Institutions and criminality: evidence from São Paulo State

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Área 10 - Economia Regional e Urbana

Abstract
The institutional quality of a region has been pointed as one of the main determinants of its economic development in the recent literature. One potential channel relating these two variables is the criminality level because good institutions foster legal productive activities and increase the costs of illegal ones, which is central to investment decisions. Due to the lack of studies relating both variables with Brazilian dataset, the purpose of this study is to measure the effects of one aspect of institutions – its enforcement – on the criminality level of the municipalities of São Paulo State. Since criminality level is relatively high in São Paulo State in relation to other regions with similar level of economic development, it is important to understand its causes. The Instrumental Variable (IV) method has been used to estimate the relationship between institutional quality and the level of criminality to deal with the reverse causality problem. It is necessary to consider the causality problem because the level of criminality may affect income per capita, and the latter has a potential to influence institutional quality. Additionally, we have considered the spatial effects on the estimations since it is unlikely that criminality and other variables among the municipalities are spatially independent. The results of the present paper indicate that institutional quality is an important determinant of robbery rate in the municipalities of São Paulo State, even when taken into consideration the influence of many other variables that can affect it, as schooling, income inequality, poverty and criminality inertia.
Key words: institutions; economic development; criminality. JEL: C36; O17; R58

1. Introduction

The economic growth and development literature highlights the importance of institutions in the economic development process (Rodrik et al., 2004; Acemoglu, Johnson and Robinson, 2001 and 2002; North, 1991). Some studies relating the quality of institutions and development highlight the role of property rights. Acemoglu, Johnson and Robinson (2001), Hall and Jones (1999) and North (1991) argue that more secure property rights are essential to foster investments in physical and human capital, and productivity. One potential way in which property rights affect the level of economic development is via criminality. Gary Becker, in his 1968 seminal paper, elaborated a model where the criminality level in a region is a consequence of the property rights enforcement, and the latter is related to the regional degree of institutional quality. The crucial assumption in Becker's model is that individuals are rational even when choosing to participate in illegal activities, i.e., they engage in them when their expected benefits are greater than their expected costs.

In a study based on England and Wales dataset, Vollaard and Hamed (2012) found that one variable related to enforcement (police number) is related to victim-reported property crime and violent crime. Taking advantage of the Collective Clemency Bill passed by the Italian Parliament in 2006, Drago, Galbiati and Vertova (2009) find that an exogenous variation in prison sentence is important in former inmates`s propensity to recommit a crime. By means of the terror alert level in Washington D.C. set by the Department of Homeland Security to deal with the reverse causality problem, Klick and Tabarrok (2005) show that the level of crime decreases during high alert periods. Pudney, Deadman and Pyle (2000) found evidence of enforcement (conviction, imprisonment and sentence length) in both short and long-term incidence of residential burglary in England and Wales even when considering measurement error and the effects of other variables. Wong (1995) finds results that points to the relevance of economic variables in criminality in Whales. For the American cities over one hundred thousand inhabitants, Sampson (1986) find evidence that local official sanctions have important deterrence effects (high risk of jail incarceration) on robbery offending.

In addition, the quality of institutions has a potential impact on criminality Ievel via income inequality. Engerman and Skoloff (2002) and Acemoglu, Johson and Robinson (2002, 2001) argued and presented evidence that inequality in initial endowment during the period of the American Continent colonization was crucial to the quality of their early institutions. In the Southern regions of the continent, extractive institutions were developed, where a concentration of economic and political power was the rule. In contrast, in the Northern ones, the initial institutions where beneficial to most of the population, having a more egalitarian society. The initial income distribution would persist through time because of the institutional inertial (Acemoglu, Johson and Robinson, 2002).

Despite the importance of the literature that relates the influence of institutional quality on economic development, there are few studies measuring the channels in which the former affects the latter for the Brazilian case. Brazil offers a valuable case study since its criminality rate is a critical problem. For example, Ferroni (2014), based on 2010 database, presented evidence that the Brazilian average homicide rate is almost 4 times higher in relation to the world average, and it also higher than the average of the Latin American countries. Since the criminality rate is one potential channel linking institutional quality and economic development level, we propose to study the effects of institutional quality on the former via São Paulo State municipalities' dataset. Institutional quality is a multidimensional concept; thus, we have construct an indicator that captures the dimension that is related to costs and benefits of criminal activities: an enforcement measure. Data for homicide rates are available for all the Brazilian municipalities, but since the Becker's model is more adequate for property crimes and our enforcement variable is constructed on the number of reported property crimes and the number of opened investigations, which are accessible only for the São Paulo state's municipalities in a comparable database, the empirical analysis are based on the latter.

Because criminality level has a potential effect on economic development level via investment rate, and the latter has influence on institutional quality, we have employed the Two Stage Least Square Method (2SLS) to circumvent the reverse causality problem. The instruments are those pointed in the literature as being important in the establishment of initial institutions: geographical and racial instruments. To the knowledge of the authors, this is the first study to take advantage of instruments that are traditional in the institutional literature to circumvent the reverse causality problem between criminality and enforcement. Additionally, since the data indicates that robbery rates are geographically correlated, it is necessary to consider spatial correlation in the estimations. If this problem is ignored, the estimates will be biased and inconsistent (LESAGE, 2008).

In the 2SLS, the instruments are longitude and proportion of white and yellow population in each municipality in 2000. Following Lamounier (2007), São Paulo State colonization was influenced by coffee plantation in its east region called "Parahyba Valley" with intensive use of slavery. In 1888, with the end of slavery in Brazil and the increase influx of Europeans immigrants, the coffee march to the state's west were based mainly on free labor with great influence of European workforce and culture. In addition, the land concentration was more intense in the municipalities of the Parahyba Valley in relation to those of the west of the state (LAMOUNIER, 2007), which have influenced the formation of their initial institutions and, by the institutional inertia, the quality of the current institutions.

The empirical results point to the importance of enforcement on robbery rates. When considered variables that captures the influence of labor market conditions, economic development level, social environment, and the crime rate inertia, a 10% increase in enforcement leads to a reduction in robbery rate from 7.5% to 23%, when considering the reverse causality problem and the spatial effects, which is a considerable effect. In the OLS regressions with robust standard errors, the results indicate that unemployment raises robbery rates. In the specifications with all regressors, a 10% increase in unemployment leads to a 3.7% rise in the dependent variable. Considering the spatial effects and the reverse causality problem, variables related to the level of economic development, as schooling and urbanization rate, seem to have a positive effect in robbery rate, with is in line with Buonanno and Montolio (2008) and Bennett (1991) findings. The estimated

results also point to importance of the inertia criminality rates across the municipalities of São Paulo State. However, contrary to the findings of many empirical results, the income inequality indicators estimated coefficients were not statistically different from zero.

Besides this introduction, the present paper is followed by Section 2 that describes the specification to be used in the empirical analysis, the estimation methods, and the dataset. Section 3 is divided in two subsections: the first with the preliminary results with an analysis based on descriptive statistics and on dispersion diagrams; and the second with the econometric results and their interpretations. The last section points to the main results of the present study.

2. Variables, Method and Data

Becker (1968) considers criminality levels from an economic perspective. According to him, individuals are rational and act in such a way. Therefore, the decision to commit a crime is related to the level of expected utility, which depends on its return and risks in relation to those of lawful activities. From the theoretical framework developed by Becker (1968), from recent empirical studies in the economic literature focusing on the determinants of crime (Fajnzylber, Lederman and Loayza, 2002; Wong, 1995), and adding the institutional quality variable, a potential econometric specification is expressed in equation (1):

(1) $$lnRobbery_i = \theta_0 i_n + \theta_1 lnEnfRobbery_i + \theta_2 lnlagRobbery_i + X'\beta_i + \varepsilon_i$$

Where $Robbery_i$ is the index that captures the crime incidence in municipality i (average robbery rate from 2001 to 2004), β_i indicates the $k \times 1$ parameter vector associated with observation i, where k is the number of explanatory variables, X_i is a $n \times k$ matrix of explanatory variables that affect the decision to engage in criminal acts by individuals, e.g., level of per capita income, schooling of the population, unemployment rate, participation rate in the labor market, proportion of young population, proportion of teenage mothers, incidence of poverty, income inequality, urbanization rate, and the municipality population size. The lagged criminality rate ($lagRobbery_i$) captures its inertia from one period to the other in municipality i (average robbery rate from 1997 to 2000). In addition to the above variables, $EnfRobbery$ is introduced to capture the effects of institutional quality on the level of property crime (robbery rate) in São Paulo State municipalities, and ε_i denotes a stochastic disturbance.

