Typologies of Crime in the Argentine Provinces. A Panel Study 2000-2008

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Abstract
This study examines the socioeconomic and deterrence determinants of crime in Argentina for different typologies of property crimes and crimes against person. We employ a panel of Argentinean regions over the years 2000-2008. Our econometric methodology follows GMM estimator commonly applied for dynamic panel data model. The results give evidence that unemployment has a positive and significant effect on total and property crimes but its impact depends on the typology of the offense. However it has no effect on crimes against person. The importance and the sign of Income per capita depend on the typology of the crime. Income inequality proved to be less important when explaining property crimes and crimes against person. The deterrence effects proxied by the arrest and sentence rates are always negative and very significant.

Abstract
Este trabajo estudia los determinantes socio económicos y de disuasión del crimen en Argentina para diferentes tipos de delitos contra la propiedad y las personas. Para ello utiliza un panel de provincias argentinas en el período 2000-2008. El método econométrico con el que se estima es GMM. Los resultados muestran que el desempleo tiene un efecto positivo y significativo sobre el delito total y en delitos contra la propiedad y su impacto depende de la tipología del delito. Sin embargo no tiene ningún efecto sobre los delitos contra las personas. La importancia del ingreso per cápita depende de las características del delito. En tanto la desigualdad del ingreso tiene menor efecto en la explicación el delito. El efecto disuasión medido por la probabilidad de arresto y sentencia es siempre positive y significativo.

Keywords: Typologies of Crime, Panel Study, Economic and Deterrence Effect
JEL Classification Codes: K42, K14, C32, E3

I. Introduction

Since the seminal work by Becker (1968) that provided the first economic theory of crime, many works have been devoted to the study of criminal behavior. His paper explains how changes in the probability and severity of punishment can alter the individual's decision to commit crime. Later, Ehrlich (1973) extended the Becker's model by considering how individuals divide their time between legal and illegal activities. If legal income opportunities are scarce relative to the potential benefits of crime, people allocate more time to illegal activities and crime is more likely to occur.

The large majority of the empirical studies has focused on United States (Ehrlich, 1973; Cornwell and Trumbull, 1994; Freeman, 1996; Glaeser, 1999; Grogger, 1998, Lochner, 2004; Lochner and Moretti, 2004; Baltagi, 2006; Imrohoroglu, Merlo and Rupert, 2006) and United Kingdom (Wolpin, 1978; Machin and Meghir, 2004), even if during the last ten years a growing number of works analyse the determinants of crime for European countries such as Germany (Entorf and Spengler, 2000; Entorf and Winker, 2007), Greece (Saridakis and Spengler, 2009) Italy (Marselli and Vannini, 1997; Buonanno and Leonida, 2006), Norway (Aasness et al., 1994), Spain (Rodríguez, 2003; Bandrés-Diez Ticio, 2001; Buonnano and Montolio, 2008), Sweden (Sandelin and Skogh, 1986; Edmark, 2005; Oster and Agell, 2007), Switzerland (Fischer, 2005). Nevertheless, there are a few empirical studies for Latin Latin American countries, mainly Colombia (Gaviria, 2000; Garcette, 2004) Chile (Beyer and Vergara, 2002), and Brasil (Carneiro et al., 2005).

In spite of this evidence, criminal activity has received little attention in Argentina and remains largely neglected by the economics of crime literature. However, we must mention some notable exemptions like Chambouleyrón and Willington (1998), Balbo and Posadas (1998) and Cerro and Meloni (2000) using panel data. These papers estimate static panel data model, considering total and property crime.

This paper tries to shed light on the effect of deterrence and socioeconomic factors on total crime, on property crime[1], on crime against persons, and on its typologies in the period 2000-2008 for Argentine Provinces. Furthermore, we apply the Generalized Method of Moments (GMM) to account for unobserved heterogeneity, measurement error in the crime rates and potential endogeneity of the deterrence variables.

The structure of this paper is as follows: After the introduction, Section II presents the theoretical and empirical evidence; Section III shows an overview of data and crime characteristics in Argentina. Section IV outlines the empirical model and discusses the econometric results. Section V concludes

II. Theoretical and empirical evidence

The hypothesis that unemployment, income distribution, and other variables characterizing the economic environment of the region affects crime can be traced out to Adam Smith. But it was not until the seminal paper of Gary Becker in 1968 that the first models of economics of crime upsurge.

Becker (1968) established that crime is an economically important activity and the decision to participate in it, is an economic choice taken by rational agents. This decision comes form a maximization problem in which agents compare costs and benefits of legal and illegal activities taking into accounts the probability of being arrested and punished.

[1] A previous study is carried out by Cerro and Rodriguez (2011)

Theoretical literature of crime emphasize on two fundamental aspects: the deterrence effect, related to the probability of being arrested and of being condemned and the social and macroeconomic effect of environment which generates an atmosphere prone to crime, measured by variables such as the unemployment rate, income per capita, income growth, inequality in income distribution, education, among others.

As discussed in Cantor and Land (1985) there is a controversy regarding the relationship between economic growth and crime. There are two different types of effect: motivation effect and opportunity effect. The first one refers to the incentive to commit crime based on bad economic conditions. Hence, during recessions, individuals increase crime participation in order to increase their income. The second one works in the opposite way: the opportunities to commit crime increase along with the economic performance[2]. (See Dettoto and Otranto 2011).

It is worth noting that the impact of opportunity and motivational effect can be different depending on the crime typology under study. For instance, property crimes can be more affected by motivation effects that imply a negative correlation with the economic fluctuations.

So the expected sign of GDP per capita and its growth is ambiguous. In this context, it could be more appropriate the use of relative deprivation indicators (GINI coefficient). The effect of inequality on crime is expected to be negative, since as Adam Smith noted "*The affluence of the rich excites the indignation of the poor, who are often both driven by want, and prompted by envy, to invade his possessions*"[3]

There are numerous studies on the relationship between crime and inequality. Many of these studies find that relative income impacts on crime (see Fajnzylber et al., 2002, Brush, 2007; Choe, 2008, Cerro and Meloni, 2001). However other works fail to find a robust effect of inequality on crime (for instance, Neumayer, 2004).

