



Residential burglary and concentrated disadvantage: A spatial heterogeneity analysis in Mexico City

Carlos Vilalta · Gustavo Fondevila

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Abstract Previous empirical studies on the correlation between residential burglary and concentrated disadvantage (CD) in Latin America commonly omit the spatial elements of the relationship. Using Mexico City (CDMX) residential burglary data for the period 2016 to 2018, we examine the predictive capacity of concentrated disadvantage in relation to residential burglary patterns, using a Geographically Weighted Regression approach to check whether their correlation varies across CDMX police quadrants. Controlling for relevant structural variables associated with residential burglary in previous studies, we find that the relationship between CD and residential burglary is positive in 844 out of 846 police quadrants (99.7%) and significantly much steeper in some quadrants than others –up to four times the median local slope. Thus, one key implication is that as this relationship is affected by spatial heterogeneity, traditional regression-to-the-mean analyses may misinform evidence-based crime prevention policies.

Keywords Residential burglary · Concentrated disadvantage · Spatial heterogeneity · Physical environment · Mexico

Introduction

Spatial heterogeneity and spatial autocorrelation are interrelated elements of spatial analysis as both inform each other (Fotheringham, 2009). The former, also referred to as spatial variability and spatial non-stationarity, is defined as the variation in relationships across space (Fotheringham et al., 2003; Mennis & Jordan, 2005; O’Loughlin & Anselin, 1992). The latter, refers to the non-random clustering of similar or dissimilar values over the map (Griffith, 1992). Spatial heterogeneity and autocorrelation may be the rule rather than the exception in environmental criminology (Vilalta, 2013).

Crime shows considerable variation across places and within places (Andresen & Malleson, 2013; Haberman, 2017; Vilalta & Fondevila, 2018). This spatial variation is caused by the aggregate effect of sociodemographic and socioeconomic characteristics (i.e. structural correlates) that happen to covary with place. This proposition may be called the component-effects explanation as it assumes that the spatial variation is due to a combination of concentrated disadvantage (Braga & Clarke, 2014; Cullen & Kulig, 2018; Graif & Sampson, 2009), crime opportunity (Natarajan, 2017; Wilcox & Cullen, 2018), and/or

C. Vilalta (✉)
Center for Research in Geospatial Information Sciences
(CentroGeo), Contoy 137, Lomas de Padierna,
14240 Mexico City, CDMX, Mexico
e-mail: cvilalta@centrogeo.edu.mx

G. Fondevila
Center for Economic Research and Education (CIDE),
Carr. México-Toluca 3655, Santa Fe, Altavista,
01210 Mexico City, CDMX, Mexico

strain and anger (Agnew, 1999; Agnew & Brezina, 2019; Botchkovar et al., 2018). This proposition only deals with the spatial autocorrelation element of crime. In terms of methods, this proposition would imply that geographically aggregated crime patterns and processes can be analyzed as one homogeneous social problem for which risk factors are neither place nor context specific.

A complementary view is the contextual-effects proposition, which holds that crime varies across places independently of the compositional characteristics of the population in the location where they live (Vilalta et al., 2021a, 2021b).¹ This proposition has two implications for environmental criminology. One, where local socially constructed behaviors such as appropriations of legal norms, street code culture, culture of honor, *machismo*, as well as the cultural constraints of local institutions, police and justice effectiveness, and the corruption or coercion of local police and justices by criminal organizations, are strong in relation to crime, it is expected these will have an aggregate effect on crime independent of the composition of the population, crime opportunities, concentrated disadvantage, and/or strain and anger (Ferrell, 2017; Fondevila et al., 2021; Hirschi, 2017; Mennis & Harris, 2013; Tittle, 2018; Van Wilsem, 2003; Vilalta et al., 2021a, 2021b). Two, also in terms of methods, the implication is that geographically aggregated crime patterns and processes should not be assumed homogeneous across countries, states, cities, neighborhoods, etc. Its analysis requires a place-specific approach, particularly in regions like Latin America where contextual forces are significant and theoretically valuable predictors of crime (Vilalta, 2014, 2016, 2020). In this respect, the theoretical and methodological utility of spatial heterogeneity is that it serves to operationalize the proposition that behaviors are place-specific rather than spatially uniform (Flint, 2002).

In light of the above, this study aims at providing correlational evidence of spatial heterogeneity (i.e. contextual-effects) in the relationship between residential burglary and concentrated disadvantage, controlling for other classical structural correlates (i.e. component-effects) in the residential burglary

literature. Geographically weighted regression (GWR) was employed to assess spatial heterogeneity, using Mexico City as case study, and police quadrants as spatial unit of analysis.

