151
DISCUSSION PAPER
Originally published by Ipea in July 2005 as number 1105 of the series Texto para Discussão.

SOCIOECONOMIC STRUCTURE, SELF-FULFILMENT, HOMICIDES AND SPATIAL DEPENDENCE IN BRAZIL

Alexandre Carvalho
Daniel Cerqueira
Waldir Lobão

ipea

151
DISCUSSION PAPER

Originally published by Ipea in July 2005 as number 1105 of the series Texto para Discussão.

Brasília, January 2015

SOCIOECONOMIC STRUCTURE, SELF-FULFILMENT, HOMICIDES AND SPATIAL DEPENDENCE IN BRAZIL[1]

Alexandre Carvalho[2]
Daniel Cerqueira[3]
Waldir Lobão[4]

1. Os autores agradecem os comentários e sugestões de Herton Araújo, Marcelos Medeiros, Constantino Kronemberg, Paulo Furtado de Castro, Carlos Octavio Ocké-Reis, Paulo Roberto Vieira e Paulo Cesar Lisboa. A contribuição de Vivian Vicente de Almeida e Pedro Albuquerque foi fundamental para a realização deste estudo.
2. Da Diretoria de Estudos Regionais e Urbanos do Ipea. E-mail: <alexandre.ywata@ipea.gov.br>.
3. Da Diretoria de Estudos Macroeconômicos do Ipea. E-mail: <dcerqueira@ipea.gov.br>.
4. Da Escola Nacional de Ciências Estatísticas (Ence) do IBGE. E-mail: <lobao@ipea.gov.br>.

Federal Government of Brazil

Secretariat of Strategic Affairs of the Presidency of the Republic
Minister Roberto Mangabeira Unger

ipea Institute for Applied Economic Research

A public foundation affiliated to the Secretariat of Strategic Affairs of the Presidency of the Republic, Ipea provides technical and institutional support to government actions – enabling the formulation of numerous public policies and programs for Brazilian development – and makes research and studies conducted by its staff available to society.

President
Sergei Suarez Dillon Soares

Director of Institutional Development
Luiz Cezar Loureiro de Azeredo

Director of Studies and Policies of the State, Institutions and Democracy
Daniel Ricardo de Castro Cerqueira

Director of Macroeconomic Studies and Policies
Cláudio Hamilton Matos dos Santos

Director of Regional, Urban and Environmental Studies and Policies
Rogério Boueri Miranda

Director of Sectoral Studies and Policies, Innovation, Regulation and Infrastructure
Fernanda De Negri

Director of Social Studies and Policies, Deputy
Carlos Henrique Leite Corseuil

Director of International Studies, Political and Economic Relations
Renato Coelho Baumann das Neves

Chief of Staff
Ruy Silva Pessoa

Chief Press and Communications Officer
João Cláudio Garcia Rodrigues Lima

URL: http://www.ipea.gov.br
Ombudsman: http://www.ipea.gov.br/ouvidoria

DISCUSSION PAPER

A publication to disseminate the findings of research directly or indirectly conducted by the Institute for Applied Economic Research (Ipea). Due to their relevance, they provide information to specialists and encourage contributions.

Discussion paper / Institute for Applied Economic

Research.- Brasília : Rio de Janeiro : Ipea, 1990-

ISSN 1415-4765

1. Brazil. 2. Economic Aspects. 3. Social Aspects. I. Institute for Applied Economic Research.

CDD 330.908

JEL: K42, C31

SUMMARY

SINOPSE

Neste estudo, desenvolvemos um modelo teórico para explicar a taxa de homicídios em uma determinada localidade e estimamos, através de métodos bayesianos, um modelo econométrico com estrutura espacial para testar as hipóteses. Admitimos que, na busca pela auto-realização, ao tomar a decisão por perpetrar a violência, o indivíduo responde não apenas a benefícios e custos econômicos esperados, mas a um sistema interno de premiação e punição, sintetizado pelas emoções. A valoração simbólica, em particular, no que diz respeito às normas estabelecidas e à valoração subjetiva da vida dependem dos laços de ligação socioeconômica e da faixa etária. As conclusões teóricas revelam que em localidades onde há maior desigualdade da renda, maior proporção de jovens na população e maior vulnerabilidade socioeconômica, maior deveria ser a probabilidade de vitimização por homicídio. Procuramos evidências das proposições teóricas com base em um modelo estatístico regressivo-auto-regressivo espacial misto, cujas informações cobriram 5.507 municípios brasileiros para os anos de 1999 a 2001. Calculamos o risco de um indivíduo residente em tal município sofrer homicídio e confrontamos essa variável com um conjunto de variáveis socioeconômicas estruturais, de modo a se obterem as elasticidades da taxa de homicídios e o efeito que a dependência espacial exerce para explicar o risco de vitimização local. Os resultados sugeriram haver evidências das proposições teóricas.

ABSTRACT

In this article we develop a theoretical model to explain the homicide rate in any given place and construct a Bayesian model with a spatial structure to test the hypotheses. We assume that in his quest for self-fulfilment the individual, when taking the decision to perpetrate violence, not only responds to expected economic costs and benefits, but also to an internal system of reward and punishment, synthesized by the emotions. Symbolic valuation, in particular, with respect to conventional rules and the subjective valuation of life itself, depends on socioeconomic and age-group bonds. Theoretical conclusions show that the probability of victimization by violence is higher in places with greater income inequality, larger proportion of youths in the population and socioeconomic vulnerability. The model tested covered 5.507 Brazilian municipalities from 1999 to 2001, and we calculated the risk of a resident in any given municipality being a victim of homicide. This variable was confronted with other structural variables in order to obtain homicide elasticities and the effect of spatial dependency in explaining the risk of local victimization. The results suggest that there is evidence to support the theoretical propositions.

1 INTRODUCTION

The pillars of economic analysis rest on the hedonist materialist philosophical tradition and thus afford a central role to the consumption of goods and services in determining levels of utility and welfare. Theoretical models of an economic nature seeking to explain the factors which determine crime are based on the idea that individual choices are derived from a group of exogenous preferences, and generally ignore the possible effects of the socioeconomic environment—family, community, institutional and cultural relationships and bonds—on the molding of the individual's values and preferences.

Becker (1968) in his seminal study argued that the decision to commit or not to commit a crime is the result of a process of maximization of expected utility, in which the individual weighs the potential gains from the criminal act, the value of punishment and the associated probabilities of detention and imprisonment, against the opportunity cost of committing crime measured by the wage he could earn in the labor market. Ehrlich (1973) extended Becker's analysis to consider what should be the optional allocation of time in the legal market or the market for crime. Block and Heinecke (1975) observed that, as the individual's decision to choose between legal and illegal sectors involves ethical and psychological differences, the question of the supply of crimes should be formulated in terms of a structure of multifactoral preferences, enabling other factors apart from income to be taken into account. They showed that Becker's and Ehrlich's results concerning opportunities for gain in the legal market are only valid if legal and illegal activities can be compared in monetary terms, and if these are independent of levels of wealth. Zhang (1997) included the existence of social programs amongst the variables that condition crime, as these would provide the individual with access to a minimum of welfare. Leung (1995) incorporated the idea that his criminal past conditions the individual's optimal decisions in favor of crime. This would explain a process of "criminal inertia", such that by opting for a criminal career the individual would be lessening his chances of abandoning crime and finding a position in the legal labor market. More recently, "economic" studies have tried to incorporate other elements, apart from the countless traditional measures of the costs and benefits expected by the offender, to explain the individual's decision to commit crime, touching on questions which used to be the preserve of sociologists, such as the questions of social interactions and social learning. Systemic interactions were introduced into economic models by Sah (1991) and Posada (1994). The basic idea was that higher crime rates, in a specific region, given a determined expenditure on law enforcement, would lead the offender to perceive that there was a lower probability of imprisonment. Thus, an exogenous increase in crime rates in any region could only be reversed by greater expenditure on enforcement. Glaeser, Sacerdote and Scheinkman (1996) also emphasized this question of social learning, arguing that such "transfers of information" between the agents of any given community, concerning criminal behaviors and techniques, determined the cost of crime, whether through knowledge of technology or through

the moral cost, to the extent that these interactions, if occurring in a criminal environment, would lead to a diminution of social control.

Sociologically-based models, on the other hand, tend to stress the influence of environmental factors in individual decision-making, especially with respect to the etiology of crime. The study by Park, Burgess and Mckenzie (1925/1967) was a landmark in this context and influenced countless theoretical frameworks including Merton's (1938) Anomie Theory, the theories of social learning [Sutherland (1942)], social control [Hirschi (1969)] and social disorganization [Sampson and Groves (1989)]. These authors based their theory on principles of human ecology, which according to Mckenzie could be defined as "(...) a study of the spatial and temporal relations of human beings as affected by selective, distributive and accommodative forces of the environment" [Park, Burgess and Mckenzie (1925/1967, p. 63)]. Notwithstanding the great influence wielded by these authors, their studies were criticized for their environmental determinism.

