DETERMINANTS OF THE CRIME RATE IN ARGENTINA DURING THE '90S

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I. INTRODUCTION

> 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.
>
> It is only under the shelter of the civil magistrate that the owner of that valuable property, which is acquired by the labour of many years, or perhaps of many successive generations, can sleep a single night in security. […] Where there is no property, or at least none that exceeds the value of two or three days labour, civil government is not necessary.
>
> Adam Smith
> The Wealth of Nations,
> Book V, Chapter 1, Part II, page 670
> Orbis Editions, 1983.

Following the lead of Gary Becker (1968) a large literature on the economics of crime has developed to test the theoretical implications of his model. This literature typically estimates the supply of offenses in which crime per 10,000 inhabitants are related to the probability of arrest, the probability of conviction, the severity of punishment, the expected income from the criminal activity, the returns from alternative legal activities, and other socio-economic factors.

The hypothesis that unemployment, income distribution and other variables characterizing the economic environment of the region or province affects crime can be traced out to Adam Smith, as shown by the introductory paragraph, and have been empirically tested widely. For example, Wong (1995) in a time series study, explains criminal behavior in England and

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Wales for 1857-92 with socio-economic variables, like the unemployment rate. In a cross-section analysis for the year 1987, Zhang (1994) also finds that income inequality, measured by the Gini Index, and the unemployment rate positively affects the crime rate. Ehrlich (1973) in a panel data study for U.S. at state- level data concludes that "... the rate of all felonies, particularly crimes against property, are positively related to the degree of a community's income inequality".

Unlike studies with U.S. and British data, recent empirical applications for Argentina, covering the 80's and early 90's, do not report strong evidence supporting the effect of socio-economic variables on crime. Kessler and Molinari (1997) report that only a measure of education of the population is significant at usual confidence levels. Likewise, Chambouleyrón and Willington (1998) find that only cars per capita (a proxy for GDP per capita) is statistically significant but the inequality indicator is weakly significant and the unemployment rate is not significant at all. Interestingly, during the 90's Argentina experienced a huge increase in the unemployment rate -particularly since 1994- and a worsening in income distribution. Many academics, politicians and opinion molders have related the worsening in unemployment and income distribution figures to the hike in crime rate, however, as mentioned earlier, only weak evidence was provided to support that view.

Is Argentina so different from the rest of the world? To answer this question the present paper, based on Becker's theoretical model, estimates a supply for offenses with panel data that spans over the decade 1990-99 and all 24 provinces.

This paper is organized as follows. Section II characterizes criminal activity in Argentina. Section III is concerned with theoretical analysis and empirical evidence. Section IV presents the theoretical model and the data used in the estimations. Section V shows the results of empirical analysis whereas Section VI is reserved for the conclusions.

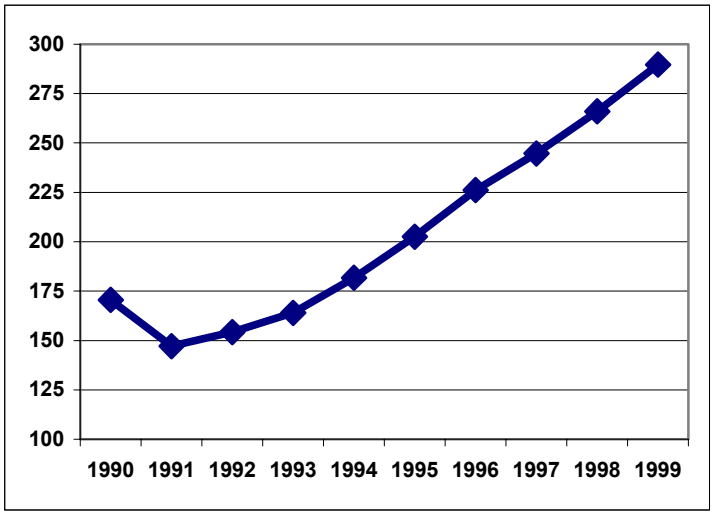
II. CRIMINAL ACTIVITY IN ARGENTINA

Recent opinion surveys show that most people view unemployment and crime to be the most important problems in Argentina. According to official statistics, the crime rate, calculated on the basis of reported crimes, has grown from 171 crimes per 10,000 inhabitants in 1990, to 290 in 1999, which gives an average annual rate of 6.1% for the decade. As shown in figure I, following a decrease in 1991 the crime rate has been growing strongly year after year. Interestingly, reported criminal activity exhibits an important dispersion among provinces (the

