The Land Value Gradient in a (Nearly) Collapsed Urban Real Estate Market

Timothy R. Hodge[1]
Gary Sands[2]
Mark Skidmore[3]

October 2014

Abstract

This paper uses data on thousands of vacant land sales to explore the pattern of land values in the City of Detroit. The analysis provides several insights, first of which is the documentation of a U-shaped land value gradient. Land values are relatively high in and near the central city (CBD), but the land value gradient is very steep; estimated land values drop precipitously to less than $1,000 for typical sized lot in vast the "donut" area surrounding the CBD. However, land values begin to rise near the city's border; higher land values there are associated with better access to suburban amenities such as shopping (largely unavailable in the city), and employment. The estimates highlight the importance of the peripheral neighborhoods to the property tax base; policymakers would do well to implement policies that help sustain these neighborhoods as well as continue efforts to revitalize highly valued CBD.

Key Words: Land Value Gradient, Vacant Land, Real Estate, Detroit

JEL Classifications: R00

Acknowledgements: We thank the Lincoln Institute of Land Policy for financial support. We also thank Fred Morgan of the City of Detroit Assessment Division for providing detailed parcel-level data and former Councilman Kenneth Cockrel for inviting us to work on this issue. Finally, we appreciate guidance from Daniel McMillen in the estimation of the locally weighted least squares regression.

[1] Department of Economics, Allegheny College, Quigley Hall 219A, Meadville, PA 16335; thodge@allegheny.edu.
[2] Urban Planning Program, Wayne State University, 1051 Hartsough Street, Plymouth, MI 48170-2143; gary.sands@wayne.edu.
[3] Department of Agricultural, Food and Resource Economics and Department of Economics, 91 Agriculture Hall, East Lansing, MI 48824; mskidmor@msu.edu.

I. INTRODUCTION

Its recent declaration of bankruptcy has brought the City of Detroit to the forefront in the media as well as among policymakers and researchers. Years of business and population exodus have resulted in thousands of parcels of vacant land, some of which are offered for sale every year. These vacant property sales provide an opportunity to explore the pattern of the land values across the city. The stylized monocentric city model generates a land value gradient that declines the further the parcel is from the CBD. While there are numerous examples of exceptions to this general framework in the real world, the model has been a very useful tool for urban economists.

Does a city that is in significant urban decline exhibit the land value gradient predicted by the monocentric city model? In this paper, we use data on thousands of vacant land sales to explore the spatial pattern of land values in the City of Detroit. While land within and near the CBD may still be highly valued, amenities such as shopping, now found only in the suburbs, lead may to higher prices on the city periphery where there is easier access so such amenities. As a prelude to our full analysis, we find that property values are relatively high near the CBD, but that the land value gradient is very steep; land values in the "donut" area around the city center are extremely low. However, our analysis also shows that land values increase near the adjacent suburbs along the city's borders.

In the next section, we offer a general discussion of economic and demographic realities in Detroit, as well as a detailed description of the Detroit real estate vacant land markets. Section 3 offers a summary of the literature on urban land value gradients and real estate in the context of a declining urban area. In section 4 we present our empirical framework and analysis, and section 5 concludes.

II. REAL ESTATE/VACANT LAND ENVIRONMENT IN DETROIT

Detroit's population decline, which began more than half a century ago, has been fueled by the loss of employment opportunities in the city. As shown in Table 1, the total number of jobs located in the city has fallen by more than half since 1970. In that year, there were twice as many jobs in Detroit as there were employed Detroit residents. By 2010, this ratio was just 1.7 due to a more rapid decline in the number of Detroiters with jobs. Job losses in the manufacturing sector have been particularly severe; the proportion of Detroit residents with manufacturing jobs, no matter where they were working, fell from 28.6 percent in 1980 (the year of peak employment for Detroiters) to 11.4 percent in 2010. These job losses had a heightened impact because of the higher wages typically paid in the manufacturing sector.

As Detroit's population declined from 1.85 million in 1950 to 714,000 in 2010, there was a corresponding decline in the demand for housing in the city. In 1960 there was a total of 533,000 housing units in Detroit, with a vacancy rate of just 5.7 percent (Table 2). Over the next five decades, the number of households dropped by half. Although the net loss in housing units during this period totaled almost 200,000, this decline was insufficient to offset the loss in households.[4] Residential vacancies in the city increased more than fourfold so that one of every four units was vacant. According to a 2009 survey by Data Driven Detroit (2010), there were over 90,000 vacant residential parcels in Detroit, 27 percent of all residential parcels.

The impacts of this ongoing decline were not limited solely to Detroit's residential areas. Since the early 1970s, the number of business establishments in the city (Table 3) fell by two-thirds. The steepest declines occurred in the manufacturing and wholesale trade sectors; over 80

[4] Throughout this period, there continued to be some new housing construction in Detroit. According to SEMCOG, the regional planning agency, Detroit issued permits for 21,400 new units between 1970 and 2014; the number of demolition permits for residential units was 186,800 during the same period.

percent of the businesses closed. Less than one-quarter of retail establishments remained open. Data from the United States Postal Service (2013) indicate that about 5,000 business properties remain vacant. The number of commercial movie theaters in Detroit has fallen to just two, from more than 120 in 1940.

There have also been draconian cutbacks in public services and facilities. The city has closed almost half of its recreation centers and swimming pools (Reese et al., 2014). Half of the city parks receive no services. Over the past two decades alone, the number of public schools fell from 261 to 97 (Dawsey, 2013). The number of public library branches has been reduced by one-third; the remaining branches have reduced service hours, some to just 26 hours per week. These trends have left large areas of the city almost completely devoid of amenities and basic services. Many Detroiters travel to the suburbs for shopping and other activities.

Figure 1 shows the geographic Distribution of vacant land in Detroit. Nearly all areas of the city have significant amounts of vacant land, about half of which is owned by the city or some other public entity. The areas with the lowest concentration of vacant parcels are in the northwest and northeast quadrants of the city.

Each year about one percent of the more than 90,000 vacant parcels are sold. These sales provide an opportunity to evaluate land value patterns. As a prelude to the econometric analysis, consider the land sales price per square foot (Figure 2). This map presents average sales price per square foot (Panel B) aggregated to the neighborhood level. The maps suggest a general pattern of higher value properties in and near the CBD and in the periphery, particularly in the northeast and northwest areas of the city. However, the "donut" area between the CBD and periphery has much lower land values.

Over time, the city and other public entities have accumulated thousands of parcels due to tax delinquency and abandonment (Alm, *et al.*, 2014). Currently, about 50 percent of property owners are delinquent on their property tax. In Michigan, county government is responsible to bringing tax foreclose proceedings on such properties. Tax foreclosed properties are offered for sale and many of these properties return to the tax paying private sector. However, about 80 percent of previously tax foreclosed properties which were returned to private ownership are again tax delinquent within two years (Detroit News, 2013). In addition, many of the undesirable tax delinquent properties are not resold, and thus become nontaxable publicly held properties. Currently, about 25 percent of Detroit's land area is publicly owned.

There is now a vast excess supply of land and that the city is now a dominant player in the Detroit land market. Thus, city policy makers are both influenced by and influence the land market. If demand for land were to increase and values were to begin to rise, the city has an incentive to offer more of its land for sale. However, the potential that the City could flood the vacant land market may inhibit land price recovery. Low prices and high public ownership in turn exacerbate fiscal challenges due to anemic property tax revenues. One objective of this research is to identify policy alternatives to help stabilize the land market and increase values in order to help the city and other overlying jurisdictions regain a more sustainable fiscal footing. With this overview of Detroit and its property market, we now turn to a review of the most relevant literature on urban decline/recovery and urban land value gradients.

III. LITERATURE REVIEW

We divide the literature review into two parts. In the first section, we discuss several articles on urban decline/renewal and land abandonment. The second section describes research that evaluates the determinants of land values in urban spaces. While the latter is more directly relevant to the present study, the discussion of the research on urban decline/renewal and land abandonment provides a useful basis for development of policies to address such challenges.

Urban Decline and Land Abandonment

We begin the discussion of urban decline by reviewing the research of Glaeser and Gyourko (2001), who consider the role of durable housing in urban decline. They suggest that changes in transport technology eliminated the advantages the "rust belt" cities once had. Changes in transportation technology, coupled with harsh climate of the Midwest, pushed both people and firms elsewhere. While manufacturing has declined throughout the United States for a variety of reasons, but Midwest cities were hit particularly hard. With the exodus of both jobs and higher income skilled wage earners, places like Detroit have been left with a reduced base of human capital and high rates of poverty.

