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Impacts of Hospital Closures on Rural Housing Values in Illinois

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Abstract

Rural hospitals may be an attractive amenity for retirees, retirement communities, and firms. In many rural communities, hospitals are often one of the largest employers. When a rural hospital closes, this is expected to reduce housing values, although no studies to date have investigated this relationship. As a pilot study for future research, we estimate the impact of White Community Medical Center's (located in Carmi, Illinois) closure in December 2005 on local housing values, using a repeat sales estimator. We find that the change in housing values for houses that sold before and after the closure was not statistically significantly affected by the distance from the house to the closed hospital. These results are limited by a small number of repeat sales in White County; further research with data from other states is needed to determine the impact of rural hospital closures on housing values.

Keywords: hospital closures, rural hospitals, rural economic development, rural wealth, repeat sales

JEL Codes: O180, R110, R150

Introduction

Since 2010, fifty-three rural hospitals have closed[1] and 283 others are at risk of closing (Mahn, 2015). Rural hospital closures impact the entire community. Access to emergency room care is one of the most immediate impacts. In emergency situations, such as a heart attack or farm accident, the additional travel time to reach an open hospital could mean life or death for that individual. In a recent study, Buchmueller et al (2006) found that increased distance to the hospital increases deaths from heart attacks and unintentional injuries in urban areas. Rural economies also may suffer when a hospital closes through potential increases in local unemployment, higher rates of outmigration, revenue loss to other local businesses (especially those that supply services to the local hospital), and difficulty in attracting new firms and residents. We expect rural hospital closures would also affect housing values, although to the best of our knowledge no one has tested this.

Past research has estimated various economic impacts of hospitals on a community (Christianson and Faulkner, 1981; McDermott et al, 1991; Stensland et al, 2002; Holmes et al, 2006; Thomas, 2015). Probst et al. (1999) estimated the economic impacts of rural hospital closures in the 1990s on local per capita income. Several studies have used input-output methods to examine the employment impacts of hospitals on local communities (Doeksen et al, 1990; Doeksen et al, 1997; Doeksen and Schott 2003). Finally, past studies have examined aspects of hospital closures that occurred during the 1980s, including: determinants of closures (Longo and Chase, 1984), patterns of closures (Mayer et al, 1987; Mullner and McNeil, 1986), and neighborhood effects of closures (McLafferty, 1982). Outside of research done by Holmes

1. Office of Inspector General considers a closed hospital as "A facility that stopped providing general, short-term, acute inpatient care [....]" (Thomas, 2015).

et al (2006) and Probst et al (1999), little research has econometrically estimated the impacts of rural hospital closures on the local economy. As a pilot study, this paper provides the framework for future research on econometrically estimate the impact of rural hospital closures on rural housing values.

We focus our research on rural Illinois where two hospitals closed between 2000 and 2010. The first rural hospital that closed in Illinois during this time period was in Franklin County. United Mine Workers of a Union (UMW) Hospital in West Frankfort, Illinois (Franklin County) closed in 2001. The other rural hospital in Illinois that closed between 2000 and 2010 was in White County. White Community Medical Center was located in Carmi, Illinois, the county seat of White County. White Community Medical Center unexpectedly closed due to financial troubles in December of 2005 (Wells, 2010).

We use a repeat sales method to estimate the impact of this rural hospital closure on housing values. We assume that a hospital is a positive amenity that affects housing values to a greater extent closer to the hospital. This hypothesis implies that housing prices should rise more or fall less if located further from a hospital that closes. Our results indicate that the distance coefficient is insignificant and has the opposite sign from our expectations, which could be caused by a small number of repeat sales observations.

The next section describes our data and the variables we used, and the econometric method used in this study. The third section discusses the results, and the fourth section concludes the paper.

Estimating the Impacts: Data and Method

Data

The housing data used in this study come from the Illinois Department of Revenue (IDOR). IDOR collects property tax records from the counties after the sale of a property.[2] Unfortunately, the data set does not contain any individual housing characteristics. The data set contains the sale date, sale price, and address of all houses (non-farm, residential) sold in all Illinois counties from 2000 through 2010. After working with other data sources to understand nonmetro housing in Illinois, we found the IDOR data to be the most complete data source on arms-length,[3] single family, residential sales transactions in the state.