The study proceeds in four steps. The first part presents a review of studies focusing on the spatial elements of residential burglary and its relationship with concentrated disadvantage. In the second part, we explain the data and methods used in this study. The third part reports the results of a Poisson global regression and a Poisson geographically weighted regression (GWR) of residential burglary counts. The study concludes with a discussion and conclusion regarding the findings, limitations, and implications of our correlational evidence.

Previous studies

The spatial elements of residential burglary

Previous studies show that burglary is a spatially structured crime (Brantingham & Brantingham, 1975; Langton & Steenbeek, 2017). Burglars select a suitable neighborhood by comparing neighborhoods and targets in terms of rewards, effort and risk of apprehension (Bernasco & Nieuwebeerta, 2005; Johnson & Bowers, 2004; Moreto et al., 2014; Piquero & Rengert, 1999; Rengert & Wasilchick, 2000; Taylor, 2018a, 2018b; Townsley et al., 2015, 2016; Vandeviver et al., 2015). Burglaries are more likely to occur in places where offenders maximize perceived benefits and minimize expected risks (Glasner et al., 2018).

In terms of rewards, burglars tend to select affluent neighborhoods (Bernasco et al., 2015; Townsley et al., 2015; Tseloni et al., 2002) as the expected gains tend to be larger there (Bernasco & Luykx, 2003). Yet, there is also evidence of burglars operating in economically disadvantaged neighborhoods (Chen et al., 2017; Liu et al., 2018; Martin, 2002; Mburu & Bakillah, 2016; Nobles et al., 2016; Piza & Carter, 2018; Taylor et al., 2015; Ward et al., 2014), with high levels of unemployment (Malczewski & Poetz, 2005; Mburu & Bakillah, 2016; Ward et al., 2014; Worrall, 2006), and residential instability (Bernasco et al., 2015; Chamberlain & Boggess, 2016; Chen et al., 2017; Nobles et al., 2016; Quick et al., 2019; Townsley et al., 2015). Neighborhoods with high

¹ This view was originally proposed in electoral geography. See Vilalta for a detailed explanation.

levels of foreclosures suffer from more residential burglary than their counterparts (Zhang & McCord, 2014).

In terms of effort and risk, burglary has operational needs and costs, such as the knowledge of burglary techniques, search and departure strategies, and the costs of being identified and arrested etc. (Oliveira, 2018; Wright et al., 2011). Burglars must consider many factors such as the number of escape routes and the number of encounter opportunities with capable guardians (Hillier & Shu, 2000). Streets with high activity or major roads tend to attract burglars (Johnson & Bowers, 2010; Nobles et al., 2016; Piquero & Rengert, 1999).

It is likely that burglars' modes of transportation play a role in determining their routes and, subsequently, selecting their targets (Ward et al., 2014). There is evidence of burglars preferring to operate in neighborhoods near to their home (Bernasco & Luykx, 2003; Bernasco & Nieuwbeerta, 2005; Chamberlain & Boggess, 2016; Chamberlain & Hipp, 2015; Martin, 2002; Townsley et al., 2015), near train stations (Bernasco et al., 2015; Clare et al., 2009; Liu et al., 2018), public transit nodes (Gerell, 2018; Moreto et al., 2014), and high levels of bus density (Chen et al. 2017). However, other studies find no evidence of public transportation statistically associated with residential burglary (Moreto et al., 2014). Proximity to the city center seem to positively correlate with residential burglary (Townsley et al., 2015). Previous studies in Mexico City report high proportions of convicted burglars and robbers operating in their own neighborhoods (Vilalta, 2010).

The combination of easily accessible targets with the total number of targets available play an important role in residential burglary (Townsley et al., 2015, 2016). More targets available translate into less criminal effort. Burglars seem to prefer neighborhoods with large population sizes (Quick et al., 2019), population densities (Mburu & Bakillah, 2016; Nobles et al., 2016) and household densities (Bernasco et al., 2015; Piza & Carter, 2018). The presence of bars and liquor stores also tend to attract residential burglars (Piza & Carter, 2018).

