ARTÍCULO

HOMICIDE RATES AND HOUSING PRICES IN CALI AND BOGOTÁ, D. C.

Andrés Domínguez

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Currently, the list of most violent cities in the world is dominated by Latin American cities. In 2015, Cali registered 65 homicides per 100,000 inhabitants. In Bogotá, the rate was 17 per 100,000 inhabitants. However, crime is not homogeneously distributed within the urban area, and literature indicates that the local response to crime affects the housing market. The objective of this paper is to estimate the relationship between housing prices and homicide rates in two Colombian cities: Cali and Bogotá. With the use of diverse sources of information and different econometric methodologies, we found that a 10% increase in homicide rates provokes a 2% decrease in housing prices in Cali and 1.8% in Bogotá.

Keywords: Urban economics, urban crime, housing prices.
JEL: D04; D1; R30; R31.

A. Domínguez
Observatorio de Dinámicas Urbano Regionales ODUR, Secretaría Distrital de Planeación SDP, Bogotá, Colombia. Email: jandresdominguezm@gmail.com.

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Domínguez, A. (2021). Tasas de homicidio y precios de la vivienda en Cali y Bogotá, D. C. *Cuadernos de Economía, 40*(83), 643-677.

Actualmente, las ciudades más violentas del mundo se encuentran en Latinoamérica. En 2015, Cali registró 65 homicidios por cada 100 000 habitantes. Para ese mismo año, en Bogotá, la tasa de homicidios reportada fue 17 por cada 100 000 habitantes. Dado que la criminalidad se distribuye heterogéneamente dentro de las ciudades, la literatura señala que la respuesta de las personas ante la criminalidad afecta el mercado inmobiliario. El objetivo de este artículo es estimar la relación entre los precios de la vivienda y las tasas de homicidios en dos ciudades colombianas: Cali y Bogotá. Usando diversas fuentes de información y diferentes métodos cuantitativos de estimación, el principal resultado encontrado fue que ante un incremento del 10 % en las tasas de homicidio, hay una disminución del 2 % en los precios de vivienda en Cali y de 1,8 % en Bogotá, D. C.

Palabras clave: economía urbana, crimen urbano, precios de viviendas.
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Atualmente, as cidades mais violentas do mundo estão na América Latina. Em 2015, Cali registrou 65 homicídios por cada 100.000 habitantes. Nesse mesmo ano, em Bogotá, a taxa de homicídio registrada foi de 17 por cada 100.000 habitantes. Dado que a criminalidade está distribuída de forma heterogênea nas cidades, a literatura indica que a resposta das pessoas ao crime afeta o mercado imobiliário. O objetivo deste artigo é estimar a relação entre os preços da habitação e as taxas de homicídio em duas cidades colombianas: Cali e Bogotá. Usando várias fontes de informação e diferentes métodos de estimativa quantitativa, o principal resultado encontrado foi que, diante de um aumento de 10% nas taxas de homicídio, há uma queda de 2% nos preços da habitação em Cali e uma queda de 1,8% em Bogotá DC.

Palavras-chave: economia urbana, crime urbano, preços da habitação.
JEL: D04; D1; R30; R31.

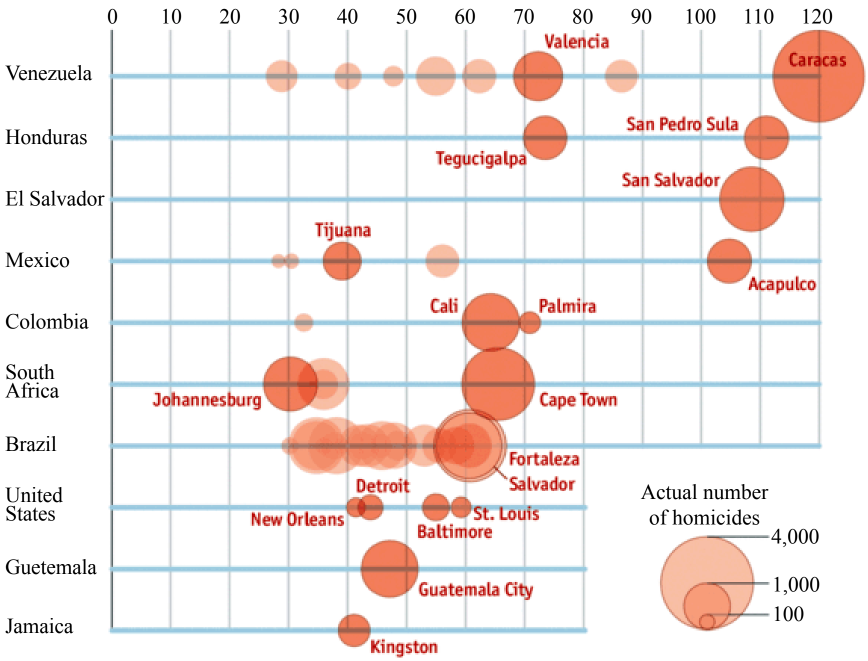
INTRODUCTION

Urban crime has a negative relationship with housing prices, which are the sums in money for which houses may be bought or sold on a real estate market. In the literature, crime is related to the theft of property; for instance, cars, wallets, and household goods; or more serious acts like murder or rape (Brueckner, 2011). Studying the relationship between housing prices and crime, from an economic perspective, is essential because it is a way of quantifying crime in terms of its representation families' wealth. Indeed, Hellman and Naroff (1979) argue that changes in utility levels derived from living in certain areas within the city, caused by variations in the crime rate, can affect property values and property tax revenues.

The housing market involves characteristics such as heterogeneity, durability, and spatial fixity. A house is a heterogeneous commodity due to characteristics such as design and age; hence, it is difficult to define a unit measure of analysis. In fact, the price of a transaction is the product of the value and the age of the dwelling. The second characteristic is durability, which refers to the fact that a homeowner acts both as an investor and as a consumer. Therefore, the owner's expectations about the future are essential, as well as their wealth and income. The third characteristic means that since a dwelling is located within a neighbourhood, both the characteristics of the neighbourhood as well as the accessibility to other urban facilities are fundamental determinants of the house price. Consequently, externalities such as level of noise, police protection, and crime are crucial factors in the housing market as this market takes a long time to adjust (Fallis, 1985).

High crime rates represent a significant welfare loss, a reduction of the expected lifespan, and an increase in uncertainty about the future (Soares, 2010). Furthermore, the quantity of money allocated to maintaining justice and prison systems is relevant. According to the Council for Public Security and Criminal Justice, (CCSP-JP, 2016), Latin American cities dominate the list of most violent cities in the world. Figure 1 shows the 50 cities with the highest homicide rates and a population higher than 300,000 people. The horizontal axis represents the homicide rate per 100,000 inhabitants, while the size of the circle represents the number of homicides. Caracas (Venezuela), San Pedro Sula (Honduras), and San Salvador (El Salvador) are at the top of the rankings. Two Colombian cities appear in this top ten: Palmira and Cali. The former is a medium-size city of 1.5 million inhabitants, and Cali is the third largest Colombian city in terms of population (2.3 million after Bogotá and Medellín). Additionally, in 2015 the registered homicide rate in Bogotá D.C. was 17 per 100,000 inhabitants, according to the Instituto Nacional de Medicina Legal (INML, 2015). Although the rate does not seem high in Bogotá D.C. —a city of 7.5 million people— the number of cases is significant.

Figure 1.
Homicides per 100,000 Inhabitants



Source: The Economist (2016) with information from 2015.

Glaeser and Sacerdote (1999) argue that there is an association between city size and crime. Furthermore, crime rates are not homogeneously distributed within an urban area, and this characteristic shows a clear association with the quality of the neighbourhood. In response to crime risk, residents generally have two options: either vote for anti-crime policies or vote with their feet, which means leaving space to demonstrate their opposition towards a situation. When individuals exercise the latter option, the local response to crime will be observed in the housing market (Buonanno et al., 2013; Gibbons, 2004). Indeed, the fear of crime, through its indirect effects on housing prices, may also hinder local regeneration and cause a downward spiral in the quality of the neighbourhood (Gibbons, 2004).

There is evidence of a relationship between urban crime and housing prices in European and North American cities. Soares (2010) indicates that death due to violence is 200% more common in Latin America than in North America and 450% more common than in Western Europe. The objective of this paper is to quantify the relationship between homicide rates and housing prices in two Colombian cities: Cali and

Bogotá D.C. We hypothesized that persistent cases of homicide will be capitalized in housing prices.