Unemployment rates measure the absence of legal income opportunities and are central part of criminiometric of the Becker-Ehrlich type models (Entorf and Spengler, 2000). Unemployment, as it limits the rate of return of legal activities, is expected to increase illegal activities. However, studies on the relationship between crime and unemployment conclude that the effect of unemployment on crime is ambiguous and appears to be very sensitive to econometric specification. Freeman (1994) and Imrohoroglu et al (2001) research support this finding. Freeman (1994) and Maciandaro (1999) set that the effect of job market on crime may be studied through time series, cross section and economic characteristic across people. Depending on the type of study performed it is likely to obtain different results (for instance, Witt et al (1998), Marselli and Vannini (2000). For Argentina, Cerro and Rodriguez Andrés (2010) in a time series study using ARDL approach find support for a long run relationship between unemployment and crime.

Rodríguez Andrés (2003) in a static panel study for Spain find that, once controlling for the endogeneity of the probability of arrest, GDP pc, and education have a positive effect on criminal activities, while unemployment is not significant.
The expected signs of deterrence variables are negative since they represent a cost to those who commit crimes. Therefore, as the rate of sentence and conviction increases, the crime rate is expected to decrease, ceteris paribus. This effect is well documented for the US and Europe (Levitt, 1998; Edmark, 2005; Entorf and Spengler, 2000). For Argentina, Di Tella and

[2] Although the potential victims could neutralize this "richness" effect by destining more resources against crime (alarms, bars, etc.)

[3] Adam Smith, The Wealth of Nations, Book V,Chapter 1, Part II, page 670, Orbis Editions, 1983.

Schargrodsky (2004) find a large deterrent effect of police on crime, by measuring the car thefts before and after an Argentinean exogenous event.
Cook (2008) analyzing urban crime find that the declination in crime observed during the 90´s in USA, is not related to socio-economic conditions but with the police enforcement. On the other hand, Dills et al. (2008) studying the crime rate for the last 40 years, find no concluding relation among crime rates and deterrence and socio economic variables.

Empirical applications for Argentina carried out by Chambouleyron and Navarro (1997) and by Kessler and Molinari (1997), who work with crime rate as dependent variable, find a significant deterrence and socio- economic effect. On the other hand, Chambouleyron and Willington (1998) using property crime, also find an important deterrence effect but not a socio-economic one. Balbo and Posadas (1998) also analyze the argentine case, using as the dependant variable the number of crimes, and they find a negative effect in the probability of arrest, not finding an important effect in the different severity of sanctions on the crime rate. On the other hand, Cerro and Meloni (1999) in a panel study find a significant socio economic effect on criminal activities. They also found an important deterrence effect measured by the probability of arrest and sentence. Perlabach et al. (2007) in a cross study for Mendoza's councils find that both deterrence and socio economic effects are relevant in crime rate explanation.

III. Overview Crime in Argentina

Argentina is a country characterized by huge volatility in its economic activity and in its judicial system. Analyzing the rate of crime in Argentina, we can identify different periods, that lead us think that deterrence and macroeconomic effect are both very important to explain crime.

At the beginning of the 80's, Argentina crime rate was very low. The deterrence effect might have been strong, given that the country was under a Military Government regime, and the Constitutional Rights were not in force.

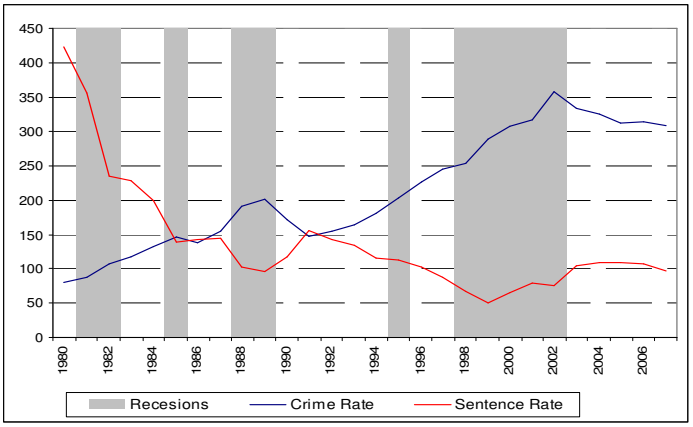
In 1983, with the upcoming of democracy, important modifications took place in the Criminal Code (especially to laws 11179, 23050 and 23057 and in 1984 the law 23077 was enacted) and in the Criminal Code Procedures (law 2372) that implied considerable reductions in the punishment to criminal activities. Consequently with these modifications we see sustained increases in the crime rate.

Despite the huge economic recovery after 2001 crisis, the crime rate keeps high, and even increasing in the last years[4]. We conjecture that a decreasing deterrence effect might have been responsible, partially, for that. Even thought since 1984 there were no considerable modifications in the Criminal Code, a new jurisprudential wave upsurge, which aims to limit the punitive power of the state, known as *Garantismo*.

According to official statistics, the reported crime rate in Argentina increased 312.6 % in the period that span from 1980 to 2008, i.e., it increased at an average annual rate of 5.2%. However the growth rate was not smooth during the whole period. During the two deep crises Argentina went thought in this period, the 1989-1990 and 2001-2002; the crime rate grew faster, and reached peaks of 202 crimes per 10000 inhabitants in 1989 and of 358 in 2002.

[4] Official data is not available since 2008, but according to Victimization Survey of Universidad Di Tella victims of crime has increased.

Graph 1. Crime and Sentence Rate. Argentina 1980-2007



After that it experienced a slight fall until 2007 when it increased again reaching 329 crimes per 10000 inhabitants in 2008. Statistics on crime are no longer available, but we conjecture that it has been increasing in the last years. Even more, the victimization survey of Universidad Di Tella, reports a victimization rate for 2008 of 28.4%, in 2009 of 34.1% and up to august 2010, 33.3%.

