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Does burglary affect property prices in a nonmetropolitan municipality?

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ABSTRACT

Although the international literature shows strong evidence of the effect of crime in large urban areas, particularly on housing prices, little is known about the link between crime and property prices in nonmetropolitan areas. This article describes the effect of residential burglary on the housing market in a nonmetropolitan municipality in Sweden, using data on property sales in 2005 and 2011. The study employs different strategies of hedonic price modelling to estimate the impact of residential burglary while controlling for property and neighbourhood characteristics; in particular, it explores the use of quantile regression and spatial analysis. The findings show that residential burglary has a significant negative effect on property prices in 2011 but no impact in 2005, which might be a result of the dramatic global economic downturn between these years. The article concludes with a discussion on the practical implications of the findings and offers suggestions for future research.

1. Introduction

Research has shown that crime has an impact on housing prices (Thaler, 1978; Rizzo, 1979; Buck et al., 1991; Bowes and Ihlanfeldt, 2001; Lynch and Rasmussen, 2001; Munroe, 2007; Hwang and Thill, 2009; Ceccato and Wilhelmsson, 2011, 2012). Yet this evidence is based on sales of properties located in large urban areas. For example, in Stockholm (the capital of Sweden), Ceccato and Wilhelmsson (2011, 2012) showed that crime and fear of crime negatively affected apartment prices and that residential burglary was the crime that affected housing prices the most. That study raised a number of new questions about the effect of residential burglary on the housing market, particularly whether this depreciative effect of crime on housing prices holds for properties located in nonmetropolitan municipalities.

The aim of this study is to contribute to this knowledge base by assessing whether residential burglary affects property prices in Jönköping, a nonmetropolitan municipality in Sweden. This is achieved by employing hedonic price modelling to estimate the impact of residential burglary while controlling for other factors (property-related characteristics, place features, neighbourhood characteristics). The willingness to pay for properties is taken as a function of the potential effect of residential burglary, together with other property and area attributes. Moreover, two independent datasets are used (one from 2005 and the other from 2011) so as to test the effect of residential burglary over time.

This paper makes important contributions about the links between housing, transaction costs, and residential burglary, and allows for some interesting comparisons to be drawn with the larger urban contexts. This research explores a set of land use attributes created by spatial techniques in combination with detailed geographical data in geographical information system (GIS). This study also assesses the variation in the estimated prices of housing across Jönköping by using quantile regression (Koenker, 2005; Zietz et al., 2007, 2008). In addition, this article tests the potential temporal variation of the effect of residential burglary on property prices. Based on data for property sales from 2005 to 2011, the study looks for indications of change in this possible effect on housing prices over this six-year period.

2. Crime and property prices: theory and hypotheses

The link between crime and property prices is well documented in the international literature (Thaler, 1978; Rizzo, 1979; Buck et al., 1991; Bowes and Ihlanfeldt, 2001; Lynch and Rasmussen, 2001). Thaler (1978) was one of the first scholars to show that property crime reduces house values by approximately 3 per cent; more recent studies have also found evidence of similar effects (Table 1),

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Table 1
Selection of studies: Impact of crime on property prices.

Source	Case study	Effect of crime on prices or rent
Kain and Quigley (1970)	St. Louis, MO, USA	No effect
Thaler (1978)	Rochester, NY, USA	Negative
Hellman and Naroff (1979)	Boston, MA, USA	Negative
Rizzo (1979)	Chicago, IL, USA, and Boston, MA, USA	Negative
Dubin and Goodman (1982)	Baltimore metropolitan area, MD, USA	Negative
Tita et al. (2006)	Columbus, OH, USA	Inconclusive
Munroe (2007)	Charlotte, NC, USA	Negative
Lynch and Rasmussen (2001)	Jacksonville, FL, USA	No effect/ positive effect
Bowes and Ihlanfeldt (2001)	Atlanta, GA, USA	Negative
Gibbons (2004)	London, UK	Negative
Ceccato and Wilhelmsson (2011)	Stockholm, Sweden	Negative
Ceccato and Wilhelmsson (2012)	Stockholm, Sweden	Negative

but not all studies have (see, e.g., Lynch and Rasmussen, 2001; Tita et al., 2006). According to Taylor (2008), where housing prices are concerned, the choice of attributes for analysis often involves characteristics of the property, characteristics of the property location, and features of the neighbourhood. However, there is no consensus on which set of relevant characteristics of the property and closest environments (including crime types) should be selected for price determination. Yet the vast majority of these studies point to a price reduction of properties when crime increases in an area (Table 1).

In the United States, Tita et al. (2006) demonstrated that crime impacted differently in different types of neighbourhoods and that violence had the most significant impact compared with any other crime. In the United Kingdom, Gibbons (2004) showed that residential burglary had no measurable impact on prices but that criminal damage did negatively affect housing prices. One explanation is that vandalism, graffiti, and other forms of criminal damage promote fear of crime in the community and may be taken as signals or symptoms of community instability and neighbourhood deterioration in general, thereby pulling housing prices down. In Sweden, residential burglary – not violence or property damage – had the greatest effect on property prices in the Swedish capital. An interpretation of this finding is that the targets of residential burglary are always in the intimacy of a private property (the apartment and objects in it), which can be perceived as more intrusive than acts of vandalism in streets or any other public place (Ceccato and Wilhelmsson, 2011), thereby strongly affecting housing prices.

