Short-Term Own-Price and Spillover Effects of Distressed Residential Properties: The Case of a Housing Crash

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Abstract Most previous empirical studies of price spillover effects of foreclosure on no-default transactions are based on data from a stable housing-market period. This study uses transactions for 2008 from a housing market with a relatively large number of real estate owned (REO) sales/foreclosures. The overall results indicate that: (1) REO and in the process of foreclosure properties have the same spillover effects, but short sales do not produce a spillover effect; (2) models that control for the overall market trend produce smaller spillover effects; (3) the marginal effect of an REO is 1%; (4) the cumulative effects of multiple distressed neighbors can be as severe as 8%; and (5) excluding transactions of homes that were sold under distress from the sample increases the estimated marginal spillover effect to about 2% and the cumulative effects to about 21%.

The literature shows that mortgage defaults and resulting property foreclosures generate a discount of about 7% to 24%, depending on location within the United States (e.g., Shilling, Benjamin, and Sirmans, 1990; Forgey, Rutherford, and VanBuskirk, 1994; Hardin and Wolverton, 1996; Springer, 1996; Carroll, Clauretie, and Neill, 1997; Pennington-Cross, 2006; and Clauretie and Daneshvary, 2008). More recently, several studies concentrated on the spillover effects of foreclosed residential properties on the sales price of nearby nondistressed properties (Immergluck and Smith, 2006; Lin, Rosenblatt, and Yao, 2008; Schuetz, Been, and Ellen, 2008; Harding, Rosenblatt, and Yao, 2009; Leonard and Murdoch, 2009; and Rogers and Winter, 2009). Most indicate that one or more foreclosed properties result in about a 1% or less effect on the neighboring properties. These studies usually estimate the spillover effects by both time and distance. All past studies have been based on a nondistressed sample from a time period with a relatively stable housing market and small numbers of distressed property transactions, and were conducted prior to 2008. For markets, such as Las Vegas during 2008, when the market ‘‘crashed’’ and financially distressed transactions dominated the market, there was and continues to be additional competition for a limited number of buyers (a ‘‘thin’’ market). Therefore, estimations of ‘‘short-term’’ spillover effects should include all transactions, including those of distressed properties.

Furthermore, past studies of spillover effects do not control for the distressed status of the sold properties, a property’s physical condition, and the endogenous time-on-the-market that may affect transaction prices. In addition, none of the studies have analyzed potential spillover differential effects between sales in the process of foreclosure by borrowers and real estate owned (REO) sales by lenders or estimated potential spillover effects of short-sale transactions.

The sale of a distressed property is usually done according to one of the following options: (1) the lender allows a preforeclosure short sale by the borrower, (2) the lender institutes the foreclosure process under a notice of default and the property is sold during the process by the borrower, and (3) the lender forecloses on the property, takes title, and sells the property in the market as REO. While previous studies estimated foreclosure spillover, no study has estimated the size of discount for houses sold under a short-sale status or separately estimated the effect of REO or in process of foreclosure properties.[1] The literature estimating own-price discounts has shown significant differences in the size of discount among the three options. Do sales under different options also produce different spillover effects? For example, one may expect either no spillover effect or a smaller-than-REO effect of a short sale. The answer to this question has both private- and public-policy implications.

This study advances the knowledge of the short-term spillover effects during a severely ‘‘thin’’ market period. The study includes data for all single-family detached home transactions in 2008 in Las Vegas, controls for the overall market trend, the types of distressed property status (short sales, sales in the process of foreclosure, and REO sales), a property’s physical condition, and the endogenous time on market of each transaction. It estimates own-price discount and the contemporaneous short-term (three-month and six-month) spillover effects for three different distance rings.

Among other findings, the results show a marginal spillover effect of about 1% from a distressed home sale that was sold as REO or sold in the process of foreclosure up to three months prior to, and within 0.1 miles from, the sale of a nondistressed home. Within the same time and distance, and controlling for the overall market trend, the cumulative effects of multiple distressed properties is about 8%. Without controlling for the price trend, the spillover effect is about 21%. Estimates of own-price discounts are from 10% to 19%, depending on the type of distressed sale. Although short sales suffer from own-price discounts, they do not have price spillover effects on their neighbors.

Review of the Literature

Exhibit 1 presents a summary of the relevant literature on the issue of foreclosure spillover effects. Beginning in the mid-2000s, research effort shifted somewhat

Exhibit 1 | Summary of Research on Spillover Effects (single-family homes)

Author(s) / Year	Journal	Data Period (Affected Properties)	Data Period (Foreclosed Properties Time Boundary)	Location	Summary of Spillover Results
Immergluck and Smith (2006)	*Housing Policy Debate*	1999	1997–1998 / none	Chicago	0.9% within 660 ft.
Lin et al. (2008)	*Journal of Real Estate Finance and Economics*	2006	1990–2006 / 2–10 years	Chicago	8.7% within 300 ft. and within 2 yrs. Only 1% at 2,700 feet and within 3–5 yrs. Little effect beyond 2,700 ft.
Schuetz et al. (2008)	*Journal of Housing Economics*	2000–2005	18 months or more prior to the sale and after sale of the affected property	New York	Between 0.2 and 0.4% within 250 ft., depending on the time span.
Leonard & Murdoch (2009)	*Journal of Geographical Systems*	2006	2005–2006 / none	Dallas County	0.5% with 250 ft. and 0.1% for longer distances.
Rogers & Winter (2009)	*Journal of Real Estate Research*	1998–2007	1998–2007 / 6–24 months	St. Louis County	1% within 200 yards and 6 mos. The effect declines with time and space.
Harding et al. (2009)	*Journal of Urban Economics*	1989–2007	12 months prior and 24 months after the sale of affected property	Seven MSAs	Roughly 1% within 300 ft. around the time of foreclosure.

from determining the discount at which foreclosed properties sold to determining the price spillover effect on neighboring properties. Immergluck and Smith (2006) examined the effect of 1997–1998 distressed properties on a sample of 9,600 homes that were sold in Chicago in 1999. They concluded that, on average, for each foreclosed property within 600 feet there was a 0.9% negative spillover effect on the values of nondistressed properties.

Lin, Rosenblatt, and Yao (2008) estimated the spillover effect of foreclosed properties on the neighboring property for Chicago. Using data on 1990–2006 foreclosed properties and year 2006 nondistressed sales, they found one of the largest spillover effects in the literature. They found the spillover effect as large as 8.7% for foreclosures within 300 feet and two years of liquidation. The effect declined sharply within a distance of 2,700 feet and five years of liquidation. Schuetz, Been, and Ellen (2008), using filing for foreclosure records from 2000 to 2005 from New York, found a spillover effect of about 0.2% to 0.4% (depending on the time span) within 250 feet distance. They also concluded that one to five foreclosures within 500–1,000 feet had no significant spillover effect, but six or more foreclosures resulted in a 2.8% discount.

Using 2005–2006 home transaction data in Dallas, Leonard and Murdoch (2009) estimate a 0.5% spillover effect from a home in some stage of the foreclosure process within 250 feet of a nondistressed home. Rogers and Winters (2009) used 1998–2007 sales data from St. Louis and found a 1% decline in the prices of nondistressed properties that were located within 200 yards and were sold six months after a foreclosure transaction. The size of the spillover effect declined with increases in distance and time. Harding, Rosenblatt, and Yao (2009) looked at house prices in seven MSAs from 1989 through 2007 and found a 1% spillover effect caused by foreclosed homes within a distance of 300 feet and around the time of foreclosure. Moreover, they concluded the effect was proportional to the number of nearby foreclosures.[2]

The above studies examined the spillover effects in various large cities during mostly stable and/or up market periods, when there was not a large number of foreclosures within relevant time and distance boundaries.[3] Of course, the spillover effects are different across different local economies and housing-market conditions. Between early 2001 and 2007, Las Vegas was a ‘‘booming’’ city with a strong house price appreciation rate. Since November 2007, Las Vegas has also been among the hardest-hit economies and housing markets. From November 2007 to December 2008, price per square footage of single-family homes dropped by about 40%. About 70% of single-family sales were sold under some sort of distress. According to RealtyTrac, Nevada is ranked number one in foreclosure rates, 1 out of every 76 homes is in foreclosure, followed by California with one 1 out of every 176 homes. The U.S. average is one out of every 466 homes. Thus, the immediate or short-run spillover effect of distressed properties may have important policy implications.