Similarly, property crime rate increased 5.14% yearly in the period 1991-2008, reaching in 2008 a rate of 193 property crimes per 10.000 inhabitants. Property crimes represent nearly 60% of total crimes and it is the larger group of crimes[5]. Among property crimes, robbery has the higher participation; it represents 52% of total property crimes, followed by thefts, with 37%, and then other types of crimes such as extortions, kidnappings, frauds and usurpation among others. (Table 1), Notice that the probability of sentence is far higher in robberies than in other property crimes, given the severity of the offense.

Table 1. Property Crimes: Theft, Robbery and Others. Argentina 2000-2008

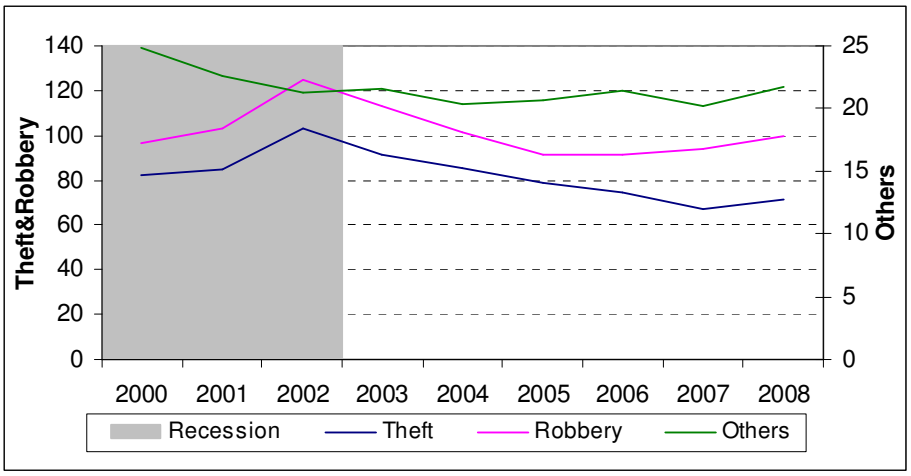
	Reported Crimes	Participation in Property Crime %	Crime Rate per 10000 inhabitants	Probability of Arrest %	Probability of Sentence %
Theft	284205	37	71.5	14.49	6.49
Robbery	398361	52	100.2	15.53	24.25
Others	86661	11	21.8	37.51	7.19
Property	769227	100	193.5	17.62	14.77

Source: Registro Nacional de Reincidencia Criminal

On the other hand, the behavior of thefts and robberies have been similar on until 2007, when robberies, ie crimes with violence, have increased participation in property crimes (Graph2). Notice that both thefts and robberies behaved similarly in the 2001-2002 crisis, while other types of property crimes do not seem to depend on bad economic conditions probably because they are mostly "white collar" type of crimes, such as extortions, kidnappings, frauds, usury, and usurpation among others, where offenders need different skills.

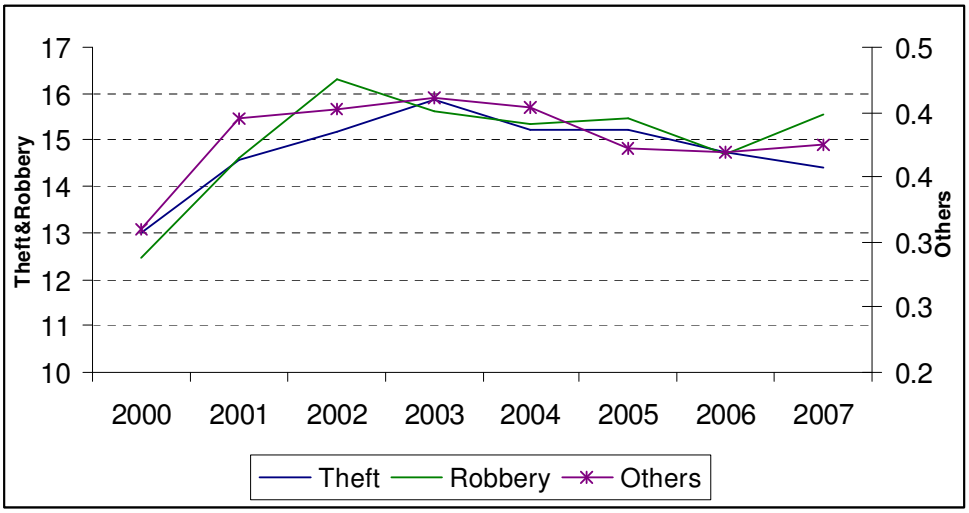
[5] Followed by Crimes Against Person, with a share of 22%, Crimes against Freedom with 11%, Crimes against Public Administration, with 2%, Crimes against personal dignity with 0,08%, and other types of crimes with 2.3%

Graph 2. Thef, Robbery and Other Property Crimes Rate. Argentina 2000-2008



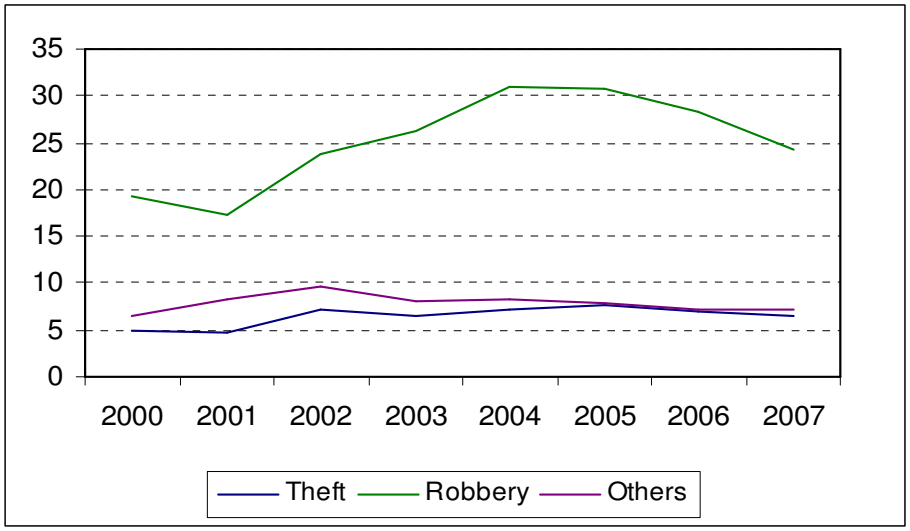
On the other hand the probability of arrest of different typologies of property crimes has shown a slight increase until 2003, then it falls up to 2007. In 2008 there is an increase in the probability of arrest of robberies.