standard deviation of the crime rate relative to the mean was 0.43). For example, in 1999 the crime ranking per province was headed by the Federal District (Capital Federal) and the province of Mendoza with 630 and 566 crimes per 10,000 inhabitants respectively, while the provinces of Jujuy, Misiones, Formosa, Entre Ríos, San Luis, La Rioja and Tucumán showed crime rates below 200. The most populated district of Argentina, Buenos Aires, had 222 crimes per 10,000 inhabitants for the same year.

Figure 1

CRIME RATE IN ARGENTINA: 1990-1999



Source: Registro Nacional de Reincidencia y Estadística Criminal and Dirección Nacional de Política Criminal

As reported in Table I, the districts with the fastest crime rate expansion during the 90's were Capital Federal with an average annual growth rate of 13.3%, Tierra del Fuego (12.3%) and Mendoza (11.1%). The provinces of Buenos Aires and Neuquén also had significant increases in their annual average crime rates, exceeding 7%. The provinces with the lowest annual growth rate for the same period were Santiago del Estero (-1.1%) and Santa Fe (0.8%)

One of the characteristics of the crime rate in Argentina is that all the provinces had similar pattern relative to the type of crime: the most common crimes in each province were those against property (robbery, burglary, larceny). On average, approximately 68% of the reported crimes in 1999 were property crimes, and 18% against persons (homicides, injuries)

Another important feature, related to the police efficiency in deterring the criminal activity, is that on average for the period 1990-97, only 40 out of 100 crimes reported had identified suspects. Capital Federal and Neuquén were the districts with the higher percentage of unidentified crimes (over 80%), while Misiones and Formosa showed more than 60% of

identified suspects for the same period. It is worth remarking that on average, the relationship between reported crimes with identified subjects and those with unidentified subjects practically experimented no changes throughout the decade. However, the dispersion among provinces was significant, as mentioned above.

Table 1

Crime Rate per Province

District	Crime Rate	
	1999 Crimes per 10,000 inhabitants	**Average Annual Growth Rate 1990-1999** %
Capital Federal	630,1	13,3
Buenos Aires	222,3	9,5
Catamarca	323,0	7,4
Córdoba	341,2	3,2
Corrientes	234,7	5,1
Chaco	356,0	2,8
Chubut	205,3	2,1
Entre Ríos	189,4	3,2
Formosa	176,8	5,5
Jujuy	119,6	2,1*
La Pampa	351,1	3,6
La Rioja	196,6	2,5
Mendoza	566,3	11,3
Misiones	159,1	3,0
Neuquén	451,9	7,3
Río Negro	276,9	3,7
Salta	247,4	1,2*
San Juan	370,4	2,8
San Luis	189,9	5,7
Santa Cruz	316,8	4,3
Santa Fe	241,0	0,8
Santiago del Estero	219,1	-1,1
Tierra del Fuego	262,2	12,3
Tucumán	195,0	3,5
Country average	**289,6**	**6,1**

Source: Registro Nacional de Reincidencia y Estadística Criminal and Dirección Nacional de Política Criminal.

* Period: 1990-1997.

Still another key variable for analyzing criminal activity in Argentina is the behavior of the probability of conviction (defined as the percentage of condemnatory sentences relative to the number of arrests), which has been declining throughout the '90s.

Inequality and Unemployment

During the early 90's Argentina carried out deep structural reforms that resulted in economic stabilization (inflation dropped from hyperinflation to first world rates) and vigorous growth,

particularly during the period 1991-97 in which the GDP grew at an annual rate of 6.1%. The reforms, which included deregulation, privatization of state-owned enterprises and trade openness brought about evident benefits but also sizable costs in terms of unemployment and income inequality.