Most previous studies of spillover effects have estimated the effect of distressed properties on a sample of nondistressed properties. They excluded distressed sale observations and did not control for distressed property status in their estimations. Such analysis may be more appropriate for normal markets and time periods that have a relative small portion of distressed housing transactions. For a ''bad'' market, such as Las Vegas in 2008, which has seen a domination of distressed properties, to estimate accurately the marginal spillover effects of distressed properties within a time and space distance on a nondistressed property, it is more appropriate to include all transactions and their distressed status within a housing market to obtain a correct ''average'' price of the entire market. The average price in a market is influenced by all transactions.[4] The current study uses samples that include all transactions and contemporaneously estimates the immediate effect of distressed properties on own-price discount, as well as the spillover effects of such properties on nondistressed houses.

Also, none of the previous studies examined the role of distressed properties on the time-on-market (TOM) of neighboring properties. Theoretically, distressed status reduces the seller's reservation price and, thus, TOM. Therefore, the effect of distressed properties on own-price and price of nondistressed properties is both direct and indirect, via TOM. As implicitly noted by Harding, Rosenblatt, and Yao (2009), distressed properties create additional competition for a limited number of buyers. This ''thin market'' not only affects the prices of nondistressed properties but also the length of time that such properties stay on the market. The search theory predicts a positive price-TOM relationship. Previous empirical studies, however, have found a negative relationship. This negative relationship has been attributed to a ''stigma'' effect of prolonged TOM (Jud, Seaks, and Winkler, 1996). A very plausible explanation of the negative relationship is offered by Huang and Palmquist (2001). In investigating a highway-noise effect on price and TOM, they found that market duration has a significant negative impact on the sales price. They concluded that as the TOM increases, sellers adjust their reservation price, resulting in an observed negative price-TOM relationship.

This paper concentrates on the short-term contemporaneous own-price discount and the spillover effects of three types of distressed properties: (1) short sales, (2) sales in the process of foreclosure, and (3) sales after lender's repossession (REO), using samples of complete counts for distressed and nondistressed properties and controlling for property's physical condition. Both space and time boundaries are used to provide estimations of the spillover effects.

Empirical Analysis

Foreclosure Process in Nevada

Foreclosure is one of several outcomes of mortgage default. When a borrower becomes delinquent on a residential loan and has no desire or ability to keep the property, then the loss mitigation involves a short sale, a sale in the process of foreclosure, or an REO sale. The process can start either under judicial foreclosure or nonjudicial foreclosure. Judicial foreclosure can take place only in the absence of a sale clause in the loan document and when the lender sues the borrower in order to obtain a decree of foreclosure and order of sale. Judicial process is rarely used in Nevada. The most common practice in Nevada is nonjudicial foreclosure under which the ''power of sale'' clause allows the lender to sell the property to recover the mortgage balance. Upon default, the lender must issue a ''Notice of Default and Election to Sell'' to the borrower.

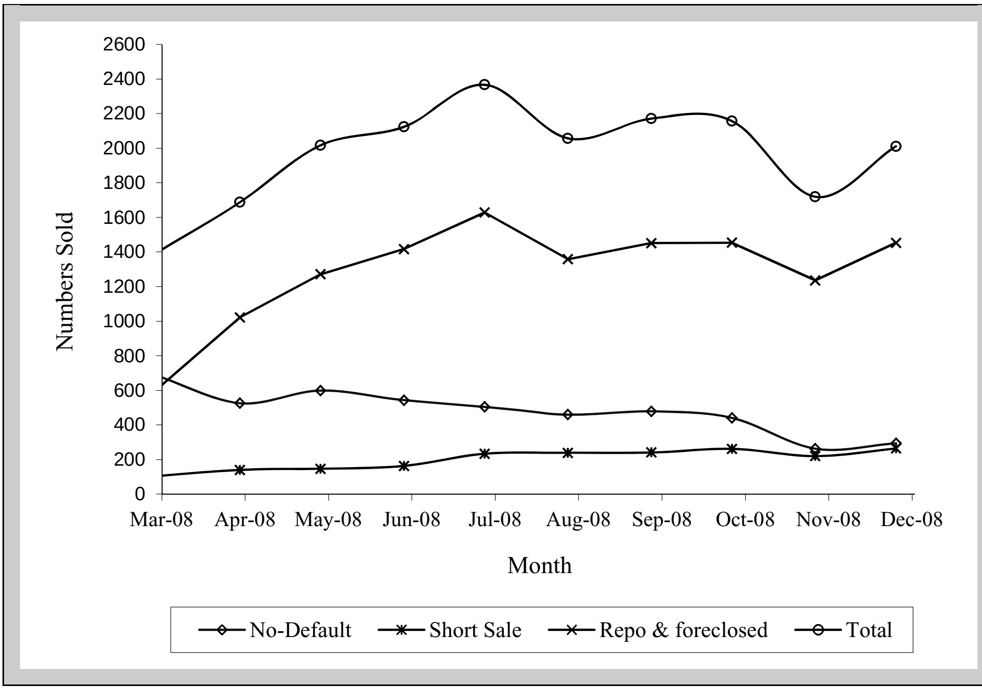
The lender also has the option of allowing a house to be sold by the borrower as a short sale at a price lower than the outstanding loan amount. The agreement can take place either before or after a ''Notice of Default and Election to Sell'' is issued and the foreclosure process is initiated but not finalized. The sale proceeds from the short sale would be remitted to the lender, even if the net proceeds were less than the mortgage balance. Although the lender could still enforce a deficiency judgment, most lenders are willing to fully discharge all mortgage debt and agree to limit the damage to the homeowner's credit. The short sale has certain advantages for the lender, the most obvious of which is avoiding additional carrying and transaction costs and the legal expenses of foreclosure or REO from the default to the final sale of the property. One disadvantage of a short sale is an agency cost; the borrower will have no incentive to maximize the sales price because in most short sales the deficiency judgment is usually waived. In the data set, there is an indicator showing the properties that were sold as a short sale, distinguishing them from houses that were sold in the process of foreclosure. Nonetheless, short sales are sales by motivated sellers under financial distress. They most likely sell with a discount and may produce a spillover effect on the neighborhood prices.

After a Notice of Default has been recorded and the lender has begun the foreclosure process, the law requires a minimum of three months from the time of notice before a sale is conducted by the lender. During the waiting period, the borrower may sell the house and remit the proceeds to the lender. Such a house is sold by the borrower while in the process of foreclosure and before it becomes a REO property. If a sale by the borrower has not been conducted during the three months after the notice has been issued, a sale is conducted by the lender. At the sale date, the lender usually bids an amount equal to the balance due plus costs. If the sale generates a nonlender successful bidder, the property is sold as a sale in the process of foreclosure. If the sale does not generate a nonlender bidder, the property reverts to the lender, and then is sold by the lender with an REO status. There is no statutory right of redemption in Nevada and the debtor cannot regain possession. It is important to note that these properties are not sold as foreclosed, but as REO by a lender/bank.