Because the concept of institutions is multidimensional, the focus in the present study is in its aspect that is more directly related to the level of criminality: law enforcement. Better institutions tend to be related to higher degree of law enforcement, raising the costs of illegal activities. The latter reduces the criminality level. Following Levitt (1998): "The most fundamental prediction of the economic approach is that changes in expected punishment will influence criminal behavior" (p. 1158). In the present study, the focus is on the effects of law enforcement on criminality level as in Figure 1:

Figure 1 – Relationship between quality of institutions and criminality level

Source: author's elaboration.

The level of criminality in the municipalities of São Paulo State is measure by the number of robbery per one hundred thousand inhabitants [1]. Therefore, it was constructed one enforcement measure: the average number of theft opened investigations divided by the average number of reported thefts from 1997 to 2000 ($EnfRobbery$). The criminality data is from São Paulo State's Secretary of Public Security and they are available in the São Paulo State's System of Data Analysis Foundation (SEADE Foundation) website.

The total number of opened investigations is the administrative procedure instituted to prove the materiality and authorship of a crime [2]. Therefore, a higher number of opened investigations in relation to the number of reported crimes increases the probability of punishment. The following equation illustrate the enforcement indicator:

(2) $$EnfRobbery = \frac{Number\ of\ theft\ opened\ investigations\ (average\ 1997-2000)}{Number\ of\ reported\ thefts\ (average\ 1997-2000)}$$

The variable that captures the enforcement for robbery rate is based on theft data because if it were based on robbery data, municipalities with higher reported robberies would tend to have less enforcement by construction. Therefore, the negative relationship between reported robbery and enforcement would be induced artificially. The enforcement indicator is based on the average number of 1997-2000 period to reduce the noise from one year to the other since small municipalities have none or a small number of registered robbery in a single year. We have chosen to study the effects of enforcement on robbery since its reporting rates are more reliable in relation to theft ones.

Since criminality level has a potential effect on investment rate and, consequently, in economic development, and the latter has influence on institutional quality, the Two Stage Least Square Method (2SLS) in indicated to circumvent the reverse causality problem. Therefore, the quality of institutions or enforcement measure, in the present study, is estimated in the first stage following equation (3):

(3) $$lnEnfRobbery_i = \alpha_0 i_n + \alpha_1 lnlagRobbery_i + X'\beta_{1,i} + \boldsymbol{Z}'\psi_i + \varepsilon_i$$

where Z is a matrix of instruments that were selected based on the institutional literature: geographical and racial instruments; and ψ_i indicates the $z \times 1$ parameter vector associated with observation i, where z is the number of instruments. The second stage is the estimation of Equation (1) with the predict institutional or enforcement variable from Equation (3) as a regressor:

(4) $$lnRobbery_i = \theta_0 i_n + \theta_1 ln\widehat{EnfRobbery}_i + \theta_2 lnlagRobbery_i + X'\beta_{2,i} + \varepsilon_i$$

where $ln\widehat{EnfRobbery}$ is the estimated $EnfRobbery$ from Equation (3). Additionally, since the data indicates that robbery rates are geographically correlated, it is necessary to consider this possibility in the estimations by means of the spatial regression methodology, since this problem can distort the results via spatial error correlation or omitted variable bias (LeSage, 2008). In a simple equation model as:

(5) $$y_i = \alpha_0 + \alpha_1 x_i + u_i$$

the spatial influence comes from the error term ($u = \lambda W u + \varepsilon$), the regressors ($y = X\beta_1 + WX\beta_2 + \varepsilon$), the regressand ($y = \rho W y + X\beta_1 + \varepsilon$) or from a combination of them. Therefore, there are several ways to capture the spatial effect across municipalities. The spatial weight matrix W is of dimension $n \times n$, where n is

[1] We are using the word robbery as the act of stealing by means of threat or intimidation, while theft as the act of stealing without the victim realizing the action.

[2] This definition is from the Crime Statistics Interpretation Manual of the São Paulo State's Secretary of Public Security - Coordination of Analysis and Planning (CAP). Available on www.ssp.**sp**.gov.br/media/documents/manual_interpretacao.pdf (accessed on December 02, 2016).

the number of observations, and each one represents a region or municipality. The non-zero elements in the row i and column j of the matrix W indicate that the municipality j is a neighbor to the municipality i.

In the present study, we have estimated the equations by means of the Spatial Autoregressive Model (SAR) and Spatial Autoregressive Confused Model (SAC) methods. These were chosen based on the AIC and BIC selection criteria [3]. The spatial dependence in the regressand (robbery rate) is indicated by the rho (ρ) coefficient, as in the following equation (SAR):

(6) $lnRobbery_i = \theta_0 i_n + \rho WlnRobbery + \theta_1 ln\widehat{Enf Robbery}_i + \theta_2 lnlagRobbery_i + X'\beta_i + \varepsilon_i$

or (SAC):

(7) $lnRobbery_i = \theta_0 i_n + \rho WlnRobbery + \theta_1 ln\widehat{Enf Robbery}_i + \theta_2 lnlagRobbery_i + X'\beta_i + u_i$

where lambda (λ) captures the spatial dependence in the error term:

(8) $u_i = \lambda Wu + \varepsilon_i$

Regarding the regressors, the level of income per capita, schooling of the population and degree of urbanization were added to capture the municipalities development level. Shelley (1981 cited in Bennett, 1991) offered a hypothesis that when economic development takes place in a region, youth migrate to urban areas. Because of the weaker personal, family and community ties in cities, criminal rates increase with economic development. Bennett (1991), based on a dataset of 117 countries from 1960 to 1984, found results that economic development raises property crime rate (the number of intentional and unlawful removals of another's property such as robbery, burglary and minor theft) until a threshold point. After this, economic development does not influence theft rate. Based on panel dataset of 46 Spanish provinces over the period from 1993 to 1999, Buonanno and Montolio (2008) find evidence that urbanization rate is positive related to property crime rates. Based on survey that was conducted between June and November 1998 in seven region of São Paulo state (15,000 domiciles in 104 cities), Gomes and Paz (2008) found evidence that burglary or larceny victimization is positive related to family education and income. However, the probability burglary or larceny victimization was increasing in income only to families classified as upper middle class, with the probability being higher for families in the upper middle class in relation to the ones in the rich income range.

To consider the labor market conditions effects on criminality, we have used participation rate on the labor market and unemployment rate. Doyle, Ahmed and Horn (1999) find evidence supporting the importance of labor market – measured by wage, participation and unemployment rates, and unemployment compensation – on property crimes. A higher participation and a lower unemployment rates are related to better opportunities in the job market, which a possible reduction in property crimes. By means of the General Method of Moments (GMM), Doyle, Ahmed and Horn (1999) results indicate that higher unemployment rate is important in property crime intensification. Gould, Weinberg and Mustard (2002), based on a dataset of less educated men from 1979 to 1997, also find evidence of labor market variables (wages and unemployment) influence on criminality in the United States, and Lin (2008) also found evidence supporting the importance of unemployment rate in property crime in the USA. The results of Buonanno and Montolio (2008) suggest that young unemployment is a good predictor of property crime in Spain. By a dataset from Greece, from 1991-1998, Saridakis and Spengler (2012) find that unemployment is crucial to understand property crime rates.