In the case of Cali, we used a cross section of cadastral housing prices from 2012 and the average homicide rates from 2000-2010 at a neighbourhood level. We found that a 10% increase in the homicide rate is related to a decrease of between 2% and 2.5% in housing prices in Cali.

For Bogotá D.C., we used the housing characteristics information registered in the *Encuesta Multipropósito* (DANE, 2017) and the crime information for 2015 registered in the INML. In this case, we estimated two models with two dependent variables: the hypothetical lease value and the effective lease value. The estimations showed that a 10% increase in the homicide rate was related with a 1.8% decrease in the hypothetical lease value and 1.7% in the effective lease value.

Additionally, we discussed a methodological issue: when the statistical information is clustered (e.g. classrooms, neighbourhoods, and economic sectors), the literature recommends estimating models using cluster standard errors. Nevertheless, there were some potentially harmful consequences derived from the formation of false clusters in the estimated standard errors. In this paper, we present a simulation exercise to show the magnitude and the direction of the bias in the standard error estimation. The remainder of the paper is organized as follows: section 2 relates the paper to the existing literature, section 3 describes data and provides the estimation results, and section 4 concludes.

LITERATURE REVIEW

The literature has affirmed that crime is a determinant social force. Individuals, households, and communities know first-hand the effects of crime on quality of life. Houser et al. (2015) have highlighted that in areas where crime is prevalent, residents notice direct effects on housing prices, education, and job availability. Then, fear of crime within urban areas has a powerful influence on perceptions of area deprivation and may discourage home-buyers, inhibit local regeneration, and catalyse a downward spiral in neighbourhood status (Gibbons, 2004). The literature has tried to measure the effect of crime on housing prices using two main methodologies: contingent evaluation and hedonic models.

Contingent evaluation tries to estimate the value of goods that are not transacted in a market. The strategy is to ask how much people would be willing to pay for them. For instance, in Cohen et al. (2004), respondents were asked if they would be willing to vote for a proposal requiring each household in their community to pay a certain amount to prevent one in ten crimes in their community. Meanwhile, in Atkinson et al. (2005), respondents were told the characteristics of a type of crime and the current risk of victimization. Then, they were asked to express their willingness to pay to reduce the chance of being a victim of this offence by 50% over the next 12 months.

In hedonic models (Rosen, 1974), a house may derive its value from the quality of its physical characteristics (e.g. living space, number of bedrooms, garage, amenities) and its location. Furthermore, the level of crime and violence in the surrounding area may be additional attributes of the property, and individuals may be willing to pay more to live in an area with lower levels of crime. Then, an estimate of how much the attribute "lower-level-of-crime" is worth in the housing price provides an estimation of the cost of crime.

Asking individuals how they would react in a certain hypothetical situation is not the same as how they will react in a real decision-making situation. Consequently, economists have long been sceptical of information extracted from stated preferences, rather than revealed ones (Carson et al., 2001; Levitt & List, 2007). This is the reason why hedonic price models have been mostly used to estimate the relationship between crime and housing prices. Hedonic models rely on the preferences revealed by market behaviour by analysing the actual amount that people pay to avoid living in high crime areas. Some literature that uses this methodology has found a negative and significant relationship between crime and housing prices.

Because there could be a potential simultaneity relationship between crime and housing prices, Table 1 and Table 2 present the literature review divided into two categories.[1] The first is related to studies that have not instrumented for crime, and the second part includes studies that have instrumented for crime. For Rochester, New York, one standard deviation increase in the crime rate caused a 3% reduction in house prices (Thaler, 1978). The measures of crime used by the author are total offences, property crimes, crimes against persons, and property crimes committed in or around homes. Hellman and Naroff (1979) obtained an elasticity of property value concerning crime equal to -0.63 for Boston. For Jacksonville, Florida, Lynch and Rasmussen (2001) found an elasticity of -0.05 for violent crimes. Meanwhile, for Atlanta, Bowes and Ihlanfeldt (2001) argued that crime may be higher in train station areas; moreover, train stations may be the source of more crime in higher-income than in lower-income neighbourhoods. Authors found that an additional crime per acre per year decreases housing prices by around 3%. Besley and Mueller (2012) presented evidence that supports the assumption that housing prices depend on the level and persistence of historical crime rates. Authors argued that houses are assets whose prices reflect the present and future expected attractiveness of living in an area. They used the information from 11 regions of Northern Ireland to evaluate the increased housing prices in response to a reduction in murders. Using a Markov switching model, the authors predicted that peace in Northern Ireland leads to an increase in housing prices of between 1.3% and 3.5% percent (nevertheless, the result is heterogeneous across regions).

[1] There is an extensive literature about urban crime (e.g. O'Flaherty & Sethi, 2015). Nevertheless, the literature review in this paper was filtered to consider the relationship between crime and housing prices.

Table 1.
Studies That Have Not Instrumented for Crime

Author	Place and Time	Results
Thaler (1978).	Rochester, New York (1971).	One standard deviation increase in the crime rate caused a 3% reduction in house prices.
Hellman and Naroff (1979).	Boston (1976).	They reported a negative elasticity of property value with respect to total crime (-0.63).
Lynch and Rasmussen (2001).	Jacksonville, Florida.	They found an elasticity of -0.05 for violent crimes.
Bowes and Ihlanfeldt (2001).	Atlanta (1991-1994).	An additional crime per acre per year in a given census tract had the effect of reducing house prices by around 3%.
Shapiro and Hassett (2012).	Seattle, Milwaukee, Huston, Dallas, Boston, Philadelphia, Chicago, and Jacksonville.	A 10% reduction in homicides would lead to a 0.83% increase in housing values the following year.
Besley and Mueller (2012).	11 regions of Northern Ireland (1984-2009).	Property prices depended on the level and persistence of historical crime rates.
Frischtak and Mandel (2012).	Rio de Janeiro.	Homicides dropped by between 10% and 25% and robberies by between 10% and 20%, while the selling price of the properties increased by between 5% and 10% and was proportionally higher in low-income neighbourhoods.

The literature shown in Table 1 has deemed crime as an exogenous regressor. Relaxing that assumption in Table 2, Rizzo (1979) found similar qualitative results for Chicago and remarked that in the housing market people reveal the cost of crime as they perceive it. Gibbons (2004) estimated the impact of recorded domestic property crime on property prices in the London area. This author considered information for five types of crime: home burglaries, burglary in other buildings, criminal damage to a dwelling, criminal damage to other buildings, and theft from shops. As a result, a one-tenth standard deviation increase in the recorded density of incidents of criminal damage had a capitalized cost of just under 1% of property values. These results meant that incoming residents perceived criminal damage as a deterioration of the neighbourhood.

Table 2.
Studies That Have Instrumented for Crime

Author	Place and Time	Instruments For Crime	Results
Rizzo (1979).	Chicago (1970).	Proportion of population between ages 15 and 24; median years of schooling; unemployment rate; population density; proportion of population receiving welfare; ratio of males to females; and the labour force participation rate.	The estimated elasticity of crime with respect to prices is -0.23.
Gibbons (2004).	London (2001).	Crimes on non-residential properties; spatial lags of crime density; distance to the nearest alcohol licensed premises.	A one-tenth standard deviation increase in the recorded density of incidents of criminal damage had a capitalized cost of just under 1% of property values.
Tita, Petras, and Greenbaum (2006).	Columbus, Ohio (1995-1998).	Homicide rate.	Negative significant relationship between prices and violent crimes.
Ceccato and Wilhelmsson (2011).	Stockholm (2008).	Murders as an instrument for crime.	If total crime increases by 1%, apartment prices are expected to fall by 0.04%.
Buonanno et al. (2013).	Barcelona (2004-2006).	Victimization rate 20 years ago; share of youth aged between 15 and 24.	One standard deviation increase in perceived security was associated with a 0.57% increase in the valuation of districts.

The difference with previous papers is that Gibbon paid attention to identification issues and deals with the endogeneity problem using instrumental variables. Ceccato and Wilhelmsson (2011) analysed the relationship between apartment prices and different measures of crime in Stockholm. The authors found that when total crime increases by 1%, apartment prices are expected to fall by 0.04%. Buonanno et al. (2013), for Barcelona, found that one standard deviation increase in perceived security is associated with a 0.57% increase in the valuation of districts.

Although comparing results is somewhat arbitrary because of the differences in the types of crimes, the empirical literature presented evidence of a negative relationship between crime and housing prices. This relationship implies that high crime rates deter new residents and motivate those-who-can to move out to lower-crime rate neighbourhoods (Gibbons, 2004).