Without exception, these studies were carried out in large urban areas. In other words, there has been little interest in assessing potential links between crime and property prices in nonmetropolitan municipalities. This neglect for smaller housing markets reflects the public perception that medium-sized and small municipalities are relatively crime free (Bell, 2006; Halfacree, 1993; Yarwood and Gardner, 2000). Ceccato and Dolmen 2011 noted that the downside of this assumption is that it ignores the potential effect of a particular crime event on the community. Crime (and fear of crime) in small and medium-sized municipalities can have a long-term effect on people's perceptions of risk and their own quality of life – even when some of these feelings are triggered by factors other than knowledge or experience of victimization (e.g. Scott et al., 2012; Little et al 2005; Ceccato and Dolmen, 2013).

Moreover, as in large urban areas, nonmetropolitan areas might have ‘no-go areas’, places that are feared by many (Barrett and Friis, 2014) and where prices are extra depreciated. Thus, it is hypothesized here that property prices also decrease in nonmetropolitan municipalities as crime increases, thereby affecting the quality and reputation of the area – like in ‘a spiral of decay’ (Skogan, 1990). The downward spiral of decay is at work in nonmetropolitan municipalities as crime and disorder generate feelings of fear that make affluent homeowners move out (Ceccato and Haining, 2005). Because these areas are dependent on property tax as a source of revenue, the inability to control crime may have effects on urban public revenues and in turn may impede these places from ensuring safety in the future (Naroff et al., 1980). Residential instability may result in increased geographical segregation based on socioeconomic status, and in this type of situation, prices are expected to go down. Yet there has been no systematic analysis of the impact of crime on property prices in nonmetropolitan municipalities over time. Thus, it is hypothesized here that changes in the residential burglary rate over a period of time also influence property prices in nonmetropolitan municipalities.

In light of recent Swedish and international research on residential burglary and housing, the following hypotheses are proposed about the case study of Jönköping, a nonmetropolitan municipality in Sweden:

Hypothesis 1. Residential burglary negatively impacts apartment prices, after controlling for attributes of the property and neighbourhood characteristics.

Hypothesis 2. Residential burglary affects different market segments differently. Residential burglary will have a stronger negative effect on high-priced apartments, regardless of year (upper quantile compared with lower quantile).

Hypothesis 3. The effect of residential burglary on property prices varies over time. Property prices will be more negatively affected in areas that show higher increases in residential burglary rates (changes). It is expected that the impact of residential burglary on neighbourhoods is not homogenous, either spatially or over time. An increase in residential burglary may have less effect on the real estate market (the effect of residential burglary on prices) in a continually criminogenic residential area than it would in an area that was once safe (low crime) but suddenly becomes a high crime neighbourhood. It takes time for new buyers to absorb the depreciative effect of crime on housing prices; there is a lag in this effect, which can be detected by fitting the model in two different times.

It is worth noting that these hypotheses are tested in property sales in Jönköping's urban area only, therefore excluding isolated and scattered property sales outside the urban concentration of the municipality. This article focuses on testing the variation in property prices on a smaller geographical scale within a single Swedish nonmetropolitan municipality.

3. The study case

Jönköping was selected as a case study for several reasons. It is perhaps not appropriate to call Jönköping a medium-sized municipality, especially in terms of its population size (it is the ninth most populous city in Sweden). However, Jönköping shares a number of characteristics with other nonmetropolitan municipalities in Sweden. First, the municipality is geographically isolated from the three main urban Swedish centres of Stockholm, Gothenburg, and Malmö (e.g. Jönköping is three hours by train/four hours by bus from Stockholm). Second, the municipality has a university and access to good transportation, but commuting from Jönköping to these main urban centres is not viable on a daily basis, which adds a new layer of isolation. Third, in terms of safety, the number of reported crimes per 1000 inhabitants in Jönköping is lower than the national average, a typical feature of nonmetropolitan municipalities in Sweden. This is also the case for residential burglary (Table 2). Fourth, the municipality has a housing market that is sufficiently large to allow the modelling of the impact of residential burglary on property prices. Municipalities smaller than Jönköping would not, however, provide sufficient observations for such a quantitative analysis as performed in this study. One major difference between municipalities within a larger metropolitan urban area and a nonmetropolitan municipality is the share of apartments. The apartment share in Jönköping is, for example, only 46 percent compared with 84 percent in Stockholm. The share of owner-occupied apartments is also much lower in Jönköping than in Stockholm (14 percent compared with 41 percent, respectively). Hence, the rental apartment market is relatively more important in Jönköping than in Stockholm. Another difference is that the supply deficit of rental apartments is much higher in Stockholm than in Jönköping, indicating that the housing market is more effective in Jönköping.

Jönköping is located in southern Sweden, along the southern end of Sweden's second largest lake, Vättern (Fig. 1). The original municipality of Jönköping has grown together with other smaller villages, forming a contiguous urban area. Jönköping has a housing deficit. Each year, many young people move to Jönköping because of its university. Although the municipality of Jönköping shows an increase in total population, several nonmetropolitan municipalities in the county have experienced a drop in population (Länsstyrelsen, 2012). Commuting has increased both to and from the municipality in the past five years. The largest commuting flows to Jönköping are from neighbouring municipalities, which may also explain the criminogenic conditions of the area. Most of the homes are apartments (about 60 percent). Of those, about 45 percent are rentals, about 35 percent are owned, and 17 percent are condominiums.

