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A Duration Analysis of Foreclosures to Sheriff Sales in Light of the Financial Crisis

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Abstract: The purpose of this paper is to address the efficiency of turning over homes that have gone into foreclosure. For the town of Muskego, Wisconsin, the number of homes going to foreclosure has decreased from the pinnacle of the housing crisis. Furthermore, the likelihood of a house going to sheriff sale after being foreclosed upon has gradually decreased from this point in time as well. This paper employs a probit model to determine the likelihood that a foreclosed home will go to sheriff sale compared to the reference years (2001-2004). From the initial stages of the housing crisis, homes in foreclosure were more likely to go to sheriff sale compared to the reference years, but this effect diminishes over time. Furthermore, a hazard model is implemented which confirms the results of the probit from a duration perspective.

1. Introduction

The varied and complex dimensions of the mortgage and housing crises continue to impact an increasing number of households, firms, and financial institutions. While the scholarly literature regarding foreclosures and sheriff sales concentrates on the direct and vicarious financial impacts on homeowners and their neighbors, there is a reserve of literature regarding the timing of these foreclosures and the likelihood that certain types of properties will be affected. This study focuses on these two facets of the foreclosure literature within the confines of a single community (Muskego, Wisconsin), an exurb on the edge of the City and County of Milwaukee. While it is often argued that real estate is local, our results find that less common methodologies, when brought together on this specific locality during the recent foreclosure crisis, provide a comparative context to the earlier literature from previous epochs.

This research study employs duration analysis and probit analysis, empirical techniques which are infrequently adopted in the foreclosure literature. First, a test of the duration between an initial foreclosure and a successful sheriff sale[1] helps to provide insight into whether households are equally at risk in this timeline. This portion of the analysis reveals that the time lag between a foreclosure and a sheriff sale is directly impacted by the characteristics of a home. Second, the probit analysis finds that the probability that a property that has been foreclosed will eventually be sheriff-sold is also guided by the hedonic characteristics of that home. The findings of these sections are consistent with an *a priori* expectation

[1] Not all foreclosures result in a sheriff sale. Slightly less than half go to a sheriff sale, while the other foreclosures are redeemed by their owners or settled outside of a sheriff sale.

that lower-valued homes are more likely to end up in a sheriff sale in a shorter time frame.

The examination of the housing and foreclosure crisis is rapidly evolving to accommodate changes in the probability and timing of housing default. Such research is becoming increasingly important because of the dominance of sheriff sales and foreclosures within the real estate market. This trend has become evident in the city of Muskego, Wisconsin (see Table 1), where there have been very few home sales in recent years which have not been impacted by a sheriff sale or the probability of one. The remainder of this study proceeds as follows: Section II provides a review of relevant studies to provide perspective on the role of the present study relative to previous empirical work on foreclosures; Section III describes the data used in the analysis and the process of identifying homes that were foreclosed upon and subsequently sold in a sheriff sale; Section IV outlines the methodology used; Section V provides and interprets the empirical findings; and Section VI provides concluding observations.

2. Literature review

While the empirical work on foreclosures is extensive, the literature is dynamic and continuously evolving to incorporate new models, test new theories, and investigate new data. Due to the recent recession and accompanying mortgage crisis, the foreclosure literature has grown rapidly. However, although this study focuses on two models that estimate different dimensions (i.e., different problems and characteristics of foreclosures) than those typically stressed in the literature, this brief literature review serves to provide perspective on the role of the present study in the overall related body of research.

The early literature provides a platform upon which future research develops and examines foreclosures according to a bank's risk assessment. This research serves to examine the relationship between mortgage default and loan-to-value ratios, risk factors, loan quality, and interest rates (Jung, 1962; Von Furtstenberg, 1969; Von Furtstenberg, 1970a; Von Furtstenberg, 1970b; Von Furtstenberg, 1974). Much of this early foreclosure literature is considered in Quercia and Stegman (1992) and Vandell (1995). The more recent research has concentrated more on the association between the current crisis and the spatial cost associated with the negative externalities created by foreclosures and/or sheriff sales (Baxter and Lauria, 2000; Immergluck and Smith, 2006; Leonard and Murdoch, 2007; Foote, et al., 2008; Harding, et al, 2009).