The social municipalities environment is captured by variables such as income inequality, incidence of poverty, the proportion of young (from 15 to 24 years old) on the population, proportion of young mother and the municipality population size. Theses variables are pointed out as influential in criminality in both economic and sociological studies. From an economic perspective, income inequality places side by side people with low and high returns from economic activities. Therefore, it increases the returns of time spend on robbery and

[3] The tests results are in the annex.

theft (Kelly, 2000). Glaeser (1994) points out that inequality impels part of the population to the marginalization of productive activities, forcing them to survive by means of illegal ones. From a sociological standpoint, income inequality generates frustration in low income people, inducing them to the practice of criminal activities (Merton, 1938, cited in Kelly, 2000). Land, McCall, and Cohen (1990, cited in Kelly, 2000) point to income inequality and poverty, unemployment and other causes of deprivation as causes of social disorganization and, therefore, criminality level.

In addition, the literature has a great deal of evidence relating income inequality and criminality level. For instance, Murray, Cerqueira and Kahn (2013), in a review of several studies conducted in different countries, highlight that the rise in inequality in Latin American countries has been a potential factor to explain their homicide rate increase while Soares (2004) points to importance of inequality in raising theft and contact crime across countries. In a cross-country analysis, Fajnzylber, Lederman and Loayza (2002) find that inequality is positively related to robbery and homicide rates. Kelly (2000), based on data from the US counties, found that income inequality is an important determinant of violent crime. For the American cities with population over 100,000, Sampson (1986) find that income inequality and poverty incidence are predictors of robbery and homicide. Justus and Kassouf (2008), in a comprehensive literature review of the determinants of crime in Brazil, conclude that variables such as income inequality and spatial effects are important to understand criminality levels. In contrast to the above cited studies, Doyle, Ahmed and Horn (1999) did not find any independent significant effect of income inequality on property crime, based on US dataset.

The proportion of teenager mother in a region is one variable related to the family environment. Nagin, Pogarsky and Farrington (1997) offer three explanations of how adolescent motherhood may increase the probability of crime involvement in offspring: 1) the lack of capacity and maturity of being a good parent "life course-immaturity account"; 2) the worst suited to be parents have children at younger age due to the lack of self-control, or early childbearing may be related to disproportionally match where both parents lack the skills to be a good parent, reinforcing bad behavior patterns "persistent poor parenting-role modeling account"; and 3) lack of resources of teenager mother as scarcity of financial resources, "cultural objects, personal attention, teaching and supervision pictures, and music, personal attention, teaching and supervision, and participation in activities that allow the child to interact with the outside world" (Blake 1981 cited in Nagin, Pogarsky and Farrington, 1997, p. 146), leading to bad consequences in the child development "diminished resources account". Nagin, Pogarsky and Farrington (1997) empirical findings point to the importance of persistent poor parenting-role modeling account and the diminished resources account as important channels linking teenager motherhood and crime involvement in offspring.

By means of a multivariate logistic regression analysis, Nagin and Tremblay (2001) present evidence that low education of the mother and teenage motherhood increases the probability of the maintenance of boys' high aggression trajectory from 6 to 15 years of age: "The odds of male offspring of poorly educated teenage mothers not desisting from a high level of physical aggression at age 6 years are 9.3 times greater than those of their counterparts without such mothers" (p. 393). Nagin and Tremblay (2001) find that only the characteristics of the mother have predictive power in such trajectories.

The proportion of young population (from 15 to 24 in the present study), has been pointed as one of the determinats of criminality rate since its is well documented in the literature that teenage and young people tend to commit more crime. For example, Cohen and Land (1987) show that people from 15 to 24 years old have higher much rates of arrest for motor vehic theft then other age groups for the years of 1960 and 1980 in the United States. For nonnegligent homicide arrest, the rate is higher for the age group from 20 to 29 in 1960 and from 15 to 29 in 1980 (COHEN and LAND, 1987). However, in a review of 90 studies, Marvell and Moody Jr. (1991) find that only a small fraction of them consistently have results indicating a significant relationship between crime rates on age structure

Two instruments were added to control for the reverse causality problem between the enforcement measure and criminality rate. Because a good institutional environmental is crucial to a higher law enforcement, instruments that are related to the former may also affect the latter. Therefore, we have made use of instruments that are traditional in the institutional and development literature, as the proportion of white and yellow population, and longitude of the São Paulo State municipalities. These are related to geography and history of the municipalities and pointed as important variables in the establishment of the initial set of institutions in cross-country studies (Rodríguez-Pose, 2013; Dmitriev, 2013; Eicher and Leukert, 2009; Acemoglu, Johnson and Robinson, 2005, 2002, 2001; Engerman and Sokoloff, 2002; Hall and Jones, 1999).

São Paulo State colonization was influenced by coffee plantation in its east region called "Parahyba Valley" with intensive use of slavery and in lands already settled where sugar cane was previously cultivated. This was the region where coffee plantations were first brought in southeastern Brazil by the end of the eighteenth century (JAMES, 1932). Between 1850 and 1860, the coffee plantations become more important in the municipalities in de middle west of the state (old west) in relation to the Parahyba Valley region (JAMES, 1932). The former region was also influenced by slavery in the coffee plantations, but to a lesser extent. Eisenberg (1989 cited in Lamounier, 2007) estimated that almost 30% of the population in these two regions was formed by slaves in the nineteenth century.

In the second half of the nineteenth century, with the end of the international slave trade in Brazil, the use of free labor in the São Paulo State's coffee plantations from other parts of the country became more usual, and the incentives for European immigration to increase the supply of free labor were intensified (LAMOUNIER, 2007). In 1888, with the end of slavery in Brazil and the increase influx of Europeans immigrants, the coffee march to the state's west were based mainly on free labor with great influence of European workforce and culture. Bassanezi et al. (2008) estimated that in 1890, 5.4% of the São Paulo State's population were composed of immigrants, and in 1900, this percentage reached 21.0%. The immigration from Italy was the most important in that period, followed from Germany and Spain (BASSANEZI ET AL., 2008). In addition, Lamounier (2007) emphasizes that the land concentration was more intense in the municipalities of the Parahyba Valley in relation to those of the western regions of the state. Therefore, the immigration in the western municipalities of São Paulo state were formed in greater proportion of free and European labor force in relation to those of the Parahyba Valley and in the middle west of the state, which have influenced the formation of their initial institutions and, by the institutional inertia, the quality of the current institutions.

3. Results

3.1. Preliminary results

Table 1 provides the descriptive statistics. The first two variables are the excluded instruments (those only in the first stage). Longitude is the absolute value of longitude, and the proportion of white is the sum of white and yellow descents divided by the total population of the municipality, in 2000. These instruments are related to geography and ethnicity, variables that had influenced the initial kind of crops plantation, the slavery or free labor proportion in the plantations and land ownership inequality. Consequently, they had impact on the formation of the initial set of conventions and rules (ENGERMAN and SOKOLOFF, 2002).

Even in only one state, it is noticeable the variation in the proportion of white plus yellow descents in the population across municipalities (from 25% to 88%). Because of the size of the state, there is not much variation in longitude across the municipalities. However, it has a high correlation with our enforcement measure. In Table 1, it is possible to observe an increase in ln schooling, ln GDP per capita and in the ln proportion of urban population, from 1991 to 2000. The higher level of economic development was associated with a reduction in poverty, but with a higher values of ln Gini and ln Theil indexes, ln proportion of teenage mothers and in ln municipalities population size. All of them have a potential positive effect on criminality.