Data

The data set for the empirical estimation includes all detached single-family houses sold between December 2007 and December 2008 out of the Multiple

Exhibit 2 | Monthly Sales by Type of Sale

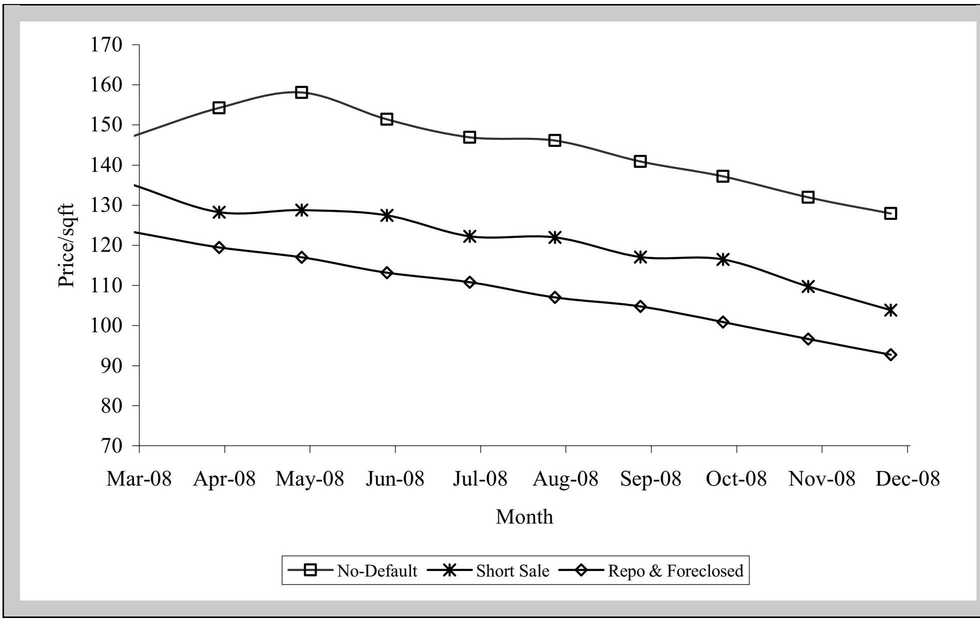


Sources: Greater Las Vegas Association of Realtors (GLVAR) and Multiple Listing Services (MLS).

Listing Services (MLS) sponsored by the Greater Las Vegas Association of Realtors® (GLVAR). Beginning with December 2007, the GLVAR provides information that shows whether the property was sold as a normal sale (no-default), a short sale, in process of foreclosure, or an REO. Variables short sale and REO were not available prior to December 2007. Thus, the analysis pertains to a down-turned housing market. The data set is restricted to properties that sold up to $2,000,000 in the ZIP Codes representing the Las Vegas MSA. The final sample consists of 7,017 regular sales (no default), 1,060 sales in the process of foreclosure, 2,185 short sales, and 12,270 repossessed sales (REO), a total of 22,532 single-family properties. There are data for 13 months. Observations from the first three months (2,828) are used to create the neighborhood three-month rings. Thus, the analyses are based on data for the last 10 months of 2008, a total of 19,704 observations.[5]

Exhibit 2 depicts the monthly number of transactions from March to December 2008 by type of sale. The total number of sales steadily increased from March to the end of July and shows a declining trend thereafter. This turnaround in sales is perhaps a reflection of the nationwide liquidity crisis that started in the summer of 2008. As expected, the number of repo-foreclosure sales dominated the market. The number of short sales also increased until July and stayed almost at the same

Exhibit 3 | Price per Square Footage by Type of Sale



Sources: Greater Las Vegas Association of Realtors (GLVAR) and Multiple Listing Services (MLS).

level for the rest of the year. The number of no-default sales declined steadily from 686 to 294.

Exhibit 3 shows the sales price per square foot for no-default, short sale, and repo-foreclosed sales. Price per square foot of no-default sales increased from March to the end of May and shows a linear declining trend thereafter. From March to December prices declined by about 13%. Prices of short sales and repo-foreclosed sales steadily declined from March to December, respectively 23% and 25%. Exhibit 4 reveals two interesting facts. First, the three trends are almost parallel, indicating that at least in the short run there is a ''constant'' or ''intercept shift'' of own-price discount for distressed properties. This also implies that empirical analyses based on a sample of no-default transactions-only will not reflect ''true average'' market prices and may produce an overestimate of spillover effects. Such analyses, exclusive of default transactions, assume that the spillover effects apply only to no-default sales. The empirical analyses relax this assumption and show potential overestimations of the spillover effects that are the result of using samples of nondistressed properties only. Of course, as shown by Harding, Rosenblatt, and Yao (2009), due to ignored maintenance, there is a contagion effect of distressed properties on the sale of nondistressed properties. If distributions of a property's physical condition are significantly different between the distressed and nondistressed properties, then not including some measures of

Exhibit 4 | Property's Physical Condition: By Type of Sale

			Default Resulting		
Condition	Total	No Default	Short Sale	Foreclosed	Repo
Excellent	0.170	0.504	0.237	0.063	0.035
Good	0.610	0.430	0.615	0.735	0.673
Fair	0.198	0.059	0.137	0.163	0.264
Poor	0.022	0.008	0.012	0.039	0.028
Observations	19,704	4,796	2,014	638	12,256

Note: The sources are the Greater Las Vegas Association of Realtors (GLVAR) and Multiple Listing Services (MLS).

property condition and using a sample of all transactions would confound the spillover effects.

Exhibit 4 shows property conditions by type of sales, as assessed by the listing agent. Not surprisingly, distributions of the subsamples with respect to property conditions are significantly different. About 7% of no-default homes and about 29% of repossessed homes were assessed as being in ''poor'' or ''fair'' condition. On the other hand, about 93% of no-default homes and 71% of repossessed homes were assessed as being in ''good'' or ''excellent'' condition. The percentage of properties assessed as in ''good'' or ''excellent'' condition decline steadily from no-defaults to short to foreclosed to repossessed sales.

The Model

Building on the existing literature, a hedonic pricing model is used to estimate the own-price discount and spillover effects of three types of distressed properties: a short sale, a sale in the process of foreclosure, and an REO sale.[6] The general hedonic model recognizes the house selling price as a function of the house and neighborhood characteristics. The modified hedonic model that accounts for sale under distress, the spillover effect of distressed sales, the market price trend, and TOM can be expressed as:

$$P = X_1\beta_x + Z_1\beta_z + (STI)\delta + (TSDC)\psi + \zeta T + \alpha(TOM) + u_1, \qquad (1)$$

where P is an $n \times 1$ vector of selling price (in natural log); X_1 is an $n \times k$ matrix of k house characteristics affecting price; Z_1 is an $n \times g$ matrix of g neighborhood characteristics affecting price; (STI) is an $n \times 3$ vector of selling-type indicator (short sale, in foreclosure process, and REO); $(TSDC)$ is an $n \times l$ matrix of the neighborhood counts of the three types of distressed properties and their squared values, measured at l time and distance boundaries; T is a monthly time trend to control for current price trends;[7] (TOM) is an $n \times 1$ vector of TOM; u_1 is an $n \times 1$ vector of regression disturbances; and β_x, β_z, δ, ψ, ζ, and α are the estimated parameters.

Generally speaking, a mortgage default decision is usually triggered by a reduction in income and cash flow due to events such as divorce, loss of job, and serious illness. Theoretically, it is also possible that a general decline in housing prices reduces the loan-to-value ratios creating a negative home equity. For example, a recent work by Pennington-Cross (2010) found that the duration of foreclosures depends on contemporaneous housing market conditions, such as declining property values. Thus, the incidence of default/foreclosure may depend on both the incidence of income interruption and the distribution of loan-to-equity ratios.[8] This discussion also raises the possibility that house price and selling-type indicators in equation (1) are jointly determined, implying that (STI) indicators are endogenous variables in the price equation. Such endogeneity is examined below.