Between 2000 and 2010, White County (according to the IDOR data set) experienced 1,389 housing sales. After matching on the same house over time, the repeat sales data set had only 76 observations. To clarify, the 76 observations are houses in White County that sold twice in the data set and did not sell twice in the same year. The White County repeat sales data set minimum sale price of the first sale was $4,500 and the minimum sale price of the second sale was $3,500. The maximum sale price of the first sale in the repeat sales data set was $158,000 and the maximum sale price of the last sale was $185,000.

According to McMillen (2003, 2008), in his work on housing values in the city of Chicago, he was able to keep roughly 10 percent of the full sample with repeat sales. We expect that nonmetro housing tenure is longer than in metro areas and that the more rural the county the longer the housing tenure. Thus, we expected to retain less than 10 percent of the larger

[2]The data were trimmed at the 1st and 99th percentiles. This trimming resulted in a loss of 37 housing sale observations in White County. Of the 37 observations trimmed, one was a repeat sale (sold twice in 2001) with a sale price of $2000 in both sales.

[3] An arms-length transaction is one that takes place between people who are not related. Each party is acting in his or her own self-interest.

housing file when we matched for repeat sales. Our repeat sales data are consistent with this expectation, since after matching we retained 5 percent of the housing sales in White County.

The hospital data come from the Center for Medicare and Medicaid Services (CMS) Provider of Service files. CMS collects data on all hospitals that receive Medicare and Medicaid reimbursements for patient visits.

After geocoding the house addresses and the hospital, we created a measure of Euclidean distance (in miles) from each house in White County to the location of White Community Medical Center. White Community Medical Center was located essentially in the center of White County. Since White County lies on the border of Illinois, it is possible that for some households in White County there could be a closer hospital in a neighboring state. In addition, houses located near the White County border could be located closer to a hospital in a neighboring county. In the full repeat sales data set for White County (76 observations), as measured by Euclidean distance, 55 observations are located less than 2.5 miles from the hospital (with 47 observations located less than 1 mile from the hospital). There are 21 observations more than 4 miles from the hospital (19 observations are located more than 7 miles from the hospital). The farthest distance is 15.08 miles.

For this preliminary analysis, we assume that a hospital is a local amenity and therefore having a hospital in the county makes the county more attractive and adds value to the homes located within that county. White Community Medical Center in Carmi, Illinois was the sole hospital in White County and it closed in 2005. In 2000, the hospital had 48 certified beds and 80 full-time equivalent employees. According to the Census 2000, the total population in White County was 15,371, the median age was 42, and 98.2 percent of the population was white. In

2000, there were 5,095 owner occupied housing units households with an average household size of 2.29 persons. The Census 2010 data show the total population in White county was 14,665, the median age was 45.2, and 98.1 percent of the population was white. There were 4,821 owner occupied housing units with the average household size at 2.03. So, between 2000 and 2010 the total county population declined and so did the number of owner occupied housing units.

Table 1 provides some insight into the full data set and repeat sales data samples for White County. Since we do not know the market values of all the housing stock in White County, we use sales transactions data. We thus assume that the houses sold during the 2000 through 2010 period are a representative sample of all of the housing stock. The houses that sold twice (or the repeat sales sample) tend to be higher priced homes. We can see that the mean, median, and interquartile range of the repeat samples by year in Table 1 are higher than the mean, median, and interquartile range of the full IDOR data set for White County.

Repeat Sales Model

Our repeat sales model is a first difference of the standard hedonic model, which regresses the log of the housing price on a rich set of structural and locational characteristics.

$$\mathbf{lnP_{cit}} = \alpha_{ct} + \beta X_i + \gamma H_{ct} + \delta d_i H_{ct} + \varepsilon_{cit} \qquad (1)$$

In equation 1, the dependent variable, $\mathbf{lnP_{cit}}$, is log of the price of property i in county c at time t. The variable, α_{ct}, indicates county by year fixed effects that account for the effects of local socioeconomic conditions or other factors that have a common impact on housing prices throughout the county. The variable, $\mathbf{X_i}$, represents a vector of fixed (over the time frame of the

study) individual housing characteristics, such as number of bedrooms and bathrooms, and location characteristics, such as distances to the nearest school, grocery store, and natural amenities. $\mathbf{H_{ct}}$ is the number of hospitals in the county (0 or 1 in the case of White County), and $\mathbf{d_i}$ is the distance from the house to the hospital. Finally, $\boldsymbol{\varepsilon_{cit}}$ is an error term assumed to be uncorrelated with $\mathbf{X_i}$, $\mathbf{H_{ct}}$, and $\mathbf{d_i}$ and independent across observations.