It is also interesting to observe the gap in studies of the determinants of crime, represented by the absence of models that specifically attempt to explain the phenomenon of lethal violence against others. It is intriguing that in countless articles which aim at a theoretical understanding of "crime"; "violent and non-violent crime"; "interpersonal crimes"; or "crimes against property", the figures used are often those referring to homicide. This must certainly be due to the scarcity (or often sheer absence) of minimally reliable data on other offenses. However, homicide can be the result of an interpersonal criminal dynamic—involving "honor" or merely a solution to a specific conflict—or associated with pecuniary gain, as in the cases of armed robbery or drug-trafficking deaths.

Some authors tried to explain homicides as being a consequence of the cultural relationships, which take place in the local area. For example, Nisbett (1993) and Cohen (1998), unlike the conventional wisdom, advocated that in the presence of a culture of honor, that encourages violent responses to insults, a stronger social organization would increase the risk of honor-related homicide. Using homicide data for United States counties, in order to test his hypothesis, Cohen (1998) found a positive relationship between honor-related homicide and social stability to the west and south counties where (according to this author) the honor culture would be strong. However, Loftin and McDowall (2003), using the same data base, showed that "Cohen's findings are due to errors in the measurement of homicide that lead to an excessive number of zero values and a few extremely high values that heavily influence the slope estimates".

Although this article recognizes the importance of the social and cultural environment in the formation of individuals' value and preference systems, it also emphasizes the rational and symbolic process of individual decision-making, in which the action probabilistically involves a homicide. We assume that in this quest for self-fulfilment the individual, when taking the decision to perpetrate violence, is responding not only to the expected economic costs and benefits but also to an internal system of reward and punishment, synthesized by the emotions. In this context, the action is a means whereby an individual optimizes the relation between pride and shame, thus strengthening his identity and self-esteem. Symbolic valuation,

in particular, with respect to conventional rules and the subjective valuation of life, depends on socioeconomic and age-group bonds. In Section 2 we will discuss individual motivations, analyzing them according to economic and self-psychology frameworks. This section aims at substantiating the hypotheses contained in the model in Section 3. In Section 4 we will present a brief description of the data used and the calculations of the rates of victimization for each municipality. In Section 5 we describe the econometric methodology used to test the proposed hypotheses. Section 6 presents the empirical results, where we use a Bayesian model with a spatial structure covering all 5.507 Brazilian municipalities from 1999 to 2001. The victimization rate variable is confronted with a vector of socioeconomic structural variables in order to obtain homicide elasticities in relation to the latter variables, on the one hand and, on the other, the effect of spatial dependency on local crime rates. Section 7 concludes the paper.

2 FROM ECONOMIC RATIONALITY TO EMOTION

2.1 ECONOMIC RATIONALITY

As Simon (1986, S210) pointed out, the treatment of rationality in neoclassical models differs from that adopted in other social sciences in three main ways: *a*) the silence concerning objectives and values; *b*) by postulating an overall consistency in behavior; and *c*) by postulating a world in which behavior is objectively rational in relation to the whole environment, including future as well as present environments. Simon also considered that if, together with these hypotheses, one also assumes that the decision maker has unlimited computational power, two important consequences follow. Firstly, it is not necessary to distinguish between the real world and the decision-maker's perception (the individual perceives the world as it really is). Secondly, the choices made by the rational decision-maker can be wholly predicted based on the real world, without any knowledge of the individual's perception, as long as his utility function is known [Simon (1986, S211)].

Neoclassical models of rational choice also completely ignore the role of symbolic and cultural values in determining individual behavior. Thus, concepts like "honesty", "duty", "dishonor", etc., are foreign to individual utility functions. This is due to the role of the hedonist materialist philosophy in shaping the economic tradition since Jevons (1871/1983)[1] and Walras (1938/1983)[2] and in which individual decisions are based on preferences as to goods and services which generate utility with use. Thus, individual behaviors that cannot be explained within the terms of the neoclassical utilitarian framework are considered to be irrational.

This link between self-interest and rational behavior was duly noted by Sen (1999, p. 31): "(...) but holding that all that does not maximize self-interest is

1. Jevons makes this hypothesis explicit right at the beginning of his study: "The science of Political Economy is based on a few notions of an apparently simple nature. Utility, wealth, value, merchandise, work, land, capital are the elements of the theme (...). Close reflection and research have led me to the somewhat unprecedented opinion that values depends entirely on utility" [Jevons (1871/1983, p. 29)].

2. The separation of science and morals is emphasized in Walras, as in the following passage: "Thus are, science, art and morals. Their respective criteria are the true, the useful or interest, and good or justice" [Walras (1938/1983, p. 17)].

irrational seems to be absolutely extraordinary (...) to consider any departure from maximization of self-interest as a proof of irrationality implies the rejection of the role of ethics in actual decision taking". Rational choice models tend to explain "supposed" irrationality by pointing out less visible implicit gains underlying actions, or by identifying asymmetries or incomplete information to explain the "wrong" choice. Imagine an everyday example: a person goes shopping in a supermarket to which he does not expect to return. The cashier gives him too much change and the customer returns the money. How can such behavior be explained from the point of view of economic rationality? Supposing that the person does not return to the market—or that he is in a game with just one play—the payoff would be greater if he did not give back the money. Rationally speaking the predictable behavior would be not to return the money.

More recently, the use of evolutionary game models and the concepts of learning and adaptation have been used to explain the kind of situation presented above. Given limited rationality, honesty can be explained using the concept of a super game (with unlimited repetitions) in which it is assumed that, up to the last round played, the decisions taken by the individual and by his opponents are known to all (and nothing more is affirmed about the rationality of the agents). In this game if the individual, analyzing past plays, perceives that he would have done better if he had been honest—and given that his opponent does not change his game—he would begin to behave honestly, not because of some intrinsic honesty, but merely because acting honestly would increase the probability of a more favorable payoff.

Even a sophisticated tool like "evolutionary games" is unable to give a satisfactory explanation for individual actions related to symbolic values (in one play) or, as we will discuss from now on, to explain the demand for symbolic goods. As appropriately emphasized by Sen (1999, p. 35) "The real question is whether or not there are several motivations, or whether human beings are guided solely by self-interest."

2.2 SELF-FULFILMENT, EMOTIONS AND SYMBOLIC GOODS

In this section we will advance the thesis that human behavior is motivated by an unceasing quest for self-fulfilment, and the individual acts (demands symbolic goods) guided by a group of social symbolic values, in order to optimize an internal system of self-reward and self-punishment dictated by the emotions. These are the internal counterpart of material and personal success and social valuation, on the one hand, and failure and social rejection, on the other. In the above example, the decision to return the money to the cashier could easily be explained by the fact that, by demanding the symbolic good "honesty", this individual would obtain an internal reward proportionately greater than the utility provided by the "illegitimate" money. Another possibility, following this line of reasoning, would be that the employee, on discovering his mistake, would reprehend the individual who would then internally pay the price of public shame.

This construct obviously violates the traditional tenets of the neoclassical framework, which state that Man's objective is to obtain greater utility, and leads us on to more complex questions concerning the individual's objective function. In

other words to speak of valuing or devaluing specific symbolic concepts is only meaningful within a theoretical system which seeks to understand human motivations. Thus, we believe that the joint use of economic and psychological analytical tools can provide us with a behavioral model of much greater explanatory power.

Psychology's theoretical systems in particular contain a class of models of personality known as Theories of Self, which establish a relation between symbolic values and the role of the emotions and human behavior. The common element in all definitions of self is to see it as an organizer, which makes behavior consistent. As explained by Marx and Hillix (1987, p. 528), Carl Rogers, one of the pioneers of this theory defines the self as "a structure made up of experiences which the individual is able to attribute to his own body or to the results of his behavior; the self is thus a self image or a becoming conscious of self. Experiences reach us labeled with values; that is, some aspects of the self-image are positive while others are negative (...)".

Theoreticians of self disagree as to how it should best be characterized: as a "central organizer" to which several human dimensions are subordinated, or as a global structure, which should be evaluated as a whole. As noted by Harter (1985), the work by James (1892/1963), Cooley (1902) and Rosenberg (1979) take the latter view, holding that the knowledge of phenomenological experiences is above the evaluation of the self's more discrete characteristics [Harter (1985, p. 62)].

Other authors such as Epstein (1973) and Kelly (1955) consider that the self is best apprehended as a cognitive construct, which relates individual characteristics and attributes. According to Kelly, one of the pioneers of this approach, self-theory was organized into two constructs: a core personal construct, which maintains a person's identity and existence, and a peripheral construct, which can be altered without significant modifications to the structure of the core. Epstein suggested a hierarchical model with self-esteem as an overarching category within which other sub-categories of self are organized: competence, moral self-approval, power, and valuation of love. Each of these divisions in turn includes physical and mental subdivisions. The lowest possible order contains an evaluation of someone's specific skill. The higher the category, the more important it is for the maintenance of self.

