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THE SPATIAL DIMENSION OF CRIME IN MEXICO CITY (2016-2019)

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Abstract

Crime exhibits specific geographical and chronological patterns in Latin American cities, and data on criminal activity allows scholars to trace spatial and chronological patterns down to specific neighborhoods and certain hours of the day in these cities. Over the last three decades, numerous studies have explored the relationship between crime, space, and time, and some studies have even established strong correlations between different patterns of land use and specific types of crimes. Few of these studies, however, have focused on the spatial configurations of criminal activity in cities and the conditions that elicit criminal activity in certain locations. Using recent crime data for Mexico City, this study employs a methodology based on crime location quotients to establish correlations that spatially characterize crime. This information can substantially improve public safety policies applied to urban contexts.

Introduction

Analyses of the spatial distribution of criminal activity started at the beginning of the 19th century. Early studies sought to explain the relationship between criminal activity and the location where it occurred (Guerry 1831; Poisson 1837; Quetelet 1831). A century later, researchers from the Chicago School went beyond the study of crime and location and applied concepts that ranged from ecology to human behavior to try to understand crime. These scholars used different analytical scales from a regional to a local approach, focusing on specific locations within urban spaces (e.g., streets, public squares, facilities, etc.). In studying locations with high crime rates, Burgess (1925) examined local environmental conditions, such as the levels of marginalization and the land use. He suggested that crime is correlated to specific characteristics of the local environment, such as socioeconomic factors and crime rate history. Burgess found that, while criminal activity may be found in specific locations, its presence goes well beyond that space as such, relating instead to the environmental conditions that prevail within that space. Burgess' study went beyond the concept of space as purely a location where a crime was committed and reconceived it as a setting that possesses all the right environmental conditions conducive to criminal activity. This was an innovative and important idea in the study of criminal patterns, shifting the focus to the conditions of a location or space as the main predictors of crime (a *place-based* approach). Burgess also started questioning whether or not a high crime spot has a spillover impact on the surrounding areas. In general, these studies helped to develop an important tool in understanding criminal activity: crime-mapping. Crime-mapping makes it easier to direct and focus resources and policing within a problematic area. In that sense, it helps with crime prevention efforts, as it allows officials to assess the risk of victimization within certain urban spaces and direct policing resources to that location. If we add in crime-timing analysis, a method that focuses on when crime rates are highest, police efforts can be distributed within a specific timeframe, not just a specific space.

Although the correlation between criminal activity and space and time is important, many researchers have also explored the relationship between criminal activity and social disorder in urban spaces. Some scholars, such as Park (1952), hypothesized that a

community maintains a state of equilibrium until external actors come in and disturb this balance through invasion, domination, or replacement of the resident population, obligating it to emigrate to other areas. Supporting this hypothesis are studies that found that population-displacement processes, in which residents of an area with high crime rates move to other areas with lower crime rates, did not carry criminal activity to the new area (Shaw and McKay 1969). This finding led to the conclusion that crime is to a great extent a product of environmental conditions within a specific territory and is not inherent to a group or an individual.

In North America, some of the first important place-based analyses of criminal activity were studies conducted in housing developments or project blocks. These were ideal for the study of place-based analyses because they exhibited certain environmental conditions that were thought to be conducive to criminal activity (Roncek, Bell, and Francik 1970). Some studies following this line of research identified specific environmental conditions that seemed to elicit criminal activity. For example, Poister (1996) found that train and bus stations are often characterized by high rates of petty theft and even assaults and auto part theft, among other crimes.

Still, it is important to mention that correlations between place and criminal activity, even when certain environmental conditions are met, are not necessarily causal in nature. Some studies, however, show strong correlation, suggesting causality. A study that examined the criminal activities associated with 40 urban parks found that both socioeconomic marginalization and physical disorder were correlated with criminal activity. In effect, the social benefits usually attributed to the existence of parks in an urban setting were diluted in areas with extreme economic hardship (De Motto and Davies 2006). These correlations, however, do not always consider the comprehensive environmental characteristics of a specific place. For instance, in a study of linear parks in Boston, Crewe (2001) found that adjacent neighborhoods had lower rates of property theft, suggesting that the existence of the parks helped to improve security rates. More studies like these are required. And of course, it is important to study a criminal's rational choice in assessing risk or opportunity when committing a crime or even the routine activities of a place from which crime patterns emerge, among other explanations.

The Goal of This Study

This study considers that, even though there are many factors that influence the spatial distribution of criminal activity, such as a neighborhood's sociodemographic characteristics, environmental deterioration, and opportunities to commit a crime, particular importance must be given to the configuration of a space or place as a key factor in understanding criminal activity (Brantingham and Brantingham 1995). In other words, the role of space for criminal activities is crucial. Criminal activity uniquely manifests in different areas, including in streets, public squares, and urban facilities. That is, individuals located in one place instead of another could become the target of a crime depending on the specific space. It is to be expected, for example, that high concentrations of people in a place will attract criminals because there are more windows of opportunity for crime—for

example, theft. In studies conducted in North American cities, it was found that criminal activity is often concentrated around liquor stores and nightclubs, as well as social housing developments, hotels, transport terminals, currency exchange establishments, and parking lots (Rengert, Ratcliffe, and Chakravorty 2005). On the other hand, there are place attributes that appear to deter crime in certain spaces. Defensive urban design is one such characteristic (Newman 1972; Brantingham and Brantingham 1995). Moreover, according to Hillier (2007) and Jacobs (1961), residents provide natural surveillance of public spaces by deploying a greater number of "eyes on the street." This implies that the presence of people is a natural mechanism to inhibit crime. Interestingly, in the case of Latin American cities, the places with the highest concentrations of people, such as historic centers, are frequently the areas with the greatest rates of petty theft and public disturbances (Valenzuela 2016). This suggests that there are other conditions at work—such as poverty, impunity, and informal economic activity—that neutralize the presumed benefits of having large concentrations of people watching each other.

In the case of Latin America, there are additional complications when examining the correlation between space/place and criminal activity. In fact, criminal activity is often impossible to disentangle from a number of other interactions including formal and informal economic activities that take place in illegal and even criminal circuits (Valenzuela and Monroy-Ortiz 2014). For example, the Center for Social Rehabilitation (CERESO) in Piedras Negras, Coahuila, functioned as a prison, but it was also a center of operations for the former *Los Zetas* cartel, one of the most violent cartels that has ever existed in Mexico (Aguayo and Dayán 2018). At the CERESO, *Los Zetas* recruited new members for their criminal organization, ordered people outside the prison to be executed (and made the corpses "disappear"), assembled double-bottom vehicles to transport drugs across the border, and hid and protected organized crime bosses. They also directed extortions, kidnappings, and other criminal activities. Separating the operations of petty criminals from those of sophisticated organized criminal cartels that control a territory is not easy at all. The existence of this space of criminal operations, positioned on the fuzzy line separating petty urban crime from organized crime, exponentially complicated actions intended to counteract criminal activity to such a degree that the CERESO, intended to be a public safety apparatus, ended up being infiltrated by crime at all levels (Payan 2016).

Considering these issues, this study intends to identify, describe, and interpret crime patterns within Mexico City and correlate them to space and time. Through an examination of these patterns in a major urban center in Latin America—Mexico City—this study hopes to contribute further to the development of a theoretical and empirical understanding of criminal activity and its correlation with space (and time). This text aims to do so by systematically understanding the spatial dimensions of crime in Mexico City as an important case study. The model generated here is also intended to be replicable in other major urban centers throughout Latin America.

Theoretical Framework and Methodology

This study is interested in an *environmental* approach to understanding criminal activity. It focuses on a criminal event as a data point at a specific space and time but considers that the crime also depends on the environmental variables of the place and time where it occurred. This study views the offending behavior as the product of interactions between the individual committing the crime and the conditions in the immediate environment. In doing so, it contrasts with other approaches that explore the transgressor's economic or internal motivations or the social influences in his or her personal history that lead him or her to crime. In that sense, this study posits that crime does not occur randomly. Instead, it argues that it is possible to recognize and deal with the environmental factors that link criminal activity with specific locations and times.