Graph 3. Probability of Arrest: Thef, Robbery and Other Property Crimes. Argentina 2000-2008



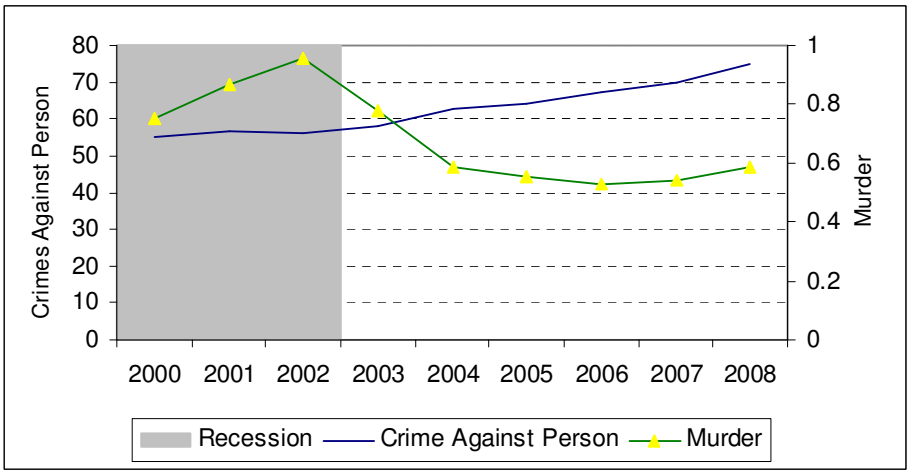
The probability of sentence is significantly different in robberies than in theft and other property crimes. This probability has increased up to 2002 to show a fall afterwards, which may be partly explained by the increased participation of young offenders (under 16 years old) that are not imputable according to penal law.

Graph 4. Probability of Sentence: Theft, Robbery and Other Property Crimes. Argentina 2000-2008



The third group in importance for its participation in total crime is crimes against person, with a share of 22%. Among these crimes we find murder, involuntary manslaughter, injuries and traffic fatalities.
Even thought murders represent only 0.8% of crimes against person; these crimes are the most sounded ones for their severity.

Graph 5 Crimes Against Person and Murder Rates. Argentina 2000-2008



Notice that crimes against person are always increasing, independently on the phase of the economic cycle, while, surprisingly, murder follows the same patterns than property crimes, it increases in 2002, in coincidence with the economic recession and then it falls afterwards with the economic expansion, to increase again in 2008 (Graph 5). The probability of arrest in murder is higher than in any other type of crime, it increases from a value of 61% in 2001 up to 88% in 2008. The probability of sentence is also high related to other types of crimes, but its behavior on time is similar to other types of crime, it increases up to 2004, to decrease afterwards.

III.1 Crime Rate in Provinces

In Table 2 we show criminal statistics per provinces in 2008. The reported criminal activity exhibits high dispersion among them. The City of Buenos Aires is at the top of crimes per inhabitants with 728.2 crimes per 10000 inhabitants[6], followed by the province of Neuquén with a rate of 613. On the other hand, at the bottom of the table, we find the province of Buenos Aires, with 201 crimes per 10000.

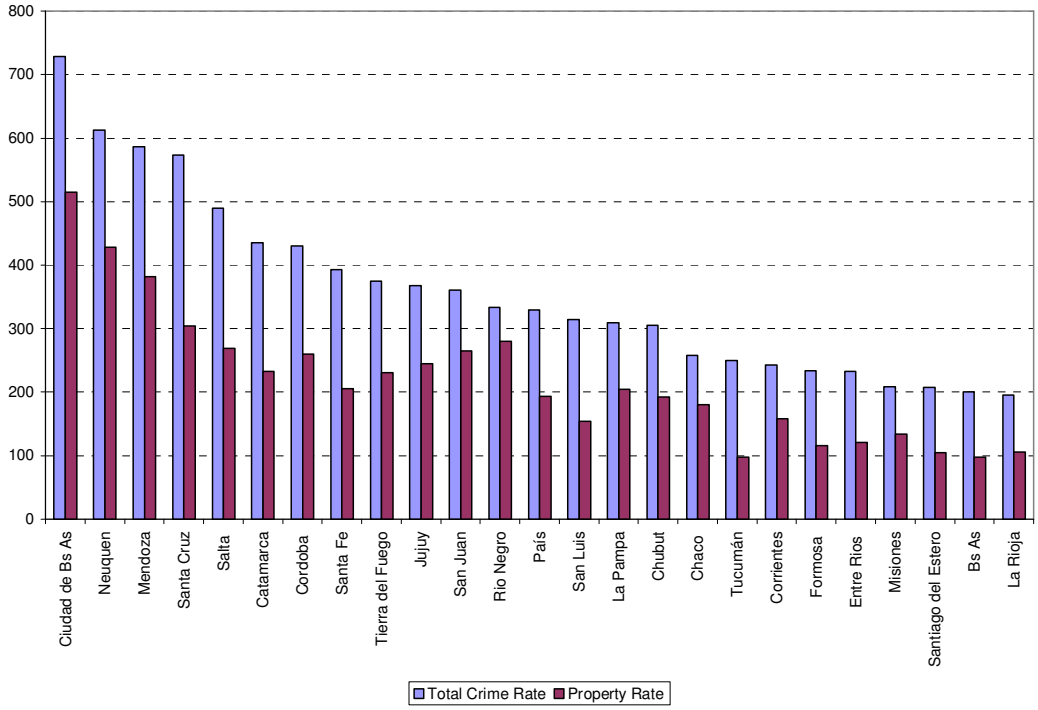
Table 2. Property Crime Rates, Probability of Arrest and Sentence.
Argentina Provinces 2008