Table 1- Descriptive Statistics

Variable	*Median*	*Mean*	*Std. Dev.*	*Min*	*Max*
Instruments					
Proportion of white	68.30	66.98	10.35	25.70	88.50
Longitude	48.63	48.64	1.73	44.32	53.06
Variables to capture the level of economic development					
ln GDP per capita 1991	6.03	6.00	0.35	4.96	7.08
ln GDP per capita 2000	6.25	6.25	0.31	5.32	7.47
ln School 1991	0.40	0.41	0.08	0.20	0.76
ln School 2000	0.52	0.53	0.09	0.33	0.88
ln Proportion of Urban Population 1991	4.33	4.26	0.31	2.74	4.61
ln Proportion of Urban Population 2000	4.43	4.37	0.23	3.07	4.61
Variables to capture labor market conditions					
ln Participation Rate 2000	4.05	4.04	0.08	3.59	4.22
ln Unemployment Rate 2000	2.60	2.53	0.40	0.69	3.42
Variables to capture the social environment					
ln Proportion of Teenager Mother 1991	0.81	0.81	0.66	-1.56	3.32
ln Proportion of Teenager Mother 2000	1.13	1.03	0.61	-0.97	2.55
ln Proportion of Child of School 1991	2.91	2.89	0.36	1.02	3.87
ln Proportion of Young 2000	2.93	2.93	0.42	-1.22	6.35
ln Proportion of Poverty 1991	3.10	3.02	0.66	1.03	4.50
ln Proportion of Poverty 2000	2.65	2.63	0.54	-0.36	4.10
ln Population size 1991	9.24	9.40	1.34	6.62	16.08
ln Population size 2000	9.36	9.54	1.39	6.68	16.16
ln Theil Index 1991	3.78	3.77	0.29	2.77	4.93
ln Theil Index 2000	3.83	3.81	0.24	3.00	4.76
ln Gini Index 1991	3.91	3.91	0.13	3.43	4.39
ln Gini Index 2000	3.93	3.93	0.11	3.56	4.33
Indicators of enforcement					
ln EnfRobbery (1997-2000 average)	2.84	2.85	0.76	0.00	4.72
Indicators of criminality level					
ln Robbery Rate (1997-2000 average)	3.88	3.83	1.48	0.00	7.06
ln Robbery Rate (2001-2004 average)	3.98	4.00	1.48	0.00	7.04
ln Theft Rate (1997-2000 average)	6.16	6.08	0.76	0.00	7.63
ln Theft Rate (2001-2004 average)	6.48	6.40	0.68	0.00	7.97

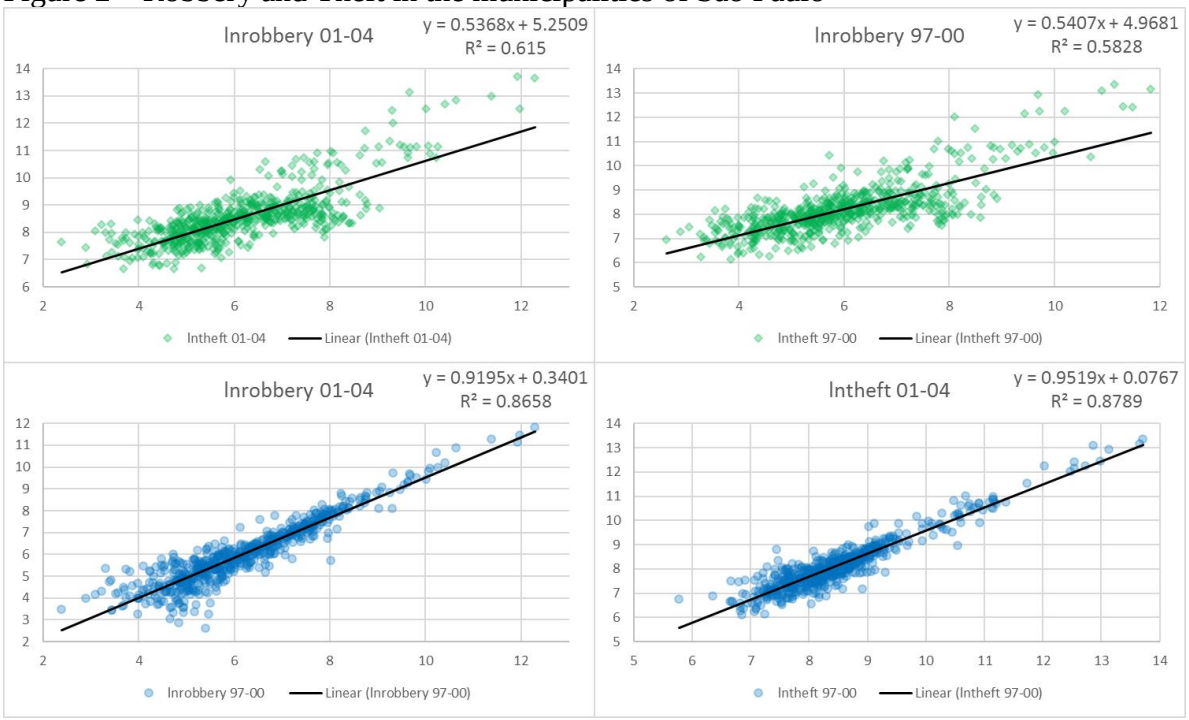
Notes: The instruments are in level. All other variables are in natural logarithm.

In the upper part of Figure 2, it is possible to note the strong correlation between the natural logarithms of robbery and theft. In its upper left-hand side is the scatterplot of both variables for the 2001-2004 period, while in its upper right is their relation for the 1997-2000 period. In Figure 2, it is possible to conclude that, on average, those municipalities with higher robbery rates are the same with more theft per one hundred thousand inhabitants and vice-versa. The correlation coefficient is somewhat stronger in 2001-2004, but in both periods, it is close to 0.60. Therefore, the enforcement indicator of robbery using theft data seems appropriate.

In the lower part of Figure 2, it is possible to check the strong correlation within each variable through time (left for ln robbery and right for ln theft), with is consistent with previous studies that show a strong inertia in criminality rates. For example, Fajnzylber, Lederman and Loayza (2002) find a strong inertia in robbery and murder rates in a study of 39 countries in the period 1965-1995. Buonanno and Montolio (2008), for the

Spanish provinces, also find an important inertial effect on serious and minor crime rates. Justus and Kassouf (2008), in a literature review for the studies with Brazilian dataset, points to the importance of inertia in criminality rates in several of them. In the present study, one of the most important variables to explain current rate of criminality is its previous period rate.

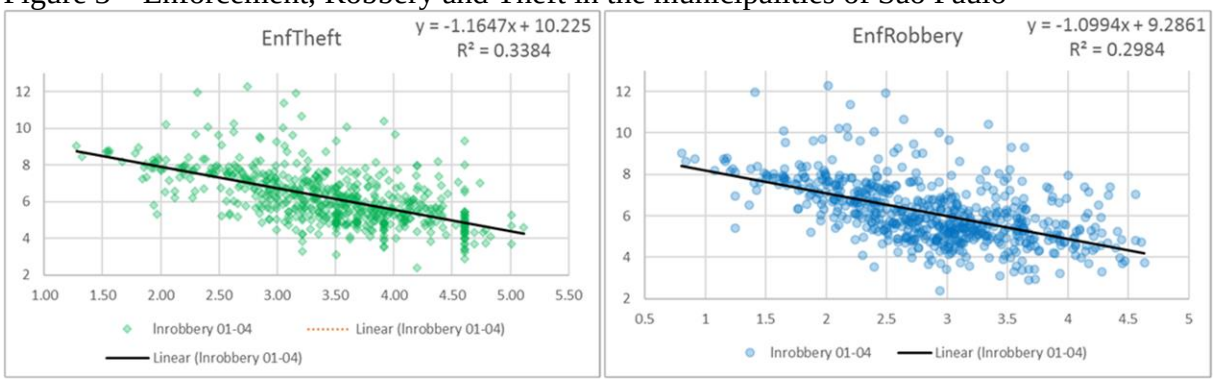
Figure 2 – Robbery and Theft in the municipalities of Sao Paulo



Source: Author's elaboration based on São Paulo State's Secretary of Public Security dataset available from SEADE Foundation.

In Figure 3, it is possible to observe the relationship between the enforcement measures and the criminality rates (both variables are in natural logarithm). The rate of robbery has only a slightly higher correlation with the enforcement indicator built on robbery data (EnfTheft) in relation to the one based on theft data (EnfRobbery), and the slope coefficients have almost the same magnitude, a little bit higher than one in absolute value in both cases. Because the variables are in natural logarithm, a 1 % increase in enforcement has a more than proportional negative effect on robbery rate.

Figure 3 – Enforcement, Robbery and Theft in the municipalities of Sao Paulo



Source: Author's elaboration based on São Paulo State's Secretary of Public Security dataset available from SEADE Foundation.