2.1. Duration

The application of duration analysis, with respect to foreclosures and sheriff sales, is a technique employed in past epochs. However, it has not been applied to the most recent crisis. In addition, the early applications of duration analysis largely ignored hedonic home characteristics. Instead, the relevant focus of duration analysis has been on the borrower's characteristics, especially credit worthiness, and how this factor influences the time between foreclosure and sheriff sale. Other work has looked at characteristics of the surrounding area, such as the unemployment rate, to look at the length of time until sheriff sale. There has been very little that experts agree on regarding the influences on duration between foreclosure and sheriff sale. For example, Pennington and Cross (2010) find that borrowers with higher credit scores at the origination of the mortgage are less likely to redeem the obligation, resulting in a shorter duration (Pennington and Cross, 2010). In addition, Capozza and Thompson (2006) find that there is little relationship between an owner's credit score and the outcome of a foreclosure.

As the literature in foreclosures grows, duration analysis has gradually moved to include models not directly connected to this work, but helpful in creating the duration process. Included in this area is research in the associated, but unique, area of the type of housing characteristics and the time spent in REO.[2] Employing duration models, recent studies also find that in both conventional (Phillips and Vanderhoff, 2004) and subprime (Capozza and Thomson, 2006) mortgage markets, foreclosed properties in geographic regions with higher unemployment rates have a longer period of time between foreclosure and sheriff sale. In other words, the time lag between foreclosure and sheriff sale in a given region is an increasing function of the region's unemployment rate.

2.2. Probit

The second estimation adopted in this study considers a probit model, one which tests whether or not a foreclosed home ultimately becomes a sheriff sale. The model in Ambrose and Capone (1998), by which a test is developed to determine whether or not a

[2] "REO" stands for real estate owned where it is typically owned by a bank, government agency, or government loan insurer.

home that is foreclosed can redeem itself, acts as a baseline guide for the present study. An important determinant in their model is the unique financial position of the home borrower. The primary findings are twofold: "(1) that defaults can be generated from borrowers with positive as well as negative equity, and (2) that the process and rates of transition from default to foreclosure are different for each of these groups of defaulters" (Ambrose and Capone, 1998, p. 427).

The model considered in this study does not include any financial information on the homeowner. Rather, it incorporates hedonic housing characteristics. Although this potentially ignores directly considering important financial/economic borrower characteristics, arguably the housing characteristics can be used to at least partially explain borrower wealth (Cebula, 2009).

3. Data and descriptive statistics

This analysis uses a thirteen year time series data from Muskego, Wisconsin, encompassing home sales from 2001 through 2013. The dataset begins in 2001, as there was a very limited number of sheriff sales that occurred prior to this. As the decade progressed, sheriff sales became more commonplace and appeared more often in Muskego's assessment records (Table 1). The foreclosure and sheriff sale data was collected from a variety of state and local sources. The City of Muskego Assessor Office keeps updated records on all homes sold during our data set timespan. However, this set is limited to information on the sale price and assessed value. In order to include specific household characteristics, these were then matched with the 2010 property tax records according to a unique tax identity code.[3]

Information on the foreclosures that occurred in Muskego in the last decade was collected from the Wisconsin Circuit Court and matched with the home sales information based on address. Foreclosures that ultimately resulted in a sheriff sale were determined through the City Assessor's personal notes that had been included with all property sales that indicated unusual sales circumstances.

Tables 1 and 2 provide descriptive statistics on the variables in the model. Some interesting information can be gleaned from these two tables. Notice that during the housing crisis, both foreclosures and the percentage of those that went to sheriff sale increased. However, by 2010, while the number of foreclosures was still high, the proportion of sheriff sales decreased dramatically. As can be seen in the Kernel Distribution (Figure A1) and the Kaplan-Meier survival estimate (Figure A2) graphs, after two years most remaining foreclosed homes were either redeemed or sold by the owner. Both of these graphs plot only the foreclosed homes that have been observed going to sheriff sale. As such, the observations from 2013 have not had enough time to come to unity.

Table 1. A growing percentage of sheriff sales[4].