As shown by Harter (1985) many theoreticians and clinical psychologists in recent models of self have emphasized the importance of individual effort in constructing an integrated and unified self [Allport (1961), Lecky (1945), and Rogers (1950)]. Allport considered integration, which he called "proprium", to be the most important property of self. The proprium includes all aspects of personality, which make internal unity consistent. Lecky constructed a theory concerning the theme of self-consistency, emphasizing that the individual's behavior consists of the efforts to maintain the integrity and unity of self. Rogers noted that negative sentiments concerning the self increase when the organization of the self-structure is threatened by a perception, which is understood to be inconsistent with the structure.

It is interesting to note that the psychological models of self themselves provide clues as to the primary motivation of the individual, which is the quest for self-

fulfilment.[3] However, achieving this objective, which can never be completely satisfied, depends on the individual's behavior in his search for the integrity and unity of self, which as seen in the preceding paragraphs involves many different dimensions. As Marx and Hillix (1987, p. 520) rightly pointed out, self-fulfilment depends on individuals' abilities to symbolize their experiences and choose paths, which enable them to surpass themselves.

We could also add that the symbolization of these experiences takes place primarily on the emotional plane. For James (1892/1963) emotions such as pride and vanity, as well as shame and mortification, are crucial elements in the construction of self. Cooley (1902) observed that this structuring depends on what we imagine other people are thinking about us, about our appearance, actions etc. Thus, in our network of social relationships, the other plays the role of mirror, what the author called the looking glass self. He made a distinction between positive emotions—such as pride, vanity, self-respect, reverence, confidence and hope—and negative emotions such as shame, mortification, guilt, contrition, self-denial and resentment.

In the literature, pride has generally been understood as a self-reward, the internal counterpart of praise, just as shame corresponds to self-punishment, the counterpart of censure [Batson et al (1988) and Lea and Webley (1996)]. In a broader sense, pride is related to the concept of self-esteem, though not identical to it; it would be more appropriate to understand pride as a source of self-esteem.

Based on the theory of self, and specifically using Cooley's (1902) study as a reference, Scheff (1988), explained that the behavior of conformity is induced by social control. His central thesis is that conformity results from the interaction of the system of deference, or the judgment of an individual by others, with two main sentiments, pride and shame. Individuals feel compelled to conform to external rules by an informal system of reward (external deference and its counterpart internal pride) and punishment (lack of deference, and its counterpart which is internal shame).

It is interesting to observe that the idea that social influence is experienced by individuals as external and restrictive, is not exactly new. Durkheim, for exemple, had already addressed the question, bequeathing us one of the main pillars of modern social thought. Scheff's contribution however, is to help us understand why conformity to rules usually occurs even in the absence of any obvious sanctions, emphasizing the internal mechanism of reward and punishment described by Cooley (1902), on the one hand, and on the other, the external and subtle, albert powerful, control mechanism constituted by embarrassment and social relations, as described by Goffman (1967).

2.3 THE VALUE OF LIFE, SOCIOECONOMIC BONDS AND ADOLESCENCE

In the previous section we described a system, which induces the individual to follow conventional rules through internal mechanisms of reward and punishment

3. Rogers, like Goldstein, believes that the organism has just one goal. It struggles for self-fulfilment, and to surpass and maintain itself [Marx and Hillix (1987, p. 529)].

established by the emotions. However we did not examine the relation between an individual's socioeconomic position and the value which such as individual attaches to specific "symbolic goods" such as: honesty and dishonesty; altruism and self-interest; a sense of self-preservation and a suicidal feeling; respect for the lives of others and a homicidal feeling (which is the central object of the present study) etc.

More specifically, in relation to criminal behavior, Hirsch (1969) inverted the classic question as to its etiology. Instead of asking why some people commit crime, he decided to investigate what leads people not to commit crime. According to this author, who was one of the pioneers of the theory of social control, the great force deterring crime is inside the individual and is related to the individual's degree of involvement and bonds with society and acceptance of the social contract. According to Entorf and Spengler (2002, p. 51): "(...) control theory maintain that persons conform to legal codes because they are banded to society. This bonding can be summarized best by means of the termini 'attachment', 'commitment', 'involvement' and 'belief'". Junger-Tas (1992, p. 26) stress that: "(...) the more individuals are attached to significant others; the more they are committed to values of conventional subsystems: the better they are involved in conventional systems; and the more they believe in conventional values and norms, the more conforming and the less delinquent their behavior will be."

We are assuming that not only are social acceptance and the strengthening of individual socioeconomic bonds crucial for compliance with the social contract, but that they also strongly influence the individual's subjective valuation of his own and other persons' lives. In other words, notwithstanding the fear of punishment, there is no reason for an individual who is excluded from the social contract and possibly socially invisible, to respect the social contract (which presupposes mutual benefits for all in society), or value other persons' lives. Likewise the individual's weak socioeconomic bonds and a virtual social invisibility decisively affect his self-esteem, leading him to despise the value of life itself.

Another decisive factor affecting self-esteem and the individual's valuation of himself and others is his age, and this is especially true during adolescence. Adolescence is known as a period of life during which countless and enormous biological and psycho-social tensions condition not just individual behavior and especially aggressive impulses, but are also fundamental to the process of value formation and acculturation itself.

The group for the Advancement of Psychiatry (1968) stress that in the second phase of adolescence, from 16 to 20, the quest for individual identity occupies a central role. During this period the loosening of bonds with parents and with internalized paternal values result in an outwardly expressed concern with cultural and ideological values and social forces. "One of the risks which the adolescent exposes himself to at this time of life is to grow, reach adulthood and discover that he is on the outside looking in, that nobody seems to need or want him, that there are no gaps he can fill, that there is no place for him. And the danger arises that the adolescent slide into a kind of limbo, an alienation" [Group for the Advancement of Psychiatry (1968, p. 97)]. The end of adolescence is marked, amongst other elements, by the development of a personal system of moral values.

Thus the individual analyzed in this article, whilst rationalizing his decisions aimed at maximizing his utility, also has a system of preferences and values conditioned by his degree of socioeconomic approval and inclusion and his age. This means that the perceived price of life can be explained by a multidimensional vector of variables:

$$P_j = F \text{ (social bonds; economic bonds; age)} \quad (1)$$

Thus the decision to perpetrate an aggression which includes the possibility of loss of lives, is conditioned by enforcement and environmental opportunity variables which, together with the system of internal rewarding and punishment, make up the group of variables which guide the cost-benefit analysis of the person deciding on the action. Figure 1 sets out the group of variables involved in the decision in question and show the effects of the partial derivatives.

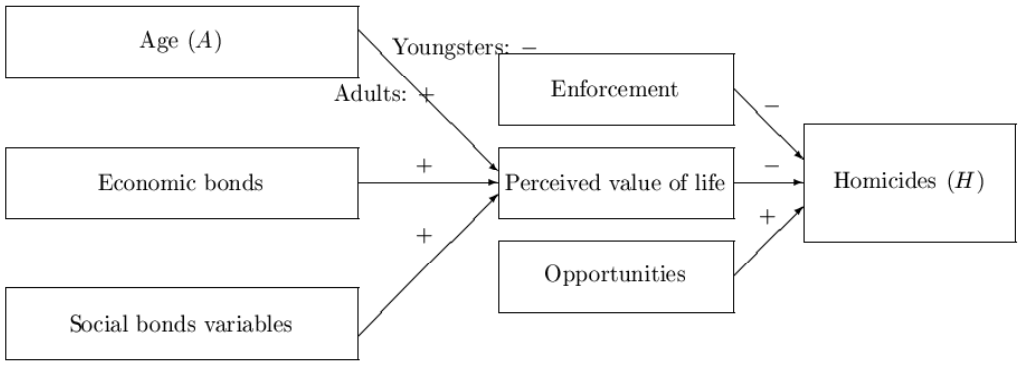


Figure 1: Theoretical Model Diagram.

3 THEORETICAL MODEL

The present approach seeks to explain the economically or interpersonally motivated homicide rate in any given place. Contrary to traditional economic models which presuppose that all individuals take the same set of options into consideration when making a decision, we assume that only a part of the population considers using violence to fulfil themselves, whether to obtain utility through economic gains or to strengthen their self-esteem by settling interpersonal conflicts.

Figure 2 illustrates the two possible decisions, which would probabilistically involve some type of homicide. For an individual who considers committing a crime with economic objectives, there is a probability τ that the action involves a homicide of third persons; a probability ψ that this individual will be caught and punished; and a probability $(1 - \pi)$ that the individual himself will be killed in action. On the other hand an individual who gets involved in a situation of interpersonal conflict (and is thinking of using violent methods to settle the matter) has a probability θ of killing his opponent; a probability ψ of being caught and punished; and a probability $(1 - \varphi)$ of being killed. It is assumed that the probabilities τ, ψ, π, θ and φ are not

controlled by the agent, even though he may be conscious of his mathematical expectations.