The certainty of arrest has a deterrent effect on burglars (Park et al., 2017). In terms of risk of apprehension, it is argued that residents in neighborhoods with low levels of collective efficacy tend to be less likely to intervene in preventing criminal acts (Sampson

& Raudenbush, 2001; Sampson et al., 1997). Three proxy measures of risk of apprehension may be the lack of collective efficacy itself (Nobles et al., 2016), surveillance (Taylor, 2018a, 2018b), as well as prior victimization, which all increase the likelihood of residential burglary (Bernasco et al., 2015; Blake, 2011; Brookman et al., 2010; Hino & Amemiya, 2019; Johnson, 2008; Lockwood, 2014; Pitcher & Johnson, 2011; Tseloni et al., 2002).

Residential burglary and concentrated disadvantage

Residential burglary has been found spatially clustered in places with high levels of concentrated disadvantage or other poverty proxies (Chamberlain & Hipp, 2015; Liu et al., 2018; Martin, 2002; Vilalta et al., 2021a, 2021b). Previous studies in Mexico City have also found that concentrated disadvantage spatially correlates with larceny theft (Fuentes & Sanchez, 2017), vehicle theft (Sanchez & Fuentes, 2016), and homicide (Vilalta et al., 2020a, 2020b, 2021a, 2021b).

Modern formulations of social disorganization theory have defined collective efficacy as the prime process responsible for the spatial clustering of crime (Braga & Clarke, 2014; Louderback & Sen Roy, 2018). Collective efficacy processes are a challenging concept to operationalize. However, previous studies have shown collective efficacy related to concentrated disadvantage and affecting crime in similar ways (Gerstner et al., 2019; Sampson et al., 1997; Vilalta et al., 2020a, 2020b; Ward et al., 2014). The argument is that concentrated disadvantage is an environmental indicator of the likelihood of residents to take an active role against crime and disorder (Sampson et al., 1997; Ward et al., 2014). Places with high levels of concentrated disadvantage may give the offender the impression of low levels of collective efficacy, thus motivating offenders to operate in such places. Most burglars live in socially disadvantaged neighborhoods themselves (Liu et al., 2018).

Collective efficacy varies across places (Browning et al., 2004; Messner & Anselin, 2004; Schnell et al., 2017; Stein et al., 2016), showing it spatially dependent and heterogeneous (Graif & Sampson, 2009; Vilalta, 2013). Concentrated disadvantage has been found to spatially spread from one place to another (Shimada, 2004; Zeoli et al., 2014).

Some measures of concentrated disadvantage have used variables and composite measures of unemployment, poverty, youth population, female-headed households with children under the age of 18, truancy, and population density (Chamberlain & Hipp, 2015; Gerell, 2018; Kirk, 2008; Miethe & McDowall, 1993; Piza & Carter, 2018; Rocque et al., 2017; Sampson, 1983; Vilalta & Fondevila, 2019; Vilalta et al., 2021a, 2021b; Ward et al., 2014). Younger populations have often been used to characterize socially disorganized locations (Piza & Carter, 2018; Ward et al., 2014).

Data and methods

Case study and unit of analysis

The case study was Mexico City and unit of analysis was the police quadrant (N=846). Mexico City, with a population of 9.2 million residents (or 7% of the total national population), is the capital of Mexico. Mexico City is, by far, the economic engine of the country. According to the OECD, Mexico City's GDP per capita was equivalent to 39.8 thousand USD in 2016.²

The average Mexico City police quadrant is 1.05 square kilometers (0.41 square miles) with a mean of 10,771 residents according to the 2020 census. We used the police quadrant as unit of analysis as they are the basic police spatial unit and provide an effective focus for policing tactics and strategy. Police quadrants also coincide with the concept of place (Vilalta, 2013). A place is the distinction between here and there, and are perceptibly unique in three elements: location, material form, and meaning and value (Gieryn, 2000). Police units have mental maps of their police quadrant and know what happens in their spatial unit of patrolling.

We assume police units in different quadrants have a different capacity to conduct preventive patrolling as well as speed of respond to call-for-service. This should impact the offender's effort to commit a crime as well as the risks of committing a burglary. Likewise, we assume that resident's confidence in police

varies across police quadrants, resulting in variation in the likelihood of crime victimization (Nieuwebeerta et al., 2008).

Dependent variable

Residential burglary investigation data are managed by the local Office of the Attorney of Mexico City (Procuraduría General de Justicia de la Ciudad de México). These data can be freely downloaded from the Open Data office of Mexico City (DACM, 2019). The database contains criminal investigations counts from January of 2016 to December of 2018, by geographic coordinates of the location of the crime and other attributes. This study used the 20,456 residential burglary investigations for the 2016 to 2018 period. Residential burglary geographic coordinate data were made to coincide spatially with the nearest city block, so to be later matched with the census data which is measured at the city block level by the National Institute of Statistics of Mexico (INEGI). We nested the 64,282 city blocks of Mexico City within their corresponding 846 local police quadrants.