Year	Foreclosures	Sheriff Sales	Duration (months)	% Sold
2001	16	4	21.23	25.00%
2002	20	12	23.83	60.00%
2003	10	5	63.50	50.00%
2004	9	1	10	11.11%
2005	14	6	36.98	42.86%
2006	24	15	27.54	62.50%
2007	35	27	23.32	77.14%
2008	41	24	30.08	58.54%
2009	64	40	22.82	62.50%
2010	82	37	19.59	45.12%
2011	54	16	16.41	29.63%
2012	35	8	11.84	22.86%
2013	36	2	5.8	5.56%

[3] The home characteristics were as of 2010 (because that is the year of the tax records), which poses a potential problem for some properties because of changes to the home after it was sold, which would be reflected in price but not in the characteristics.

[4] Note that the duration is an average of the duration of all sheriff sales censored to omit sheriff sales that occurred after 67 months from initial foreclosure. 95% of all sheriff sales occur within this time frame. This doesn't include observations that never went to sheriff sale.

Although the fall in home sales first began to manifest in 2008, the number of foreclosures and sheriff sales was already rising as early as 2006. However, this spike in foreclosures was not accompanied by a similar rise in either the duration until sheriff sale or the average percentage of foreclosures that resulted in a foreclosure. Instead, there was on the one hand a rise in both the number of foreclosures and the number of sheriff sales while on the other hand a more recent decrease in the average amount of time between foreclosure and sheriff sale (almost one standard deviation below the mean in 2010). The latter phenomenon could plausibly be attributable in part to increased efficiency of the banks at selling properties, despite a depressed real estate market.

The descriptive statistics for the data used in the models, shown in Table 2, represents the household characteristics of the homes that were sold as well as descriptors of the area that surrounds them. The average home in Muskego is arguably typical of what one would expect in such a community, with an average of three bedrooms and two bathrooms. A number of older homes, some of which were built in the mid 1800's, were sold during this time period. Properties located on one of Muskego's three lakes were rare among the homes that sold, or sheriff-sold, with slightly more than five percent having lakefront property. Due to the low number of observations with lakefront characteristics, lakefront variables were not included as independent variables.

Table 2. Descriptive Statistics.

	Mean	Std. Dev.	Min	Max
Dependent Variables:				
Months in Panel	37.86813	34.92486	1	167
Sheriff Sales	0.246851	0.431191	0	1
Months to Sheriff Sale	10.0071	24.86484	0	133
Independent Variables:				
Land Value	71365.57	38079.94	6900	329600
Improvements Value	164479.7	71834.07	35000	504600
Total Rooms	6.38336	1.359976	3	11
Bedrooms	3.212494	0.725689	1	6
Bathrooms	1.827645	0.672562	1	5
Square Feet	1841.644	650.9835	696	4603
AgeatForeclosures	38.5284	27.28024	1	137
2005	0.05915	0.235913	0	1
2006	0.062872	0.24274	0	1
2007	0.062586	0.242224	0	1
2008	0.095683	0.294164	0	1
2009	0.115953	0.320178	0	1
2010	0.143896	0.350994	0	1
2011	0.079764	0.270935	0	1
2012	0.037506	0.190003	0	1
2013	0.014143	0.118085	0	1

4. Empirical models

Empirical analysis on foreclosures has largely been subdivided into two succinct models. The first is a duration model that estimates the determinants of the length of time from a foreclosure to a sheriff sale, remedy by the home owners, or some other scenario. The second model includes a probit model that estimates the probability of a home being sheriff-sold once a foreclosure has occurred. This study attempts

to build on previous work by combining these two previously unrelated pieces of literature into a single study on one community.

4.1. Duration analysis

The duration analysis models the time from a foreclosure until a sheriff sale. In its earliest incarnation, the medical and biological sciences used duration analysis to study the treatment of diseases. In this medical example, the primary variable of interest is the number of days that the respective patients survive provided a certain treatment. It is critical to note that there are different groups of participants in these studies. Provided a time line with a start point and an end point, some patients survive the entire study period. However, in other studies, patients enter the research pool at differing points along a timeline. Some may also die following the completion of the project. The observations containing only partial information are considered censored observations.

In general, censored observations arise whenever the dependent variable of interest represents the time to a terminal event and the duration of the study is limited in time. Censored observations may occur in a number of different areas of research. For example, social scientists may study the "survival" of marriages, high school drop-out rates (time to drop-out), turnover in organizations, bank failures, and so forth (Chou and Cebula, 1996). In each case, by the end of the study period, some subjects will still be married, or will not have dropped out, or are still working at the same company, or are still solvent, as the case may be; thus, those subjects represent censored observations.