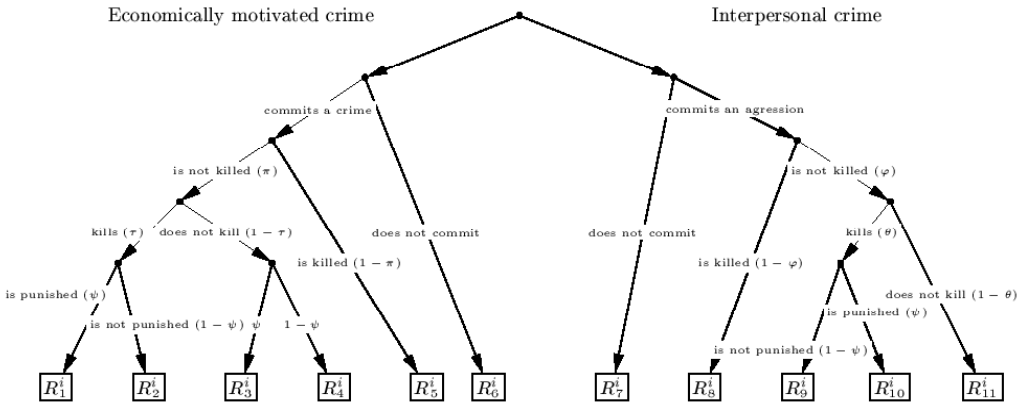


Figure 2: Decision Tree for Homicides.

3.1 THE SELF-FULFILMENT FUNCTION

As we discussed above, the individual aims at self-fulfilment. This can be achieved not only by using the goods and services obtained with his monetary income *R*, but also by means of actions consistent with his system of valuation of symbolic goods. Thus if the individual gets involved in an interpersonal conflict which, for example, includes questions of honor (and of course dishonor)—and he admits using violence to settle the quarrel—his decision will necessarily involve some appraisal of the value of honor, which bolsters his pride and strengthens his self-esteem, and the value of dishonor, which shames him and lowers his self-esteem. He will also appraise the value of person's lives $P^i_{j\neq i}$ and his own life P^i_i, as, probabilistically at least, his action can result in loss of human lives. We define the self-fulfilment function generically as $A = f(R, S, -P^i_j)$. Where R = income; S = symbolic good; and P^i_j is the subjective value (for individual i) of the life of individual j.

3.2 PAYOFFS

The individual who considers entering the market for crime weighs the possibility of obtaining income R^i_w in the legal labor market, against an expected income in the market for crime, which will depend on the crime income P^i_c, the states of nature "being killed or not being killed" and "killing or not killing someone", and "facing the possibility in each of the latter situations of being or not being caught and punished". To commit a crime the individual incurs an operational cost C. If he is caught this individual is punished with a years in prison, if the crime in question involves the death of others, or b years in prison, if there is no homicide, with $a > b$. For simplicity's sake let us assume that the cost of imprisonment for the individual corresponds to the income that he could obtain in the labor market if he were not in prison. Thus we can describe the payoffs associated with the decision to commit or not to commit an economic crime as follows:

$$R_1^i = -aR_w^i - P_j^i - C, \text{ with } i \neq j,$$

$$R_2^i = P_c^i - P_j^i - C, \text{ with } i \neq j,$$

$$R_3^i = -bR_w^i - C,\ R_4^i = P_c^i - C,\ R_5^i = P_i^i - C,\ R_6^i = R_w^i.$$

On the other hand, the individual who becomes involved in an interpersonal conflict considers the possibility of using violent methods as a way of obtaining a symbolic good which restores his pride V^i_c. When the individual, on the contrary avoids a skirmish, even if he feels justified, we assume that he has suffered a loss with value $-V^i_N$. Thus we have the following payoffs:

$$R_7^i = -V_N^i,\ R_8^i = -P_i^i,\ R_9^i = V_c^i - P_{j\neq i}^i,$$

$$R_{10}^i = V_c^i - fR_w^i - P_{j\neq i}^i,\ R_{11}^i = 0,$$

where f is the number of year in jail the criminal will spend in case he is arrested. To simplify the analysis, we assume that, in case he commits the aggression, but he does not kill nor is killed, the implied payoff will be null $R_{11}^i = 0$. In both decisions the individual will choose to use violence, which may be lethal or not, based on a probabilistic distribution, as long as: $E\,[A(\textit{perpetrate})] \geq E\,[A(\textit{not perpetrate})]$.

3.3 NECESSARY CONDITIONS FOR VIOLENCE TO BE PERPETRATED

Given risk neutrality, the necessary conditions for individual i to commit an economic crime are given by

$$\pi\tau\psi A(R_1^i) + \pi\tau(1-\psi)A(R_2^i) + \pi(1-\tau)\psi A(R_3^i) +$$
$$+\pi(1-\tau)(1-\psi)A(R_4^i) + (1-\pi)A(R_5^i) \geq A(R_6^i)$$

$$\Rightarrow P_c^i\pi(1-\psi) - R_w^i[1+\pi\tau\psi(a-b)+\pi\psi b] - C\pi - \pi\tau P_{j\neq i}^i - (1-\pi)P_i^i \geq 0 \qquad (2)$$

Therefore,

$$\frac{\partial Crime}{\partial P_c^i} > 0; \frac{\partial Crime}{\partial R_w^i} < 0; \frac{\partial Crime}{\partial C} < 0; \frac{\partial Crime}{\partial P_{j\neq 1}^i} < 0; \frac{\partial Crime}{\partial P_i^i} < 0$$

The necessary condition for individual i to commit an interpersonally motivated crime is given by

$$(1-\varphi)A(R_8^i) + \varphi\theta(1-\psi)A(R_9^i) + \varphi\theta\psi A(R_{10}^i) + \varphi(1-\theta)A(R_{11}^i) \geq A(R_7^i).$$
$$\Rightarrow -(1-\varphi)P_i^i - \varphi\theta P_{j\neq i}^i + \varphi\theta V_c^i - \varphi\theta\psi fR_w^i + V_N^i \geq 0, \qquad (3)$$

and the partial derivatives are

$$\frac{\partial Aggression}{\partial P_i^i} < 0, \frac{\partial Aggression}{\partial V_c^i} > 0, \frac{\partial Aggression}{\partial R_w^i} < 0, \frac{\partial Aggression}{\partial P_{j\neq i}^i} < 0, \frac{\partial Aggression}{\partial V_N^i} > 0.$$

Therefore, the probability that one commits a homicide depends on the set of variable described below:

$$H_i = g(P_i^i, P_{j\neq i}^i, P_c^i, C, V_c^i, R_w^i, V_N^i).$$

However, according to equation (1), the prices P_i's are function of social bonds, economic bonds and age. Therefore, we can rewrite

$$H_i = h\,(social\ \ bonds,\ economic\ \ bonds,\ age, P_c^i, C, V_c^i, R_w^i, V_N^i). \tag{4}$$

In the empirical exercise presented in Section 6, we run several regression models to study the relevance of the right-hand-side variables in the equation above to explain the occurrence of homicides in Brazilian municipalities.

4 MAPPING HOMICIDES IN THE MUNICIPALITIES

In the spatial econometric modeling used henceforth we estimated regressions in which the logarithm of the homicide rate in each municipality is the dependent variable and socioeconomic information taken from the Municipal Information Database [Base de Informações Municipais (BIM)] of the Brazilian Geography and Statistics Institute [Instituto Brasileiro de Geografia e Estatística (IBGE)] are the independent variables. In order to calculate the homicide rate for Brazil's municipalities, we used the absolute figures for intentional homicide, obtained from the System of Information on Mortality [Sistema de Informações sobre Mortalidade (SIM)], the official data from Ministry of Healthy, covering the period 1999 to 2001. A first idea would be simply to use this absolute number as a dependent variable in the model's equations. However this type of procedure does not allow for differences in the municipalities' size, in terms of numbers of residents and households or total area.

A more detailed analysis must take these differences into consideration and find a common denominator for the number of homicides, as is usually the case in studies of comparative criminology and epidemiology.

In the latter, for example, the numbers of deaths from cancer or the number of women with diabetes are analyzed. In these studies, the number of people with disease is divided by the number of people in the relevant group in each area. In our case the idea would be to divide the number of homicides by the number of residents in each municipality, in order to measure the risk of occurrence. Therefore a first estimate of the risk of homicide in each municipality would be simply.

$$r_i = \frac{v_i}{n_i},\ i = 1, 2, ..., N. \tag{5}$$

where r_i is the risk or the rate of occurrence of intentional homicides, v_i the absolute number of homicides between the years 1999 to 2001, n_i is the number of residents in municipality i and N = 5,507 is the number of municipalities in Brazil, for the year 2000.

However, this is not necessarily the most appropriate way of calculating the relative rate of occurrence, especially when, according to the Year 2000 Census, many municipalities have few residents. In these situations more advanced techniques must be used to avoid the problems caused by the existence of sparsely populated municipalities. In the present study, we used several procedures taken from epidemiology studies as presented in Clayton (1987) and Breslow and Clayton (1993).

