Urban Studies, Vol. 42, No. 9, 1637–1656, August 2005

Assessing the Geography of Vandalism: Evidence from a Swedish City

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[Paper first received, May 2004; in final form, March 2005]

Summary. This paper investigates the occurrence of vandalism at the small-area level for the Swedish city of Malmö using data from the Skåne Police Authority's database. Demographic, socioeconomic and land use characteristics measured at the small-area level are used as predictors of vandalism with particular interest in the role of collective resources. Standardised vandalism ratios were calculated and mapped using a geographical information system (GIS). Spatial regression models were used to test hypotheses relating to the variation in vandalism rates. Findings show that spatial variation in vandalism is significantly related to social disorganisation risk factors as well as land use factors, but that the physical presence of local leisure associations (a 'collective resource') produces higher vandalism rates.

1. Introduction

Vandalism is a common but underresearched offence (LaGrange, 1999, p. 393). It is an indicator of other underlying social problems. Physical disorder flags for potential offenders that guardianship is probably low so that perhaps other crimes can be carried out in the area. As Sampson and Raudenbush (1999, p. 609) claim, expressive or predatory crimes, such as vandalism, may not directly 'cause' other more serious crimes but they do share the same explanatory processes, with the difference that they can be observed by everybody in the area: residents, visitors and potential offenders.

Since the seminal work on social disorganisation by Shaw and McKay (1942), there has been acknowledgement that group level and neighbourhood risk factors (ecological and contextual effects) contribute in addition to individual and household level risk factors (compositional effects) to an understanding of the geographical distribution of offences and offenders in urban areas. More recent investigations into the role of neighbourhoods have drawn on concepts that include social capital, social cohesion, collective efficacy and local attachment (Kennedy *et al.*, 1998; Rosenfeld *et al.*, 2001; Sampson *et al.*, 1997; Morenoff *et al.*, 2001; Hirschfield and Bowers, 1997; Warner and Rountree, 1997; Woldoff, 2002). Strong social ties, high levels of trust among neighbours, local attachment as well as civic engagement are all regarded as protective 'collective resources', although controversy remains as to whether they do deter crime (Bursik, 1999; Patillo-McCoy, 1999).

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0042-0980 Print/1360-063X Online/05/091637–20
DOI: 10.1080/00420980500185645

Much of the empirical work in this area has been either American or British in focus. These are two societies that have strongly market-oriented forms of capitalism, a trend that has become more pronounced over the past 20 years. They also have particularly marked levels of social and economic inequality. There is a need to extend the empirical range to include other types of political economy, such as the more socially oriented forms of capitalism found in other parts of Europe (Rothstein, 2001; Kumlin and Rothstein, 2003). This is because of the apparent links between political economy and the scale of social and economic inequality which is likely to impact on crimes such as vandalism (Stone, 2000; Rothstein and Stolle, 2001). Sweden, a country with a more socially oriented form of capitalism where the planning system incorporates strong welfare principles (Bengtsson, 1994; Timonen, 2003), is appropriate on this criterion. In addition, Sweden has experienced an increase in vandalism of 30 per cent since the late 1980s and it has become a serious problem in certain urban areas (BRÅ, 2002). Malmö was chosen as the study area because vandalism is a problem in the city, being the fourth most common type of offence recorded there. Furthermore, good quality geocoded data are available for the city. Within the limitations encountered when using secondary data, the purpose of this paper is to examine the geography of vandalism and to explore the relationships between this geography and data on neighbourhood characteristics.

The structure of this paper is as follows. Section 2 defines vandalism, discusses the sites where vandalism is most prevalent in a city and the importance of neighbourhood context in encouraging or discouraging acts of vandalism. The theoretical framework for the analysis is proposed, containing a discussion of how neighbourhood characteristics are expected to impact on vandalism rates. A description of the main characteristics of the study area and the dataset is given in section 3. After the calculation of standardised vandalism ratios in section 4, the relationship between vandalism patterns and neighbourhood characteristics are analysed and the results are reported in section 5. Section 6 discusses directions for future work. In particular, we discuss how future research might further reveal the ways in which government intervention impacts on the geography of different crimes.

2. The Geography of Vandalism

2.1 Defining Vandalism

Vandalism is a criminal offence involving damage to or defacing of property belonging to another person or the public. In the US, it is legally defined as

> a wilful or malicious destruction, injury, disfigurement, or defacement of any public or private property, real or personal, without the consent of the owner or persons having custody or control (the FBI's Uniform Crime Reporting Program, 1997; quoted by Stahl, 2000; see also Moser 1992, p. 51).

The Swedish Legal Penal Code has a similar definition, regarding as a vandal any "person who destroys or damages property, real or moveable, to the detriment of another's right thereto" (Ministry of Justice, 1999, p. 36).

The concept of vandalism overlaps the concept of disorder. For Sampson and Raudenbush (1999), vandalism is considered a physical disorder because it refers to a particular kind of wilful degrading of the urban landscape. Skogan (1990) distinguishes two forms of disorder. Physical disorder involves visual signs of negligence and unchecked decay, such as abandoned or ill-kept buildings, broken streetlights and rubbish; social disorder involves certain forms of behaviour resulting in *graffiti* and physical destruction. "Physical disorder refers to on-going conditions, while social disorder appears as a series of more or less episodic events" (Skogan 1990, p. 2). However, as Canter (1984) and Namba and Dustin (1992) emphasise, there is a need for a clear definition of vandalism in relation to other similar

behaviour. For Namba and Dustin, vandalism is not the same as depreciative behaviour.

> The critical distinction between vandalism and depreciative behaviour hinges on the degree to which the perpetrator of the act 'knows better' (Namba and Dustin, 1992, pp. 65–66).

2.2 *Sites of Vandalism*

The underlying reasons for vandalism and where it occurs are many. It may be a form of entertainment for groups of young people; it may be a symbolic act or a demarcation of a group's territory. It may be the way a group expresses its revolt or frustration towards a situation or an expression of intergenerational conflict (Skogan, 1990). Cohen (1973) distinguished between vindictive vandalism (a form of vengeance), play vandalism (breaking windows, *graffiti*), tactical vandalism (sabotage in the workplace) and malicious vandalism (out of boredom or frustration).

Vandalism is often directed at unclaimed or impersonal common spaces rather than at private homes. Acts of vandalism are often committed by bands of youths who come from poor, high-density residential areas and who commit their acts of vandalism very close to their homes (Ley and Cybriwsky, 1974; Mawby, 1984, quoted by Skogan, 1990). It may be a form of entertainment among groups of young people (Mahoney and Stattin, 2000) or a way to express dissatisfaction triggered by 'relative deprivation' (Burton *et al.*, 1994).