3.2. Econometric results

3.2.1. OLS results with robust standard errors

Table 2 brings the results of the Ordinary Least Square (OLS) method. The explained variable is robbery by 100.000 inhabitants, and the explanatory variable we are most concerned about is institutional quality (the enforcement measure). The latter is the number of theft opened investigations divided by the number of thefts (EnfRobbery). The other variables are usually reported as important determinants of criminality, as discussed in the previous section. In Table 2, the estimated results point to the importance of enforcement in deterring robberies in São Paulo State municipalities. In Column (1), the only explanatory variable is the enforcement measure, and its estimated coefficient points that a 1% increase in the later reduces crime by about 1.04%. What is striking in Table 2 is that this variable alone explains about 30% of the variation in robberies rates across municipalities.

In Column (2), the unemployment rate and the labor force participation rate are included as explanatory variables to capture the effects of labor market condition on robbery. As expected, higher rates of unemployment lead to more robberies, while the participation rate has the opposite expected sign. However, with the inclusion of additional control variables, the participation rate estimated coefficients turn to not significant, as can be observed from Columns (3) to (7) of Table 2. In the other hand, unemployment rate remains positive and significant in all specifications. A 10% increase in later leads to approximately 3,7% robbery outbreak in the results with all the explanatory variables – Columns (6) and (7), with is in line with Saridakis and Spengler (2012). They find evidence supporting a positive link between unemployment and property crime in Greece: "The GMM (short-run) estimates of the unemployment rate range from 0.236 to 0.866 suggesting long-run unemployment elasticities of 0.76, 0.81 and 1.45 for breaking and entering, theft of motor cars and robbery, respectively." (p. 171).

The estimations with the inclusion of variables related to the level of municipal development, as GDP per capita and average schooling level, are presented in Column 3. Both seem to affect criminality positively. One possible explanation is that in municipalities with higher development, the expected return of robbery is also higher, as argued by Becker (1968) and in line with the results of Bennett (1991). Nevertheless, with the addition of more explanatory variables, both variables become not significant, as shown in the subsequent columns of Table 2.

In Column (4) estimations, it is added the variables that capture the social environment. The proportion of teenage mother and proportion of families living in poverty capture families' vulnerability. Both variables do not have a significant effect on robbery rate in most specifications, with the same results for income inequality indexes (Gini and Theil) and the proportion of urban population (urban 2000). The proportion of young population (from 15 to 24 years old) has a positive and statistically significant effect on robbery in all specifications; a 10% increase in the proportion of young population leads to a rise in robbery rate from 1.4 to 2.8%. With the introduction population size (population 2000) and past robbery rate by 100,000 habitants (average from 1997 to 2000), in the fifth and sixth columns, with the latter added to capture the inertia effect, there are a noticeable increase in the coefficient of determination. Both variables have positive and significant estimated coefficients, pointing to their importance in robbery rate determination. The inclusion of both reduces the estimated coefficients of enforcement in absolute value, but they remain statistically different from zero at a 5% level.

Considering Table 2 results, the measure of institutional quality appears to be relevant in understanding robbery rates in São Paulo state's municipalities. Besides the inertial effect, the variables that has consistently shown an effect on crime rate are the unemployment rate, the proportion of young population and the municipalities' population size.

Table 2 – OLS estimations – robberies as the dependent variable

Robbery Dependent Variable: Robbery rate (2001-2004) - OLS – *Robust Standard Errors*							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Enforcement	-1.0394	-0.7417	-0.5734	-0.5418	-0.3365	-0.1488	-0.1489
	(0.1027)***	(0.0914)***	(0.0774)***	(0.0784)***	(0.0743)***	(0.0707)**	(0.0707)**
Unemployment 2000		1.3155	1.0316	1.0008	0.6995	0.3747	0.3727
		(0.1365)***	(0.1371)***	(0.1469)***	(0.1444)***	(0.1389)***	(0.1388)***
Participation 2000		4.2363	0.7458	0.6945	0.5149	0.0734	0.0678
		(0.6044)***	(0.7433)	(0.8039)	(0.7458)	(0.6154)	(0.6139)
Schooling 2000			2.4137	3.0387	-0.5297	0.0565	0.0465
			(0.8940)***	(0.9621)***	(0.9632)	(0.8010)	(0.7954)
GDP-PC 2000			1.2805	1.0881	0.8756	0.0677	0.0500
			(0.2901)***	(0.5925)**	(0.5592)	(0.4105)	(0.4127)
Proportion of Young (15-24)				0.2771	0.2193	0.1404	0.1409
				(0.0800)***	(0.0718)***	(0.0797)*	(0.0796)*
Young Mother 2000				0.1434	0.0556	0.0619	0.0630
				(0.0744)*	(0.0708)	(0.0595)	(0.0597)
Poverty 2000				-0.1063	-0.1749	-0.2377	-0.2469
				(0.2278)	(0.2015)	(0.1522)	(0.1524)
Gini 2000				0.1712	-0.3619	0.3747	
				(0.8099)	(0.7789)	(0.5969)	
Theil 2000							0.1891
							(0.2790)
Urban 2000				-0.3327	-0.5166	-0.1609	-0.1623
				(0.2740)	(0.2533)**	(0.1878)	(0.1857)
Population 2000					0.4739	0.1745	0.1748
					(0.0492)***	(0.0412)***	(0.0407)***
Robbery 97-00						0.5682	0.5682
						(0.0443)***	(0.0441)***
Constant	6.9618	-14.3311	-9.2792	-8.1113	-5.1729	-1.7402	-0.8195
	(0.2990)***	(2.5825)***	(2.4576)***	(3.4913)**	(3.2735)	(2.5595)	(2.3508)
Adj. R^2	0.2833	0.4384	0.5369	0.5438	0.6036	0.7301	0.7301

Notes: Unemployment is for 10 years old or more. Schooling is the human capital proxy (H). Standard errors are in parentheses. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

One problem in Table 2 estimations is that they do not take into consideration the reverse causality problem. The level of criminality may affect income per capita via allocation of productive resources into unproductive ones, and by raising the costs of productive activities and, consequently, reducing investment rates. In its turn, income per capita has a potential to influence institutional quality, and the latter, the enforcement degree. Therefore, the reverse causality problem should be considered, since the OLS estimators may be biased and inconsistent if this is the case.

3.2.2. Two Stage Least Square (2SLS) with robust standard errors

Table 3 reports the Two Stage Least Square (2SLS) results to circumvent the reverse causality problem. The excluded instruments for the São Paulo State municipalities are the proportion of white plus yellow population and longitude. The specifications are similar to those in Table 2 with the difference being the estimation method (2SLS instead of OLS), the lagged explanatory variables (from 1991 census instead of 2000) to reduce the potential of endogenous explanatory variable problem, the exclusion of the labor market variables and the proportion of young population. Unemployment rate and participation rate were not included because they tend to experiment considerable variation over time, so their value ten years before should not be important in 2001-2004 average robbery rates. Since the young population in 1991 is part of the adult population in 2000, this variable was also dropped in the estimates. Instead, we have used the proportion of children out of school in each municipality, in 1991, since they are the potentially problematic share of the young population in 2000.

In Table 3, the impact of enforcement on robbery is more than doubled when it is the only explanatory variable. For a 1% increase in enforcement, there is a decrease of 2.75% in robbery rate, which is a considerable effect. Its estimated coefficients experiment a slightly decline with the inclusion of the control variables that measure labor market conditions, economic development, social and family environment, and they remain statistically different from zero. There is a more relevant reduction in enforcement effect on robbery with the inclusion of the variable that captures its inertia, but in the last two columns of Table 3, a 1% improvement in enforcement leads to a more than 2% decrease in robbery rate.

From the variables capturing economic development, only the proportion of urban population in 1991 (Urban 1991) has a positive and significant effect on criminality in all specifications that it is considered, which supports the view that the weaker personal, family and community ties in cities tend to foster criminal activities (SHELLEY, 1981, cited in BENNETT, 1991). From the social environment variables, only the one capturing past poverty rate (Poverty 1991) is statistically different from zero and with a positive effect on crime rates. Therefore, controlling for all other variables, the municipalities with more incidence of poverty tend to experiment higher robbery rates. Table 3 reports that inertia coefficients are also positive, but they are smaller than the previous results (from Table 2), and its estimated coefficients are significant only at 10% level.