For our repeat sales model, we first difference the hedonic model above (Bailey et al, 1963). In doing so, we difference out the effects of fixed housing and location characteristics ($\boldsymbol{\beta X_i}$). Equation 2 shows what remains in the model.

$$\mathbf{lnP_{cit} - lnP_{cis} = \alpha_{ct} - \alpha_{cs} + \gamma(H_{ct} - H_{cs}) + \delta d_i(H_{ct} - H_{cs}) + \varepsilon_{cit} - \varepsilon_{cis}} \qquad (2)$$

The dependent variable is the difference of the natural logs of price between the first and second time of sale, $\mathbf{lnP_{cit} - lnP_{cis}}$, (where time s < time t). Since the focus is within White County, changes in any local factors other than the hospital that have a common impact across all observations within the county and year are accounted for by $\boldsymbol{\alpha_{ct} - \alpha_{cs}}$. The coefficient $\boldsymbol{\gamma}$ is not separately identifiable from $\boldsymbol{\alpha_{ct} - \alpha_{cs}}$, but this does not affect estimation of $\boldsymbol{\delta}$, which is the parameter of interest. We hypothesize that $\delta < 0$; i.e., housing prices are expected to be lower further from a hospital, which implies that housing prices should rise more or fall less for houses located further from a hospital that closes (i.e., we expect that $\delta d_i(H_{ct} - H_{cs}) > 0$ if $H_{ct} - H_{cs} = -1$ (a closure) since we expect $\delta < 0$).

Our key variable of interest, distance to the closed hospital, is correlated with other important spatial variables such as distance to the town center or distance to shopping areas or the highway. As long as these distance variables do not change over time, they drop out of the repeat sales estimation. Differencing in the repeat sales model enables us to isolate the effect

of distance to the closed hospital on the unit price gradient even though the unit price is unobserved. Another benefit to repeat sales is that the method examines the same house twice, so we are able to examine the appreciation or depreciation of the house over time. A downside to using repeat sales, which is an extreme form of matching (matching only on the same house that sells twice in the data set), is that our sample size is significantly reduced.

Results and Discussion

We report the results of four regression models based on equation (2) in Table 2. In all models, distance (d_i) is a continuous variable, measured in miles from the house to the hospital.[4] In Models (3) and (4), d_i is multiplied by ($H_{ct} - H_{cs}$), which is the change in the number of hospitals in the county. If a hospital closes, then ($H_{ct} - H_{cs}$) < 0. As noted earlier, we expect that $\delta < 0$ in equation (2); i.e., the coefficient of the interaction term of distance x ($H_{ct} - H_{cs}$) in Models (3) and (4) is expected to be negative.

By the parallel trends assumption implicit in equation (2), the distance to the hospital should not affect changes in housing values for houses where both sales occurred prior to the closure or where both sales occurred after the closure. In other words, before or after the hospital closure when the county experienced no change over time in the number of hospitals, ($H_t - H_s$) = 0 in equation (2). Therefore, the effect of distance to the hospital on the change in housing values is expected to be statistically insignificant when there is no change in the number of hospitals in the county. If the effect of distance is not small and statistically insignificant, it means that something else besides a hospital closure was responsible for a

[4] We obtained qualitatively similar results using a dummy variable for houses at least 7 miles from the hospital location.

different trend in housing prices further from the location of the hospital compared to close to the hospital.

We tested the parallel trends assumption in Models (1) and (2). Model (1) restricts the repeat sales sample to observations where both sales occurred prior to the hospital closing. There are 22 observations in Model (1) where the first and last sale occurred before or during 2005. We include repeat sales observations in 2005 in Model (1), since the hospital closed during Christmas weekend in December and because this was reportedly an unexpected event (Wells, 2010). In addition, there were no repeat sales observations in December 2005. Model (2) restricts the repeat sales sample to only observations where both sales occurred after the hospital closed, in other words, after 2005. Model (2) has 15 repeat sales observations. In Models (1) and (2), we find the distance coefficients to be small and statistically insignificant, supporting the parallel trends assumption.

