Tulane Economics Working Paper Series

Property Tax Delinquency and its Spillover Effects on Nearby Properties

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Working Paper 1623
December 2016

Abstract

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Keywords: State and Local Taxation, Housing Supply and Markets, Property Tax Delinquency.
JEL codes: H71, R31

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This paper investigates the impact of property tax delinquency on the sales price of nearby residential properties, an effect that we call the "delinquency discount". We use a sample of 34,500 home sales and the population of delinquent properties for Chicago, Illinois during the period 2010 to 2013. We focus on the delinquency discount for properties within the same census block. We also examine the effect of delinquency duration on neighboring properties, as this measures the level of their financial distress. We estimate the magnitude of the delinquency discount using several alternative estimation methods, in each case controlling for local foreclosure activity. Our preferred method is a matching estimator, as it works to eliminate the potential for omitted variable bias that is common in this type of estimation. We find large, negative, and statistically meaningful effects of delinquent properties for which the local government has placed a tax lien and has put the lien up for sale to private investors. For properties with a tax lien that are not successfully sold, we estimate a negative spillover of 5.1 percent ($12,872) on surrounding properties. Properties with a tax lien that are sold to private investors have a smaller, but still negative impact on surrounding property values of 2.5 percent ($6310).

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Acknowledgements:
The authors would like to thank the participants at the Lincoln Institute of Land Policy's Urban Economics and Public Finance Conference for their insightful comments. We are particularly grateful to two anonymous referees and especially to Dan McMillen for helpful comments and suggestions. The authors thank the Lincoln Institute of Land Policy and the Institute for Housing Studies for help with acquiring the data for this project. The opinions expressed are those of the authors, and do not necessarily reflect the policies of the Department of Housing and Urban Development or the Administration. Please address all correspondence to Zackary Hawley, Department of Economics, Texas Christian University, TCU Box 298510, Fort Worth, TX 76129 (phone +1 817 257 6722; fax +1 817 257 5058; email z.hawley@tcu.edu).

1. Introduction

Housing markets are inherently spatially dependent, and so the effects of one homeowner's financial distress are likely to be borne at least in part by nearby homeowners. Identifying these spatial aspects has attracted considerable recent attention. Much of this work has attempted to measure the spillover effect of one homeowner's *mortgage foreclosure* on nearby properties, and in a review of this literature Lee (2008) concludes that this mortgage foreclosure effect is significant, ranging between a 0.9 percent to 8.7 percent reduction in the sales price of nearby properties.[1]

However, the spillover effects from other types of homeowner financial distress are not as well understood, such as distress related to *property tax delinquency*. Property tax delinquency can occur on all properties, regardless of mortgage status. In fact, examining only spillovers from mortgage foreclosures leaves out the potential for spillovers from other types of financial distress on the 25 million housing units (34.3 percent of all owner-occupied homes) that do not have a mortgage (American Community Survey, 2012). Property tax delinquency is unique in that it may occur after a mortgage is paid off, or when financial distress is less severe than distress that may lead to foreclosure. Since property tax payments are usually due once or twice per year, the timing of delinquent property tax payments may also indicate a different level or form of distress than delinquent mortgage payments, which are typically due each month. However, the spatial effects of property tax delinquency are not as well understood.[2]

This paper examines the impact of property tax delinquency on the sales price of nearby residential properties, an effect that we call the "delinquency discount". We use a sample of

[1] Among a large and growing literature on foreclosure effects, see Immergluck and Smith (2006), Schuetz et al. (2008), Campbell et al. (2011), Towe and Lawley (2013), Anenberg and Kung (2014), and Fisher et al. (2015). See especially Harding et al. (2009) and Hartley (2010).

[2] However, as discussed later, see Simons et al. (1998), Whitaker and Fitzpatrick (2012), and Gillen (2013).

34,500 home sales and the population of delinquent properties for Chicago, Illinois during the period 2010 to 2013. As has been demonstrated with other spatial spillovers (Campbell et al. 2011), we expect the effect of property tax delinquency to dissipate with distance, so we focus on the delinquency discount for properties within the same census block. We also examine the effect of delinquency duration on neighboring properties, as this measures the level of their financial distress. We estimate the magnitude of the delinquency discount using several alternative estimation methods, in each case controlling for local foreclosure activity. Our preferred method is a matching estimator similar to that used in McMillen (2012), as it works to eliminate the potential for omitted variable bias that is common in this type of estimation.

We find large, negative, and statistically meaningful effects of delinquent properties for which the local government has placed a tax lien and has put the lien up for sale to private investors. For properties with a tax lien that are not successfully sold, we estimate a negative spillover of 5.1 percent ($12,872) on surrounding properties. Properties with a tax lien that are sold to private investors have a smaller, but still negative impact on surrounding property values of 2.5 percent ($6310).