DATA AND RESULTS

In this section, we present data, theoretical approximation, quantitative methodologies, and the estimated results of the relationship between homicide rates and housing prices in Cali and Bogotá D. C. (Appendix A presents a map of Colombia that shows the geographic location of both cities). In this context, it is relevant to note that Cadastral information in Colombia is one of the oldest and most extensive in Latin America. Nevertheless, it is limited to formulate politics (Departamento Administrativo de Hacienda Municipal, 2012).

For Cali, we used the cadastral housing prices of 2012 to estimate the relationship between homicide and housing prices, using homicide rates from a neighbourhood level. For Bogotá D.C., we used information registered in the *Encuesta Multipropósito* (2017), specifically the hypothetical lease value and effective lease value. As we stated in the introduction, the homicide rate is defined as the number of homicides committed in a year per 100,000 inhabitants, excluding homicides committed as a result of armed conflict.

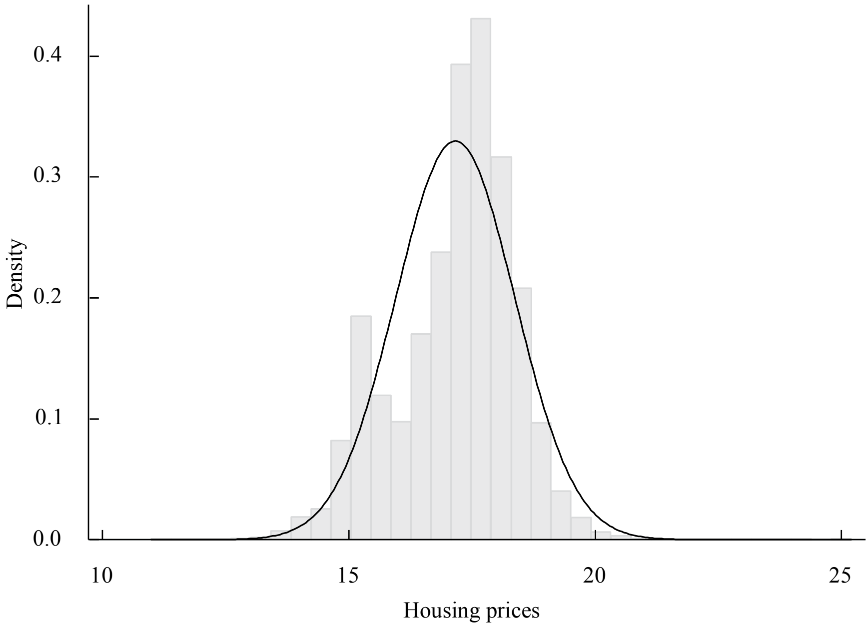
Table 3 summarizes the key variables from the housing price and homicide data for Cali. The mean log of housing prices is 17.16, with a standard deviation of 1.21 (Figure 2 shows the distribution of this variable); the homicide rate that we used is a ten-year average (2000-2010) at neighbourhood level. This average measure was included in the econometric model to avoid simultaneity effects with the housing

Table 3.
Summary Statistics for Cali

	Mean	Std. Dev.	Minimum	Maximum
ln (Housing price)	17.16	1.21	10.99	25.20
Homicide rate	104	155	0	1628
Area (km^2)	0.36	0.50	0.02	7.84
Distance to CBD (*km*)	4.76	2.12	0	9.78
Distance to main roads (*km*)	0.41	0.59	0	5.23

Note: 338 Neighbourhoods.
Source: Cadastral housing prices of 2012 and *Observatorio Social de Cali*.

Figure 2.
Distribution of Log Housing Prices for Cali



Source: Cadastral housing prices of 2012.

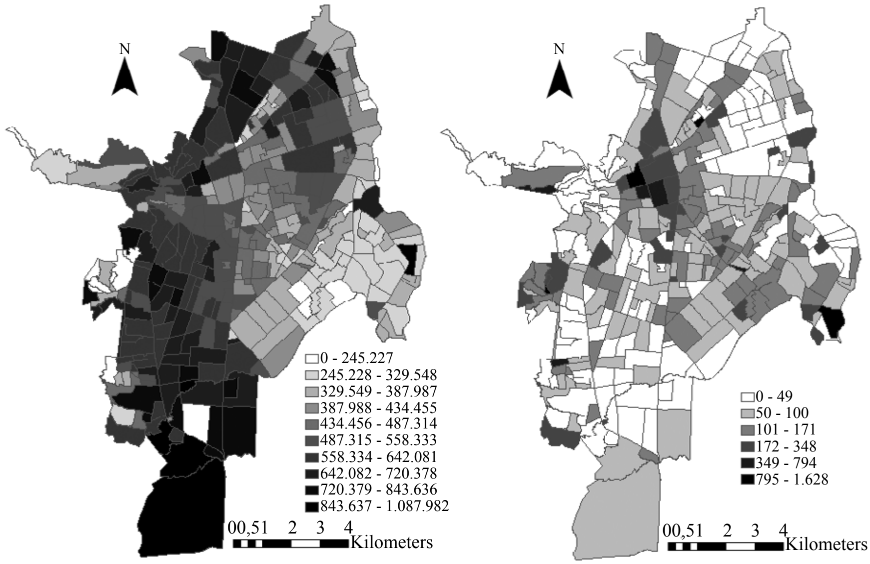
prices variable, which is from 2012. This rate could be interpreted as the violence environment for each neighbourhood. The variable had a mean of 104 with a standard deviation equal to 155.[2]

The urban area is divided into 338 neighbourhoods: the average size of a neighbourhood is 360 square meters; the average distance between the Central Business District (CBD) and the centroid of a neighbourhood is 4.76 kilometres. The CBD is the area within the city where the most important economic activity is concentrated (the CBD could or could not coincide with the historical place where the city was founded). The average distance from the centroid of a neighbourhood to the closest main road is 0.41 kilometres.

The left map in Figure 3 displays the average housing prices per square meter in Colombian pesos while the second map (right) exhibits the homicide rates at neighbourhood level. The map of housing prices shows that neighbourhoods with higher housing prices are distributed in the western part of the city. In the second,

[2] Appendix 2 shows information about neighbourhoods within *Comuna* 6 (Cali is divided into 22 *comunas* and 338 neighbourhoods). A *Comuna* is an administrative division within the city and it is made up of neighbourhoods.

Figure 3.
Housing Prices per Square Meter (left) and Homicide Rates (right) in Cali



Source: Cadastral housing prices of 2012 and Observatorio Social de Cali.

it can be observed that there are high homicide rates in central areas and some peripheral areas of the city. We hypothesized that persistent cases of homicide will be capitalized in housing prices.

Table 4 summarises key variables related to housing prices and homicide data for Bogotá D.C. The mean log of hypothetical lease value was 13.31, with a standard deviation of 1.27, and the mean log of effective lease value was 13.13 with a standard deviation of 0.8 (Figure 4 shows the distribution of these variables). The mean for the homicide rate was 18.93 per 100,000 inhabitants with a standard deviation equal to 27.55. It is important to highlight that this homicide rate of 18.93 was slightly different from the homicide rate of 17, which was the official data from the INML (2015). The difference is due to disparate official calculations. One estimation came from the 2005 national census population projections conducted by *Departamento Administrativo Nacional de Estadística*, DANE; however, the rate that we are reporting in this paper was calculated with projections from the planning office of Bogotá D. C. (*Secretaría de Planeación Distrital*, SDP).

Figure 4 shows the distribution of the logarithm of housing prices: hypothetical lease value (left) and the effective lease value (right) from the *Encuesta Multipropósito* report (2017). As we observed in Table 4, the hypothetical lease value was slightly higher than the effective lease value. This characteristic is

Table 4.
Summary Statistics for Bogotá D.C.

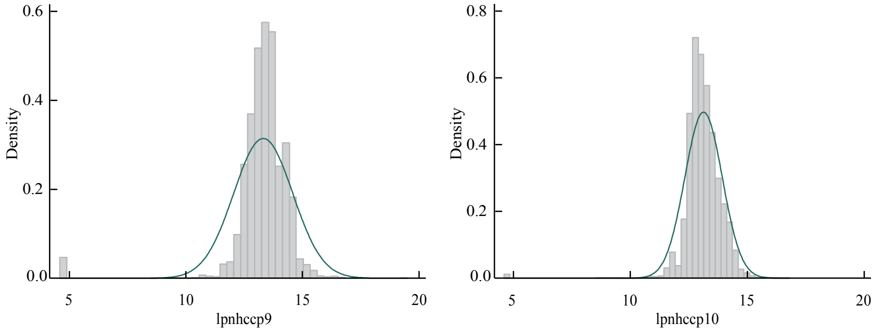
	Mean	Std. Dev.	Minimum	Maximum
ln (hypothetical lease value)	13.31	1.27	4.60	19.52
ln (effective lease value)	13.13	0.80	4.59	16.81
Homicide rate	18.93	27.55	0	145
Population 2015	70,024	62,075	932	351,846
ln (Accessibility (friction = 1))	9.88	0.85	6.83	11.55

Note: 112 spatial units (Unidades de Planeación Zonal - UPZ).
Source: *Encuesta Multipropósito* (2017) and INML (2015).

relevant because in the econometric models, the set of explanatory variables was similar, and the estimated coefficient related to the homicide rate was not that different.