The average unemployment rate, which historical remained at one-digit level, surpassed the 10% barrier in May 1994, and had a peak of 18% in 1995. Since then, the rate has descended in the main urban districts although on average it is still around 14%. On the other hand, the Gini index, as well as most of the inequality and poverty indicators, showed an improvement after the stabilization plan was launched, as a result of the drastic decrease in the inflation rate, but in the following years began to worsen, particularly since 1996. According to Gasparini and Marchionni (1999), the Gini index grew (which means a worsening in income distribution) on average 4.1% between 1996 and 1998.

III Theory and empirical evidence

Economic theory of crime analyzes criminal behavior as a rational response to the opportunities available to potential criminals. The key assumption is that individuals maximize their expected utility. An individual decides whether to engage or not in criminal activities by comparing the costs and benefits involved in legal and illegal activities. Costs include penalties imposed by law, probability of arrest given offense, probability of conviction given arrest and other costs related to religious beliefs, ethics and morality. Assuming that all crimes are reported and setting aside the costs related to religion, ethics and morality:

Expected cost of crime = Penalties*Prob.(Arrest)*Prob(Conviction given arrest) **(1)**

From (1) it is easy to verify that the cost for criminals do not alter if we can compensate a decrease in the probability of arrest (caused, for example, by a fall in police expenditure) by an increase in penalties. Nevertheless, it is important to consider that for risk-takers criminals, an increase in the probability of arrest will have a greater deterrence effect than making sanctions more severe.

There is a great amount of empirical literature related to the determinants of the crime rate. Usually, dependent variables are the crime rate, measured by the number of crimes per capita, or the property crime rate and independent variables includes costs for criminals and socio-economic variables. Summarizing, the literature emphasizes on two fundamental aspects:

- The deterrence effect measured either by the probability of arrest and conviction, or by the number of policemen per inhabitant, police and justice expenditures.

- The socio-economic effect generated by an environment prone to crime. It is generally measured by variables such as the unemployment rate, income per capita, inequality in income distribution, different levels of education, labor force participation rate for urban males and labor force participation, social program analysis, and so on.

As shown in Table 2 the results obtained from U.S. and British data identify the deterrence effect as well as the socio-economic effect. In general, empirical studies find that crime rate is well explained by the probabilities of arrest and conviction, which have an important deterrence effect. Sanctions are sometimes significant to explain criminal behavior. For example, Ehrlich (1975) finds that, independently from ethical considerations, the capital punishment deters crime.

Empirical applications for Argentina, recently carried out by Kessler and Molinari (1997), Balbo and Posadas (1998) and Chambouleyron and Willington (1998), show a significant deterrence effect captured by the probabilities of arrest and conviction. The evidence supporting the impact of socio–economic variables on crime is rather weak. In a panel data study for the period 1988–1993, Kessler and Molinari (1997) find that the only social variable that explains the supply of offenses is the percentage of population over 15 years old with primary education. Balbo and Posadas (1998) also estimate a supply of offense but no socio-economic variable is included. They find a negative effect in the probability of arrest, but a rather weak effect in the different severity of sanctions on the crime rate.

In a panel data study for the period 1982-1994, Chambouleyron and Willington (1998), using property crime as a dependent variable conclude that the deterrence effect, captured by the negative sign of arrest, conviction and imprisonment probabilities, is significant. From the set of variables aimed at capturing the socio-economic effect, only cars per capita (proxy for GDP per capita) is highly significant. Inequality, measured as the ratio of illiterates and number of people that have finished the third level of education, is statistically significant at 10% in some regressions and the unemployment rate is not significant at all.

