Ceccato, Vania; Wilhemson, Mats

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The cost of fear of crime on apartment prices

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Vania Ceccato
Department of Urban Planning and Environment
School of Architecture and the Built Environment
Royal Institute of Technology
Drottning Kristinas väg 30, Stockholm 10044
Sweden
Tel. +46-8-7909221
vania.ceccato@abe.kth.se

Mats Wilhemson
Centre for Bank and Finance
School of Architecture and the Built Environment
Royal Institute of Technology
Drottning Kristinas väg 30, Stockholm 10044
Sweden
Tel. +46-8-7909225
matswil@kth.se

Abstract

Evidence shows that crime affects housing prices. However, whether fear of crime impacts equally on prices of properties is an issue that is little investigated in the international literature. In this article we assess the impact of perceived safety on housing prices in the city of Stockholm, capital of Sweden. The study uses data over apartment sales and responses of 2008's Stockholm Safety Survey aggregated by parishes. The effect of perceived safety is assessed using hedonic pricing modelling controlling for a number of land use covariates using Geographical Information System (GIS). Results show that fear of crime has a strong impact on apartment prices, regardless the measure tested. The effect of fear of crime on property prices is little affected by vandalism levels in an area. Apartment prices are lower in areas that show high levels of fear of crime, where people do not take precautionary measures to prevent crime and where people avoid going out by themselves.

Keywords: fear of crime, housing prices, hedonic modelling, GIS.

1. Introduction

Fear of crime has an impact on people's lives (Taylor, 1995). It affects people's movement patterns and daily living habits, fear also drives residential location and choice of schools (Adams and Serpe, 2000, Gibbons, 2004). Perceived safety is argued to be more important than actually crime because it goes beyond the tangible economic and physical losses imposed by criminals on crime victims. Williams et al. (2000) suggests that fear of crime causes more damage than actual victimization due to the effect of long-term stress. Fear also affects social order, mutual trust and social cohesion (Moore and Shepherd, 2006), it promotes insecurity and anxiety that may have the power to affect the local housing market more than actual crime rates. However, whether fear of crime impacts on prices of properties is an issue that is little investigated in the international literature (but see, e.g., Linden and Rockoff, 2005, Pope, 2008). Many studies assessed the effect of actually crime on property prices but their results may be considered as inconclusive or context dependent (e.g., Thaler, 1978; Buck et al., 1991, Bowes and Ihlanfedt, 2001, Gibbons, 2004, Ceccato and Wilhemsson 2010). Under Swedish conditions, for instance, Ceccato and Wilhemsson (2010) show that crime does affect property prices. When offences were broken down by types, residential burglary, theft, vandalism, assault and robbery individually had a significant negative effect on property values not only on the location of the property but also in its surrounding areas.

In this article we assess whether fear of crime affects apartment prices using data of about 9000 apartment sales in Stockholm, Sweden, in 2008. This will be achieved by employing hedonic pricing modelling to estimate the impact of crime and fear of crime controlling for other factors (property related characteristics, place features, neighborhood characteristics). The study explores a set of land use attributes created by spatial techniques (e.g., cluster techniques, inverse distance matrices) in GIS in combination with detailed geographical data in hedonic pricing modelling. A series of variables that are often not used in previous studies using GIS, such as proximity to highways, water, underground stations are included. The use of spatial analysis in combination with GIS (Geographical Information Systems) has been argued to be useful tools for urban analysis of safety (Ceccato and Snickars, 2000, Chainey and Ratcliffe, 2005). Then, whether perceived safety (instead of crime rates) affects property

prices will be assessed using hedonic pricing modelling. Methodologically, we suggest and aim to demonstrate that, combined with housing hedonic variables, land use measures created using GIS, hedonic prices models are a powerful tool for advancing our knowledge about the impact of fear of crime on property prices. As far as we know, the effect of fear of crime on property prices as it is performed in this study has never before been empirically tested.