The search and/or "stigma" theories suggest and the most recent empirical literature shows, that not only does the TOM affects the reservation and transaction prices, but also the seller's choice of listing and reservation prices as well, indicating that TOM is an endogenous variable in the price equation. Thus, simultaneous estimations of price and TOM equations are deemed appropriate.[9] The TOM equation can be expressed as:

$$TOM = X_2\gamma + \lambda(P) + (STI)\pi + (TSDC)\varphi + \xi T + u_2, \quad (2)$$

where X_2 is an $n \times m$ matrix of m exogenous variables affecting TOM, u_2 is an $n \times 1$ vector of regression disturbances, and γ, λ, π, φ, and ξ are regression parameters. Separate ordinary least squares (OLS) estimations of equations (1) and (2) assume that all of the right-hand-side variables, including *TOM* (in equation 1) and price (in equation 2), are exogenous. Of course, these variables are endogenous, correlated with their respective disturbance, and OLS estimators are inconsistent. The traditional two-stage least squares (2SLS) instrumental variable estimators are consistent but do not use information from cross-equation correlations of disturbances, u_1 and u_2, producing inefficient estimates.

To account for endogeniety of the price and *TOM* variables and to utilize information from the cross-equation correlations of disturbances, Green (2003, pp. 404–07) suggests a three-stage least squares (3SLS) estimation method. In the first stage, each endogenous variable is predicted using all exogenous variables in the system. In the second stage, the predicted values of the endogenous variable, as well as other equation-specific exogenous variables, are included as explanatory variables in each equation (i.e., predicted values of TOM for the price equation and predicted values of the price for the TOM equation). Residuals from the second stage are then used to obtain a consistent estimate of the covariance matrix of the two disturbances. Using this consistent estimate of the covariance matrix and generalized least squares (GLS), consistent and efficient estimates of the parameters of the system of the two equations can be obtained.

The count of distressed sales, by types of distressed types, that neighbor a nondistressed sale are needed to estimate the spillover effects. This requires the creation of relevant time and space boundaries. After considering previous research and the population density of Las Vegas, the number of distressed properties that sold within the past three months and within 0.1 miles (528 feet), 0.25 miles (1,320 feet), and 0.5 miles (2,640 feet) of each observation are determined.[10] That is, three separate mutually exclusive rings are created: from zero to 0.1 miles, from 0.1 to 0.25 miles, and from 0.25 to 0.5 miles. In addition, the numbers for within the past six months of each observation are determined and an analysis is conducted for both a three-month and a six-month time frame. Eighteen variables (three types of distressed for three distance rings, and for two time frames) and their squared value are added to each observation in the data set. Nonlinearity of the relationships is investigated below.

Variables

The natural logarithm of selling price, equation (1), is modeled as a function of the physical characteristics of a house, (X_1), neighborhood characteristics, (Z_1), and marketing time (*TOM*). In addition, the current price trend is controlled by including monthly time trend (*T*). Indicators for a short sale, a sale in the process of foreclosure, and REO (*STI*) are included to estimate own-price discount and potential spillover effects on neighbors, along with a vector of the three types of distressed property counts within the distance and time frame described before, (*TSDC*), and their square values to test for nonlinearity.

In addition to variables typically found in previous hedonic models, the physical characteristics vector includes property condition (excellent, good, fair, and poor) recorded by the listing agent, and some unique characteristics of the Las Vegas Valley, such as various house views (see Exhibit 5). Furthermore, property-occupancy status indicators such as vacant, owner occupied, and tenant occupied are also included. Often distressed properties are sold as cash transactions. Previous research shows a cash discount for such transactions. The model includes an indicator reflecting cash versus mortgage transactions.

The neighborhood characteristics vector includes the percentage of population ages 25–35, percentage of population age 55 or older, percentage of population

Exhibit 5 | Definition and Descriptive Statistics of Variables

	Three-Month Spillover		Six-Month Spillover	
Variables	Mean	Std. Dev.	Mean	Std. Dev.
Selling Status				
The property was sold with no default (%)	0.243		0.204	
The property was sold as a short sale (%)	0.102		0.111	
The property was sold in the process of foreclosure (%)	0.032		0.016	
The property was sold as an REO (%)	0.622		0.668	
Number of Neighbors by Sale Status				
No. of short sale neighbors: 0–0.1 miles distance	0.122	0.381	0.233	0.555
No. of short sale neighbors: 0.1–0.25 miles distance	0.418	0.778	0.803	1.183
No. of short sale neighbors: 0.25–0.5 miles distance	1.073	1.385	2.060	2.185
No. of neighbors sold in the process of foreclosure: 0–0.1 miles distance	0.068	0.277	0.132	0.386
No. of neighbors sold in the process of foreclosure: 0.1–0.25 miles distance	0.231	0.552	0.458	0.822
No. of neighbors sold in the process of foreclosure: 0.25–0.5 miles distance	0.579	1.001	1.177	1.508
No. of neighbors sold as REO: 0–0.1 miles distance	0.772	1.245	1.549	2.022
No. of neighbors sold as REO: 0.1–0.25 miles distance	2.516	2.918	5.038	4.863
No. of neighbors sold as REO: 0.25–0.5 miles distance	6.380	6.280	12.825	10.759
Selling Price Net of Seller's Contribution to Closing Costs	$245,232	$145,725	$234,231	$139,776
Price per Square Footage	$117.50	$34.36	$112.61	$32.36
Days on Market	67.964	77.471	65.015	76.950
Property Physical Condition Indicators (assessed by the listing agent)				
Condition poor	0.022		0.023	
Condition fair	0.198		0.206	
Condition good	0.610		0.612	
Condition excellent	0.170		0.159	

Exhibit 5 | (continued)

Definition and Descriptive Statistics of Variables

	Three-Month Spillover		Six-Month Spillover	
Variables	Mean	Std. Dev.	Mean	Std. Dev.
Property Occupancy Status Indicators				
Vacant	0.863		0.866	
Occupied by owner	0.124		0.119	
Occupied by a tenant	0.014		0.014	
Sold Cash	0.157		0.164	
Property's Physical Characteristics				
Property age	10.554	10.372	10.744	10.607
Building square footage	2,092	814	2,083	824
Lot square footage	6,583	4,656	6,539	4,539
Number of bedrooms	3.469	0.797	3.472	0.794
Number of bathrooms	2.795	0.753	2.791	0.757
Number of garages	2.150	0.730	2.134	0.745
Property has a fireplace	0.643		0.641	
Property has a pool	0.192		0.192	
Property has a spa	0.127		0.124	
Two-story building	1.578		1.579	
Has golf course view	0.016		0.013	
Has mountain view	0.133		0.122	
Has strip view	0.018		0.015	
Has park view	0.009		0.008	
Has city view	0.028		0.025	
Has lake view	0.002		0.002	
Property's Neighborhood Characteristics				
Percentage age 25–35	26.132	8.127	26.248	8.108
Percentage age 55 or older	36.753	10.995	36.585	10.803
Percentage with a high school diploma	53.665	6.558	53.911	6.500
Percentage with a college degree	40.648	9.326	40.212	9.418
Percentage with a child at home	31.180	7.480	31.289	7.515
Summerlin	0.058		0.055	
Anthem	0.030		0.025	
Lake Las Vegas	0.001		0.001	
Seven Hills	0.009		0.009	
The Lakes	0.006		0.005	
Commission and Agents' Characteristics Factors				
Commission rate paid to buyer's agent	3.026	0.472	3.014	0.460
Commission is variable	0.188		0.184	

Exhibit 5 | (continued)

Definition and Descriptive Statistics of Variables

	Three-Month Spillover		Six-Month Spillover	
Variables	Mean	Std. Dev.	Mean	Std. Dev.
Listing agent's no. of listings above average	0.322		0.321	
Property listed and sold by the same agent	0.045		0.042	