For Glaeser and Gyourko (2001), the question is not why cities like Detroit struggle to recover; rather, the question is "why are they still there at all?" The researchers then make the case that while people and jobs leave the cities, the stock of durable housing remains for years, providing abundant low cost housing. Further, since housing supply is fixed in the short run, reduced housing demand results in a substantial reduction in prices. The remaining low cost housing stock tends to attract a relatively low skill, low income population; it is only when housing stock deteriorates as it ages that population really begins to decline. We have seen the general pattern described by Glaeser and Gyourko (2001) play out in Detroit. However, by 2010 vast tracts of dilapidated housing stock had been demolished, leaving more than 90,000 parcels of vacant land. What is to be done with this excess supply of land and what is the prognosis for the future of land values?

Rosenthal (2008) focuses on neighborhood level changes in economic status over long periods of time, documenting that over the 1950-2000 period roughly two-thirds of all low income neighborhoods in 36 Metropolitan Statistical Areas became higher income neighborhoods 50 years later. In contrast, over the same period most high income neighborhoods moved down the income ladder. Focusing on Philadelphia County, Rosenthal shows a typical neighborhood takes roughly 100 years to complete a full cycle of change up and down. For Rosenthal, urban decline and renewal is a long-run dynamic process in which the quality of housing stock plays a key role, with an aging housing stock causing a neighborhood's economic status to decline. Much of Detroit's housing stock emerged rapidly between 1910 and 1950 as manufacturing employment increased. Concurrent with the rapid decline in manufacturing jobs, many higher income families fled to the suburbs in search of new high quality housing stock and a higher quality of life. Today, much of the dilapidated housing stock in Detroit has been torn down—entire neighborhoods no longer exist. If one were to take a longer view, Rosenthal's work suggests that with a stable population in the Detroit region there is an emerging opportunity for redevelopment in the City of Detroit as the housing stock in the first-ring suburbs age, and there is the potential for new attractive housing to be built in large tracts of land in Detroit.

Turning more specifically to property abandonment, White (1986) considered the role of property taxes in the decision to abandon property in New York City. Using neighborhood level data on abandonment in the late 1970s, she finds that the abandonment rate is quite sensitive to property taxes; her estimates suggest that a one percent increase in property taxes leads to a 2.1 percent increase in abandonment. The role of property tax policy and practice in Detroit has also received some attention. Statutory tax rates in Detroit are roughly double the region-wide average. Further, evidence presented by Hodge, *et al*. (2014) indicates that some Detroit properties may be over-assessed by a factor of five. Alm, *et al*. (2014) examined the factors that have led to Detroit's exceptionally high rate of tax delinquency, currently about 50 percent. They show that both high tax rates and over-assessment are contributing factors to tax delinquency. They also provide some evidence that critical services, such as public safety, also play a role in delinquency (neighborhoods with longer police response times have a higher rate of tax delinquency, for example). In this context, it would seem that a critical issue in terms of positioning Detroit for future growth is to bring tax rates down so that they are more competitive as well as reduce assessments so that they are in line with state guidelines. Finally, improving key public services will also be important.

Thus far, we have considered the role housing stock plays in declining cities, and factors that contribute to property tax delinquency and property abandonment. While this discussion is essential for understanding the Detroit land market, our primary empirical objective in this paper is to estimate the determinants of land values, and thereby inform policies that may strengthen the Detroit land market. We now turn our discussion to the research on urban land values, beginning with the Muth-Mills monocentric city model.

Urban Land Value Gradient

The monocentric city model developed by Muth (1969) and Mills (1972) provides a baseline for understanding urban spatial structure. The model has been used extensively and has frequently been subject to empirical testing. And, while many researchers no longer consider the monocentric city model to be accurate depiction of modern urban spatial structure, McMillen (2006) notes that the central city still dominates urban spatial patterns in many cities: "Although the model is oversimplified, it remains a useful analytical tool, requiring only modest modifications to be remarkably accurate." In our empirical analysis, we use the monocentric city framework with some modifications to guide our analysis of Detroit land values.

These modifications are informed by our knowledge of the city as well as the work of several researchers. The first consideration is the acknowledgement that though the city center dominates many urban places, there are other driving forces that can influence land values. For example, Dubin and Sung (1987) consider rent gradients in non-monocentric cities; where households value access not only to the CBD, but to places other than the CBD. Similarly, research, such as that of Cheshire and Sheppard (1995) and Ahlfeldt (2010), shows accessibility to amenities and employment, which are not always located in the CBD, are also important determinants of land values. Finally, Colwell and Munneke (1997) demonstrate how the estimation of the land value gradient can be biased if one does not use a function that controls for parcel size because often times parcels tend to be larger the farther they are from the CBD.

In the case of Detroit each of these issues is relevant. Amenities such as shopping and employment opportunities are now found primarily in Detroit's suburbs. Thus, proximity to the suburbs or proximity to major roadways that provide easier access to the suburbs may play a key role in land values within the City of Detroit. Also, a number of dis-amenities exist in Detroit that may affect land values. We consider various abandoned and/or toxic sites in our evaluation; for example, proximity to the well-known Packard plant. Finally, our empirical specification is informed by Colwell and Munneke (1997) in that we include parcel size as an explanatory variable. With this review, we now turn our attention to estimating the determinants of land values in Detroit using detailed data on recent land sales.

IV. EMPIRICAL ANALYSIS

The framework we use to evaluate land values in the City of Detroit is a Cobb-Douglas land price function similar to that outlined by Colwell and Munneke (1997):

[1] $P_i = \beta A_i^{\gamma} c_i^{\delta}$

Where for parcel i, γ is the area (A) elasticity of price, δ is the rate at which price changes with distance to the center (c), and β is the price of the first unit of area (the first square foot of a parcel) at the center of the city. We expect a steep land value gradient in the area immediately surrounding the city center. We hypothesize that land values will begin to rise near the city borders as shopping and other amenities are available in the adjacent suburban communities. We therefore empirically test the following augmented land price function:

[2] $P_i = \beta A_i^{\gamma} c_i^{\delta} b_i^{\rho}$

where ρ is the rate at which the price changes with the distance to the nearest city border (b).

Data

The City of Detroit's Assessment Division provided parcel-level data for this research. The raw data include information for 444,183 real and personal property parcels, of which we focus on vacant land parcels. In total there are 93,786 vacant parcels, 47 percent of which are owned by the City of Detroit or some other public entity. We excluded these as well as a number of vacant parcels that were sold as part of a "bundle" of parcels; that is, the sale of the given parcel was included with one or more other properties. Importantly, a single sales price is recorded for all the properties included in the bundle; therefore it is not possible to determine the value of a particular parcel within the bundle. For this reason, we omitted 10,225 parcels from our evaluation. Finally, we also omitted all 2,235 industrial parcels from the analysis yielding a total of 81,326 residential and commercial parcels in our sample. Of these, 3,788 parcels, 4.6 percent, sold during the 2006-2010 period.

We focus on recently sold properties for two reasons. First, the sales prices of recently sold properties represent most current market values. This is particularly important given the real estate crisis. Second, given that there is a continual process of tearing down dilapidated housing stock, the further back one goes in time the more likely it is that the sales price reflects both land and structure at the time of sale. Summary statistics for all of the variables we consider are provided in Table 4, and more detailed definitions for all variables are provided in the Appendix.

Consider first the full sample of all 81,326 vacant parcels. About 43 percent of the vacant parcels are classified as residential, and 7 percent of the parcels are classified as commercial, respectively. The remaining properties are in non-taxable status with most of these held by the City of Detroit or some other public entity. Average state equalized value (which is one half of estimated market value) is just $2,155, but this figure is skewed by a few highly valued properties; median state equalized value is just $222. Similarly, the average lot size is very large at 256,707 square feet, but the median is just 3,485. Further, only 16 percent of the lots are larger than 5,000 square feet, which is the threshold for being "buildable" under the current zoning ordinance. About 60 percent of all privately owned vacant lots are tax delinquent. The average property is 2.2 miles from the city center and 5.6 miles from the nearest city border. Finally, note that in 2010, relatively few property sold. This is primarily due to the fact that our 2010 data include information for only part of the year.

Turning to the sample of parcels that actually sold during the 2006-2010 period, we see first that the mean price is high ($37,723), but the median sales price is just $811. In fact, as we discuss in more detail below, about a quarter of all sales were for less than $10. Finally, the vacant parcels that sold are, on average, closer to the city center and farther from the city border than the full sample. With this summary of the data, we now present our empirical analysis of the determinants of land values.