2. Fear of crime and property prices: theory and hypotheses of study

The feeling of being safe is an important quality of a home and its setting (Lind and Bergenstråhle (2002). Security plays an important role when people in Sweden are choosing a place to live (Fransson et al., 2002, Magnusson and Berger, 1996, Björkund and Klingborg, 2003, Werner, 2003). Lack of security can affect housing quality in so many ways (for a discussion, see Björkund and Klingborg, 2003). Although these studies are more concerned on how people assess housing qualities in general, they clearly indicate that security is a factor of importance in their choice. In Magnusson and Berger (1996), for instance, safety was ranked as 4.1 in a scale from 0 to 5 whilst in Fransson et al., (2002), 85% of the interviewed population regarded safety as a quality that they take into consideration before choosing a place to live. None of these studies however deal with the specific relationship between lack of safety (fear of crime) and housing prices, or in other words, whether people in Stockholm would be willing to pay more to live in safer neighbourhoods.

Below we explain how **hedonic prices models** can be a useful tool to analyze property values. These models are based on the principle that goods are not homogenous and differ in numerous attributes, which can be implicitly revealed by observed differences in prices (Rosen, 1974). In the case of housing, preferences for various attributes are revealed through the price one implicitly pays for these attributes, which can be expressed as:

$$y = \beta x + \varepsilon \qquad (1)$$

where y is a vector of observations on the sales price; X is a matrix observations on the property attributes, β is the associated vector of regression coefficients (the marginal implicit price of each

attribute) and ε is a vector of random error terms. According to Taylor (2008), where housing prices are concerned, the choice of attributes often involves characteristics of the property, characteristics of the property location and features of the surroundings.

There is no agreement on which set of relevant characteristics of the city structure and environments should be selected for price determination. They are often related to different environments to which the property is exposed, and how these may add to or subtract from the value the property. It is difficult, however, to control for all possible relevant neighbourhood factors (Can, 1990). An apartment facing a lake may add value to a property, whilst one close to an industrial site or close to a sex offender residence may have its price discounted (see e.g., Larsen et al., 2003, Linden and Rockoff, 2006, Karlsson, 2008, Kryvobokov and Wilhemsson, 2007).

Criminal damage affects negatively housing prices (Gibbons, 2004). The idea is that vandalism, graffiti and other forms of criminal damage motivate fear of crime in the community and may be taken as signals or symptoms of community instability and neighbourhood deterioration in general, pulling housing prices down. Other studies has shown that signs of disorder (such as, rubbish and litter lying around, graffiti on walls, teenagers hanging around street corners, noisy neighbours, and lack of illumination) may be more conducive to producing fear than serious crimes do since that such signs of disorder indicate that people and authorities have lost control (Hunter, 1978). In this study this is assessed by testing fear whilst controlling for vandalism rates.

Fear of crime seems to be more than a function of risk of and actual experiences with victimization. How a person perceives risk (in this case, the risk of being victimised by a crime), is dependent on its individual's characteristics, such as physical abilities, age, gender, previous personal experiences but also on more general aspects that mediate fear and risk in modern societies. Some critics have therefore argued that naming and specifying fear of crime is necessary (of which crime, who fears) but this is not completely unproblematic since focusing on differences in fear by gender, race and age may increase the risk of group stigmatisation. For a complete review of these criticisms, see Lee (2007),

Lee and Farral (2009). Fear is also influenced by other more multi-scale factors (national, global) that reach individuals in their daily life through, for instance, the media (Smith and Pain, 2009, Day, 2009).

Fear may be alleviated by implementation of security measures, in other words, by buying alarms and padlocks may make people feel safer. In the UK, for example, Jackson and Gray (2007) found that around one-quarter of those who said they took precautions, feel safer and less at risk. The choice for not taking extra security measures in people's homes is used in this analysis to test its potential effect on fear, and indirectly on property prices.

Assuming the impact of fear of crime has on community life, we deem it likely that:

1. Areas with depleted perceived safety are also the ones with lower housing prices after controlling for other factors (property related characteristics, place features, neighbourhood characteristics).
2. Investing in security commodities (e.g., alarms, sprays, padlocks) makes people feel safer, so fear of crime would affect less on housing prices in areas where people 'protect themselves'. If they don't take precautionary measures, they feel unsafe and avoid going out by themselves.
3. When criminogenic conditions (particularly vandalism) of an area are controlled for, the impact of fear of crime has on apartment prices is reduced.
4. Housing prices is dependent on levels of social cohesion in a community. Those who live in areas where their ethnic background is perceived as a problem, they may live in more segregated parts of the city, where bigger discounts would be expected when buying a property.