Independent variable

The independent variable (IV) was concentrated disadvantage. A set of variables representative of concentrated disadvantage in the context of Mexico were subjected to Principal Component Analysis (PCA) (Vilalta et al., 2016, 2020a, 2020b; Vilalta & Mughah, 2014). PCA is perhaps the most used technique for dimensionality reduction. Previous studies have used the same index approach to measure concentrated disadvantage (Piquero et al., 2005; Simes, 2018; Umbach et al., 2018; Vilalta et al., 2020a, 2020b).

Data from the 2010 census were used to measure concentrated disadvantage: The proportion of population between 15 and 29 yrs. old, the proportion of female headed households, the proportion of unemployed population, and the proportion of population between 6 and 15 yrs. old that do not attend school as proxy of truancy. These measures are relevant as disputes are often resolved informally and violently because residents of disadvantaged neighborhoods are dissatisfied with police protection and the judicial system (Kubrin & Weitzer, 2003; Vilalta et al., 2016, Vilalta et al., 2020a, 2020b). This is particularly true

² See: <https://www.oecd.org/cfe/MEXICO-Regions-and-Cities-2018.pdf>

in contemporary Mexico where lynching of presumed offenders have occurred (Cruz & Kloppe-Santamaría, 2019; Godoy, 2004; Santamaría & Carey, 2017).

Control variables

We assumed that police quadrants with features listed below could be considered crime generator and crime attractor places as they bring together potential criminals with potential victims (Bernasco & Block, 2011; Brantingham et al., 2005; Deryol et al., 2016; Kinney et al., 2008).

The following variables were used as controls: metrobus stations, metro stations, banks, bars, convenience stores with carry-out liquor permits, restaurants, primary streets, and police stations. We expected more burglary crimes would happen in quadrants with more mass transit accessibility. Police stations were also included as it was expected that police presence would decrease homicide, although this is debated (Nilsson, 2012). Our results in fact showed we were mistaken in this assumption –the presence of police stations actually increased the residential burglary count. However, this is due to incorrect processing of crime data by the local police. This is explained in the discussion and conclusion section. Population density was also included as control.

Statistical analysis

Since the focus of this study is spatial heterogeneity, we made use of the Geographically Weighted Regression (GWR) technique. This technique is suited for the detection of spatial heterogeneity, that is, the variation in relationships across places. It allows regression coefficients to covary with location. GWR calculates separate coefficients for each location which can later be mapped.

Each police quadrant was assigned a spatial weight with the use of Euclidean distances and a distance decay function. An adaptive Gaussian kernel was used for this purpose. The method for finding the optimal bandwidth around each quadrant was the Cross-Validation (CV) method in the R software. The resulting adaptive quantile bandwidth was 0.764, that is, about 646 of the 846 quadrants.

A Global Poisson and a Poisson GWR model were used to relate residential burglary counts to a principal component (PCA) of concentrated disadvantage.

Table 1 Concentrated disadvantage scoring coefficients for component 1 (unique)

	Coefficients
Pop. 15–29	0.671*** (0.017)
Unemployment	0.279*** (0.060)
Female HH	– 0.512*** (0.044)
Truancy	0.458** (0.041)
Component 1	1.718*** (0.083)
Explained variance (Rho)	0.429
LR test for independence (Chi squared)	438.1***
LR test for sphericity (Chi squared)	438.4***

Standard errors in parenthesis

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Our results showed significant spatial heterogeneity across police quadrants in the relationship (local slopes) between concentrated disadvantage and residential burglary.

Results

We used a principal component analysis (PCA) for the construction of the concentrated disadvantage indicator. The indicator, or component, consists of four quadrant-level correlates. Only one component had an eigenvalue above one. Consistent with previous research, the resulting PCA component reported an eigenvalue well above 1, suggesting a good measure of concentrated disadvantage. Higher scores of concentrated disadvantage reflect worse levels of disadvantage. Table 1 shows the scoring coefficients.

The results of the spatial autocorrelation analysis of residential burglary is presented in Fig. 1. This correlogram indicates that residential burglary is significantly clustered within a distance interval between 0 and 3.1 km. No spatial pattern is detected at further distances. Figure 2 shows the map of residential burglary criminal investigations at the police quadrant level. A few spatial pockets of residential burglary can be observed in the south of the city.