Land use composition and a city's physical structure play important roles in the distribution of vandalism. Vandalism is often found in the central areas of cities where there is public entertainment (Wikström, 1991). Vandalism also takes place in unstable deprived areas but it is expected that offenders will not only act where they live but also in neighbouring areas. The behaviour of vandals may be motivated by situational factors (Zimbardo, 1970) but show elements of a spatially contagious process, spilling over into nearby areas which then suffer vandalism not so much because of their situational characteristics but rather because of their geographical proximity to a deprived neighbourhood.

2.3 *Vandalism: Neighbourhood Influences*

We now discuss the importance of neighbourhood (or community) factors to our understanding of the occurrence of vandalism. Such factors may be ecological (a group-level property), or contextual (an aggregation of a property of the individuals comprising the group). We focus on the term 'collective resources' (an ecological property) drawing largely on American and British criminological traditions. The term 'collective resources' is used here as a general term to cover the concepts of social capital, social cohesion, social disorganisation, collective efficacy and local attachment—despite each of these different terms being used in the literature in their own right (see, for example, Wilson, 1986; Morenoff *et al.*, 2001). We avoid choosing any one of these concepts for three reasons. First, as stated by Hirschfield and Bowers (1997), these concepts are often used interchangeably because they are not well defined nor is there universal agreement on their meaning. Secondly, these concepts have different conceptual starting-points and this makes any comparison between empirical findings problematic. Thirdly, at an operational level it is difficult to distinguish between them. Table 1 provides a summary, distinguishing between the conceptual underpinnings to each term and their measurable indicators. The main point is that vandalism may be particularly high in areas where collective resources are 'low' or 'weak'. We later outline processes linking collective resources and vandalism and show how such interplay can have an ambiguous outcome.

Shaw and McKay (1942) in their work on Chicago argued that low economic status, ethnic heterogeneity and residential instability led to community disorganisation. This in turn resulted in sub-cultures of violence and high rates of delinquency. According to

Table 1. Urban crime and collective resources

Approaches	Defining attributes	Selected indicators	Sources
Social disorganisation (original version)	Inability of communities to realise common values or maintain effective social control	Economic deprivation, ethnic heterogeneity, population turnover	Shaw and McKay (1942); Kornhauser (1978)
Social disorganisation (extended version)	As above, plus absence of civic engagement, lack of formal and informal public control	As above, plus voter turnout, housing occupancy rates, measures of poverty, children in single-parent households, presence of physical resources that benefit the community (such as police stations)	Bursik and Grasmick (1993)
Social capital	High levels of social trust and co-operation between citizens for mutual benefit; civic engagement	Income inequality, voter turnout, unemployment rate, age composition, male divorce rate, involvement in voluntary groups, indicators of social trust	Kennedy *et al.* (1998); Rosenfeld *et al.* (2001)
Social cohesion	Absence of social disorganisation plus presence of social capital and high levels of collective efficacy (see below)	Single-parent households, recent immigrants, ethnic heterogeneity, social heterogeneity, life style and demographic indicators, police calls for service, neighbourhood watch schemes	Hirschfield and Bowers (1997)
Local ties and neighbourhood attachment	Sense of place, affection; attitudinal and behavioural attachment; shared problem-solving	Measures of belonging, attachment and commitment to a place, ethnic heterogeneity, family structure, education level, housing ownership, measures of sentiment and satisfaction, levels of trust; participation in local associations	Tuan (1990); Shamai (1991); Woldoff (2002)
Collective efficacy	Willingness to act (informal social control) combined with trust/ solidarity and shared expectations	Female head of household, unemployment, ethnic background, housing ownership, residential mobility, long-term ethnic segregation, measures of social trust, shared expectations for social control, organisations/programmes in the neighbourhood, neighbourhood watch schemes, local associations, relatives and friends living in the neighbourhood	Sampson *et al.* (1997); Morenoff *et al.* (2001)
Physical (infra)structure	Built environment characteristics; permeable versus defensible spaces; presence of local institutions and clubs	Age, ethnic background, housing ownership, deprivation, residential instability, measures of spatial integration and people's interaction, spatial design, presence of libraries, retail institutions, bars, participation in youth centres and recreation	Jacobs (1961); Newman (1972); Peterson *et al.* (2000); Hillier (2002); Mahoney and Stattin (2000)

Morenoff *et al.* (2001), it was not until the 1970s and 1980s that social disorganisation was defined explicitly by Kornhauser (1978) and Bursik (1988) as 'the inability of a community structure to realise the common values of its residents and maintain effective social controls'. Empirical evidence shows that individuals living in problem areas may refrain from local social life and this breaks down formal and informal social control and involvement at the neighbourhood level (Skogan, 1990; Perkins *et al.*, 1992; Kelling and Coles, 1996). In Britain, since the 1970s, evidence has shown that social disorganisation risk factors have a positive correlation with vandalism (see, for example, Herbert, 1977; Baldwin and Bottoms, 1976). Similar findings were found in Sweden (Roos, 1986; Wikström, 1991). Bursik and Grasmick (1993) suggested an expanded version of social disorganisation theory, integrating formal public control with informal processes of control.

Social capital has been associated with social bonds that create networks that bring a collective benefit to neighbourhood residents.[1] Communities with high stocks of social capital are more effective in exerting informal social control through the establishment and maintenance of norms (Hirschfield and Bowers, 1997; Rosenfeld *et al.*, 2001). High levels of social capital or cohesiveness (Beauvais and Jenson, 2002) are expected to diminish the occurrence of vandalism (Roos, 1986; LaGrange, 1999) and other offences (Martin, 2002; Rosenfeld *et al.*, 2001; Morenoff *et al.*, 2001), particularly in disadvantaged areas (Hirschfield and Bowers, 1997). However, high social capital does not necessarily result in collective benefits. Social capital can be bonding, or exclusive, or bridging, or inclusive (Putnam, 2000, p. 22). Groups may exclude and/or subordinate other groups. Thus, the formation of a delinquent juvenile gang in a neighbourhood is a typical example of a bonding process that excludes those that do not follow the established within-group rules. For other examples where local social ties do not necessarily translate into more social control and lower crime rates, see Wilson (1986) and Patillo-McCoy (1999).

Sampson *et al.* (1997), however, argue that action to restrict crime does not necessarily require 'strong local social ties or associations'. Collective action may take place where personal ties and social networks are weak. What is important is a willingness to intervene on behalf of the common good. Collective efficacy is the group-level term used by Sampson *et al.* (1997) to refer to the situation where there are shared expectations within the group *and* a willingness to engage in processes of social control.

Attachment may be crucial to an understanding of why certain neighbourhoods are able to organise themselves and exercise social control. The concept of local attachment places less emphasis on social networks, emphasising instead individual-level responses (Tuan, 1990; Shamai, 1991; Woldorf, 2002). Woldoff (2002) provides an interesting example relating levels of neighbourhood attachment to the presence of physical and social disorder.