The average net income for all families in Jönköping is lower than that for the nation as a whole. The so-called vulnerable residential areas are dominated by apartment buildings and by populations with high unemployment and low education levels. Dependence on social aid in these vulverable residental areas is high compared with the city in general. These areas often have a large proportion of foreign-born persons (Jönköping City Office, 2009) and are located on the outskirts of the municipality.

The number of reported crimes per 1000 inhabitants in Jönköping is lower than those in Stockholm, Gothenburg, and Malmö, as well as the national average. This applies to both violence and thefts, but reported violence rates have increased slightly faster than the national average rate (about 33 percent in Jönköping and 28 percent in Sweden) since early 2000. For thefts, Jönköping follows the national trend of a reduction of 30 percent since 2000 (Fig. 2). The reduction of theft rates in Jönköping (Fig. 2) did not happen homogenously throughout the city. Increases for overall crime rates between 2005 and 2011 were found in areas on the outskirts of the municipality, particularly in the eastern areas. Although there was an *overall* reduction in residential burglary in Jönköping, increases were concentrated in the eastern areas of the municipality, particularly in Huskvarna.

Table 2
Main characteristics of Jönköping in relation to the capital city, Stockholm.

Characteristic	Jönköping (small municipality)	Stockholm (capital city)
Land area, km^2	44	187
Population, 2014/2013	131 847	897 700
Population density, 2014/2013, inhab./km^2	2996.5	4796.8
Apartment share, %	84	46
Unemployment rate, 2013/2012, %	7.4	5.3
Youth unemployment rate, 2013/2012, %	15.1	5.2
Crime per 100,000 inhabitants, 2013	10 204	22 532
Residential burglary per 100,000 inhab., 2013	158	287

Source: Wikipedia (2014a,b); Stockholm Municipality (2012), pp. 3, 59; BRÅ (2014); own results.

4. Data and method

In this section, the datasets used in the analysis are presented. They derive from a number of different sources. The processes of creating spatial variables and crime rates are also discussed. The remainder of the section is devoted to the estimation of the hedonic price equation.

4.1. Data

The estimation of the hedonic equation in this article is based on two cross-sectional data sets that include arm's-length transactions of apartment sales in cooperative housing societies (*bostadsrätter*) in Jönköping, Sweden. The database contains the following information: property address; area code; parish code postal code; x,y coordinates; selling price; date of disposal; date of contract; monthly fee to the cooperative; number of rooms; living area; year of construction; presence of balcony and elevator; price per square metre; number of the floor of the specific apartment; and the total number of floors. The data cover a time span from January through December of 2005 and 2011, with 450 and 716 transactions of apartment sales, respectively.

The merging of apartment sales data with land use and demographic and socioeconomic data from the City Planning Office for Jönköping (Stadsbyggnadskontoret) and Jönköping Police was carried out with GIS. The database of the City Planning Office consists of data on built-up areas, the waterfront, roads, bars, bus stops, population age, and population income, whereas the database of Jönköping Police contains crime statistics, such as the number of burglaries per 10,000 inhabitants. Measures of distance to the central business district (CBD) of Jönköping were created to reflect the properties relative locations in the city context. Buffer analysis (Ceccato and Haining, 2005) allowed the creation of variables that would indicate proximity to different types of amenities (e.g., a park) or disamenities (e.g., a road). Instead of a fixed distance being defined, different distance bands were tested (50 m, 100 m). Buffer analysis was used for limiting areas surrounding geographic features (a point, a polygon, or a line). In a GIS, the process involves generating a polygon around existing geographic features and then identifying or selecting features based on whether they fall inside or outside the boundary of the polygon.

Residential burglary data for 2005 and 2011 were provided by Jönköping Police and contained the x,y coordinates of each address. The GIS function 'creating points' was used to associate a dot to each apartment address. These dots were later used in determining residential burglary rates per small unit area (Fig. 3). To link residential burglary rates by area to the x,y coordinates of each apartment sale, the map of the city of Jönköping was layered over the apartments' x,y coordinates. Residential burglary rates were calculated for each corresponding sale within the boundaries of a polygon. This procedure was performed with the standard table 'join function' in GIS. Rates per small unit area were calculated for total crime, residential burglary, theft, vandalism, and violence, as well as drug-related offences, with residential population as the denominator. Fig. 3 shows the differences between dots and polygons by showing counts, rates, and changes in rates (2005–2011) for residential burglary. Most areas with increases in rates between 2005 and 2011 are located in Huskvarna (on the right-hand side of the map).