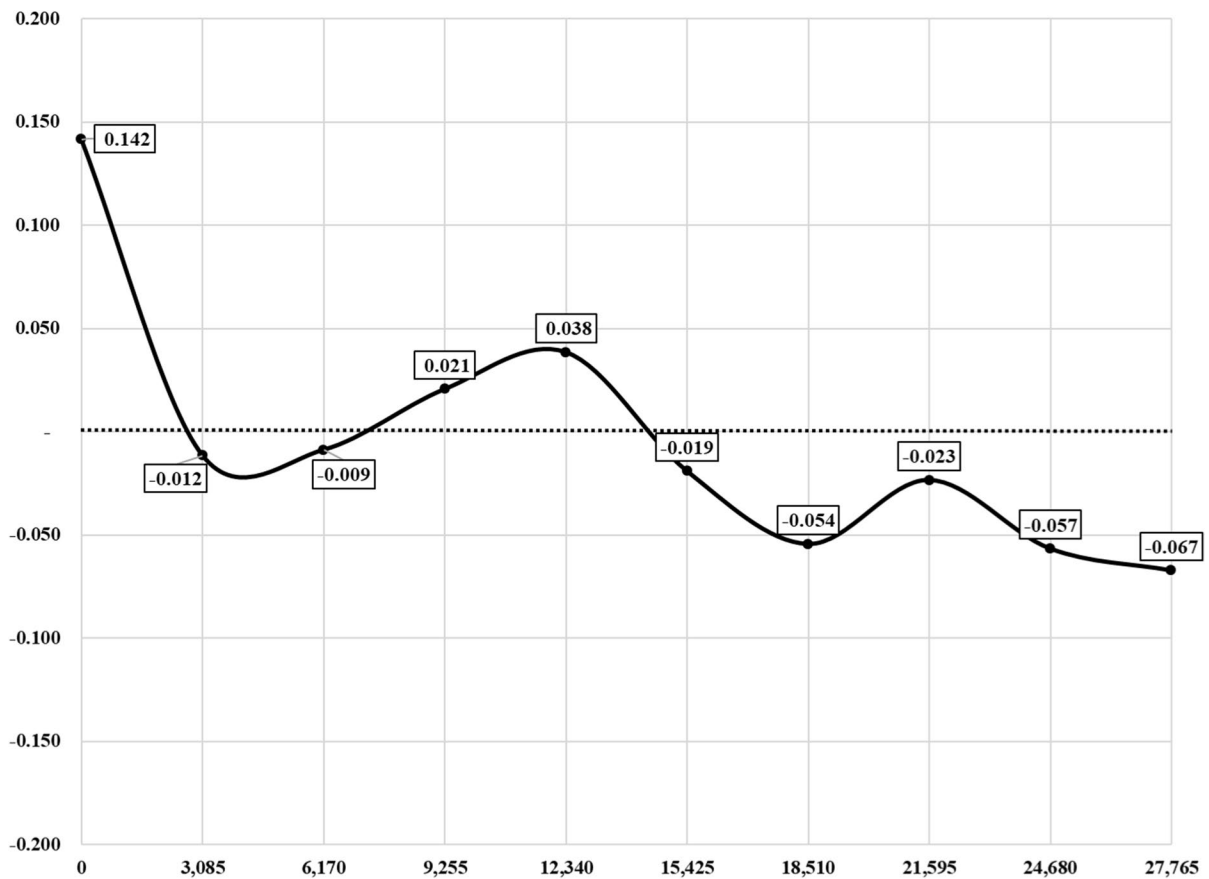


Fig. 1 Mexico City: Correlogram of residential burglary criminal investigations per police quadrant (2016–2018)

Table 2 shows the results of the Global and GWR Poisson regressions for residential burglary. Starting with the Global specification, we found concentrated disadvantage statistically associated with residential burglary controlling for crime generator and crime attractor correlates. All correlates are statistically significant. In contrast to Piza and Carter (2018) case study of Indianapolis, we find that a higher count of bars correlates negatively with residential burglary. We found that higher levels of residential burglary were recorded in police quadrants with more primary streets as others have already reported (Johnson & Bowers, 2010; Nobles et al., 2016; Piquero & Rengert, 1999). This suggests that residences in police quadrants with faster routes (for escape) may be at higher risk of burglary.