	Property Crime Rate per 10000 inhabitants	Probability of Arrest per 100 Property Crimes	Sentence Rate per 100 Arrest
Ciudad de Bs As	515	5.45	49.41
Neuquen	429	14.11	12.44
Mendoza	382	na	na
Santa Cruz	305	22.31	3.58
Rio Negro	280	7.35	25.55
Salta	269	na	na
San Juan	265	21.95	4.64
Cordoba	260	19.90	6.06
Jujuy	245	19.33	0.65
Catamarca	233	19.62	3.16
Tierra del Fuego	231	32.69	3.89
País	**193**	**20.19**	**14.09**
Santa Fe	206	19.85	14.93
La Pampa	205	37.38	7.52
Chubut	193	22.37	5.33
Chaco	180	49.56	2.02
Corrientes	159	18.35	3.96
San Luis	154	20.39	4.07
Misiones	134	13.66	9.04
Entre Rios	121	26.80	4.60
Formosa	115	41.29	5.52
La Rioja	106	37.14	4.01
Santiago del Estero	105	36.72	0.48
Tucumán	98	31.76	4.07
Bs As	98	30.20	21.13
Source: Registro Nacional de Reincidencia Criminal			

[6] We conjecture that in the City of Buenos Aires the crime rate is overestimated, since population used to calculate this rate is smaller, given that many persons from the province of Buenos Aires, from the rest of the country and from abroad work and visit this City.

The annual average growth rate also show great disparity, going from 8.0% per year in Ciudad de Buenos Aires in the period 1980-2008 to 0.77% in Santiago del Estero.
Property Crime Rate shows similar behavior than Total Crime (Graph 6). The highest rate corresponds to the City of Buenos Aires with a value of 515.8 property crimes per 10.000 inhabitants, while Province of Buenos Aires exhibits the lowest rate with only 95.8 property crimes per 10.000 inhabitants.

Graph 6. Total and Property Crime Rates. Argentine Provinces 2008

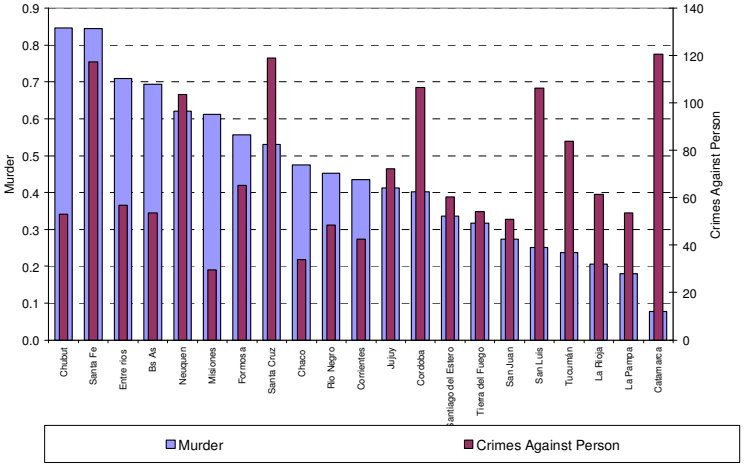


Probability of Arrest and Sentence also vary greatly among provinces. The highest probability of arrest corresponds to the Province of Chaco, with a value of 49.56 arrests, while the City of Buenos Aires has the lower value (5.45%). The average of the country is 20.19% of arrest related to property crimes.

On the other hand the probability of sentence varies greatly among Argentinean provinces. The highest rate corresponds to the City of Buenos Aires with 49.41%, while the lowest one to the province of Santiago del Estero, with only 0.48%, the average of the country is 14.09%. This sentence rate is related to the provincial justice performance.

We can also see huge dispersion in Murder (Graph 7) among provinces. At the top of Murder Rate is the province of Chubut with 0.84 murders per 10000 inhabitants, while at the bottom we have the province of Catamarca with a rate of only 0.08, but on the other hand it is the province with higher crimes against person.

Graph 7. Crimes Against Person and Murder Rates, Argentina Provinces



Socio-economic conditions vary greatly among provinces (Table 3). GDP pc takes values as high as 31014 constant 1993 pesos per capita in the City of Buenos Aires as small as 2996 in the province of Santiago del Estero, i.e ten times smaller. The unemployment rate also shows great disparities among provinces. The province of San Luis has an unemployment rate of just 1.3, while Entre Ríos and Santa Fe reach values of 10.6%. On the other hand Gini coefficient, a measure of income distribution within each province, also shows important differences among provinces. The higher dispersion corresponds to Chaco, while the lower one to the province of Formosa.

Table 3. GDP per capita, Unemployment Rate and Gini Coefficient. Argentina Provinces 2008

PROVINCE	GDP pc (constant 1993 pesos)	Unemployment rate (%)	Gini coefficient
Buenos Aires	7309	9.4	41.1
Catamarca	4304	8.6	41.7
Chaco	3779	3.9	44.5
Chubut	9172	6.7	37.6
City of Buenos Aires	31014	5.7	44.2
Córdoba	7727	7.3	41.5
Corrientes	4305	6.9	44.3
Entre Ríos	5706	10.6	38.9
Formosa	3752	2.7	35.4
Jujuy	3915	7	41.1
La Pampa	8739	4.6	41.5
La Rioja	5012	7.1	38.5

Mendoza	8123	4	40
Misiones	4353	5	42.5
Neuquén	11601	7.1	40.9
Río Negro	8318	9.9	42.7
Salta	4245	9.2	41.6
San Juan	5782	7	39.7
San Luis	7860	1.3	38.3
Santa Cruz	14120	2	39
Santa Fe	8075	10.6	42.8
Santiago del Estero	2996	5	39.3
Tierra del Fuego	18494	5.6	37.8
Tucumán	4848	9.2	43.9
Source: Ministry of Economics, INDEC and IELDE			

IV. Model

The model to be used for the empirical analysis of the argentine case intends to capture the deterrence and socio-economic effects. The variable to be explained will be total crime rate and property crime rate, globally and for different property crimes and crimes against person typologies, defined as the number of reported crimes per 10.000 inhabitants.