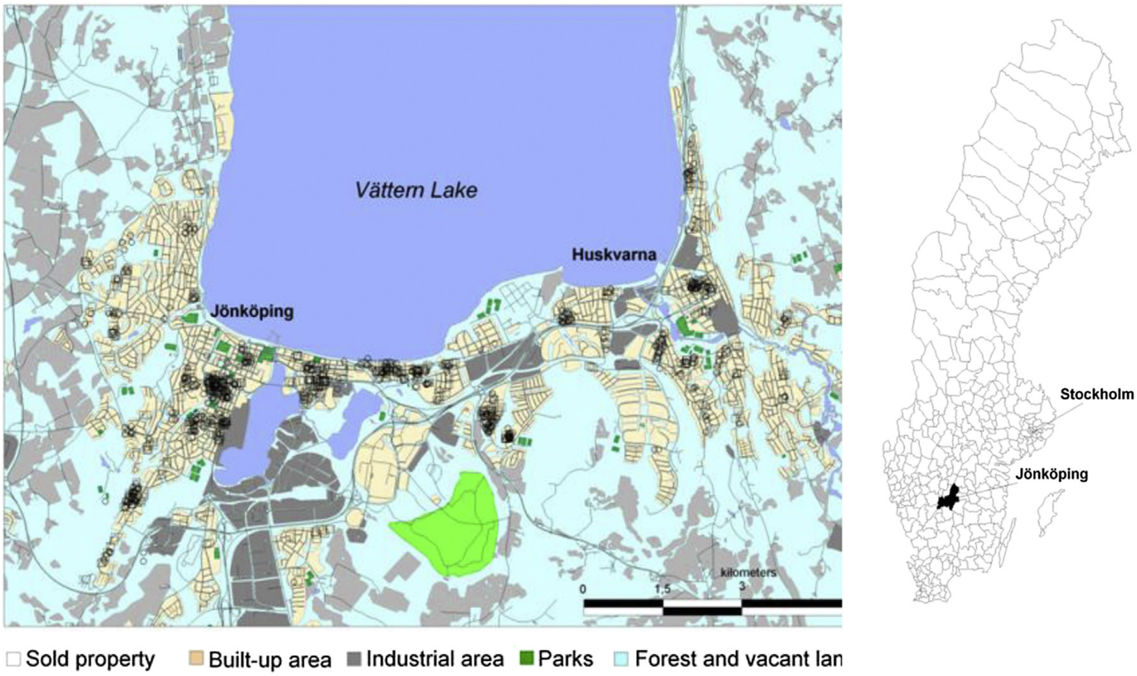

Fig. 1. Study area.

This study concentrates on reporting the results of residential burglary only because it was the type of crime with sufficient numbers of observations for both 2005 and 2011. Moreover, Ceccato and Wilhelmsson (2011) found that residential burglary in Stockholm exhibited the strongest effect on apartment prices in comparison to other types of crime. These previous results thereby provide a good basis for studying the effects of residential burglary in Jönköping.

4.2. Modelling

The price of a property reflects attributes associated with it (or perceived to be), which can be of two types: those related to the property itself and those related to the environment in which the property is located. Property characteristics that can affect its price include the size of the apartment, the size of the rooms, the age of the apartment, the architectural style of the apartment, the floor level of the apartment, and the cost of condominium fees. The price is also a function of where the property is located in the neighbourhood and/or in the municipality. One way to assess the individual contribution of each attribute to the price of a good is to employ hedonic price modelling. Traditionally, hedonic price modelling is used to assess property values and one's willingness to pay for the property (Wilhelmsson, 2000, 2002a). Rosen (1974) suggested that the price of a good is based on attributes that are not homogenously distributed over space; such differences can be implicitly revealed by observed differences in prices. In the case of housing, preferences for various attributes are revealed through the price that one implicitly pays for these attributes.

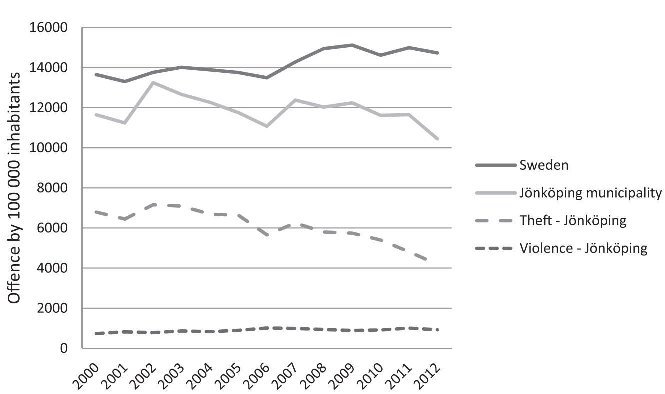

Fig. 2. Offences per 100,000 inhabitants, Sweden total, Jönköping total, theft and violence rates. Data source, BRÅ (2013).

All continuous variables were transformed before modelling by taking the natural logarithm. The transformation is a common practice in this type of research because it facilitates the interpretation of the results as all estimates are in elasticity form. The benchmark hedonic model used all previously described property and apartment attributes together with time period dummies (month) and location variables. The first model was estimated using ordinary least squares (OLS). The second model was estimated controlling for outliers (robust regression). Spatial diagnostics were also tested (e.g., Moran's I). The crime variable was residential burglary per 1000 inhabitants.

A problem recognized in the literature is the endogeneity between crime and housing prices (Gibbons, 2004). To address endogeneity bias, an instrumental variable was used in the third model to try to remove residential burglary correlation with unobservable influences on apartment prices, using variables that are correlated with residential burglary but not with apartment prices. In this study, the following instrumental variables were used: the share of young males in the area and the share of convenience stores (e.g. 7-Eleven). To test whether the variable residential burglary was indeed endogenous, we first used a test proposed by Wooldridge (2006) and used by Wassmer (2008). Residential burglary was regressed against all explanatory variables including the two instruments (numbers of males and stores per square kilometre). We then predicted the residuals and used them as an additional independent variable in the structural equation where the variable apartment price is used as dependent variable. To test