We found that metro stations as well as metrobus stations significantly reduce the risk of residential burglary. Residential burglary involves objects of

considerable value (e.g. electronic goods, jewelry, etc.) and size (e.g. power tools, hand tools, bikes, etc.), for which easy access to public transportation should be useless. Similarly, residences in police quadrants with bank locations have lower odds of burglary victimization. As it is expected to see more policing in police quadrants with bank locations, perhaps residences nearby these facilities are at a lower risk of residential burglary.

Unexpectedly, although it is expected that police stations would decrease the odds of residential burglary, the results of the Global Poisson regression show more police stations increasing the risk of residential burglary. This contradiction has already been raised in a recent case study on homicide in Mexico City (Vilalta et al., 2020a, Vilalta, Muggah, et al., 2020b). It seems that this contradictory finding is due to a data collection error. Perhaps, as with the case of homicide crime investigations, some residential

Fig. 2 Mexico City: Residential burglary criminal investigations per police quadrant (2016–2018)

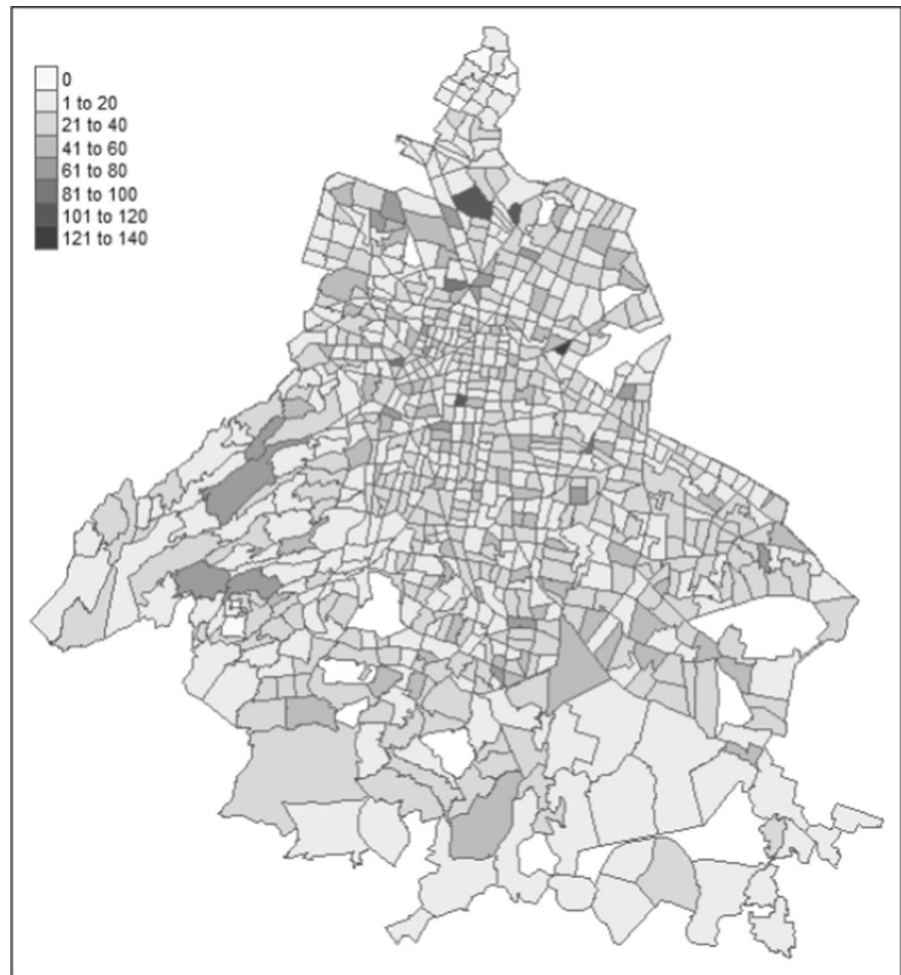


Table 2 Global and GWR Poisson regression local varying coefficients for residential burglary