In order to capture the deterrence effect, we include variables that measure the cost of developing criminal activities: the probability of arrest related to crime and the probability of sentence once arrested. The expected sign of these variables is negative since they represent a cost to those who commit a crime. As these probabilities depend on different agents (the probability of arrest depends on police performance, whereas the probability of sentence depends on juridical performance) we have to consider them separately, when data availability allow us. (see Table I in Appendix)

There are different variables that point to the social-economic factors: unemployment, measures of income distribution (Gini coefficient) and GDP per capita may be important to explain criminal activities, GDP growth and economic growth cycle.

These variables indicate two different types of effect: motivation effect and opportunity effect. The first one refers to the incentive to commit crime based on bad economic conditions. Hence, during recessions, individuals increase crime participation in order to increase their income. The second one works in the opposite way: the opportunities to commit crime increase along with the economic performance. (see Dettoto and Otranto 2011).

It is worth noting that the impact of opportunity and motivational effect can be different depending on the crime typology under study. For instance, property crimes can be more affected by motivation effects that imply a negative correlation with the economic fluctuations.

We can also include other variables that measure socio economic conditions such as level of education and mortality rates. These variables differ significantly among provinces, but they do no vary much over time, so they can be captured by the fixed effect.

IV.1 Econometric framework

In order to investigate the impact of socioeconomic factors on crime, we estimate the following dynamic panel data model:

$$CR_{it} = \alpha_i + \lambda_t + \eta\, CR_{it-1} + \beta X_{it} + \varepsilon_{it} \qquad (1)$$

here *i* states for province and *t* for year, *CR* is the log of the number of crimes (total or property) per 10,000 inhabitants, α_i is a province effect, λ_t is a year fixed effect, X_{it} is a vector of economic and deterrence effect variables, and ε_{it} is the error term. The fixed effects remove variation in crime rates caused by factors varying across provinces but constant over time.

From an econometric perspective, there might be several methodological problems which might arise in estimating these empirical models. First using a panel data approach, it is well known that OLS coefficients are biased as they ignore the presence of unobservable individual effects. Second, we also include lagged values of crime rate, in this context, OLS results in inconsistent estimates. Third, it is very unlikely that our regressors are strictly exogenous: the relationship between crime and its socioeconomic factors is often characterized by two way causality. Fourth, crime rates are measured with error which might lead to biased estimates.

Here we opt for the 'system' Generalized Method of Moments estimator (henceforth, 'system GMM') proposed by Arellano and Bover (1995) . This estimator is designed for dynamic panel data models. The Arellano and Bond estimator can perform poorly if the autoregressive parameters are too large or the ratio of the variance of the panel-level effect to the variance of idiosyncratic error is too large. Building on the work of Arellano and Bover (1995), Blundell and Bond (1998) developed a system estimator that uses additional moment conditions. (see Bond 2002). This estimator is designed for datasets with many panels and few periods. This method assumes that there is no autocorrelation in the idiosyncratic errors and requires the initial condition that the panel-level effects be uncorrelated with the first difference of the first observation of the dependent variable.

In all our specifications, we report the p-values of the Arellano-Bond tests for autocorrelation applied to the first difference equation residuals (in which we expect not to reject the null hypothesis on an autoregressive regression model AR(1) but we are hoping to reject the null hypothesis of second order autocorrelation so as to conclude that lagged values of the endogenous variables are valid instruments). Finally, we report the p-values of the standard Sargan test of overidentifying restrictions (the null hypothesis is that the instruments used by the system GMM estimator – *as a group* –are exogenous). These specification tests will confirm whether the system GMM estimator is indeed appropriate in our case.

IV.2 Data

Data used in this paper were collected from several national sources. Data on crime, arrest and on sentences were extracted from Registro Nacional de Reincidencia Criminal. Crime rates were defined as the number of reported offences per 10,000 inhabitants. Arrest rates were defined as the number of crimes with known subjects related to crimes. Sentence rates, were defined for total crime and for crimes against person as the number of sentences per 100 crimes, while for murder and property crime with its different typologies as the number of sentences per arrest (see Table I in Appendix). The Gini coefficient was obtained for the period 1990-1999 from Gasparini et al (2000) and since 2000 to 2007 from Instituto de Estudios Laborales y Desarrollo Económico (IELDE). Data is not available before 1990.

GDP per capita in constant pesos were obtained from Office of the Ministry of Economics and Public, from Mirabella and Nanni (1998), and from 2000 to 2008 estimates based on income-output matrix.

Data for unemployment rates (%) were extracted from the Permanent Home Survey by Instituto Nacional de Estadística y Censos (INDEC). The dataset used in this paper is a panel of annual, province level observations running from 1980-2007. Table displays summary statistics for the variables employed in the empirical analysis.

IV.3 Empirical Results

Total Crimes

The results of the two step estimator Arellano-Bover/Blundell-Bond model are presented in Table 4, first column. The dependent variable – Crime Rate- lagged once is very significant, far more than the other explicatory variables. It measures the inertia effect in time and it indicates that an increase in the crime rate in t-1 of 10%, increases the crime rate in 7.2% the next period.