At its core, this essay addresses the spatial and time dimensions of crime, focusing on the surrounding environment that prevails in a specific location at a certain time, and seeks to decipher the way in which a place and time invite or inhibit criminal activity. This is not to deny that there are other factors that contribute to crime, but this essay focuses on space- and time-related factors in an urban setting that can be associated with crime. It assumes that crime is a combination of several elements—physical and psychosocial—that contribute to a place or time being more or less favorable to the commission of a crime. To be sure, urban spaces and daily life are quite complex and often do not allow for the factors leading to crime to be narrowed to a few variables. However, the environmental variables related to criminal activity can be organized in a typology so that it is possible to graph criminal activity by location and time patterns. This is key to understanding the place and time perceptions of public or personal safety within a territory.

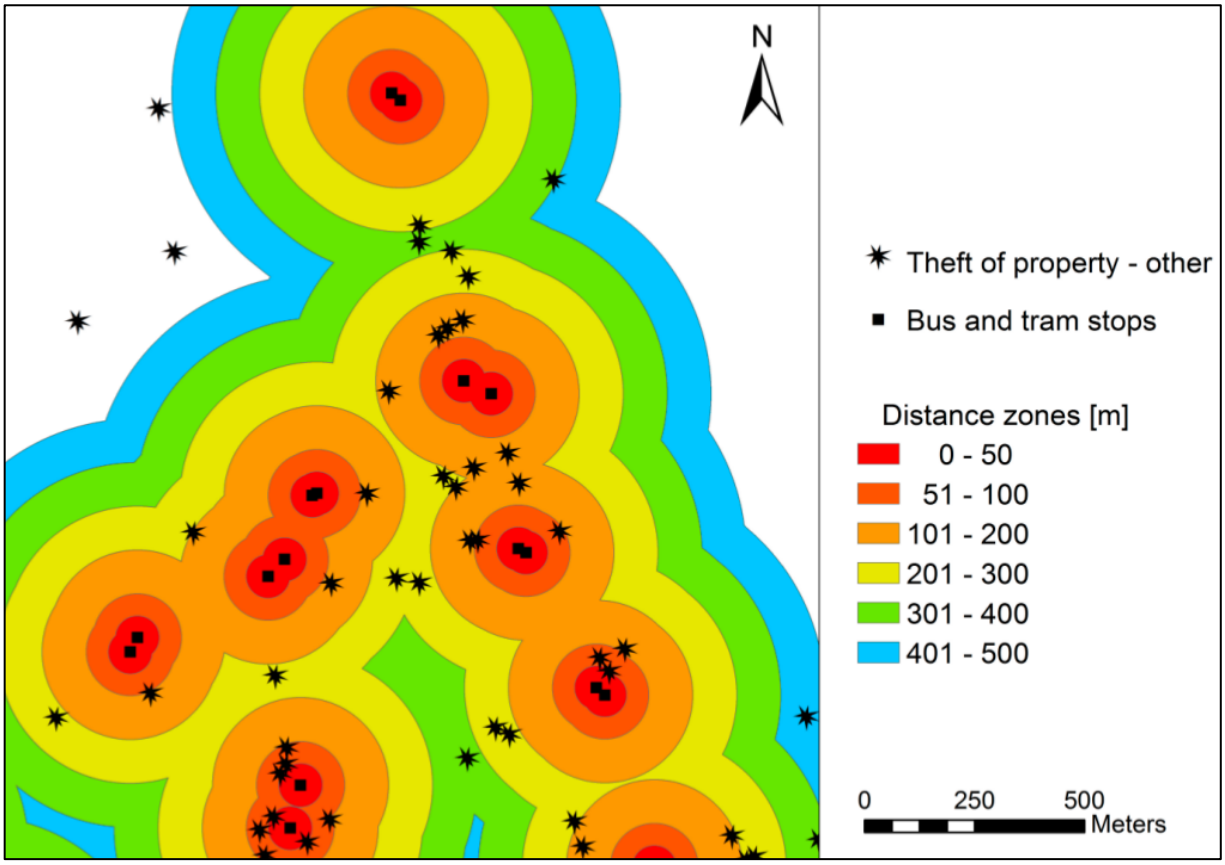
This study uses the crime location quotient (CLQ)[1] as a methodology useful to link the location (and time) of criminal activity to land use in the surrounding area as well as to high-risk economic units—e.g., types of business. This allows us to correlate specific economic units with certain criminal activities and to identify crime clusters. One example would be robberies in areas surrounding banks (while banking is going on). Another example is the areas around nightclubs, bars, and cantinas, where a variety of crimes occur (robbery, extortion, and even kidnapping and homicide), especially around business hours. These spaces are complex and are sometimes linked to organized criminal activities, such as drug sales, etc. The CLQ method, however, can capture such dimensions because it focuses on crime events, not the organization behind or the opportunistic dimensions of a crime. In that sense, the CLQ method is a useful analytical tool, regardless of the type of crime. It has, for example, been used to assess policing strategies and programs that do not appear to inhibit violent crime (Lawton, Taylor, and Luongo 2005) and to reduce robbery

[1] The crime location quotient (CLQ) method is a technique for crime mapping analysis to compare an area's share of an activity with the reference area's share of the same type of activities. Compared to other traditional crime analysis methods, such as hot spot (kernel density) analysis, it has the advantage of being able to incorporate discontinuous backgrounds in the analysis. The strength and direction of influence of land use is rated as: >3.0= strong attraction; 3.0-1.1= attraction; 1.0= lack of balance of influence; 0-9-0.5= detraction; <0.5 = strong detraction.

and assaults (Newton, Johnson, and Bowers 2004), which has led to the implementation of aggressive policing and targeted surveillance in certain places.

Thus, the CLQ method has been widely employed in criminology studies, including in a study by Rengert, Ratcliffe, and Chakravorty (2005), who identified that illegal drug markets in the state of Delaware thrived in areas within a radius of 400 feet from self-service liquor stores and homeless shelters. However, another study by Lawton, Taylor, and Luongo (2005) found that installing police stations on corners plagued by drug dealing activities had no effect on violent crime within a zone of 0.1 miles. In contrast, recent studies in Malaysia (Hashim, Sadek, and Mohd 2018) report that a certain configuration of schools associated with drug dealing-related crimes have high CLQ values (over three) in a buffer zone of 0-500 meters. Similarly, in the city of Szczecin, Poland, researchers determined that locations such as bars, nightclubs, shopping centers, and bus stops had high CLQ values, from three to six, according to the different kinds of crimes, primarily in the buffer zone of 0-50 meters (Sypion-Dutowska and Leitner 2017). Figure 1 shows the results of the Sypion-Dutowska and Leitner study.

Figure 1. Spatial Distribution of Street Robbery in Relation to Land Use—"Bus and Trolley Stops"



Source: Sypion-Dutowska and Leitner 2017.

The CLQ method is an analytical tool originally used in regional studies, because it allowed scholars to compare a specific urban place with a larger polygonal area. This in turn allows for the creation of a buffer ring surrounding the location of criminal activity (see Figure 1). The total number of crimes reported in a space is then divided by the buffer area in spatial units, providing a crime density value represented by the quotient of the total crimes by measurement unit in the region being studied. It is consequently possible to divide the territory into zones based on the quotient assigned to a specific space. For example, a CLQ of three would indicate that the relationship between the crime and the land use or economic unit in question is triple that of the region.[2]

By applying the CLQ methodology, it is possible to understand the structure of crime in space and time and to identify the elements that define those spaces and times where criminal events occur. That is, using the CLQ method, we can detect the areas with a disproportionate concentration of certain types of crimes and then map out the specific crime patterns, whether crime events are small or large in number. A practical implication of this methodology is that policy makers can create ring zones with distance intervals that range from 50 to 100 meters or more around the locations that register high criminal activity (such as schools, security institutions, bars, etc.). In some studies, these ranges are calculated with the Geosphere R library, which allows researchers to compute the distance between two points with angular coordinates, generating multiple ring buffers with the following distance intervals: 0-50, 51-100, 101-200, 201-300, 301-400, 401-500 meters, etc. These distances, used in some studies such as that of Sypion-Dutkowska and Leitner (2017), imply a range of potential actions for policing practices or even a change in land use for the purpose of deterring criminal activity.