Table 2

Synthesis of Some Relevant Papers on the Determinants of the Crime Rate

Author	Type of Analysis	Method	Period	Country	Dependent Variables	Non- Economic Variables	Economic Variables	Conclusions
Ehrlich (1972)	Panel	2SLS and SUR	1940-1950-1960	States of the U.S.	- Crime rate contemporaneous and lagged - Probability of arrest and Probability of conviction	-Average time spent in prison	-Average income - Percentage of population under the poverty line - Percentage of non-white - Unemployment - Labor force participation - Educational level - Percentage of men in the population	Participants in illegal activities respond to incentives (as well as those in the legal market) Crime rate is associated with income inequality
Wong (1994)	Time Series	Distributed lags model with constrained parameters	1857-1892	England and Gales	Crime Rate	- Probability of arrest - Probability of conviction - Severity of punishment	-Unemployment rate -Real wage -Primary school enrollment	Participants in illegal activities respond to incentives, particularly to changes in legal and illegal benefits. Economic prosperity diminishes the crime rate.
Zhang (1994)	Cross Section	OLS	1987	U.S. states	Crimes against property	- Length of the conviction -Probability of Arrest -Probability of conviction	- Income - Gini Index - Unemployment rate - Welfare programs - Urban population - White population	Economic conditions affect property crime. Cash or in-kind welfare programs have a negative and often significant effect on property crime. Medicaid and school lunch programs apparently have little effect on property crime.
Andreoni (1995)	Cross Section	Simultaneous equations	1960	40 states	- Crime rate - Probability of arrest and conviction - Police expenditure		- Prob. of condemnatory sentence - Average income - Percentage of families under the average income. - Percentage of non-whites - Unemployment rate - Labor force participation - Education - Percentage of men	Two main conclusions: (a) penalties have a direct and significant negative effect on crime. (b) penalties have a direct and significant negative effect on probabilities of conviction. Combining these effects in a reduced-form model, Andreoni finds that the marginal deterrent effect reported by Ehrlich (1973) vanish
Levitt (1997)	Panel Data	OLS-2SLS-LIML	1970-1992	U.S. cities (59)	-Crime rate - Police performance (used as natural experiment in electoral years)		- Percentage of black - Percentage of household with female head -Expenditure on welfare per capita - Expenditure on education per capita - Unemployment rate	Electoral cycles are use to explain the negative relationship between violent crimes and police personnel.
Balbo y Posadas (1998)	Panel Data	OLS with fixed effects	1971-1995	Argentina	Crimes per 1000 inhabitants	- Police personnel per 1000 inhabitants - Prob. of arrest - Prob. of conviction given arrest - Prob. of “parole” given conviction - Prob. of imprisoned given conviction - Prob. of fine given conviction - Percentage of men - Percentage of population under 21 years		-Deterrence effect is confirmed -Severity of punishment has no effect on crime rate
Cambouleyron y Willington (1998)	Panel Data	2SLS with fixed effects	1982, 1985, 1988, 1991 y 1994	Argentina	Property Crimes per capita	- Probabilities of arrest and Prob. of conviction - Number of condemnatory sentences per capita	- Number of cars per capita - Income inequality - Unemployment rate	Independent variables are identified. Parameter bias is avoided.

IV. The model

The reduced form of supply of offenses function is as follows[1]:

Crime= F (*Prob. Arrest; Prob. Conviction; Prob. Imprisonment; Unemployment; GNPpc; Inequality)*

Since the probabilities are costs to criminals, their expected signs are negative. We consider them separately because they depend on different agents: the probability of arrest depends on police performance, whereas the probability of conviction depends on judiciary performance. On the other hand, these probabilities might be correlated among themselves, which might bias (overestimating) the coefficients. For instance, if the number of arrests goes up, the probability of arrest increases; but if the number of sentences is given by the capacity of the judiciary system, the probability of a condemnatory sentence as well as the number of sentences relative to the number of crimes, decreases.

The same reasoning can be applied to the probability of imprisonment: as the number of sentences increases, given the capacity of prisons, the probability of imprisonment will decrease. Chambouleyron and Willington (1998) estimate three separate equations in order to solve this problem[2].

Socio-economic environment can be described by the rate of unemployment, income inequality and GDP per capita. Earning opportunities in the labor market as well as in illegal activities will influence the allocation of time and effort between legal and illegal activities, therefore increases in the unemployment rate, as diminishes the rate of return of legal activities, is expected to increase illegal activities. For the same reason, a higher income inequality means a worse legitimate earning opportunity, hence it would increase crime.

Income inequality can be used to approximate the returns from legitimate earnings opportunities. A higher income inequality means a worse legitimate earning opportunity, hence a rise in income inequality would increase crime

[1] *A priori*, expenditures in police and justice should be included in the supply of offenses equation. However, the probabilities of arrest and conviction are affected by these expenditures, which in turn are impacted by the rate of crime, so they are included when estimating structural equations.