Notes: The sources are the Greater Las Vegas Association of Realtors (GLVAR) and Multiple Listing Services (MLS). The number of observations for three-month spillover is 19,704; the number of observations for six-month spillover is 14,605.

with a high school diploma and percentage with a college degree, and percentage of households with a child at home, all measured on January of 2008. The vector includes location indicators for five upscale large-planned communities (Summerlin, Anthem, Lake Las Vegas, Seven Hills, and the Lakes).[11]

In addition to vectors (*P*), (*STI*), and (*TSDC*), the length of time needed to generate an acceptable offer, *TOM* in equation (2), depends on vector (X_2). Among other variables, vector (X_2) includes the property's physical condition and occupancy status variables that are also included in the price equation. *TOM* also is influenced by the broker's effort level and the listing agent's characteristics. Actual broker effort is unobservable, but depends on the commission rates offered to listing and buyer agents (Sirmans Turnbull, and Benjamin, 1991). The commission incentive is accounted for by including an indicator that measures whether the listing commission is a variable rate versus a flat rate (the total commission rate that is a part of the listing contract is not available). The buyer's agent commission rate is also included. Of course, an agent's experience, skill, training, and expertise are important in identifying potential buyers and making faster sales (Yang and Yavas, 1995; and Jud, Seaks, and Winkler, 1996). Thus, a proxy is included for the agent's years of experience in the local market, whether the property was listed and sold by the same agent, and if the listing agent's total number of listings was above the average listings by all agents.[12] Together these three variables and the two commission rate variables satisfy the exclusionary condition for estimating the endogenous *TOM* variable of the price equation. It should be noted that the primary goal is to estimate own-price discount and spillover price effects of distressed properties. The TOM analysis is included to account for potential indirect effects on prices via TOM.

Variable names and descriptive statistics for the sample of three-month and six-month spillover estimations are provided in Exhibit 5. Exhibit shows that about two-thirds of the properties were sold under some sort of distress. The portion of distressed sales increased over time, the three-month spillover sample (the last ten months of 2008) compared with the six-month spillover sample (the last seven months of 2008). Average numbers of all three types of distressed neighbors increased with increased distance, due to a larger area of the outer rings, and with an increased time frame. The overall average number of distressed neighbor sales was 12.1 for the three-month spillover sample and 24.2 for the six-month spillover sample.

As expected, the average property sale prices show a declining trend, reduced from $245,232 to $234,231 and from $117.5 per square foot to $112.6 per square foot. A comparison of the two samples shows that the marketing time declined by about three days. The average property had a lot of about 6,500 square feet, about 2,080 square feet of living space, and was about 10 years old. As Exhibit 5 indicates, there are similar distributions between the two samples with respect to property and neighborhood characteristics, occupancy status, and property condition.

Results

As mentioned before there is a possibility that house price and sales-type indicators in equation (1) are jointly determined. In that case, the indicator variables, (*STI*), are endogenous in the price equation and may not sufficiently control for possible latent characteristics of the distressed properties. For example, if distressed properties have "unknown" stigma attached to them, then OLS would underestimate the negative effect of distressed-type variables. The type of sale decision is endogenized by applying an endogenous treatment effect model. A dichotomous variable is created that is equal to one if the house was sold as a distressed property and is equal to zero otherwise.

Estimation of a two-equation system, the continuous price and the probit treatment effect equations, correct for any self-selection bias and endogeniety of the decision to sell a house as distressed property (Heckman, 1979; and Vella and Verbeek, 1999). The estimation of the probit equation includes all the right-hand side variables in the price equation (except *STI* indicators) and the following two variables: the number of homes and the number of occupied homes in the neighborhood as defined by ZIP Code.[13] From the results of the probit model, the inverse Mills ratio for each observation is estimated and included, along with the indicator variable for distressed status, as an independent variable in the price equation.

The above methodology was applied to both the three-month and 6-month data. The estimated coefficients of the inverse Mills ratio were negative, small in size, and statistically insignificant. In addition, the estimated correlation of error terms across equations, ρ, were also highly insignificant. These findings may be the result of the weak exclusionary variables.

Exhibits 6 and 7 report the OLS and the 3SLS estimated results for the natural log of price for three-month and six-month spillover effects.[14] These exhibits

Exhibit 6 | Ordinary Least Squares and Three-Stage Least Squares Estimation of the Log of Selling Price: Three-Months Spillover

	OLS (1)		OLS (2)		3SLS	
Variables	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.
Monthly time trend			−0.0228	−47.67***	−0.0234	−43.28***
Months on Market	0.0005	1.11	−0.0003	−0.77	−0.0184	−3.85***
Number of Neighbors by Sale Status						
No. of neighbors sold in the process of foreclosure / REO: 0–0.1 miles distance	−0.0200	−10.22***	−0.0107	−5.76***	−0.0106	−5.46***
No. of neighbors sold in the process of foreclosure / REO: 0–0.1 miles distance squared	0.0019	5.69***	0.0009	2.66***	0.0008	2.40**
No. of neighbors sold in the process of foreclosure / REO: 0.1–0.25 miles distance	−0.0125	−11.61***	−0.0068	−6.66***	−0.0074	−6.87***
No. of neighbors sold in the process of foreclosure / REO: 0.1–0.25 miles distance squared	0.0007	8.10***	0.0003	4.29***	0.0004	4.45***
No. of neighbors sold in the process of foreclosure / REO: 0.25–0.5 miles distance	−0.0105	−19.38***	−0.0041	−7.67***	−0.0040	−7.26***
No. of neighbors sold in the process of foreclosure / REO: 0.25–0.5 miles distance squared	0.0003	13.62***	0.0001	5.20***	0.0001	4.83***
No. of short sale neighbors: 0–0.1 miles distance	−0.0063	−0.98	0.0054	0.89	0.0045	0.71
No. of short sale neighbors: 0–0.1 miles distance squared	0.0047	1.36	0.0022	0.68	0.0019	0.57
No. of short sale neighbors: 0.1–0.25 miles distance	−0.0018	−0.60	0.0040	1.39	0.0025	0.84
No. of short sale neighbors: 0.1–0.25 miles distance squared	0.0013	1.42	0.0010	1.12	0.0011	1.22
No. of short sale neighbors: 0.25–0.5 miles distance	−0.0023	−1.20	0.0040	2.20**	0.0033	1.72*
No. of short sale neighbors: 0.25–0.5 miles distance squared	0.0002	0.57	0.0001	0.26	0.0001	0.28

Exhibit 6 | (continued)

Ordinary Least Squares and Three-Stage Least Squares Estimation of the Log of Selling Price: Three-Months Spillover

	OLS (1)		OLS (2)		3SLS	
Variables	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.
Sale Type:						
Sold as a "short" sale	−0.1194	−26.18***	−0.1023	−23.60***	−0.0929	−17.76***
Sold in the process of foreclosure	−0.1088	−15.25***	−0.1324	−19.56***	−0.1470	−18.50***
Sold as an REO (lender owned)	−0.1447	−39.05***	−0.1320	−37.54***	−0.1539	−22.69***
Property's Physical Condition:						
Condition poor	−0.2265	−25.65***	−0.2338	−27.97***	−0.2269	−25.84***
Condition fair	−0.0805	−17.60***	−0.0858	−19.81***	−0.0837	−18.55***
Condition good	−0.0389	−10.46***	−0.0439	−12.47***	−0.0432	−11.79***
Adjusted R^2	0.8784		0.8910		0.8817	

Notes: The table covers the full sample (19,605 observations from June to December 2008). In addition to the included variables, each specification includes the house and neighborhood characteristics, vacancy status, and cash transaction indicator variables. Estimated coefficients of these variables for all specifications, as well as those for the TOM equation for the 3SLS estimation, are available upon requests.