A space and time understanding of criminal activity is a useful tool for policy makers because it helps them know the total number of crime events and the distance between them. The crime events are plotted for each distance range, and the CLQs are calculated for all crimes, allowing for the efficient deployment of resources to fight crime. The CLQs allow researchers to compare the density of events throughout a city and place its different territorial units (distance zones) under observation. Such decisions can be made precisely because the location quotient allows researchers to assess the direction (attraction or inhibition), the distance range, and the intensity of the influence of the land use on a specific type of crime (Sypion-Dutkowska and Leitner 2017).

Like most methodologies, the CLQ method has its limitations. One is the arbitrary setting of distance ranges. Another is that each crime data point may have its own unique dynamic. Thus, the CLQ method for studying different locations in the same buffer zone could lead to biases in the results and their interpretation. Another limitation of the CLQ method is the assumption that the distribution of crimes in different locations is uniform, which is not necessarily true, especially when extremely high or low crime rates coexist in a single

[2] This allows us to assert that drug dealing in North American cities intensifies when there are liquor stores, homeless shelters, or currency exchange/check cashing establishments in the vicinity (Rengert, Ratcliffe, and Chakravorty 2005).

neighborhood. This assumption can lead to the inflation or deflation of the represented information (Zhang and Peterson 2007). It is also important to note that the CLQ method cannot measure the proximity of relative data points within a space. Moreover, this method assigns equal value to all crime data points regardless of the distance between the economic unit and the center of the ringed area, which means that the resulting value more accurately reflects the density rather than the seriousness of the crime committed. Consequently, measuring the seriousness value of a crime could allow for a more accurate measurement of the problem. Another issue is the definition of the buffer zones' range, since the existence of an optimal distance that would include the points associated with criminal activity has not been truly rationalized. The range, however, should not be so extensive as to dilute important interactions between the economic unit or the business type and the criminal event. Additionally, the assumption that crime is uniform throughout a territory is problematic, which increases the probability of having to exclude certain single-use areas (such as parks, airports, vacant lots, etc.). This could distort the characterization of an area and consequently affect the expected analytical rigor.

Some studies searched for more robust CLQ values to overcome these limitations. The work of Leslie and Kronenfeld (2011), for example, uses a co-location CLQ, where distance buffer areas are modified using additional statistical analyses and cross-correlations to compensate for biases. Wang, Hu, Wang, and Li (2017) use distances based on road network configurations. They do not use ringed distances in a geometric-Euclidean way. Instead, the actual relationship between location and crime is based on street dynamics, presumably a better representation than distance ranges. They also include Monte Carlo simulations, which allow them to construct CLQ value significance analyses. Still, the CLQ method continues to be a useful tool in criminology as it helps to identify spatial patterns associated with different types of crime and establishes values that allow for different locations to be correlated with the occurrence or absence of certain criminal activities within a specific time frame.

Formula

The quotient of a location is defined by the following formula:

$$LQmC_i^k = \frac{\frac{NmC_i^k}{A_i^k}}{\frac{NmC^k}{A^k}}$$

$LQmC_i^k$ is the LQC/CLQ by type of crime *m* within distance range *i* and land use type *k*

(LQC= Location Quotient of Crime or CLQ= Crime Location Quotient)

NmC_i^k is the number of crime events type *m* with a distance range *i* with land use type *k*

A_i^k is the distance range *i* with land use type *k*

NmC^k is the number of events by crime type *m* with the potential range of influence with land use type *k* (distance range 0–500 m)

A^k is the area with land use type k with the potential range of influence within a distance range of 0–500 m

i defines the six distance ranges: i = 1–6 (0–50, 51–100, 101–200, 201–300, 301–400, 401–500 m)

k defines the types of land use (k = 1–30)

m defines the total number of crimes as well as the individual types of crimes (m = 1–10)

Case Study

This paper focuses on Mexico City, in the understanding that this major metropolitan area of Latin America is an excellent case study to apply the CLQ methodology. This study may also be used to draw conclusions for other major urban centers on the continent. The application of the CLQ method to Mexico City is intended to help identify criminal activity clusters in the context of Latin America, based on the Mexican experience.

Data

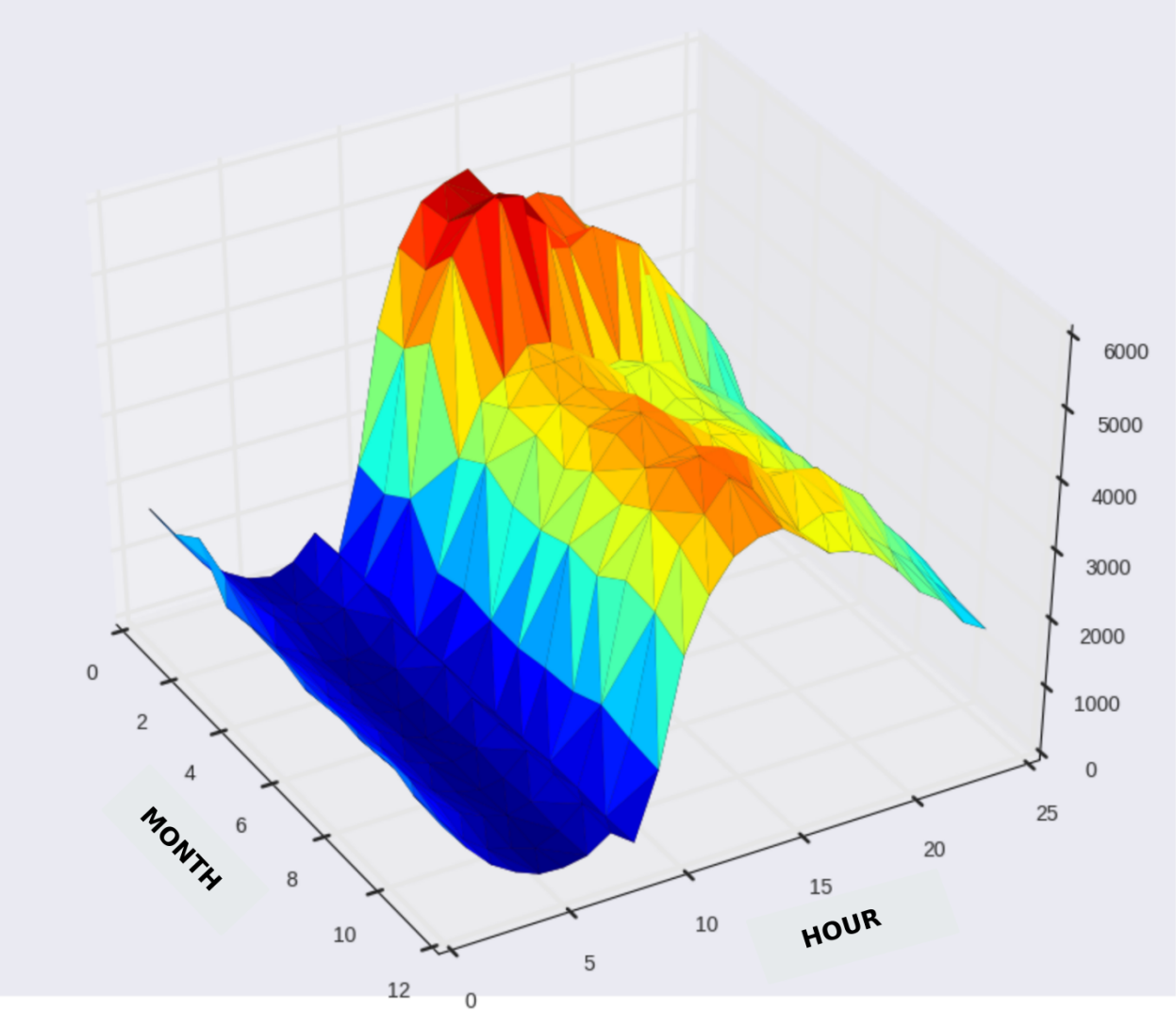
This analysis used open data from crime investigation files of the Executive Secretary of the National Public Safety System of the Attorney General's Office from 2016-2019 (CDMX 2016-2019). These data are publicly available through the government of Mexico City and include a monthly record of the characteristics of criminal activity as well as the geolocation of each crime as it was reported. This database contains 762,135 records for the period of reference. An important caveat is that crimes reported to the District Attorney's office are considered to be a lower percentage of the total number of criminal events that actually occurred, as most people, for lack of trust in government, simply do not report crime. The data, however, is still a representative sample of crimes in Mexico City. In addition, this study uses data from the National Statistics Directory of Economic Units (DENUE) for the 2014-2018 period, which includes data for Mexico City from 2010 to April 2019 (ENVIPE 2018). These data also provide geolocation information for over 476,853 records, including the number of employees at and the economic activity of nearby businesses. This helps to map criminal activity within the urban space and then correlate it with data from DENUE to detect the type of economic units that are close to the criminal events. The result is the identification of spatial (and time) patterns for criminal activity in Mexico City.