The criminological tradition that relates crime to a neighbourhood's physical (infra)-structure is long and full of controversy (see, for example, Jacobs, 1961; Newman, 1972). One set of studies examines how people's interaction in an area and, consequently, its guardianship are influenced by the area's spatial structure and the relationship that space has towards the city as a whole (for example, Hillier, 2002). Another set focuses on all types of neighbourhood physical infrastructure that facilitate people meeting together and hence that might be expected to support the formation of social ties.[2] It refers to the collective infrastructure that is supplied by local government such as neighbourhood community centres, parks, swimming pools and local associations. It also refers to infrastructure supplied by private business, such as childcare centres, local stores and cafés. The presence of such resources seems to have an ambiguous impact on crime levels. Residents may value local services highly but may not use them (Ceccato, 2001) preferring the service outlet near their workplace. Another reason for their ambiguous effect is that they may attract groups of individuals

who offend (Peterson *et al.*, 2000; Mahoney and Stattin, 2000).

Figure 1 summarises a conceptual framework for reflecting the impact of collective resources and other predictors on vandalism. Crime and disorder in a neighbourhood or locally generate feelings of fear and insecurity. This may lead to relatively affluent households deciding to move out (Skogan, 1990; Dugan, 1999).[3] In the case of vandalism, in the course of population turnover, the demographic component is particularly important since the concentration of expressive crimes is often associated with areas that have large numbers of young people. Residential instability may result in increased geographical segregation (socioeconomic and ethnic), since only those who cannot afford other places to live in will move into the neighbourhood. Those who are unable to leave physically, withdraw psychologically, finding friends elsewhere or simply isolating themselves (Skogan, 1990).

These processes in turn feed a reduction in a neighbourhood's collective resources (Bursik, 1988). Figure 2 elaborates these links. It is the final stage in the feedback cycle that is particularly difficult to assess because neighbourhoods react in different ways to rising crime and disorder. Taylor (1996) classifies community reactions into forms of resistance versus accommodation. Low social control and guardianship are only one form of accommodation consistent with a downward spiral. Low voter turnout is another indication of negative accommodation (Callahan, 1998), leading to a further "weakening of the norms governing behaviour" (Sampson *et al.*, 1997, p. 41).

On the other hand, there will be neighbourhoods where individuals work together to improve local conditions, generating collective resources through formal and informal networks. In these areas, high vandalism rates will at a certain moment in time be associated with high collective resources. Thus, vandalism "triggers communication about local problems among neighbours who would not otherwise interact" (Woldoff, 2002, p. 92). What determines when and why certain neighbourhoods go for a more constructive solution to their local problems while others do not, is an unanswered question in the literature and goes beyond the scope of this paper.

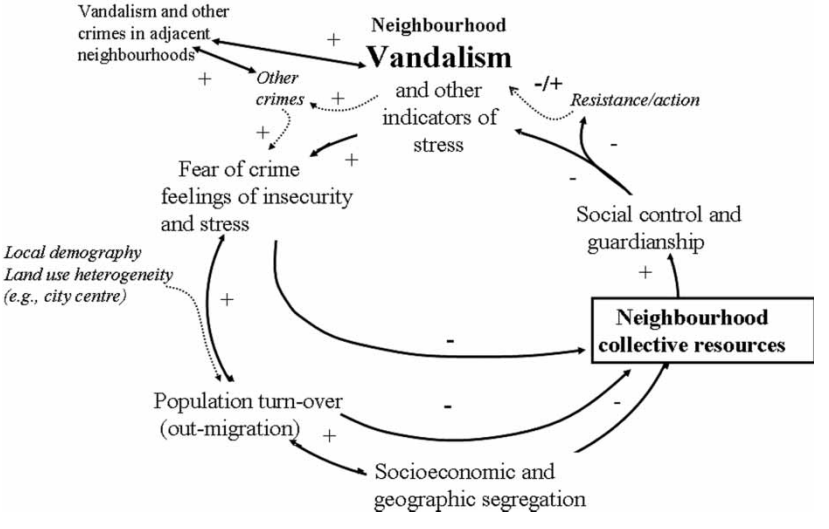


Figure 1. A conceptual framework for the link between collective resources and neighbourhood vandalism: a link that can be broken by 'resistance/action'. Figure 2 expands the box labelled 'neighbourhood collective resources'.

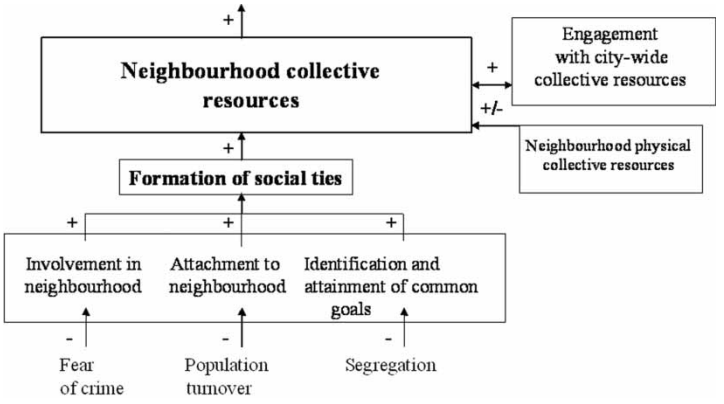


Figure 2. Collective resources at the neighbourhood level (see also Figure 1).

3. The Case Study

The main characteristics of the study area as well as a description of the dataset used in this analysis are now presented.

3.1 Patterns of Vandalism: The Case of Malmö, Sweden

Malmö is the third-largest Swedish City with, in 2001, over 250 000 inhabitants (Figure 3). It is the major Swedish city of the Öresund region. Malmö is a multicultural city. More than one in five residents in the city is of foreign descent, with immigrants from eastern Europe, Latin America, the Middle East and Africa.