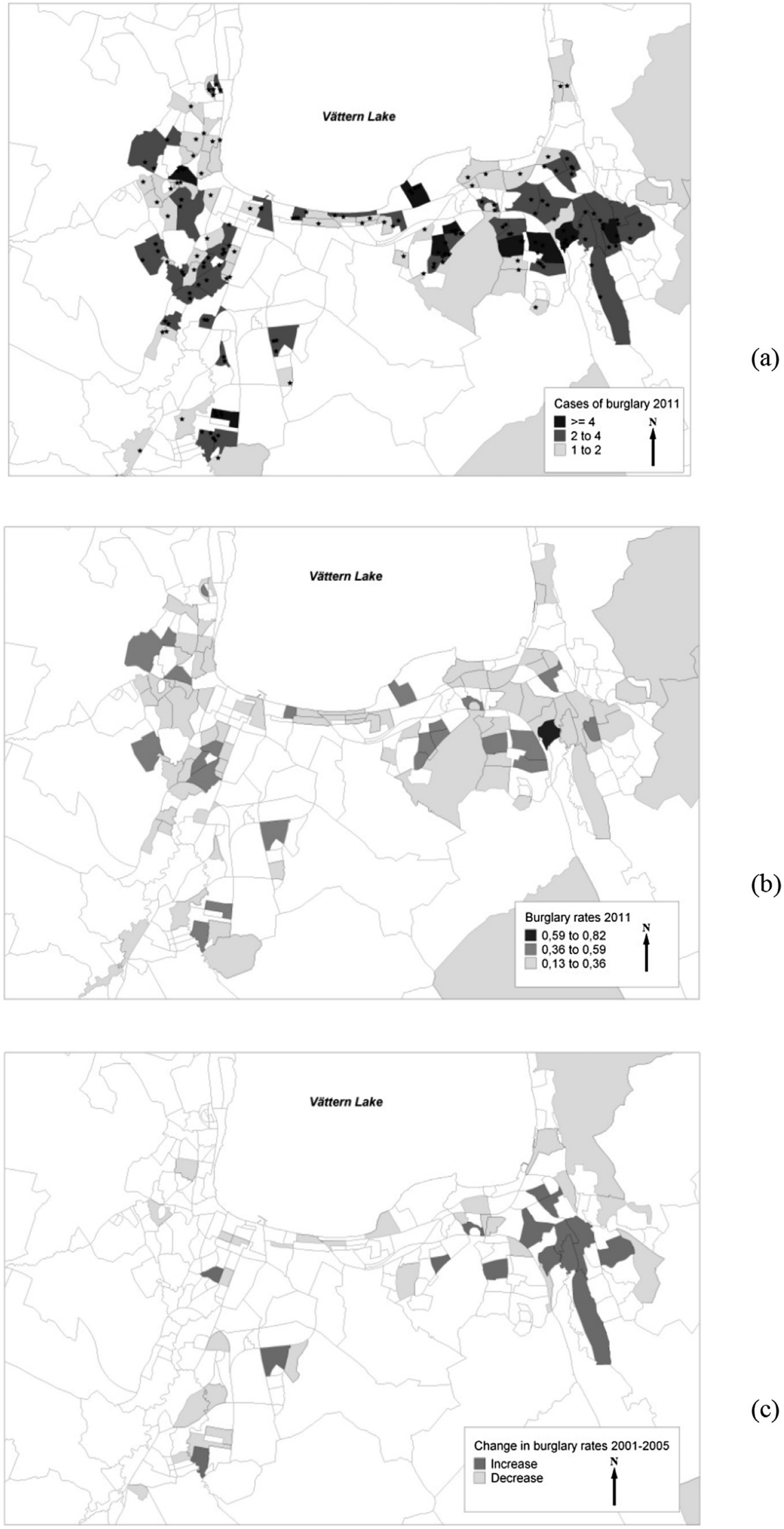

Fig. 3. Residential burglary: (a) Counts, (b) Rates and (c) Change 2011–2005.
Data source: Jönköping police records, 2012.

for weak instruments, an F test was performed (the results are discussed in section 5). The exogeneity condition was tested with Sargan J and difference-in-Sargan statistics (for an extended discussion about instrument approaches and weak instruments, see Murray, 2006; Bascle, 2008; Stock and Watson, 2012).

The fourth set of models is composed of the quantile regression models. To identify the implicit prices of housing characteristics for different points in the distribution of house prices, the data set is split at .25 and .75, resulting in three quantiles – referred to here as 'lower', 'mid', and 'upper'. This allows higher-priced properties to have a different price for a housing characteristic than lower-priced properties. Quantile regression is based on the minimization of weighted absolute deviations to estimate conditional quantile functions. For the mid quantile, symmetric weights are used, and for the lower and upper quantiles, asymmetric weights are employed (Koenker and Bassett, 1978; Koenker and Hallock, 2001, as cited in Zietz et al., 2007).

The fifth and sixth models are a spatial lag model and a spatial error model, respectively. They are used for several reasons. The benchmark OLS model shows indications of spatial autocorrelation on residuals, a condition that goes against the basic assumptions of OLS regression. One way to deal with this violation is to use spatial lag and spatial error models (Wilhelmsson, 2002b). The use of these models is necessary to obtain unbiased and efficient estimates for the regression parameters in the model. Another reason is that the spatial lag model can help indicate the concentrations of a phenomenon that go over polygon boundaries and, perhaps, some type of diffusion over space. The spatial error model 'captures the spatial influence of unmeasured independent variables' (Baller et al., 2001: 567). Therefore, it can help evaluate the extent to which the clustering of housing prices *not* explained by the measured independent variables can instead be accounted for with reference to the clustering of error terms. An inverse distance weight matrix was created to represent the spatial arrangement of the city and was used for the spatial diagnostics of the models. A significant Moran's I test means that the model shows problems of autocorrelation on residuals, which can, among other things, inflate the goodness of fit of the model. A common practice is to test alternative autoregressive models, such as spatial lag and spatial error models. The measure Akaike information criterion (AIC) was used as a reference to assess the performance of the models because it takes into consideration the trade-off between the number of independent variables in the equation and the number of observations.[1]