3. The study area and the data

Stockholm[1] is a safe city (Del Frate and Van Kesteren, 2004, Stockholm municipality, 2008). Figure 1 illustrates Sweden performance as a whole in 2000s victim survey, the difference between Western (including Sweden) and Eastern European countries is striking. These results are in line with the 2008's victimization survey (based on 20.000 respondents) in Stockholm city that shows that the majority of adult population does not worry about crime.

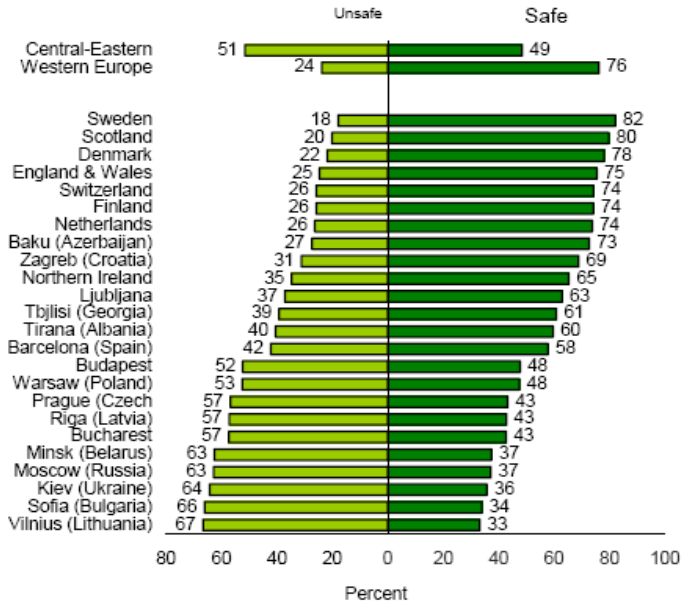
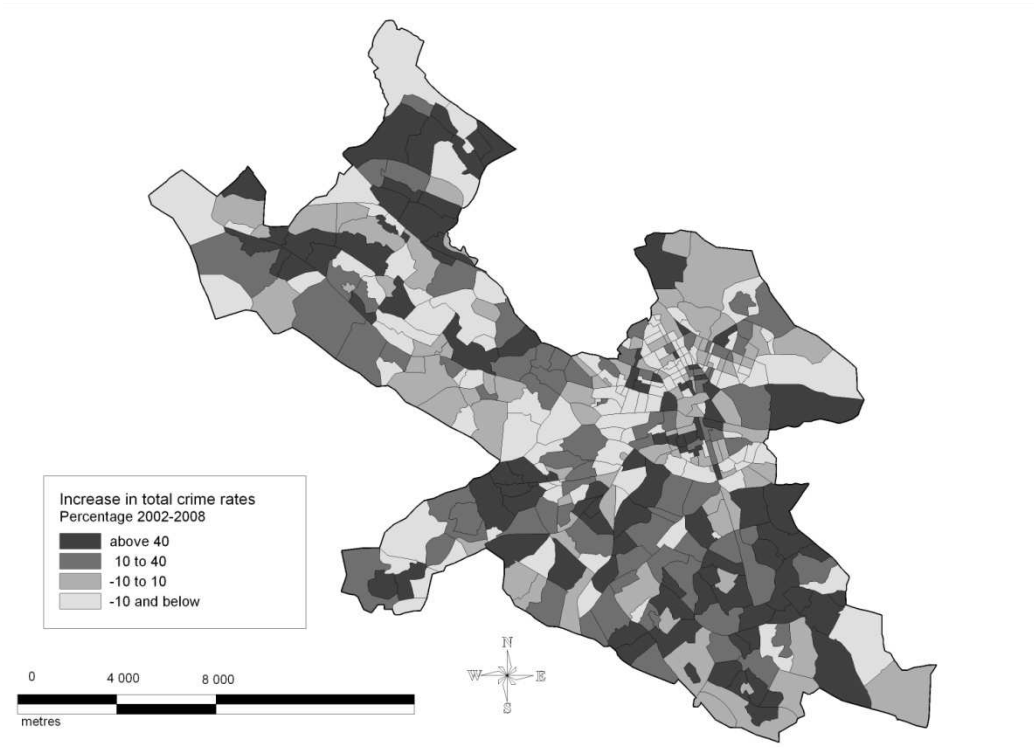