Malmö is a very compact, monocentric city. Most of the population lives in the central districts of the city, in multifamily buildings. Around 25 per cent of the population are composed of young people (aged 15–29). There are no residential slums or run-down residential areas in the inner city or elsewhere in Malmö of the sort found in many cities in

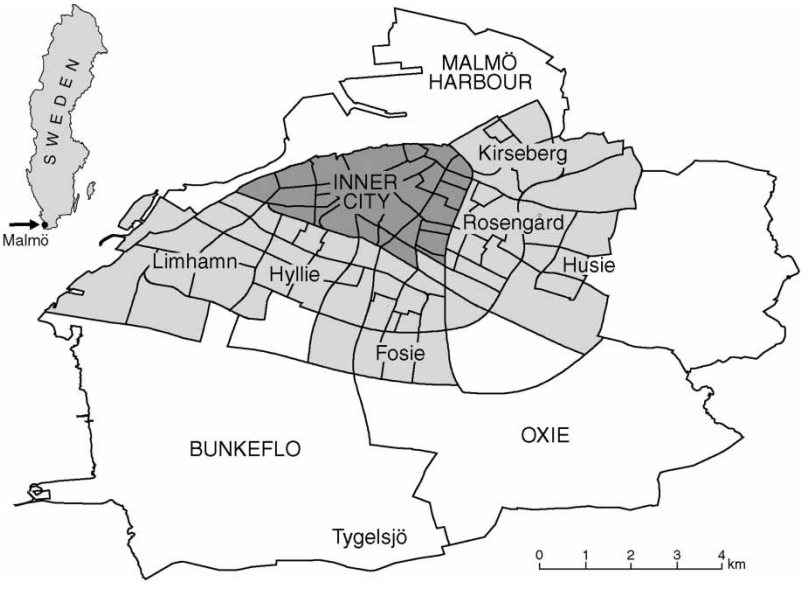


Figure 3. Malmö: inner city and surrounding districts. *Note*: areas in white were excluded from the analysis.

Britain or the US. Areas such as Rosengård, parts of the inner-city areas, Fosie and Kirseberg are, however, relatively deprived with a large share of the households receiving social allowance (Figure 4). The city's harbour has, together with Copenhagen, good regional transport links. Malmö has a very lively central area, with bars, cinemas, museums, theatres and libraries. Since July 2000, the Öresund bridge between Malmö (Sweden) and Copenhagen (Denmark) has opened up and has increased the flow of people not only into and out of Malmö but also across the whole Öresund region (Öresundsbro, 2002). It is of interest to note, given the discussion in section 2.3, that Malmö has one of the largest local association memberships per capita, especially those related to sports and recreation. A significant share of these associations is dominated by single ethnic minority groups, which may indicate a strong potential for bonding rather than bridging social capital.

The area selected for study consists of 91 per cent of the total population. It excludes a few peripheral areas, the harbour, large industrial and vacant areas and parts of Bunkeflo and Oxie. These excluded areas represent large geographical units with relatively small populations in comparison with their geographical size and are more or less isolated from the main city core. These peripheral areas were excluded because robust estimates of standardised vandalism ratios could not be obtained from such small populations.

3.2 *The Dataset*

Data on vandalism were extracted from the Skåne Police Authority's database. The data refer to the year 2000 and were recorded by district (*delområde*). The final map comprised 86 districts, with an average population of about 2700 inhabitants, varying from just over 300 to just over 9900. In Malmö, vandalism is defined as: offences on physical targets (for example, causing damage to cars, walls, buildings, including *graffiti*) and forms of social disorder (as defined by Sampson and Raundenbush, 1999) such as disturbance (for example, by starting fires).

Data reliability is an important issue when dealing with vandalism data (Mawby, 1977). Underreporting is a particular problem. It is likely that vandalism is underreported in deprived areas or areas with low levels of collective resources. There are other problems of data quality that arise during the process of recording vandalism. These can be caused by a lack of information about the event from the

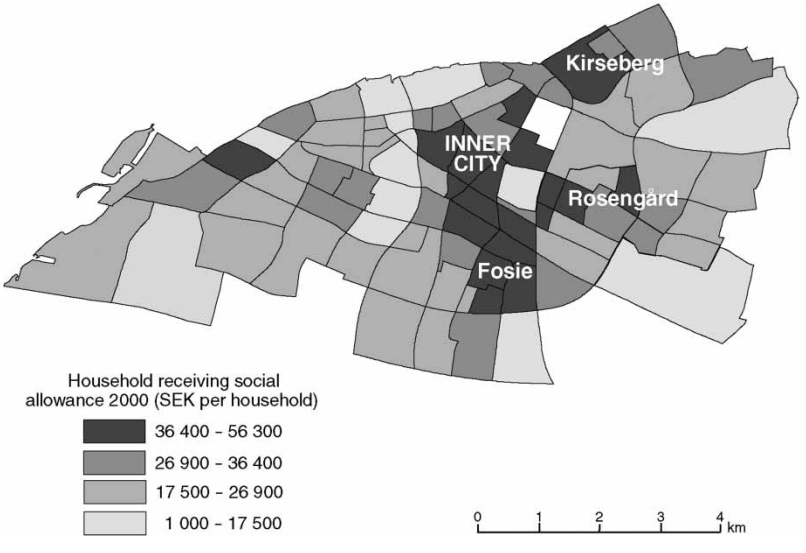


Figure 4. Malmö: households receiving social allowance (SEK per household, 2000).

victim (not knowing exactly where the offence took place). The police officer may fail or be unable to record the event properly (missing record on the exact location/time of the event) or may not have followed agreed reporting conventions—a particular problem with vandalism. Another source of inaccuracy arises in the geocoding process: matching the offence address database and the reference street map. In the case of Malmö's offence database, the geocoding process was mostly performed using the interactive mode in GIS, reaching the rate of 89 per cent over all cases of recorded vandalism in 2000.

Data on the population's demography and socioeconomic status were obtained from Malmö's municipal database by district units. Unfortunately, these statistics were not all available for the same years. The statistics for households are from the beginning of the 1990s whilst the statistics for local leisure associations are for 1998. For further details see Table 2.

(1) Age characteristics of the population (population aged between 12 and 22 years old; population aged 65 and over). It is expected that the risk of vandalism is highest in areas with a large proportion of young people since they are regarded as potential offenders for this type of crime. The presence of a large proportion of older people would have the opposite impact, as they are potential guardians. LaGrange (1999) points out, drawing on the work of Felson and Cohen (1980), that residents in early adulthood are likely to be absent from their homes more frequently and therefore guardianship may be substantially reduced. The opposite could be expected for the group 65 or older. The demography of areas might affect local daily

Table 2. Characteristics of the dataset

Type of data	Description	Year	Source
Offence	Vandalism represented by the following offences: causing damage, disturbance and *graffiti* in the Swedish penal code system 1201, 1202, 1203, 1205, 1207 (BRÅ, 1999)	2000	Skåne Policy Authority
Small-area characteristics	Proportions of:		Malmö municipal database (Statistics Sweden)
	Population aged between 12 and 22 (X_1)	2000	
	Population aged 65 and older (X_2)	2000	
	Unemployed labour force (X_3)	2001	
	Population with (at least) one parent born abroad (X_4)	2001	
	Population born abroad (X_5)	2001	
	Population moving into the area within last year (X_6)	2000	
	Population moving out of the area within last year (X_7)	2000	
	Rented flats of municipal companies (X_8)	1990	
	Flats in a cooperative housing society (X_9)	1990	
	Privately owned single family houses (X_{10})	1990	
	Families earning the lowest disposable income (X_{11})	1999	
	Families earning the highest disposable income (X_{12})	1999	
	Households receiving social allowance (X_{13}) and W_X_{13}	2000	
	Index of ethnic heterogeneity (X_{14})	2001	
	Voter turnout (X_{15})	1998	
	Local leisure associations by pop. (X_{16}) and W_X_{16}	2002	
	'Neighbourhood Watch Schemes' by pop. (X_{17}) and W_X_{17}	2002	
	Green areas – dummy (X_{18})		
	Central area – dummy (X_{19})		

Note: *W_X* denotes the local spatial average of the variable using each area and its neighbouring areas that share a common boundary (see the text for a fuller explanation).

activity, social interaction and hence crime rates.