The remainder of the article is organized as follows. We first provide more background on the delinquency process coupled with a literature review. The discussion of the methodology is in the third section. The fourth section describes the data, and the results are presented in the fifth section. We conclude in the final section.

2. Understanding Property Tax Delinquency

Property tax delinquency affects local governments' ability to provide services to its residents. Further, collection of unpaid property tax bills is costly both administratively and

financially. Excessive delinquent property tax balances during economic downturns exacerbate these costs. For example, in 2013 Detroit experienced a property tax delinquency rate of 48 percent (Alm et al., 2015), making budgeting for local public services difficult, while Philadelphia in 2011 experienced a property tax delinquency rate of 19 percent with an uncollected balance of $472 million (Kekstra, 2011). Localities apply penalties when taxpayers are late with their property taxes, and in persistent cases of delinquency governments may force the transfer of ownership to recoup some costs of delinquency. Regardless, local governments must often cut services or raise taxes to cover the revenue shortfall from unexpectedly high rates of property tax delinquency (Miller, 2013).

Using sample data from Chicago, Illinois, we focus on how the county collects and penalizes property tax delinquency. It should be recognized that each local government with a property tax may handle delinquent properties differently (Anderson and Miller, 2015). Therefore while property tax delinquency is not unique to Chicago, the results of this study are characterized by the situation in Chicago. The generalizability of these results to other cities is not warranted, but the comparison of these results with previous literature may provide an indication of severity.

2.1. Types of Property Tax Delinquent Properties

We define four types of property tax delinquent properties, each of which corresponds with the duration of delinquency. The duration of delinquency is an important consideration as length of time signals the strength of financial distress of the homeowner.

Property taxes are due twice a year in Chicago. The first installment is due every year on the first business day of March. The second installment due date varies each year, but is typically 6 to 9 months after the first installment. The county publishes information on properties with an

unpaid balance after the second installment in the local newspaper. We define this first type of delinquent properties as "certified" delinquent properties. An owner of a certified delinquent property pays the balance due prior to the following tax lien sale.

The county holds a tax lien sale annually, and the sale typically occurs 7 to 9 months after the second installment due date. A tax lien sale is the sale of delinquent property taxes by a local government to private investors. When a taxpayer becomes delinquent, the local government places a lien against the property, which represents a collateralized receivable but does not give direct ownership of the property. We define the types of properties that are delinquent at the time of the tax lien sale as either "sold" or "unsold" delinquent properties. A sold property is one where the lien is sold to an investor; an unsold property is unsold at the tax lien sale.

The unsold properties that continue to be delinquent are offered at the bi-annual scavenger sale. We label this fourth type of delinquent property as "tax foreclosure". The total duration of delinquency at this point is three years or longer. These properties are by statute eligible for tax foreclosure.

Figure 1 provides a visual representation of these four types of delinquency: certified, sold, unsold, and tax foreclosure.

2.2. Previous Literature

Spillover effects are not new in urban real estate markets; these negative externalities can arise from mixed land use (McMillen and McDonald, 2002), forced sales (Campbell et al., 2012), or housing vouchers (Galster et al., 1999). Examining more closely financial distress as a cause, several studies have identified the effect of *mortgage foreclosure* on nearby properties (Lee, 2008).[3] The studies are informative, but they largely ignore homeowners in financial

[3] See also the many references in Note 1.

distress who are without a mortgage or homeowners in financial distress who are not delinquent on their mortgage payment. It is these homeowners upon whom we focus.

To our knowledge, there are only three studies that directly estimate what we have termed the delinquency discount. These studies generally find a significant negative relationship between the concentration of property tax delinquent properties and the sales price of nearby properties. Using property tax delinquency data from Cleveland for the years 1992 through 1994, Simons et al. (1998) find that a 1 percentage point increase in property tax delinquent properties decreases residential sales prices in the "nearby area" by 2.245 percent. This study suffers from spatial consistency as the "nearby area" is defined as property on the same page as the auditor's map book. Whitaker and Fitzpatrick (2012) examine Cleveland home sales between 1 April 2010 and 20 June 2011, and they find that tax-delinquent recent foreclosures reduce the sales price of nearby homes by as much as 7.6 percent. They also find evidence that the effect of nearby foreclosures is overestimated when nearby tax delinquent and vacant properties are not considered.

Gillen (2013) focuses on Philadelphia. He finds that each additional delinquent property within 500 feet of the sale (fewer than five delinquent properties in total) is associated with a 0.218 percent reduction in the sales price. He addresses the potential endogeneity between property tax delinquency and home prices by implementing an event study strategy that disentangles changes in the local price trend and changes in the number of nearby delinquent properties. He also estimates a nonlinear relationship between home prices and nearby delinquent properties. His estimates indicate that beyond the first 5 delinquencies each additional delinquency is associated with a 1.089 percent decline in the sales price; after 15 delinquencies,

Gillen (2013) finds that each additional delinquency is associated with a 0.451 percent decline in the sales price.