Table 3 – 2SLS estimations – robberies as the dependent variable

Robbery Dependent Variable: Robbery rate (2001-2004) – 2SLS – *Robust Standard Errors*						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Enforcement	-2.7585	-2.6595	-2.8213	-3.0469	-2.3055	-2.3218
	(0.2281)***	(0.3230)***	(0.4127)***	(0.5790)***	(0.7248)***	(0.7299)***
Schooling 1991		2.6551	-0.0044	1.4202	1.4577	1.3326
		(1.4599)*	(1.6771)	(1.9978)	(1.5141)	(1.5201)
GDP-PC 1991		-0.3188	1.4526	1.4051	0.7860	1.0817
		(0.5271)	(1.0896)	(1.1602)	(0.8699)	(0.9273)
Child Out of School 1991			-0.4005	-0.3633	-0.2474	-0.2571
			(0.3020)	(0.3018)	(0.2540)	(0.2554)
Young Mother 1991			-0.0378	-0.0244	-0.0181	-0.0183
			(0.1234)	(0.1327)	(0.1040)	(0.1039)
Poverty 1991			1.2087	1.2210	0.8201	0.9692
			(0.5125)**	(0.5492)**	(0.4813)*	(0.5136)*
Gini 1991			-1.1558	-1.0082	-0.4634	
			(1.4140)	(1.4989)	(1.1496)	
Theil 1991						-0.4378
						(0.5952)
Urban 1991			0.7286	0.8625	0.7038	0.6960
			(0.3356)**	(0.3823)**	(0.2993)**	(0.3010)**
Population 1991				-0.1864	-0.1776	-0.1755
				(0.1613)	(0.1159)	(0.1171)
Robbery 97-00					0.2780	0.2720
					(0.1517)*	(0.1524)*
Constant	11.8678	12.3972	2.2941	3.0824	2.9302	0.7080
	(0.6479)***	(3.6088)***	(4.4290)	(4.9985)	(3.8074)	(5.0311)
Weak Instruments	58.807	34.603	23.666	14.188	4.730	4.710
(p-value)	2e-16***	5.37e-15***	1.22e-10***	9.38e-07***	0.00914***	0.00932***
Wu-Hausman	153.290	190.596	148.564	135.456	49.010	49.460
(p-value)	2e-16***	2e-16***	2e-16 ***	2e-16***	6.52e-12 ***	5.27e-12 ***
Sargan	1.057	0.571	3.069	2.455	2.447	2.428
(p-value)	0.304	0.450	0.079*	0.117	0.118	0.119

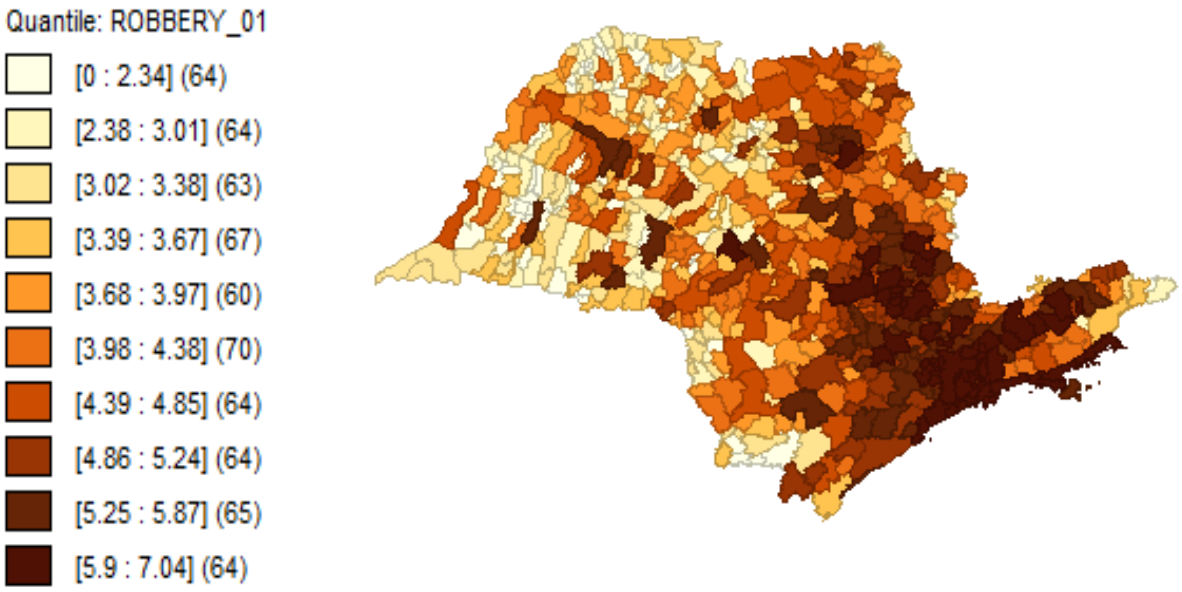
Notes: instruments: longitude and proportion of whites + yellow. Standard errors are in parentheses. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

All the estimations were taken with standard robust error to circumvent the heteroscedasticity problem that is usual in cross data estimations. The tests with the results in the bottom part of Table 3 are to check the validity of the instruments. In other words, if they are not correlated with the error term (exogenous instruments) and relevant, i.e., not weakly correlated with the endogenous regressors. These are the two most important characteristics of good instruments (Stock and Yogo, 2005). The tests in Table 3 include: 1) tests for weak instruments (F test of the first stage regression for weak instruments), where the null hypothesis means that the instruments are weak; 2) Wu-Hausman testes to check if the IV method is consistent as the OLS one, i.e., if the regressor should be treated as endogenous, where the null means that the regressor should be treated as exogenous (OLS is more appropriate than IV); and 3) Sargan tests of overidentifying restrictions to test if the excluded instruments are exogenous, where the null is that the instruments are valid (not correlated with the error term). For the six estimations in Table (3), the F-tests to check for weak instruments reject the null that they are weak. The Wu-Hausman tests indicate that the enforcement variable should be treated as endogenous in all specifications; therefore, the IV method is appropriate, and the Sagan tests for overidentifying restrictions point to the validity of the null hypothesis, indicating that the instruments are valid, except for the results in Column (3) of Table 3, at 10% level.

3.2.3. Spatial econometric results with robust standard errors

Figure 4 indicates that there is a high spatial correlation in robbery rates in the municipalities of São Paulo state, in line with the criminality literature review for the Brazilian studies of Justus and Kassouf (2008). Therefore, it is important to regard the spatial effects in the estimations. The quantiles in Figure 4 show that the municipalities with high robbery rates are surrounded by those with similar rates, which is evident in the cluster of municipalities in the vicinity of the capital state (São Paulo city), and other important municipalities, as Campinas, Sorocaba, São José dos Campos, Santos and Ribeirão Preto. The same is valid for the municipalities with low robbery rates, as in those situated in the northwest and west of the state

Figure 4 - Robbery rate per 100 thousand habitants – 2001-2004



Source: own elaboration based on the Department of Public Security of São Paulo State dataset.

Table 4 reports the 2SLS spatial econometric results for the Spatial Autoregressive Model (SAR) and Spatial Autoregressive Confused Model (SAC) methods. These were chosen based on the AIC and BIC selection criteria [4]. The excluded instruments are longitude and proportion of white plus yellow population. With the consideration of the spatial effects, the enforcement measure maintains its negative and significant effect on robbery rates with the results reported in Table 4. The proportion of urban population and the inertia have a positive effect on property crime (robbery). However, the estimated coefficients of poverty turn to not significant. Schooling has positive and significant effect in all specifications, except in Column (4) of Table 4. Population has positive and significant coefficients when the inertial effect is not regarded, but it turns to not significant with its inclusion. In Table 4, the results indicate that the inertia is an important variable to be considered in the estimations and its estimated coefficients are highly significant.