(2) Socioeconomic status (unemployed labour force; family disposable income; people receiving social benefits). Poverty has long been associated with disorder and crime (see, for example, Park and Burgess, 1933; Shaw and McKay, 1942).

(3) Residential instability (population moving into/out of an area; rented and owner-occupied housing). Data on population turnover and housing tenancy has traditionally been used as predictors of crime. Areas with a high proportion of rental units tend to have a less permanent resident population than well-established owner-occupied housing tracts (Bursik, 1988). In these areas, residents may be unable or unwilling to participate in long-term schemes for crime prevention.

(4) Ethnic segregation and heterogeneity (population born abroad; population with at least one parent born abroad; index of ethnic heterogeneity). The index of ethnic heterogeneity (Blau, 1977) measures ethnic mixing. According to Veysey and Messner (1999), heterogeneity creates intergroup tensions, limiting community members' guardianship and supervision of children. The index measures the probability that two randomly chosen individuals do not belong to the same group taking into account both the number of groups and the distribution of the population across them. The index is given by

$$1 - \sum_i P(i)^2$$

where $P(i)$ is the proportion of the population in ethnic group i.

The closer the value of the index is to 1, the greater the heterogeneity. A homogeneous population would give a value of 0. It could be argued that many ethnic groups from different origins, cultures and backgrounds living in the same area imply that members of these groups may not have many things in common (such as, language, religion, interests) with other groups. In certain circumstances, the areas where such groups live may be particularly at risk from vandalism.

The variable groups (1) to (4) have an explanatory status with respect to the incidence of crime, and vandalism in particular, in their own right. However, they also have an explanatory status which is partially entangled with the concept of collective resources and how that concept is operationalised or measured (see Table 1). Poverty is associated with low collective resources (LaGrange, 1999; Peterson *et al.*, 2000). Ethnic segregation and heterogeneity may indicate a lack of integration and interaction with the host society and induce low levels of collective resources (Dias, 1993; Sampson *et al.*, 1997). The same is often argued in the case of neighbourhoods with high population turnover (Bursik, 1988; Skogan, 1990; Dugan, 1999; Sampson *et al.*, 1997; Sampson and Groves, 1989).

We now turn to a second group of variables that provide more direct measures of collective resources.

(5) Physical collective resources (local leisure associations). We have used local leisure associations as an indicator of the neighbourhood's physical infrastructure that facilitates people meeting together and hence might be expected to support the formation of social ties. As Bursik (1999) points out, much stress has been put on the 'supervisory' capacity of communities but there are aspects related to the 'socialisation' capabilities of communities that are equally important when analysing crime. This is particularly important among youth groups in Sweden (see, for instance, Mahoney and Stattin, 2000). The specific indicator of involvement in these associations was the rate of local associations per unit of population of each district. A similar indicator was used by Veysey and Messner (1999), Rosenfeld *et al.* (2001) and Martin (2002). The data were gathered from the Malmö municipal database on local associations for 2001 and are mostly composed of sport associations.[4] Unfortunately, the data give no indication of how active the associations are or how they differ in terms of participation rates—so all associations are given the same weight. Each record contained the name, type of association (for example,

sports, arts) and address. Leisure associations that had no local link were excluded (such as religious, political and international organisations). Around 90 per cent of a total of 502 were geocoded and mapped. As many as 18 per cent of these associations had only an area code number (postal box) instead of a street address. In these cases, they were geocoded by district.

(6) Neighbourhood engagement (Neighbourhood watch schemes—NWS). We incorporated NWS as a measure of neighbourhood engagement to an area as well as integration into the wider society. Consistent with previous research by Hirschfield and Bowers (1997), this indicator was derived using a list of addresses of neighbourhood watch schemes. The dataset was provided by a local insurance company (Länsförsäkringar Skåne) responsible for recording all such schemes in Malmö. Each address was geocoded and 98 per cent were mapped indicating the existence of 67 NWS. In a few cases, where the street number was missing, the first number of the street was used for geocoding. Using GIS, NWS were aggregated into small-area units and a rate of NWS by population of each small-area unit was calculated.

(7) Civic engagement (voter turnout). We also included an indicator of civic engagement, represented here by the percentage of the eligible population who voted in the local elections in 1998 per district from the municipal statistical database. According to Callahan (1998), low voter turnout is a sign of political disaffection and instability. It may indicate a lack of trust on the part of certain groups in society as a whole or simply a lack of integration in the case of citizens born abroad. A similar indicator was used in previous research by Callahan (1998) and Rosenfeld *et al.* (2001).

(8) Land use. Finally, in order to to take regional effects into consideration in the regression model, land use variables were included. One land use variable indicates whether an area was part of the inner city ($D(i) = 1$) or otherwise ($D(i) = 0$). This was created since the city centre concentrates office buildings, hotels, restaurants, a sports stadium, cinemas and a railway station that are vulnerable to vandalism. The inner-city boundaries were the areas on the district map that officially belonged to the inner-city areas (*Innerstaden*). The other land use variable indicated whether or not the zones had large gardens, parks and green areas. Since these green areas dominate several central districts (such as Pildammsparken, Malmöhus) and may influence the geography of vandalism, a dummy variable for green areas was also included in the model. These central parks are potential targets for vandalism since they constitute spaces between residential areas and are often not well guarded.

4. Standardised Vandalism Ratios

For each of the $N = 86$ districts of Malmö, a standardised vandalism ratio (SVR) was calculated. Standardisation is a useful way of representing data for a set of areas where the areas differ in size (absolute values would tend to overemphasise large areal units) or where it is necessary to allow for differences in population characteristics between areas (Haining, 2003). For other examples of standardised offence ratios, see Ceccato and Haining (2004). The Standardised Vandalism Ratio (SVR) for district i is given by

$$SVR(i) = [O(i)/E(i)] \times 100$$

where, $O(i)$ is the observed number of cases of vandalism and $E(i)$ is the expected number of cases of vandalism.