We improve upon the previous literature in three important ways. First, we empirically estimate the effect of nearby delinquent properties on sales price while controlling for the duration of delinquency. Second, assuming that observables are correlated with unobservables, we control for selection based on observables and reduce the potential bias from missing variables by using a matched sales technique based on McMillen (2012) that improves the precision of the estimate. Third, we estimate the delinquency discount while controlling for the local incidence of foreclosures. These three improvements tighten the estimate of the delinquency discount.

2.3. Mechanisms

Some mechanisms through which delinquency and the duration of delinquency may affect nearby house values include lack of maintenance, loss of social connectivity, or home abandonment. While we do not differentiate the importance of each mechanism in our estimates, the magnitude of the delinquency discount for different types of delinquent properties indicates that one mechanism is more likely (or more influential) than the others.

Since delinquent property taxpayers have limited financial resources, their ability to maintain their property is reduced significantly. If this effect is compounded by additional nearby homeowners suffering financial distress, neighborhood blight is likely to cause a delinquency discount. Alternatively, the decision to become delinquent may be a signal of property abandonment. Homeowners vacating properties induce a large strain on the social atmosphere of the neighborhood. As the social connectivity of the residents falls, the delinquency discount

increases. Additionally, vacant properties attract crime (Spelman, 1993), and rising crime rates may depress the value and reduce the attractiveness of a nearby property.

Further, when blighted and/or vacant properties are put up for sale or auction, this increases the supply of available houses. The increased supply leads to lower prices, and, when these properties are sold, the sales put further downward pressure on the valuation of nearby properties. These are some of the same causal pathways through which foreclosure negatively affects nearby housing values (Lee, 2008).

These causal pathways may be a function of the duration of delinquency. Harding et al. (2009) find that the longer a homeowner is delinquent on mortgage payments the larger the foreclosure discount on nearby properties. We argue that the estimated delinquency discount should also increase with the duration of delinquency. If property neglect or neighborhood blight increases with the duration of delinquency, we expect the delinquency discount from tax foreclosure eligible properties to be the largest followed by unsold, sold, and certified properties.

The relationship between sold and unsold properties does not depend on the duration of delinquency but rather the condition of delinquent properties. Prior research by Miller and Nikaj (2013) and Miller (2014) finds that the probability of a tax lien selling at auction depends on the investors' estimates of the property's market value. Investors are unwilling to purchase liens against properties that are seriously neglected. These properties require significant repairs in order to resell or rent. Since an unsold property may require a larger investment than a sold property, we expect the delinquency discount from nearby unsold properties to be larger.

3. Methodology

We use several methods to determine the size of the delinquency discount. The first applies a standard hedonic estimation method to our entire sample of properties. A second method constructs a matching sample, and estimates the impact of delinquency on the full matching sample and also on a sample that includes only repeat sales. These methods provide estimates of the implicit or shadow prices for each characteristic of the property and location. We are particularly interested in the delinquency discount, or the implicit price for the count of nearby delinquent properties. We calculate counts of delinquent properties within the Census Block of a delinquent property, as we expect the discount to be present mainly for such nearby properties.[4] Likewise, the delinquency discount should vary with the duration of delinquency, so we measure each type of delinquency within the Census Block.

The standard log-linear hedonic model controls for a set of observed characteristics at the property and/or neighborhood level. Following Rosen (1974), we estimate an expanded version of the standard log-linear hedonic specification;[5]

$$\ln(P_{ij}^{t}) = \alpha + \sum_{d=1}^{4} \beta_d N_{id} + \Omega' Z_i + \lambda F_j^t + \gamma^t + \theta_j + \gamma^t * \theta_j + \varepsilon_i^t \qquad (1)$$

In equation (1), the dependent variable P_{ij}^{t} is the natural log of sales price of property i in neighborhood (measured by Census Block) j at time t. The responding variable N_{id} is the number of nearby delinquent properties for property i with duration of delinquency d. The delinquency discount by duration is quantified by the estimates of β_d. Each property i is also described by a vector of observable time invariant characteristics (Z_i) and the public use microdata area

[4] Note that we have also estimated the impact of delinquent properties within 660 feet and between 661 and 1320 feet of the delinquent property. The assignment of nearby properties using concentric rings is consistent with much of the literature. Immergluck and Smith (2006) use the same size rings to estimate the Chicago foreclosure discount. Harding et al. (2009) use 4 rings: up to 300 feet, 301-500 feet, 501-1,000 feet, and 1,000-2,000 feet. Their results suggest that by the fourth ring the impact goes to zero. In addition, 660 feet by 660 feet is a good approximation of a city block in Chicago (Ahlfeldt and McMillen, 2014).