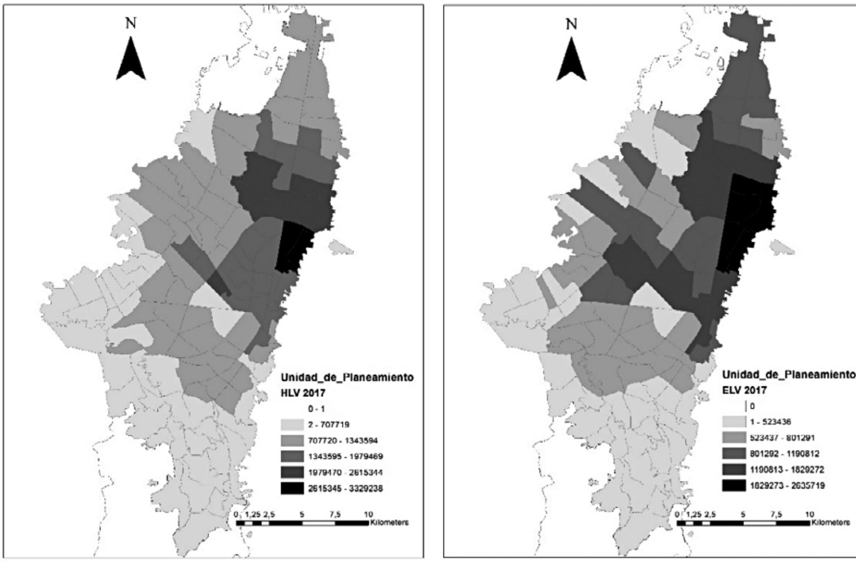
The maps in Figure 5 display the hypothetical lease value (left) and the effective lease value (right) from the information in the *Encuesta Multipropósito* (2017). Both maps indicate that the higher lease values at the level of *Unidades de Planeación Zonal* (UPZ)[3] were in the north-eastern part of the city. The lower lease values were distributed in the periphery: predominantly the south and west.

Figure 4
Distribution of Log Hypothetical Lease Value (left) and the Effective Lease Value (right) for Bogotá D.C.



[3] UPZs are planning instruments that establish urban regulations for a set of neighbourhoods that have common characteristics in their urban development, as well as in their predominant uses and activities.

Figure 5.
Hypothetical Lease Value (left), Effective Lease Value (right)

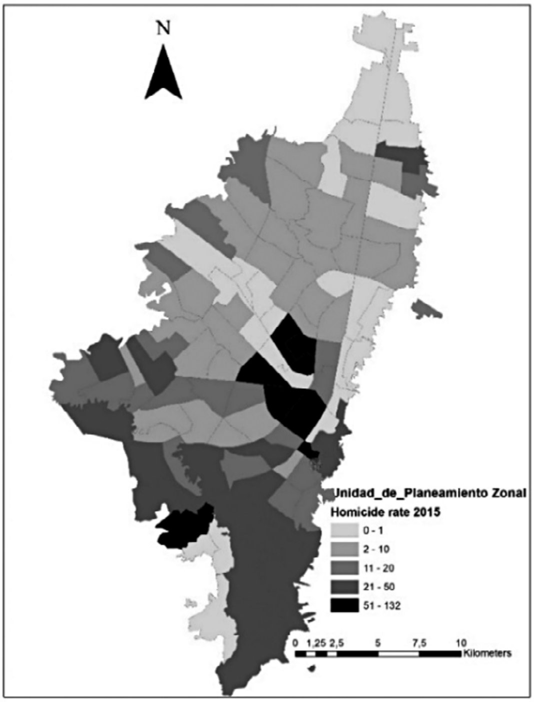


Source: *Encuesta Multipropósito* (2017) and own calculation.

Finally, Figure 6 shows the homicide rates at the UPZ level for 2015. In the case of Cali, we used the average homicide rate for one decade to avoid simultaneity effects with housing prices. Meanwhile, for Bogotá, we used homicides for 2015 and housing prices for 2017. The urban area is divided into 112 UPZs according to the *Encuesta Multipropósito* (2017). The map shows that higher homicide rates were in UPZs in the geographical centre of the city and the south area. As Table 4 demonstrates, the average population in a UPZ was 70,024; the average of the log accessibility indicator was 9.88. The log accessibility indicator was calculated as the weighted average of the number of jobs for each UPZ. In the next section, which presents the regression model, we will explain the construction of this variable.

This section exhibited the geographical distribution of housing prices and homicide rates for Cali and Bogotá D.C. The sources of data used were different as were the years and the spatial units of reference. Nevertheless, in both cases, it was possible to use a theoretical model of reference and econometric estimations methodologies.

Figure 6.
Homicide Rates in Bogotá D.C. 2015



Source: INLM (2015) and own calculations.

THEORETICAL MODEL

In this section, we present a theoretical model to identify the relationship between both variables of interest: homicide rates and housing prices in the urban structures of Cali and Bogotá D.C., and the model's main equation, which we estimated with econometric methodologies. It is worth highlighting that in the literature review Hellman and Naroff (1979) provided a theoretical alternative to consider a crime indicator within the residential location model.

The theoretical problem for the typical household was to maximize a utility function, $U = U\left[z, Q\ Hr(j)\right]$, subject to $Y = z + P(j)Q + T(j)$. In this model, the variable z represents a composite good (numeraire), Q represents the quantity of housing attributes per unit of land, $Hr(j)$ is the homicide rate in a neighbourhood j, Y represents the income, $P(j)$ is the price per unit of housing, and $T(j)$ the transportation cost.

The maximization problem, for which the utility function of an individual agent or household includes the residential location and for which the budget constraint includes the commuting cost, was replicated in more current literature, including Brueckner (2011, chapter 2), Fujita and Thisse (2013, chapter 3), and others. The difference was that Hellman and Naroff (1979) assumed that the homicide rate only enters the utility function for the household in the location with a negative relationship: $\partial U / \partial Hr < 0$.

Using a Cobb-Douglas utility function $U = z^{\alpha} Q^{\beta} Hr^{-\gamma}$ and the budget constraint, the indirect utility function can be obtained, which can be solved for *P* to get the bid-rent function (remember that *P* is the price per unit of housing in the budget constraint):

$$P = \left[\left(\frac{\alpha}{\alpha+\beta}\right)^{\alpha}\left(\frac{\beta}{\alpha+\beta}\right)^{\beta}\frac{1}{\bar{U}}\right]^{1/\beta}(Y-T)^{(\alpha+\beta)/\beta}\,Hr^{-\gamma/\beta}$$
$$= C_{*}(Y-T)^{(\alpha+\beta)/\beta}\,Hr^{-\gamma/\beta}$$

where $\bar{U}$ equals the constant and equal utility level for each household in the city. The bid-rent in the equation above can be interpreted as the willingness to pay for housing. This is positively related to income and negatively related to the transportation cost. The equation demonstrates that when the homicide rate increases beyond a threshold level $(Hr > 1)$, the bid-rent shifts down:[4]

$$\frac{\partial P}{\partial Hr} = \frac{-\gamma}{\beta} C_{*}(Y-T)^{(\alpha+\beta)/\beta}\,Hr^{(-\gamma/\beta)-1} < 0$$

It is possible to demonstrate that the function decreases at an increasing rate, which means that the second derivative is positive. Hellman and Naroff (1979) argued that the impact on residential property values at any location *j* is the combined effect of a decrease in bid rents and a resulting decline in density. Then, the total residential property value at any location *j* is given by:

$$V(j) = P(j)D(j) = B_{*}(Y-T)^{(2\alpha+\beta-\alpha\delta)/\beta(1-\delta)}\,Hr^{(-2\gamma-\gamma\delta)/\beta(1-\delta)}$$

Taking the log of both sides of the equation resulted in an equation where housing price was a linear function of income, distance from the Central Business District (CBD), and the homicide rate. In the literature, the value of the coefficient of the homicide rate variable represents the elasticity of housing prices regarding the homicide rate. Considering the model developed by Hellman and Naroff (1979) and following Thaler (1978), the econometric model can be estimated as follows:

[4] A value of one is given when the crime level is at a minimum acceptable level or when it has no perceptible impact on utility.

$$V_{ij} = \mu + \delta Hr_j + \sum_k \beta_k Q_{ik} + u_{ij}$$

where V_{ij} is the logarithm of housing price i in a neighbourhood j; μ is the constant term; Hr_j is the homicide rate in the neighbourhood j; Q_{ik} is the attribute k of a house i; β_k is the estimated price associated with each attribute k; and u_{ij} is an error term. Indeed, Thaler (1978) argued that the willingness to pay for housing depends not only on the structure and land, but also on the surrounding neighbourhood. Ridker and Henning (1967) estimated the effect of air pollution on property values with a similar econometric specification, and Gibbons (2004) and Tita et al. (2006) evaluated the cost of urban property crime in London and Columbus, Ohio, respectively. With these references in mind, we estimated the relationship between homicide rates and housing prices for the Colombian cities.