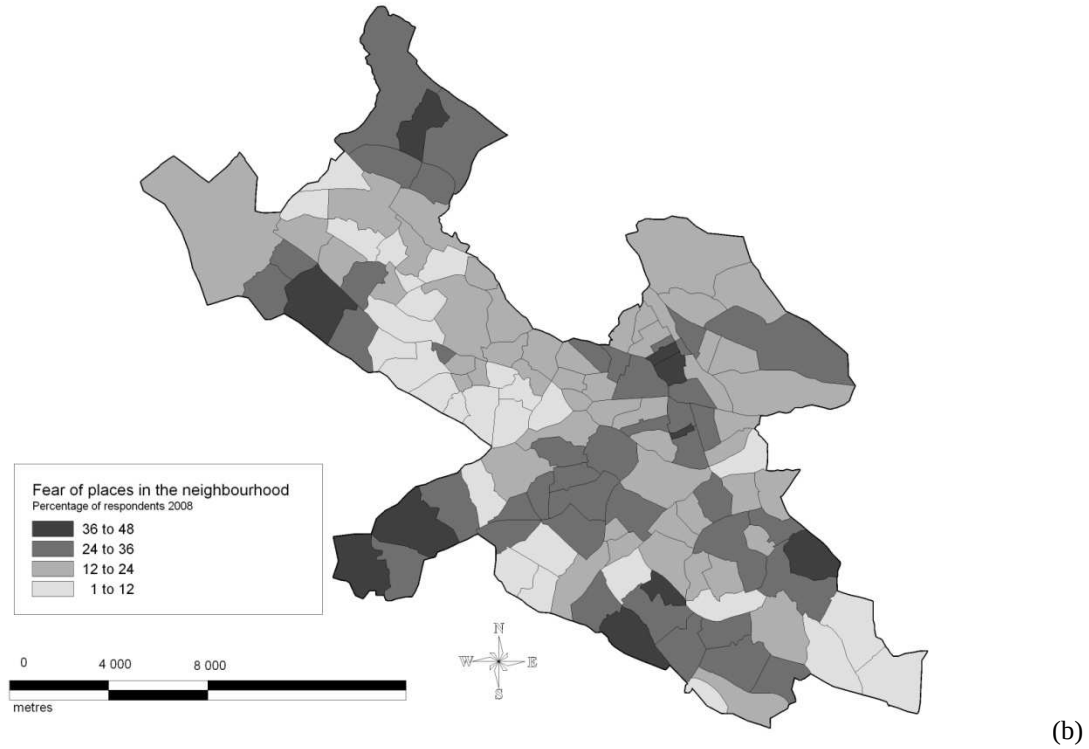
Figure 1 - Fear of crime in 2000 ICVS (How safe do you feel walking alone in your area after dark? Do you feel very safe, fairly safe, a bit unsafe, or very unsafe?).
Source: Del Frate and Van Kesteren, (2004), p.19.

About 20 percent of population often fears crime and about half of the interviewed population would agree that sometimes (at least once a year) would fear to be a victim of crime. Most people feel places in their own neighbourhood (or part of them) as unsafe, particularly after dark. They are also concerned about their families' and friends' safety. Nearly 6 percent declare that their ethnic background would affect the likelihood of being a victim of a crime (Stockholm municipality, 2008).

[1] The capital and largest city of Sweden. The city of Stockholm had over 810 000 inhabitants in 2008, while the Greater Stockholm area had over 1.9 million inhabitants. The case-study area is limited to the city of Stockholm, which means the inner-city area and those suburbs belonging to the city of Stockholm.



(a)



(b)

Figure 2 – (a) Increase in total crime rates (%), police recorded statistics, 2002 and 2008.
(b) Feeling unsafe in the neighborhood (% of respondents) , 2008's Stockholm's S cafety survey.

Some living in more vulnerable areas would more often express their fear of being a victim of crime than the average respondent. Jackson et al. (2008) shows similar results from the UK. Those who reported being worried about crime "tended to live in lower crime areas, have fewer victimization experiences, and know fewer victims", which suggest that the "fear of crime manifests in the everyday when individuals are typically at the 'sharp end of life' – perhaps they find themselves in threatening situations more frequently than those who lead more protected lives, who if they have some kind of 'fear' are more likely to be 'anxious'" (Jackson, 2008:151).