Econometric Issues

From equation [2], the basic empirical specification is

[3] $$lnP_i = ln\beta + \gamma lnA_i + \delta lnb_i + \rho lnc_i + N_j + T_t + e_i$$

with key variables A, b and c are defined above for parcel i, N is a vector of j (53 of 54) neighborhood indicator variables, T is a vector of t time indicator variables for the years in which the parcels was sold[5], and e is the error term. In addition, our regressions include a vector of control variables: indicator variables for whether or not the parcel is zoned *Residential* (yes=1, no=0) or *Commercial* (yes=1, no=0), an indicator variable for whether the parcel is large enough to be *Buildable* according to current zoning regulations (yes=1, no=0) and *Distance to Packard Plant*, which is perhaps Detroit's most notorious toxic abandoned manufacturing site.[6]

Ordinary Least Squares

We begin our analysis using an ordinary least squares (OLS) method with a correction to obtain robust standard errors. However, there are three complicating issues that we consider and address: truncation of land values on the left-hand side; over-dispersion of land values on the right-hand side; and potential sample-selection bias due to the fact that not all parcels are equally likely to be offered for sale. Consider first the issues of truncation and over-dispersion.

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[5] The omitted base year indicator is for 2006. The included time indicator variables are for 2007, 2008, 2009, and 2010.

[6] Detroit has many toxic sites, but not all are well-known and thus they may not affect sales prices. In addition to the Packard Plant we also considered distances to the following toxic/dilapidated sites: Detroit Train Depot, Carter Industrials, Federal Mogul, ChemServ Corp., Detroit Coke, Revere Copper and Brass, Marathon Oil Refinery, Koch Carbon, and Bellevue (Uniroyal). However, these sites were generally not significant determinants of land values in analyses using parametric approaches. See Thompson (2013) for a discussion of Detroit's toxic legacy. We also included an array of distance measure from a parcel to major roadways leading in and out of the city. Again, these measures were generally not significant predictors of land values and are therefore not included in parametric estimates that are presented in the paper.

As shown in Figure 3, there is truncation at the low side of the price distribution and potential skewness on the high side of the price distribution, though the high side skewness appears to be a minor issue when price data are expressed in natural logarithms. As can be seen in the figure, just over a quarter of land sale observations recorded a price of $10 or less. In some cases, this might reflect the dire market conditions that exist in some neighborhoods. Or, it may result from county government policy to set the price of a tax delinquent parcel to include back taxes owed as well as the agreed upon price. Unfortunately, information on recently sold parcels does not include the amount of back taxes due at the time of purchase. Thus, we do not observe the full price. In addition to truncation on the left side of the distribution, we also have a number of highly priced vacant land sales that may affect the coefficient estimates generated from ordinary least square analysis.

Truncation and Skewness

There exist empirical treatments for truncation such as a Tobit regression analysis. However, we also have some skewness on the high price end of the distribution as well. With ordinary least squares, exceptionally large values can substantially affect coefficient estimates, even if they represent only a small percentage of the total sample. We address these two problems simultaneously by implementing an interval regression procedure. The nature of truncation bias is that observations with positive error terms are disproportionately sampled. Treating low-valued observations as censored as does the interval regression procedure allows these observations to potentially take more negative values, which mitigates potential truncation bias. On the other side, treating high-valued observations as censored allows highly priced properties to be included in the sample, but mitigates the disproportionate impact due to their exceptionally large values. In our analysis, we treat any sales price observations outside the interquartile range as censored: that is, properties with sales prices of $200 or less, or $9,000 or more, are censored at the respective threshold values.[7] While somewhat *ad hoc*, an interval regression procedure is arguably an improvement over the standard OLS estimation that ignores these issues. We note that in the absence of truncation and skewness, both OLS and interval regression produce consistent coefficient estimates. Further, with both approaches we use procedures to obtain robust standard errors. We first present the OLS regression estimates and then the estimates from interval regression analysis.

Sample Selection Bias

Perhaps of greater concern is potential sample selection bias. While researchers such as McMillen (1991) and Colwell and Munneke (1997) have addressed sample selection in the context of zoning regulations, to our knowledge the existing literature has not addressed the idea that all parcels are not necessarily equally likely to be sold.[8] For example, in the case of Detroit, nearly half of vacant parcels are owned by a public entity; it may be that publicly owned parcels are less likely to be sold than privately owned parcels. Similarly, a large number of parcels are too small to develop according to current zoning guidelines, and may therefore be less likely to be purchased. The point is that there is potential sample selection bias, and failure to account for selection issues could generate biased estimates. Our data set includes all vacant land (sold and unsold) in Detroit as of 2010, and thus we are able to test for and, if present, address this type of potential sample selection issue with appropriate econometric techniques. Specifically, we estimate the determinants of the probability that a parcel is sold during the 2006-2010 period (*S*), and then conditional on the parcel selling, the determinants of the sales price (P). This joint

[7] We also estimated a series of interval regressions in which the left and right side observations are treated as censored, but the cut-off points are incrementally move from the interquartile to the interquintile and interdecile ranges. The coefficients generated from these regressions are similar to those presented, but the magnitudes of the coefficients become more similar to the OLS estimates as range is widened.

[8] We thank Daniel McMillen for bringing this issue to our attention.

process is estimated simultaneously using a procedure proposed by Heckman (1979) in order to address the potential bias introduced by property owners' self-selection into selling.[9] In the first step, we estimate the *S* selection equation, represented by:

$$[4] \qquad S_i = \begin{cases} 1 & \text{if } PC_i\alpha + D_i\beta + u_i \geq 0 \\ 0 & \text{if } PC_i\alpha + D_i\beta + u_i < 0 \end{cases}$$

where S_i indicates whether property i is sold (yes=1, no=0), PC_i is a vector of property characteristics that includes *State Equalized Value*[10], indicator variables for whether a lot is zoned *Residential* (yes=1, no=0) and *Commercial* (yes=1, no=0), *Size of Lot*, whether the lot is *Buildable* (yes=1, no=0)[11], and D_i is a vector of "distance" variable(s) that includes the distance the parcel is from the city center (*Distance to City Center*), the distance the parcel is from the city's border (*Distance to Border*), as well as *Distance to Packard Plant*.

In the second stage of the Heckman procedure, we estimate factors that determine the sales price, conditional on the property being sold. The Heckman second stage outcome equation is represented by equation [5]:

$$[5] \qquad P_i = X_i\delta + D_i\gamma + \varepsilon_i$$

where *Sales Price* (P) for parcel i is equal to price at which the parcel sold during the 2006-2010 period, X_i is a vector of property characteristics that includes whether the lot is zoned *Residential* (yes=1, no=0), *Commercial* (yes=1, no=0)[12], *Size of Lot*, whether the lot is *Buildable* (yes=1,

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[9] See Achen (1986) and Sigelman and Zeng (1999) for theoretical and intuitive discussions on the Heckman procedure.
[10] To identify the system, State Equalized Value is included in the selection equation but not the second stage price equation.
[11] Under current zoning law, a parcel must be at least 5,000 square feet in order to build on the lot. However, in prior years buildable lots could be smaller; these now vacant lots cannot be built upon under the current zoning regulations without special approval from city officials.
[12] The omitted category includes non-taxable properties, which are properties held by the city or some other public entity and properties held by charitable and other not-for-profit entities.

no=0), time indicator variables, and D_i is a vector of “distance” variable(s) as defined above. We estimate the selection and outcome equations jointly by maximum likelihood.

Nonparametric Methods—Locally Weighted Regression

Following Meese and Wallace (1991) and McMillen (1996), we also use nonparametric methods to evaluate Detroit land values. Specifically, we used the locally weighted regression (LWR) technique in which more weight is given to “nearby” observations when estimating the land value regression. The local fitting approach developed by Cleveland and Devlin (1988) can and has been used in a variety of contexts, including geography where “local” is defined by actual distance.[13]

As described in McMillen and Redfearn (2010), minimizing equation (6) with respect to α and β yields the LWR estimator:

[6] $$\sum_{i=1}^{n}(P_i - \alpha - \beta'(X_i - X))^2 K\left(\frac{X_i - X}{h}\right)$$

The weight that observation i receives in estimating the value of P at the target point X is determined by the kernel function K(ψ).[14] There are a number of choices for the kernel weighting function, where an increase in ψ signifies declining weights. However, the results are not sensitive to the choice of kernel weight function. Rather, the choice of bandwidth, h, is more important. The bandwidth determines the proportion of observations that receive a positive weight as well as how quickly weight declines with distance. Thus, the more important issue is determining an appropriate distance at which observations no longer receive weight in the

[13] See also McMillen (2010), McMillen and Redfearn (2010), Sunding and Swoboda (2010) and Swoboda, Nega, and Timm (2015) for property value applications in urban economics.
[14] In equation (6), for ease of exposition both property characteristics and distance variables are included in X.

regression. We follow Cleveland and Devlin (1988) and McMillen (1996), and use a rule of thumb where the regressions are estimated using about 30 percent of the observations.