GDP per capita, unemployment rate and Gini coefficient have positive and significant effect on crime rate, showing that those provinces with higher GDP pc, unemployment and higher dispersion in the income distribution have higher reported crime rate[7], while economic growth cycle, indicates that in recessions crime rate increases, showing that the motivation effect dominates the opportunity one. On the other hand sentence rate has a negative and significant effect on crime rate: an increase of 10% in the sentence rate decreases the crime rate in 1%. All the variables jointly are significant, with a probability of rejecting the null of 0% (Wald test).

Sargan test of overidentifying restrictions show that the instruments and the model are correct, not rejecting the null (Table 4). We also test for the presence of first and second order autocorrelation in the first differenced errors by Arellano-Bond test. When the idiosyncratic errors are independently and identically distributed (i.i.d.), the first differenced errors are first-order serially correlated. However serial correlation in the first-differenced errors at an order higher than 1 implies that the moment conditions used are not valid since it would yield inconsistent GMM estimators. The output presents no significant evidence of serial correlation in the first-differenced errors at order 2.

[7] We interpret coefficients in this way, since the variance between is far grater than the variance within for these variables.

Table 4. GMM Estimation Results. Total and Property Crimes

	Total (1)		Property (2)		Property (3)		Theft (4)		Robbery (5)		Other (6)	
	1980-2008		1990-2008		2000-2008							
	Coefficient	P>|z|	Coefficient	P>|z|	Coefficient	P>|z|	Coefficient	P>|z|	Coefficient	P>|z|	Coefficient	P>|z|
Crime Rate$_{t-1}$	0.734	0.00	0.686	0.00	0.650	0.00	0.130	0.00	0.229	0.00	0.036	0.00
GDP pc	0.107	0.00	0.049	0.57								
GDP Growth					-0.002	0.02	0.004	0.00	-0.002	0.00	0.005	0.00
Unemployment Rate	0.076	0.00	0.120	0.00	0158	0.00	0.127	0.00	0.059	0.02	-0.049	0.42
Gini	0.594	0.00	0.182	0.36	0.213	0.33	1.117	0.00	0.487	0.00	0.338	0.59
Arrest Rate			-0.162	0.00	-0.176	0.00	-0.714	0.00	-0.759	0.00	-1.020	0.00
Sentence Rate	-0.102	0.00	-0.054	0.03	-0.051	0.000	-0.192	0.000	-0.119	0.00	0.000	0.99
Cycle	-0.023	0.00	0.057	0.00								
Constant	-0.800	0.019	-0.137	-0.09	0.262	0.738	-0.536	0.642	1.649	0.00	3.428	0.13
Wald chi2 (5)	4521	0.000	4692	0.000	1474	0.000	2267	0.000	2948	0.00	7184	0.00
p-value Sargan test of over -identifying restrictions	20.95	1.000	19.83	1.000	18.54	1.000	18.38	0.986	18.61	0.98	16.85	0.99
p-value Arellano and Bond test for AR(1) in first differences	-1.84	0.063	-1.479	0.139	-1.518	0.128	-2.147	0.031	-2.089	0.036	-1.943	0.051
p-value Arellano and Bond test for AR(2) in first differences	0.679	0.497	0.434	0.663	0.456	0.647	-0.362	0.717	-1.461	0.143	-0.319	0.749

Table 5. GMM Estimation Results. Crimes Against Person and Murder

	Crimes Against Person (1)			Murders (2)		
	2000-2008					
	Coefficient	P>|z|	Coefficient	P>|z|	Coefficient	P>|z|
Crime Rate$_{t-1}$	0.272	0.00	0.207	0.00	0.267	0.00
GDP pc	0.339	0.00			-0.486	0.00
GDP Growth	0.0008	0.054				
Unemployment Rate	-0.009	0.752	0.067	0.378	0.002	0.95
Gini	0.179	0.260	1.004	0.049	0.033	0.95
Arrest Rate			-0.497	0.00	-0.452	0.00
Sentence Rate	-0.077	0.00	-0.308	0.00	-0.359	0.03
Cycle	-0.013	0.419	-0.037	0.194	-0.0509	0.082
Constant	-0.731	0.20	-3.305	0.097	5.103	0.079
Wald chi2 (5)	2268	0.00	3536	0.00	4979	0.000
p-value Sargan test of over -identifying restrictions	18.39	0.98	12.93	0.98	10.34	0.98
p-value Arellano and Bond test for AR(1) in first differences	-1.65	0.09	-2.704	0.0069	-2.53	0.011
-value Arellano and Bond test for AR(2) in first differences	0.594	0.55	1.169	0.2421	0.877	0.38

Property Crimes

The results obtained for Property Crime Rate as dependent variable is shown in Column 2, Table 4. The main difference with the results obtained for the total crime rate is that the coefficient of Unemployment Rate becomes larger (it comes from 0.076 to 0.157), while GDP pc and Gini coefficient are not significant. For property crime rates, unemployment is twice as important as for total crime rates explanation, while the difference in economic activity and/or differences in income distribution are less important. On the other hand GDP growth is negative and significant, meaning that motivation effect dominates opportunity effect as expected. The inertia effect is also very significant.
The results of Sargan and Arellano-Bond tests are similar to those obtained for the former model, so the same comment applies: the instruments are correct and autocorrelation AR(1) is not a problem for GMM estimations.

Property, Theft, Robberies and Other Property Crimes

The results for these typologies of crimes as dependent variables are presented in Table 4 Columns 3, 4, 5 and 6.

First, for property crimes, results are very robust to the period considered; magnitude, sign and significance of the parameters estimated are almost identical when considered both periods, 1990-2008 and 2000-2008.

Second, the inertia effect measured by the lagged dependent variables is far smaller than in aggregate property crime, with a value of 0.13, 0.229 and 0.036 for theft, robberies and other crimes respectively, probably since more disaggregate type of crimes are better explained by socio economic and deterrence variables.

Third, GDP growth coefficient is positive and significant in the case of theft and other crimes, indicating that the opportunity effect dominates over motivation effect. For robberies, that coefficient becomes negative and significant, as in property crimes.