Fear of crime is unfortunately not a perfect fit with the geography of crime. Figure 2(a) illustrates, for instance, areas with increases in crime rates between 2002 and 2008 in Stockholm whilst Figure 2(b) show the patterns of declared fear of places by neighbourhood. Police recorded statistics show significant increases in violent offences and vandalism. The latter has almost doubled between 1997 and 2007 for Stockholm City. But crime, particularly property crime, is not concentrated in blocks of flats in the most peripheral parts of the city. Highly desirable housing central areas are often targeted by crime. Although there are some common areas, the overall correlation between them is significant but low (r=.135 at 99% when apartments are used as units). One reason for this mismatch is that according to Jackson (2004), fear of crime is often exaggerated because surveys reflect both 'experience fear' (summation of frequency of emotions) and 'expressive fear', which involves individuals' perceived vulnerability and broader social attitudes and values. Despite such limitations, this study is going to use data from 2008's Stockholm safety survey. The data is combined in a database with other cross-sectional data that have been merged from Stockholm Statistics (USK), Stockholm's house office city (Stadsbyggnadskontoret) and Stockholm Police. The former consists of information concerning neighbourhood characteristics such as proximity to waterfront and subway stations, and the latter about crime statistics (such as number of burglaries per 10,000 inhabitants).

The estimation of the hedonic equation is based on a cross-sectional data that includes arm's-length transactions of condominiums in Stockholm, Sweden. The data cover a time span from January 2008 to December 2008 and consist of 9,622 transactions of condominiums. The data source is Broker

Statistics (Mäklarstatistik AB), a real-estate broker association that covers around 70-80 percent of all broker transaction in Stockholm. The database contains property address, area code, parish code, selling price, living area, year of construction, presence of balcony and elevator, price per square meter, date of contract, condominium fee, number of rooms, date of disposal, number of the floor of the specific apartment, total number of floors, post code and x,y coordinates. For simplicity of the analysis, we excluded seven per cent of multiple addresses; in other words, we kept only one transaction for x-y coordinates. Our final database consists of 8938 transactions of condominiums. The x-y coordinates of each apartment were transformed into Dirichlet polygons using GIS and then imported into GeoDa 0.9.5–1 (Anselin 2003). This was necessary to be able to produce a weight matrix (Queen's matrix is set to 1 if the pair of cells share a common edge or vertex and 0 otherwise, first-order criterion) and generate autocorrelation diagnostics on the residuals of the OLS regression.

The average price is SEK 2.3 million and the variation around the average price is substantial. The typical apartment in the sample is 50 years old, with approximately 62 square meters of living space over 2.3 rooms. Only two per cent of the sample is newly built apartments. More than half of the apartments are located in buildings built between 1900 and 1945. The fee paid for maintenance is about SEK 3000 per month. Approximately 20 per cent are located on the first floor and around 25 per cent on the top floor. Almost 11 per cent of the apartments have an elevator and more than half of the apartments are located in properties with an elevator.

4. Results and discussions

Table 1 shows the results of the hedonic price equations. About 78 per cent of the variation in apartment prices can be explained by the included hedonic attributes. According to the OLS model, all estimated parameters concerning property and apartment attributes have expected sign and are of reasonable magnitude.

Table 1 - Hedonic price equation (OLS regression)