[5] This technique is similar to Simons et al. (1998).

foreclosure rate at time t (F_j^t).[6] The set of implicit prices for the observable characteristics is given by the vector $\mathbf{\Omega}$ while a version of the foreclosure discount is given by λ. We include fixed effects for quarter of sale γ^t to control for unobservable changes in the housing market over time. We also include neighborhood fixed effects θ_j to capture unobserved characteristics constant over time and an interaction term of quarter of sale and neighborhood. The random error term is denoted ε_i^t.

The hedonic specification has two main advantages. The first is estimating multiple implicit prices for the observable characteristics of the property and location. The second is that this technique retains a large sample size leading to increased efficiency of the estimands. However, the specification does have several weaknesses. The model requires specifying a functional form that may not be the appropriate form, it may suffer from unobservable characteristics or omitted variable bias that fixed effects may not fully capture, and it does not directly address the simultaneity concerns between property tax delinquency and home prices. Even so, the hedonic specification provides a useful benchmark for the delinquency discount.

An alternative, and our preferred, approach uses a matching technique to construct a more consistent data set, to which we then apply different estimation methods. The starting point is to construct a matched pair data set. We pair each transaction in the first period to a similar transaction in each of the subsequent periods, thereby creating a smaller sample than the full sample but also a more consistent sample (conditional on observable characteristics) over time.[7] We use propensity score matching to select the pair of each transaction, basing the match on all

[6] We include a standard set of controls including number of bedrooms, number of bathrooms, presence of a fireplace, garage size, age of home, distance from the central business district (measured as straight line distance to the intersection of State and Madison), and indicators of being close to transit, Lake Michigan, and rail lines.
[7] There were 2,046 transactions in the first quarter of 2010. We pair each of those transactions without replacement to the transactions in the subsequent 15 quarters. We end with 30,021 observations due to some imperfect matches and quarters with fewer than 2,046 transactions. This corresponds to 27,955 pairs, as the first quarter transactions are not paired to themselves.

of the property and location characteristics found in the hedonic method. McMillen (2012) pioneered this approach to better estimate local price indices, and he provides a detailed description of implementing the technique.[8]

We use the matched pair data set to calculate the delinquency discount, and we apply the standard hedonic approach of equation (1) to this matched pair data set. This method provides a significant efficiency gain over only looking at matched pairs of the same house (repeat sales). With the added observations and the inclusion of controls for observable characteristics, we are able both to gain precision and to avoid a major concern of repeat sales estimation (e.g., the home may have been renovated between transactions). As emphasized earlier, our matching method also controls for selection based on observables and reduces the potential bias from missing variables, under the reasonable assumption that observables are correlated with unobservables.[9]

We also use a restricted version of this matched pair data set, in which we use only repeat sales in the estimation. The repeat sales strategy examines only those homes that have sold more than once. This method can be derived from a similar estimating equation as the hedonic specification with one fundamental change, differences:

$$\ln(P_{ij}^{\tau} / P_{ij}^{t}) = \sum_{j=1}^{19} \mu_j D_{i,j} + \sum_{d=1}^{4} \beta_d (N_{id}^{\tau} - N_{id}^{t}) + \lambda (F_j^{\tau} - F_j^{t}) + \varepsilon_i^{t,\tau} \qquad (2)$$

[8] The matching pair technique is also more flexible than either the hedonic or repeat sales specifications in that the later focus on changes over time in mean prices whereas the matching technique can characterize changes in price levels throughout the full distribution. Deng et al. (2012) use this flexibility to calculate price indices across the full distribution of prices for Singapore from 1995-2010.

[9] Also, we modified the matching technique to take into account a delinquency dimension. We match housing transactions that had zero nearby delinquencies with similarly observable homes that sold and had nearby delinquencies. Unfortunately, our current dataset does not provide enough observations with similar observable characteristics to perform this match well, and we are left with roughly 1000 observations from which we could not estimate any statistical significance after controlling for the standard set of observables.

The dependent variable in equation (2) is the natural log of the ratio of transaction price at time τ to sales price at time t, where τ>t. D is the standard indicator matrix that identifies transaction date. As before, the coefficients of interest are β_d, which describe the delinquency discount by duration of delinquency. Since the foreclosure rate varies over time, we include the difference in the foreclosure rate at time τ and time t.

Note that this estimating equation is similar to the specification that Harding et al. (2009) use to identify the causal impact of additional foreclosures on sales price. They point out that by simultaneously estimating a local price trend μ and the impact of nearby foreclosed properties, the bias is removed from the estimates of the foreclosure discount.[10] We employ the identical strategy, but we use it to measure the delinquency discount. This strategy assumes that the size of the discount is constant over time and that the effect is linear in additional delinquent properties.[11] Note also that by differencing the repeat sales method applied to the matched pair data set removes all time invariant characteristics (both observable and unobservable) of the property and location.[12] This is one advantage of this strategy, but it comes at some cost, mainly a smaller sample size. The full matched pair data set provides a larger sample size than the repeat sales method.