Analysis

Before applying a crime location quotient (CLQ) analysis, this paper explores the correlations between types of criminal activities and the time of day and the month of the year. Crime data comes from the Mexico City District Attorney's office, which can be

compared with the information from the DENUE for the period spanning 2016, 2017, and 2018, as well as the first quarter of 2019.[3]

Figure 2. Dynamics of Crimes by Time of Day and Month (January 2016 – March 2019)



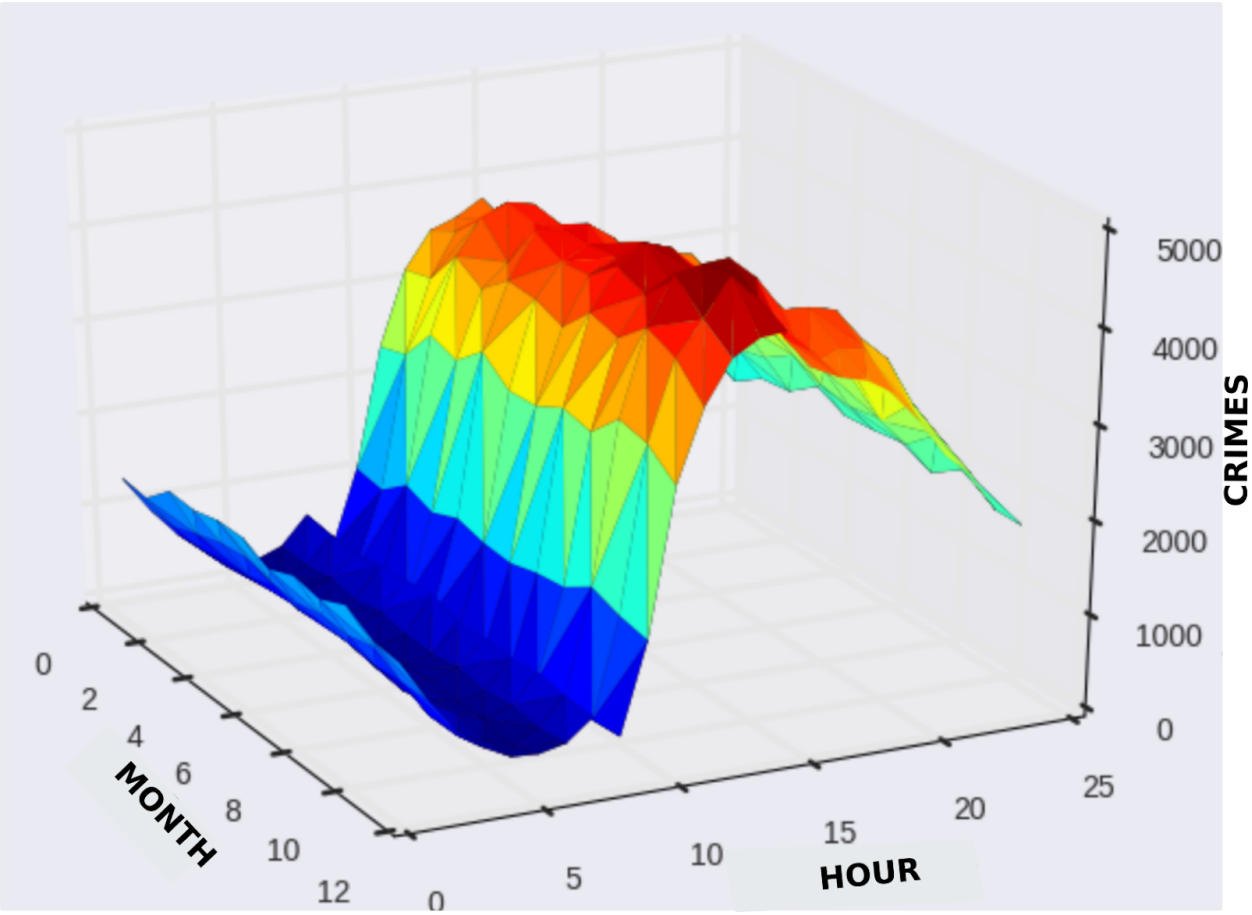
Source: CDMX 2016-2019 and DENUE 2018 crime data.

Figure 2 shows total crime hotspots in an hourly and monthly time frame. The first three months of 2019 show a spike (in red). It also shows that most crimes occurred from 12:00 p.m. to 4:00 p.m. (in red and orange). The aggregate information shows that most crimes

[3] According to figures from the National Survey on Victimization and Perception of Public Safety (ENVIPE 2017), the so-called "black figure" (unreported crimes) in Mexico was 93.2%; in other words, approximately 93 of every 100 crimes committed in Mexico were not reported. However, we believe that even 7% of the cases is a representative sample of the total number, with nearly 745,613 records for the period of reference.

occur in broad daylight, around lunchtime. It is also noteworthy that this is a very busy time for banks, for people leaving school and work, and for intensive use of public transportation. In other words, most criminal activity is linked to the intensive use of urban space.