The estimate of the duration between a foreclosure and a sheriff sale uses a hazard model framework to identify the home characteristics which could influence the possible termination of that district. Hazard models incorporate information about the timing of events, making efficient use of the data. The hazard model allows for a number of foreclosed properties remaining in this status throughout the study. These properties are accounted for by converting them to censored data. This occurs due to the inability to assign a duration value, t, and include them in the hazard function. If included, these censored observations would create a downward bias inflating the survivor function. In order to further limit bias in our hazard estimates, we censor observations that have surpassed 67 months without going to sheriff sale because over 95% of the sheriff sales occur within this time frame.

Two duration econometric methodologies are adopted. The first method uses a nonparametric approach to estimate the survivor, hazard and integrated functions, allowing for any possible patterns of duration dependence in the data. The second method uses a Cox proportional hazard model with time-varying covariates. This allows for the examination of characteristics influencing a sheriff sale while controlling for the characteristics of the homes that owners were able to redeem.

The estimation of the nonparametric hazard function assumes that the process of moving from a foreclosure to a sheriff sale is continuous and the survival time data are observations on a continuous variable. The function estimated at this point is the hazard function, which represents the instantaneous transition intensity in moving from a state where no event has occurred to one where an event occurs (i.e., the occurrence of a sheriff sale):

$$hazard(t_k) = \frac{number of\ terminated\ TID}{number\ of\ available\ TID\ districts} \quad (1)$$

For example, a small interval of time, Δt, times the nonparametric estimate of the hazard rate at tk and would offer insight into the probability of an even occurrence in $(tk + \Delta t)$, conditional upon its having survived until tk. The estimation of this function assesses the pattern of duration dependence that exists in the data. The hazard and survivor functions create these estimates using the Kaplan-Meier product-limit estimators. They are generated as follows.

Suppose that $t_{i1} < t_{i2} < ... < t_{ij} < \cdots < t_{iJ_1} < \infty$ represents $(J_i - 1)$ survival times for each foreclosure, i, that is observed in the data. The survivor function at time t_j, $S(t_j)$ represents the proportion of those foreclosures that would terminate in time $t_j + \Delta t$, conditional upon having survived until that time. In this study, the survivor function represents the proportion of foreclosures that are yet to be sheriff-sold. The Kaplan-Meier estimate of the survivor function is calculated as the product of one minus the number of exits or events (i.e., when a foreclosed home is sheriff-sold) as a fraction of the risk set (i.e., the total number of foreclosures that can fail at that point in time). This is the product of one minus the exit rate at each of the survival times. The nonparametric estimate of the survivor function is calculated as:

$$\hat{S}(t_j) = \prod_{j|t_j<t}(1 - \frac{d_j}{n_j}) \quad (2)$$

where d_j represents the number of sheriff-sold foreclosures, and n_j represents the total number of foreclosures at risk of completion, i.e, those who either have a completed spell, or a censored spell of length t_j or longer.

Using the Kaplan-Meier estimate of the survivor function requires three assumptions. First, the censored observations have the same prospect of survival as those that continue to be studied. Second, the *survival* of a foreclosure (i.e., it hasn't been sheriff-sold) is the same for households that span the data set as well as those which are created during the study. Third, the event studied (i.e., the sheriff-sale of a home) happens at a specified time.

The integrated hazard function, $\hat{H}(t_j)$, is estimated by the Kaplan-Meier estimate of the survivor function, being constructed as:

$$\hat{H}(t_j) = -\ln(\hat{S}(t_j)) \tag{3}$$

The integrated hazard function is estimated as the negative of the natural logarithm of the product limit estimate of the survivor function.

The estimates of the hazard functions are step functions, representing a lack of observed transitions to the state where a foreclosure fails at every point in calendar time. As a result, this dataset can only derive estimates of $S(t)$ and $H(t)$ at dates where transitions are observed. The last estimate occurs at the transition of a home with the largest non-censored survival time.

These step functions have limitations for the estimation of the hazard function. It is observed that the nonparametric estimate of the hazard rate is not well defined. Whereas the hazard rate should be estimated as the derivative of the integrated hazard function, the estimate reveals a step function. The estimation of the hazard function is achieved by smoothing the estimated integrated hazard function. By estimating the integrated hazard function using a kernel and differentiating, this smoothed hazard yields a smoothed hazard function.