The approach used here to calculate the risks or rates of occurrence of homicides is based on Bayesian hierarchical techniques or mixture models. We assume that the number of occurrences observed in each municipality has a Poisson distribution with an average population $n_i \times r_i$. The rates r_i have a lognormal distribution, with parameters μ and σ^2. We opted for a lognormal distribution because conceptually this means that the logarithms of the rates r_i have a normal distribution, and in order to be consistent with the econometric models used in the following sections.

From the number of homicides v_i and the number of inhabitants n_i in each municipality, we obtained the posterior distributions for the parameters μ and σ^2, and the posterior distributions for risks r_i, using Gibbs sampler [see Gelman *et al* (2000) and Tanner (1996)]. Finally, the estimations of the homicide occurrences $\hat{r}_i$, which shall be used in the following sections for the econometric modeling, are the averages of the posterior distributions for r_i.

Figure 3 allows us to visualize that the greatest probabilities of victimization are to be found in metropolitan areas. This has been widely pointed out by specialists and reports in the media. Thus, out of the 127 municipalities with a rate of victimization higher than 50 per one hundred thousand inhabitants, 51 belong to metropolitan areas, and 44 of these municipalities are located in the Southeast. It is also noteworthy that just eight states account for these high rates of victimization. Lethal violence in the municipalities of the Center-West is less in evidence, but this is possibly due to the region's lower population density, with the small absolute numbers of victims, providing a mistaken impression of "social peace". The State of Pernambuco stands out in this respect with lethal crime present in practically all municipalities, and not just those in metropolitan areas, with the violence extending to municipalities like Petrolina in the western part of the state.

Figure 4 shows the rate of victimization for young males between 15 and 24. One can observe that this map of violence is practically the same as the preceding one, showing how closely related the two crime dynamics are. The clearest difference between the overall rate of risk and the rate of risk for young people is to be found in the states of the Center-West and Roraima. The problem of victimization of young people is particularly dramatic in the metropolitan areas of Rio de Janeiro, São Paulo and Espírito Santo.

Figure 3: Map of Homicide Rates for the whole Population.

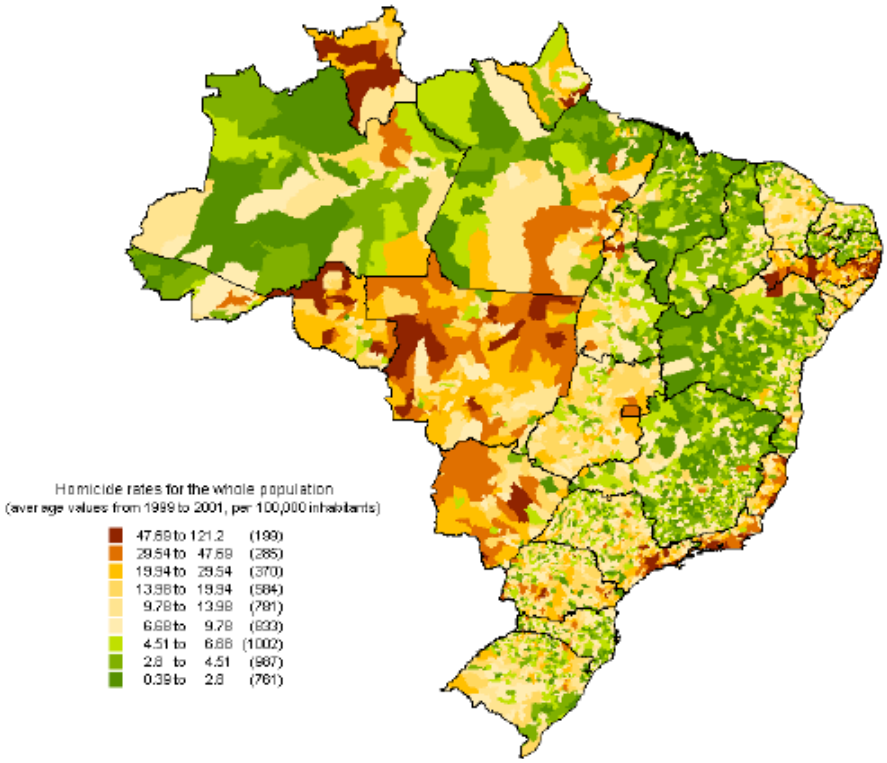
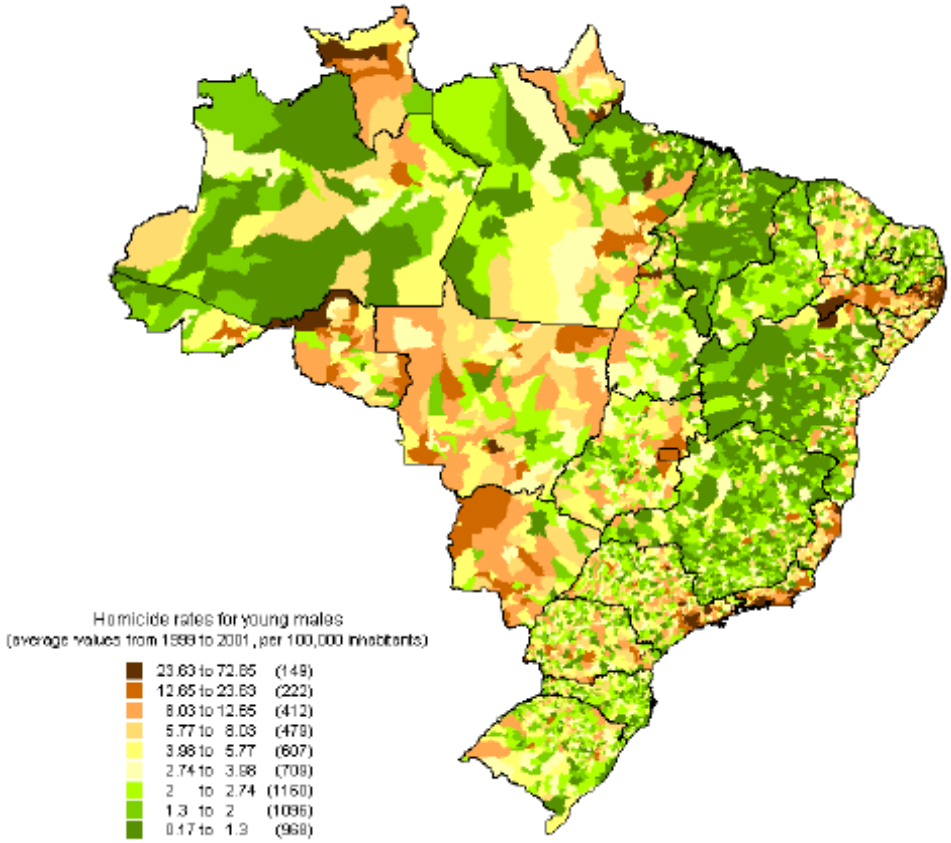


Figure 4: Map of Homicide Rates for Young Males.



5 ECONOMETRIC METHODOLOGY

In Section 3, we developed a theoretical model in order to explain homicide motivation at the individual level, emphasizing the role of individual perceptions about society values. The model points out that the probability of one to commit a homicide increases with one's relative individual deprivation, and this effect is more pronounced for teenagers. Thus, a higher proportion of individuals who suffer relative deprivation and a higher proportion of teenagers will imply a higher incidence of homicides.

In this section, we develop an econometric exercise to test the hypothesis that a higher proportion of teenagers and a higher amount of social exclusion would imply a greater violence incidence, in particular homicides—see equation (4). Due to the spatial nature of the observations used in our empirical study, we expect the homicide rate in each municipality to be correlated with the homicide rates in the neighboring municipalities. It is also possible that the covariates of any given municipality may affect not only its own homicide risk but also the risks in neighboring municipalities.

Given the possibility of spatial autocorrelation, it may not be appropriate to use simple linear regression models. The presence of spatial autocorrelation not only affects the estimate of the variance-covariance matrix, but can also bias the estimates due to model misspecification. In order to account for spatial interactions in the data we used spatial regression models, suggested in Anselin (1988), LeSage (1999), and Anselin and Florax (1995). We now present a succinct description of the models used, and then extend the spatial models to accommodate the presence of heterocedasticity in the residuals.

5.1 SPATIAL AUTOCORRELATION MODELS

The first model used is a linear regression including a spatial autoregressive term in order to capture the effects of the neighboring municipalities. LeSage (1999) calls this model a mixed spatial autoregressive-regressive model, which has the following specification:

$$Y = \rho WY + X\beta + \varepsilon, \tag{6}$$

where ε is a $N \times 1$ vector of non-observable residuals, following a multivariate normal distribution with mean 0 and covariance matrix $\sigma^2 I_N$, Y is a $N \times 1$ vector with the dependent variable data for the N municipalities in the sample, ρ is a scalar spatial autoregressive coefficient, X is a $N \times k$ matrix, with k covariates for Y, β is a $k \times 1$ vector of coefficients, σ^2 is the variance of the residuals, and I_N is the $N \times N$ identity matrix. Given the variance-covariance matrix $\sigma^2 I_N$, it can be concluded that ε is a vector of independent and identically distributed residuals. The parameters ρ, β and σ^2 are unknown and have to be estimated from the data.