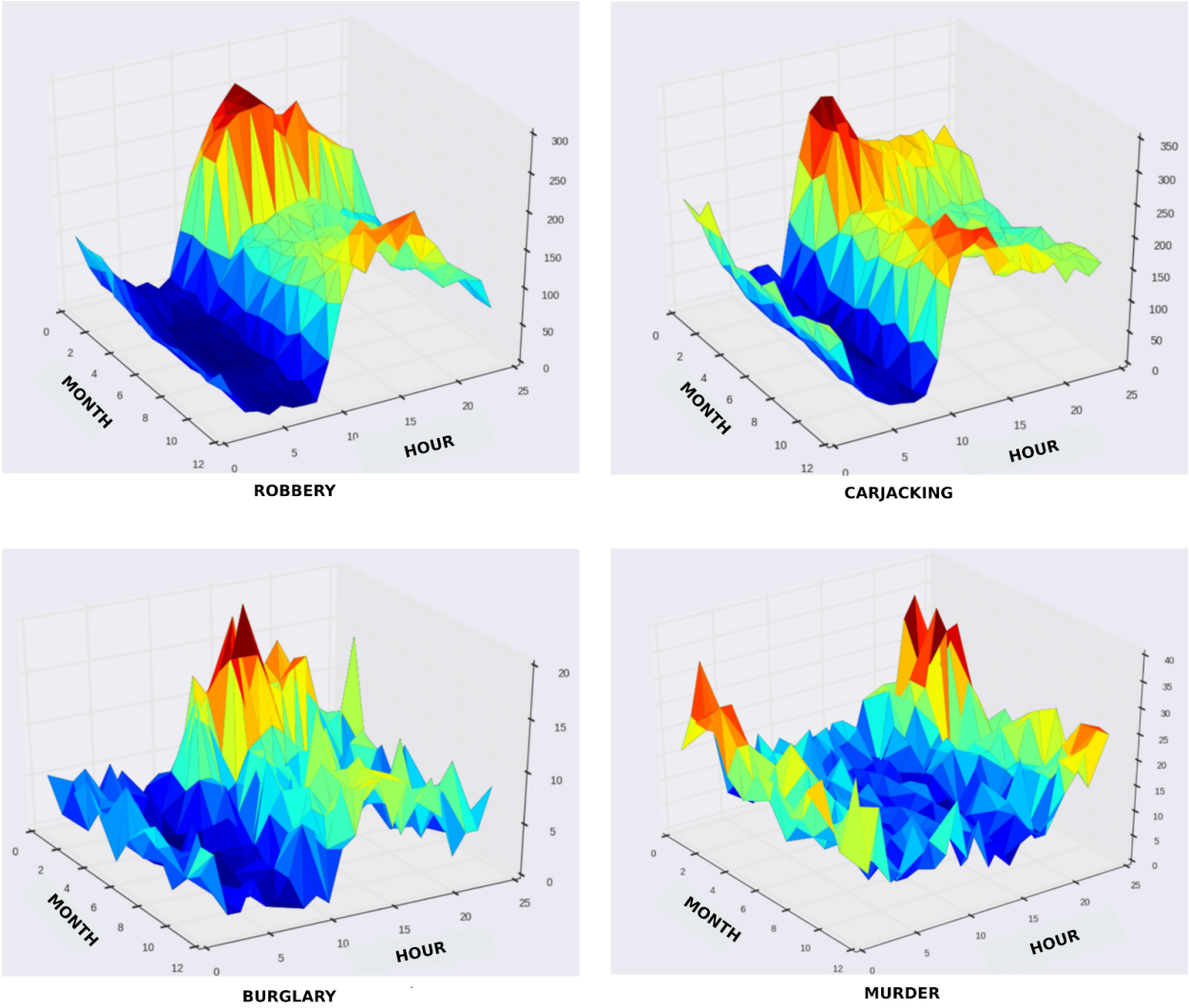
Figure 3. Criminal Behavior by Time of Day and Month (January 2016 – December 2018)



Source: CDMX 2016-2019 and DENUE 2018 crime data.

For the purposes of comparison, Figure 3 eliminates the first three months of the year. This graph shows that the frequency of crime is more even, and the highest point (in red) corresponds to the months of October and November. It also shows that the lowest frequency of crime is between midnight and 10:00 a.m. The disaggregated values for type of crime (Figure 4) offer a very different understanding. Each type of crime—robbery, vehicle theft, burglary, and homicide—peaks at a different time, although most values are still higher early in the year. Consequently, the crimes with the greatest number of data points, as represented in Figure 4, are distributed throughout the day, with vehicle theft more common in midday, home burglaries more common in the early afternoon, and homicides more common late at night. This is important because it means that authorities must respond accordingly by making their assessments and crime prevention programs more flexible to respond to different crimes at different times of the day and even seasonally.

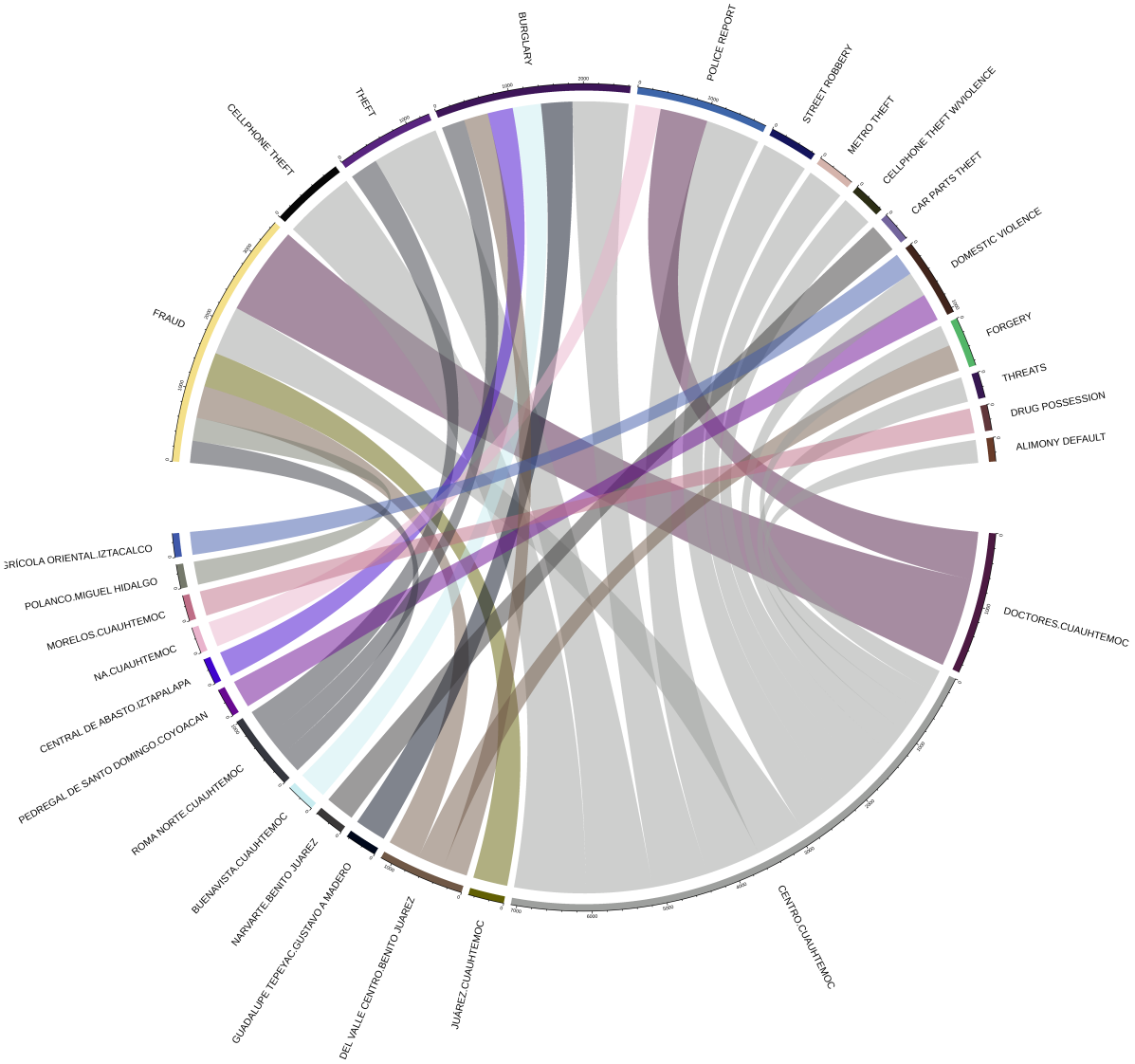
Figure 4. Different Dynamics of Crime in Mexico City 2016-2019



Source: CDMX 2016-2019 and DENUE 2018 crime data.