The locally weighted estimator generates coefficient estimates for each value of x employed. $\hat{\beta}(x)$ is constructed for every observation in the data set; to see the regression surface it becomes necessary to generate predicted P values ($\widehat{P}$). Perhaps the best approach to summarizing the locally weighted regression results is simply to map $\widehat{P}$. The key advantage of the locally weighted regression is that it allows the coefficients to adapt locally by giving more weight to nearby observations, thereby allowing local features to more prominently play role in generating the coefficient estimates.

Locally weighted regression analysis requires that a separate WLS regression be estimated for each observation in the data set.[15] It then becomes possible to generate predicted P values as described in detail in McMillen (1996). In our analysis, however, we have an added layer in that we wish to generate predicted land values for the more than 300,000 parcels in the city, but we have 3,788 vacant land sales. Once we generate predicted land values for all the observations in our data set, we link parcels that did not sell to the closest recently sold parcel in the set of sold properties. Once the non-sold parcels are linked with the sold parcels, we generate a map illustrate the pattern of predicted land values for the entire city.

Empirical Results2

Parametric Estimates

The OLS and interval regression estimates are presented in Table 5, and the Heckman sample selection estimates are found in Table 6. Consider first Table 5, where columns 1-3 contain the OLS estimates and columns 4-6 contain the estimates for the interval regressions. In

[15] We estimated the locally weighted regression using the R 'McSpatial' package as described in McMillen (2015).

column 1 and 4, we include the control variables and c_i (distance from the city center). In columns 2 and 5, we include the control variables and b_i (distance to the border). Finally, in columns 3 and 6 we include both c_i and b_i. These different specifications allow us to evaluate the respective roles of c_i and b_i on land values. Note that the OLS and interval regression analyses yield similar coefficients, though the coefficients are larger in the interval regressions.

Before discussing the key distance variables, consider the control variables. Relative to the omitted category (non-taxable parcels), residential and commercial parcels sold for higher prices. Larger lots and lots large enough to be buildable under current zoning regulations sold for more as well. This finding highlights the importance of property rights to land value. The change in zoning regulations that has occurred over time now requires a larger minimum lot size for construction, which effectively removes the right to build on smaller lots of which there are thousands. In principle, a property owner may receive a special permit to build on a small lot, but the process requires time and money, and the outcome is uncertain. Our estimates indicated that the value of a parcel is 30 to 60 percent lower if it does not meet the minimum size threshold in the OLS and interval regression estimates, respectively. Lots that sold before the real estate crash in 2008 sold for more; the time indicator variables show that average land sales prices in 2010 were more than 70 percent lower than 2006. Also, results indicate that properties immediately surrounding the abandoned Packard Plant sold for less.

Turning to the key variables of interest, we see in columns 1 and 4 that distance to the CBD is a significant determinant of price; vacant properties sold for a higher price near the CBD. However, as shown in columns 2 and 5 the coefficient on the distance from the border is negative and highly significant; that is, property values decline the further the parcel is from the border. These two specifications seem to offer conflicting information on the form of the land value gradient. One the one hand, the regressions in columns (1) and (4) suggest that property values decline from the city center as is typical in the monocentric city model. In recent years there has been a significant reinvestment in Detroit's CBD (Hudson-Weber Foundation, 2013). However, we also see from results in columns (2) and (5) that property values are higher near the city's border. To reconcile these findings, consider the estimates in column 3 and 6. Specifically, in columns (3) and (6) we include both the distance from the city center and the distance to the border in a single regression, and here we see that both distance variables are larger in absolute magnitude and their statistical significance also increases. Properties close to the city center are valued more highly, as are properties near the border. While the OLS and interval regression results are consistent with one another, note that the coefficients in the interval regressions are generally larger than those presented in the OLS. A primary finding in these regressions is that we observe U-shaped land value gradient where property values are highest near the CBD and near the city's border. We will offer additional discussion of the U-shaped land value gradient, but first consider the Heckman selection estimates.

Table 6 presents the estimates from the first stage sale selection equation and then the second stage sales price equation. Just as with the OLS and interval regression estimates, we present in column 1 the estimates with control variables and the distance to the CBD, in column 2 control variables and distance to the border, and in column 3 both the distance to the city center and the border. The selection equation coefficients clearly demonstrate potential for selection bias; parcels with greater state equalized value, that are of larger size, are buildable under current zoning regulations, and are closer to the border were more likely to be sold during the 2006-2010 period.[16] We also see that parcels that are zoned *Residential* and *Commercial* are less likely to

[16] The coefficients presented for the first stage selection equation are the marginal effects generated for mean values of the independent variables.

be sold than properties in non-taxable status. Further, the estimated effect of the independent variables is large enough to be meaningful. A 10 percent increase in state equalized value and a 50 percent increase in square feet of area increases the probability that the parcel will be sold by 1 percent. The probability that a lot will be sold increases by 0.5 percent if it meets the threshold size for being *Buildable* under current zoning regulations, and according to the estimates in column 3, a 10 percent increase in the distance from the city border reduces the probability that the parcel will sell by 1 percent.

While the selection estimates are of interest and value, our primary focus is on the determinants of sales price, which are also present in Table 6. After correcting for sample selection, we see that these estimates are very similar to the OLS regressions. Overall, the Heckman estimation results suggest that while there is clearly non-random selection of parcels into the "sold" status, non-random selection appears not to be generating significant bias in the coefficient estimates.

To illustrate further the dual effects of the two distance variables consider Figure 4, which provides the land value gradient generated from coefficients on distance to the CBD and distance from the border.[17] Figure 4 shows that property values are relatively very high near the city center, but they dissipate rapidly as distance from the center increases. Land values drop to about $5,000 per parcel two miles from the CBD. McMillen (2006) notes that higher incomes tend to flatten the land value gradient. In the case of Detroit, income has been declining and is now very low, and thus it is not surprising the land value gradient is so steep. Property values in the middle "donut" ring around the city center are extremely low, less than a $1,000, but land values begin to rise about one mile from the border. Rising land values at the border is

[17] The figure is based on the most conservative coefficients, which are generated from the Heckman selection estimation.

consistent with the notion that accessibility of amenities and employment in suburbs serves to buoy land values in the city.

It is also important to note that while property values are relatively high near the CBD, the aggregate property values in the large areas near the border is substantial and thus should be noted by policy makers. These estimate show that property along the periphery has retained value more so than other parts of the city; if the goal is to preserve and enhance property values and thus preserve property tax base, city officials may want to consider explicit strategies for maintaining the stability of the peripheral neighborhoods, and not focus attention solely on the substantial investments currently being infused in the city center.

Though not a primary focus of this study, we also note the negative impact of the Packard Plant on land values. Our findings suggest that removal of this toxic site would likely improve land values of nearby properties. The estimates presented here can be used to determine whether the benefits of clean-up and removal are sufficient to justify the substantial costs of tear down and bio-hazard clean-up.[18]

Nonparametric Estimates—Locally Weighted Regression Estimation

The estimates from the local weight regression approach are not easily summarized in table, given that this approach generates 3,788 regressions, one for each sold property in our data set. Instead we calculate predicted land value per square foot for the entire city, including those parcels with structures. More specifically, all non-sold parcels (with and without structures) are matched to the nearest parcel that was sold (and for which we can generate a predicted land value). We then generate a map of predicted land values per square foot for the entire city, which is presented in Figure 5. In these regressions, we included distances from the Packard Plant as well as distances to the following toxic/dilapidated sites: Detroit Train Depot, Carter

[18] We intend to conduct this cost-benefit analysis in future work.

Industrials, Federal Mogul, ChemServ Corp., Detroit Coke, Revere Copper and Brass, Marathon Oil Refinery, Koch Carbon, and Bellevue (Uniroyal). We also included an array of distance measures from parcel to major roadways leading in and out of the city.

The predicted land value map clearly illustrates Detroit's very steep land value gradient. That is, land values per square foot are very high in the central business district (CBD), as depicted by the black parcels which represent the highest 0.1% of land values per square foot on the map. Values plunge rapidly as distance from the CBD increases, but generally begin to rise near the city's border, probably because amenities such as shopping and the like are readily available in the nearby suburbs. While there are several areas within the donut around the CBD that have retained some value, generally the analysis shows that land extremely low in the areas around the CBD. The average predicted land value in the red areas is about $1,000 for the average sized lot. Finally, land values are shown to increase near the city border where suburban amenities are more accessible.

CONCLUSIONS AND IMPLICATIONS

This paper provides several insights, first of which is the documentation of a U-shaped land value gradient. The land values are relatively very high in the central city, but the land value gradient is also very steep—land values drop precipitously to about $5,000 just two miles from the CBD. Property values fall to less than $1,000 for typical sized lot in the red areas surrounding the CBD. However, generally land values begin to rise near the city's border. This result is consistent with the notion that access to amenities such as shopping (which is largely unavailable in the city) and employment in the suburbs leads to higher land values on the periphery.