[2] Estimations of these equations are presented in Table 1A in the Appendix. Notice that the probability of sentence is underestimated and not overestimated as Chambouleyrón and Willington suggest.

Per capita income is used to measure potential returns from legal earnings, so an increase in income may lead to an increase in crime. Those provinces with a higher GDP per capita are expected to be more attractive for criminals since they entail greater opportunities.[3] However, there is also a pure income effect: if criminal activity were an inferior good, the pure income effect would be negative. Hence, the effect of the income on crime is ambiguous.

Data and Variables Used in the Estimations

We worked with a panel data spanning for even years in the period 1990-1999, including 22 provinces[4]. The crime rate and the probabilities of arrest, conviction and imprisonment were obtained from the Registro Nacional de Estadística y Reincidencia Criminal, and from the Dirección Nacional de Política Criminal. The source of the unemployment rate and the income distribution series was the Permanent Household Survey published by INDEC. We also obtained from INDEC data on population and education. Mirabella and Nanni (1998) estimated GDP per province. Two measures of income distribution were used. The first one was calculated as the ratio of the percentage of population over 25 years with third level education to the percentage of the same population with primary school. The second one is the Gini Index estimated by Gasparini and Marchionni (1999).

The definitions of the variables used are:

- $Crime_{it}$: offenses reported to the police per province and per 10,000 population. All crimes.
- $PROBAR_{it}$: Probability of arrest in the province i in the year t, measured as the total number of arrests divided by total reported crimes.
- $PROSE_{it}$: Probability of condemnatory sentences (conviction), calculated as the number of sentences relative to the number of arrests.
- $PROCONEF_{it}$: Probability of imprisonment, defined as the number of persons confined divided by the number of condemnatory sentences
- U_{it}: Unemployment annual rate, calculated as an average of the May and October publications.

[3] Although, the potential victims could neutralize this wealth effect by assigning more resources against crime (alarms, bars).
[4] The provinces of Río Negro and San Luis were not included.

- $GDPpc_{it}$: GDP per capita. The population was obtained from the INDEC estimations for the decade.

- $INEQ_{it}$: Income inequality version 1, measured as a quotient between the number of students at the level relative to those at primary school.

- $INEQ2_{it}$: Income inequality version 2, measured as the Gini Coefficient

As shown in Table 3, the average number of offenses per 10,000 inhabitants during the 90's was 226, the probability of arrest given offense was 41%, the probability of sentence given arrest was 8.7% and the probability of imprisonment given sentence was 37%. It is important to remind that if we consider the probability of sentence given the number of offense is 3.6% and the probability of imprisonment given the number of offense is 1.3%, this means that only 3.6% of the total number of offenses received a condemnatory sentence, but only 1.3 percent effectively went to prison.

The maximum value of the crime rate (630 crimes per 10,000 inhabitants) corresponds to Capital Federal (may be well explained by the Adam Smith quotation at the beginning of the paper). It also corresponds to Capital Federal the maximum value of GDP per capita.

Table 3
Descriptive Statistics. Argentina 1990-1999

	Average(X)	Maximum	Minimum	Standart Deviation(S)	S/X
Crime Rate	226,48	630,06	86,29	96,57	0,426
Probability of Arrest	0,413	0,813	0,061	0,145	0,351
Probability of Sentence	0,087	0,665	0,003	0,099	1,128
Probability of Imprisonment	0,371	0,909	0,106	0,139	0,374
GDP	5979	16444	2737	2185	0,365
Unemployment Rate	0,097	0,206	0,026	0,039	0,407
Gini Coefficient	0,330	0,411	0,257	0,032	0,098
Inequality	0,062	0,218	0,019	0,032	0,524

V. Results of the empirical analysis

The estimations were carried out by Weighted Least Squares (since we detected heteroscedasticity) with panel data per province, for even years of the period 1990-1999. A fixed effect by province was included in order to capture the differences among provinces,

that change slowly across time, and that may affect the crime rate, such as poverty and other socio-economic variables

We also estimated a simultaneous equation model by TSLS and Weighted TSLS[5] and performed a Wu-Hausman test to verify if endogeneity affects the estimation of the coefficients by OLS. Usually probabilities of arrest, sentence and imprison are considered endogenous, since they depend on the expenditure in police and justice, which in turn depend on the crime rate.