In section 3.2, for Cali, we use a cross section of cadastral housing prices from 2012 and the average homicide rates from 2000-2010 at the neighbourhood level. Due to data availability, it was possible to estimate two model specifications, one was similar to those from Thaler (1978), Gibbons (2004) and Tita et al. (2006), and the second was an econometric strategy developed following Buonanno et al. (2013). In section 3.3, for Bogotá D.C., we used information about lease values and housing characteristics registered in the *Encuesta Multipropósito* (2017), and information of crime from 2015 registered in the INML.

HOMICIDE RATES AND HOUSING PRICES IN CALI

The literature mentioned that it is possible to estimate standard errors of the coefficients using an Ordinary Least Square (OLS) equation, assuming that all observations in the database are unrelated. However, the correct standard error estimation procedure was given by the underlying structure of the data. Indeed, some economic phenomena did not affect observations individually, but they affected groups of observations within each cluster. In our case, it was more appropriate to use clusters at neighbourhood level. This resulted in a data structure where unobservable elements of housing prices within a cluster were correlated, while they were uncorrelated across clusters. This kind of correlation occurs because some regressors take the same value for all observations within clusters. In fact, Hr_j is perfectly correlated within neighbourhoods (Cameron & Miller, 2015).

Table 5 shows the results for different estimation strategies using data for Cali: OLS model; the heteroscedasticity correction suggested by White (1980), which is known as having robust standard errors; cluster-robust standard errors;[5] and

[5] For a regressor k, the variance inflation factor, $\tau_k \approx 1 + \rho_{xk}\rho_u\left(\bar{N}_j - 1\right)$, is increasing in the within-cluster correlation of the regressor, ρ_{xk}; the within-cluster correlation of the error, ρ_u; and the number of observations in each cluster, $\bar{N}_j$ (Cameron & Miller, 2015).

Table 5.
Dependent Variable: Log Housing Prices for Cali

	OLS	Robust	Cluster	RE
Homicide rates	-0.0037***	-0.0037***	-0.0037***	-0.0031***
	(-229.35)	(-188.17)	(-6.77)	(-9.42)
ln (Area in square meters)	1.27***	1.27***	1.27***	1.39***
	(370.37)	(257.79)	(18.95)	(465.55)
ln (Area in square meters)2	-0.02***	-0.02***	-0.02**	-0.03***
	(-50.03)	(-35.78)	(-2.34)	(-79.29)
Liquefaction risk	-0.33***	-0.33***	-0.33***	-0.29***
	(-222.15)	(-211.40)	(-8.36)	(-8.98)
Distance from main roads	-0.0003***	-0.0003***	-0.0003***	-0.0002***
	(-245.23)	(-210.46)	(-8.98)	(-9.52)
Constant	12.82***	12.82***	12.82***	12.32***
	(2001.17)	(1388.66)	(119.70)	(356.56)
R-squared	84%	84%	84%	84%
N	504,617	504,617	504,617	504,617

Note: t-statistics in parenthesis. Significant level: *** 1%; ** 5%; * 10%.

a Random Effects (RE) model, where *j* represents clusters and *i* represents individual housing prices as follows:

$$V_{ij} = \mu + \delta Hr_j + \sum_k \beta_k Q_{ik} + \left(\alpha_j + u_{ij}\right),$$

In the RE model, the estimation of standard errors is valid because it considers correlations of residuals within each cluster. Furthermore, if residuals α_j are asymptotically correlated with explanatory variables, coefficients of the RE model tend to coefficients of a fixed-effects model. Consequently, the correlation between random effects and explanatory variables is corrected. Therefore, a consistent estimate with *N* observations was obtained.[6]

[6] A strong assumption of the RE model is the dependence pattern within each cluster: if $u_{ij} = \alpha_j + \varepsilon_{ij}$ and $u_{hj} = \alpha_j + \varepsilon_{hj}$ then $E\left(u_{ij}, u_{hj}\right) = \sigma_\alpha^2$ for all *j*.

We found a significant negative relationship between housing prices and homicide rates. The elasticity is around -0.24, which means that a 10% increase in the homicide rate is related to a 2.4% decrease in housing prices. The reported elasticity was calculated using the estimated coefficient of the model as follows:

$$E_h = \frac{dPrice \,/\, Price}{dHr \,/\, Hr} = \hat{\beta}_{Hr}(Hr),$$

where E represents the elasticity for the housing price; $\hat{\beta}_{Hr}$ is the estimated coefficient; and Hr is the homicide rate variable.

The coefficient of the area variable was significant and positive. In contrast, the coefficient of the squared area was significantly negative (this variable was included to control for nonlinear effects). As an additional control variable, we included a geological variable called liquefaction risk. Geological variables such as soil composition, rock depth, water capacity, soil erodibility, and seismic and landslide hazard have been used in the literature about urban structures (Combes et al., 2010; Combes & Gobillon, 2015; Rosenthal & Strange, 2008).

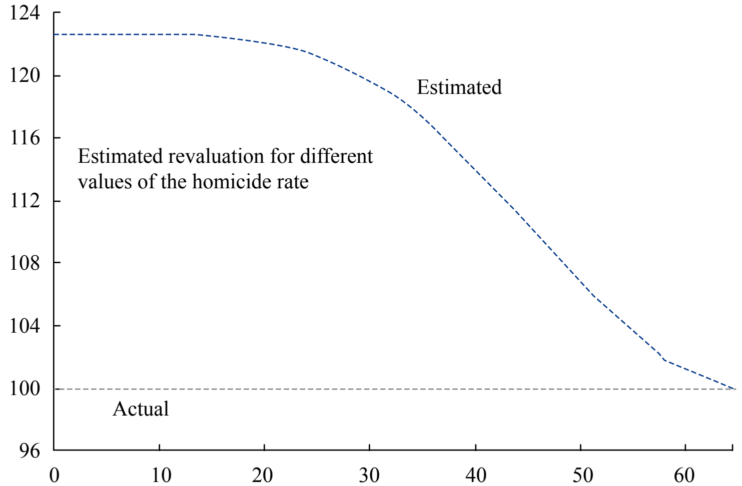
The soil characteristics were important to be able to identify original settlements, and they have been determinant in developing agglomeration processes in those areas. Liquefaction risk refers to the strength and hardness of the soil when it is affected by earthquakes. The risk is present in areas where the soil is saturated with water and then acts like a liquid when shaken by an earthquake. Earthquake waves cause water pressure to increase in the sediment, so sand grains lose contact with each other, and the soil loses its ability to support high buildings. Nobody would be willing to pay the same price for two equivalent houses when one is in an at-risk area and the other is not. The coefficient of the liquefaction risk variable was significantly negative. We included the distance to main roads, and we also found a significantly negative coefficient.

The results reported in Table 5 reveal that in the presence of correlation within each cluster (neighbourhood), the OLS standard errors can overvalue the estimator precision. The literature mentioned that when there is a large number of clusters, statistical inference after OLS should be based on cluster-robust standard errors (Cameron & Miller, 2015).[7] An alternative to this methodology is to estimate a RE model because it considers the within dependency and, in this way, provides efficient estimates. Furthermore, the RE model is consistent in N even in when there is correlation between the random effects and the explanatory variables.