5. Results

The findings show that, regardless of the modelling strategy employed, residential burglary in Jönköping has a significant negative effect on property prices in 2011, but no impact in 2005. A possible explanation for this finding is that neither residential burglary nor other property characteristics affect the market in the same way over time. Table 3 shows the results of the models described above – from left to right: the standard OLS regression model, the robust on outliers model, the instrumental model, the quantile regressions model, and the spatial models. The results indicate that more than 60 percent of the variation in apartment prices in 2005 can be explained by the included hedonic attributes and that this value increases to 77 percent in 2011. Under each model, the coefficient estimates are followed by either t or z values for all models (a value above 2 indicates statistical significance of a coefficient estimate, which was inspected in combination with alpha values). The p values for the Wooldridge exogeneity test are .415 and .003 in 2005 and 2011, respectively. These values indicate that residential burglary is indeed endogenously determined in the 2011 sample but is exogenously determined in the 2005 sample. According to Stock and Watson (2012: 481), a first-stage F statistic less than 10 indicates that the instruments are weak. Here the F statistics are estimated to be equal to 4.8 in the 2005 sample and 11.12 in the 2011 sample. That is, the instruments are considered to be weak in the 2005 sample, but strong in the 2011 sample. Fortunately, in the 2005 sample, burglary did not seem to be endogenously determined. According to the overidentification tests, both instruments are exogenous (see Sargan J statistics; p values of .85 and .78). A difference-in-Sargan test (see p value of C statistics) was run on the 'male' and 'store' instruments, respectively, to test whether they violate the exogeneity condition. The statistics show that both instruments can be considered to be exogenous (p values of .835 and .553, respectively). The lagged response model performs well, with 69 percent (2005) and 77 percent (2011) of the variation in prices being explained, and there is no evidence of spatial autocorrelation in the residuals. By comparison, the spatial error model explains less of the variation in prices but shows the same significant variables in both 2005 and 2011.

Overall, the 2011 findings for Jönköping are in accordance with evidence from previous studies based on larger urban centres and/or metropolitan areas (see, e.g., Thaler, 1978; Hellman and Naroff, 1979; Rizzo, 1979; Dubin and Goodman, 1982; Munroe, 2007; Bowes and Ihlanfeldt, 2001; Gibbons, 2004; Ceccato and Wilhelmsson, 2011, 2012). All estimated parameters concerning property and apartment attributes have the expected sign. The estimates for the location variables (proximity to water, distance from road, distance to city centre, burglary rates) have lost power or become non-significant when moving from OLS to the spatial models (in other words, these variables do not explain the variation of prices in the spatial models as they do in the OLS ones). Similar to what has been previously demonstrated in Stockholm (Ceccato and Wilhelmsson, 2011), spatial models in Jönköping capture the real spatial structure that is a proxy of the location variables in the classical OLS models. When the spatial structured is controlled, the models perform better (compare AIC values as well as goodness of fit values).

In both 2005 and 2011, the properties' distance to the main centre of Jönköping (not Huskvarna) was the variable that most affected property prices negatively. The coefficient concerning the variable distance to the eastern centre of Huskvarna is significant and negative but, in most of the models, much less important than the city of Jönköping itself. Property prices are also discounted by an average of 20 percent if they were built after the 1960s. By contrast, housing prices increase if houses are larger or close to the water, particularly in 2011. It is interesting to observe that the effect of the estimated parameters concerning location variables is similar in 2005 and 2011. The significant coefficients show stability across models and across the years.

The findings partially confirm the second hypothesis that residential burglary affects different market segments differently – at least for the sales in 2011. The variable burglary rates is slightly more significant for prices in the upper range than for those in the lower range or midrange. In addition, being close to the water and far from a major road is particularly more important for property prices in the lower range than for the prices in other quantiles. The size of the property is important in 2011 for all price categories, but in 2005, it affects apartment prices in the upper range in particular.

Testing of hypothesis 3 revealed that the size of the sample in 2005 (40 percent smaller than in 2011) seems to have also had an effect on the power of the model, which could explain the non-

[1] $\mathrm{AIC} = n \cdot \ln(\mathrm{RSS}/n) + 2k$, where n is equal to the number of observations and k is equal to the number of independent variables. RSS is the residual sum of squares.

Table 3
Hedonic price equation – Apartments sold in housing cooperatives in Jönköping, 2005 and 2011.