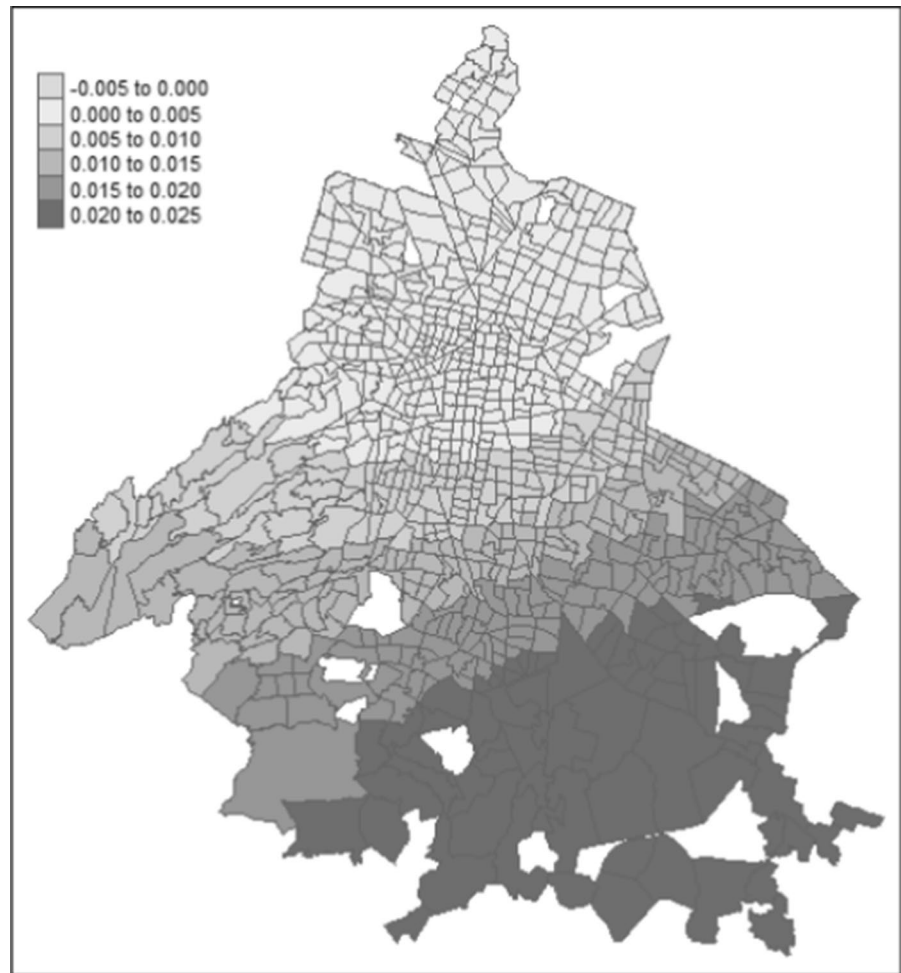
	Min	Median	Max	Global
Concentrated disadvantage	0.000	0.006	0.025	0.015***
Police station	0.168	0.170	0.172	0.171***
Metrobus stations	− 0.024	− 0.020	− 0.014	− 0.019***
Metro stations	− 0.115	− 0.100	− 0.089	− 0.096***
Banks	− 0.006	− 0.003	0.000	− 0.005*
Bars	− 0.019	− 0.015	− 0.011	− 0.015***
Convenience stores	0.062	0.067	0.071	0.071***
Restaurants	0.003	0.005	0.005	0.004***
Primary streets	0.018	0.020	0.022	0.021***
Pop. density	0.000	0.000	0.000	0.000***
Intercept	2.845	2.859	2.866	2.842***
CV bandwidth ^a	0.764			
AIC				10,648.0
MSE	870.5			

*** $p < 0.01$, ** $p < 0.05$,

* $p < 0.1$

^aAdaptive Gaussian Kernel

Fig. 3 Mexico City: GWR local slopes of the effect of Concentrated Disadvantage on Residential burglary



burglary investigations may have been recorded by the police as if they had occurred either in immediate vicinity or even within the police station. We comment more on this on the next section.

Finally, we found that bar density reduces the odds of residential burglary, whereas restaurant and convenience stores density significantly increase the odds. Restaurants and convenience stores are spatially clustered and correlate positively with concentrated disadvantage, meaning that more of both are located in higher disadvantaged areas. Bars neither have a discernible spatial pattern at the police quadrant level nor do they correlate as strongly with concentrated disadvantage as the previous two correlates.

The Poisson GWR specification shows significant local variations in the relationship between residential burglary and concentrated disadvantage –local coefficients range from minus 0.005 to positive

0.025. Figure 3 shows the spatial distribution of the estimated parameters of concentrated disadvantage. Slopes are spatially autocorrelated ($Z=48.9$, $p<0.001$).³ Deviance residuals are also spatially autocorrelated ($Z=2.537$, $p=0.005$). The estimation sample descriptive statistics are shown in Table 3.