With the estimated coefficients, the increase in housing prices when the homicide rate diminishes can be simulated. In Figure 7, the horizontal axis measures the homicide rate, while the vertical axis indicates the average (percentage) increase

[7] In Appendix 3, we present a simulation procedure that analyses the potential consequences on the estimated standard errors derived from forming false clusters. As shown in Table 5, the formation of false clusters has important implications on the significance level of estimated coefficients.

Figure 7.
Estimated Housing Prices for Different Values of the Homicide Rate



of a housing prices index. In this graph, 100 is the observed value of the housing prices for the actual homicide rate of 64.45. As the graph shows, when the homicide rate is “zero”, the estimated real estate value (property value in the form of land and buildings) reaches 122.64— a 22.64% increase—which can be interpreted as an increase in people’s welfare.

AN ALTERNATIVE ESTIMATION: HEDONIC PRICES

A standard method to estimate the effect of crime on housing prices is to use a two-stage model. In the first stage, we estimated the shadow price of the location of houses and in the second, we tested if crime could explain some of the variability of the estimated locational valuation (Buonanno, et al., 2012; Gibbons, 2004; Thaler, 1978; and others). Table 6 displays the estimation of the hedonic housing price regarding the size of the property (area in square meters and the square of the area to include nonlinear effects) to obtain the hedonic housing price at the neighbourhood level (see Figure 8).

In the second stage, we tested if the homicide rate explains some of the variability of the hedonic price at neighbourhood level. It was difficult to find exogenous variables to explain housing prices. We used liquefaction risk as a control variable. As we argued in the previous section, nobody would be willing to pay the same price for two equivalent residences when one is located in an at-risk area and the other is in an area with no risk, so we expected a negative coefficient.

Table 6.
Hedonic First Stage: Dependent Variable Log Housing Prices

ln (Area in square meters)	1.40***
	(258.28)
ln (Area in square meters)2	-0.03***
	(-47.03)
Fixed effects by neighbourhood	Yes
Constant	-28.44***
	(-10.69)
R-squared	89%
N	524,400

Note: Robust t-statistics in parenthesis. Significant level: *** 1%; ** 5%; * 10%

Figure 9 shows the distribution of homicide rates at the neighbourhood level up to 400. However, there are several neighbourhoods with homicide rates of 500, 1000, and 1628. Table 7 exhibits the second stage estimation. The estimated regression excluded neighbourhoods with more than 400, 300, 200, and 100 homicides per 100,000 inhabitants to check whether the coefficient was stable across the distribution of the variable. The number of neighbourhoods was reduced in each econometric estimation. We controlled for liquefaction risk, and the coefficient associated with this variable was negative as expected.

Figure 8.
Hedonic Housing Prices at the Neighbourhood Level

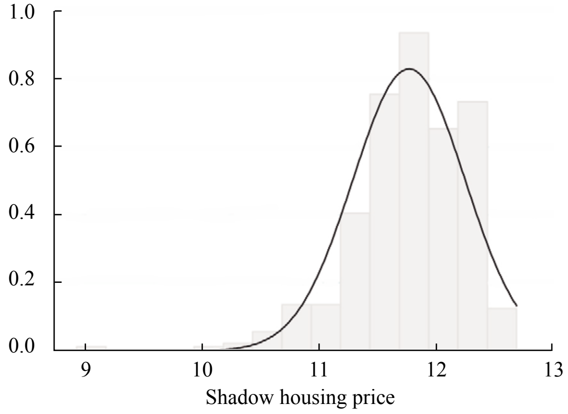
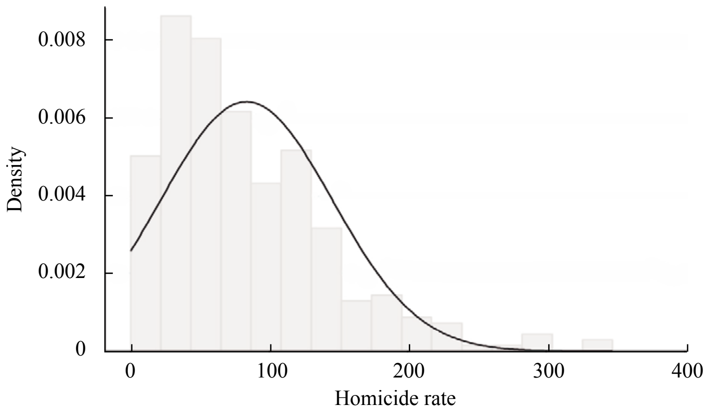


Figure 9.
Homicide Rates at Neighbourhood Level



In Table 8, we report the "price-homicide" elasticity derived from the hedonic second stage estimation:

$$E_h = \frac{dPrice / Price}{dHr / Hr} = \hat{\beta}_{Hr}(Hr),$$

Table 7.
Hedonic Second Stage

	<400	<300	<200	<100
Homicide rate	-0.0024***	-0.0026***	-0.0033***	-0.0044
	(-6.33)	(-6.38)	(-6.78)	(-4.80)
Liquefaction risk	-0.2737***	-0.2661***	-0.2638***	-0.2365
	(-6.69)	(-6.46)	(-6.38)	(-4.79)
Distance from main roads	-0.0002***	-0.0002***	-0.0002***	-0.0002***
	(-7.16)	(-7.12)	(-7.35)	(-6.79)
Constant	12.24***	12.25***	12.30***	12.34
	(282.15)	(277.15)	(258.25)	(227.56)
R-squared	28%	29%	29%	23%
N	319	317	302	215

Note: Robust t-statistics in parenthesis. Significant level: *** 1%; ** 5%; * 10%

where E_h represents the elasticity for the housing price for a neighbourhood in strata; h; $\hat{\beta}_{Hr}$ is the estimated coefficient; and H_r is the homicide rate.

We found that a 10% increase in the homicide rate was related to a 2% decrease in housing prices, excluding neighbourhoods with homicide rates higher than 400. The decrease in housing prices is 2.1%, 2.5%, and 2.1%, excluding neighbourhoods with homicide rates of more than 300, 200, and 100, respectively. However, as mentioned by some of the literature, the homicide rate has higher consequences in lower socioeconomic strata neighbourhoods. For that reason, we differentiated results by socioeconomic strata.

Table 8.
Housing Prices, Homicide Rate, and Elasticity by Strata

				E_h			
Strata	**Observations**	**Average Price**	H_r	**<400**	**<300**	**<200**	**<100**
1	12.74%	327,914	119	-0.26	-0.28	-0.30	-0.21
2	23.52%	384,455	128	-0.23	-0.25	-0.30	-0.25
3	28.52%	533,101	111	-0.20	-0.21	-0.24	-0.22
4	10.19%	639,195	56	-0.13	-0.14	-0.19	-0.19
5	19.74%	684,311	63	-0.15	-0.16	-0.19	-0.18
6	5.29%	784,783	48	-0.11	-0.12	-0.16	-0.15
All	100%	533,051	104	-0.20	-0.21	-0.25	-0.21

Source: Cadastral housing prices of 2012 and Observatorio Social de Cali, own calculations.

In Colombia, residential areas have been divided into six socioeconomic status (strata) since 1988. The stratification system, where 1 is the lowest strata, and 6 is the highest, divides the city into areas of wealth and poverty. With this socioeconomic stratification system, the public administration guarantees that the upper strata pay a higher rate for public utilities (electricity, water, and sewage) to subsidize the cost of those utilities for the lower strata. Thus, the stratification makes low-income families settle in areas where they can afford to pay housing and basic services. Income-based class division explicitly categorized via public policy is strange. However, in our case, we used it to differentiate the negative effect of the homicide rate on housing prices according to different wealth levels because the stratification classifies neighbourhoods with similar characteristics. The second column in Table 8 reveals that around 65% of dwellings in Cali are in strata 1, 2, and 3.

The third column in Table 8 presents the average price of the square meter by strata; column 4 shows the homicide rate per 100,000 inhabitants (it is clear that the rate is higher in lower strata). The last four columns indicate that the price-homicide rate elasticity is more negative in lower strata. In any case, the fact that the elasticity decreases with strata may be the result of the definition of elasticity: (percentage change price) / (percentage change homicide rate). This situation implies that if the homicide rate goes from 1 to 2 in a wealthy neighbourhood, the percentage change is 100%. If the homicide rate goes from 100 to 150 in an impoverished neighbourhood, the percentage of variation is 50%. Lastly, if the homicide rate goes from 0 to 1 in a wealthy neighbourhood, the percentage of variation is infinite, so that elasticity must be zero.