Table 4 – Spatial (SAR and SAC) with 2SLS estimations with lagged explanatory variables

Robbery Dependent Variable: Robbery rate (2001-2004) – 2SLS – *Robust Standard Errors*						
	SAR			**SAC**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Enforcement	-0.6877	-0.7559	-0.7760	-0.7594	-0.7482	-0.7723
	(0.3460)**	(0.3885)*	(0.3930)**	(0.3601)**	(0.3745)**	(0.3822)**
Schooling 1991	1.3858	1.4540	1.4117	1.2835	1.4928	1.4334
	(0.8157)*	(0.7050)**	(0.7100)**	(0.8261)	(0.6946)**	(0.7020)**
GDP-PC 1991	-0.0461	-0.25155	-0.0663	-0.0208	-0.2590	-0.0705
	(0.4586)	(0.4343)	(0.4673)	(0.4621)	(0.4292)	(0.4626)
Child Out of School 1991	-0.0935	-0.0807	-0.0839	-0.1261	-0.0731	-0.0797
	(0.1615)	(0.1464)	(0.1475)	(0.1644)	(0.1432)	(0.1449)
Young Mother 1991	-0.0168	-0.0100	-0.0122	-0.0161	-0.0099	-0.0121
	(0.0626)	(0.0580)	(0.0579)	(0.0627)	(0.0578)	(0.0578)
Poverty 1991	0.0299	0.0254	0.1275	0.0660	0.0191	0.1242
	(0.2457)	(0.2507)	(0.2720)	(0.2487)	(0.2461)	(0.2680)
Gini 1991	0.8128	0.7756		0.7819	0.7846	
	(0.6416)	(0.5822)		(0.6462)	(0.5765)	
Theil 1991			0.2115			0.2138
			(0.2976)			(0.2952)
Urban 1991	0.5003	0.4656	0.4521	0.5404	0.4575	0.4476
	(0.1767)***	(0.1652)***	(0.1659)***	(0.1793)***	(0.1621)***	(0.1635)***
Population 1991	0.2020	0.0447	0.0464	0.1932	0.0432	0.0455
	(0.0735)***	(0.0657)	(0.0665)	(0.0765)**	(0.0642)	(0.0653)
Robbery 97-00		0.3461	0.3443		0.3483	0.3454
		(0.0667)***	(0.0672)***		(0.0647)***	(0.0656)***
Constant	-3.6795	-0.9645	0.0146	-3.5202	-0.9562	0.0324
	(2.0688)*	(1.7809)	(1.9082)	(2.0958)*	(1.7689)	(1.8937)
Rho (ρ)	0.5813	0.3561	0.3491	0.5699	0.3563	0.3491
	(0.0623)***	(0.0613)***	(0.0610)***	(0.0643)***	(0.0606)***	(0.0605)***
Lambda (λ)				0.0689	-0.0700	-0.0539
				(0.1427)	(0.1452)	(0.1428)

Notes: instruments: longitude and proportion of whites + yellow. Standard errors are in parentheses. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

In Table 4, rho (ρ) estimated coefficients are statistically different from zero in all specifications, indicating that the spatial dependence in robbery should be considered in the estimations. Otherwise, the estimates will be biased and inconsistent (LESAGE, 2008). Since the rho estimative are positive, the municipalities with high robbery rates tend to be surrounded by those with greater than average robbery rates.

[4] The tests results are in the annex.

On the other hand, the estimated lambda coefficients are not statistically different from zero, indicating that the spatial error correlation across municipalities are not relevant. Consequently, the SAR estimation method seems more appropriate than the SAC one.

Because the municipalities are interconnected, the estimated coefficients in Table (4) captures the spatial spillovers arising from the effects of one variable in the neighboring municipalities and back to the municipality itself (LESAGE, 2008). Therefore, it is necessary to estimate the direct and indirect effects to correctly interpret the way a municipality's regressors influence its robbery rates. The average direct effect measures the impact of a specific region's regressor on its own regressand. The average indirect effect captures the influence in the regressand of specific region coming from a change in the neighboring regions' regressor. The total effect is the sum of the direct and indirect effects, and it captures the average total effect of a change in a regressor in all region on the explained variable of a typical region (LESAGE, 2008).

Table 5 reports the direct, indirect (neighborhood) and total effects of the specifications in Columns (2) and (5) of Table 4 [5]. The estimated SAR results indicate that the direct effect is important for the enforcement indicator, lagged schooling, the proportion of urban population and lagged robbery rates. Table 5 reports that a 10% increase in enforcement of a typical municipality leads to decrease in its robbery rate from 7.5 to 7.9, which is an important outcome. The lagged schooling has a sensible direct effect, with a 10% increase in this variable leading to a 15% rise in robbery rate in the same municipality. The proportion of urban population and the lagged robbery rate also have positive influence on the regressand, with a 10% increase in each one leading to a 4,7% and 3,5% expansion in robbery rate, respectively.

Table 5 – Direct and Indirect Effect of Spatial (SAR and SAC) with 2SLS estimations with lagged explanatory variables for the specifications (2) and (5) of Table 4

Robbery Dependent Variable: Robbery rate (2001-2004) – Direct and Indirect effects (SAR and SAC)						
	SAR results			SAC results		
	(2)			(5)		
	Direct	Indirect	Total	Direct	Indirect	Total
Enforcement	-0.787	0.402	-0.385	-0.755	-0.407	-1.162
	(0.027)**	(0.914)	(0.872)	(0.044)**	(0.027)**	(0.030)**
Schooling 1991	1.513	-0.773	0.740	1.507	0.813	2.319
	(0.023)**	(0.919)	(0.862)	(0.034)**	(0.085)*	(0.044)**
GDP-PC 1991	-0.262	0.134	-0.128	-0.261	-0.141	-0.402
	(0.565)	(0.936)	(0.905)	(0.515)	(0.501)	(0.506)
Child Out of School 1991	-0.084	0.043	-0.041	-0.074	-0.040	-0.114
	(0.539)	(0.940)	(0.927)	(0.594)	(0.619)	(0.600)
Young Mother 1991	-0.010	0.005	-0.005	-0.010	-0.005	-0.015
	(0.905)	(0.986)	(0.990)	(0.886)	(0.917)	(0.896)
Poverty 1991	0.026	-0.014	0.013	0.019	0.010	0.030
	(0.835)	(0.947)	(0.929)	(0.977)	(0.913)	(0.982)
Gini 1991	0.807	-0.412	0.395	0.792	0.427	1.219
	(0.214)	(0.933)	(0.890)	(0.157)	(0.228)	(0.177)
Urban 1991	0.485	-0.248	0.237	0.462	0.249	0.711
	(0.006)***	(0.922)	(0.873)	(0.003)***	(0.016)**	(0.003)***
Population 1991	0.047	-0.024	0.023	0.044	0.024	0.067
	(0.542)	(0.943)	(0.810)	(0.497)	(0.467)	(0.481)
Robbery 97-00	0.360	-0.184	0.173	0.352	0.190	0.541
	(0.000)***	(0.915)	(0.854)	(0.000)***	(0.001)***	(0.000)***

Notes: instruments: longitude and proportion of whites + yellow. Simulated p-values are in parentheses. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

[5] The estimated direct, indirect and total effects related to the results presented in Columns (3) and (6) of Table 4 are in Annex A.

In the right part of Table 5, the SAC results indicate similar direct effect of enforcement, lagged schooling, lagged proportion of urban population and past robbery rate in relation to the SAR estimates. In addition, the indirect effects have the same sign as the direct ones and they are significant for the above-mentioned variables, magnifying their total effect on robbery rate. For example, raising enforcement in the neighboring municipalities reduces robbery rate in the average municipality in the region. Therefore, it is crucial to have synergy among neighboring municipalities in public policies to raise enforcement and, consequently, reduce robbery rate.

The above results points to the importance of enforcement in reducing the level of robbery in the municipalities of São Paulo State. The results also indicate that schooling and proportion of urban population have a positive effect on robbery when controlling for the other regressors, indicating that economic development tends to increase property crimes with is in line with Gomes and Paz (2008). The same positive relation occurs for past robbery rates, indicating the strong inertia in robbery rates across São Paulo municipalities.

4. Conclusions

In the present study, an analysis of crime determinants was executed to improve the understanding of such a complex phenomenon that affects many people`s quality of life. It is especially important in Brazil because of its high criminality rates when compared to other countries. The focus was narrowed to the municipalities of São Paulo State because of dataset availability.