At a more general level, this series of graphs shows that crimes such as street robbery, vehicle theft, and home burglary exhibit similar patterns and spike around midday. However, intentional homicide occurs more frequently between 8:00 p.m. and 1:00 a.m., which matches the information presented later in this paper and shows that the occurrence of this crime is concentrated in the immediate vicinity of bars, nightclubs, and cantinas. In regard to the time of year—without taking into account the spike from January to March (as explained in the previous graph)—we can see that the first two crimes have a spike towards the end of the year, while intentional homicide picks up during the first quarter of the year and remains constant throughout the period under study.

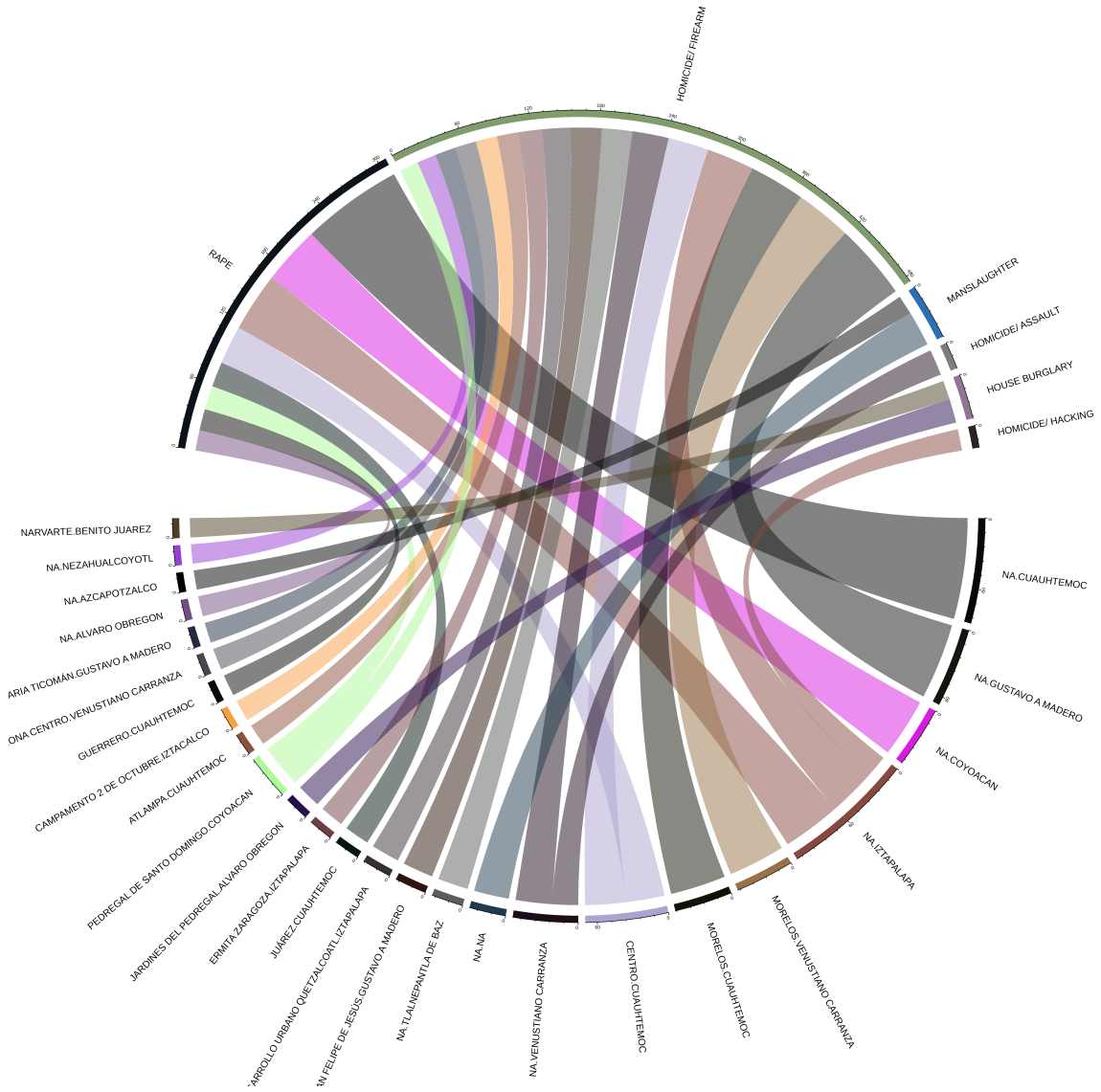
Figure 5. Communities with High Rates of Crime in Mexico City 2016-2019



Source: CDMX 2016-2019 and DENUE 2018 crime data.

Based on the previous graphs, we can now proceed to identify the specific places with a higher frequency of criminal activity, that is, those urban spaces that may correspond more closely with the high plateau in the graphs, say, between 12:00 p.m. and 4:00 p.m. In the chord diagram (Figure 5), the *Centro* (downtown) and *Doctores* neighborhoods standout in terms of specific crimes such as fraud, street robbery, and property theft. *Colonia del Valle* shows a concentration of crimes such as the use of counterfeit currency, fraud, and shoplifting. The *Roma Norte* neighborhood is associated with different types of street robbery and, to a lesser degree, fraud. The capital's *Centro* community is notorious for all different kinds of crimes due to the high concentration of stores, jobs, transportation, and street vending, all made worse by low levels of effectiveness in law enforcement.

Figure 6. High-Impact Crime Neighborhoods in Mexico City 2016-2019



Source: CDMX 2016-2019 and DENUE 2018 crime data.

With the diagram shown in Figure 6, we can corroborate that some areas have high-impact crime rates, such as *Morelos* (where *Tepito*, a notoriously dangerous neighborhood, is located), *Centro* (downtown), and neighborhoods that are located in the municipalities of *Venustiano Carranza*, *Gustavo A. Madero*, *Iztapalapa*, *Cuauhtémoc*, and *Coyoacán*. Criminal behavior is also heavily influenced in certain neighborhoods by conflicts that involve organized criminal groups fighting for territorial control, including the *Cartel Jalisco Nueva Generación* (CJNG), *La Unión Tepito*, *Fuerza Anti-Unión*, and *Cártel de Tláhuac*. The presence of these groups has resulted in an increase in violent crimes in urban spaces. Accordingly, and adjusting for fighting organized crime, strategies could be developed based on predictive patterns to reduce criminal events.

Figure 7. Crime Location Quotient: Kidnapping and Economic Units

CLQS ASSOCIATED WITH KIDNAPPING

Economic Units	0-50	51-100	101-200	201-300	301-400	401-500
Bars, Clubs, Discos	2.8	0-7	0.5	0.5	0.5	0.3
Schools	1.5	1.1	0.7	0.6	0.4	0.4
Banking Institutions	0.0	1.8	0.5	0.7	0.3	0.4
Liquor Stores	0.0	1.2	1.3	0.6	0.4	0.3
Police Stations	0.0	0.6	0.6	0.6	0.5	0.4

CLQ Strength and Direction of Influence of Economic Units	
>3.0	Strong Attraction
3.0-1.1	Attraction
1.0	Lack of Balance of Influence
0.9-0.5	Detraction
<3.0	Strong Detraction

Source: CDMX 2016-2019 and DENUE 2018 crime data.

Figure 7 shows that kidnapping has a significant correlation with the presence of bars, nightclubs, and cantinas, with a CLQ value of close to three, which indicates a particular correlational strength in the range of 0 to 50 meters between the establishment and the exact location of the kidnapping, although the quotient value decreases considerably after that range. The strength of this correlation can be explained by the link between these types of establishments and criminal organizations, many of which use these places as points to execute diverse crime activities, including kidnapping, extortion, drug dealing, etc. In these businesses, they may quite possibly identify the victims they will eventually kidnap just outside the establishment.

Interestingly, schools have a significant CLQ value of 1.5 for kidnapping in the same range of distance, which stays high within a range of up to 100 meters from the school facility. This suggests that students are being targeted for kidnapping purposes. There is evidence elsewhere that this has become a common practice, especially around the time parents are picking up their children from school. As this is a type of crime with a high social impact, authorities should pay closer attention to the spaces adjacent to schools in their public safety and security policies.