*Significant at the 10% level.

**Significant at the 5% level.

***Significant at the 1% level.

Exhibit 7 | Ordinary Least Squares and Three-Stage Least Squares Estimation of the Log of Selling Price: Six-Months Spillover

	OLS (1)		OLS (2)		3SLS	
Variables	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.
Monthly Time Trend			−0.0263	−36.7***	−0.0269	−33.61***
Months on Market	−0.0002	−0.35	−0.0007	−1.39	−0.0272	−4.86***
Number of Neighbors by Sale Status	−0.0136	−8.68***	−0.0084	−5.62***	−0.0086	−5.33***
No. of neighbors sold in the process of foreclosure / REO: 0–0.1 miles distance	0.0006	3.83***	0.0003	2.18***	0.0004	2.15**
No. of neighbors sold in the process of foreclosure / REO: 0–0.1 miles distance squared	−0.0086	−10.57***	−0.0066	−8.50***	−0.0070	−8.31***
No. of neighbors sold in the process of foreclosure / REO: 0.1–0.25 miles distance	0.0002	6.84***	0.0002	5.59***	0.0002	5.57***
No. of neighbors sold in the process of foreclosure / REO: 0.1–0.25 miles distance squared	−0.0060	−15.71***	−0.0039	−10.45***	−0.0038	−9.55***
No. of neighbors sold in the process of foreclosure / REO: 0.25–0.5 miles distance	0.0001	10.13***	0.0001	7.46***	0.0001	6.74***
No. of neighbors sold in the process of foreclosure / REO: 0.25–0.5 miles distance squared	−0.0014	−0.29	0.0081	1.79	0.0063	1.29
No. of short sale neighbors: 0–0.1 miles distance	0.0029	1.59	0.0009	0.51	0.0011	0.56
No. of short sale neighbors: 0–0.1 miles distance squared	0.0034	1.4	0.0057	2.49	0.0034	1.34
No. of short sale neighbors: 0.1–0.25 miles distance	0.0005	1.14	0.0005	1.09	0.0005	1.08
No. of short sale neighbors: 0.1–0.25 miles distance squared	0.0043	2.75***	0.0073	4.86**	0.0063	3.92***
No. of short sale neighbors: 0.25–0.5 miles distance	−0.0002	−1.01	−0.0002	−1.18	−0.0002	−0.97
No. of short sale neighbors: 0.25–0.5 miles distance squared						

Exhibit 7 | (continued)

Ordinary Least Squares and Three-Stage Least Squares Estimation of the Log of Selling Price: Six-Months Spillover

	OLS (1)		OLS (2)		3SLS	
Variables	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.
Sale Type						
Sold as a "short" sale	−0.1207	−22.84***	−0.1134	−22.43***	−0.0999	−15.99***
Sold in the process of foreclosure	−0.1291	−11.62***	−0.1414	−13.29***	−0.1632	−13.21***
Sold as an REO (lender owned)	−0.1541	−33.7***	−0.1545	−35.31***	−0.1900	−21.6***
Property's Physical Condition						
Condition poor	−0.2391	−23.58***	−0.2411	−24.84***	−0.2264	−20.99***
Condition fair	−0.0764	−14.18***	−0.0769	−14.92***	−0.0698	−12.22***
Condition good	−0.0347	−7.79***	−0.0356	−8.36***	−0.0322	−6.93***
Adj. R^2	0.8839		0.8937		0.8744	

Notes: The table covers the full sample (14,605 observations from June to December 2008). In addition to the included variables, each specification includes the house and neighborhood characteristics, vacancy status, and cash transaction indicator variables. Estimated coefficients of these variables for all specifications, as well as those for the TOM equation for the 3SLS estimation, are available upon requests.

*Significant at the 10% level.

**Significant at the 5% level.

***Significant at the 1% level.

include only the estimated coefficients of interest. Coefficient estimates of property and neighborhood characteristics, as well as other control variables (32 in all), are not reported but are available upon request. The coefficients of these variables are statistically significant, have the expected signs, are robust across samples, and are consistent with the findings of previous research. Estimated coefficients of the TOM equation are also not reported but are available upon request. These estimates indicate that, ceteris paribus, the higher the price the longer the marketing time. Distressed neighbors do not have a significant spillover effect on the marketing time. Properties with a short-sale status take 17 days more than no-default properties to sell. Properties in the process of foreclosure and REO sell 25 and 40 days, respectively, quicker than no-default properties. Marketing time is impacted by a property's physical condition. Vacant homes take longer to sell. All variables related to the agent's characteristics are significant.

Results of three specifications are reported in Exhibit 6 and 7. To provide a baseline for a comparison that allows investigation of the potential bias in the estimated spillover effects that may arise from not isolating the overall market price trend and the endogeniety of the TOM, specification (1) provides OLS estimates of the price equation without the time trend variable. Specification (2) provides OLS estimates with the time trend variable added to the model. Specification (3) is the result of 3SLS that endogenize the *TOM* variable.[15]

Starting with Exhibit 6, specification (1), an additional REO property that was sold within the last three months and within 0.1 miles from a nondistressed property has about a 2.0% (albeit declining) negative spillover effect. The effect declines to 1.2% and 1.0% as distance is increased to between 0.1 and 0.25 miles and between 0.25 and 0.5 miles, respectively.[16] The coefficients of short-sale counts have the expected negative signs but are insignificant both statistically and in magnitude. The coefficients of the three types of properties' distress status are all highly significant. A short sale has a discount of 11.3%, a sale in the process of foreclosure has a discount of 10.3%, and an REO sale is discounted by 13.5%. The coefficients of the variables of a property's physical condition are significant and economically meaningful. Relative to a property in excellent condition, a property in good condition is sold with about a 3.8% discount. The discount increases to about 20.3% for a property in poor condition.

Controlling for the overall market trend, specification (2), reduces the negative spillover effect of REO in all three distance rings by almost one-half. The spillover effects are now about 1.1%, 0.68%, and 0.041%, respectively.[17] Short-sale spillovers are still insignificant and economically meaningless. Inclusion of time trend does not significantly alter the size of own-price discounts associated with sale type or property condition. The coefficient of time trend itself is highly significant and indicates an average overall market price decline of about 2.3% per month.[18] The OLS estimate of the *TOM* variable in specifications (1) and (2) are both economically and statistically insignificant, perhaps due to the endogeniety of this variable.

The final specification in Exhibit 6 reports the results of the 3SLS estimates that endogenize the *TOM* variable. Notice that there is no meaningful change in the size or significance of the estimated coefficients of spillover effects, the sale type, or property condition variables.[19] The coefficient of *TOM*, however, is now highly significant, indicating an average decline of about 1.8% for each additional month that a property stayed on the market. This finding is consistent with those of previous research, see Endnote 9.

Based on the results of the three-month time frame, the model that includes the number of distressed neighbors and its square value, property distressed status, property's physical condition, extended house and neighborhood characteristics, the time trend, and endogenized TOM produces the most accurate estimates of spillover effects for the Las Vegas market and for the period under consideration. There are significant own-price discount and spillover effects from REO. On the other hand, while short-sale properties are themselves sold with an own-price discount, they do not have spillover effects on neighbors. In fact, this pattern of significant own-price discount but no spillover effect of short sale is repeated in all the estimated models and samples.

Exhibit 7 reports the results of identical specifications as Exhibit 6, except it estimates the six-month spillover effects. The estimates are statistically highly significant, with correct signs, and are robust across specifications. The overall pattern of results is very similar to that in Exhibit 6, including the pattern of differences between the OLS and the 3SLS results. However, the coefficients of the own-price discounts are slightly higher for all three forms of distressed properties. As expected, the sizes of the spillover coefficients are smaller, due to a further time lapse. Moving from three months to six months, the spillover effect of the closest distance ring drops by about 19% (1.06% vs. 0.86%).