4. Data

The transaction data in Chicago has been compiled from multiple sources by the Institute for Housing Studies (IHS) located in the Real Estate Center at DePaul University. We use the residential transaction data for Chicago from 2010 to 2013. IHS manages an extensive collection

[10] Assuming the difference in number of foreclosed (or delinquent) properties is not correlated with the error term.
[11] The linear assumption is tested below with a quadratic specification as a robustness check.
[12] The technique also assumes the implicit prices of those attributes are constant over time. If either of these two assumptions does not hold then the repeat sales estimation suffers from omitted variable bias, similar to the hedonic approach.

of housing data from Cook County, Illinois including transaction level property sales. The data include transaction price and date as well as the following housing characteristics: number of bedrooms, number of bathrooms, a fireplace indicator, number of garage spaces (up to two spaces), and age of building. Also, the data include for each property sold the property identification number (PIN). We use the PIN to determine the physical location of each property and use ArcGIS to geo-code all transactions.

IHS cleaned the data of outliers that do not appear to be arm's length transactions by matching the multiple listing service (MLS) provided by Midwest Real Estate Data LLC. and the recorder of deeds via Property Insight Inc. Using the matching process, potential data entry errors, unpredicted depreciation, total renovation, or fraud that may bias the estimate of the delinquency discount are mitigated.

We use the foreclosure data compiled by IHS court data provided by the Property Insight and the Record Information Service (RIS). We calculate the annual single family foreclosure rates by public use microdata area (PUMA) in the city of Chicago. The universe count of the total number of single family properties in each area is based on the Cook assessors' office data.

The Cook County Treasurer's Office supplied property tax delinquency data from 2010 to 2013. The Treasurer's Office list includes every delinquent property in the city of Chicago and the duration of delinquency by tax year. Additionally, the delinquency data include PINs which we use, similar to the transaction data, to determine the physical location of the property.

In Table 1, we present summary statistics for the full sample and the matched sample. The full data set includes 34,644 observations, and the matched pair data set has 30,021 observations. Housing characteristics for both samples are similar in mean and standard deviation. The average home sold over the sample period had about three bedrooms and two

bathrooms, and 86 percent of transactions included at least a one car garage. The homes are located on average 8.7 miles from the central business district (the intersection of State and Madison streets), and are about 63 years old. The average home sold had over 4 certified delinquent properties and over 3 sold delinquent properties within the Census Block. The average number of unsold delinquent properties is 1.401 for the full sample and 0.477 for the matched pair sample; the average numbers of tax foreclosure delinquent properties are 0.475 and 0.184 for the full and matched pair samples, respectively.[13] The matched sample includes 28,058 transactions across its 30,021 observations. This illustrates one benefit of using the matched sample versus the repeat sales sample (e.g., a larger sample).

5. Results

5.1. Full Sample Log-Linear Hedonic Estimates

We estimate equation (1) with three different specifications. In the first specification, we exclude the four property tax delinquency variables. In the second specification, we incorporate the delinquency effects of properties within the Census Block. In the third specification, we also include the vacancy count with the Census Block. In all specifications, we include the standard hedonic variables that capture the observable property and location characteristics. All specifications also control for the foreclosure rate at the public use microdata area. Lastly, in an attempt to control for the unobservable characteristics, we use census tract and quarter of sale fixed effects.

Table 2 presents the estimation of the log-linear hedonic specification. The results of specification (2) imply that property delinquencies of the shortest ("certified") and the longest ("tax foreclosure") duration have no significant impact on property prices within the Census

[13] The total amount of taxes owed by these delinquent properties is approximately $14,500.

Block. The former effect is likely because of the short period in which these certified properties are allowed to have an impact; the latter effect is likely because we only observe these tax foreclosure properties twice, or once every two years, so that when we observe these properties they are already 3 or more years delinquent. In contrast, "sold" delinquent properties generate a delinquency discount of -2.8 percent, and "unsold" delinquencies generate a comparable discount of -2.7 percent. Given the average sales price, these estimates imply a delinquency discount of about -$6600. The results of specification (3) are similar, if slightly smaller. In all three specifications, we find evidence that additional tax foreclosure properties ("Foreclosure rate") within the Census Block decrease sales prices by over 20 percent. The standard hedonic variables are uniformly significant, with the usual effects.

The results from the log-linear hedonic specification are consistent with the prior literature and provide a benchmark for comparison. However, the hedonic specification does not directly address the simultaneity issue.

5.2. Matched Pair Data Set Estimates

Table 3 provides the matched pair data set estimates from the log-linear hedonic regressions using the same three specifications as in Table 2. Once again, the results of specification (2) imply that property delinquencies of the shortest and the longest duration have no significant impact on property prices within the Census Block, for similar reasons as before. Also, "sold" delinquent properties generate a delinquency discount of -2.9 percent (specification 2) to -2.5 percent (specification 3), while "unsold" delinquencies generate a somewhat larger discount of -5.3 percent to -5.1 percent. Given the average sales price of the matched pair data set, these estimates imply a delinquency discount that ranges from -$6310 to -$13,377. Other variables have similar effects as well. For example, in all three specifications additional tax

foreclosure properties ("Foreclosure rate") within the Census Block again decrease sales prices by about 20 percent, and the hedonic variables again have similarly significant.