Fourth, unemployment rate is significant and positive both for theft and robberies. Notice that the effect of unemployment on crime is twice as much as in theft, with a value of 0.127, than in robberies (0,059).

Gini coefficient, which is a measure of income distribution, is positive for the three types of property crimes considered, and significant for thefts and robberies, indicating that the worst income distribution, the higher property crimes will be. The effect is greater for theft than for robberies: a deterioration of 10% in income distribution will increase thefts in 11%, while robberies 4.87%. This fact jointly with the coefficient of unemployment seems to indicate that socio economic conditions are more important for theft than for robberies, possibly because those who commit thefts are eventual thieves, less specialized and consequently more dependent on economic conditions.

Deterrence effect, measured by arrest and sentence rate, is significant and negative for both theft and robbery, being the effect of arrest stronger than the effect of sentence. These results point to the relevance of both police and judicial performance in the deterrence of crime.

For theft, robberies and other property crimes estimations, the results of Sargan and Arellano-Bond tests indicates that the instruments are correct and autocorrelation AR(1) is not a problem for GMM estimations.

Crimes Against Person

The results of the two step estimator Arellano-Bover/Blundell-Bond model are presented in Table 5, first column. The dependent variable lagged once is capturing the inertia effect, and it is positive and significant.

GDP pc has a positive and significant effect, possibly since crimes against person include traffic fatalities, whose participation has increased pari pasu with the huge increase in fleet. At the same time, the increase in fleet has been higher in regions with higher GDP pc. GDP growth is also positive and significant. A similar explanation holds, but GDP growth is measuring mainly the effect on time. Unemployment, Gini coefficient and cycle are not statistically significant.

On the other hand sentence rate [8] has, as usual, a negative and significant effect on crime.

Murder

Murder has a very low participation in crime against persons, just 0.8%, but generally are much sounded crimes due to its severity. Results are presented in table 4, second and third column.

We find that unemployment rate is not significant in the explanation of murder. The deterrence effect, measured by the probability of arrest and sentence, is always negative and significant.

On the other hand, we find a negative and significant effect of GDP pc and cycle on murder, meaning that murder behaves contracyclically, ie, it increases in recessions and decreases in expansion, consistently with what we observed in Graph 4. Additionally it increases in regions with lower GDP pc, indicating that murder is related to economic condition.

Both for crimes against persons and murder, the results of Sargan and Arellano-Bond tests indicates that the instruments are correct and autocorrelation AR(1) is not a problem for GMM estimations.

V. Conclusions

This paper examines the effect of socioeconomic variables on crime aggregate and for different typologies of crime in Argentina over the period 1980-2008 and subperiods. For that purpose we use regional data at province level and estimate a dynamic panel data model by using the Generalized Method of Moments (GMM) developed by Arellano and Bover (1995), Blundell and Bond (1998).

We found that socio economic effect is very important in explaining crime. The impact and the significance of the different explanatory variables depend on the category of crime.

[8] In this case, sentence rate is measured as the ratio between sentence and crimes against person, since we do not have data of arrest.

We analyzed total crime rate, property crime rate: composed by theft, robberies and other property crimes and crimes against person, including murder separately. We accounted for different categories of crime in order to avoid the aggregation bias (Cherry and List, 2002).

The inertia effect, measured by the lagged dependent variable, is always positive and significant, but the magnitude depends on the categories of crime. It indicates that an increase in the rate of crime today will increase the crime rate in the next period.

GDP per capita has a positive effect on total and property crime, but it is not significant in the last case. It indicates that those provinces with higher GDP per capita presents better opportunities for those committing crimes, increasing the crime rate, so the opportunity effect dominates over motivation effect across provinces. The effect of GDP pc is also positive on crimes against person, possibly because this crime includes traffic fatalities that have been increasing with the increase in fleet, especially in those provinces with higher GDP pc. The sign of this variable in the case of murder is negative; indicating that those regions with lower GDP pc have higher rate of murder.

GDP growth captures the effect of economic growth on crime rates,effect. It is negatively associated to property crimes and robberies, but positively with theft, other property crimes and crimes against person. In the former motivation effect dominates over opportunity effect along time, as expected. The reverse is true for theft. In the case of crime against persons it may be capturing (similar to GDP pc) the positive association between GDP growth and traffic fatalities growth, mainly due to fleet growth.

On the other hand, unemployment rate, that may be interpreted as the opportunity cost of being in legal rather than illegal activities, is always positive and significant (with the sole exception of other property crimes) in total and property crimes, indicating that the higher the unemployment rate is, ie the less the opportunity cost of being in illegal activities, the higher the crime rate will be, as expected. The magnitude of the effect on crime depends on the typology of crime. It varies from 0.059 to 0.158, being higher for property crime rate and theft than for other type of crimes. Thefts depend more on motivation than on opportunities. In crimes against person and murder this coefficient is not significant.

Income inequality, measured by the Gini coefficient, is always positive, but not always significant, meaning that those provinces with worst income distribution have higher rates of crime, both for property crime and for crimes against person.

Deterrence effect measured by the probability of arrest and sentence is always negative and significance, indicating that is a cost for those who commit crimes. The higher the arrest rate is, that depends on policy performance, and the sentence rate, that depends on judicial performance, the less is the crime rate.

In conclusion: a) Socio Economic Variables are very important in explaining crimes, but their sign and magnitude depend on the typology of crime. Surprisingly murder also depends on socio economic conditions. b) Deterrence effect is always significant and negative, independently on the type of crime.

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Appendix.

Table I. Crime Data Availability

	Recorded Crime Rate	Arrest Rate	Sentence Rate
Total Crime	1980-2008	1980-2000	1980-2008
Property Crime	1990-2008	1990-1997 2000-2008	1990-2008
Theft	2000-2008	2000-2008	2000-2008
Robbery	2000-2008	2000-2008	2000-2008
Other Property Crime	2000-2008	2000-2008	2000-2008
Crime Against Person	2000-2008		2000-2008
Murder	2000-2008	2000-2008	2000-2008