		OLS		Robust on outliers		Instrumental		.25 quantile		.50 quantile		.75 quantile		Spatial lag		Error	
		Coef.	*t* values	Coef.	*t* values	Coef.	*t* values	Coef.	*t* values	Coef.	*t* values	Coef.	*t* values	Coef.	*z* values	Coef.	z values
2005 ($N = 441$)	Area	.974	7.05	1.000	7.18	.984	6.92	.686	4.90	.967	4.27	1.082	7.63	.837	6.71	.958	7.54
	Fee	−.655	−9.03	−.62	−8.87	−.656	−9.24	−.572	−7.65	−6.616	−5.52	−.504	−7.32	−.476	−7.31	−.598	−8.25
	Room	.277	3.43	.262	2.98	.264	2.89	.391	4.10	.302	2.08	.211	2.52	.286	3.57	.301	3.84
	Top floor	.031	.098	−.382	−7.90	.039	1.17	−.022	−.67	.048	.90	.95	3.01	.043	1.46	.048	1.71
	Road50 m	−.017	−.53	−.0133	−.33	−.0002	−.00	.047	.94	−.041	−.55	−.026	−.67	−.028	−.69	−.040	−.98
	Water50 m	. 385	4.78	−.382	3.93	.361	3.49	.455	4.50	.400	2.58	.389	3.03	.317	3.51	.327	3.60
	DistJönköping	−.294	−18.63	−.285	−18.07	−.295	−18.33	−.287	−15.09	−2.281	−10.96	−.246	−20.13	−.191	−11.20	−.292	−11.20
	DistHuskvar	−.073	−2.02	−.052	−1.46	−.095	−2.06	−.085	−1.61	−.064	−.89	−.007	−.21	−1.100	−2.46	−.069	−1.13
	Age40_64	.019	.44	−.009	−.19	−.004	−.07	.327	3.79	.121	1.00	.120	1.71	−.078	−1.34	−.098	−1.48
	Age65_84	−.089	−1.60	−.137	−2.66	−.108	−1.88	.094	.098	−.002	−.02	−.028	−.41	−.226	−3.75	−.207	−3.11
	AgeOlder_85	−.035	−.42	−.142	−2.22	−.068	−.87	.224	2.98	−.079	−.56	.143	1.75	−.227	−2.97	−.198	−2.41
	RBurgrate05	−.229	−1.85	−.216	−1.69	−.618	−1.17	−.630	−1.16	−.362	−.43	−.350	−.80	−2.240	−.53	−.077	−.15
	Constant	16.784	24.30	16.199	24.93	17.02	23.37	16.966	19.75	12.208	13.94	14.407	23.83	5.343	4.16	16.424	20.50
	R^2/(pseudo)	.613		.596		.611		.433		.394		.404		.691		.617	
	AIC	16828.8		12634.8		1631.2		1825.1	–	1640.3		1865.7		–		–	
	λ/ρ	–	–	–	–	–	–	–	–			–		ρ = 774	9.86	λ = .909	15.98
	Moran's I	14.122		13.191		13.667		12.574		13.302		12.620		–		–	
2011 ($N = 750$)	Area	.8525	11.38	.844	10.82	.979	.089	1.139	9.49	.843	9.08	.884	8.60	.820	10.56	.964	12.04
	Fee	−.235	−5.03	−.198	−4.28	−.157	−2.92	−1.184	−3.02	−.101	−1.90	−.031	−.51	−.061	−1.02	−.097	−1.42
	Room	.161	.022	.131	2.46	−.017	−.21	−136	−1.30	.017	.20	.003	.03	.040	.53	−.025	−.30
	Top floor	.027	1.24	.027	1.34	.029	1.38	.0115	.41	.045	2.01	.058	2.36	.032	1.70	.032	1.81
	Road50 m	.008	.34	.025	1.02	.015	.59	−.017	−.5.42	.061	2.32	.031	1.10	−.025	−1.11	−.048	−1.86
	Water50 m	.406	10.50	.389	4.47	.609	5.47	.683	5.42	.491	4.49	.499	3.98	.423	4.28	.499	4.35
	DistJönköping	−.251	−18.20	−2.248	−22.91	−2.287	−17.79	−2.288	−12.00	−.288	−17.25	−2.266	−15.58	−.138	−7.71	−.266	−10.31
	DistHuskvar	−.051	.030	−.045	−1.89	−.253	−3.52	−.213	−2.19	−.219	−5.86	−.279	−3.38	−.189	−2.71	−.221	−2.45
	Age40_64	−.203	−6.00	−1.199	−5.89	−.218	−6.32	−.124	−2.58	−.208	−5.86	−.253	−6.79	−.230	−5.26	−.276	−5.57
	Age65_84	−.340	−8.33	−3.321	−8.80	−3.347	−6.32	−.277	−5.32	−3.342	−8.91	−.351	−8.36	−.343	−7.25	−.346	−.6.52
	AgeOlder_85	−.247	−.5.23	−2.234	−5.86	−.452	−5.67	−.421	−4.03	−.388	−4.66	−.454	−4.75	−.476	−4.74	−.562	−4.71
	RBurgrate11	−.230	−3.44	−.278	−3.86	−1.842	−3.37	−1.741	−2.42	−1.641	−2.89	−1.947	−3.10	−1.178	−2.30	−1.586	−2.56
	Constant	14.675	29.73	14.34	33.87	15.987	26.00	15.035	16.59	15.738	24.87	15.601	24.22	2.939	2.80	14.834	16.34
	R^2/(pseudo)	.697		.691		.697		.450		.449		.467		.772		.690	
	AIC	2928.6	–	2935.3		2935.3		3221.6		1781.5		1966.8		−25.668		−79.284	
	λ/ρ	–	–											ρ = .805	14.43	λ = .979	51.28
	Moran's I	20.000		18.946		20.191		19.735		17.561		18.37		–		–	

Note: Dependent variable = natural logarithm of transaction price. Parameter estimates months of the year are not shown in the table.

significance of important variables (including residential burglary) that are significant in 2011. If this is the case, these findings indicate the existence of a threshold in terms of sample size in which hedonic modelling can actually produce a model fit. Another explanation is that these covariates could not explain the variation of apartment prices in that particular year; the model is therefore misspecified. For this reason, comparisons between results will be made only in a cross-sectional manner in the remainder of this article.

