim of the mortgage lender to the current market value of the house.

Up to mid-2010, the major federal programs in place to curtail foreclosures included the United States Federal Housing Authority’s (2010) Hope for Homeowners Program and the United States Treasury’s (2009) Making Home Affordable Plan. Both of these fall under the first policy category described above of trying to slow foreclosure activity among existing mortgage holders. Operating with extensive restrictions on who can qualify and using federal financial backing that amounts to
hundreds of billions of dollars, the intent of both of these federal interventions is to make it easier for a mortgage holder to refinance an existing balance at terms that are more desirable. As noted by Simon (2009), the success of these federal programs has been limited. Luigi, Sapienza, and Zingales (2011) believe this is the case because many holders of underwater mortgage find it unpalatable to refinance a home with a mortgage loan greater than the home’s market value. Instead, a significant number prefer to default on an underwater mortgage. Understanding this, a more appropriate intervention would be to forgive mortgage principal. This is exactly the tactic taken by new public policies designed to curtail this foreclosure crisis at both the federal and California State levels after mid-2010 (Streifeld 2010; and Wasserman 2010). As Posner and Zingales (2009) and others have shown, lenders are usually better off if they renegotiate loans rather than foreclose upon them. However, as Posner and Zingales also describe, loan modifications often stall from the borrower’s side due to problems in getting the appropriate documentation in order and/or lack of access to credit counselors/lawyers who could help the negotiation of such a modification.

To increase the efficacy of such efforts, one reform the federal or state governments may want to consider is a requirement for greater mortgage counseling capacity and/or mandatory mediation in the foreclosure process. As observed by Jakabovics and Cohen (2009), in the late 2000s at least 80 percent of the United States’ homeowners at risk of default had not discussed the situation with their mortgage lender. Such non-communication illustrates the need for a structured mediation process between mortgage lender and holder at least once before a foreclosure sale takes place. Jakabovics and Cohen point to the success of such mediation in curbing the number of foreclosures in the City of Philadelphia and State of Connecticut. Mayer et al. (2009) also evaluates the National Foreclosure Mitigation Counseling Program and offer evidence that it is achieving its intended effect of helping some homeowners avert foreclosure.

In conjunction with federal and state policies designed to slow mortgage foreclosures, that usually entail an infusion of new public dollars or new mortgage regulations, it is also reasonable to consider more localized efforts. Immergluck (2008) describes the role that local planning policy can play in curtailing foreclosure. Johnson, Turcotte, and Sullivan (2010) specifically prescribe a methodology to determine the foreclosed homes a municipality should purchase to stabilize a neighborhood. Furthermore, Kingsley, Smith, and Price (2009) stress the importance of developing a coordinated local response to variation in the causes of home mortgage foreclosure that occurs across neighborhoods. While Quercia and Cowan (2008) offer evidence on the positive impact of such a response in Minnesota communities.

In summary, this paper has described the continuing foreclosure crisis that struck the United States in the second half of the 2000s, and affected some metropolitan areas like Sacramento with great intensity. The major policy implication to take away from this investigation is that the calculated external effects of this crisis are very likely large enough to justify government actions to curtail foreclosure activity when it reaches the magnitude of foreclosure activity observed in the Sacramento Area. To choose among the array of policy tools that exist for dealing with a foreclosure crisis of this magnitude in a particular area, it is best to consider the specific causal nature (home price trends, unemployment, subprime lending, etc.) of the area’s foreclosure problem.
References