The matrix W is known as a contiguity matrix, and shows how close to each other the municipalities in the sample are. Let W^* be the matrix whose element (i, j) is 1, if the municipalities i and j are neighbors, and 0 if they are not. The main diagonal of W^* is by definition 0. The matrix W is constructed from W^* by dividing the elements of each line of W^* by the sum of the elements of the line. Thus each line

of W adds up to 1. This definition of W means that the i^{th} row of ρWY shows how the value of its neighbor's dependent variable affect the value of the dependent variable y_i in municipality i. Note the similarity between the construction in equation (6) and the autoregressive models normally used for time series.

LeSage (1999) calls the second model considered in this article a spatial autoregressive errors model. This model has the following specification:

$$Y = X\beta + u, \quad \text{where} \quad u = \lambda Wu + \varepsilon \tag{7}$$

The residuals vector ε has a multivariate normal distribution with mean 0 and covariance matrix $\sigma^2 I_N$. Note that the spatial autocorrelation is modeled directly on the regression residuals $u = [u_1\ u_2\ \ldots\ u_N]'$. In this case, the non-observed residuals are spatially autocorrelated with an autoregressive coefficient λ. This construction is analogous to time series regressions, with autocorrelated residuals.

5.2 BAYESIAN APPROACH

Given the specifications presented in equations (6) and (7) above, the estimation can be performed using, for example, maximum likelihood estimators. The advantage of using these estimators is that they are easy to compute. In general the maximum point of the log-likelihood function can be found using an interactive procedure in which it is necessary, at each step, to carry out maximization with just one free parameter. Statistical inference can then be performed based on observed information matrix, obtained numerically or analytically. See Anselin (1988), Anselin and Florax (1995) and LeSage (1999) for more details.

In the following section we will use the models in equations (6) and (7) to study the relation between crime, specifically the occurrence of homicides, and socioeconomic variables. In this case the dependent variable will be the logarithm of the estimated risks $\hat{r}_i$, calculated from the number of occurrences in each municipality i, as described in Section 4. It is possible that the accuracy of these estimates varies according to the number of inhabitants in each municipality. In this case heteroscedasticity is to be expected in the vector of residuals ε both in the mixed spatial autoregressive-regressive model and in the spatial autoregressive errors model.

We thus need to reformulate models in equations (6) and (7) in order to capture the possible presence of heteroscedasticity in ε. The covariance matrix for ε will no longer take the form $\sigma^2 I_N$, and will be replaced by a more general form $\sigma^2 V$, where V is a diagonal matrix with dimension $N \times N$. The elements of $\sigma^2 V$'s main diagonal give the variance of each component of ε. The estimation of this more general model using a maximum likelihood approach is a much more complex task. In this article we decided to use Bayesian procedures, as described in Barry and Pace (1999), Pace and Barry (1998) and LeSage (1997 and 1999).

The mixed spatial autoregressive-regressive model, with the presence of heteroscedasticity, has the following specification:

$$Y = \rho WY + X\beta + \varepsilon, \text{ where } \varepsilon \sim N(0, \sigma^2 V),\ V = \text{diag}(v_1, v_2, \ldots, v_n) \tag{8}$$

To estimate the model in equation (8) we obtained a posterior distribution of unknown parameters, by using the MCMC (Markov Chain Monte Carlo) procedure.[4] The a prior distributions in this case are:

$$\beta \sim N(c,\ T),\ \sigma\ \sim \frac{1}{\sigma},\ \ \zeta \sim \Gamma(m,k),\ \ \frac{\zeta}{v_i} \sim ID\ \frac{\chi^2(\zeta)}{\zeta} \quad i = 1, ..., N$$

where $N(c,\ T)$ is a multivariate normal distribution with a prior average c and a prior variance-covariance matrix T, and $ID\,\chi^2(\zeta)$ is a N x 1 vector of independent chi-squares distributions:

with ζ degrees of freedom, σ^2 is a improper prior distribution for the parameter σ, and $\Gamma(m,k)$, is a gamma distribution with parameters m and k. Similarly, the model with autoregressive spatial errors can be extended to accommodate the heteroscedasticity in the following way:

$$Y = X\beta + u, \text{ where } u = \lambda Wu + \varepsilon,\ \varepsilon \sim N(0,\ \sigma^2 V),\ V = \text{diag}\,(v_1, v_2, ..., v_n) \qquad (9)$$

In the next section we will discuss an application of models in equations (8) and (9) in order to study the relation between the logarithm of estimated homicide occurrence $\hat{r}_i$ and variables which describe the municipalities' socioeconomic structure.

6 EMPIRICAL RESULTS

In this section we present the main econometric results using specifications based on the theoretical formulation in Section 3. Our aim is to study how socioeconomic factors affect the risks of occurrence of homicide in the country's municipalities. To this end we used the logarithm of estimated risks $\log \hat{r}_i$, $i = 1, 2, \ldots, N$, as the dependent variable for the N municipalities of the sample. The results presented here were obtained from a mixed autoregressive-regressive spatial model with heteroscedastic residuals ε, according to specification (8). We also estimated a model with spatial autoregressive errors as in equation (9). For this second model, the elasticity estimates were very similar to those in model (8) and thus were not included in this article.

The explanatory variables were taken from the BIM of the IBGE. The socioeconomic information refers to the year 2000, the period during which the homicides occurred. The following variables were included in logarithms: *a*) employment rate; *b*) average wages in business establishments; *c*) proportion of households without a toilet; *d*) proportion of young people in the population (15 to 24); *e*) proportion of population in urban areas; *f*) proportion of poor children (proportion of individuals from 0 to 14, whose per capita household income is lower than 1/2 a minimum wage; *g*) proportion of children not attending school; *h*) proportion of adolescent parents (proportion of female adolescents between 15 and 17, who have children); *i*) proportion of illiterate children; *j*) Gini Index (which measures income inequality); and *l*) intensity of poor people (the gap between household per capita income of poor persons and the

4. For more details, see Tanner (1996).

poverty line, measured as a percentage of the value of this poverty line). With the exception of the employment rate we expected all the relations between the probability of victimization and the other variables to be positive. The average wage in business establishments was included in the model in order to characterize the opportunity of committing crimes for economic reasons. Thus it would be expected that there would be a greater probability of victimization in regions with lower wages. Together with the preceding variables we included several dummy variables to capture regional (differences). We added dummies for municipalities in all metropolitan areas and specific dummies for the large metropolitan areas: Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo and Porto Alegre. Finally due to differences between states in the SIM records and the lack of information concerning the organization of the police and judiciary, and therefore the probability of punishment, we included dummies for all states. After estimating a saturated model (for all states), we kept only the significant state dummies.

Columns 2 and 4 of table show the results of the linear regression, with the parameters estimated via minimum ordinary squares. Columns 5 and 7 of the same table depict the results of the mixed autoregressive-regressive spatial model, derived from equation (8), where the parameters were estimated according to the Bayesian procedure described in Subsection 5.2. In the case of the mixed autoregressive-regressive spatial model, the table presents an additional parameter; the spatial autoregressive coefficient ρ. We obtained a statistically significant estimate for this parameter equal to 0.382. The significance of ρ indicates the presence of spatial autocorrelation between the homicides rate in the several municipalities in the country.

We can use the theoretical discussion of Sections 2 and 3 to interpret results shown in table. Considering the blocks of variables described in Figure 1, relating to socioeconomic bonds we included the following variables in the empirical model: the employment rate, proportion of households without a toilet, proportion of poor children, proportion of children not attending school, proportion of adolescent parents, proportion of illiterate children, intensity of poor people and the Gini Index. In all cases, the parameters were statistically significant and confirmed expectations. An increase in social disorganization leads to an increase in the rate of homicide, and this may be a consequence of the low value afforded to life (the person's own life and that of others). In this respect it is interesting to observe the magnitudes of the elasticities found and particularly the enormous influence of income inequality on the dynamic of homicides.