6. Discussion and conclusions

The objective of this study is to assess whether residential burglary affects property prices in a Swedish nonmetropolitan municipality in the same way as for a large city, namely, Stockholm, the capital of Sweden. Hedonic price modelling was employed to estimate the impact of residential burglary while controlling for other factors (property-related characteristics, place features, neighbourhood characteristics) for two time periods (2005 and 2011). This study set out to assess the use of quantile regression in hedonic price modelling to identify the significant coefficients across a given distribution of property prices.

Overall, the results for Jönköping for 2011 are in agreement with evidence from previous studies based on larger urban centres and/or metropolitan areas. The most important finding is that properties are discounted to a greater extent in areas with a concentration of residential burglary. These findings allow for some interesting comparisons to be drawn with the larger urban contexts. As with any other disamenity, poor urban safety (high residential burglary) is incorporated into the housing market and becomes part of the final property price in both metropolitan and nonmetropolitan municipalities.

The findings indicate that residential burglary has a negative impact on property prices and that its effect varies across price categories. For instance, the variable burglary rates is slightly more significant for prices in the upper quantile than for those in the lower quantile or the midquantile. These results provide evidence of the need to consider buyers' preferences as well as their capacity to pay for these preferences. As expected, buyers of the higher-priced properties in the market appreciate certain housing characteristics in a different way compared with buyers of lower-priced properties. In summary, residential burglary in Jönköping is an endemic problem that is incorporated by buyers and housing market agents in the process of price setting.

It is difficult to explain for certain why residential burglary has a significant negative effect on property prices in Jönköping in 2011 but no impact in 2005. These findings may indicate that neither residential burglary nor other property characteristics affect the market in the same way over time. A possible explanation might be the dramatic global economic downturn between these years, which affected the structure of the housing markets in both supply and demand. Another explanation is that although overall crime rates have been stable in Jönköping during the past decade, they have increased in certain areas of the municipality. This change in the geography of crime might be one of the underlying factors of why residential burglary affects prices in 2011 but not in 2005. In addition, the size of the sample or the misspecification of the model may help explain the poor performance of the models based on the 2005 data.

This study is not free of limitations. An important one is a potential problem with sample selection bias – that is, when properties that sell are not a random selection of all properties. Perhaps properties in high crime areas are less likely to sell; if this is the case, then the results will be biased. Future studies could deal with this potential problem by collapsing data over a number of years into a database until all neighbourhoods have enough selling objects. Future research should also explore the effect of other potential amenities that are likely to affect housing prices, such as the location of schools. These findings indicate the possible existence of a threshold in terms of size of the dataset (number of observations) in hedonic modelling, at least in the assessment of the area-level effect. Thus, tiny differences in willingness to pay over space in a small sample of sales perhaps do not have an impact on housing prices where regression models are concerned. However, the 'lack of effect of willingness to pay' may not be a result of a small number of observations but rather a genuine mechanism of price appreciation. For instance, in small municipalities, the effect of living close to nature may not be as important as in an inner-city neighbourhood, where this amenity is scarce.

A remaining question is whether prices are affected by fear of crime as they are by crime. In the Swedish context, levels of overall worry are the same in urban and medium-sized and small municipalities, whereas fear of crime (triggered often by local factors) is higher in Stockholm, Gothenburg, and Malmö than in nonmetropolitan areas (Ceccato and Dolmen, 2013). Because fear of crime is eminently an urban phenomenon, its impact on property prices is expected to be small or non-significant in nonmetropolitan municipalities – contrary to the effect of residential burglary, as shown in the case of Jönköping.

What do these findings say about crime and housing markets in nonmetropolitan municipalities in Sweden? Although the rental apartment market is relatively more important in Jönköping than in Stockholm (the apartment share and owner-occupied apartment housing in Jönköping are smaller than in Stockholm; see Table 2), the effect of residential burglary on property prices is similar in these municipalities. Thus, the findings reported in this article have clear practical implications. Residential burglary does have an effect on housing markets, regardless of municipality size. For police, security, and housing companies, findings of this type can be useful not only in identifying buildings and/or areas in the community that are in great need of housing safety measures (e.g. locks, better doors, illumination) but also in establishing neighbourhood safety schemes and safety partnerships with residents and other local actors. For individual citizens, when searching for a new home, buyers can make use of the local knowledge about the area to obtain a discount when purchasing a property that is located in a building or in a part of the municipality that is frequently targeted by burglars. For urban planners, the evidence put forward here can be helpful in two ways. From a physical planning point of view, if certain buildings and/or areas are highly targeted by crime, an inspection of the design and layout of places and activities that potentially 'allow' burglary to happen is fundamental. From a social point of view, findings such as these can be valuable in the early detection of other problems in the area. For instance, an area with many burglaries may also become plagued with vandalism, which, in the long run, prompts people to move out. A safety initiative that engages residents and other local actors in partnerships may help curb crime. As indicated by Yarwood (2001:409), for these initiatives to be successful, they must engage all sorts of people in a locality, not just those who are already involved in crime prevention, and allow as wide a range of voices as possible to be heard, thereby preventing discriminatory practices against groups. If well planned, such initiatives have the potential to foster new social contacts among locals, improve the overall perceived quality of the area, and, in the long run, disrupt the ongoing downward spiral of the area.

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