The model estimated is as follow:

$$\text{Log}(\text{CRIME}_{it}) = a_o + a_1 \text{Log}(\text{PROBAR}_{it}) + a_2 \text{Log}(\text{PROSE}_{it}) + a_3 \text{Log}(\text{PROCONEF}_{it}) + a_4 \text{Log}(U_{it}) + a_5 \text{Log}(\text{GDPpc}_{it}) + a_6 \text{GDPgrowth}_{it} + a_7 \text{Log}(\text{INEQ}_{it}) + a_7 u_{it}$$

The double log specification was chosen on the basis of the Box-Cox test. The results presented in Table 4 show that all the variables considered had the expected sign and were statistically significant, except for the GDP per capita (in model 2) and the rate of growth of GDP (in both models). The probability of imprison is not significant at usual levels, which may be explained for the high correlation between the probability of sentence and imprison (see Table in Appendix).[6] It is worth remarking that the coefficient estimations under different methods were very robust to the method of estimation, which makes the estimations more reliable.

The econometric results ***confirm the importance of the deterrence effect.*** Due to the logarithmic form of the model, the coefficients are elasticities. According to Model 1, an increase in the probability of arrest of 10% would decrease the rate of crime by 3.38%. Whereas an increase in the probability of sentence of 10% would decrease the crime rate by 2.67%.

We could also capture a socio-economic effect on the crime rate. Given the estimated coefficient, a 10% rise in the Unemployment Rate will increase the crime rate in 1.8%. The inequality coefficient is significant at 1% meaning that a worsening in income inequality of 10% will increase the crime rate in 3.3%. Gini coefficient is not significant at usual confidence levels (Model 1)

[5] The instruments used were the lagged probabilities

[6] A Wald test is carried out to establish if variables that measure the deterrence effect are simultaneously equals to zero, rejecting the null hypothesis at 1%.

Table 4

Estimations with panel data including fixed effects.

Method: Weighted Least Squares Dependent Variable: LOG ($CRIME_{it}$)

Model	Model 1	Model 2
PROBAR	-0.338***	-0.320***
PROBSE	-0.267***	-0.255***
U	0.184**	0.164***
GDPpc	0.278**	0.269
DGDP	-0.303	-0.337
INEQ1	0.313***	
INEQ2		0.132
R^2	0.787	0.809
Number of Observations	115	107

Note: A fixed effect is included, which turned to be significant at 1%.
* Significant at 10%
** Significant at 5%
*** Significant at 1%

The level of GDP per capita is positive (as pointed out by Adam Smith) and significant, meaning that those richer areas attracts criminals, its rate of growth is negative (but not significant) implying, as expected, that an increase in the rate of growth of GDP will diminish the crime rate.

However, if a *hysteresis* effect is present, increases in unemployment and income inequality will bring about increases in the crime rate, but decreases in those variables will not diminish the crime rate in the same magnitude.

VI. Concluding Remarks

The present paper estimates econometrically the determinants of the crime rate in Argentina for the 1990-1999 period. Like previous empirical applications for Argentina, a significant deterrence effect was found, unlike them we also identify a strong socio-economic effect on the crime rate. The unemployment rate and the income inequality indicator were found

positive and significant, indicating that a worsening in socio-economic conditions impacts positively on crime. Likewise, the level of the GDP per capita was also found positive and statistically significant implying that richer areas attracts criminals because of opportunities available to them. These findings are consistent with those obtained by Zhang (1994) for USA data.

These results are of great significance in order to ***design policies aimed at fighting crime.*** If the variables that characterize the social and economical environment were not significant, policies should only include reforms for justice and police. Instead, if unemployment and income inequality are important (as in our model), policies should have a wider range including areas such as education and labor (that have direct implications on income distribution and employment). With these results, the social programs aimed at reducing unemployment get stronger, since they have an additional impact on crime. Nevertheless this does not mean that "any" program should be implemented in order to reduce crime. The previously mentioned study by Zhang for the United States, show that not all the social programs have a strong impact on illegal activities.

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