LINEAR REGRESSIONS WITH AND WITHOUT SPATIAL AUTOCORRELATION

Explanatory variable	Simple linear model			Regressive-autoregressive spatial mixed model		
	Estimate	Std. error	Value-p	Estimate	Std. error	Value-p
Intercept	2.442	0.320	0.000	1.253	0.298	0.000
UF 12 – Acre	–1.025	0.114	0.000	–0.748	0.111	0.000
UF 13 – Amazonas	–0.949	0.075	0.000	–0.646	0.074	0.000
UF 15 – Para	–1.010	0.054	0.000	–0.803	0.058	0.000
UF 16 – Amapá	–0.566	0.128	0.000	–0.418	0.147	0.003
UF 17 – Tocantins	–0.600	0.054	0.000	–0.434	0.054	0.000
UF 21 – Maranhão	–1.099	0.055	0.000	–0.741	0.055	0.000
UF 22 – Piauí	–0.853	0.054	0.000	–0.551	0.052	0.000
UF 23 - Ceará	–0.497	0.055	0.000	–0.346	0.053	0.000
UF 24 - Rio Grande do Norte	–0.615	0.053	0.000	–0.418	0.051	0.000
UF 25 - Paraíba	–0.713	0.051	0.000	–0.524	0.051	0.000
UF 26 - Pernambuco	0.383	0.053	0.000	0.276	0.051	0.000
UF 27 - Alagoas	–0.210	0.064	0.001	–0.168	0.063	0.004
UF 28 - Sergipe	–0.292	0.068	0.000	–0.225	0.071	0.001
UF 29 - Bahia	–0.968	0.044	0.000	–0.678	0.045	0.000
UF 31 - Minas Gerais	–0.900	0.033	0.000	–0.610	0.036	0.000
UF 35 - São Paulo	–0.478	0.036	0.000	–0.354	0.038	0.000
UF 41 - Paraná	–0.398	0.039	0.000	–0.299	0.039	0.000
UF 42 - Santa Catarina	–0.748	0.044	0.000	–0.501	0.044	0.000
UF 43 - Rio Grande do Sul	–0.420	0.044	0.000	–0.289	0.044	0.000
UF 52 - Goiás	–0.377	0.043	0.000	–0.278	0.043	0.000
Employment rate	–0.040	0.015	0.008	–0.043	0.014	0.001
Average wage[a]	0.053	0.007	0.000	0.053	0.007	0.000
Prop. households without a toilet	0.027	0.010	0.010	0.021	0.010	0.014
Prop. youngsters	0.769	0.150	0.000	0.543	0.137	0.000
Prop. urban population	0.000	0.021	0.994	0.022	0.019	0.120
Prop. poor children	0.202	0.036	0.000	0.157	0.033	0.000
Prop. children not attending school	0.069	0.016	0.000	0.042	0.015	0.003
Prop. adolescents with children	0.076	0.015	0.000	0.048	0.013	0.000
Prop. illiterate children	0.055	0.022	0.012	0.050	0.020	0.006
Gini index	2.167	0.140	0.000	1.537	0.131	0.000
Intensity of poor people	0.452	0.067	0.000	0.314	0.062	0.000
Dummy metropolitan areas	0.151	0.035	0.000	0.087	0.033	0.004
Dummy MA Recife	0.485	0.143	0.001	0.163	0.122	0.088
Dummy MA Salvador	–0.412	0.164	0.012	–0.265	0.165	0.051
Dummy MA Belo Horizonte	0.069	0.081	0.400	0.014	0.079	0.429
Dummy MA Rio de Janeiro	0.722	0.124	0.000	0.402	0.105	0.000
Dummy MA São Paulo	0.962	0.090	0.000	0.598	0.084	0.000
Dummy MA Porto Alegre	–0.050	0.099	0.618	–0.015	0.091	0.436
Spatial autocorrelation coefficient	------	------	------	0.382	0.017	0.000

[a] It corresponds to the average wage in business establishments.

The variable used for the age block was the proportion of young people in the municipality's population and its elasticity was found to be positive, confirming the hypothesis that age is an important factor in the homicide rate. The age structure's influence on homicides is also fundamental, second only to income inequality. In the empirical model's block of variables entitled "opportunities", we included average wages[5] and the urban proportion of the municipality's population (presenting better opportunities for criminal action). As can be observed, the elasticities of both variables were positive. However, the effect of the urban population on homicides was reduced by the inclusion of metropolitan dummies, which probably absorbed some of that effect making this variable non significant. As mentioned above, the problem of the absence of "enforcement" variables was minimized by the inclusion of dummies.

The only metropolitan area dummies, which were negative, were those for Salvador and Porto Alegre and the latter was not statistically significant. In spite of Porto Alegre's metropolitan area negative dummy coefficient of –0.050, the dummy coefficient for overall metropolitan areas was 0.151. Thus the net effect for the Porto Alegre area was still positive in terms of the occurrence of homicide. In Salvador's case the estimate's negative sign (even after adding the 0.151 coefficient for metropolitan areas as a whole) may be due to the lack of reliable SIM data for this metropolitan area. Thus it is interesting to note that the empirical results of this section are compatible with the theory with all elasticities calculated showing the expected signs, according to the theoretical model presented in Section 2.

7 FINAL COMMENTS

In this article we develop a theoretical framework to explain the homicide rate in any given place, which can be attributed to economic or interpersonal motivations. In the main equation, homicides are not only explained by the probability of punishment and income in the legal and illegal markets, but also by the cultural environment and prevailing ethical-normative system and by the individual's age group and socioeconomic bonds. It is assumed that a greater degree of socioeconomic vulnerability leads to weaker bonds between individuals and the social contract and dominant culture, and a lower valuation of their own and other persons' lives. Thus the homicide rate in a given region can be explained by individual attributes such as socioeconomic bonds and age, and also by "enforcement" variables and the environmental opportunities that favor crime.

In order to study this theoretical proposal empirically we develop a Bayesian model with a spatial structure covering 5.507 Brazilian municipalities between the years 1999 and 2001, where we calculate the risk of an individual resident in a municipality suffering homicide. This variable is confronted with a vector of structural socioeconomic variables, in order to obtain homicide elasticities in relation to these latter variables and the effect of spatial dependency in explaining the risk of

5. The idea is that an increase in accessible wealth through some type of extortion gives the criminal an incentive to commit an illegitimate act. In many cases this act can lead to the death of the victim or the criminal himself, causing an increase in the aggregate rate of violence.

victimization in that particular place. The results suggest that there is evidence to support the theoretical propositions.

The present study can be extended in different ways in order to obtain a better understanding of the factors, which influence crime, mainly violent crime. In this article we use a cross-section analysis of the data, obtaining a static photograph of patterns of crime in several Brazilian municipalities. However it would also be interesting to have a dynamic analysis of the geographical evolution of violence. In this case space-time econometric models can be used. On the other hand, the modeling presented in Section 2 can be refined theoretically, in order to obtain computer models, which can be used to reproduce (or explain) the aggregate behavior observed in the municipal homicide data. The authors are presently investigating these extensions.

BIBLIOGRAPHY

ALLPORT, G. *Pattern and growth in personality*. New York: Holt, Hinehart & Wisdom, 1961.

ANSELIN, L. *Spatial econometrics: methods and models*. Dordrecht: Kluwer Academic Publishers, 1988.

ANSELIN, L., FLORAX, R. *New directions in spatial econometrics (advances in spatial science)*. Springer-Verlag, 1995.

BARRY, R., PACE, R. A Monte Carlo estimator of the log determinant of large sparse matrices. *Linear Algebra and its Applications*, v. 289, n. 1-3, p. 41-54, 1999.

BATSON, C. *et al*. Interpersonal relations and group processes. *Journal of Personality and Social Psychology*, v. 55, n. 1, p. 52-77, 1988.

BEATO, C., REIS, I. Desigualdade, desenvolvimento socioeconômico e crime. *Desigualdade e pobreza no Brasil*. Rio de Janeiro: IPEA, 2000.

BECKER, G. Crime and punishment: an economic approach. *Journal of Political Economy*, v. 76, p. 169-217, 1968.

BLOCK, M., HEINECKE, J. A labor theoretic analysis of the criminal choice. *American Economic Review*, v. 65, p. 314-325, 1975.

BRESLOW, N., CLAYTON, D. Approximate inference in generalized linear mixed models. *Journal of the American Statistical Association*, v. 88, n. 421, 1993.

BREWER, M. B., HEWSTONE, M. *Emotion and motivation*. Oxford, UK: Blackwell Publishing Ltd., 2004.

CANO, I., SANTOS, N. *Violência letal, renda e desigualdade no Brasil*. Rio de Janeiro: 7 Letras, 2001.

CANTOR, D., LAND, K. Unemployment and crime rates in the post-world War II United States: a theoretical and empirical analysis. *American Sociological Review*, v. 50, p. 317-332, 1985.

CERQUEIRA, D., LOBÃO, W. *Condicionantes sociais, poder de polícia e o setor de produção criminal*. IPEA, 2003 (Texto para Discussão, 957).

———————. Determinantes da criminalidade: arcabouços teóricos e resultados empíricos. *Dados — Revista de Ciências Sociais*, Rio de Janeiro, v. 47, n. 2, p. 233-270,2004*a*.

———————. Criminality, socioeconomic environment and police: government challenges. *Revista de Administração Pública* (RAP), Rio de Janeiro, Fundação Getulio Vargas, v. 38, n. 3, p. 371-400, 2004b.

CLAYTON, D. Empirical bayes estimates of age-standardized relative risks for use in disease mapping. *Biometrics*, v. 43, p. 671-681, 1987.

COHEN, D. Culture, social organization, and patterns of violence. *Journal of Personality and Social Psychology*, v. 75, p. 408-419, 1998.