Table 4 presents the estimation results from the repeat sales regressions using the matched pair data set. Now all four delinquency variables have negative and statistically significant impacts on ratio of the recent sales price to the prior sales price. Similarly the foreclosure rate also has a negative and statistically significant impact. (Remember that unchanging property characteristics are not included in the regressions due to differencing.)

5.3. Summary and Robustness Tests

The estimates in Tables 2, 3, and 4 uniformly suggest that increases in the duration of delinquency increase the delinquency discount, at least for intermediate time lags of delinquency (between1 to 3 years). The discount structure is suggestive that blight is a significant mechanism driving the discount.[14]

These results are also consistent with the mechanism of additional housing supply and reduced valuation. Homeowners under financial distress for longer periods may be forced into selling their homes. This increases the local housing supply available to buyers pushing down the price. These properties are also maintenance-deprived, which when sold reflects on nearby homes through comparable sales.

Aside from the repeat sales matched pair estimates, we have also estimated other specifications as robustness tests. For example, we estimated a second order polynomial form of equation (2) for the matched pair data set (including the smaller repeat sales data set), with largely unchanged results. We also attempted to apply the approach used by Campbell et al. (2011) to estimate the foreclosure discount. However, they had daily data, while our data are

[14] This assumes that blight increases with duration of delinquency. It may be that the property is improved by the city once foreclosure is assessed. Maintenance (such as yard work) or demolition may occur quickly at this stage.

yearly, so that we did not find any significant impacts of delinquency using their approach. Finally, we also used an alternative data set on foreclosures that contains proprietary foreclosure data from RealtyTrac. These data report foreclosure "activity" in terms of foreclosure legal filings and notices on a zip code basis, and we measured foreclosure activity using RealtyTrac's "notice of trustee sale" counts. These data are only for 2010-2011, which reduces the sample size. Even so, our basic results are unaffected by the source of the foreclosure data.

6. Conclusions

In this analysis, we improve upon the previous literature in three important ways. First, we empirically estimate the delinquency discount while controlling for the duration of delinquency. Second, we use the matched pair sales technique of McMillen (2012) to control for selection based on observables and to reduce the potential bias from missing variables. Third, we estimate the delinquency discount while controlling for foreclosure rates.

Our estimation results across our various methods clearly indicate a significant "delinquency discount" on nearby home prices. In our preferred specification, we find the discount of one additional property that has become delinquent within about 1 to 3 years within the Census Block has negative and significant impacts on nearby properties of -2.5 percent for sold delinquencies and -5.1 percent for unsold delinquencies. These estimates imply that the delinquency reduces the average home price between -$6310 and -$12,872. These results provide local governments with a more complete estimate of the cost of property tax delinquency. We also find that mortgage foreclosure has a negative impact on housing prices.

Our results highlight the importance of extending the discussion of financial distress among homeowners beyond foreclosure. The literature examining the many negative effects of

mortgage foreclosures is extensive, examining such factors as childhood outcomes (Been et al., 2011), health outcomes of homeowners (Pollack and Lynch, 2009), and the foreclosure discount (Immergluck and Smith, 2006). The harmful effects of property tax delinquency are likely to be highly correlated with mortgage foreclosure.

By focusing on the foreclosure crisis, policymakers have neglected homeowners without a mortgage. Over 25 million housing units, or 34.3 percent of owner-occupied housing units, did not have a mortgage in 2012, and these homeowners without mortgages are not immune to economic downturns. Examining the social cost of property tax delinquency provides a more complete picture of the housing market collapse. This study helps in that pursuit by confirming the existence of a delinquency discount in Chicago. The results can be used to design policies that mitigate the social cost of property tax delinquency as well as to spur additional research on the social cost of property tax delinquency.

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Figure 1: Phases of delinquency.

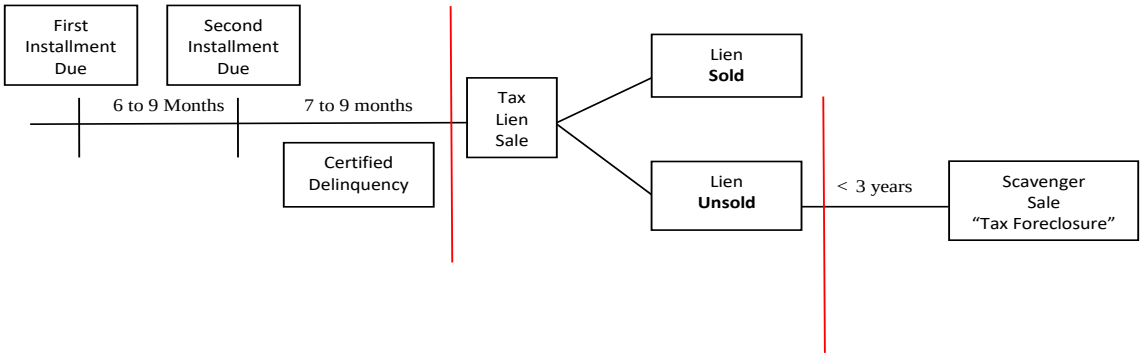

Table 1: Descriptive statistics.