In this analysis, an average vandalism rate for Malmö was obtained by dividing the total number of offences by the total size of the chosen denominator. For each area i, this average rate is multiplied by the size of the chosen denominator in area i to yield $E(i)$. It is important to choose a denominator for calculating $E(i)$ that is relevant to the offence, accounts for size effects and yields robust and reliable rate estimates. Wikström (1991) pointed out the difficulty of defining plausible denominators for many offences, suggesting a list composed of best denominators and those actually available for the calculation of city

crime rates. For vandalism, the denominator suggested is the area of the unit, which is used in this study. Other denominators could be used and some were tested. We comment on this later. It is important that whatever denominator is used it meets the criteria above. As far as subsequent modelling is concerned, any variables that could be used as denominators for the $E(i)$ term, but are not, can be entered as predictors in the regression analysis. This way, their explanatory status can be evaluated. Figure 5 shows the map of area-related relative risk for vandalism in Malmö, highlighting all areas where $O(i) > E(i)$.

The city centre, because of its particular characteristics in terms of large transient populations and mixed land use (Wikström, 1991; Roos, 1986), is particularly vulnerable to acts of vandalism. The more central the district, the higher the relative risk of vandalism. As was expected, the central areas, especially the inner city, concentrate most of the highest scores, where the observed value for occurrence of vandalism is greater than the expected value based purely on area. The CBD is located in the core area of the inner city and is characterised by office buildings and also has a major shopping area, as well as hotels, restaurants, a sports stadium, cinemas and a regional hospital. The centre is also close to the harbour area in the north, which also contains the main public transport junction located in the inner-city area. The central station is a place where many travellers pass everyday since train lines link Malmö to regional centres as well as to Stockholm, Gothenburg and the continent via Denmark across the Öresund bridge.

Residential areas located in the southern parts of the city such as Fosie and parts of Rosengård and Husie also show high standardised vandalism ratios. Fosie and Rosengård are typical disadvantaged areas with high proportions of residents born abroad, living in rented apartments with a relatively large proportion of households receiving social benefits. This may be indicative of a lack of social stability or a high level of social disorganisation (Park and Burgess, 1925, 1933; Shaw and McKay, 1942).

5. Modelling Standardised Vandalism Ratios

In order to test hypotheses about the statistical significance of different predictors (see section 3.2) in explaining the variation in

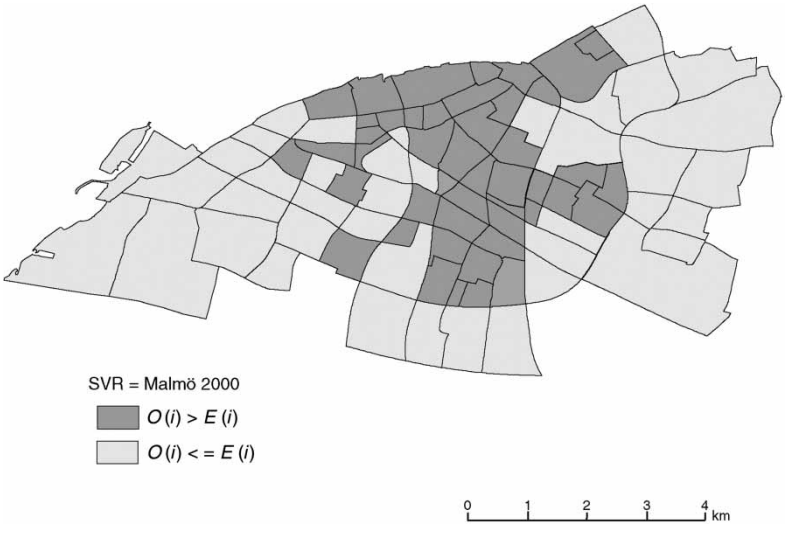


Figure 5. Standardised vandalism ratios, highlighting areas with higher than expected counts, $O(i) > E(i)$.

SVR, normal linear regression was used. The model is given by

$$\mathbf{Y} = \mathbf{X}\beta + \varepsilon$$

where, $\mathbf{Y}$ denotes the $N(=86)$ vector of SVRs for the 86 districts; $\mathbf{X}$ is an Nxp matrix with p explanatory or predictor variables, including the constant term; β is the p vector of regression coefficients (including the intercept); and ε is the random error vector with mean $\mathbf{0}$ and variance $\sigma^2\mathbf{I}$.

The set of SVR values shows a highly skewed distribution. The raw SVRs were transformed using the square root transformation to produce a dataset more nearly normal. This model is fit by ordinary least squares (OLS). We experimented with other denominators for the expected count in the SVRs including population and a combination of population and area. The models provide a poor fit and it was decided to include population data as predictors in the model rather than as a basis for calculating expected counts.

A few of the independent variables (X_{13}, X_{16} and X_{17}) were also included as spatial averages denoted *W_X*. This was done if the corresponding unaveraged variable was significant in any model. The effect of the level of some explanatory variables might extend beyond the census district where that level is recorded. In other words, their effect is predicted to 'spill over' in a geographical sense. The effects on crime of organisations that promote collective resources extend beyond the boundaries of the particular districts within which they are located (see section 2.2). The local attachment of neighbours contributes positively not only to the welfare of residents who live in the area but also to others living nearby—although beyond a certain distance their actions could increase vandalism through a displacement effect. Another reason for creating these lagged explanatory or predictor variables was to counter the limitations imposed by unit boundaries on the analysis. Cities are divided into census districts that are entirely artificial and do not correspond to local communities (Morenoff *et al.*, 2001). Indicators of poverty (such as households receiving social allowance) might be included in their lagged form for both these reasons (Craglia *et al.*, 2000). To calculate a spatial average, the values for each area and its adjacent neighbours were used. The computation of the spatially lagged variables uses a simple row standardised binary contiguity weight matrix. This is a matrix with N rows and columns. Non-zero entries on row i correspond to the labels of the spatial units that are adjacent to i. The entry corresponding to i is also non-zero. If there are k adjacent neighbours then the $k+1$ non-zero entries each have the value $1/(k+1)$. This is refered to as a row standardised binary connectivity matrix. For details, see Haining (2003, p. 82).

The regression analysis and the creation of the lagged variables were implemented in SpaceStat 1.91 (Anselin, 1992) since the software has regression modelling capabilities that are appropriate for spatial analysis (see also Ma *et al.*, 1997). SpaceStat provides several diagnostics measuring the fit of the model. It includes tests such as for multicollinearity among predictor variables and tests on model residuals (normality, heteroscedasticity and spatial autocorrelation). In order to test for spatial autocorrelation in the residuals, the binary weight matrix was based on neighbours sharing a common border and used to represent the spatial arrangement of the data. The full set of explanatory or predictor variables was included in the model. Based on the spatial diagnostics of the residuals of the OLS model, the lagged response and spatial error models were also fitted (Haining, 2003, pp. 312–316). Findings are presented in section 5.1 and in Appendix 1.