In Colombia, crime is constant across the income distribution. For that reason, the rich are more likely to adopt costly protective behaviour and neighbourhood watch programmes, install anti-theft devices at home, hire private security personnel or migrate (Gaviria & Vélez, 2002). In fact, in Brazil, homicide victimization is also more common in lower socioeconomic strata (Soares, 2006). Also, in Argentina, most of the increase in burglary rates were shouldered by the poor, since the rich were able to adopt effective protective strategies (Di Tella et al., 2010).

HOMICIDE RATES AND HOUSING PRICES IN BOGOTÁ D. C.

As we previously mentioned, for Bogotá D.C., we used the housing characteristics information and two dependent variables: the hypothetical lease value and the effective lease value. The information comes from the *Encuesta Multipropósito* (2017), and it is possible to control for different characteristics of each house. The information about the number of homicides corresponds to the data registered in the INML (2015). The estimations reported in Table 9 allow it to be concluded that a 10% increase in the homicide rate is related with a 1.8% decrease in the hypothetical lease value and a decrease of 1.7% in the effective lease value.

In these regression models, we included an accessibility indicator, z_s, to consider the distribution of employment within the city. This indicator is calculated as a weighted mean of the number of jobs at locations h, with weights that are a decreasing function of distance between s and h (Koster & Rouwendal, 2013; Lucas & Rossi-Hansberg, 2002). To be specific, z_s is defined as follows:

$$z_s = \int J_h e^{-\delta d_{sh}} \, dh \,,$$

where J_h denotes the number of jobs at location h, d_{sh} denotes the distance between locations s and h, and $\delta > 0$ is a given decay parameter. The external effect is more localized for higher values of δ, which implies that for a company the value of establishing itself close to other producers is also higher. As we mentioned, it is important to include the employment gradient of the urban structure in this variable.

The regression models include control variables, for instance, if the housing is an apartment, control variables would be the number of people living in the house, the strata, track quality, and variables of the house quality. The complete regressions are presented in Tables 4A and 4B (Appendix D). Using, quantitative methodologies, we revealed a negative relationship between homicide rates and housing prices in Cali and Bogotá D.C. As we previously mentioned, studying this relationship is essential to quantify crime in terms of its representation in property values, property tax revenues, and family heritage.

Table 9.
Models for Bogotá D.C.: Dependent Variable Hypothetical Lease Value (HLV) and Effective Lease Value (ELV)

	Ln(HLV)	**Ln(ELV)**
Homicide rate	-0.0018***	-0.0017**
	(-4.69)	(-2.60)
ln(Accessibility (friction = 1))	0.1091***	0.1226***
	(8.69)	(4.44)
People	0.0441***	0.0467***
	(11.09)	(8.90)
House/Apartment	0.1168***	0.0949***
	(8.36)	(5.44)
Strata	(+)	(+)
Track quality	(+)	(+)
House quality	(+)	(+)
Constant	11.75***	11.48***
	(98.54)	(43.96)
R-squared	9%	31%
N	43,160	30,580

Note: Robust t-statistics in parenthesis. Significant level: *** 1%; ** 5%; * 10%
Source: *Encuesta Multipropósito* (2017), own calculations.

A COMMENT ABOUT ENDOGENEITY

The literature mentioned that problems of endogeneity arise through the correlation between the regressors and the random disturbances. Consequently, treating the crime rate as an exogenous variable may result in a biased estimated elasticity in a regression to explain housing prices. This bias appears because crime occurs disproportionately in more impoverished neighbourhoods, with low housing prices, or conversely if criminals target areas with high housing prices. In both cases, the neighbours' behaviour will depend on their individual characteristics, and these may well be systematically related to unobserved housing prices determinants (Buonanno et al., 2013; Gibbons, 2004). We may infer a causal relationship between local characteristics and housing prices, when, in fact, the unobserved component is the one that drives neighbourhood characteristics.

Estimating the impact of crime on housing prices is empirically challenging because of omitted variables. Furthermore, it is difficult to find valid instruments for crime. To mention several examples, Gibbons (2004) used instruments such as crimes on non-residential properties, spatial lags of crime, or the distance to the nearest public house or wine bar. Buonnano et al. (2012) used a 20-year lag in the victimization rate and the percentage of youth aged between 15 and 24 as instruments of crime rates. Nevertheless, it is hard to instrument murders.

In the present paper, the explanatory variable referred to homicides, but not to theft or crime in general. Homicide and theft could be correlated, but motives for homicide may differ from the motivations of theft. Indeed, the propensity to report a theft varies with the severity of the incidence. Faced with the difficulty of finding valid instruments, we tried to address endogeneity problems by including homicide rates and all the variables that may provoke the correlation between regressors and random disturbances on the right-hand side of the equation lags.

CONCLUSIONS

High homicide rates discourage attracting new residents to a neighbourhood but encourage those people-who-can to move to neighbourhoods with a lower homicide rate. This phenomenon has consequences on the housing market. The objective of this paper was to estimate the relationship between homicide rates and housing prices in Cali and Bogotá D.C. For Cali, we used housing prices cadastral information from 2012 and the average homicide rates between 2000-2010 at the neighbourhood level. For Bogotá D.C., we used the information relating to housing characteristics and two dependent variables: the hypothetical lease value and the effective lease value, from *Encuesta Multipropósito* (2017). With the information from this survey, it was possible to control for different characteristics of each house.

The analysis was performed using different estimation strategies. In the first methodological strategy for Cali, we estimated a model where the dependent variable was housing prices and one of the explanatory variables was the homicide rate. We found that a 10% increase in the homicide rate is related to a 2.4% decrease in housing prices. In the second strategy, we estimated a two-stage model: in one stage we estimated the hedonic price at neighbourhood level, and then we estimated a regression to test whether the homicide rate has a negative relationship with the estimated hedonic price. We found that, on average, a 10% increase in the homicide rate is related to a decrease of between 2% and 2.5% in housing prices. In the third strategy, with data for Bogotá, the estimations showed that a 10% increase in the homicide rate is related to a 1.8% decrease in the hypothetical lease value and 1.7% in the effective lease value. Indeed, when estimating the models with different strategies and different data, the estimated coefficient of the homicide rate variable does not result that different.

To diminish homicide rates, judiciary and police procedures need to be strengthened (the Minister of Defence of Colombia revealed that in 2018, Cali and Bogotá had approximately 300 police officers per 100,000 inhabitants, while medium-sized cities such as Bucaramanga or Tunja have more than 600 (Semana, 2019). Therefore, the number of police officers per city could be more efficiently reorganized). Also, sites where crime is concentrated need to be identified, criminal gangs must be deactivated, and the illegal carrying of weapons must be controlled more effectively (Appendix B shows that in Cali, 90% of the homicides were committed with guns). Finally, to improve estimations, future work will be to include additional house characteristics and evaluate strategies to deal with potential endogeneity problems.

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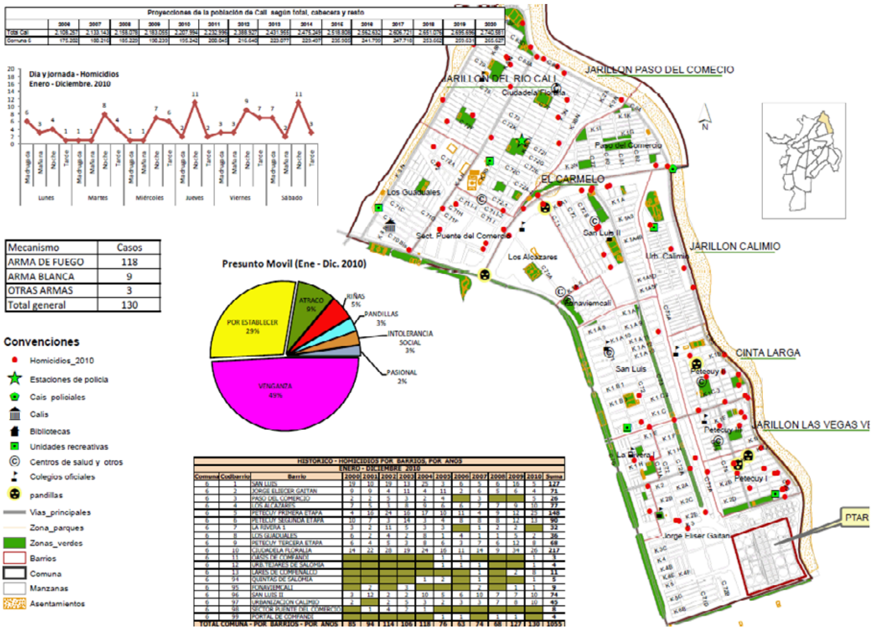
APPENDIX A

Colombian municipalities

Source: *Instituto Geográfico Agustín Codazzi*, IGAC, own design.