A Cox proportional hazard model with time-varying covariates models the time until a foreclosure is sheriff-sold. This model is developed by maximizing the partial likelihood function. Under this framework, the hazard function for the sale of a foreclosure can be written as: $h_i(t|x_i(t),\beta)$, where $i = 1, \dots, n$, $x_i(t)$ is a vector of time-varying independent variables, and β is a vector of parameters to be estimated.

Suppose that $t_{i1} < t_{i2} < \dots < t_{ij} < \cdots < t_{iJ_1} < \infty$ represent $(J_i - 1)$ distinct survival times for each foreclosed on home i that is observed in the data. At time $t_{iJ_i} \geq t_{iJ_i-1}$, either an event (i.e., sheriff sale of a foreclosure) is observed, or the event on the ith foreclosure is censored at that point in time. The vector of time-varying covariates, $x_i(t)$, corresponding to time t_{ij}, $J = 1, \dots, (J_{i-1})$, is assumed to reflect observed measurable characteristics of household i over the interval $[t_{ij}, t_{ij+1}]$ for $J = 1, \dots, (J_{i-1})$. This hazard model contains time-varying covariates in the sense that these covariates may vary *across* intervals, $[t_{ij}, t_{ij+1}]$, although they are assumed to be constant *within* the intervals of time.

The estimation of this model is done using the partial likelihood approach suggested by Cox (1972, 1975). In this model, the indicator variables are defined as:

$$f_i = \begin{cases} 1 \; if \; foreclosed \; property \; is \; sheriff \; sold, \\ \quad i.e., \; the \; event \; occurs \\ 0 \; otherwise \end{cases} \tag{4}$$

Thus, the contribution by the ith sheriff sale to the partial likelihood is:

$$L_i(\beta_i) = \frac{h_i\left(t_{J_i} \middle| x_i\left(t_{J_i}\right), \beta\right)^{f_i}}{\sum_{m \in R_i} h_{im}\left(h_i\left(t_{J_i} \middle| x_i\left(t_{J_i}\right), \beta\right)\right)} \tag{5}$$

where $R_i = \{m | t_{j_m} \geq t_{j_i}, m = 1, \dots, N\}$, the risk set associated with sheriff sale i (i.e., the set of foreclosures that have not failed before sheriff sale i did). It is important to note that the censored foreclosures do not contribute to the partial likelihood in the numerator, although they do enter the denominator. As a result, the proportional hazard specification is given by:

$$h_i(t|x_i(t), \beta_i) = \bar{h}(t)\exp(x_i(t)\beta) \tag{6}$$

where $\bar{h}$ is the baseline hazard. Substituting this into the equation above, taking logs, and then summing across all individual foreclosures yields the partial log likelihood for the entire sample, namely:

$$lnL(\beta) = \sum_{i=1}^{N} \{f_i x_i\left(t_{j_i}\right)\beta - \; ln[\sum_{m \in R_i} \exp(x_m(\, t_{j_i})\beta)]\} \tag{7}$$

The advantage of this partial likelihood approach is that, in estimating the vector of parameter β, only part of the hazard needs to be specified. As a result of the structure of the partial likelihood function given in the equation above and the proportional hazards assumption, we do not have to define the density or survivor functions. Nor do we have to specify the baseline hazard, h, since it drops out when equation 6 is inserted into equation 5. This feature of the model is particularly useful when estimating the

model since it allows us to directly estimate the vector of parameters β in the hazard function without needing to specify the underlying density or survivor functions, even in the presence of endogenous regressors.

4.2. Probit

The probit model estimates the unique household characteristics that result in a foreclosed home being sheriff-sold. In doing so, the probit model adopts the following equation:

$$P(y_i = 1|Z_i) = G(\varphi Z_i) \quad (8)$$

where y_i is a stationary variable that assumes a value of 1 if the home was sold through a sheriff- sale or a value of 0 if the home did not result in a sheriff sale. Curing the default is a common method for homeowners to exit foreclosure procedures without a sheriff sale. The stationary dependent variable is estimated against a vector of control variables, Z_i, which includes the same household characteristics described in the above section.