We document significantly lower land values for parcels that do not meet the minimum lot size requirement for new residential construction.   Also, properties with close proximity to the toxic abandoned Packard Plant are also of lower value. Out evaluation makes it clear that land values along the periphery are much higher than in the “donut area” of the city. While this is not surprising to those familiar with the Detroit real estate market, our findings can inform city strategies for investing in and maintaining neighborhoods. Of note, the estimates show that land values are higher on periphery and thus make a substantial contribution to the tax base. This suggests that sustaining and stabilizing these neighborhoods as well as continuing efforts to revitalize the highly valued CBD should be priorities.

The work of Rosenthal (2008) may also inform longer-run strategies. According to Rosenthal’s evaluation, neighborhoods cycle from high-income to low-income over time, and then back again. Further, this cycle is heavily influenced by the aging of the housing stock. Higher-income households gravitate to neighborhoods where the housing stock is newer and of higher quality, whereas older neighborhoods with aging housing stock attracts low-income households. Thus, the rise and decline of neighborhoods is to a large extent determined by the age and quality of the housing stock. In Detroit, much of the oldest and most dilapidated housing stock has been torn down; these areas are now available for the development new housing stock.

At the same time, the housing stock in the first ring suburbs in the Detroit region is aging. In the coming years, we may see a reversal of migration patterns. That is, higher income households may seek new high quality housing either in the outer suburbs or back in the city where large tracts of land are available for redevelopment. Similarly, the aging housing stock in the first ring suburbs, which are now quite reasonably priced, may attract lower income households. Because the regional population has been stable, it seems that there is at least some potential for the neighborhood cycling Rosenthal (2008) documents. However, Detroit officials will have to provide tax-public service environment that is conducive to redevelopment. Naturally, offering a competitive tax rate and core public services will be important if the city is to be positioned for the long run dynamics described by Rosenthal (2008).

In addition to the policy relevance of our analysis, we offer contributions to the literature on urban land values and redevelopment. First is the evaluation of land values in the context of a declining city in the wake of the real estate crisis. Second, we use a unique data set that includes both actual vacant land sales data as well as data on unsold vacant land in the City of Detroit to estimate a land value gradient. These data also allow us to uses a Heckman selection procedure to address potential sample selection (not all parcels are equally likely to be sold). While we find that some parcels are indeed more likely to be sold than others, there is little evidence that selection bias has resulted in biased estimates. We also provide evidence for a U-shaped land value gradient in Detroit, and evidence that small lot land values are suppressed by the minimum lot size requirement.

While the exceptionally low land values documented in this paper reflect the grim current circumstances in Detroit, the analysis offers some hope. First, we show that land values are high in and near the CBD as well as along the city's borders. Second, as illustrated by Rosenthal (2008), the nature of aging housing stock influences the long-run dynamics of neighborhood decline and renewal. Given that much of Detroit's old housing stock has been eliminated and that the first ring suburban housing stock is aging, Detroit could be positioned for redevelopment of higher end housing, which would be attractive to high-income households.

In the longer-run context, a key role for policy makers today is to prepare for this potential opportunity by offering a competitive tax-service environment in order to be attractive to both developers and households in the coming years. As the City emerges from bankruptcy, there is an opportunity to reset the tax-public service package. Improvement to the tax-service package in Detroit is also essential for ameliorating the ongoing tax delinquency problem (Alm, *et al*., 2014), and thus reducing the flood of properties moving into public hands. While there is evidence to suggest a resurgence in the central city[19], as it stands prospects for the reemergence of Detroit for higher income redevelopment seem limited.

The Detroit Future City (2010) report offers a strategic framework for developing a vision for Detroit's future, and one component of this framework includes a discussion of vacant land management. As highlighted by Detroit Future City (2010), public lands are held by many public entities.

> Public land in Detroit is held by many separate agencies, including city, county, and state agencies, as well as autonomous or quasi-governmental entities such as the Detroit Public Schools, the Detroit Housing Commission, and the Detroit Economic Growth Corporation. Few other cities have such fragmented holding of their public land inventory. There is no consistency of policy, procedure, or mission among these agencies, while many are hamstrung by burdensome legal requirements and complex procedures. The Department of Planning and Development controls the largest number of properties, yet its ability to do strategic disposition is constrained by procedural obstacles, including the need to obtain City Council approval for all transactions, however small and insignificant from a citywide perspective.

Regardless of whether the potential long-run decline/renewal dynamics documented by Rosenthal (2008) will be manifested in Detroit, an essential element in preparing for any future development is for the city and all other public entities to develop a unified mission and

[19] See for example recent articles on redevelopment led by Daniel Gilbert (http://www.freep.com/article/20140522/COL06/305220263/Tom-Walsh-Techweek-Detroit-Dan-Gilbert-Beth-Niblock), on rising housing costs in downtown Detroit (http://money.cnn.com/2014/05/27/real_estate/downtown-detroit/index.html) and the potential for foreign investors, particularly Chinese investors, to acquire property in Detroit (http://www.npr.org/2014/03/04/285711091/chinese-investors-arent-snatching-up-detroit-property-yet).

framework for managing a vast amount of potentially very valuable land.

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Table 1 City of Detroit Change in Employment

	Detroit Resident Employment		Jobs in Detroit
	Total	Manufacturing	Total
1970	361,184	201,400	735,164
1980	394,707	113,100	562,120
1990	355,462	68,830	442,490
2000	331,441	62,235	345,424
2010	203,893	23,220	347,545
Change 1970-2010	-43.5%	-88.5%	-52.7%

Sources: US Census, SEMCOG

Table 2 City of Detroit Housing Stock Trends

	Total	Occupied	Vacant
1960	533,199	514,837	18,362
1970	529,155	497,753	31,402
1980	461,500	424,033	37,467
1990	410,150	374,057	36,093
2000	375,096	345,424	29,762
2010	349,170	271,050	78,120
2012	336,586	253,072	83,514
Change 1960-2012	-36.9%	-50.8%	+454.8%

Sources: US Census, American Community Survey

Table 3 City of Detroit Trends in Business Establishments

	Retail	Services	Manufacturing	Wholesale	Total
1972	9,768	8,907	2,398	2,392	23,465
1977	6,803	6,468	1,954	1,657	16,882
1982	5,531	4,058	1,518	1,389	12,496
1987	3,847	3,734	1,255	1,176	10,012
1992	3,448	3,189	1,061	961	8,659
1997	2,253	4,479	825	740	8,297
2002	2,179	5,254	647	611	8,691
2007	2,157	4,738	472	450	7,817
Change 1972-2007	-77.9%	-46.8%	-80.3%	-81.2%	-66.7%

Source: Economic Census.

Table 4: Vacant Land Sale Summary Statistics

	Full Sample		Sales Sample	
Variable	**Mean (SD)**	**Median**	**Mean (SD)**	**Median**
Sale (yes=1, no=0)	0.046 (0.210)	-	-	-
Sales Price ($)	1,744 (63,947)	0.00	37,723 (295,077)	811
State Equalized Value ($)	2,155 (49,059)	222	3,279 (29,474)	613
Residential (yes=1, no=0)	0.427 (0.495)	-	0.688 (0.466)	-
Commercial (yes=1, no=0)	0.071 (0.257)	-	0.140 (0.347)	-
Size of Lot (square feet)	256,707 (22,100,000)	3,485	54,305 (3,046,622)	3,790
Buildable (yes=1, no=0)	0.156 (0.363)	-	0.219 (0.413)	-
Distance to Packard Plant (feet)	24,413 (15,210)	21,377	24,413 (15,211)	21,377
Distance to City Center (miles)	2.200 (1.323)	2.103	1.842 (1.265)	1.639
Distance to Border (miles)	5.561 (2.576)	5.254	6.209 (2.707)	5.944
Sold in 2007 (yes=1, no=0)	0.011 (0.102)	-	-	-
Sold in 2008 (yes=1, no=0)	0.011 (0.103)	-	-	-
Sold in 2009 (yes=1, no=0)	0.007 (0.082)	-	-	-
Sold in 2010 (yes=1, no=0)	0.001 (0.029)	-	-	-
Tax Delinquent (yes=1, no=0)	0.297 (0.457)	-	0.489 (0.500)	-
Number of Observations	81,326		3,788	

Table 5: OLS and Interval Regression Land Sale Estimates
(z-statistics in parentheses)