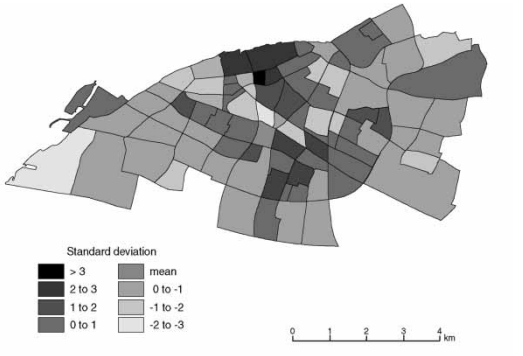
5.1 Vandalism Ratios in a Neighbourhood Context

The following discussion of results is in two parts. The first part discusses results from the OLS model and from the lagged response and spatial error models. The second part refers to a discussion of the variables that are significant in both the OLS and lagged response models.

The results from the OLS model show that the lagged variable of local leisure

associations (W_X_{16}), households receiving social allowance (X_{13}) together with two dummy variables (the dummy variables identifying the inner city (X_{19}) and green areas (X_{18})) were statistically significant in explaining the pattern of relative risk in Malmö.

The model explains nearly 62 per cent of variation in the SVRs and Figure 6 shows the areas where the model underpredicts (positive residuals) and those where it overpredicts (negative residuals) the SVR. The explanatory variables do not suffer from multicollinearity. This is indicated by the multicollinearity condition, 2.89 where a value of 20 or above is indicative of a multicollinearity problem. Diagnostic checks show that the errors are normal (Jarque Bera test) and homoscedastic (White test) as shown in Figure 6. Moran's I test shows spatial autocorrelation in the residuals at less than the 1 per cent significance level. In this case, a common practice is to fit either a lagged response model or a spatial error model to try to handle the problem of autocorrelation in the residuals. The lagged response model includes a lagged form of the response variable as one of the independent variables. It is theoretically appealing because as a model it accords with observations made about the contagious nature of vandalism (see section 2.1). This variable is calculated by taking the sum of the observed and expected counts in the adjacent areas and dividing the sum of the observed counts by the sum of the expected count. Unlike the calculations for certain explanatory variables, this calculation does not include the spatial unit at the centre. We denote this $W^{+}Y$. For completeness, we ran both types of spatial model and compared their results to the ones from the OLS model. The reason for this is that these two models are similar in statistical terms and choosing between them may be a difficult task from just inspecting the diagnostics from the OLS model.



Ordinary least square estimation

Y = square root of the standardised vandalism ratios

$Y = 7.50 + 0.24X_{13}^{***} + 2.48\ W\_X_{16}^{**} - 2.67X_{18}^{***} + 6.12X_{19}^{***}$

(11.24) (8.32) (2.41) (-3.59) (6.42)

(t-values in brackets)

** significant at the 5 per cent level; *** significant at the 1 per cent le

R^2 X 100 = 61.9 per cent

R^2 (adjusted) X 100 = 59.9 per cent

Normality of errors — Jarque–Bera 4.07 Prob 0.13
Multicollinearity condition 2.89
Heteroscedasticity — White 19.07 Prob 0.12
Moran's I (error) 3.44 Prob 0.00
Lagrange multiplier (lag) 21.80 Prob 0.00
Lagrange multiplier (error) 23.55 Prob 0.00

Figure 6. Results of ordinary least square regression model with diagnostics.

The results from the lagged response and OLS model are similar. The exception is that in the OLS model residuals are autocorrelated (a problem that is solved in the lagged response model) whilst in the lagged response model residuals do not have constant variance and, consequently, the regression estimates may not be efficient. This may be a consequence of using data from spatial units which vary in areal extent. The lagged response model performs well: 68.5 per cent of the variance in SVRs is explained by the model and there is no evidence of spatial autocorrelation in the residuals (Table 3). By comparison, the spatial error model only explains 25 per cent of the variation in SVRs and spatial autocorrelation in the residuals remains a problem (Appendix, Table A1). The much poorer performance of this model is because it retains fewer significant predictors and spatially autocorrelated variation is assigned to the error (unexplained) component of the model. The model does not appear to be very informative and we shall not discuss it further.

The predictors that are significant in both the OLS and lagged response models are local leisure associations (X_{16}) or (W_X_{16}),

Table 3. Spatial lagged response model: maximum likelihood estimation, results and diagnostics

Y = square root of the standardised vandalism ratio

$$Y = \underset{(3.07)}{2.83} + \underset{(6.40)}{0.55}(W^{+}Y)^{***} + \underset{(7.19)}{0.18}(W\_X_{13})^{***} + \underset{(2.47)}{2.06}\, X_{16}{}^{**} - \underset{(-4.14)}{2.50}\, X_{18}{}^{***} + \underset{(3.11)}{2.74}\, X_{19}{}^{***}$$

(z-values in brackets)

**significant at the 5 per cent level; ***significant at the 1 per cent level.

$R^2 \times 100 = 68.5$ per cent

Heteroscedasticity—Breusch–Pagan 34.78 Prob 0.00
Lagrange multiplier (error) 0.008 Prob 0.92

households receiving social allowance (X_{13}) or (W_X_{13}) and dummies for green areas (X_{18}) and centre (X_{19}). All the regression coefficients are positive except for X_{18} which indicates that vandalism ratios are lower in areas with large parks and gardens.

The findings are indicative of two distinct elements in Malmö's map of vandalism. First, vandalism is found in places where people converge, often in large numbers and where there may be an absence of capable guardians (X_{19}, X_{16}). This includes the CBD although, interestingly, not parks and public gardens.

The second element of the map identifies vandalism in disadvantaged areas of Malmö (X_{13}), especially those areas with local leisure associations (X_{16}) or other facilities that draw people to congregate in such areas. Certain districts of Malmö have seen a more than doubling of the number receiving social allowance in the past decade (Statistics Sweden, 2001). These relatively poor areas are scattered across the city (unlike in many Western European and American cities) and are often described as segregated areas "with very high and constant unemployment, youth crime, vandalism and antagonism between different groups" (Adolfsson, 1995, p. 256). Their social and economic segregation is not merely dependent on the ethnic component but may be intertwined with it (Cars *et al.*, 1999), although none of the variables for ethnic characteristics is significant in the models. The variable for households receiving social allowance (X_{13}) was not significant in its spatially averaged form in the OLS model, but was in the lagged response model. On the other hand, the leisure associations' variable is significant in its lagged form in the OLS model but not in the lagged response model. We suggest that the effects of high levels of these variables on vandalism rates extend beyond the areas where such levels are recorded. This is an indication of a possible contagious process associated with vandalism which is also indicated by the significance of W_Y in the lagged response model.