	Basis		Fear of crime		Fear of crime control. vandalism	
	Coefficient	t-values	Coefficient	t-values	Coefficient	t-values
Area	. 6989	52.76	.7079	55.18	.7086	55.24
Room	. 1927	16.11	.1789	15.43	.1777	15.32
Fee	-.1195	-18.88	-.1165	-19.00	-.1167	-19.03
Age1	. 1946	13.58	.2063	14.87	.2082	14.98
Age2	.1258	14.79	.1275	15.48	.1284	15.58
Age3	-.0294	-3.18	-.0202	-2.25	-.0200	-2.23
Age4	-.2047	-18.0	-.1637	-14.71	-.1638	-14.72
Age5	-.1691	-13.4	-.1288	-10.42	-.1299	-10.51
New	. 0922	3.93	.0755	3.321	.0766	3.37
Elev	-.0470	-4.70	-.0520	-5.36	-.0491	-5.04
Elev*floor	.0033	.233	.0122	.0136	.0121	.890
Balc	-.0110	-1.04	-.0149	-1.45	-.0143	-1.39
Elev*Balc	-.0074	-.909	-.0088	-1.11	-.0089	-1.12
First	-.0388	-4.98	-.0376	-4.98	-.0372	-4.93
Top	. 0289	4.00	.0309	4.43	.0298	4.26
Water100	. 1065	9.39	.0774	7.00	.0772	6.99
Water300	. 0295	3.36	.0140	1.65	.0094	1.08
Water500	. 0986	12.56	.0684	8.88	.0693	8.99
Sub100	.0064	.657	.0042	.442	.0082	.858
Sub300	. 0375	5.21	.0293	4.19	.0323	4.58
Sub500	. 0261	3.29	.0509	6.57	.0545	6.94
Train100	-.0294	-.889	-.0225	-.702	-.0171	-.532
Train300	-.0659	-3.29	-.0720	-3.72	-.0713	-3.68
Train500	. 0159	1.22	.0250	1.98	.0285	2.24
Road100	-.1018	-3.06	-.118	-3.67	-.1193	-3.71
Road300	. 0098	.676	-.0063	-0.45	-.0059	-.4202
Road500	. 0448	4.53	.0039	.409	.0047	.4907
Main100	. 0128	1.80	.0203	2.95	.0201	2.92
Main300	.0549	6.45	.0606	7.36	.0596	7.22
Main500	-.0927	-9.81	-.0950	-10.38	-.0942	-10.30
Distance	-.3597	-70.05	-.353	-70.93	-.3576	-68.16
Fear of crime			**-.0100**	**-24.39**	**-.0098**	**-23.61**
Vandalism rates					**-.0089**	**-2.722**
R-square	.7653		.7800		.7803	
Adj R-square	.7641		.7788		.7790	
AIC	945.7		368.3		362.9	
Moran's I	.50		.48		.48	

Note: Dependent variable=natural logarithm of transaction price. Parameter estimates concerning sub-markets and time are not presented in the table as well as estimates concerning floor, number of floor, missing information about floor, number of floors, elevator and balcony. Moran's I = presence of autocorrelation on residuals (significant at 99% level)

All measures of fear negatively affect house prices. Areas that have more people afraid tend to have their apartments highly discounted (Afraid is indicated here by those who declared fear to be a victim of crime everyday up to a couple of times per year in the last twelve months). To test the hypothesis that crime levels affect fear of crime, we tested the impact of fear of crime on apartment prices by controlling for the criminogenic conditions, in this case, vandalism rates. Vandalism rates were chosen because it has a direct contribution to the feeling of social order and control of an area. Findings show that both vandalism rates and fear of crime come up significantly in the model but interestingly, the effect of fear of crime is independent of the impact of vandalism in an area. There is no sign of reduction of the impact of fear of crime on apartment prices when vandalism of an area is controlled for.

Table 2 shows the results of the impact of fear on apartment prices using three different measures. (1) Fear of places in the neighbourhood, (2) Fear of crime, non-protection (no precautionary measures against crime) and avoiding going out in the neighbourhod by themselves, (3) Fear of crime related to own ethnic background.

Table 2 – Different measures of fear of crime – OLS regression

	Fear of places in the neighbourhood	Fear of crime, non-protection, avoid going out even. neighbouhood	Fear of crime related to own ethnic background
	OLS coefficient	OLS coefficient	OLS coefficient
Fear of places in the neighbourhood	-.0140 (-31.99)		
Fear of crime		-.0041 (-9.49)	
Non-protection		.0031 (7.94)	
Avoid going out Even. neighbouhood		-.0437 (-32.32)	
Fear of crime related to own ethnic background			-.0356 (-43.88)
R-square	.7895	.7802	.8071
AIC	-26.46	362.9	-805.0
Moran's I on residuals	.46	.47	.43

Note: t-values with brackets, respectively. Parameter estimates concerning housing attributes, land-use characteristics and time dummies are not shown in the table. Moran's I = presence of autocorrelation on residuals (significant at 99% level)

After checking for the effect of overall fear of crime on housing prices, the impact of fear of places in the neighbourhood was assessed (Do you feel sometimes afraid of being in certain places in your neighbourhood because you could become a victim of crime?). As expected, the variable fear of places has a stronger effect on property prices (Table 2) than overall fear (Table 1).