Estimation Method	**OLS** (1)	**OLS** (2)	**OLS** (3)	**Interval Regression** (4)	**Interval Regression** (5)	**Interval Regression** (6)
Dependent Variable	**Ln(Sales Price)**	**Ln(Sales Price)**	**Ln(Sales Price)**	**Ln(Sales Price)**	**Ln(Sales Price)**	**Ln(Sales Price)**
Independent Variable						
Residential (yes=1, no=0)	0.749*** (4.70)	0.749*** (4.72)	0.737*** (4.65)	1.668*** (5.44)	1.675* (5.48)	1.649*** (5.40)
Commercial (yes=1, no=0)	1.578*** (6.59)	1.587*** (6.63)	1.552*** (6.48)	3.289*** (7.18)	3.307*** (7.21)	3.235*** (7.07)
Ln(Size of Lot) (square feet)	0.166* (1.85)	0.169* (1.88)	0.164* (1.82)	0.343** (1.99)	0.350** (2.02)	0.342** (1.96)
Buildable (yes=1, no=0)	0.302* (1.79)	0.300* (1.78)	0.305* (1.80)	0.634* (1.93)	0.625* (1.90)	0.637* (1.94)
Ln(Distance to Packard Plant) (feet)	1.434*** (4.17)	0.731** (2.14)	1.002*** (2.88)	3.227*** (4.38)	1.599** (2.15)	2.214*** (2.88)
Ln(Distance to City Center) (miles)	-1.330* (-1.79)		-2.446*** (-2.84)	-2.813* (-1.85)		-5.358*** (-3.17)
Ln(Distance to Border) (miles)		-0.833*** (-2.63)	-1.243*** (-3.57)		-1.919*** (-3.03)	-2.82*** (-4.02)
Sold in 2007 (yes=1, no=0)	0.181 (1.16)	0.167 (1.07)	0.171 (1.10)	0.597* (1.95)	0.571* (1.87)	0.583* (1.91)
Sold in 2008 (yes=1, no=0)	-0.388** (-2.53)	-0.392** (-2.56)	-0.392** (-2.56)	-0.609** (-2.05)	-0.613** (-2.06)	-0.611** (-2.06)
Sold in 2009 (yes=1, no=0)	-0.703*** (-3.91)	-0.688*** (-3.83)	-0.710*** (-3.96)	-1.348*** (-3.82)	-1.312*** (-3.73)	-1.365*** (-3.87)
Sold in 2010 (yes=1, no=0)	-0.731 (-0.568)	-0.757 (-1.33)	-0.759 (-1.34)	-1.042 (-0.86)	-1.096 (-0.91)	-1.107 (-0.92)
Wald Chi^2				961.02***	907.23***	1,011.23***
Adjusted R^2	0.072	0.073	0.076			
Number of Observations	3,788	3,788	3,788	3,788	3,788	3,788
Number of Left Censored Observations				963	963	963
Number of Right Censored Observations				944	944	944

All estimates include a set of 53 (of 54) neighborhood indicator variables. *Indicates statistical significance at the 90% confidence interval; ** Indicates statistical significance at the 95% confidence interval; *** Indicates statistical significance at the 99% confidence interval.

Table 6: Heckman Vacant Land Sale Selection and Price Estimates
(z-statistics in parentheses)

Estimation Method	**Heckman**	**Heckman**	**Heckman**
Dependent Variable	**Sale (Yes/No) Ln(Sales Price) (1)**	**Sale (Yes/No) Ln(Sales Price) (2)**	**Sale (Yes/No) Ln(Sales Price) (3)**
Independent Variable	**First Stage Sale (yes/no) Estimates**		
Ln(State Equalized Value)	0.011*** (16.01)	0.011*** (15.38)	0.011*** (15.95)
Residential (yes=1, no=0)	-0.015*** (-3.29)	-0.015*** (-3.25)	-0.015*** (-3.28)
Commercial (yes=1, no=0)	-0.029*** (-4.97)	-0.029*** (4.94)	-0.029*** (-4.99)
Ln(Size of Lot) (square feet)	0.002*** (3.29)	0.002*** (3.32)	0.003*** (3.33)
Buildable (yes=1, no=0)	0.005*** (2.77)	0.005*** (2.73)	0.005*** (2.73)
Ln(Distance to Packard Plant (feet)	0.004 (1.03)	0.001 (0.20)	0.0002 (0.08)
Ln(Distance to City Center) (miles)	0.015** (2.03)		0.005 (0.62)
Ln(Distance to Border) (miles)		-0.012*** (-3.65)	-0.011*** (-3.06)
	Second Stage Price Estimates		
Residential Classification (yes=1, no=0)	0.689*** (4.56)	0.693*** (4.61)	0.678*** (4.52)
Commercial Classification (yes=1, no=0)	1.495*** (6.47)	1.511*** (6.54)	1.3473*** (6.38)
Ln(Size of Lot) (square feet)	0.153* (1.71)	0.157* (1.75)	0.151* (1.68)
Buildable (yes=1, no=0)	0.265 (1.55)	0.266 (1.56)	0.269 (1.58)
Ln(Distance from Packard Plant) (feet)	1.449*** (4.26)	0.747** (2.21)	1.023*** (2.97)
Ln(Distance from City Center) (miles)	-1.412* (-1.82)		-2.481*** (-2.91)
Ln(Distance from Border) (miles)		-0.778** (-2.44)	-1.193*** (-3.41)
Sold in 2007 (yes=1, no=0)	0.172 (1.11)	0.158 (1.03)	0.162 (1.05)
Sold in 2008 (yes=1, no=0)	-0.400** (-2.63)	-0.404*** (-2.66)	-0.403** (-2.66)
Sold in 2009 (yes=1, no=0)	-0.721*** (-4.03)	-0.705*** (-3.93)	-0.728*** (-4.07)
Sold in 2010 (yes=1, no=0)	-0.731 (-1.29)	-0.757 (-1.34)	-0.759 (-1.35)
Lambda (Invers Mill's Ratio)	-0.354	-0.332	-0.342
Log pseudolikelihood	-23,832	-23,832	-23,826
Number of Observations Number of Uncensored Obs.	77,538 3,788	77,538 3,788	77,538 3,788

All estimates include a set of 53 (of 54) neighborhood indicator variables. *Indicates statistical significance at the 90% confidence interval; ** Indicates statistical significance at the 95% confidence interval; *** Indicates statistical significance at the 99% confidence interval.