5. Results

5.1. Duration

The duration model examines the entire dataset consisting of 441 foreclosures[5] that occurred between 2001 and 2013. However, it is possible that a number of these properties that were foreclosed toward the end of the dataset are yet to either be redeemed or sheriff-sold. This makes the duration of more recent sheriff sales appear shorter because only the more "successful" sales had occurred[6].

An *a priori* expectation is that the duration would be shorter in more recent years, possibly from the acquisition of institutional knowledge, and Table 3 shows that the duration prior to, during, and after the recession[7] has declined over time. However, as noted earlier in the paper, the most recent years need more time for the observations to mature. Prior to the recession, there were a number of foreclosed homes which persisted for as long as four years before finally being sheriff-sold. Half of the entire set of observed sheriff sales from 2001-2013 occurred within 27 months of the initial foreclosure.

Table 3. Duration model: exponential distribution.

	Coefficient	S.E.	Hazard	S.E.	P-Value
Log(Land Value)	0.0217454	0.1612651	1.021984	0.1648103	0.8930
Log(Improvements Value)	0.6106176	0.4485502	1.841568	0.8260359	0.1730
Total Rooms	-0.0140879	0.1044003	0.9860109	0.1029399	0.8930
Bedrooms	-0.0230977	0.1615519	0.977167	0.1578632	0.8860
Bathrooms	0.1174356	0.2044071	1.124609	0.2298782	0.5660
Square Feet	-0.0010368	0.0006563	0.9989637	0.0006557	0.1140
Square Feet Squared	7.87E-08	0.000000113	1	0.000000113	0.4850
AgeatForeclosures	0.0012436	0.0043267	1.001244	0.0043321	0.7740
2005	0.6140748	0.5199245	1.847946	0.9607925	0.2380
2006* **	1.600736	0.3692629	4.956678	1.830317	0.0000
2007* **	2.12756	0.3360975	8.394357	2.821323	0.0000
2008* **	1.592561	0.336536	4.916326	1.654521	0.0000
2009* **	1.857926	0.3060055	6.410425	1.961625	0.0000
2010* **	1.511011	0.3116393	4.531311	1.412134	0.0000
2011* **	1.314586	0.3625771	3.723209	1.34995	0.0000
2012* **	1.354706	0.4407782	3.875622	1.708289	0.0020
2013	0.9134816	0.7548721	2.492987	1.881886	0.2260
Constant	-11.8498	4.925049	7.14E-06	0.0000352	0.0160

[5] There were 441 foreclosures between 2001 and 2013, but some of them were multiple foreclosures where the home redeemed itself and went into foreclosure again. Some of these resulted in a sheriff sale after multiple foreclosures.

[6] By more successful we mean that only the sheriff sales which occurred within a shorter period of time (more successful for the bank) have been completed recently.

[7] We used the NBER dates for the recession, which started in December 2007 and lasted through June 2009.

Table 4. Duration model: Cox distribution.

	Coefficient	S.E.	Hazard	S.E.	P-Value
Log(Land Value)	0.0323029	0.158658	1.0328	0.1638668	0.8390
Log(Improvements Value)	0.4873566	0.4337037	1.6280	0.7060727	0.2610
Total Rooms	0.0152035	0.1055975	1.0153	0.1072152	0.8860
Bedrooms	-0.0333472	0.1600151	0.9672	0.1547671	0.8350
Bathrooms	0.0948381	0.2005458	1.0995	0.2204962	0.6360
Square Feet	-0.0009296	0.0006624	0.9991	0.0006618	0.1600
Square Feet Squared	6.61E-08	0.000000116	1.0000	0.000000116	0.5680
AgeatForeclosures	0.0003045	0.0042322	1.0003	0.0042335	0.9430
2005	0.2856165	0.520241	1.3306	0.6922233	0.5830
2006* **	1.050828	0.3701369	2.8600	1.058598	0.0050
2007* **	1.383411	0.3368237	3.9885	1.343415	0.0000
2008* **	0.836131	0.3388181	2.3074	0.7817963	0.0140
2009* **	1.017742	0.3104975	2.7669	0.8591278	0.0010
2010* **	0.6073011	0.3166325	1.8355	0.5811698	0.0550
2011	0.2593707	0.3674487	1.2961	0.4762554	0.4800
2012	0.2074221	0.4460264	1.2305	0.5488363	0.6420
2013	0.7175917	0.7654634	2.0495	1.568811	0.3490