As discussed before, exclusion of distressed properties from the analysis, as is done by most past research, may produce a potential biased estimate due to nonrandom sample selection (self-selection) or incidental truncation. For comparison to past research, however, the 3SLS model is applied to samples that exclude REO and foreclosed observations. Exhibit 8 reports the results for three-month and six-month time frames. The same as nonrestricted samples, all spillover variables are statistically significant, but compared to the nonrestricted sample, the size of the spillover coefficients are larger, particularly for the most inner distance ring. For example, ignoring the coefficient of the quadratic term, for the three-month time frame, moving from the most inner distance ring to the most outer distance ring, the spillover effects of the restricted sample are 1.17, 0.32, and 0.07 percentage points higher than those of the nonrestricted sample.

Almost all the past research estimated somewhat ''long-term'' spillover effects of distressed properties for different localities during a ''stable'' housing market. The analyses in this study pertain to a short-term effect during a ''crashed'' market. Las Vegas is one of the seven MSAs that are analyzed by Harding Rosenblatt,

Exhibit 8 | Three-Stage Least Squares (3SLS) Estimation of the Log of Selling Price Samples Exclude Foreclosed and REO Homes

Variables	3-Month Ring Coeff.	3-Month Ring *t*-Stat.	6-Month Ring Coeff.	6-Month Ring *t*-Stat.
No. of neighbors sold in the process of foreclosure/REO: 0–0.1 miles distance	−0.0223	−5.93***	−0.0204	−7.22***
No. of neighbors sold in the process of foreclosure/REO: 0–0.1 miles distance squared	0.0021	3.30***	0.0013	4.44***
No. of neighbors sold in the process of foreclosure/REO: 0.1–0.25 miles distance	−0.0106	−5.21***	−0.0088	−6.21***
No. of neighbors sold in the process of foreclosure/REO: 0.1–0.25 miles distance squared	0.0005	3.18***	0.0003	4.50***
No. of neighbors sold in the process of foreclosure/REO: 0.25–0.5 miles distance	−0.0047	−4.64***	−0.0037	−5.66***
No. of neighbors sold in the process of foreclosure/REO: 0.25–0.5 miles distance squared	0.0001	3.63***	0.0001	4.64***
Adj. R^2	0.8689		0.8912	

Notes: The number of observations in the 3-month ring is 6,810; the number of observations in the 6-month ring is 4,608. In addition to the included variables, each specification includes the house and neighborhood characteristics, vacancy status, and cash transaction indicator variables. Estimated coefficients of these variables for all specifications, as well as those for the TOM equation for the 3SLS estimation, are available upon requests.

*Significant at the 10% level.

**Significant at the 5% level.

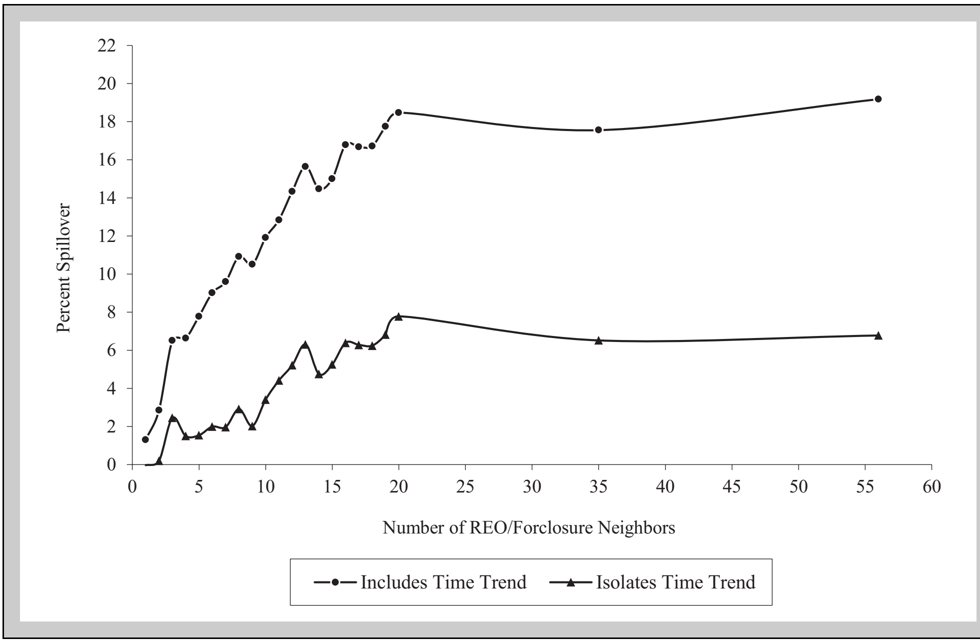
***Significant at the 1% level.

and Yao (2009). They used repeat sales data from 1990 to 2007 and estimated up to a 36-month spillover effect of distressed properties on nondistressed sales within four different distance rings. Comparing the results in the current study from the first distance ring (up to 528 feet) with the combined results to their first two rings (up to 300 feet and 300 to 500 feet) is perhaps the most adequate. The highest statistically significant spillover effect they found was three-to-six months after foreclosure and within 300 feet, −0.52%. They also found that up to three months after REO and within 300-to-500 feet, the spillover effect was −0.46%. Their quadratic model also showed that the 36-month average effect within 300 feet was −0.19 (albeit declining rate), with no effect within 300–500 feet. As expected, the short-term spillover effects during the 2008 market are larger. The 3SLS estimates, based on nonrestricted samples, produce spillover effects of −1.06% (Exhibit 6) and −0.87% (Exhibit 7) within the closest distance ring and within three months and six months after REO, respectively. The corresponding estimates for restricted samples (equivalent to the past research) are −2.23% and −2.04%.

Although the estimated coefficients of the quadratic terms are small, the estimated models so far indicate a nonlinear spillover effect relationship between price and the number of distressed properties. Nonetheless, even the nonlinear specifications provide estimates of average effects. The cumulative effects of the number of REO properties within the 0.5 mile and within the three-month time frame are examined to better focus on the severity of multiple distressed neighbors. In doing so, the counts in the three distance rings were added up. Then, indicator variables were added to the model, so houses with only one distressed property were assigned a dummy variable equal to one, zero otherwise; houses with two distressed properties were assigned a dummy variable equal to one, zero otherwise; and so on. The maximum number of REOs was 56, so 56 indicators were created. The estimated coefficients of these indicators showed a relatively sharp increase up to 20 counts, relatively stable values between 21 and 35, and a fluctuating pattern thereafter. Thus, to obtain a smoother picture, individual indicators for up to 20 counts were allowed and one indicator was created for 21 to 35 and another for 36 and more. These smoothed results are plotted in Exhibit 9.

Exhibit 9 shows plots of the coefficients from two 3SLS estimations; one model does not control for the declining market trend, the second does. Both graphs depict the same pattern. When the model controls for time trends, there is no significant spillover effects from the first and second units of distressed homes in the neighborhood. Rings with three distressed units suffer 2.5% spillover effects. The effects continue to increase to 7.8% for rings with 20 units of distressed homes. When time trend is not controlled for, the estimated spillover effects are about 1.3% for rings with one unit, 2.8% for rings with two units, and 6.5% for rings with three units. The effects continue to increase to about 18.5% for rings with 20 units. Plots based on restricted samples, not shown here, indicate that rings with 20 units of distressed homes experience 12.2% spillover effects when the model includes the time trend variable and 20.8% when it is not. These

Exhibit 9 | Spillover Effects by Number of REO / Foreclosed Properties in the Neighborhood (Smoothed): Within 0.5 Miles and 3-month Time Frame



Source: Estimated Coefficients of REO Count Indicators.

findings indicate the importance of separating effects of overall price trends and the contagion spillover effect of nearby distressed properties, as discussed by Harding, Rosenblatt, and Yao (2009).