	Full sample		Matched Sample	
Variable	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
Sales price	$ 244,239	$ 370,297	$ 252,393	$ 373,283
Log of sales price	11.758	1.185	11.856	1.098
Certified delinquent properties within Census Block Group	4.924	2.503	4.620	4.359
Sold delinquent properties within Census Block Group	3.539	2.351	3.241	3.616
Unsold delinquent properties within Census Block Group	1.401	3.056	0.477	1.736
Tax foreclosure delinquent properties within Census Block Group	0.475	1.196	0.184	0.545
Bedrooms	3.377	0.938	3.384	0.939
Bathrooms	2.063	0.895	2.090	0.901
Fireplace	0.907	0.291	0.905	0.293
Garage, 1 car	0.116	0.321	0.121	0.326
Garage, 2 car	0.753	0.431	0.765	0.424
Distance from city center (in miles)	8.742	2.856	8.728	2.780
Within 1/4 mile of EL stop	0.053	0.225	0.056	0.229
Within 1/2 mile of Lake Michigan	0.016	0.126	0.017	0.130
Within 1/4 mile of rail line	0.105	0.307	0.108	0.311
Age of house at time of sale	63.671	38.317	62.253	37.876
Foreclosure rate	2.798	1.174	2.843	1.151
Vacancy count within Census Block Group	1.244	2.345	0.772	1.278
Observations	34,644		30,021	

Notes: These data represent residential (up to 6 units) sales transaction data for Chicago area between 1 January 2010 and 31 December 2013. The matched sample applies McMillen's (2012) matching technique to produce a pseudo repeat sales data set. Foreclosure rate corresponds to the yearly ratio of foreclosed properties to households at the Public Use Microdata Area.

Table 2: Log-linear hedonic regressions.

Specification	(1)		(2)		(3)	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Property tax delinquency effects						
Within Census Block Group						
Certified delinquent properties			-0.001	0.002	0.001	0.002
Sold delinquent properties			-0.028***	0.003	-0.025***	0.003
Unsold delinquent properties			-0.027***	0.003	-0.023***	0.003
Tax foreclosure properties			0.007	0.007	0.005	0.006
Property characteristic, location, and foreclosure effects						
Number of bedrooms	0.035***	0.006	0.040***	0.005	0.041***	0.005
Number of bathrooms	0.338***	0.011	0.331***	0.011	0.331***	0.011
Fireplace	0.034***	0.010	0.033***	0.009	0.032***	0.009
Garage, 1 car	0.351***	0.020	0.304***	0.015	0.302***	0.015
Garage, 2 car	0.420***	0.019	0.372***	0.014	0.370***	0.014
Age of house at time of sale	0.006***	0.001	0.005***	0.001	0.005***	0.001
Age squared	-0.000***	0.000	-0.000***	0.000	-0.000***	0.000
Distance from city center	0.039	0.027	0.036	0.024	0.034	0.023
Within 1/4 mile of EL stop	-0.001	0.030	-0.005	0.029	-0.006	0.029
Within 1/2 mile of Lake Michigan	-0.044	0.101	-0.039	0.087	-0.029	0.086
Within 1/4 mile of rail line	0.088***	0.024	0.094***	0.024	0.094***	0.023
Foreclosure rate	-0.247*	0.131	-0.209*	0.114	-0.224**	0.113
Vacancy count					-0.026***	0.003
Constant	11.456***	0.460	11.490***	0.402	11.543***	0.399
Community fixed effects	Yes		Yes		Yes	
Quarter fixed effects	Yes		Yes		Yes	
Quarter*Community fixed effects	Yes		Yes		Yes	
N	34,644		34,644		34,644	
R^2	0.808		0.820		0.821	

Notes: The dependent variable is the natural log of the sales price. The property tax delinquency effects are measured in number of delinquent properties within the Census Block Group for each residential sales transaction in Chicago. Certified tax delinquent properties are those listed by the municipality to have not paid at least one installment of the property tax owed. Unsold delinquent properties are those listed in the municipality's tax lien sale for missing at least one property tax payment and the tax lien was offered but not sold at the sale. Sold delinquent properties are those listed in the municipality's tax lien sale for missing at least one property tax payment and the tax lien was sold at the sale. Tax foreclosure properties are those for which the property tax has not been paid for two years or longer and the property is eligible for tax foreclosure. Age squared is also included in all of the specifications and returns a negative and significant result; The average age at which dwellings begin to lose value is approximately 35 years. Foreclosure rate corresponds to the yearly ratio of foreclosed properties to households at the Public Use Microdata Area. Vacancy count is the number of vacant/abandoned residential properties within the block group as reported by the City of Chicago.