APPENDIX B

Information about Comuna 6



Source: *Observatorio Social de Cali*.

APPENDIX C

Potential consequences on the estimated standard errors derived from forming false clusters

When the statistical information is clustered (e.g. classrooms, neighbourhoods, economic sectors), the specialized literature recommends estimating models using cluster standard errors. In this section, we have conducted a simulation exercise to show potential consequences on the estimated standard errors derived from forming false clusters. The starting point is the OLS estimation of the regression model in Table 5:

$$y = X\beta + u,$$

where y represents the log of housing price, and the explanatory variables are the area, the square of the area, and the fixed effects of neighbourhoods. Using the OLS estimation of $\beta = \hat{\beta}$ and the standard error of disturbances $\hat{\sigma}_u - 0.39$, we generated a new dependent variable y^s as follows:

$$y^s = X\hat{\beta} + u^s,$$

where u^s is a normal independent random number distribution with a zero mean and a standard deviation of $\hat{\sigma}_u - 0.39$. These random disturbances verify the standard hypothesis of the regression model; then, the population matrix of variances and covariances of the estimated coefficients was obtained as follows:

$$cov(\hat{\beta}) = (0.39)^2 (X'X)^{-1}$$

Once the simulated dependent variable, y^s, has been generated, we estimated the equation with errors clustered at neighbourhood level, which means that we are dealing with false clusters. The new estimated covariance matrix is $cov(\tilde{\beta})$. This strategy facilitates the comparison between the population covariance matrix $cov(\tilde{\beta})$ and the estimated covariance matrix $cov(\hat{\beta})$. We estimated the equation with clustered errors 1,000 times. For each standard error of the coefficient, we calculated the percentage of error, pe_j, as follows:

$$pe_j = \left[\frac{\sqrt{var(\tilde{\beta}_j)} - \sqrt{var(\hat{\beta}_j)}}{\sqrt{var(\hat{\beta}_j)}} \right].100$$

Figure 1A presents the percentage of error. The area error seems to be free from bias; however, the absolute value of the error is 6.3%. The worrying results for the cluster option are those related to neighbourhood fixed effects, which implies an important negative bias. Figure 1A shows the distributions of the percentage of error, pe_j, for two groups of variables: area of the house and neighbourhood fixed effects. The average of the distribution of errors for neighbourhood fixed effects is -96%. The main conclusion is that false cluster can have an important cost. Nevertheless, in this paper, the statistical significance of the coefficients is invariant to the option selected, as shown in Table 5 of the main text.

Figure 1A.
Consequences of Forming False Clusters

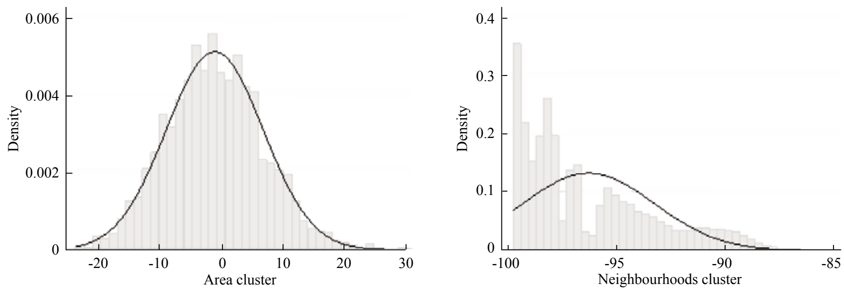
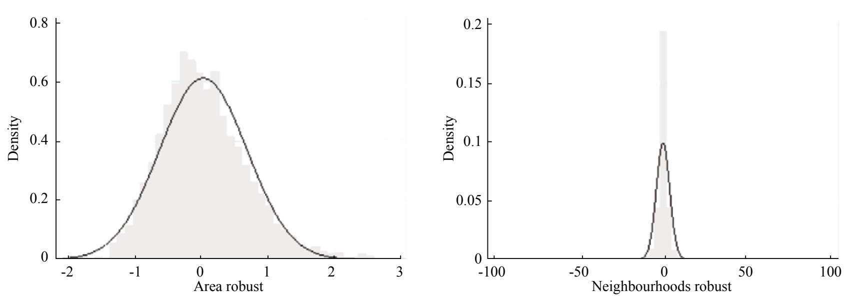


Figure 2A shows results from a similar simulation process using the heteroscedasticity correction suggested by White (1980). The estimations of the covariance matrix are denominated *robust*. As in the previous exercise, the robust correction is unnecessary, but enables us to analyse the potential effects of making such corrections.

Figure 2A.
Consequences of Unnecessary Robust Correction



APPENDIX D

Complete Regression Models for Bogotá D.C.

Table 4A.
Dependent Variable: Hypothetical Lease Value (HLV)

Variable	Coef.	Std. Err.	t	[95% Conf. Interval]	
Homicide rate	-0.0018	0.000	-4.690	-0.003	-0.001
Accessibility	0.109	0.013	8.690	0.085	0.134
People	0.044	0.004	11.090	0.036	0.052
Unpaved street	-0.089	0.033	-2.720	-0.153	-0.025
Pedestrian	-0.071	0.013	-5.420	-0.096	-0.045
Path	-0.114	0.026	-4.370	-0.165	-0.063
Residential complex	0.059	0.014	4.100	0.031	0.088
Elevator	0.076	0.022	3.430	0.033	0.120
Cracks in the wall	-0.093	0.030	-3.130	-0.151	-0.035
Shingle roof	-0.100	0.028	-3.570	-0.154	-0.045
Business	0.056	0.027	2.090	0.004	0.108
House	0.117	0.014	8.360	0.089	0.144
Room	-0.430	0.069	-6.270	-0.564	-0.296
Estrato 2	0.184	0.027	6.890	0.131	0.236
Estrato 3	0.519	0.031	17.010	0.459	0.579
Estrato 4	1.030	0.036	28.280	0.958	1.101
Estrato 5	1.204	0.043	28.170	1.120	1.288
Estrato 6	0.495	0.051	9.700	0.395	0.596
Wall material	0.133	0.064	2.070	0.007	0.260
Floor material	-0.123	0.025	-4.980	-0.172	-0.075
Factories	0.050	0.018	2.760	0.015	0.086
Buses	-0.063	0.021	-3.050	-0.103	-0.022
_cons	11.754	0.119	98.540	11.520	11.988

Source: *Encuesta Multipropósito* (2017), own calculations.

Table 4B.
Dependent Variable: Effective Lease Value (ELV)

Variable	Coef.	Robust Std. Err.	t	[95% Conf. Interval]	
Homicide rate	-0.0017	0.001	-2.600	-0.003	0.000
Accessibility	0.123	0.028	4.440	0.068	0.177
People	0.047	0.005	8.900	0.036	0.057
Unpaved street	-0.090	0.026	-3.430	-0.143	-0.038
Pedestrian	0.049	0.026	1.920	-0.002	0.100
Street in fair condition	0.039	0.013	2.900	0.012	0.065
Street in bad condition	0.067	0.020	3.300	0.027	0.108
Residential complex	0.239	0.020	12.200	0.200	0.278
Elevator	0.284	0.039	7.230	0.206	0.362
Cracks	-0.044	0.017	-2.620	-0.077	-0.011
Faults or deficiencies	0.054	0.019	2.890	0.017	0.091
Cracks in the wall	-0.067	0.028	-2.370	-0.124	-0.011
Shingle roof	-0.065	0.023	-2.800	-0.110	-0.019
Ventilation	-0.061	0.027	-2.280	-0.114	-0.008
Business	0.091	0.023	3.970	0.045	0.136
House	0.095	0.017	5.440	0.060	0.130
Room	-0.473	0.028	-16.980	-0.528	-0.418
Estrato 2	0.093	0.030	3.100	0.033	0.153
Estrato 3	0.357	0.048	7.460	0.262	0.453
Estrato 4	0.863	0.055	15.810	0.754	0.971
Estrato 5	0.977	0.109	8.990	0.761	1.193
Estrato 6	1.312	0.117	11.250	1.080	1.544
Floor material	-0.101	0.018	-5.630	-0.137	-0.066
Pubs in the UPZ	0.040	0.018	2.270	0.005	0.076
Drug sales in the UPZ	-0.044	0.015	-2.830	-0.074	-0.013
_cons	11.483	0.261	43.960	10.964	12.002

Source: *Encuesta Multipropósito* (2017), own calculations.