Figure 1: Parcel Level Map of Vacant Land

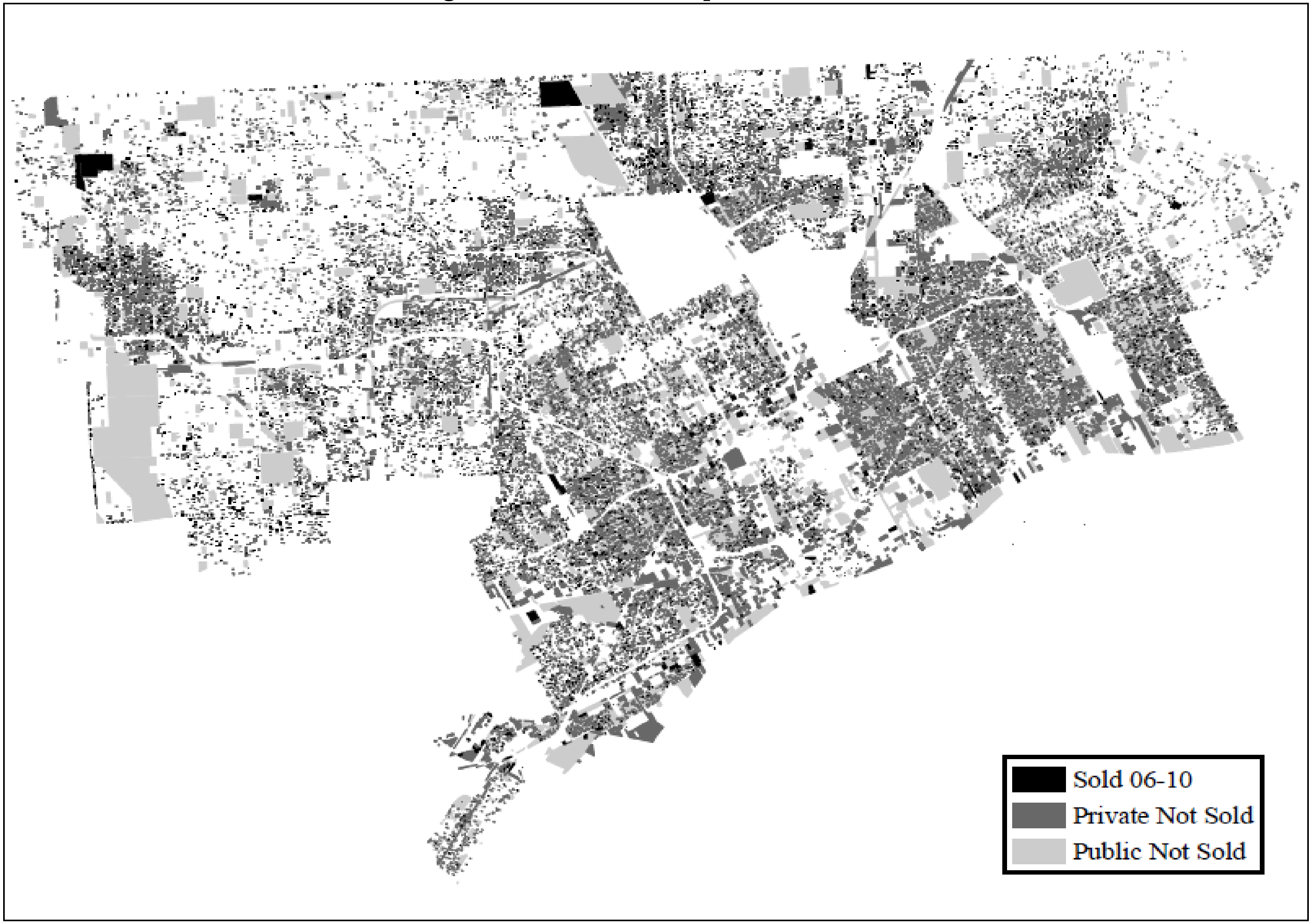


Figure 2: Vacant Land Sales Prices per Square Foot

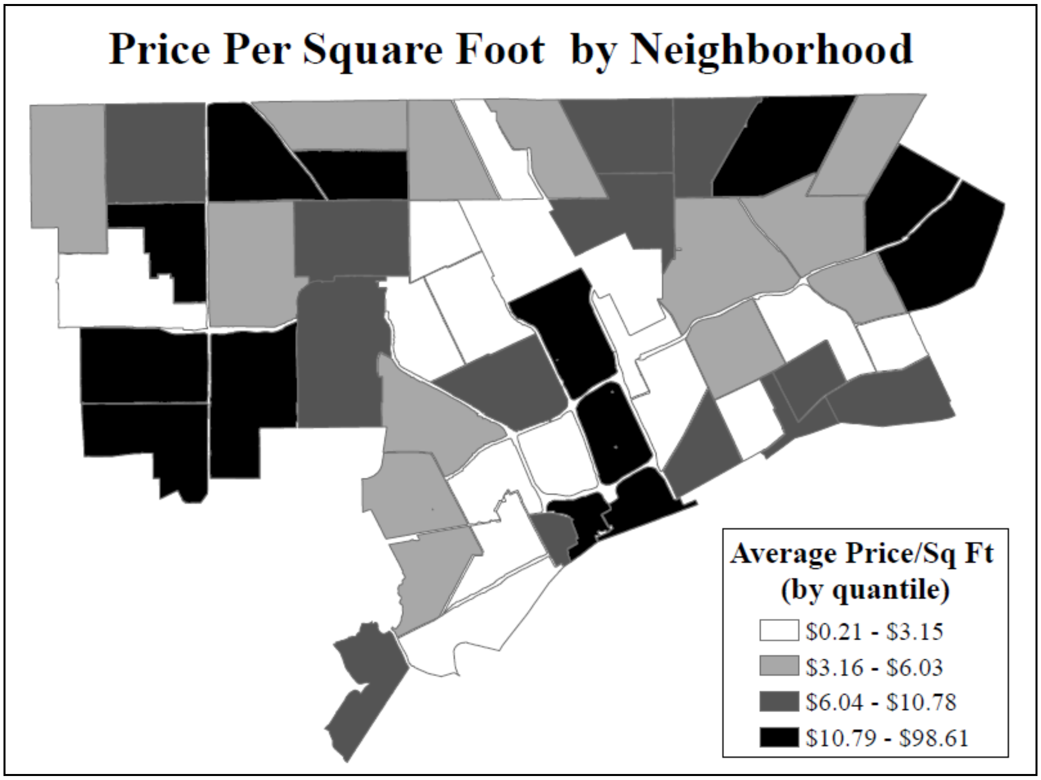


Figure 3: Frequency Distribution of Land Sales Prices

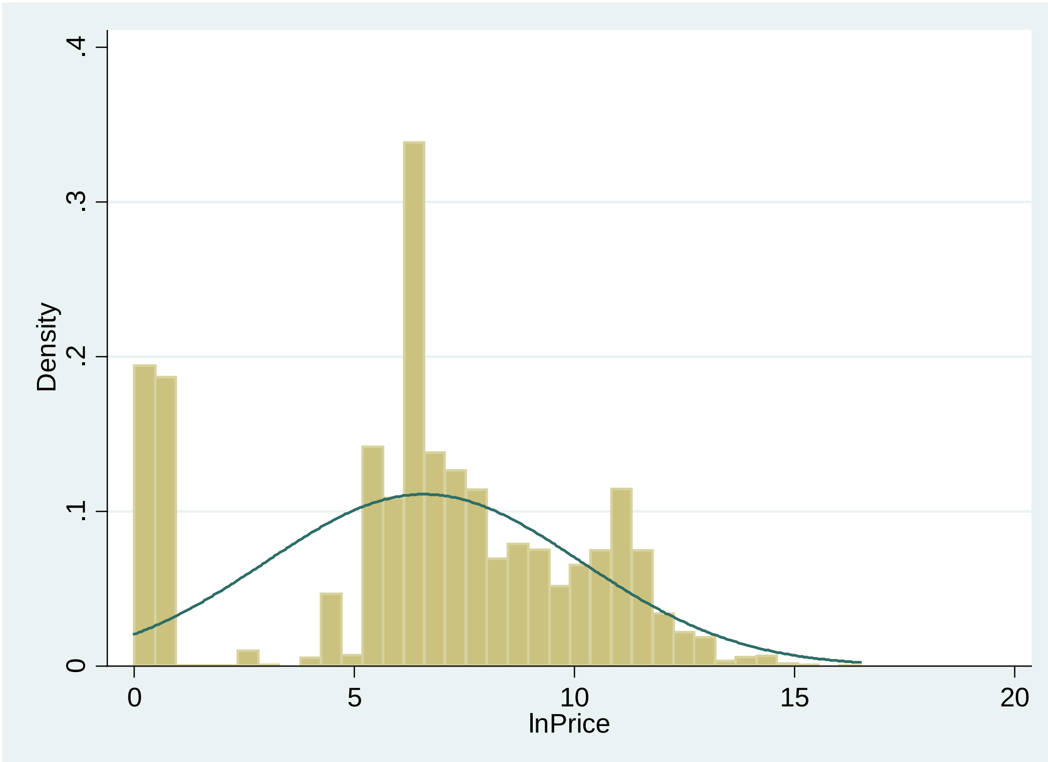
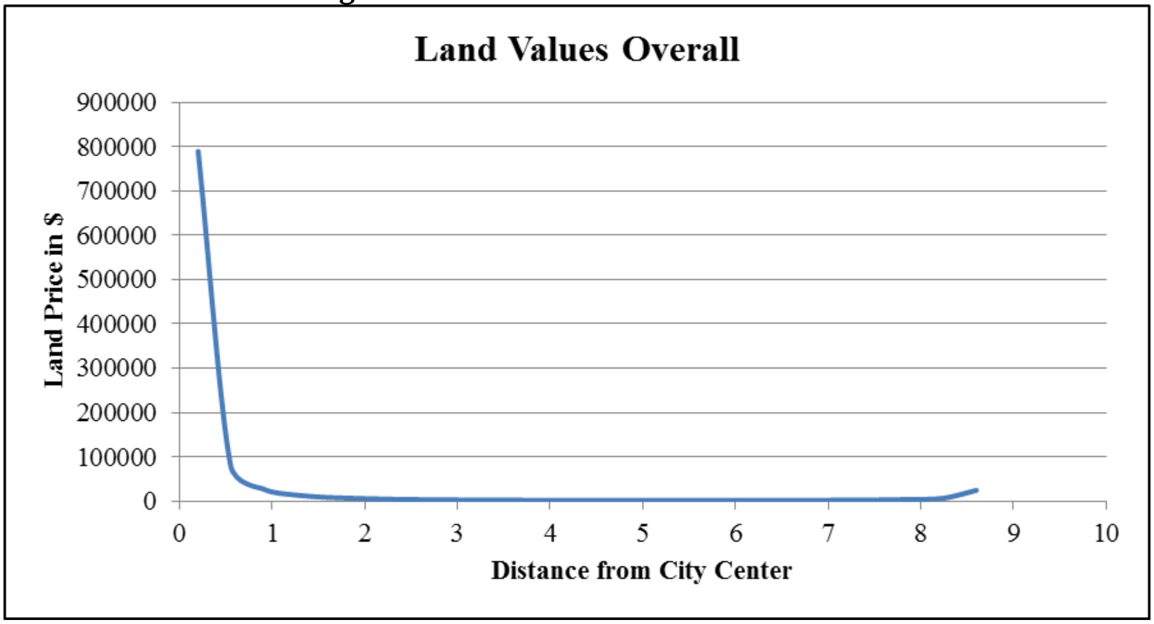