Discussion and conclusion

This study is an application of spatial heterogeneity analysis to the relationship between residential burglary and concentrated disadvantage. Mexico City police quadrants were used as case study because of

³ This is the Z value of the Moran's I spatial autocorrelation coefficient. Based on a Queen first order contiguity matrix.

Table 3 Estimation sample descriptive statistics for police quadrant variables (N=846)

Variable	Mean	SD	Min	Max
Residential Burglary	24.2	16.1	0	129
Concentrated disadvantage	0.000	1.31	– 4.367	3.915
Police station	0.6	0.8	0	5
Metrobus stations	1.2	2.9	0	23
Metro stations	0.2	0.5	0	3
Banks	2.0	3.1	0	22
Bars	1.0	2.2	0	30
Convenience stores	2.1	2.3	0	19
Restaurants	8.3	9.9	0	82
Primary avenues	4.5	4.9	0	50
Pop. Density (Km ²)	21,587.2	22,431.3	0	98,429.9

our knowledge of the region and the importance of providing cross-national evidence that aggregated criminal activity is influenced by local contextual and structural characteristics.

The reader must know this is an observational study based on a cross-sectional analysis of the data. As such, the limits of our evidence is that it is purely correlational. Having said that, we present evidence that concentrated disadvantage is a strong predictor of residential burglary at the police quadrant level of spatial aggregation. The relationship between the two variables is markedly spatially heterogeneous across police quadrants. The relationship is positive in 844 out of 846 police quadrants (99.7%), however steeper in some quadrants than others –up to four times the median local slope. One major implication of these findings is that as concentrated disadvantage seems to be the main risk factor for residential burglary, Sampson (2012) is correct in insisting that spatially targeted policies to reduce concentrated disadvantage are necessary if residential burglary is to decrease.

Likewise, given that residential burglary is positively associated with convenience stores, restaurants and primary streets, it seems that more and better police patrolling may impact burglary victimization (Ratcliffe, 2004). Mexico City authorities could promote spatially targeted policies for which the police quadrant seems a suitable spatial unit.

These findings are not too different from what has been reported in previous studies on residential burglary or other property crimes. We coincide

with previous studies in the U.S. that find a spatial match between concentrated disadvantage and residential burglary (Chamberlain & Hipp, 2015; Liu et al., 2018; Martin, 2002). Likewise, for the case of Mexico, we find that residential burglary is one more crime among others like larceny, vehicle theft, and homicide that is positively associated with concentrated disadvantage (Fuentes & Sanchez, 2017; Sanchez & Fuentes, 2016; Vilalta et al., 2020a, Vilalta, Muggah, et al., 2020b, Vilalta et al., 2021). It thus seems that crime will hardly be resolved without reducing the levels of concentrated disadvantage in the city.

Aside of the limits of correlational evidence, there are other limitations to this study. One is that our results suggest that some criminal investigations may be being recorded administratively as if they had occurred either in proximate distance or even within police stations. Even though we may assume this error is spatially random, this can affect the validity of the evidence to some degree. Another is that, only a minority of residential burglaries are reported to the police. According to the National Institute of Statistics and Geography (INEGI), only 19.7% of all residential burglaries in Mexico City were reported to the police in 2018. It must be added that, according to the same source, the victimization rate for residential burglary in 2018 in Mexico City was 2028 per one hundred thousand adults—a decrease of 0.3% from the 2035 per one hundred thousand adults in 2017.⁴ One final limitation, which is in itself something to be explored in future studies, is to compare the predictive capacity of concentrated disadvantage with other proxy measures such as the Marginality index as measured by the National Council of Population in Mexico. This comparison would allow comparativists to identify which measures environmental indicators of poverty and collective efficacy are better suited to indicate the likelihood of residents in neighborhoods to take an active role in crime prevention.

We have therefore spatially modeled the relationship between concentrated disadvantage and residential burglary only for a sample of crime events for which we do not know if the distribution is spatially

⁴ See the Mexico City crime victimization report of 2018: https://www.inegi.org.mx/contenidos/programas/envipe/2019/doc/envipe2019_cdmx.pdf

or otherwise statistically biased. Unfortunately, there is no way around the former unknown if we are to use official crime data. To be fair though, past research has been able to make meaningful contributions to the literature facing the same difficulty. Clearly, our results can be replicated and improved in future studies.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Research involving human participants and/ or animals Not applicable to current study given no involvement of human participants.

Informed consent Similarly, not applicable to the present study.

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