The duration models use two specifications, which are shown in Tables 3 and 4. Both the exponential and a Cox distribution yield similar results. However, for purposes of interpretation the Cox-Proportional Hazard model is preferred due to the assumed baseline hazard of sheriff sale. A number of variables have a hazard ratio that is close to unity, implying that they have little effect in determining the likelihood of a foreclosed home going to sheriff sale at any given point in time. Only some of the year dummies were statistically significant, meaning that if one were to foreclose in one of those years, the hazard of sheriff sale would be different compared to the reference years of 2001-2004. As can be seen from the results the hazard rates are higher during the beginning of the financial crisis and decline steadily until 2011, where the hazard ratio is no longer statistically different from the reference year. The Kernel Distribution and Kaplan-Meier survival estimate graphs are shown in the appendix.

5.1. Probit

The second estimation is a probit model with results represented in Table 5. Whether or not the filing of a foreclosure on a home resulted in a sheriff sale serves as the dependent variable. A review of the results finds that hedonic traits of homes have little to no impact on the probability that a foreclosed home will go to sheriff sale. In this regard, sheriff sales are an equal-opportunity proposition for those who experience foreclosures. The probit model shows that homes that foreclosed in the years 2006-2009 were more likely to go to sheriff sale than the reference group of 2001-2004.

6. Conclusions

This study covers two of the less commonly used estimates of foreclosures on one community. There has been a growing amount of literature concerning foreclosures as a result of the most recent recession and the bursting of the housing market bubble. This study combines two previously unlinked econometric methods and looks at a more robust analysis of the foreclosure market in Muskego, Wisconsin. These two threads of foreclosure research are the hazard of sheriff sale and the probability of a sheriff sale once a foreclosure has occurred. Taken individually these each help explain the effects of a foreclosure, but together they provide a unique insight into foreclosures and sheriff sales.

Table 5. Probit model.

Variable	dy/dx	S.E.	P-value
Log(Land Value)	-0.0396572	0.05284	0.4530
Log(Improvements Value)	0.1003551	0.12863	0.4350
Total Rooms	0.0215381	0.03781	0.5690
Bedrooms	-0.0219074	0.05687	0.7000
Bathrooms	0.00000332	0.06743	1.0000
Square Feet	-0.0002775	0.00022	0.2150
Square Feet Squared	2.21E-08	0.00000	0.5810
AgeatForeclosures	-0.0003079	0.00144	0.8310
2005	0.0828111	0.15141	0.5840
2006**	0.2750775	0.11471	0.0160
2007***	0.3968779	0.09067	0.0000
2008*	0.2073717	0.10493	0.0480
2009***	0.2487511	0.09294	0.0070
2010	0.0661235	0.09333	0.4790
2011	-0.0789244	0.09839	0.4220
2012	-0.17708	0.09882	0.0730
2013***	-0.4048531	0.05984	0.0000
Pseudo R-Squared			0.1369
Observations			441