Table 3: Matched sample - Log-linear hedonic regressions

Specification	(1)		(2)		(3)	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Property tax delinquency effects						
Within Census Block Group						
Certified delinquent properties			0.000	0.002	0.002	0.002
Sold delinquent properties			-0.029***	0.003	-0.025***	0.003
Unsold delinquent properties			-0.053***	0.005	-0.051***	0.004
Tax foreclosure properties			-0.002	0.014	-0.003	0.013
Property characteristic, location, and foreclosure effects						
Number of bedrooms	0.044***	0.005	0.046***	0.005	0.047***	0.005
Number of bathrooms	0.333***	0.011	0.327***	0.011	0.326***	0.011
Fireplace	0.029***	0.010	0.025***	0.010	0.025***	0.010
Garage, 1 car	0.325***	0.019	0.292***	0.017	0.289***	0.017
Garage, 2 car	0.393***	0.017	0.360***	0.015	0.356***	0.015
Age of house at time of sale	0.005***	0.001	0.005***	0.001	0.004***	0.001
Age squared	-0.000***	0.000	-0.000***	0.000	-0.000***	0.000
Distance from city center	0.052**	0.026	0.046**	0.023	0.042*	0.023
Within 1/4 mile of EL stop	0.009	0.031	0.009	0.031	0.005	0.031
Within 1/2 mile of Lake Michigan	-0.018	0.097	0.004	0.081	0.022	0.077
Within 1/4 mile of rail line	0.083***	0.025	0.091***	0.024	0.094***	0.024
Foreclosure rate	-0.246*	0.133	-0.193*	0.114	-0.215*	0.110
Vacancy count					-0.045***	0.005
Constant	11.339***	0.455	11.364***	0.397	11.450***	0.390
Community fixed effects	Yes		Yes		Yes	
Quarter fixed effects	Yes		Yes		Yes	
Quarter*Community fixed effects	Yes		Yes		Yes	
N	30,015		30,015		30,015	
R^2	0.797		0.807		0.809	

Notes: The dependent variable is the natural log of the sales price. The property tax delinquency effects are measured in number of delinquent properties within a given distance from residential sales transactions in Chicago. Certified tax delinquent properties are those listed by the municipality to have not paid at least one installment of the property tax owed. Unsold delinquent properties are those listed in the municipality's tax lien sale for missing at least one property tax payment and the tax lien was not sold at the sale. Sold delinquent properties are those listed in the municipality's tax lien sale for missing at least one property tax payment and the tax lien was offered but not sold at the sale. Tax foreclosure properties are those for which the property tax has not been paid for two years or longer and the property is eligible for tax foreclosure. Age squared is also included in all of the specifications and returns a negative and significant result; The average age at which dwellings begin to lose value is approximately 34 years. Foreclosure rate corresponds to the yearly ratio of foreclosed properties to households at the Public Use Microdata Area. Vacancy count is the number of vacant/abandoned residential properties within the block group as reported by the City of Chicago.

Table 4: Matched sample – Repeat sales regressions.

Specification	(1)		(2)	
	Coefficient	**Standard error**	**Coefficient**	**Standard error**
Property tax delinquency effects				
Within Census Block Group				
Certified delinquent properties	-0.023***	0.002	-0.021***	0.002
Sold delinquent properties	-0.087***	0.003	-0.075***	0.003
Unsold delinquent properties	-0.086***	0.006	-0.078***	0.006
Tax foreclosure properties	-0.063***	0.014	-0.062***	0.013
Foreclosure rate	-0.442***	0.011	-0.460***	0.010
Vacancy count			-0.146***	0.008
N	27,955		27,955	
R^2	0.556		0.569	

Notes: The dependent variable is the natural log of the ratio of sales price, recent to prior. The property tax delinquency effects are measured as the difference (second sale minus first sale) in the number of delinquent properties within the Census Block Group of a residential sales transaction in Chicago. Certified tax delinquent properties are those listed by the municipality to have not paid at least one installment of the property tax owed. Unsold delinquent properties are those listed in the municipality's tax lien sale for missing at least one property tax payment and the tax lien was offered but not sold at the sale. Sold delinquent properties are those listed in the municipality's tax lien sale for missing at least one property tax payment and the tax lien was sold at the sale. Tax foreclosure properties are those for which the property tax has not been paid for two years or longer and the property is eligible for tax foreclosure. Foreclosure rate corresponds to the yearly ratio of foreclosed properties to households at the Public Use Microdata Area. Vacancy count is the number of vacant/abandoned residential properties within the block group as reported by the City of Chicago.