COOLEY, C. *Human nature and the social order*. New York: Charles Scribner's Sons, 1902.

EHRLICH, I. Participation in illegitimate activities: a theoretical and empirical investigation. *Journal of Political Economy*, v. 81, p. 521-565, 1973.

———————. Crime, punishment, and the market for offenses. *Journal of Economic Perspectives*, v. 10, p. 43-67, 1996.

ENTORF, H., SPENGLER, H. *Crime in Europe—causes and consequences*. Springer: Germany, 2002.

EPSTEIN, S. The self concept revisited or a theory of a theory. *American Psychologist*, v. 28, p. 405-416, 1973.

FAJNZYLBER, P., LEDERMAN, D., LOAYZA, N. Determinants of crime rates in Latin America and the world: an empirical assessment. *World Bank Latin American and Caribbean Studies*. Washington, DC: World Bank, 1998.

GELMAN, A. *et al*. *Bayesian data analysis*. Chapman and Hall/CRC, 2000.

GLAESER, E., SACERDOTE, B. Why is there more crime in cities?. *Journal of Political Economy*, v. 107, p. 225-258, 1999.

GLAESER, E., SACERDOTE, B., SCHEINKMAN, A. *Crime and social interactions. Quarterly Journal of Economics*, v. 111, n. 2, 1996.

GOFFMAN, E. Interaction ritual. *Essays on face-to-face behavior*. New York: Pantheon Books, 1967.

GROUP FOR THE ADVANCEMENT OF PSYCHIATRY . *Dinâmica da adolescência. Aspectos biológicos, culturais e psicológicos*. São Paulo: Cultrix 1968.

HARTER, S. Competence as a dimension of self-evaluation: toward a comprehensive model of self-worth. In: LEAHY, R., L. (ed.). *The development of the self*. New York Academic Press, p. 55-121, 1985.

HIRSCHI, T. *Causes of delinquency*. Berkeley, CA: University of California Press, 1969.

JAMES, W. *Psychology*. New York: Fawcett, 1963 (original work published in 1892).

JEVONS, W. A teoria da economia política. São Paulo: Abril Cutural, 1983. (Os Economistas, translation of *The Theory of Political Economy*. 1871.)

JUNGER-TAS, J. An empirical test of social control theory. *Journal of Quantitative Criminology,* v.8, p. 9-28, 1992.

JUNIOR, A., FAJNZYLBER, P. *O que causa a criminalidade violenta no Brasil? Uma análise a partir do modelo econômico do crime: 1981 a 1996*. Cedeplar/Face/UFMG, 2001 (Working Paper).

KELLY, G. *The psychology of personal constructs*. New York: Norton, 1955.

LAND, K., CANTOR, D., RUSSEL, T. Unemployment and crime rate fluctuations in the post-World War II United States: statistical time series properties and alternative models. In: HAGAN, J., PETERSON, R. D. (eds.). *Crime and inequality*. Stanford: Stanford University Press, 1994.

LEA, S. E. G., WEBLEY, P. Pride in economic psychology. *Journal of Economic Psychology*, v.18, p. 323-340, 1996.

LECKY, P. *Self-consistency: a theory of personality*. New York: Island Press, 1945.

LeSAGE, J. P. Bayesian estimation of spatial autoregressive models. *International Regional Science Review*, v. 20, n. 1-2, p. 113-129, 1997.

————————. *The theory and practice of spatial econometrics*. Department of Economics, University of Toledo, 1999.

LEUNG, S. Dynamic deterrence theory. *Econômica*, n. 62, 1995.

LOFTIN, C., McDOWALL, D. Regional culture and patterns of homicide. *Homicide Studies*, v. 7, n. 4, p. 353-367, 2003.

LYNCH, J. Crime in an international perspective. In: WILSON, J. Q., PETERSILIA, J. (eds.). *Crime*. San Francisco: ICS Press, p. 11-38, 1995.

MARX, M., HILLIX, W. *Sistemas e teorias em psicologia*. São Paulo: Cultrix, 1987.

MERTON, R. Social structure and anomie. *American Sociological Review*, v. 3, p. 672-682, 1938.

MESSNER, S., BLAU, J. Routine leisure activities and rates of crime: a macro-level analysis. *Social Forces*, v. 65, p. 1.035-1.052, 1987.

NISBETT, R. E. Violence and U.S. regional culture. *American Psychologist*, v. 48, p. 441-449, 1993.

PACE, R., BARRY, R. Simulating mixed regressive spatially autoregressive estimators. *Computational Statistics*, v. 13, p. 397-418. 1998.

PAIXÃO, A. Crime, controle social e consolidação da democracia. In: REIS, F. W., O'DONNELL, G. (eds.). *A democracia no Brasil*. São Paulo: Vertice, 1988.

PARK, R., BURGESS, E., McKENZIE, R. (eds.). *The city*. The University of Chicago Press, 1925/1967.

PARROTT, W. G. The nature of emotion, chapter one. In: BREWER, M. B., HEWSTONE, M. (eds.). *Emotion and motivation*. Oxford UK: Blackwell Publishing, 2004.

POSADA, C. Modelos economicos de la criminalidad y la possibilidad de una dinamica prolongada. *Planeacion y Desarrollo*, n. 25, 1994.

ROGERS, C. The significance of the self-regarding attitudes and perception. In: REYMERT, M. L. (ed.). *Feelings and emotions: the Mooseheart Symposium*. New York: McGraw-Hill, 1950.

ROSENBERG, M. Conceiving the self. New York: Basic Books, 1979.

SAH, R. Social osmosis and patterns of crime. *Journal of Political Economy*, v. 99, 1991.

SAMPSON, R. The community. In: WILSON, J. Q., PETERSILIA, J. (eds.). *Crime*. San Francisco: ICS Press, p. 193-216, 1995.

————————. Collective regulation of adolescent misbehavior: validation results from eighty Chicago neighborhoods. *Journal of Adolescent Research*, v. 12, p. 227-244, 1997.

SAMPSON, R., GROVES, W. Community structure and crime: testing social-disorganization theory. *American Journal of Sociology*, v. 94, p. 774-802, 1989.

SAMPSON, R., WOOLDREDGE, J. Evidence that high crime rates encourage migration away from central cities. *Sociology and Social Research*, v. 70, p. 310-314, 1986.

SCHEFF, T. Shame and conformity: the deference-emotion system. *American Sociological Review*, v. 53, n. 3, p. 395, 1988.

SEN, A. *Sobre ética e economia*. São Paulo: Companhia das Letras, 1999.

SIMON, H. Rationality in psychology and economics. *The Journal of Business*, v. 59, n. 4, 1986 (Part 2: *The Behavioral Foundations of Economic Theory*).

SOROKIN, P. *Sociedade cultura e personalidade—sua estrutura e dinâmica. Sistema de sociedade geral*. São Paulo: Globo, 1968.

SUTHERLAND, E. H. Development of the theory. Private paper published posthoumosly. In: SCHUESSLER, K. (ed.): *Edwin Sutherland on analyzing crime*. Chicago: Chicago University Press, p. 30-41, 1942/1973 (revised edition).

TANNER, M. *Tools for statistical inference, methods for the exploration of posterior distributions and likelihood functions*. Springer Series in Statistics, 1996.

WALRAS, L. *Compêndio dos elementos de economia política pura*. São Paulo: Abril Cultural, 1983. (Os Economistas, translated from *Abrege des Elements d'Economie Politique Pure 1938*).

ZALUAR, A. *A máquina e a revolta. As organizações populares e o significado da pobreza*. São Paulo: Brasiliense, 1985.

ZHANG, J. The effects of welfare programs on criminal behavior: a theoretical and empirical analysis. *Economic Inquiry*, v. 35, p. 120-137, 1997.

Ipea – Institute for Applied Economic Research

PUBLISHING DEPARTMENT

Coordination
Cláudio Passos de Oliveira

Supervision
Everson da Silva Moura
Reginaldo da Silva Domingos

Typesetting
Bernar José Vieira
Cristiano Ferreira de Araújo
Daniella Silva Nogueira
Danilo Leite de Macedo Tavares
Diego André Souza Santos
Jeovah Herculano Szervinsk Junior
Leonardo Hideki Higa

Cover design
Luís Cláudio Cardoso da Silva

Graphic design
Renato Rodrigues Buenos

The manuscripts in languages other than Portuguese published herein have not been proofread.

Ipea Bookstore

SBS – Quadra 1 – Bloco J – Ed. BNDES, Térreo
70076-900 – Brasília – DF
Brazil
Tel.: + 55 (61) 3315 5336
E-mail: livraria@ipea.gov.br

Composed in Adobe Garamond 11/13.2 (text)
Frutiger 47 (headings, graphs and tables)
Brasília – DF – Brazil

Ipea's mission
Enhance public policies that are essential to Brazilian development by producing and disseminating knowledge and by advising the state in its strategic decisions.

ISSN 1415-4765

ipea Institute for Applied Economic Research

Secretariat of Strategic Affairs

BRAZILIAN GOVERNMENT BRASIL