Figure 4: Detroit Land Value Gradient



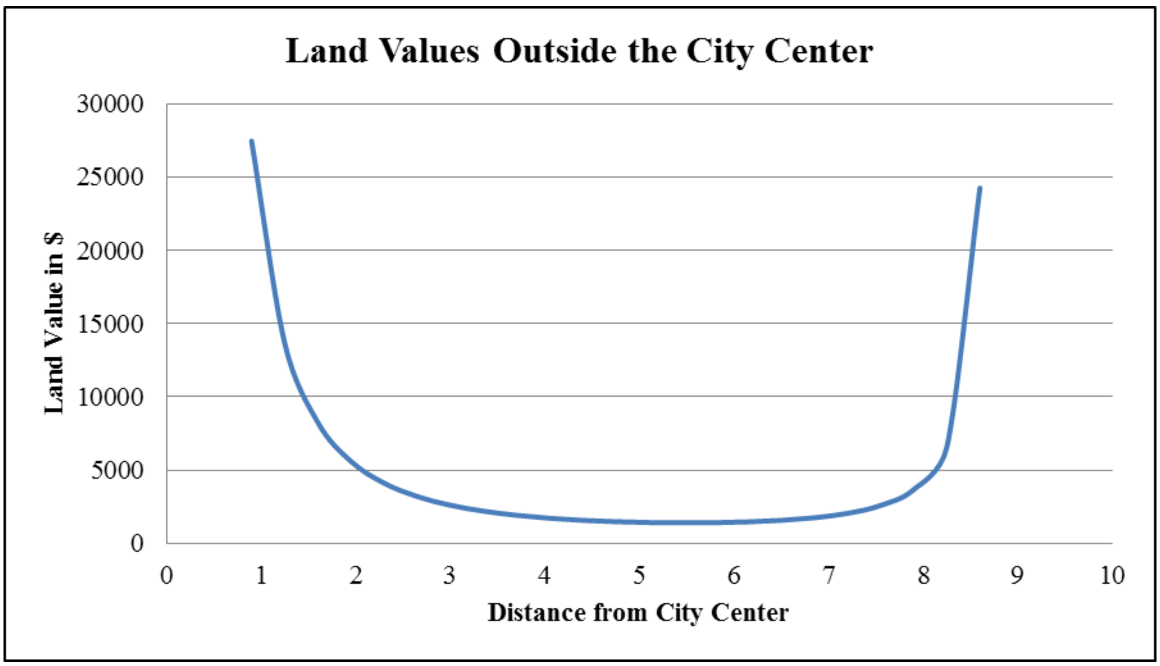
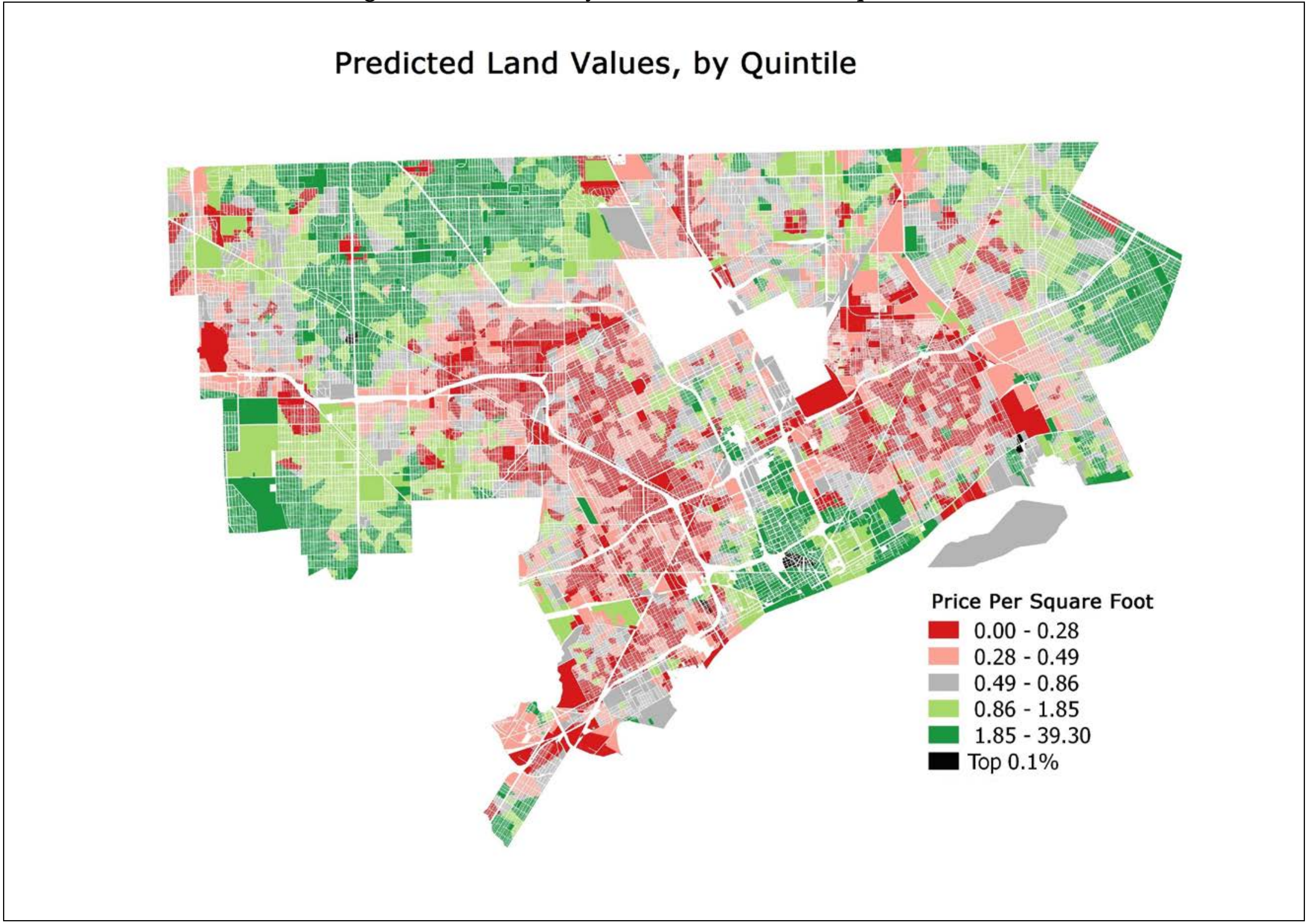


Figure 5: Predicted Citywide Land Values Per Square Foot



Appendix: Variable Names and Definitions

Variable Name	Definition
Sale (yes=1, no=0)	Indicator variable equal to one if the property sold during the 2006-2010 period, and zero otherwise.
Sales Price	Sales price in dollars of land being sold.
State Equalized Value	State equalized value of the property, which is ½ of estimated market value.
Residential (yes=1, no=0)	Indicator variable equal to one if the property sold is zoned residential, and zero otherwise.
Commercial (yes=1, no=0)	Indicator variable equal to one if the property sold is zoned commercial, and zero otherwise.
Size of Lot (square feet)	Size of lot in square feet.
Buildable (yes=1, no=0)	Indicator variable equal to one if the property is large enough (over 5,000 sq. ft.) to build on, given current zoning policies.
Distance from City Center (miles)	Linear distance from a given parcel to the city center.
Distance from Border (miles)	Linear distance from a given parcel to the nearest border of the city.
Distance from Packard Plant (feet)	Linear distance from a given parcel to the abandoned and toxic Packard Plant.
Sold in 2007 (yes=1, no=0)	Indicator variable equal to one if the parcel was sold in 2007, and zero otherwise.
Sold in 2008 (yes=1, no=0)	Indicator variable equal to one if the parcel was sold in 2007, and zero otherwise.
Sold in 2009 (yes=1, no=0)	Indicator variable equal to one if the parcel was sold in 2007, and zero otherwise.
Sold in 2010 (yes=1, no=0)	Indicator variable equal to one if the parcel was sold in 2007, and zero otherwise.
Tax Delinquent (yes=1, no=0)	Indicator variable equal to one if the property is tax delinquent, and zero otherwise.