Model (3) restricts the repeat sales estimation to only observations where the first sale occurred before the hospital closed (including sales in 2005) and the second sale occurred after the hospital closed. We refer to this model as a straddle model, since the housing sales straddle the hospital closure. The 39 repeat sales observations in Model (3) capture the interaction effect of hospital closure x distance to the hospital. We expect that Model (3) results should be similar to Model (4). Model (4) uses the full repeat sales sample (76 observations) and also includes the interaction effect of hospital closure x distance to the hospital. We find that the distance coefficient in Models (3) and (4) are similar, but not exactly the same. The distance coefficients in both models are statistically insignificant and have the opposite sign from what we expected.

Conclusion

In summary, the coefficient of the interaction of the hospital closure with the distance variable in Models (3) and (4) was positive and statistically insignificant, which is contrary to what we expected. The small sample size is partly the reason for the insignificance of the distance variable. Furthermore, we suspect there may be some omitted factors that are both correlated with the distance to the hospital and changed over the same time period that the closure occurred. If this were true, it would cause a bias, even though we differenced out the effects of variables that are correlated with distance to the hospital but that do not change over time in equation (2). Further investigation into economic changes in White County that occurred in the vicinity of the hospital (i.e., near the town center) around the same time as the hospital closure is necessary to determine if we have an omitted factor causing bias to our results.

This study set out to determine the impact of a hospital closure on rural property values, specifically investigating whether distance to a hospital closure affects housing values. We used a repeat sales methodology to address this. This research will serve as a basis for future studies on rural hospitals as amenities and their broader impacts on measures of rural wealth. Only two hospitals closed in Illinois between 2000 and 2010, so we plan to extend this research to include other states. This will enable us to have a more robust sample of counties that experienced hospital closures and greater statistical power to detect any effects that exist.

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Table 1. Descriptive Statistics on the White County Housing Sales Data

White Repeat Sales				White All Data			
year	**Mean**	**Median**	**IQR**	**year**	**Mean**	**Median**	**IQR**
2000	73300	71500	56000	2000	38023	30000	39000
2001	31800	35000	11500	2001	35349	28000	31500
2002	39833	51000	43500	2002	46905	33150	50000
2003	67442	67500	54250	2003	42115	34000	47000
2004	50909	35500	59500	2004	48086	40000	39000
2005	74600	83000	54000	2005	48225	37000	38500
2006	75958	65000	40000	2006	58783	42500	55000
2007	72500	74000	64000	2007	53634	46250	52100
2008	59000	59000	13000	2008	49940	43000	52500
2009	38271	48937	38750	2009	59100	49600	55500
2010	63000	48750	21750	2010	58474	45000	50000

Source: Illinois Department of Revenue sales transactions data (2000-2010).
Note: The IQR is interquartile range. After trimming, the total number of houses that sold in White county between 2000 and 2010 was 1,389. The total number of repeat sales was 76.

Table 2. Repeat Sales Estimation

	White County			
	(1)	(2)	(3)	(4)
distance	-0.011	0.034	0.021	0.019
	(0.015)	(0.021)	(0.017)	(0.015)
year dummies	x	x	x	x
N	22	15	39	76
adjusted R^2	0.009	-0.38	0.026	0.028
F	2.55	-	2.15	2.22

Source: Illinois Department of Revenue sales transactions data (2000-2010).
Note: Model (1) restricts the repeat sales sample to only observations where both sales occurred prior to hospital closing. Model (2) restricts the repeat sales sample to only observations where both sales occurred after the hospital closed. Model (3) restricts the repeat sales to only observations where the first sale occurred before the hospital closed and the second sale occurred after the hospital closed. Model (4) uses the full repeat sales sample and uses the linear distance from the house to the hospital. All repeat sales models calculated with robust standard errors. (* p<0.10, ** p<0.05, *** p<0.01) N is the total number of observations in the regression.