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Appendix

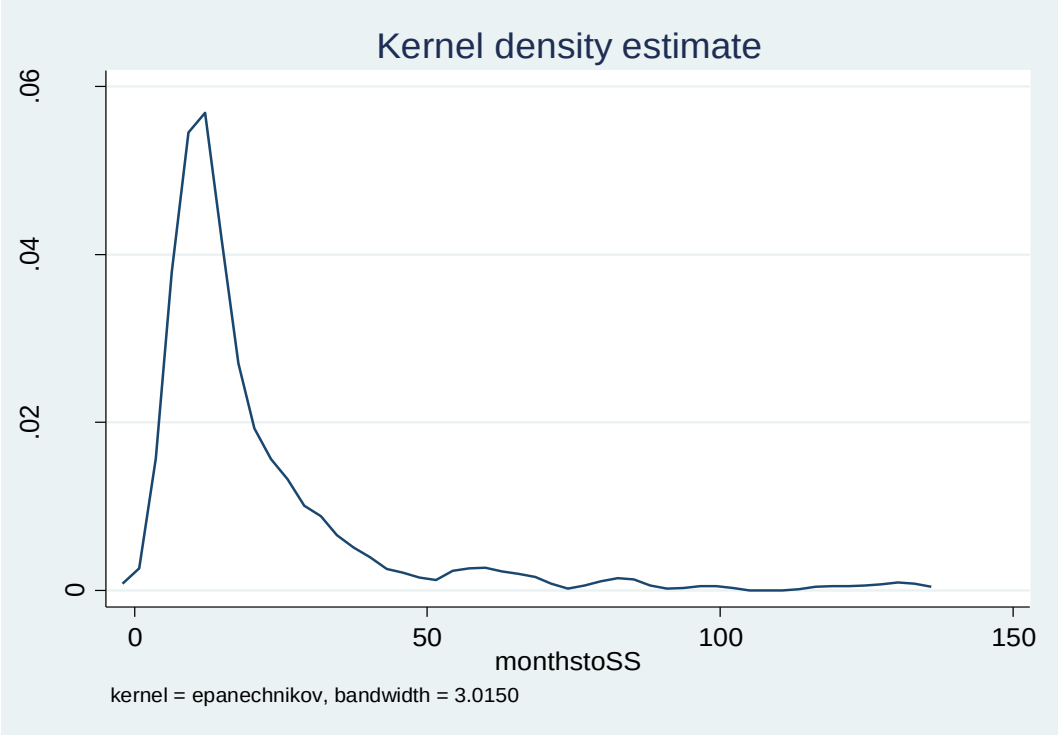

Figure A1. Kernel Distribution for Months to Sheriff Sale.

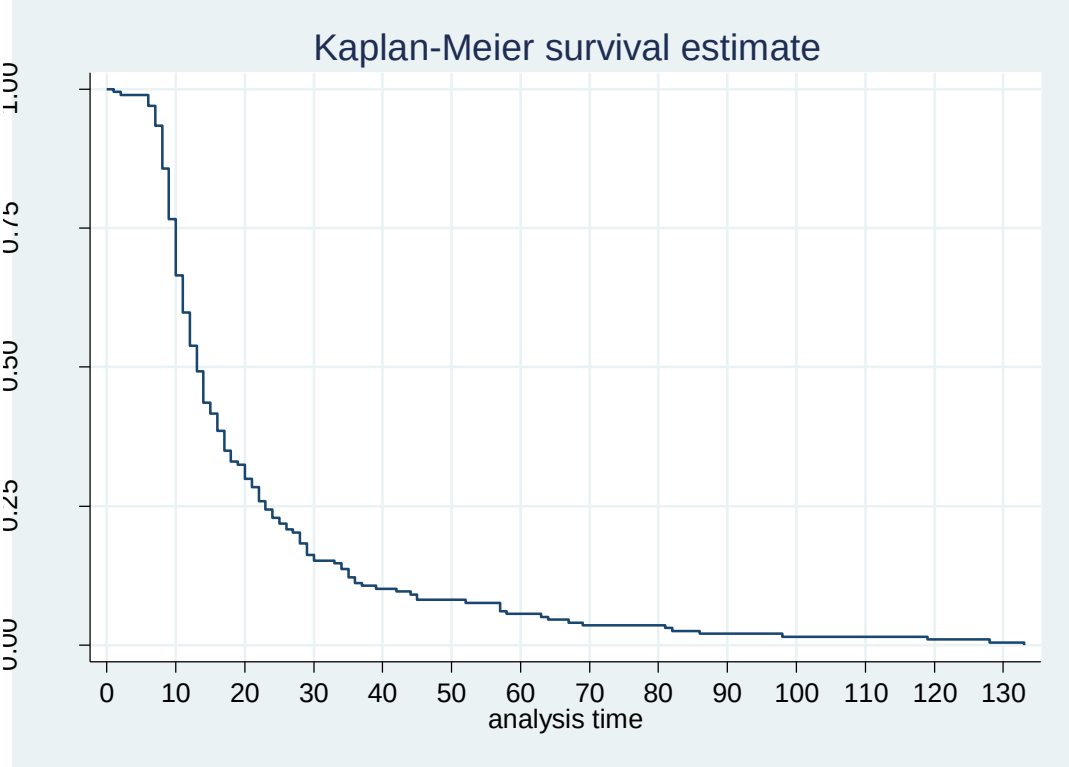

Figure A2. Kaplan-Meier Survival Estimate.