Bars, nightclubs, and cantinas are also frequented by a relatively young sector of the population, and youth are easily identifiable targets for kidnapping in these places. Unfortunately, when kidnapped, their absence is not often noticed immediately because their friends and acquaintances may stay out for many hours or even days. In contrast, schools provide scenarios that present specific temporary windows of opportunity for kidnapping, and the absence of a child is generally swiftly noticed.

Figure 8. Crime Location Quotient: Homicides and Economic Units

CLQS ASSOCIATED WITH HOMICIDES

Economic Units	0-50	51-100	101-200	201-300	301-400	401-500
Bars, Clubs, Discos	1.8	1.4	0.8	0.6	0.4	0.3
Schools	1.5	0.6	0.7	0.5	0.4	0.4
Banking Institutions	1.7	0.8	0.6	0.5	0.4	0.4
Liquor Stores	1.7	0.6	0.8	0.6	0.4	0.4
Police Stations	1.4	0.9	0.8	0.5	0.4	0.4
Parks & Public Spaces	0	0.7	0.7	0.6	0.5	0.3

CLQ Strength and Direction of Influence of Economic Units	
>3.0	Strong Attraction
3.0-1.1	Attraction
1.0	Lack of Balance of Influence
0.9-0.5	Detraction
<3.0	Strong Detraction

Note: These values show the correlation between each type of land use and distance range (in meters). Bars, clubs, and discos show the highest CLQ with relation to homicides, suggesting a strong correlation. While police stations prove to be a negative control for other types of crimes, in this case the CLQ is 1.4 for a 0-50-meter range. Parks and public spaces have been incorporated, since they show the lowest value on the chart.

Source: CDMX 2016-2019 and DENUE 2018 crime data.

Figure 8 deals with the most serious of all crimes, homicide. Not all homicides are the same, however. Manslaughter, or non-intentional homicide, is different from intentional homicide, as there is generally no intention to take someone's life. Thus, intentional homicide is a key focus, because it points to the degree of violence in a particular urban space—and tends to be associated with the presence of gangs and organized criminal groups. Figure 8 allows us to link this high-impact crime within ranges of 0 to 100 meters from bars, nightclubs, and cantinas, corroborating their connection to organized crime. After bars and nightclubs, homicides also commonly occur around banking institutions and liquor stores, followed by schools and police stations—although the perpetrator does not often intend to kill his or her victim in these cases. Finally, public parks have the lowest CLQ values for homicides (Figure 8), and the homicides that do occur in parks seem more related to the proximity of other businesses. The fact that few homicides occur in parks is of particular interest. Parks have been a focal point of public discussion, with many arguing that public spaces like parks deter certain crimes—perhaps because there are too many "eyes on the street." This observation can be empirically verified in this analysis. Even when these spaces require the convergence of other social actions, such as situational crime prevention programs, their structural importance must be recognized and valued.

Figure 9. Crime Location Quotient: Home Burglary and Economic Units

CLQS ASSOCIATED WITH HOME BURGLARY

Economic Units	0-50	51-100	101-200	201-300	301-400	401-500
Pharmacies	1.2	0.8	0.8	0.6	0.4	0.3
Retail / Minisuper	1.2	0.9	0.6	0.6	0.4	0.4
Parking Lots	2.1	0.7	0.6	0.5	0.4	0.4
Public Restrooms	1.2	0.4	0.8	0.6	0.4	0.4
Hotels & Services	1.7	0.3	0.7	0.5	0.4	0.4
Motels	0.0	0.0	1.2	0.2	0.4	0.5
Public Transport	0.0	1.5	0.7	0.5	0.5	0.3
Metro/Underground	1.9	0.5	0.2	0.6	0.5	0.4
Construction Works	1.5	0.0	0.8	0.7	0.5	0.3
Savings Banks	1.4	1.8	1.0	0.8	0.3	0.3
Justice & Security	0.6	0.5	0.8	0.6	0.5	0.3
Parks & Public Spaces	0.0	0.4	1.1	0.6	0.4	0.4

CLQ Strength and Direction of Influence of Economic Units	
>3.0	Strong Attraction
3.0-1.1	Attraction
1.0	Lack of Balance of Influence
0.9-0.5	Detraction
<3.0	Strong Detraction

Source: CDMX 2016-2019 and DENUE 2018 crime data.

Conditions correlated to home burglary include being located near to certain economic units (types of businesses), such as public parking lots (CLQ value of 2.1). This is possibly due to the frequent access of unidentified cars and drivers to the parking lots as well as having adjacent walls to neighboring houses. It could also be due to the presence of people that are not residents of the neighborhood, meaning residents are not always on the lookout for strangers. Similarly, being near metro stations is conducive to home burglaries, as well as being close to hotels, as they always involve the presence of strangers, and residents may not be on guard. Lastly, the presence of banks, pharmacies, stores, and public restrooms in the vicinity also present a modest yet significant correlation with home burglaries. Interestingly, recreational parks, motels, and urban and suburban public transportation stops provide a deterrent effect, or are at least are not directly associated with burglaries, possibly due to the constant presence of pedestrians on the sidewalks and in these public spaces.

Figure 10. Crime Location Quotient: Express Kidnapping and Economic Units

CLQS ASSOCIATED WITH EXPRESS KIDNAPPING

Economic Units	0-50	51-100	101-200	201-300	301-400	401-500
Pharmacies	1.3	0.5	0.9	0.6	0.4	0.4
Retail / Minisuper	1.9	1.6	0.8	0.5	0.4	0.3
Parking Lots	2.1	0.8	0.7	0.5	0.5	0.3
Public Restrooms	3.1	0.4	0.9	0.5	0.6	0.3
Hotels & Services	0.8	1.2	0.4	0.6	0.5	0.4
Motels	6.2	0.0	0.4	0.9	0.5	0.2
Public Transport	3.1	1.6	1.2	0.6	0.3	0.3
Metro/Underground	4.4	1.7	0.6	0.4	0.6	0.3
Construction Works	0.0	0.5	1.0	0.4	0.4	0.4
Savings Banks	5.1	2.6	0.2	0.6	0.3	0.4
Justice and Security	1.7	0.7	0.9	0.5	0.4	0.4
Parks & Public Spaces	0.0	0.0	1.1	0.5	0.8	0.2

CLQ Strength and Direction of Influence of Economic Units	
>3.0	Strong Attraction
3.0-1.1	Attraction
1.0	Lack of Balance of Influence
0.9-0.5	Detraction
<3.0	Strong Detraction

Source: CDMX 2016-2019 and DENUE 2018 crime data.

Express kidnappings are a crime variation that appeared in Mexico a few years ago. They involve abducting a person at random and taking him or her to an ATM to withdraw money or calling a family member to ask for money in exchange for the immediate release of the person. It is generally a short-term event, as opposed to a more traditional kidnapping, when a person may be retained for much longer. Figure 10 shows that the businesses associated with express kidnappings are 1) motels (CLQ value of 6.2), possibly because the kidnappers are not interested in being easily located; 2) banks and ATMs (CLQ value of 5.1), because they signal the presence of cash; and 3) metro stations (where there are established robbery and express kidnapping networks). Finally, public restrooms and public parking lots are also associated with express kidnappings, likely because it is common for employees of certain establishments to have connections with criminal organizations that help them identify potential victims. Studying the CLQ values related to express kidnapping shows that this type of crime is linked to lodging establishments, particularly motels (with a CLQ value of 6.2). Motels rank high possibly because it is easy to get into a car without having to show identification; they have a high turnover rate for guests and employees, making it harder to detect specific suspicious behaviors; it is possible to move from one room to another without raising suspicions; and, lastly, they are

places where most criminals can remain unnoticed. The next economic unit or business type associated with express kidnappings is savings banks, especially credit unions, which is likely because of the opportunity to immediately obtain money from the victim who is taken to an ATM to withdraw cash.