The OLS results in Table 2 point to the importance of unemployment and the proportion of young population in robbery rates. In the specification of Column (6) and (7), a 10% increase in unemployment and in the proportion of young population rise robbery by 0.37% and 0.14% (point estimates), respectively. Other important variables are the municipalities' population size and past robbery rates. However, the municipalities' (lagged) population size loses its significance when the reverse causality problem and spatial correlation are considered. With the IV results, the estimated coefficients of the enforcement measures experiment a relevant increase in absolute values, while they are reduced when taking into account the spatial effects, but they remain significant in all specification and estimation methods. Hence, the present study's results that suggest the importance of enforcement in the reduction of robbery rates are robust to the different specifications and methodologies.

In addition, the IV results indicate that poverty incidence, the proportion of urban population and the inertia are relevant variables to understand property crimes across the municipalities, but poverty incidence loses its significance in the spatial regressions estimations. When the reverse causality and spatial effects are considered, the results indicate that a 10% increase in enforcement have a considerable negative direct effect on robbery: from 7.5% to 7.9% when considering labor market conditions, economic development level, social environment, and its inertia. Variables capturing the municipalities' economic development seem to positively influence robbery, as schooling and proportion of urban population. Finally, all regressions results point to the importance of the inertia in robbery rates. Contrary to many studies though, the variables that measure income inequality (gini and theil indexes) does not appear to affect robbery rate across the São Paulo state municipalities.

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Annex A

Table A1 - First stage results of the IV regressions (no spatial effect)

Enforcement as the Dependent Variable: Robbery rate (1997-2000)							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Proportion of White	0.7216	1.1447	1.2064	0.9201	0.7603	0.7550	0.7076
	(0.2634)***	(0.2522)***	(0.2537)***	(0.2516)***	(0.2513)***	(0.2513)***	(0.2534)***
Longitude	0.1906	0.1355	0.1031	0.0853	0.0581	0.0573	0.0530
	(0.0157)***	(0.0159)***	(0.0169)***	(0.0167)***	(0.0177)***	(0.0177)***	(0.0180)***
Schooling 1991		-0.6667	-2.0528	-0.1707	-0.1974	-0.2358	
		(0.4904)	(0.5503)***	(0.6213)	(0.6134)	(0.6152)	
GDP-PC 1991		-0.5974	0.2217	0.1360	0.3316	0.4031	
		(0.1217)***	(0.2694)	(0.2627)	(0.2636)	(0.2755)	
HDI-M 1991							0.4513
							(0.3852)
Child Out of School 1991			-0.3404	-0.2194	-0.2052	-0.2076	-0.1367
			(0.0858)***	(0.0860)**	(0.0849)**	(0.0849)**	(0.0951)
Young Mother 1991			0.0017	0.0137	0.0077	0.0081	0.0125
			(0.0385)	(0.0376)	(0.0371)	(0.0371)	(0.0371)
Poverty 1991			0.5394	0.4312	0.4644	0.4971	0.3541
			(0.1319)***	(0.1297)***	(0.1283)***	(0.1320)***	(0.0661)***
Gini 1991			-0.4823	-0.2368	-0.3797		-0.1041
			(0.3732)	(0.3657)	(0.3626)		(0.2219)
Theil 1991						-0.2275	
						(0.1758)	
Urban 1991			0.2283	0.3025	0.2900	0.2893	0.2749
			(0.1147)**	(0.1123)***	(0.1109)***	(0.1106)***	(0.1102)**
Population 1991				-0.1826	-0.1303	-0.1298	-0.1375
				(0.0305)***	(0.0326)***	(0.0325)***	(0.0289)***
Robbery 97-00					-0.1107	-0.1121	-0.1062
					(0.0265)***	(0.0265)***	(0.0260)***
Constant	-6.9008	-0.6487	-3.1805	-1.9845	-1.3049	-2.3918	-1.7049
	(0.8049)***	(1.1201)	(1.4945)**	(1.4688)	(1.4592)	(1.7337)	(1.6572)
Adj. R^2	0.1855	0.2797	0.322	0.3572	0.3735	0.3741	0.3743
F-stat	74.34	63.52	34.98	36.79	35.9	35.99	39.52
P-value	(< 2.2e-16)	(< 2.2e-16)	(< 2.2e-16)	(< 2.2e-16)	(< 2.2e-16)	(< 2.2e-16)	(< 2.2e-16)
Degree of Fred.	642	640	635	634	633	633	634

Table A2 – Direct and Indirect Effect of Spatial (SAR and SAC) with 2SLS estimations with lagged explanatory variables for the specifications (3) and (6) of Table 4

Robbery Dependent Variable: Robbery rate (2001-2004) – Direct and Indirect effects (SAR and SAC)						
	SAR results			SAC results		
	(3)			(6)		
	Direct	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**
Enforcement	-0.776	-0.115	-0.891	-0.779	-0.407	-1.187
	(0.038)**	(0.925)	(0.876)	(0.039)**	(0.026)**	(0.028)**
Schooling 1991	1.412	0.021	1.433	1.446	0.756	2.202
	(0.059)**	(0.931)	(0.915)	(0.043)**	(0.104)	(0.055)*
GDP-PC 1991	-0.066	-0.001	-0.067	-0.071	-0.037	-0.108
	(0.921)	(0.938)	(0.940)	(0.885)	(0.804)	(0.854)
Child Out of School 1991	-0.084	-0.001	-0.085	-0.081	-0.042	-0.123
	(0.541)	(0.991)	(0.962)	(0.600)	(0.629)	(0.607)
Young Mother 1991	-0.012	-0.0001	-0.012	-0.012	-0.006	-0.019
	(0.858)	(0.985)	(0.976)	(0.849)	(0.881)	(0.859)
Poverty 1991	0.128	0.002	0.129	0.125	0.065	0.191
	(0.493)	(0.965)	(0.985)	(0.635)	(0.733)	(0.665)
Theil 1991	0.212	0.003	0.215	0.216	0.113	0.329
	(0.547)	(0.943)	(0.934)	(0.462)	(0.464)	(0.457)
Urban 1991	0.452	0.007	0.459	0.452	0.236	0.688
	(0.006)***	(0.929)	(0.892)	(0.005)***	(0.014)**	(0.004)***
Population 1991	0.046	0.001	0.047	0.046	0.024	0.070
	(0.483)	(0.932)	(0.916)	(0.481)	(0.471)	(0.471)
Robbery 97-00	0.344	0.005	0.349	0.349	0.182	0.531
	(0.000)***	(0.932)	(0.911)	(0.000)***	(0.002)***	(0.000)***

Notes: instruments: longitude and proportion of whites + yellow. Simulated p-values are in parentheses. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

Table A3 – Information Selection Criteria AIC and BIC for each of the seven specifications of Table 2

	AIC						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SEM	1852.80	1753.83	1651.65	1636.58	1573.93	1460.73	1460.33
SLX	1978.08	1847.37	1724.69	1670.82	1605.44	1441.55	1442.08
SDEM	1844.89	1746.10	1642.91	1625.36	1562.72	1434.48	1434.46
SAR	**1836.94**	**1734.02**	**1631.78**	**1619.03**	**1559.61**	**1428.87**	**1429.01**
DURBIN	1837.36	1737.66	1636.34	**1617.04**	**1556.87**	1434.20	1434.33
SAC	**1832.92**	**1734.69**	**1633.77**	1621.68	1559.86	**1430.40**	**1430.57**
	BIC						
SEM	1870.68	1780.65	1687.41	1694.68	1636.50	1527.77	1527.37
SLX	1995.96	1883.12	1778.33	1769.14	1712.70	1557.75	1558.28
SDEM	1867.23	1786.33	1701.01	1728.16	1674.45	1555.15	1555.13
SAR	**1854.81**	**1760.84**	**1667.54**	**1677.13**	**1622.18**	**1495.91**	**1496.04**
DURBIN	1859.71	1777.88	1694.44	1719.83	1668.61	1554.87	1555.00
SAC	**1855.26**	**1765.98**	**1674.00**	**1679.78**	**1622.43**	**1497.44**	**1497.61**