Apartment prices is also dependent on levels of social cohesion in an area as suggested in hypothesis four. Those who live in areas where their ethnic background is perceived as a problem, they may live in more segregated parts of the city, where bigger discounts would be expected when buying a property. People's declared vulnerability (fear of being a victim of crime because of their ethnic background) is directly incorporated in the housing market in a form of discounted apartments.

Investing in security commodities makes people feel safer, but this does not mean that fear of crime become less important when purchasing an apartment. Its effect on properties still remains even after controlling for security commodities. In the specific case of apartments in Stockholm, apartment prices are lower where people do not take precautionary measures to prevent crime, where people avoid going out by themselves and show high levels of fear of crime.

At this stage this study does not take into account unsolved problems with OLS basic assumptions of regression modeling (e.g., spatial autocorrelation on residuals, multicollinearity of a couple of explanatory variables and endogeneity). The next step will therefore be devoted to these modeling problems and to the testing of hypotheses relating fear of crime to people's socio-economic resources and differences in the city's criminogenic conditions.

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Appendix: The database of study

Data Type	*Source*	*Variable*	*Description*	*Unit*	*Average*	*Standard deviation*
Apartment sales	Broker Statistics (Mäklarstatistik) Year: 2008	Price	Transaction price	SEK	2336776	1413819
		Area	Living area	Square meter	62.25	26.76
		Room	No. of room	Number	2.33	1.02
		Fee	Monthly fee	SEK	3127.21	4853.02
		Age1	Before 1900	Binary	.0523	.22
		Age2	1900-1930	Binary	.3475	.48
		Age3	1930-1945	Binary	.2204	.41
		Age4	1945-1965	Binary	.0846	.28
		Age5	1965-1993	Binary	.0621	.24
		Age6	1990-	Binary	.2330	.42
		New	Sale year = building year	Binary	.0206	.14
		Elev	Elevator in the house	Binary	.5856	.49
		Balc	Balcony in the apartment	Binary	.1087	.31
		First	First floor	Binary	.2048	.40
		Top	Top floor	Binary	.2668	.44
Externality data and sub-market characteristics	Stockholm's housing office (Stadsbyggnadskontoret)	Distance	Distance to CBD	Meter	5137.03	3554.02
		Water100	100 meter buffer from water	Binary	.0829	.28
		Water300	300 meter buffer from water	Binary	.3072	.46
		Water500	500 meter buffer from water	Binary	.4821	.50
		Sub100	100 meter buffer from subway station	Binary	.0983	.30
		Sub300	300 meter buffer from subway station	Binary	.4623	.50
		Sub500	500 meter buffer from subway station	Binary	.7070	.46
		Train100	100 meter buffer from commuting train station	Binary	.0085	.09
		Train300	300 meter buffer from commuting train station	Binary	.0391	.19
		Train500	500 meter buffer from commuting train station	Binary	.0858	.28
		Road100	100 meter buffer from highway	Binary	.0072	.08
		Road300	300 meter buffer from highway	Binary	.0655	.25
		Road500	500 meter buffer from highway	Binary	.1535	.36
		Main100	100 meter buffer from main street	Binary	.2641	.44
		Main300	300 meter buffer from main street	Binary	.6439	.48
		Main500	500 meter buffer from main street	Binary	.8012	.40
Crime	Stockholm Police	Robbery	Robbery per 10,000 inhabitants	Rates	93.776	3141.251
		Vandalism	Vandalism per square meter of area	Rates	4.306	5.158
		Burglary	Residential burglary per 10,000 inhabitants	Rates	51.481	92.930
Fear of crime	Stockholm municipality	Overall fear	Have you in the last twelve months felt afraid of being a victim of crime? Percentage of respondents that answered: Yes (felt afraid everyday up to those who felt a couple of time per year only)	Percentage	50.45	7.40
		Fear_Neighb.	Do you feel sometimes afraid of being in certain places in your neighbourhood (bostadshus och närhet) because you could become a victim of crime? Percentage of respondents that answered: Yes, in one or several places.	Percentage	21.25	9.47
		Fear_Protection	Do you (or your family) protect yourself or your house against crime?	Percentage	24.40	9.21
			Percentage of respondents that answered: No, we do not take extra protection measures against crime.	Percentage	5.59	4.58
		Fear_Ethnic	Have you in the last twelve months felt afraid of being a victim of crime of any kind because of your ethnic background (Swedish or Foreign)? Percentage of respondents that answered: Yes, often or sometimes.			