It is important to point out that express kidnappings also reach into low -and middle-income sectors of the population, which results in the following locations having a high CLQ value: metro stations, public restrooms, parking lots, and small businesses. In contrast, traditional longer-term kidnappings occur in establishments associated with organized criminal activities such as bars, nightclubs and cantinas, and liquor stores. They also occur at academic establishments where the victims are likely to be students in secondary or higher education. Express kidnappings increased by 80% during the first four months of 2019 compared to the same period in 2018.

Figure 11. Crime Location Quotient: Homicide with Firearms and Economic Units

CLQS ASSOCIATED WITH FIREARM-RELATED HOMICIDE

Economic Units	0-50	51-100	101-200	201-300	301-400	401-500
Pharmacies	2.0	0.5	0.7	0.6	0.4	0.4
Retail / Minisuper	2.9	1.0	0.7	0.6	0.4	0.4
Parking Lots	1.0	0.4	0.8	0.5	0.4	0.4
Public Restrooms	3.0	1.3	0.9	0.6	0.4	0.3
Hotels & Services	0.0	0.8	0.9	0.4	0.5	0.4
Motels	2.5	0.6	0.8	0.6	0.4	0.4
Public Transport	4.5	0.4	0.8	0.6	0.4	0.3
Metro/Underground	1.8	1.8	0.7	0.7	0.4	0.3
Construction Works	0.0	0.0	0.5	0.9	0.4	0.3
Savings Banks	2.8	0.4	1.0	0.4	0.5	0.4
Justice & Security	1.4	0.9	0.7	0.5	0.4	0.4
Parks & Public Spaces	0.0	0.9	0.5	0.4	0.6	0.3

CLQ Strength and Direction of Influence of Economic Units	
>3.0	Strong Attraction
3.0-1.1	Attraction
1.0	Lack of Balance of Influence
0.9-0.5	Detraction
<3.0	Strong Detraction

Source: CDMX 2016-2019 and DENUE 2018 crime data.

According to data from the National Institute of Statistics and Geography, 35,964 homicides were committed in 2018, the highest figure ever recorded in Mexico (although 2019 surpassed that number). Some 75% of these involved firearms. The rapid increase in

homicides with firearms in Mexico appears to be directly related to the availability of firearms, which in turn is related to arms trafficking, perhaps exceeding 200,000 weapons per year (Parsons and Vargas 2018). In the case of Mexico City, homicide with firearms is concentrated in urban and suburban public transportation stations (with a CLQ value of 4.5), followed by public restrooms and shoeshine shops (3.0), mini-markets and employee credit unions (with CLQs of 2.8 and 2.9 respectively), motels (with 2.5), and pharmacies (with 2.0). The Mexico City Metro has a CLQ value of 1.8 within both a radius of 50 and 100 meters.

Figure 12. Crime Location Quotient: Retail Drug Dealing and Economic Units

CLQS ASSOCIATED WITH RETAIL DRUG DEALING

Economic Units	0-50	51-100	101-200	201-300	301-400	401-500
Savings Banks	1.4	0.0	0.5	0.4	0.5	0.4
Retail / Minisuper	1.1	0.8	0.7	0.5	0.4	0.4
Construction Works	0.0	0.0	0.7	0.3	0.4	0.5
Parking Lots	0.5	0.6	0.5	0.5	0.4	0.5
Pharmacies	1.6	0.8	0.6	0.5	0.4	0.4
Hotels & Services	0.7	0.5	0.9	0.4	0.4	0.4
Justice & Security	1.7	0.8	0.6	0.5	0.4	0.4
Motels	0.0	0.7	1.4	0.5	0.3	0.4
Private Primary Schools	1.4	0.3	0.5	0.5	0.5	0.4
Public Primary Schools	0.7	1.0	0.7	0.6	0.4	0.4
Private Secondary Schools	0.0	0.4	0.7	0.3	0.5	0.4
Public Secondary Schools	1.8	0.4	0.8	0.5	0.5	0.4
Public Universities	4.8	1.2	0.4	0.5	0.4	0.4
Private Universities	1.4	0.9	0.6	0.6	0.5	0.3
Multilevel Private Schools	1.8	0.8	0.8	0.5	0.5	0.4
Multilevel Public Schools	1.3	1.0	0.8	0.6	0.3	0.4
Public Restrooms	1.6	1.0	0.9	0.5	0.4	0.4
Public Transport	0.0	0.0	0.7	0.5	0.5	0.4
Metro Underground	5.2	1.3	0.9	0.4	0.5	0.3

CLQ Strength and Direction of Influence of Economic Units	
>3.0	Strong Attraction
3.0-1.1	Attraction
1.0	Lack of Balance of Influence
0.9-0.5	Detraction
<3.0	Strong Detraction

Source: CDMX 2016-2019 and DENUE 2018 crime data.

In Figure 12, CLQ values for drug dealing are presented. Based on this analysis, metro stations stand out above the rest of urban spaces with a value of 5.2. Public universities have a value of 4.8, in both the range of 50 meters and slightly over 100 meters from the center. Similar, although with less intensity, are private schools (1.8), public secondary schools (1.8), and public restrooms and pharmacies (both 1.6). It is noteworthy that drug dealing is quite structured in the Mexico City Metro, taking advantage of the swift speed of transportation within the system and the total number of passengers per day, estimated at over 5.5 million.

Conclusion

The objective of this study was to understand the patterns of crime on a space-time spectrum. Following this, this paper outlines the relationship between criminal events and territories in Mexico City, with the expectation that it is a large metropolitan area representative of all of Latin America. Although this could be interpreted as spatial determinism, it is not the case. Instead, these findings can lead to various strategies in crime prevention and policing. Of course, the determinants of crime and violence are rooted in cultural, economic, and social causes, but its manifestations take place in certain times and spaces, for which knowing where and when criminal activity is likely to happen can be quite useful. In the last three decades, public safety policies have focused on identifying the areas with the greatest occurrence of crimes (known as "hot spots" or "access points"), but they have paid little attention to analyzing *how* crimes occur within a space. Crime activity analysis in space and time does help to locate high-risk areas and to identify how criminal activities are executed within a territory. Indeed, the spatial location and time of a crime are but two of the many elements that make up a comprehensive understanding of criminal activity. However, they are key features because they involve useful concepts such as mechanisms and interconnections between formal and informal economies and legal and illegal actors within the city (Valenzuela and Monroy-Ortiz 2014).

This study does not make value judgments about certain neighborhoods or socio-economic classes—factors which are often implicit in decision-making about crime and policing. Instead, this paper seeks to understand spatial and time-based correlates of criminal activity to protect everyone, in good or bad neighborhoods. This explains why our first consideration from a spatial point of view is that the criminal economy exists within a system made up of environmental factors, which cuts across different spaces and dimensions and may arise in any given place. The same is true with time. If we study the relationship between location, time, and criminal activity, we can mobilize resources to the areas where crime concentrates and remobilize them to new areas where new crimes emerge, thus accounting for the changing nature of criminal patterns, depending on the month, the day, the hour, and the space.

Finally, scale is of relevance in environmental criminology analyses, as local crime can be the manifestation of trends that go beyond the scope of the analytical framework. Local crimes can point to criminal dynamics that have a regional, national, or international scope, such as drug trafficking, extortion, and human trafficking, where the territorial impact transcends

political demarcations. The use of the CLQ method at different scales is particularly effective in the analysis of crimes that are linked to mobility within the territory. Accordingly, places located in crime corridors and the times of day that crimes most frequently occur must be studied not only in terms of the occurrence of specific crime events, but also in terms of their impact on the surrounding territorial context and time-based spillovers. The findings of this study clearly show that there are significant geographic and time correlations between crimes and the locations where they occur, and that may be of great value to policy makers when considering issues of public safety and security.

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