These findings are in accordance with previous Swedish literature (Roos, 1986; Wikström, 1991) which states that the variation in vandalism rates within inner-city areas is explained by the location of places of public entertainment, primarily meeting-places, whilst for the outer city it is related to areas with socioeconomic problems. However, none of these previous studies tried to test the impact of indicators of collective resources at the small-area level on vandalism. In both the OLS and lagged response models, the sign of the regression coefficient shows that high rates of local leisure associations (W_X_{16}) are associated with high SVRs. This was the only variable that we can link directly to collective resources and which has proved significant. As suggested above, a possible explanation for this may be that local leisure associations, especially those for young people, may affect negatively their surroundings since it is there where certain groups of young people may hang around and engage in casual acts of vandalism. Mahoney and Stattin (2000) showed in a Swedish case study that youth participation

in low-structured leisure activities, such as the ones that take place in youth recreation centres, was associated with high levels of anti-social behaviour (criminality, aggressive behaviour, alcohol/drug use, delinquency). Youth recreation centres are part of the Swedish welfare system and have for decades been supported financially by the national government. For further comments on the implications of these findings for decisions about recreation opportunities for youths in Sweden, see Stattin *et al.* (2005).

Another explanation might be that local associations are established in or close to areas where the relative risk of vandalism is already high and their effects are not strong enough to act as a counter. In Malmö, many leisure associations are located near central residential areas. Moreover, people in Malmö are quite active in participating in local associations. The city has one of the country's largest number of associations per capita. Participation in associations is encouraged in Sweden and financially supported by the state. About 20 per cent of all local associations in Malmö are organised by ethnic groups. In the case of Malmö, the existence of local leisure associations might help to build 'bonding' ties within groups, but fails in creating links between groups locally. This might be true especially for those areas with many ethnically based associations. In the international literature, Ross and Jang (2000) found similar results when assessing social ties among neighbours in Illinois, US. Formal participation in neighbourhood organisations showed little buffering effect on neighbourhood disorder, fear and mistrust.

6. Final Considerations

Regression modelling has allowed us to explore the significance of a set of aggregate variables as predictors of vandalism ratios by small area for Malmö. Results show that, even though vandalism is related to the city's land use structure and the presence of structural criminogenic conditions, the presence of local leisure associations does relate in a rather unexpected way to vandalism rates. In any future aggregate scale analysis, the incorporation of other types of indicator beyond the ones used in this study might help to establish more clearly the connection between area characteristics and collective resources and vandalism. Police calls for service, could, for instance, be incorporated in the analysis as an indicator of the area's need for external help and their trust in local institutions. We noted that a problem with the analysis was that vandalism is likely to be underestimated in less cohesive areas, since people do not take the trouble to report or might even be afraid to do so. Checking the pattern of more serious crimes, such as violent crimes and burglary, might offer a way of revising estimates of the level of vandalism.

An outstanding question is whether and how areas with social problems and vandalism might manage to break a spiral of decay (section 2.3). One may also wonder whether or not such a process will be generated spontaneously, through government intervention, or a combination of both. In Sweden, reduction of segregation and social exclusion has been an important social policy target (see, for example, SOU, 1997, 1999, 2000) and many social programmes have been put into practice either through mechanisms linked to welfare (such as improving labour force skills) or through the creation of programmes focused on specific geographical areas. Large urban areas, such as Malmö, have received special attention since they concentrate most of the areas with social problems in the country (such as Storstadssatsningen). An important feature of these programmes has been the attempt to establish a bottom–up approach by engaging with those living in areas with social problems. Such interventions provided incentives to a range of initiatives that aim at creating collective resources that could positively impact on the inhabitants' quality of life. Although policy-oriented research is under way to assess the general impact of these interventions, little can yet be said about their influence on the geography of vandalism. For future research,

it would be useful to look further at the effects of government intervention in neighbourhoods which have social problems and yet which appear to have low vandalism rates. This could help to clarify if these areas are managing to break the spiral of decay and the role of government intervention in such a process.

This study is an example of how one can use aggregated urban indicators often available in local planning agencies to try to explain the geography of vandalism. As with any other study using aggregated cross-sectional data, we are able to ascertain the links between the occurrence of vandalism and small-area socioeconomic and demographic characteristics. However, what cannot be done, which is essential before policy recommendations can be made, is to observe the time sequence of events and start to understand process. For this, longitudinal and individual-level data are needed to extend area-based analyses. A way forward is to undertake longitudinal individual studies of members of youth local leisure associations as well as studies of youngsters with a record of anti-social behaviour both as individuals and as part of groups. The aim is to provide convincing arguments to link criminal behaviour, neighbourhood characteristics and collective resources in societies like Sweden, where most of the physical collective resources (such as youth meeting-places) are regarded as public goods that should be available all over the country as part of the welfare system. So far, the Malmö findings have put some doubts on the positive effect of such collective resources on vandalism that is commonly taken for granted in the international literature. For future research, one of the main challenges is to elucidate more clearly the *mechanisms* by which collective resources influence the number of minor offences.

Notes

1. Despite the fact that the concept of social capital dates back to the beginning of the 19th century (see Hanifan, 1916; Jacobs, 1961; Bourdieu, 1983), its usage only spread in the 1990s with the work of Coleman (1990) and Putnam (1993, 1995, 2000) who launched it as a focus for research and policy discussion (Smith, 2001). In Putnam (1993, p. 35), social capital is referred to as "features of social organisations, such as networks, norms, and trust, that facilitate action and co-operation for mutual benefit".
2. In a country such as Sweden, most of the basic physical collective resources have always been planned together with new residential areas. The Swedish planning system tries to maintain welfare principles by providing basic public infrastructure. However, this does not guarantee the survival of private businesses. This loss it is argued has an effect on social contacts for groups that are less mobile, such as children and elderly people. Lundberg (1998) points out the fundamental social role that shops play for elderly people in Stockholm, since it is often there where they meet their acquaintances and friends.
3. At the scale of a town or city, this leads to a weakened taxbase, degrading the institutional structure and resulting in a loss of civic leadership (Wilson, 1986; South and Messner, 2000).
4. See http://booking.malmo.se/booking/forening/start.asp.

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Appendix 1. Results of Spatial Error Regression Model with Diagnostics

Table A1. Error model: maximum likelihood estimation

Y = square root of the standardised vandalism ratio

$$Y = 9.80 \quad +0.18\ X_{13}^{***} \quad -2.64\ X_{18}^{***} \quad +0.82(W\_e)$$
$$\quad (5.15) \quad (6.84) \qquad (-4.56) \qquad (13.13)$$

(z-values in brackets)

***significant at the 1 per cent level.

$R^2 \times 100 = 24.7$ per cent

Heteroscedasticity—Breusch–Pagan 0.10 Prob 0.94
Lagrange multiplier (error) 63.18 Prob 0.00
Lagrange multiplier (lag) 0.23 Prob 0.62
0.82 is the estimated value of the spatial parameter in the correlated error model denoted W_e.