Conclusion

Previous studies on the spillover effects of distressed properties on selling prices of neighboring single-family homes did not include the distressed sales observations in their analysis and did not control for distressed status and a property's physical condition. They also did not control for the endogenous TOM that may affect transaction prices. Furthermore, no study ever analyzed a potential spillover differential between sales in process of foreclosure by borrowers and REO sales by lenders or the estimated potential spillover effect of short-sale transactions.

Past studies' approach may be appropriate for the estimation of long-term spillover effects under normal market conditions and time periods, with relatively small numbers of distressed property transactions, such as in the early 2000s to 2007. For ''thin'' markets, such as Las Vegas during 2008, when the distressed transactions dominated the market, there was and continues to be additional competition for a limited number of buyers and the estimation of short-term spillover effects should, therefore, include all transactions, including those of distressed properties. This study includes data for all single-family detached home transactions in 2008 in Las Vegas, controls for the types of distressed property status, a property's physical condition, the market price trend, and the TOM of each transaction. It estimates the short-term (three-month and six-month) contemporaneous own-price discount and the spillover effects for three different distance rings.

The empirical results show that: (1) properties sold as REO or in the process of foreclosure, on average, cause a marginal spillover effect of about 1.06% within 0.1 miles and within three months after their transaction. The spillover effect declines to about 0.7% to 0.4% for distances between 0.1 miles and 0.5 miles. The six-month spillover effects are about 20% lower than those of three-month models. Samples that exclude homes sold under distress produce up to about 58% higher spillover effects than nonrestricted samples. The cumulative effects of multiple distressed neighbors can be as severe as 8%. When market trend is not controlled for, models significantly overestimate the spillover effects. Finally, distressed properties, including short sales, have significantly large own-price discounts, about 10% to 19%.

Lastly, the findings of this study suggest that short-term spillover effects of distressed properties are much larger than pervious estimates of the same market, Las Vegas (Harding, Rosenblatt, and Yao, 2009). It also suggests that, although short sales suffer own-price discounts, they do not have price spillover effects on their neighbors. This is perhaps due to relative property upkeep that may take place when borrowers are permitted to use a short-sale process instead of a foreclosure process. This finding has a significant implication for lenders who may even consider allowing borrowers to short sell to themselves, reducing monthly mortgage payments to avoid a more costly foreclosure. It also has public-policy implications, such as providing incentives to both lenders and borrowers to utilize short sales. This is an important issue worthy of future research.

Endnotes

1. In previous studies it is often not clear whether the ''foreclosure'' status referred to a sale in the process of foreclosure or a sale as REO, or both.

2. Harding, Rosenblatt, and Yao (2009) discusses potential omitted variable bias, due to unobserved house and neighborhood characteristics, resulting from a hedonic specification to estimate the spillover effects. They use repeat sales data from 1989 to 2007. The 19-year period allows them to obtain enough repeat sales observation and estimate long-term spillover effects on price appreciation. They also acknowledge that the repeat-sales approach assumes that there is no change in house and location characteristics over time and that house and location attribute prices stay constant over time. In any case, repeat-sales data are not available when dealing with a short-run analysis. The approach would not be the best for the estimation of short-run spillover effects.

[3] These studies, with the exception of Harding, Rosenblatt, and Yao (2009), which used data from 1989 to 2007, utilized data from 1998 to 2007 and either do not include a time boundary for spillover effects or a boundary range from a minimum of six months to ten years.

[4] In a technical term, exclusion of some observations may produce potential bias estimate due to nonrandom sample selection (self-selection) or incidental truncation. See Green (2008), Chapter 24.

[5] For the six-month time frame analyses, observations pertaining to the first six months were deleted and the estimations were based on the last seven months of 2008, a total of 14,605 observations.

[6] In the first two types of sales the title will be in the name of the borrower. Only in the REO case will the title vest with the lender.

[7] As discussed by Harding, Rosenblatt, and Yao (2009), to obtain an accurate estimate of spillover effects it is important to isolate the effect of overall market price trends. Exhibit 3 shows an almost perfect linear declining price trend in the sample. Thus, a linear time trend variable is included in the regression analysis.

[8] As mentioned by an anonymous referee, it may be the case that expectations of future house prices may affect the decision to default and allow a foreclosure. The default option can be seen as a put option the value of which will change with house prices. However, Nevada allows for deficiency judgments so if house prices are expected to fall, increasing the value of the put option, there will be an offsetting increase in the amount of the deficiency judgment. Further complicating the default decision is the uncertainty of the time frame that the lender will institute a foreclosure action. As a result, it is not likely that homeowners' expectations of short-term price changes will affect the default/foreclosure decisions.

[9] For examples of TOM and price endogeniety studies, see Sirmans, Turnbull, and Benjamin (1991), Yang and Yavas (1995), Yavas and Yang (1995), Knight (2002), Harding, Knight, and Sirmans (2003), and Clauretie and Thistle (2007).

[10] The numbers for within 200 feet are also calculated. Given a relatively low population density, 4,154 square miles, in Las Vegas, the 200-feet calculation does not produce sufficient numbers of neighbors. For comparison, Schuetz, Been, and Ellen (2008) used rings of 250 feet to 1,000 feet for New York, which has a population density of 27,440 square miles. Actual transaction date and house latitude and longitude were used to form the rings.

[11] The neighborhood variables for more than 60 ZIP Code areas come from the data that are collected and analyzed by the Center for Business and Economic Research at the University of Nevada, Las Vegas.

[12] The Greater Las Vegas Association of Realtors (GLVAR) does not reveal the year a broker joined the organization. Broker members, however, are given an identification number when they join the GLVAR. The ID number is assigned chronologically as members join and can proxy the extent of the agent's experience in the Las Vegas real estate market.

[13] Theoretically, best exclusionary variables for the estimation of the probit decision equation would be some measures of owner and loan/equity characteristics, such as employment status, accumulated equity, mortgage interest rate, etc. Unfortunately, as

this information is extremely time-consuming to obtain, if available at all, thus, neighborhood variables are used instead.

14 The initial analyses, based on various tests of individual and sets of coefficients (t and F test), revealed no statistically significant differences in spillover effects of REO and in the process of foreclosure. Thus, all reported results combine these two categories of distressed. For simplicity, this combined category is referred to as "REO."

15 The initial analyses, based on various individual coefficient and set of coefficients (t and F test), reveal the statistical significance of the property's distressed status, ($F_{(3,\ 19652)} = 546.9$), and physical condition, ($F_{(3,\ 19652)} = 264.8$), variables. Thus, these variables are included in all specifications.

16 Given that the dependent variable, price, is measured in natural logarithm, the precise percentage effect of the lake view variable on price is calculated as $Exp^{(\beta)} - 1 = Exp^{(-0.0200)} - 1 = -1.98\%$. F-tests (for OLS) and chi-square tests (for 3SLS) indicate that the estimated spillover effects differences between/among the distance rings are statistically significant.

17 Chi-squared tests, with one degree of freedom, for the differences between the pairs of REO's spillover coefficients between specifications (1) and (2) are all statistically significant.

18 During the period under consideration, about 70% of sold houses were distressed. Housing inventories for sale, both new and existing houses, were as high as Las Vegas has ever seen, reducing prices by more than 40%.

19 Per an anonymous referee's suggestion, specification 4 was estimated for subsamples of March–June, July–September, and September–December 2008. The estimated spillover effect coefficients were robust and stable across the subsamples.

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Daneshvary would like to acknowledgement the University of Nevada, Las Vegas, College of Business summer research financial support. We express our thanks to the *participants of the Economics Department's Seminar Series at UNLV for their comments.*

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